

REDISCOVERING WOOD: THE KEY TO A SUSTAINABLE FUTURE
THE INTERNATIONAL CONFERENCE ON THE ART AND JOY OF WOOD

BANGALORE, INDIA

19 OCTOBER – 22 OCTOBER 2011



PROCEEDINGS

PART 1- CONFERENCE OVERVIEW

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Contents

Acknowledgements	vi
Summary	1
Objectives of the conference and intended impacts	3
The Structure and organization.....	5
A The building blocks.....	5
B Event organisers, financiers, sponsors and supporters	9
Synthesis of the presented ideas	5
Opening ceremony:	9
Why we are here? Different perspectives on the role of wood in sustainable development (Session I).....	10
An introduction to wood culture: building on the past (Session II)	12
The use of wood in different cultures (Session III and V).....	13
Artistic aspects of wood use and design (Session IV and VIII)	15
Wood architecture: What can be done? (Session VI and VII)	16
Selling the art and joy of wood products to consumers (Session IX)	18
Wood industry development in the formal sector (Session X)	20
Development of the handicraft sector (Session XI).....	23
Promoting wood culture in the future (Session XII and XIII).....	24
Sustainable wood supply: the key to success (Session XIV)	28
Focus on Sandalwood and Teak (Session XV).....	29
Thoughts emerged on where to go from here.....	30
Summary of the deliberations.....	31
The ideas to ponder for the enablers of the journey to sustainable development.....	36
Feedback	37
Conclusions.....	38
Side events	38
Photo-competitions held in connection with the event	39
Appendix 1- List of oral presenters	52
Appendix 2. List of participants.....	55
Part 2: Sessions from 1 to 15	68
Part 3: Posters	99

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Photo Contest Judges: Kartiki Gonsalves (India), Tomasz Juszcak (Poland), Masakazu Kashio (Japan) and Marco Perri (Italy)

Painting Competition Judges: Jasmine Khanna and Shan Re

Poetry Competition Judges: Malathi Rao, Vimala Rao and L N Santhkumaran

Summary

This conference and exhibition was one global event to celebrate the International Year of Forests. This was organized to help the participants understand the outlook for wood products and contribute to develop strategies for future sustainable development. The main intention was to explore how socio-economic trends are affecting the use of wood products and what challenges and opportunities arise as the consequence of these developments. Underlying belief was that greater wood use can make a significant and valuable contribution to society's desire for a more sustainable future. Also, a sustainable and prosperous forest products sector is essential for sustainable forest management.

This conference attempted to explore how the changing expectations of consumers and society shape the future for wood products. It also intended to examine how producers and users of wood can respond to these changes to identify potential opportunities and strengthen sustainability in the sector. It partly focussed on the social, aesthetic, cultural and traditional aspects of wood use and how the strong linkages between wood and society could be used to support the future development of the sector as a whole.

The event comprised of four-day conference (including one day field trip) and exhibition. It was held at the J. N. Tata Auditorium Complex located at the Indian Institute of Sciences campus in Bangalore, India from 19 to 22 October, 2011. More than 60 presenters from 18 countries orally communicated their ideas and about 15 poster presenters showcased their stories. More than 278 attendees from 30 countries participated in the deliberations and discussions that spread into 17 sessions.

Alongside the technical sessions, on all four days, a commercial exhibition and wood products display was held adjacent to the conference venue. This provided hands on experience because it portrayed the art and joy of working and living with wood to the participants and the general public. Commercial exhibitors showcased their products or services containing a high degree of craftsmanship, artistic input and innovations to the conference participants and about 5,000 local visitors. Wood carvers and other artisans from China, India, Cameroon, Indonesia, Japan and Turkey demonstrated different wood carving styles and techniques. Videos of the presentations, exhibition, field trip, cultural events etc are available at <http://www.wood.info/artjoywood/?p=video>.

Take away points relevant to policy makers

1. Wood products that embrace culture and traditions are gaining popularity. These connect the past with the present through well designed wood products that suits the changing lifestyles of the society. This trend will benefit the small and medium wood-based enterprises in future. However, for achieving this, wood use should be integrated in national policies and green growth frameworks. Policies that discourage wood use should be reconsidered because sustainable production of wood presents new opportunities in many parts of the world to revive the wood culture.
2. Wood utilization policies should ensure sustainable wood supply to small and medium enterprises.
3. Adding as much value as possible to every m³ of wood through product and process innovations should be encouraged by policies and incentives. One aim should be to maximise livelihood opportunities while minimizing over-exploitation of wood resulting from mass production of low value products. Maximum value should be added before wood products are exported.
4. Policies should promote wood use considering its environmentally damaging substitutes with the new understanding of life cycle analyses (LCA). As green programmes outside the forests are expected to produce more wood, policies should govern how wood is used to pave ways for a sustainable future. Policy coherences regarding integrating wood use at intersectoral level is a great need. Standards and codes, regulations etc should be re-examined with better understanding on the wood's credential.

5. Policies should encourage the use of 'good wood' to benefit the economy, environment and society with the view of enhancing sustainable forest management (SFM).
6. The credentials of wood should be communicated well to potential wood users and general public. Celebrating National Wood Day and encouraging wood user networks could promote wood use. In order to address threats like deforestation and to build consumer confidence, certification measures that indicate 'good wood' should be promoted without significantly impacting negatively the small and medium wood-based enterprises.
7. Education on how to use wood should be promoted to inspire the young people and to address the skill shortage in many regions to work creatively with wood.
8. Alliances involving foresters, environmentalists, architects, designers etc should be encouraged to find new opportunities for wood and strengthen the links between the producers and users.

Take away points for wood users.

1. Product and process innovations that consider the socio-economic trends are the key to survive a crisis and stay well in business. The relevance of art and joy of wood concept is implied in attractive products that employ better designs and integrate sustainability into the products. They touch the heart and mind of people. The societal requirements for modern lifestyle products need to be integrated into the wood product itself. Customization of wood products and finding the right niche is essential for survival amidst increasing competition. Drawing inspiration from local traditions and culture is of great importance to innovate, diversify and design the products that suit the changing lifestyle needs.
2. To inspire the people who do not currently use wood, working closely with designers, architects etc is essential.
3. Limited raw material supply constitutes a challenge for many entrepreneurs, but shifting to unconventional species and production of high value products could address this partly. Recycling wood, designing hybrid products with compatible material, minimizing wastage and using every part of the tree etc are important to maximise resource use and profit.
4. Wood users should share knowledge through global wood networks to increase efficient wood use and enhance global wood use.
5. Actively communicating to the public (e.g. Wood Day, high impact events etc) is indispensable to convince how wood use can make a difference to our life.
6. Considering the new markets in the back drop of lifestyle changes, wood users should prepare themselves to capitalize further on the emerging marketing opportunities of social networking, internet technologies etc.

Take away points for general public.

1. Public perceptions towards wood use remain negative mainly stemming from the fear of deforestation and negative impacts on environments caused by exhaustive exploitation of wood for mass commodity production in the past. The art and joy concept of wood use propose turning the

old consumption model around and promotes use of 'good wood' for high end uses. So, it is relevant even in wood scarce regions.

2. Using 'good wood' from responsible sources is essential to benefit the society, economy, environment and SFM. Massive tree planting outside conventional forests provide new opportunities for production of 'good wood'. This would enable transition to wood from its environmentally damaging substitutes that replaced wood in the last two centuries. Unless the public understands well what wood can offer, this transition is impossible. Consequently, its potential contribution to support the livelihood of millions of people and a green economy will continue to be underexploited. So, it is relevant to change the unfounded negative societal perceptions towards wood.

Conclusions

The conference concluded that forestry, as a profession, has often failed to engage with people on an emotional level about the qualities and benefits of wood products, with most of the discussion about SFM focused on scientific and technical debates. Linkages existing between wood and society on social, aesthetic, cultural and traditional aspects were inadequately emphasized in the past. While people understand that wood products are preferable to non-wood products from an environmental perspective, they remain concerned about the environmental impacts of tree harvesting and are sceptical about progress in this area. The green credentials of 'good wood' need to be communicated more. Focusing on efficient wood use (e.g. minimizing wastage, recycling), attractive designs etc will result in eco-friendly and higher value wood products portraying the art and joy of wood. They will meet the environmental, artistic and cultural aspirations of the society while supporting the livelihood of people and SFM.

The art and joy of wood is an attractive concept and reflects the livelihood and artistic dimensions of wood. However, this needs to be popularised widely so that everyone gets inspired to take a piece of the forests to their homes and get connected to the nature and environment in more sustainable ways.

Objectives of the conference and intended impacts

Increase in wealth in many regions implies threats and opportunities to sustainable development. Wood that is produced sustainably and used wisely has a role to play here. Being a natural and recyclable material that originates from a renewable resource that stores carbon, wood and wood products possess many positive environmental attributes. Despite this, the public has not viewed wood use very favourably in recent years, tending to link this with bigger problems in forestry like deforestation and forest degradation. However, these perceptions may change as societies move towards a low-carbon or "green" economy and people move away from the dominance of mass-production in modern lifestyles. This event was therefore proposed in the firm belief that greater wood use can make a significant contribution to society's desire for a more sustainable future. The underlying conviction was that a sustainable and prosperous forest products sector is essential for sustainable forest management.

a. Relevance of the theme

In a green economy, the role of wood as a natural and renewable product needs more emphasis. Contextually, sustainable production and use of wood deserves more attention than ever before. This is indispensable for our sustainable future. The International Conference and Exhibition on the Art and Joy of Wood was organised as part of the International Year of Forests with this view to promote discussion and share ideas on how more widespread wood use could be encouraged, capitalising on the emerging social trends in the 21st century.

Even though wood products constitute an indispensable part of human life, the importance of wood production is sometimes overlooked in debates about forestry and forest management. This lack of

attention was the motivation to try to explore these issues, in particular how far the social dimensions of wood use (culture, traditions and aesthetics) can be integrated into the development of the sector.

The economic and environmental dimensions of wood product use have been discussed widely now, but the discussions on the socio-economic, aesthetic and cultural dimensions of wood use seem limited. The theme of art and joy of using, working and living has never been relevant in the past as of today. Their relevance is demonstrated by the innovations that blend art and joy theme with our modern life (e.g. Apple computers). Following this trend, high value wood-based handicrafts, building products, musical instruments, furniture, wood panel products, sports goods etc would gain more relevance to our life. The relevance of adding value per m³ of wood is gaining much relevance as wood is scarce in many regions. This added value implies numerous livelihood options, especially for the rural population. Creativity reinvigorates the 'art and joy' of using wood to pave way for innovations. Nevertheless, how the producers should reorient themselves to find innovative opportunities using the emerging trends have not been discussed widely. This conference intended to address this gap.

b. The objectives and deliberations' composition

The overall objective of the conference was to help the participants understand the outlook for wood products and contribute to develop strategies for their future development. The presentations and discussions were expected to shed new light on how wood use can continue to contribute to sustainable development and remain firmly connected to human life. They were expected to persuade the participants regarding the bright future of wood in a more sustainable World and to give away new ideas to benefit their work on the ground.

The specific objective of the conference was to explore how socio-economic trends are affecting the use of wood products and what challenges and opportunities arise as the consequence of these developments. Thus, the conference aimed to examine the following issues:

- How wood use can make a greater contribution to sustainable development and
- How wood producers and users can benefit from increased prosperity and the growing demands for more sustainable consumption and lifestyles.

The conference tried to examine the ways in which the production and use of wood products can contribute to sustainable development and how growing demands for sustainability might present new opportunities for the development of the wood products sector. This conference focused, on the socio-economic, aesthetic and cultural dimensions of wood use that will encourage more widespread wood use in the 21st century. The discussions surrounded the three themes below.

Emerging trends in economies and lifestyles: What are the main trends affecting wood use and how can these be utilised to strengthen the forest products sector?

Stories portraying the winds of change: Case studies showing how some wood producers and users have already developed strategies or innovated to build successful enterprises based on changing consumer demands and needs.

Wooden paths to a sustainable future: How can the linkages between wood use and sustainable development be strengthened and used to promote more and higher-value wood use?

Among others, the specific questions that the event tried to address are:

- What are the broad social and economic trends affecting the markets and end-uses of wood products?
- How are producers and users of wood responding to these trends and what more can be done?
- What is the scope to develop higher value wood products that capture some of the benefits of rising prosperity?
- Why do negative perceptions of wood use persist in some places and how can these be overcome?

- How can stakeholders in the wood products sector develop strategies to strengthen the linkages between wood use and sustainable development?
- What types of support are needed from policy makers, researchers, technical experts and industry associations?

The deliberations were expected to share views and experiences and enable better networking amongst the participants so that everyone will take away better idea on the outlook for the sector.

c. Intended impacts

The event was expected to improve our understanding on the linkages between wood and society that could be used to support the future development of the sector as a whole. Within this objective, increased visibility of wood in the International Year of Forests was one of the intended outcomes of the event. The success of the event was expected to be based on (i) the feedback of the participants (ii) the innovative ideas propagated and (iii) the benefits to participants' work on the ground.

The Structure and organization

A The building blocks

The event was comprised of four day conference (including one day field trip) and four-day exhibition. It was held at the J N Tata Auditorium Complex located at the Indian Institute of Sciences campus in Bangalore, India from 19-22 October, 2011. Videos of the presentations, exhibition, field trip, cultural events etc are available at <http://www.wood.info/artjoywood/?p=video>.

1. The conference: The conference spread into 17 sessions in three days including an opening ceremony on the first day and a plenary session on the last day.

Presenters and attendees: More than 60 presenters from 18 countries orally communicated their ideas (Appendix 1) and about 15 poster presenters showcased their stories. About 278 participants from 30 countries (see Appendix 2) heard innovative ideas from the experts at the cutting edge of the industry. The foreign delegates constituted roughly 50% of the participants (excluding the students). This event targeted not only foresters but also many innovators (e.g. designers) and practitioners (e.g. architects of wooden multi-storey buildings) who could play crucial role in wood's development on our journey to sustainable development.

2. The commercial exhibition: Alongside the technical sessions, on all four days, a commercial exhibition and wood products display was held in the exhibition ground adjacent to the conference venue. Forty booths occupied by diverse exhibitors (more than 100 persons) provided hands on experience because it portrayed the art and joy of working and living with wood to the participants and the general public. It synchronized well with the deliberations happened within the conference halls.

Exhibitors and visitors: Commercial exhibitors included those organisations specialising in products or services containing a high degree of craftsmanship, artistic input and innovations. The exhibitors occupied all the 40 stalls (3m*3m) and the diversity of the exhibitors was unique with 9 plywood and panel exhibitors, 4 equipment and service providers, 10 consumer goods and services, 7 institutions and organisations and 10 artisans (Photos 1-6). The musical instrument makers, furniture traders and artisan groups caught the attention of the visitors and media.



Photo 1. A snapshot view of the exhibition



Photo 2. Diversity of exhibitors- musical instruments



Photo 3. Diversity of exhibitors- handicrafts



Photo 4. Diversity of exhibitors- furniture



Photo 5. Diversity of exhibitors- souvenirs



Photo 6. Diversity of exhibitors- doors and windows



Photo 7. Artisans making handicrafts



Photo 8. Artisans showcasing their products

Ten groups of sponsored artisan exhibitors demonstrated a variety of handicrafts. Sixteen artisans who came from 9 Indian states showcased their crafts and a range of different wood carving styles and techniques (Photos 7-9). They presented, in a practical way, the art and joy of wood. Wood carvers and other artisans from China, India, Cameroon, Indonesia, Japan and Turkey demonstrated their skills and techniques to the conference participants and public (Photos 10 and 11). This attracted about 5,000 local visitors (including a large number of local students - Photo 12) who were also made aware of the relevance of the International Year of Forests.

Artisans' skill demonstrations: The artisans from 6 countries demonstrated a range of different wood carving styles and techniques to the participants and public at 30 minute intervals (Photos 13 and 14). This generated curiosity among other artisans and it turned out as 'learning from each other's' experience.



Photo 9. Artisans displaying their products



Photo 10. A Cameroonian artisan working with wood

Photos, photo stories, poems and drawings display: The winning entries of these competitions were displayed at the exhibition that attracted attention of the visitors.

The International Year of Forests T shirts and bookmarks- In order to generate awareness regarding the importance of the year to forests and wood, visitors were given a special IYF bookmarks produced by FAO-India office, New Delhi. Visitors were encouraged to state "why wood is good" in the feedback sheet selected 40 of which received the International Year of Forests T shirts provided by FAO, Rome.



Photo 11. Japanese artisan working with face masks



Photo 12. Students learning from the artisans



Photo 13. An artisan demonstrating his skill to visitors



Photo 14. Another view of skill demonstration to visitors

3. Social and cultural activities: Additionally, diverse social and cultural activities provided a practical and "hands on" experience of the themes of the conference.

a. Music from wood concert: The concert was given by the Laya Lahari Percussion Ensemble of the Ayyanar College of Music, Bangalore. Traditional wooden instruments were explained to the participants and local musicians played them during this concert that demonstrated the rich variety of musical styles found across India (see more at <http://sites.google.com/site/anoorshivu/layalahari>).

b. The field trip: On 22 October, after the conference, participants went on a field trip to a Sandal Soap Factory (instrumental for producing sandal soap in Karnataka state since 1916- <http://www.mysoresandal.co.in/aboutus.php>), Mysore Palace (a treasure house of artworks and exquisite carvings which was rebuilt in 1912 after the original palace that was made of wood got burned down in 1897- <http://www.mysorepalace.gov.in>) and Channapatna village (famous for the production of a particular form of laquered wooden toys and dolls whose traditional craft is protected as a Geographical Indication (GI), administered by the Government of Karnataka). These demonstrated the art and joy of wood and provided enriching experience to the participants.

c. Institute visit: Tours of the Institute of Wood Science and Technology campus not only exposed the facilities available at the Institute but also showed the fenced sandal trees indicating the hard realities of sustainable production of wood on the ground.

d. Networking opportunities: Conference dinner, cocktail reception and B2B meeting enabled better networking amongst the participants.

4. Competitions related to the event: Reflecting the theme and artistic contributions of wood to the society, competitions were organised for photographs (global), photo-stories (global), poetry (national) and drawing (local) on the theme "art and joy of wood".

B Event organisers, financiers, sponsors and supporters

This conference and exhibition was hosted by the Indian Ministry of Environment and Forests. It was organised by the Institute of Wood Science and Technology, Bangalore (India) Indian Plywood Industries Research and Training Institute, Bangalore (India) and Indian Forest Research Institute, Dehradun (India) in collaboration with the Food and Agriculture Organization of the United Nations (Rome) International Wood Culture Society (China) and International Union of Forest Research Organizations.

FAO provided major chunk of the financial requirements of the event. The Indian Ministry of Forests and Environment, Government of India sponsored the reception and IWST provided most of the logistic and organizational needs for the conference and IPIRTI for the exhibition respectively (including staff time). The IWCS sponsored considerable number of paper presenters, participants and artisans. FAO supported the travel and subsistence of the artisans came from different corners of India and supported the travel of a few presenters and participants.

The main sponsors were the American Hardwood Export Council and Programme for the Endorsement of Forest Certification (PEFC). The Commonwealth Forestry Association (CFA) partly supported the Students' conference. Other sponsors include Industrial and Laboratory Equipment Co. (Mysore), Bangalore and Elixir Technologies, Bangalore. The 'Wood News', as media partners for the event, popularised the event amongst its readers. Likewise, many organizations popularised the event through magazines or newsletters (e.g. Modern Woodwork, Teaknet Bulletin, Wood and Ply Digest, Non-Wood News, InfoSylva etc), email blasts and websites.

Synthesis of the presented ideas

Opening ceremony:

Mr S Suresh Kumar (Minister for Law and Urban Development, Government of Karnataka, India) inaugurated the Conference in the presence of Mr Jitendra Choudhury (Forest and industry Minister,



Photo 15: Lighting the lamp to inaugurate the event- a local tradition

Government of Tripura, India- who presided the opening ceremony), Dr P J Dilip Kumar (Director General, Indian Ministry of Environment and Forests), Dr V K Bahuguna (Director General, Indian Council of Forestry Research and Education), Dr Michael Martin (Director, Forestry Department, FAO, Rome), Dr Howard Rosen (IUFRO), Mr S C Joshi (Director, IWST, India) and Dr CN Pandey, (Director, IPIRTI, India) (Photo 15) .

Most of the speakers talked on multiple perspectives on why wood are good. Mr Joshi described the current view of wood use as an environmentally unsustainable activity in India even though wood use has been prominent in the past and art

and joy of using wood has been part of the culture. He explained how the policy makers and politicians are influenced by narrow views of conservation impacting forestry and wood use negatively which has

implications on the livelihood of people. Mr Suresh Kumar, while emphasizing the relevance of celebrating wood for art and joy, described the conference as one rare occasion where science, culture, art and joy meet on the same platform to commemorate and recognize wood's legacy. In urban environs, he explained wood brings natural beauty and 'woods and wood' cannot be separated from everyday life. Dr Bahuguna explained that the artistic view of wood use will bring back the glory that wood enjoyed in the past, before the substitutes emerged.

Mr Chaudhury described the International Year of Forests as an opportunity to reinforce the relationship between the mankind and forest ecosystem and to benefit our sustainable future. The shortage of hardwood in many places has led craftsmen to use previously unused alternative species. At the same time, due to lack of alternatives many people exploit hardwood as fuel for meeting the livelihood needs. Bamboo has been seen as an alternative to address the shortage of wood in Tripura state in India (with 23% of the area is under bamboo cover) production and consumption of which creates considerable local employment through value addition and product diversification. This model has changed the old perception of bamboo as poor man's timber. Likewise, rubber wood from plantations (used as firewood earlier) has also seen greater value addition by local artisans and product manufactures that has increased the export potential in recent years. These have implications on the livelihood of people and the revenue to the state. Further, the low embodied energy of these wood products (against non-wood substitutes) and insulation properties make wood much environment-friendly. The success lies in SFM and how one harnesses the potential through creative entrepreneurship. Ecotourism and provision of ecosystem services could grow as a by product of production of the raw material for this.

Dr Dilip Kumar highlighted the credentials of wood drawing from his past personal experiences especially from musical instruments which has been predominantly handicraft-based than produced in masses. He linked illegal removals of trees in India due to the overreliance on a specific species for a specific purpose. The demand for wood products could escalate at a faster pace due to rapid economic growth in India which is already a net importer of wood. Concurrently, the forests are expanding in the country (with the involvement of local communities). Tree cover is expected to spread mainly outside the conventional forest areas with the greening programmes like the 'Green India Mission', one of the eight missions of India's action plan on climate change. Expanding urban areas will require more woods, particularly for green spaces that maintain the health of the society and environment.

Dr Michael Martin explained that culture embraced wood in the past and we should connect it with sustainable consumption and production needed in the future to serve the needs of the impending 9 billion people. Dr Pandey suggested the relevance of 'breaking the ice' between various sectors to make wood available sustainably to manufactures of various products.

Why we are here? Different perspectives on the role of wood in sustainable development (Session I)

Dr Saara Taalas and Dr Dick Sandberg presented the relevance of looking in more detail the consumption patterns that will influence relationships with material culture. The consumption patterns change over time suiting to everyday life of that time at a locality. For instance, in Nordic countries, the same forests that served livelihood of people in the past are now important centres for recreation- a change of dimension from livelihood to sports. Thus, the relations with forests have dramatically changed. Many people are now secondary stakeholders (using its products) than directly depending on it for livelihood as people did 100 years ago. The same happened to the relation with the material originating from the forests. For instance, in Sweden firewood dominated harvest from forests (40%) in 1900, but is less than 8% now. On the contrary, pulpwood that was just 5% of the harvest in 1900 constitutes now 44%. Only sawmilling remained relatively the same. Visions for Finnish bio economy business levels reflect the increasing relevance of living trees and bio-energy in future. The wood products will be there but the requirements will change- from volume to specific requirements on properties (e.g. shape stability). The tactile of part of wood see more money but the traditional paper and pulp products are likely to lose its relevance in Northern Europe because of high prices, changing markets and long rotation of forest trees.

Thus, the pulp mills diversify with new products (e.g. textiles). Innovation in new processes will drive ways for new wood use in future (e.g. polymers and chemicals, bioenergy etc). Prioritising purpose will determine wood's value. For example, using wood for bioenergy (which gains relevance in Northern Europe) might negatively influence many other business levels. Increasing business value should be given emphasis as trees could be sold 100 times through process innovations.

Dr Michael Martin wondered why wood still continues to bear the consequences of negative perceptions of the society. He explained how wood use could help to take the forest to home and meet the aspiration of the modern society towards nature. Despite several advantages of wood to store carbon to mitigate climate change, the global forums seem reluctant to promote it. One reason for this is the approach of the wood products industry for satisfying the material needs that expanded from the artisan level to very large scale (e.g. paper and pulp). The demands of economies of scale (reducing costs and being competitive) led to expansion of large industries within short time span. Consequent ramifications of large scale exploitation (e.g. clearance of forests) were not coherent with peoples' sentiments concerning forests and did not correspond to their views of forests as a source of a myriad of things. Consequences of these actions combined with the internal value struggle amongst public regarding other uses of forests paved way towards negativism regarding wood products.

This is the right time to address this paradox for sustainable development using wood which is well embedded in the culture of many parts of the world. Wood use is part of relic of the past and still portrays high social and cultural value in many societies. Many countries try to move towards modern wood products today partly because wood products could capitalise on the efficiency of photosynthesis and replace the material that damages our environment. Considering the needs of the imminent 9 billion people, production and consumption of wood cannot be thought separately. The challenge today is how to bring back the positive attributes of wood by rescaling the concept of consumption model from commodity products to value added products. One way to achieve this is to work closely with the futurists and those who could provide inspiration like designers, architects etc. Such an alliance might pave way for the rediscovery of a series of products based on photosynthesis with a common perception of a sustainable future. It will create a product opportunity that is renewable and which captures and store carbon. Effective communication on the credentials of wood is needed to enlighten the potentials of wood use for sustainable development.

Contextually, there are lessons to learn from the craftsmen in many parts of the world who add value to wood by creativity. They practice value added production than commodity production. This implies turning the economic and consumption model around. One way to this is to concentrate on art, beauty and tradition to draw inspiration for future applications based on traditional designs and uses which has relevance in today's life. This will enable planting more socially preferred trees and set a legacy of using more 'good wood'. While deforestation remains as a big issue in some regions of the world, tree planters struggle to find good market for sustainably produced wood in some other regions. The challenge is how to give value to that wood where the 'art and joy concept' could draw its importance. For example, using only locally produced food products in some restaurants in Italy enhances the value and relevance for such products. Product differentiation and product distinction and naming them have advanced in agricultural sector where forest products remain to find its way. Therefore, a better alliance between futurists, architects, planners, designers, product manufacturers and foresters is crucial to make a difference in making a rational linkage between wood products sector and sustainable development.

Dr Balaram proposed the design needs of wood relating to spiritual connections between the society and wood. Artistic products constitute spiritual attainment for many handicraftsmen who make the wood live again. This powers the life of dependent people in their families. The cultural ethos like 'trees as god' existed in India where permission was sought from a myriad of creatures before trees were cut. Wood use continues to exist in many parts of the world catering to the diverse needs of the living or the dead (e.g. sandal wood or cremation by the rich) and the industry. In many cases, wood use implies that the past co-exists with the present because it takes traditions into the modern society. Despite having more than half of the world's forests, many developing countries export unprocessed/minimum processed wood. This

constitutes modern colonization in a globalised economy. The future for sustainability is better indicated by green awareness, green movements and green guarding which act against unsustainable industries. Designing could effectively help to tap its potential at three levels (a) planting more trees (b) processing of wood and producing end products that minimise wastage (e.g. using every part of the tree, not high grade timber alone) and (c) enhancing opportunities for reuse. Employing various qualities of wood has resulted in low cost products which are light and beautiful. Innovations emerge out of imagination, creativity and technology integrating the special qualities of wood. Thus, technologies shape wood and wood could suit modern technology (e.g. wood laptops). Mindful designs enhance value of the tree by using every part. Adding value by wood's reuse they discourage extravagant wood use and help in innovative policy interventions. These could contribute to SFM and poverty reduction through beautiful products that helps to nurture nature. However, local people do not get enough wood due to concessionaires who target international markets. Contextually, illegal logging, even though not desirable, offers livelihood at certain instances to a few people who do not have much alternatives. Laws remain unenforceable in some situations like this.

Dr Pascal Kamdem explained wood's role in sustainable development of Africa quoting the case of Cameroon where timber constitutes the main export product after crude oil and petroleum products. All the three sectors of forestry viz. (i) silviculture (production of wood) (ii) first level of transformation (logging and saw milling- low value added) and (iii) second level of transformation (furniture, construction, crafts etc- high value added), face problems. Artisans lack good quality wood because large companies export wood to cater the need of international markets. About 30% of artisans work in informal sector with low emphasis on sustainability. Their livelihood could be improved by better strategies. Export continues without much processing despite laws in the disguise of not commercially important species. The wastes are enormous due to absence of the industries that could use wood residues, small diameter logs and currently unused parts of the tree like branches. Currently, logging and sawmilling adds very little value and is very primitive. Secondary sector is underdeveloped and oriented towards export. Nearly 60% of the primary and secondary sectors are represented by the artisans (only half in the formal sector). There exists opportunities to advance in the secondary sector through training to add greater value which will enhance job opportunities. Only two species account for 55% of the total production because of international demand and no strategy exists to meet local demands. Interventions by technology, infrastructure and marketing strategy (that enhances local consumption) will improve the wood industry that accounts for 6% of the GNP. This will consequently increase job opportunities for people and increase national income. The taxes related to import of tools and equipments should not impose barriers to technology transfer. Likewise, financing local entrepreneurs will help to address the issues in the processing sector. Direct channels of communication with the local people (e.g. wood tours) will open ways to improve wood's status for sustainable development.

An introduction to wood culture: building on the past (Session II)

Dr Howard Rosen described the evolution of wood culture in the USA (the value and the way one uses wood in the society) where per capita consumption of wood and fibre products is four times the world average. Yet, growth dominated removals in recent decades in the US forests. Historically, wood dominated the life of early settlers who found myriad of opportunities with wood causing massive scale destruction of forests. The destruction of forests continued till the beginning of the 20th century till the idea of wise use of forests and making it open and accessible to all the people emerged. Most of the large trees gradually disappeared and products emerged using small size timber. Adoption of wood composites, wood plastic composites and carbohydrate economy (cellulosic biorefinery) is on increase in the USA.

Dr Sangeeta Gupta narrated the historical connections between wood and Indian life for the last 5,000 years some of which continues even today. She described how wood shaped Indian life with diverse wood use (based on scientific wisdom of wood) in temples, palaces etc that varied at different parts of India. Wood, excavated during archaeological excavations, gives links to diverse wood culture of the past. Local knowledge matches with modern day findings regarding wood's potentials that enabled its use for thousands of years. However, in India there is high demand for wood and supply is limited. This paves way

for illicit felling and inappropriate wood substitution damaging the environment. Removal of trees from natural forests is banned in the country. Likewise, wood use is banned for certain purposes (e.g. construction by government agencies). However, the relevance of locally grown wood enhances in India, with the emergence of new national programmes like the Green India Mission.

Dr Andrea Klein indicated the relevance of not discarding the wood that deviates from straight design. She explained the evidences of its use in the past ranging from wooden tools in the Bronze Age to ship building in the 18th and 19th century. Thus, the crooked tree or their parts which is normally discarded by many people could find better uses by employing design capabilities better for specific application and taking advantage of the natural shape. Thus, the value of the trees could be enhanced.

Mr V Ramakrishnan demystified the fourth dimension of wood as the indescribable feeling beyond the five senses which draws from the umbilical connection of humans with nature. For example, using wooden benches for Ayurvedic treatments provide a feeling of healing even before someone starts the treatment. Likewise, the casks providing special tastes to whisky constitute another example to the fourth dimension. It is the feeling of oneness or exhilaration with nature and tranquillity and eternity which is embedded in many cultures (e.g. seeking permission from the tree before cutting it).

The use of wood in different cultures (Session III and V)

Dr Michael Grabner narrated how to draw the ideas for the future based on historical wood utilization. For example, most of the traditional skills are being lost in Austria with disappearance of the craftsmen. He explained that current utilization of wood in Austria can benefit from the past history (e.g. producing of wooden bags instead of plastic). Sustainability is an issue (despite comparatively high forest cover in Austria) which indicates the need of using presently underutilised species and assortments. An interdisciplinary view is greatly helpful to this end.

Dr Kunhamu elaborated the wood legacy of Kallai, a suburban village and a historic wood trading centre in South India. He explained the upturns and downturns of the wood trade in Kallai which once dominated in south Asia. It was attributed by bountiful supply of diverse high quality timbers from nearby public and private forests to meet international market demands. Private forests (with little extraction control) supplied timber to sustain trade. The first organized saw mill in Kerala was established here in 1893 for wood processing. The domination could be attributed to the demand for specific timbers of certain dimensions for specific end uses (e.g. long teakwood planks for boats for the Royal Navy and in the Middle East). Most of the saw mills disappeared gradually due to diminishing raw material supply (due to ban on clear felling, nationalising private forests etc) and trade. Consequently, the tribes (Baramis and Khalasis) engaged in ship building locally lost the job opportunities. Gradually the traders who survive today diversified trade concentrating on lesser used species and catered to the needs of domestic small timber demands. Currently, boat building gains relevance stemming from its demand for tourism. About 63% of teakwood supply in Kerala is from the homesteads and forest department provides only 34%. The relevance of wood supply through trees outside the forests is therefore increasing. More attention and support to this could revive the local wood trade.

Mr Subramony and Mr Nripal Adhikari explained the potential of bamboos for housing programmes and the relevance of bamboos that occupy 3% of the world's forests, for environmental sustainability. Very short rotation nature of bamboo makes it as a sustainable and affordable material (30-50% cheaper than conventional material) for housing combined with its strength, insulating and earthquake resistant properties. Bamboo is gaining relevance as countries start changing building codes to enable its widespread use. It could help in post-disaster recovery also (e.g. Sichuan province, China) by addressing the shortage of raw material to rebuild.

Dr Victor Adekunle explained how wood has been part of human life over millennia and explained how wood, in form of boats, paved the way to Africa. He explained social, religious and magico-cultural aspects of wood in Nigeria and its versatility for sustainable national development. Wood is an integral part of the Nigerian society playing a significant role throughout the life right from birth to death. Myriad of wood

products suit societal culture and tradition (e.g. local music instruments, extracts from wood for local drinks, medicine etc) and provide job to rural people in Nigeria. Specially made coffins indicate value addition to wood based on the local culture. The role of wood in providing health care is increasing in Nigeria because of low costs, ready availability, proven performance and effectiveness to treat certain ailments, as local people believe, over modern medicine. As population increase the demands for wood also increases and it constitute as a challenge in forest management. The forest resources management in Nigeria fell in three phases viz. (1) the reservation phase between 1899 and 1930 (2) the exploitation phase between 1930 and 1960 and (3) the development phase from 1960 onwards. The first phase was led by colonial authorities (soon after the logging knowledge arrived in 1881 in Africa); the second phase was influenced by international markets and the third by large-scale afforestation. Considering the relevance of wood for GDP, national employment and export revenue in Nigeria, forests need to be sustainably managed. Sawn wood production constitutes the most active wood industry evolved from pit sawing since 1782 and the first mechanical saw mill by 1900. Plywood and particle board industry evolved from 1948 when the first plant was established (largest of that kind globally at that time) but most of them are moribund today. Diverse small scale wood-based industries are also scattered throughout the country. Provision of incentives for expanding their business and developing credit facilities to procure more efficient wood working tools will help this sector develop further.

Dr Jiang Xiaomei cited the relevance of Hongmu timbers (the woods used for the Ming and Qing Furniture like *Pterocarpus santalinus* in Qing dynasty and *Dalbergia odorifera* in Ming dynasty) which symbolise Chinese national culture. The artistic achievements of Ming and Qing dynasty are reflected in classic Chinese furniture (which has a history of more than 1000 years). The design of furniture and carvings on them are designed to carry the elements of Chinese culture. The human body engineering is also considered during designing (e.g. 'S curve' chair back). The 'tenon and mortise structure' (the soul of traditional Chinese furniture) makes the design unique. Hongmu culture also considers Chinese aesthetics. The timbers are sourced from various countries (e.g. *Pterocarpus santalinus* from India). The Chinese national standard 'Hongmu' tries to develop healthy markets since 2,000. While the living standards and the economy are fast improving, Hongmu culture is embraced by even common people. For better inheriting and developing Hongmu products, sustainable development of the resources (e.g. precious trees breeding project), utilising unconventional species and evolving designs that are rich in modern styles are important.

Dr Remadevi presented the wooden monuments in India that constitute as epitomes of beauty and portray local talent and traditions spanning centuries (e. g carvings in wood and architectural designs in palaces and temples). Wood played a great role in Indian society where one palace in 300 B.C. alone measured nearly 15 km long and 2.5 km wide. Diverse wood products manifest today the diverse local cultures that India inherited from its past. Even though the woods used for this varies across the country, they play a great role today in portraying the cultural heritage (e.g. Chariots) in India. She indicated the relevance of maintaining them by suitable treatments (e.g. wooden flag posts treated with oil before their use in temples) and preventive measures from all the agents of degradation. Conservation therapy needs development to enable appropriate interventions for this.

Dr Edmond Adjovi described the typology of wood sculptures in West Africa where wood resources vary highly between countries (from deserts to rain forests) that consequently shapes wood use in the society. The royal courts, traditional religions and agrarian rites were instrumental for developing sculptures, the main ones being statues and masks, statues, sculptures, furniture, tom-tom etc. These play a great role in the life of West African societies. They helped to express ideas in wood and reflect African culture which has been part of social life for 2,000 years (as in Nigeria). The craftsmen combined aesthetics and function within social, religious, cultural, political, economic, historic and therapeutic contexts. For example, masks represent specific circumstances of life and used for dance, marriage, funeral etc. Likewise, statues link the visible and invisible world (e.g. statues of twins in Benin).

Dr Stephen Tekpetey explained the lifestyles changes in a few urban centres in Ghana and showed the trends on substitution of wood in buildings. Export of wood products contributes significantly to the

national economy of Ghana. Wood has been a main ceiling material in buildings and residential complexes till the advent of substitutes recently and plywood dominates the scene currently. However, other material (e.g. plastic) are gradually replacing wood in urban centres because of lower levels of customer satisfaction on durability, attractiveness and design of wood-based panels. As people in Ghana are getting wealthier, durable wood supply is dwindling and information regarding availability of other material is growing. So, wood is likely to lose further. There is a need to educate people on the advantages of wood (e.g. thermal properties, carbon storage etc) over other material and address the impeding issues (durability, design, availability etc) with suitable interventions to retain and improve wood's prominence.

Artistic aspects of wood use and design (Session IV and VIII)

Prof Ranjan explained the aspects to learn from the design detailing in wood, particularly on the furniture design of Mr Gajanan Upadhaya, an Indian designer. A good furniture design evolves not by chance, but with a great thought process and fine detailing. Many a times the end product will not be known when the design process starts, but will be arrived at through experimentation and series of prototypes. He explained the fusion of ideas with other leading world designers that reflected in Mr Upadhaya's work. It indicates the relevance of designing with fine detailing to suit specific needs. It also involves an understanding of the geometry, structure, behaviour of the material used, world view regarding what will work etc. Future wood work and design has many lesson to learn from his works.

Mr Jirawat Tangkijngamwong emphasized the relevance of sustainable living as the key to a sustainable future. He portrayed the ways of wood use in Thailand where it has been an integral part of societal life. Only a small portion of the furniture industry is export oriented and most of them are small and medium enterprises. Most of these enterprises are slow, unproductive and uncompetitive who needs support. He emphasized the relevance to focus on certain areas like creativity and sustainability to add value to natural products. Thai design is a combination and contrast of material. It mixes traditional craft with new technology and aim for harmony of style and function and integrates the sense of Thai. It reflects nature because it draws inspiration from nature and everyday life. Deesawat (a company started as a saw mill in 1972) was shown as a good example of restructuring to small scale (with 200 staff) and innovate market opportunities to survive a crisis. Modular products suiting cosy lifestyles helped the company to survive the crisis. Low energy consumption and minimum wastes makes the process efficient. Design was the key element to manufacture the products that suit contemporary lifestyles (both indoor and outdoor). He discussed how this company minimizes energy consumption and turn wastes to wealth. He detailed the SOOK concept (small order O.K) in Thailand that helps wood industry to thrive.

Mr Achmad Zainudin explained how wood carving has been integral part of Jepara culture (in Indonesia) since the Stone Age. It continues to support livelihood of people even today (nearly 150,000 wood workers, mostly small scale businesses). Jepara represent the largest wood working cluster in Indonesia. Differentiation in terms of products and artistic creativity has been the key to its survival. However, the small scale industries face competition today against big players.

Dr Hakki Alma discussed various wood carving arts of Turkey and its historical relevance as one of the oldest arts of Turkey for thousands of years suiting to the local customs and culture. Distinct woodcarving in a few mosques in Anatolia, which dates back to the 13th century, portrays this. Animal motifs got gradually abandoned and replaced by vegetal and geometric motifs to suit the needs when the Turks adopted Islam. He explained how certain techniques learnt from the past (e.g. dovetail technique) and special tools could add value to the products today. He also stressed on the relevance of clustering small and medium enterprises.

Mr Kitazawa Hideta presented the relevance of Japanese traditional wood carving and its importance in Japanese culture. Wood carving has 1,400 years of history in Japan (started with Buddha statue carving). He explained diverse carving techniques he uses (following the heritage in the family) and showed the special tools he made. He elaborated his expertise in mask making with many woods (e.g. Hinoki or Japanese Cypress). Wood offers great potential for creativity and will last for long. The masks express various stages of life and states of mind. He explained how to keep the product as natural (e.g. using

natural paint from oyster shell powder). Demand for masks still exists. However, there are only a few wooden mask makers in Tokyo and he wanted to retain the tradition.

Dr Olga Sevan described the traditional and modern house paintings in Russia, particularly the relevance of drawing on wooden structures that reflect the traditions and everyday life which are unique to specific regions. She emphasized the relevance of restoring these monuments.

Dr Wang Guixiang stated that Chinese traditional architecture constitute predominantly wood-framed building system compared to its counterparts in many parts of Europe. Chinese architecture is a long and uninterrupted system, but changes evolved to buildings under various dynasties. Historically, wood has been an integral part of the buildings and many of them exists even today (for example, the Buddhist pagoda of 67 m high built in 1056 AD).

Wood architecture: What can be done? (Session VI and VII)

Mr. Michael Green proposed where the wood buildings will be going in future based on how wood has permeated to modern lifestyle of people in North America. He explained wood as the main solar building material available today, but has not reached to the breadth of the industry. He demonstrated how his firm MGB Architecture design with wood for multi-storey structures that suits modern societal needs. The architecture evolved from log cabins to Burj Dubai during the course of industrial revolution pushing the boundaries possible with new material (e.g. Eiffel Tower by iron in 1889). This spread the message of what is possible that helped to stretched imagination to high rise buildings. Steel and concrete innovations thus dominated the 20th century. Wood on the other hand confined as regional and limited to residential purposes with limited innovations. Consequently, wood largely remained at the stage before industrial revolution, even in many industrialised countries (e.g. Canada). For example, building codes allowed maximum 4 stories tall buildings made of wood in Western Canada till 2008. In 2009, pushing the boundaries resulted in 6 stories tall in 2009 in Western Canada while 9 storey building with wood has already been made in the UK. Thus, building codes limit the ability to innovate in wood. 19 storey building that was built 1,400 years ago still exists in Japan in a wet climate and a high earthquake zone, yet still survived over long span of time. Thus, imagination got limited in the last 100 years compared to that of 1400 years ago.

Climate change constitutes one predominant reason why wood should be used in buildings. Building sector contributes directly and indirectly to climate change. Wood can address this problem if it is sourced from sustainably produced sources and designed with more rapidly renewable wood solutions. Engineered wood products can provide a sustainable solution because 1 m³ of wood can store up to 1.6 tonnes of CO₂. It is technically possible to make even 30 story building with wood, with the possibilities created by innovations and new wood products. Mass timber (cross laminated timber, laminated strand lumber, laminated veneer lumber etc) allows rescaling the imaginations regarding buildings. A systemic change is needed than mere cosmetic ones for green buildings which address only part of the problem. In the next 20 years, roughly 40% of the global population will need affordable homes. Current models of construction to solve this need will cause a bigger human challenge through climate change. Nearly 70% of the world will be urban by 2050, especially in the fast growing economies like China and India. So, designing the right solutions to erect tall urban buildings is pertinent. He presented the concept of FFTT (Finding Forests Through Trees) which is similar to steel frame construction, but done in wood with minimum steel use. The preliminary design experience indicates that it is simple, doable, adaptable and cost effective. The mass of the structure of a 12 storey building was about 3.5 times when concrete was considered instead of mass timber. Likewise, CO₂ released to the atmosphere was 398 tonnes when concrete was considered while 1,105 tonnes of CO₂ was prevented from entering to the atmosphere with mass timber use. The costs of construction did not differ significantly between the two types.

Dr Dustin Tusnovics presented how timber architecture can make a difference and build a better world with low energy consumption. He explained why Miesian architecture has to face a crisis today with a growing understanding of the impacts of the built environment on climate change. Quest is now for sustainable and energy-efficient architecture and how to deal with built environment as a system. Despite

the emphasis on sustainable development, slum dwellers increased substantially today and are likely to grow considerably in the nearby future. Here, the value of architecture becomes relevant. Today, added complexity to the system leaves the decisions to the specialists who do not necessarily improve the architectural quality which stresses the need for experimentation with alternate building technologies. Evaluation and assessment tools are likely to see a shift from short term to long-term observation periods where both the use of material during and after the life of a building will be considered where sustainably produced wood (that stores carbon and could be used after its use in building) becomes relevant. However, there is a dearth of people who specialize in timber use in buildings even in Austria where timber is integrated well in the industry and has long tradition of timber use in construction. This indicates the relevance of training young generation focussing on the technical, creative, economic and communication aspects to act as links between the industry and others (users, planners, municipalities, policy makers etc) to enhance acceptance of timber.

He explained the experience with a project (Skills Training Facility) using volunteers from Austria in the small informal settlement of Magagula, in South Africa with South African pinewood. Timber architecture was found to be a fast way to realise structures. Also, the project shared technology with 27 volunteers from the local informal settlement who helped in construction. The volunteers could transfer the skills to others. Slum-upgrading project with modular timber units in Mathare, Kenya also used wood as the main building element with a combination of other locally available material. Lesedi Nhahle Training Crèche project in Haenertsburg, South Africa aimed to showcase how good architecture could demonstrate sustainability (heating and cooling can be addressed without air-conditioning and heating and how locally available material could be used). Based on these experiences, the conviction has been that it is practically impossible to realise anything similar to constructing with wood in a limited time frame. He stressed that the value of architecture lies in its ability to enable involvement, generate awareness, deal with uncertainty, accept complexity, comprehend diversity and respect the needs of the future. There is a need to develop need-based designs and wood products (e.g. simpler and lighter that even the unskilled labourers/women could make use of) to bring key change to the building process and to improve the life of poor urban dwellers and disadvantaged sections of the society. Communicating the credentials of wood and considering the cultural dimensions are equally relevant. Likewise, the assessment methods (e.g. BREEAMS, LEADS etc) should consider the social dimension of sustainability, which is rather neglected now. Opportunities emerge today to increase the contributions of forests and wood products to the economy and society as evidenced by the timber industry in Austria. If a country which relatively smaller area of forests realise its potential, many countries with comparatively more wood resources could possibly realise it better.

Mr Andrew Waugh explained how he used cross-laminated timber with 'honey comb structures' to make a nine-story building (Stadthaus, the tallest modern timber structure in the world that stores 186 tonnes of carbon (<http://www.waughthistleton.com/project.php?name=murray&img=1>)) in London. The building structure was finished in 27 days (with four people). The design took care of shrinkage and creep (shortening due to compression under load), stability, acoustics, fire prevention etc. Wastes generated were negligible. Many related works were practically convenient (e.g. electric connections). The demand for the apartments was high when it was finished. He concluded that prefabricated wood products and software to visualise various aspects of construction (e.g. deflection) of high rise buildings could help the architects to better employ wood today.

Based on social housing in Curitiba, Brazil, Dr Ederson Zanetti explained the relevance of wood from sustainable sources in the mitigation of global climate change. Construction and forest sectors can play a major role on reducing the global climate change impacts. Both the sectors contribute to livelihood of a large number of people. As the environmental goods and services will hold a larger share in international trade by 2050, it is better to seek the potentials of complementarities of both the sectors. Shortage of housing in many parts of the world presents an opportunity for wood use, especially when incentives like carbon credits could encourage tree growth. The world stock of wood is increasing and SFM provides an opportunity to increase wood's potential to store carbon in buildings. Green construction solutions are

possible today with wood. Maximising wood residues use will minimise waste in the production chain while meeting the energy needs. Carbon credits for the houses could incentivise more wood use from sustainably managed sources. For enabling wider scale use, he proposed to establish a Global Wood Network.

Dr Emmanuel Appiah-Kubi presented why there is low interest for using wood in housing in Ghana and presented the psychological and technical barriers to wood use. Even though in Ghana wood is plenty, easily transportable and holding many advantages as a construction material, the popularity of timbers in house construction is decreasing (despite wooden houses portray timber's durability and its great potential as a housing material). Wooden houses are considered as old fashioned and many prefer alternative products (concrete, steel, plastic, glass etc). Structural use of wood is limited due to unfounded prejudice and lack of data regarding the properties (strength, durability etc) of a variety of wood available locally. A large part of the population has not seen timber houses or lived within them. The majority of the respondents will not consider using timber in buildings due to susceptibility to fire, floods, insect attack and decay, theft etc. Considerable number of respondents thought that timber houses are for the poor who cannot afford to construct with steel or concrete. However, a section of the respondents will still use wood because it is cheap, readily available, provides ventilation and suitable for hot and cold weather alike. But, the local supply of suitable wood products is low due to the high cost of production, export, dwindling timber resources etc. Lack of local expertise (e.g. architects, designers) in timber construction constitutes another impediment. More efficient processing methods, increased value-addition, more expertise in timber construction, planting fast growing species, promoting non-timber forest products (e.g. bamboo) etc should be considered to promote wood for housing along with education and sensitization of the general public to enhance wood's wider acceptability.

Mrs Roshan Shetty explained the relevance of vernacular architecture for sustainable development, based on experience from South Canara region, south India where vernacular houses have survived for more than 4 - 7 centuries. These adapted well to the local environment and culture. Locally available material (e.g. wood) has been used extensively here. Wood helps in the natural cycle of life of trees and the local resources can be better made in use than depending on resources from elsewhere. It also reflects the craftsmanship and serves as the decorating element of the houses. It indicates the richness of the persons (e.g. well carved doors/windows preferred by rich persons). The design and wisdom of the vernacular architecture needs to be better understood and adapted more widely to draw inspiration for modern architecture.

Mrs Neelam Manjunath's paper emphasized the relevance of bamboo from the status as the poor man's timber to a predominant building material. Three projects were presented as a testimony to its great potential. Prefabricated products enable construction of bamboo houses in weeks. It presented cost effective construction with minimum waste. Local availability of bamboo and emerging innovative designs are likely to promote use of bamboo in future for construction.

Selling the art and joy of wood products to consumers (Session IX)

Based on experiences from his family farm, Mr Jim Birkemeier presented on the full value forestry and how to create new jobs from dead trees. The loss of jobs comes partly as a result of heavy mechanization that will impact the people who depend on the industry. He uses only small machinery. He suggested the relevance to target the dead and dying trees and to select the ones not growing well first and add value to the wood by creativity. Adding value to low diameter logs is important to prevent them from other low value end uses. Adding value to wood that is out of expected shape is also relevant. Likewise, making use of all the trees irrespective of its commercial value is important to a forest owner. He suggested adding value to trees by targeting local wood and designing innovative products even with scrape wood to suit the tastes of the local customers. "Mega Value" products that take more time and skill to produce (like furniture, cabinets, countertops, stairways, etc.) can earn more money with less volume of better quality wood. Wood art creations like jewellery, boxes, ornaments etc can increase the value substantially. He felt that even though his business model seems old-fashioned and opposite of industrial forestry today, this

business model is universally adaptable because innovative high-value products can be manufactured and marketed on a small scale to create new jobs. This will enhance the per unit value of wood and create more jobs per unit area of forests/woodlands. Direct marketing of high value products in a local economy can make this feasible where earning is limited only by imagination. He felt that global certification is expensive with no significant benefit to their local business. On the other hand, providing excellent local service and earning word of mouth sales was the main growth force of their success.

Mr Giedrius Leliuga presented identifying customer needs and control of supply as the keys to success based on his experience with his three enterprises that use European Oakwood (which is declining at the same rate as of the tropical forests). Availability of high diameter Oakwood logs is dwindling and the quality declines. The preference of the Oakwood for particular end uses (e.g. flooring) compared to other species signifies the relevance of having more sustainable supply. They even survived economic recession because the demand is going up for Oakwood flooring and have control of the development chain (from the forests directly to the end-user) till the end product with minimum marketing costs. However, flooring with wood represents hardly 6% of the total flooring sector in Europe and therefore with better marketing strategies, wood can find better possibilities against its present day substitutes. Good quality products and intelligent marketing are crucial to be successful.

Mr M V Rao presented the centuries-old tradition of toy art in Etikoppaka, an Indian village in Andhra Pradesh where around 200 artisans produce beautiful toys and other handicrafts using mostly the wood of *Wrightia tinctoria*. The artisans switched over to other jobs when new opportunities arose. However, the involvement of a few institutions (Fine Arts Department of Andhra University, National Institute of Design and National Institute of Fashion Technology) in the development of new designs and innovative products attracted national and international customers. These combined with setting up of a design centre in the village reinvigorated the traditional art. Inspired by the success, people living in nearby areas also started following the paths of the artisans in Etikoppaka. However, export dwindled in recent years due to the inability to cope with the new export norms (e.g. forest certification, eco-friendly compliance labelling etc). Frequent power failures and lack of availability of local timber (of small diameter) pose constraints to toys production. The artisans started using rubber wood, but they are not locally available. They depend on inconsistent supply of wood from various sources and therefore sustainable supply of wood is crucial for their sustainable livelihood. The trees raised recently through Joint Forest Management could revive the industry, but the actions are yet to be taken by the forest department to provide this wood to the artisans.

Dr Sudipta Dasmohapatra presented the consumer purchase trends and perceptions of wood products in the USA. During recession the consumption of wood products declined, but it is likely to go up in future again. The likes and dislikes of consumers towards wood products vary with the type of product. What a consumer value is important (price, durability etc) for the industry. Diversity of the society connotes that different sections may have different requirements. Intergenerational preferences, especially when the life expectancy is increasing, will influence the consumer trends. Likewise is the effect of globalization with innovative products and knowledge passing boundaries quickly than ever before. The people in the US are going greener and considerable proportion of the population aspires for the products with green credentials (e.g. certified products). Consequently, the value of green building construction is rising and the preference for local products is on increase. Customization (instead of standardisation) and quick delivery is another emerging trend. Innovative marketing strategies use creativity to lure the customers to the retailers while technological revolution (e.g. internet) enables wider direct marketing. As people are getting richer, the industry also reorient towards the products that cater to the needs of luxury products. The local migration of people due to various reasons and the family composition (e.g. people living alone) implies that preferences may vary. So multitude of factors in the society will shape the wood product industry and the market strategies.

She explained how consumer purchase of wood products is driven by key attributes like price (matching with the quality), time of delivery etc and discretionary income (e.g. disposable income available for remodelling/improving home). Consumer value varies depending on the types of customers that can help in product differentiation. Expressed customer needs will help in incremental innovations. Likewise, latent

needs and desired outcomes also will influence the value. Price, quality, appearance and durability generally determine the value. However, origin (e.g. as in the case of wines), local sourcing (e.g. Wood from the Hood), customization and green credentials are likely to add value further. Customized products are likely to surpass the standardised ones in future. The customer survey they conducted indicated that durability, appearance and price were the most important attributes for wooden household furniture. Nevertheless, considerable proportion of the respondents expressed that they will buy local and recyclable products. Environmental attributes like low toxic emissions, where the wood comes from, how they can be disposed with minimum environmental impact after use etc were evident in selection of household wood furniture. About one-third of the respondents were willing to pay more for environment-friendly furniture. Preference for local products was largely evident in food products (because of local socio-economic benefits) which indicate the possible future trend for wood products also (e.g. nearly 50% of the respondents will pay more for locally produced furniture). Four different segments of customers were evident- bargain hunters (price as the main driver), quality conscious buyer (price neutral but cares for quality, durability and appearance), convenience oriented green buyers (preference for customer service and ease of use, local and environmentally products etc) and carefree green locavores (local purchase, customization, green products etc important). The production and marketing of wood products should consider the consumer segmentation and the factors that influence product selection.

Wood industry development in the formal sector (Session X)

Dr Jegatheswaran Ratnasingam explained how furniture industry clusters developed in Malaysia (one among the top ten furniture exporters in the world). The wood-based industry grew prominently in recent decades contributing to significant levels of employment and foreign exchange earnings. It surpassed even the rubber industry which was one economic powerhouse of the country. Export of value added products was low until 1986 when logs, sawn wood and plywood were exported. Greater value addition happened after 1986 due to the charges/restrictions imposed for export of logs and sawn wood. From 1996, value addition was greatly incentivised and from 2006, incentives were provided for innovations and marketing to ensure global competitiveness. Many consumers relocated to Malaysia after the restriction of export of logs and sawn wood. This combined with other growth drivers enabled rapid growth of the wood industry. Rubber wood played a great role because it ensured sustainable supply of internationally preferred wood for the industry. Today, 80% of the furniture produced in Malaysia is from rubber wood. Now the trials are going on with oil palm lumber, marketed as 'tiger wood' because of its characteristic texture. Labour is expensive now and 43% of the workers in the furniture industry are foreign (mainly from Indonesia, Myanmar and Bangladesh) with little skills retention possibility. Human resource development fund (generated through 1% contribution of the pay roll of the companies) is expected to improve the local human resource and retention. Investments for technology development are increasing. Domestic investments grew substantially (70%) over the foreign direct investments as the industry matured. Government policies (e.g. financial incentives, tariff, industrial estates, political and economic stability, infrastructure development etc) and factor inputs led to the success of the Malaysian furniture industry.

Furniture export jumped from US\$ 6 million in 1982, to US\$ 2.5 billion in 2008 which is mainly attributed by the furniture clusters that provided economies of scale, flexibility and product diversification. With about 3,500 furniture manufacturing enterprises, the Malaysian furniture sector provides employment to about 87,000 workers. The furniture industry is dominated by small and medium enterprises (85%). The diversity and flexibility provided by the clusters in the supply chain add value to this 'fashion' industry. These clusters that developed furniture industry also contributed significantly to the development of entrepreneurship in the rural economies. The clusters are benefited by the local conditions which spur value addition and industrial growth. For example, Muar furniture cluster is close to wood resource and ports and has well experienced and skilled carpenters with well built facilities and infrastructure. The number of skilled carpenters increased in the last decade as a result. Nevertheless, a few clusters fully supported by the government did not perform well indicating the role of the industry to maintain the growth. Networking and trade opportunities constitute one notable benefit of the cluster that greatly helps to enhance entrepreneurship, employment and livelihood options. It also helps in sustaining the wood-

working tradition. However, there are several challenges for the cluster (demands of economies of scale amidst little product diversification, low entry barrier, lack of innovation and diversification within clusters etc). The wood supply from forests is expected to stagnate and the forest plantations are yet to deliver wood sustainably to the clusters. Woodworkers suffer from '3D syndrome' with little interest amongst youngsters for wood working. Likewise, low wage economy and dependence on foreign contract workers pose challenges to the clusters. Moreover, capacity utilization is not optimum, reinvestments are low while innovation is stagnating. Yet, cheaper wood products from the Asian region may affect the competitiveness of the Malaysian industry in future. However, the furniture clusters have already created a competitive edge to face the emerging challenges.

Dr Satyanarayana Rao stated that demands for all the categories of wood outstrip its local supply in India. He argued that while technology-based plantations received attention in recent years (especially outside the forests) little attention was paid to technology-based utilization. Promoting technology based processing and utilization targeting small and medium-sized enterprises is important to develop wood as a sustainable material. Enhancing domestic resource base, augmenting supplies through imports and achieving resource efficiency in manufacture and use are crucial for sustainability. Tree growing programmes are taken up by the government of India in a massive scale to meet the national objective of greening 33 % of land area with tree/ forest cover. Many industries in private sector already became successful in technology-based plantation development. Imports of wood products, after trade liberalisation in 1996, steadily increased (mainly in unprocessed wood). However, imports have implications like the undesirable consequences in importing countries and the costs involved to get it right (e.g. certification or compliance with the laws). Use pattern is relevant rather than mere demand-supply analyses. Research output, technology packages and technology absorption are not well linked. Research and development should reorient to the changing needs. Technology absorption has been slow due to many impediments (e.g. wood preservatives use). A cluster approach with a multidisciplinary outlook could partly address this along with developing products that suit the needs and changing lifestyles of people (e.g. sleek designs). More emphasis on market, policy and social aspects are needed in research. Likewise, examination from different dimensions (e.g. environmental) for convincing evidences using Life Cycle Analysis is also needed. A favourable operational regime and processing are relevant to the wood industry which becomes mostly plantation dependent today.

Small and medium enterprises suffer from various issues- low levels of technology application, low recovery of waste, low quality output of timber (due to improper processing techniques and low degrees of modernization), low utilization of alternate timbers (despite successful suitability studies) and low quality products even from high value timbers. Even though utilization is recognized in the national forest policy, a roadmap to achieve rational utilization is not in place yet in India. Production forestry was encouraged in the past, but the focus remained on the 'how much is produced and removed' rather than 'how' they were used. Therefore, focus should be on technology – based utilization also. The Indian National forest policy prescribed development of substitutes to replace wood and wood products as one of the priority areas (for research and development to ease the pressure on wood resources) while the policy also identified 'utilization' as another priority area. Yet, many regulations disable the wood industry. Therefore, developing a National Wood Use policy would promote technology-based processing and utilization. Likewise, innovative approaches are needed to foster partnership models and provide technology and policy support to diverse stakeholders. Market already exists for a wide range of wood products and more opportunities emerge with changing lifestyles and higher incomes, which may lead to market-created product diversification and quality products for high end niche markets. Likewise, considering the emergence of short rotation and small dimension plantation timber in India, policies and incentives need to be developed to promote the growth of the value added processing and manufacturing industries, following successful examples (e.g. Malaysia) in plantation based industries.

Mr Shengfu Wu presented the struggles in Chinese woodworking industry even though forest area increased in the last decade. China has promoted forest plantations (Poplar, Eucalyptus, *Acacia mangium* etc) in recent years to cater to the needs of the industry which grew rapidly in the last 30 years. Industries

try to adapt to changed raw material supply (e.g. low diameter) in terms of machinery, technology, labour skills, residual use etc. Chinese Timber Traceability System addresses the sustainability of supply. The industry focuses on diverse products adding value manifold to wood and bamboo depending on the end use (for example high value furniture from residues added 40 times the value). Even the residues are well used today (e.g. tree bark). The efficiency has improved, quality was ensured (to suit the international markets) and innovative technologies were developed. Recovery rates in China constitute one of the highest in the world today. Diligent, disciplined and hard working wood workers partly contributed to this rapid development. However, increasing production cost (mainly attributed by increasing labour cost) raises question on maintaining the comparative advantage. Likewise, fluctuating foreign exchange rate, efficiency, regulatory measures (e.g. carbon tax) and recovery issues need to be addressed. Likewise, appropriate measures are needed to effectively deal with economic recession, trade barriers and decreasing export because many industries are closing down resulting in loss of employment raising questions on how to survive. The Chinese government encourages to target the expanding domestic market. Importance given today to biomass based and environment-friendly products (expanding plantations that capture carbon and products that store carbon over wood's life cycle) offer new opportunities.

Dr Arif Nuryawan presented the wood industry scenario and marketing aspects of small, medium and large industries in Indonesia. Primary and secondary wood industries grew rapidly in 1980s, after the government prohibited the export of logs and sawn timber. Industry is increasingly becoming plantation dependent which has implications on the products and wood processing. Only half of the small and medium enterprises (Panglong) in Madan, Indonesia have machines even though they are in this business for 30 years. He examined the four elements of marketing mix (set of elements to enhance marketing share) viz. product, price, place of distribution and promotion. Questionnaire surveys revealed that they differ between the small, medium and large industries. Promotion was limited in case of small scale industries (e.g. exhibition) while the advantage of technologies was better realised by medium and large enterprises.

Mr Nguyen Chien Thang presented the overall scenario of sustainable furniture in Vietnam (that will meet growing demands with less wood) using certified wood, recycled wood and combinations with other material (e.g. bamboo, rattan, water hyacinth etc or recycled aluminium, plastic, iron etc) to enhance durability and attractiveness. The source of wood was uncared in Vietnam in the past which changed in recent years. Of about 1,000 exporters in Vietnam, more than 200 are certified. The thrust is on effective design to avoid wastage, limited use of toxic chemicals and educating consumers about the green products. Design should adapt to the changing situations (e.g. material, social etc) and minimise wastage. Consumer acceptance needs to be considered as a priority and therefore enhance their understanding (e.g. minimising the waste to save the raw material). Vietnam saw rapid growth of furniture industry in recent years. It is the fastest growing industry in Vietnam making the country as its biggest exporter in South-East Asia and second largest in Asia after China. Wood for recycling is imported from different parts of the world (e.g. construction sites, old furniture etc). By employing suitable designs, attractive products are made from them. Even rejected scrape wood and residues (which were used for low value uses (e.g. burning)) are used to make value added products (e.g. particle board). Their imports consequently dwindled with the increase in local production. Combination with other non-wood material also contributed to fast development (e.g. rattans, bamboo, leaves etc). Aesthetic furniture could be made even in combination with the material from water hyacinth. The scrape metals (e.g. iron, aluminium etc) discarded from factories and the metals remnants of the war in Vietnam are recycled to make sustainable furniture. Expanding forests brings newer opportunities. Forest cover expanded from 32% in 1998 to 39.5% in 2010 which is targeted by the government as 43% in 2015. Expanding forest plantations helps to reduce the reliance on imports and promote industry and consequently contribute to 4.6 million rural jobs in the country.

Dr Aimi Lee Abdullah presented the likely changes in timber consumption in Europe related to the issues of regulations to prevent illegal logging. From where wood comes from is important to ensure that

consumption in one region does not lead to destruction of forests elsewhere. Efforts are currently made to prevent illegal timber entering the supply chain to continue to use wood while sustaining the resources. The Forest Law Enforcement, Governance and Trade (FLEGT) Action Plan addresses this and Voluntary Partnership Agreement (VPA) constitutes the centrepiece of the Plan which will be legally-binding once it is signed. Six countries have signed already VPAs and many others are negotiating. Efforts are being made today to minimise the footprints of import in other countries and ensuring traceability of wood which is essential for a sustainable future. The European Union (EU) wide Timber Regulation to ban illegal timber and to require EU importers to exercise “due diligence” (in determining and assuring legality of timber imports) is adopted now. The legislation will be operational from 2013 which is a strong market instrument to improve forest governance and the legal and regulatory framework in timber exporting countries. This will affect all companies importing timber and timber products into EU member states. As per the new regulation, the timber importer must have information on the country of harvest, supplier, quantity etc for ensuring that the timber is legally harvested and comply with national legislation. They have to assess the risk of the timber import in terms of legality. The product manufacturers also need to keep proper records to this effect. All wood products like solid wood, flooring, plywood, pulp and paper etc need to fulfil EU procurement policy for export to EU by 2013. Handicrafts, recycled products, printed papers like books, magazines, news paper etc are, however, exempted at present from this policy.

Development of the handicraft sector (Session XI)

Dr Rajesh Bhowmik detailed how wood is intricately connected with the local culture amongst the tribal artisans of North-East India. The wooden crafts have a wider demand among the tribal groups and vary with each tribal group. Some tribes carve out images from pieces of wood which depicts their lifestyles and social structure. Mask is another popular product among tribes and used in traditional dances. Local musical instruments are also made of wood. Preservation of tribal culture is possible through maintaining a heritage of wooden crafts.

Dr Pankaj Aggarwal's paper dealt with the ideas for ensuring sustainability of the craftsmen in Chennapatna (a toy village in Karnataka, India) where more than 5,000 skilled craftsmen have long been involved in traditional wooden lacquered toys and ivory craft. The intervention of government helped the industry to survive against the cheaper toys from countries like China that threatened the industry. The demand of toys from this village is increasing now. Yet, the middlemen in the supply chain make profit like in other cottage industries. The lack of sufficient profit barely incentivises the artisans to continue the tradition. Likewise, traditionally preferred species suitable for wood turning (*Wrightia tinctoria*) is dwindling. Research institutes like IWST standardised alternative species like rubber wood, Acacias etc, but convincing the toymakers constitute a challenge that further research programmes should consider. Using sufficiently available and cost effective alternative species will help the artisans to upgrade their socio-economic status. Also, enhancing the skills of artisans in design, communication, marketing etc is essential. Exposing the artisans to national and international trade fairs is likely to develop their skills further. Artisans should be connected with related departments, research institutes etc and networking of artisans amongst themselves and with others should be encouraged.

Dr Ramakantha presented the need for strengthening solid wood based handicraft sector in Manipur, India where Cane and Bamboo products are more widespread. Manipur has a rich cultural heritage and an ancient but still thriving art and craft industry using diverse material. Manipuri dolls are famous in the region and the wooden handicrafts are examples of creativity and artistic excellence of the people of Manipur. More than 400,000 artisans find livelihood through the handicrafts sector where solid wood carving constitutes one major component. Solid wood is widely used for making toys, idols of gods, musical instruments etc. Supply of traditionally preferred local timbers for this has dwindled because of deforestation resulting from slash and burn agriculture and other factors which will influence the handicrafts sector. About 173 km² area of forests vanished between 2003 and 2005 alone in the state. More research is needed on the suitability of lesser exploited wood and growing of those timbers.

Dr Siddapa presented the relevance of self help groups (SHGs) for socio-economic transformation of Karnataka state in India. Credit and forest inputs play an important role in all sectors any part of the world. Even though many needs (e.g. energy and diverse food products) are met from forests, the percapita forest area in India is too low. This demands diversification of forest resources for domestic purposes through more efficient ways. Institutional credits have a role to play in value addition, but women and weaker sections of the society receive insufficient credits in developing countries. Bankers could help the poor through suitable bank loans which would return as deposit later. A large part of the rural people, especially women, does not have ideas on banking transactions which would be a challenge. However, many developing countries now try to bring the previously excluded population through SHGs or NGOs to encourage gainful production and employment activities by special programmes and subsidies. SHGs, especially women, could address problems like poverty. The women and children development department of Karnataka state gives emphasis for training of the women for integrating forest resources along with other production process. About 140,000 SHGs operate in Karnataka engaged in diverse activities and many SHG's are based on forest resources, including handicrafts. They save the profits derived from these enterprises and evidences portray the positive societal changes which could bring further socio-economic transformation.

Dr Mangala De Zoysa explained the heritage of wood-based handicrafts in Sri Lanka. The handicrafts industry, being largely a cottage industry, contributes greatly to sustainable economic development and the eradication of poverty in local economies. Wood-based handicraft represents one of the oldest wood based industries in Sri Lanka. Variety of species are used for handicrafts, masks, puppets, drums, carvings of Lord Buddha etc and are related to country's cultural heritage (e.g mask dancing with music from wood drums, puppet dancing etc). Traditional health practices (e.g. panchakarma in Ayurveda), that becomes popular with tourism development, also uses wood. The government is trying to sustain the traditional technology and cottage industry. For example, LAKSHALA (Sri Lanka's handicrafts board) provides support to 3,500 master craftsmen at cottage industries. Local raw material supply is dwindling that reduces the profit. As a result, wages are lowered by the entrepreneurs pushing the craftsmen into poverty. So, creating plantations to ensure sustainable supply is important. Training and support are being provided by the government to enhance employment through innovative handicrafts products. Many market promotion activities are also underway at the national and international level. The government initiatives reinvigorate the growth of the handicrafts sector and have relevance in value addition. With increasing exports, the demand for wood-based handicraft products is on increase (e.g. wooden toys). Tourism development encourages the handicrafts production which follows international quality standards. These will promote cultural heritage, improve rural livelihood and expand exports.

Mr Srinivasan Raghavan presented diverse seasoning processes and their challenges. The benefits of seasoning include stability for wood's end use manufacturing process, minimising warping, bending, cracking and shrinkage and ingrainings of good polishing and finishing attributes. The decision for seasoning are influenced by investments, lands for drying, boiler, operation staff, boiler inspection certificates etc.

Promoting wood culture in the future (Session XII and XIII)

Dr Gabriel Hemery presented the efforts to revive Britain's lost wood culture which lost its forests primarily for agriculture and economic development. He stated that the forest cover in UK is too low (12%) compared with many other European countries (e.g. Finland with more than 70%). It is the second least wooded country in Europe. Two-third of the forest area is either neglected or not managed effectively. The woodland cover increased substantially in recent decades. Yet, growing trees for wood is very rare even though timber constitutes Britain's sixth largest import. About 82% of the forests are under private ownership (63,000 owners). Public perception on forestry stems from the mistakes that are made in the last century regarding the selection of the species (e.g. exotic species for plantations in Britain), lack of consideration for landscape or social elements (e.g. exploitation of the natural woodlands) etc. Forestry is more connoted with cutting trees than planting them and influenced by the negative public perceptions regarding deforestation, especially in the tropics. He contrasted this with livestock. People visit lamb farms and appreciate its beauty while they eat the same next year on their table without significant issues as the

slaughtering process is not obvious to them. With the same analogy a beautiful tree is turned into diverse wood products. The exploitation process needed for this is so visible. As a consequence, many of the general public find it difficult to comprehend. People in modern world are increasingly disconnected from nature (nature deficit disorder). Sustainable forestry is not easily comprehensible for the general public like how cutting down a 100 year old tree could be sustainable. Forests are more attributed to recreation, biodiversity, aesthetic values etc than wood. Many NGOs concentrate on planting more trees, but cutting trees and using them efficiently is rarely talked. Yet, wood is as popular as ever in today's society and sales boom for various wood products that are integral part of our life even though many users are not generally aware of where the wood comes from. Forestry is changing according to the changing focus of new role for trees in climate change mitigation and ecosystem services. Certification schemes provide assurance regarding sustainability of wood used. The concepts of 'wood miles' and 'wood security' will deliver the benefits for home-grown wood. However, evidences suggest that lack of management may adversely affect woodland biodiversity and therefore some form of management of tree resources is needed. One great challenge for this is how to communicate this to the public and professionals. Communicating the benefits of SFM has been one important complexity of forestry today.

He presented the wood culture initiatives of the Sylva Foundation like wood land mapping/inventories, wood land management plans etc to help the woodland owners who could explore for financial assistance using these. Efforts are also made to connect the user and producer by wood marketing. Likewise, public perceptions were influenced by activities like 'a single Oak tree initiative'. Students debated on cutting a tree. They learnt various aspects of that tree like its age (222 years- using dendrochronology), physical characteristics like height, weight (14,385 kg) etc. They understood the carbon storage (3.93 tonnes of carbon) as well. Artists, photographers etc captured their creativity from the tree. The tree was felled in front of 450 people. The processing of the tree was also seen by the students. Different people including students were involved in designing the products. Students collected seeds from the tree before it was felled and they replanted in the felled area. Thus, a tree was used to tell the story of wood.

Communicating the potential of trees and wood is important considering their increasing relevance for bio-economy, climate change mitigation, ecosystem services etc. "Nature deficit disorder" which is prevalent in today's urban life need to be addressed by reconnecting the society with nature. SFM should partly aim to recover wood culture by rebuilding understanding and trust in the society. Contextually, adopting close to nature forestry practice (for example continuous cover) would minimise landscape and environmental impact. This will consequently minimise public ill-feeling towards forestry, while leading to more sustainably managed forests. He explained the Sylva Foundation's activities intended to recover Britain's lost wood culture by helping people to understand more about sustainable woodland management, allowing experts to have a say in policy development, developing a closer relationship for members of the public with trees and supporting and encouraging woodland owners to undertake SFM.

Dr Yang Ping presented the promotion of wood culture in Japan where 66% of the land is under forest cover. Many temples, statues etc (made of wood) constitute as national treasures. Japan encourages promotion of wood culture through various ways. Wood education to inspire the young (to appreciate wood culture and wood products) is part of the Japanese national strategy. It is led by Japan Wood Products Information and Research Centre. A lifelong learning has been designed to educate adults and children on wood culture which will deepen their understanding of wood's properties and advantages, the environmental significance of wood use etc. Wood education in schools follows a stepwise approach- touching with sensitivity, understanding the potentials and learning through application. Needed educational material is developed where different dimensions of wood education are covered for communicating the credentials of wood. To meet the goals of wood education, platforms for enabling information exchange on wood education are set up. Wood education forums and workshops are led by the Japan Wood-Products Information and Research Center. Instructors are trained on several aspects of wood (including wood working) who trains the school students. Off school workshops teach students about the credentials of wood using hands on activities, graphics and toys. Making strip activities enable the students to experience the properties of wood and students make different shapes employing their

creativity. Such wood working experience at an early age will make children as wood enthusiasts. The National Championship of Woodworking skills (continuing for more than a decade now) also attract students who portray their wood working skills. This 'idea to product competition' imparts education and nurture wood enthusiasts who are essential to serve the needs of green consumers and sustainable development.

Mr Joshi presented the need to rethink on forestry sector in India where most forests are in public sector. He detailed wood's relation with culture and history (e.g. temples), various religious activities, health systems (e.g. sandalwood in Ayurveda) and modern life (e.g. musical instruments, arts, toys, crafts, boats etc). He felt that colonial legacy influenced forestry practices concerning which species to grow as plantations (e.g. Teak) and how to control wood extraction (e.g. permits). Large numbers of native species were neglected and the species needed to sustain livelihood were not given adequate importance during colonial periods. While reserving forests to meet the state's interests, the needs of the local communities, who depended on forests, were barely considered which influenced local wood use. Dwindling wood resources negatively affected craftsmen, artisans and other traditional wood users to continue their rich tradition. Likewise, negligible support from the state discouraged the communities and threat to livelihood security forced many of them to move away from wood working profession. Thus, diverse culture of art and craft declined gradually. After India attained independence, the perception of wood as an inferior material compared to steel, aluminium, glass etc also influenced craftsmen who were traditionally related with such professions. In addition, the efforts to supply preferred wood to these communities remained neglected due to lack of holistic forestry practices. Exhaustive policies lacked integrated approach and implementation tools. The environmental movements in recent decades resulted in further severe restrictions on providing wood products to the society from forests and instead substitutes were encouraged to avoid tree felling.

At the same time, wood as a raw material, contributed greatly to development of many presently industrialised nations while in India wood use dwindled due to the problems stemming from the policies and influences from the environmental movements. The NGOs and environmentalists raised scepticisms regarding the ability of foresters to meet the aspirations of the society in managing forests. Their views gained more visibility compared to that of foresters. Wood use gained negative image in society and even foresters did not do enough to reverse this. Even in massive tree growing programmes like the Green India Mission, wood use is not adequately addressed. The industries and local communities face problems of inadequate supply of needed wood today. In such a situation, 'art and joy concept' is a challenge in India while many developed countries can afford to conserve the forests and develop niche areas of wood use. Lack of accurate data (e.g. demand and availability of wood) and need-based research adds complexity to this. Policies that lack integrated approach and methodologies to implement constitute another problem. Indian forestry is at the cross roads because of combination of all these.

Conflicts arise more frequently between conservation and development because of demand for resources due to economic growth. Concurrently, a section of Indian society is increasing its wealth and their increasing demands of modular products are largely met through imports. New opportunities emerge for wood, especially from the need of minimising climate change inducing non-wood substances. Thus, the need for greener products, climate change benefits of forestry etc provide opportunities for growing more wood. Therefore, communicating the advantages wood and changing the mindset of the environmentalists and general public is essential. Propagating the 'art and joy concept', showcasing successful examples and communicating the green credentials through concerted efforts are needed to bring back wood use that has disappeared in India to enrich modern homes with wood. Bringing together various stakeholders including the environmentalists is important to get the wood sector to be heard more in green programmes.

Ms Ying Lin Hung presented on the wooden paths to a sustainable future in terms of a cultural approach. Wood is well embedded in language and culture in China and its relevance is well depicted through various ways in the society. Why 'wood is good' is a question that need to be approached with caution because of potential dangers of deforestation or misuse of wood. Answering this question depends how well wood is

managed by the modern society. Cultural perspective has relevance here which includes civilization, lifestyles, set of values and attitudes etc. Wood culture is influenced by these elements. IWCS emphasizes this cultural approach and communicates it through various ways and provide a platform for information exchange. Sedan chair in Taiwan was a historic mode of transport. But the belief of gods seated in Sedan is deeply printed in people's mind and therefore has a religious significance. The craftsmen who carry out the wood work beyond generations take wood culture forward. She cited the example of Mr Makoto Kuroda in Japan who represents 13th generation in a wood crafts family. He dedicates his life to preserving traditional craftsmanship. Wood carving contests (e.g. Baham, Cameroon in 2011) encourage the craftsmen. Also providing hands on experience to people to produce some local products is done during some exhibitions in China. She explained the relevance of celebrating World Wood Day on 21st March to communicate wood's possibilities. Mr Morris Lin detailed the experiences of 'Elegant Living' on how culture is being integrated into the products and innovative wood products are being designed using creativity. About 4 million ha of plantations are also managed by them to produce wood.

Mr Criswell Davis presented on designing with Sustainable US Hardwoods. Trees are unique and designers and architects can make wonders with it. Destruction of wood was part of early settlers' life in the US as wood served diverse human needs for housing, transportation, tools, energy etc. Forests were cleared for agriculture also. Many of these areas were reforested later. The volume of US hardwoods has doubled in the past 50 years. The forest area increased by 18% because of sustainable forestry and selection harvesting practices. Today, about 90% of the hardwood producing land in the US is owned by over 4 million private land owners who sell hardwood logs only once or twice in their lifetime. However, most of them are unaware of certification and those who are aware perceive it as expensive, complicated and of no great benefit. There is little demand for certified wood and 75% of all US hardwood lumber produced are consumed domestically. Despite having only 8% of the world's hardwood forests, US are the largest hardwood lumber producer in the world with about 24% share. He portrayed beautifully designed structures with US hardwoods in different parts of the world. In many cases, hardwood was found to be better than steel. He explained the advantages of hard wood over other material including beauty. Wood is a natural product and there is variation in colour and designers could take advantage of this. The hardwoods were found to perform well in humid environments also. Designing with hardwoods yields great environmental benefits.

Dr Nobuaki Hattori presented the state of life cycle assessment (LCA) and carbon footprint assessment (CFP) in Japan which is needed to visualise eco-friendliness of wood. Carbon footprint must be calculated based on LCA. Life cycle Impact assessment Method (LIMI) is already available in Japan and a version applicable for Asia is coming soon. It helps in calculation of all potential damage costs. Potential damage costs for wooden houses were found to be the lowest based on economic input-output LCA compared to other material. CFP, same as process based LCA, is gaining relevance in Japan. The carbon footprint was labelled in eco-products and many non-wood products are now labelled in Japan following the trends in UK and France. This is now being extended to wood products.

Dr Maria Riala presented how to map customers' minds with respect to housing needs and preferences in Finland. Using a mind map method, based on means-end theory of consumer research, they assessed Finnish customers' housing needs and wants. Preliminary findings indicate that consumers are more concerned of other attributes of housing than building material. However, ecological values were found to gain importance which has implications for timber construction. The findings suggest that façade material is more important than the frame material and good soundproofing was not that important. As a building material, wood has closeness to nature, peaceful living environment etc that possibly creates a positive image of wood among a section of the respondents. Timber construction industries should concentrate more on houses that are practical, attractive and of high quality with good architecture. These will enable the industry to gain more share of the market because, as previous studies indicated the Finnish construction industry struggles with quality issues.

Sustainable wood supply: the key to success (Session XIV)

Dr Rathore presented the status of wood consumption in the handicrafts industry in Jodhpur, India that was assessed by questionnaire surveys. Wood handicrafts industry (mainly at cottage level) in India is labour intensive and offers employment to 6 million artisans. The industry supports the socio-economic development of weaker section of the society who produces toys, furniture, other decorative articles (e.g. gift items, photo frames, paintings, carvings etc) which are exported to many countries which enhances national and state revenue. Jodhpur Handicraft exporter Association (JHEA) registered in 1998 (comprising 226 members) represent 300,000 artisans and craftsman. In the desert state of Rajasthan, despite the paucity of the raw material, wood work is well known with many unique artistic features (e.g. the lattice-work on wood). The industry, however, concentrates on a few selected species (sourced only through agro forestry) and recycled wood material (e.g. railway sleepers) which reduces pressure on forests for their needs. Most of the industries (90%) are small or medium and uses less than 0.1 million cubic feet of wood annually. Exports of finished products gradually rose except towards the end of the last decade. All the wood used by the industry are treated and seasoned even though 79% of the industries do not own seasoning and preservation treatment facilities. The demand for wood is increasing but the supply is decreasing. Therefore, substitutes are being tried by Arid Forest Research Institute to screen the potential for utilization by the handicraft industry. Data is being generated to enhance the acceptability of the substitutes by successful seasoning and treatments of lesser used species (to enhance the shelf life of wood products). There are several strengths of the industry like aesthetic and functional qualities, cheap labour, low capital needs and high value addition, uniquely designed products which are handmade (with low competition) and ability to serve small orders etc. At the same time, there are weakness like inconsistent quality, insufficient marketing, insufficient facilities and infrastructure (e.g. seasoning and treatment, wood testing), untimely delivery schedule, lack of skilled labour, failure to ensure international standards etc. These weaknesses need to be addressed to survive against the threats raised by better quality products elsewhere (e.g. South Asia, South Africa etc) and stricter international standards. Considering the lack of quality of wood provided by some plantations, willingness exists to raise plantations with support from Research Institutes and State Forest Departments for their needs (like the pulp and paper industry) if the land is provided by the government. The industry needs to be helped with certification related issues in the near future.

Dr Anoop presented the current wood supply crisis in Kerala, India despite having about 45% of its land under forest/tree cover. Kerala was earlier a wood surplus state and still a greener state. Yet, the wood supply from forests is negligible today and only salvage felling is allowed in forests (green felling has been banned for decades). Consequently, plantations and state forests account only 9% of total industrial round wood supply in Kerala while 76% comes from the homesteads and estates, as previous studies indicate. Thus, trees outside forests, particularly from homesteads, agroforestry and plantation resources, satisfy Kerala's increasing wood demand. The remaining gap is met through imports from various continents. The demand for timber is increasing with economic growth while wood is getting scarce (e.g. booming construction industry). He cautioned about wood security as increased dependency on imported timbers, which is likely to increase in near future, could increase the ecological footprint. Shift to bamboo has already happened and he suggested using palm wood also to meet the supply gap. Timbers grown in homestead/private estates like rubber wood, silver oak etc are potential resources of the future. Currently, lesser used species also need to be explored to substitute dwindling popular species. Because, wood supply influences negatively the sustainability of the industry (e.g. match wood industry in Kerala), efforts should be made to grow more trees in farms to address the wood scarcity. However, certain regulations discourage planting of trees in farms which indicates the relevance of a farm forestry policy and a separate department other than agriculture and forestry mandated for farm forestry within the state. Likewise, forest departments should relook the species encouraged in their popular tree planting campaigns to include the trees that provide timber in addition to the other benefits.

Dr Shashidhar presented the changing trends in timber usage in Nagaland, India where 52% of the land is under forests. About 88% of the forests are owned by communities and individuals and only the remaining

are with the government. This limits the policy implementation of the Indian government which is generally intended for publicly owned forests. Slash and burn cultivation is part of the socio-cultural activity in Nagaland which affects the forest negatively, especially with the reduction of cultivation cycle. Communities used timber for genuine domestic purposes earlier and the exploitation was well controlled by the communities. Demand was less and the timber was used in construction, carving and handicrafts with little commercial dimensions. Now, the demand from outside the state gives economic and commercial dimension to timber extraction, that too without proper planning. This results in massive timber removal from forests despite the national legislation banning timber removal from natural forests. Forest composition changed and plantations were established in recent years. The increased demand and less availability of commercially important species increased their price suddenly since 1980s. One of the reasons for this was sudden appearance of wood processing units in the state who exported timber to nearby states. Many wood products gained popularity in recent years (e.g. furniture). Handicrafts are also being produced, but cater mainly to needs of local market. Wood carving is unique to the tribal communities and part of their culture. Plantations of short rotation timber species with technological interventions like engineered wood products would help in managing the forests sustainably.

Mr Madan Mohan Jalan described the green credentials of bamboo. Bamboo sequesters more CO₂ compared to timber and has several other ecological advantages. In a fast growing economy, the demand for various human needs like energy, construction etc cannot be met only by timber because India is already a net wood importer. In this context, bamboo can play a role. Traditionally, bamboo was used for handicrafts, but today they have greater roles and provide jobs to a large number of people. The National Bamboo Mission intends to provide technology, marketing support and expand bamboo cultivation. Till 2002, bamboo was unknown for fabricated houses. But today, many buildings are constructed with bamboo products. The government is planning to encourage the industry and the policy favours growing and removal of bamboo unlike timber.

Focus on Sandalwood and Teak (Session XV)

Mr Venkatesha Gowda explained that natural sandalwood need not be grown for 35-40 years as thought earlier. The gestation period in plantations can be reduced to 12 - 15 years. Even though the annual sandal production declined, the price of sandalwood increased. Many of sandal wood resources face over exploitation and many countries presently take steps towards commercial cultivation. India was producing the largest quantity of sandalwood oil earlier, meeting over 80% of world demand. Due to over exploitation and other reasons, production declined drastically during recent years. So, many states in India attempt to encourage sandalwood cultivation. Karnataka and Tamil Nadu state forest departments amended legislation to make the tree grower as the owner of Sandalwood. 'Grow more sandalwood' campaign was launched by the Karnataka Soaps and Detergents Limited, India and nearly 250 growers were brought under this in Karnataka. Various state agencies assist farmers for growing sandalwood. Considering the high financial returns, more farmers should be encouraged to cultivate it.

Mr Ananthapadmanabha stated that Sandalwood production in India is declining and no concerted efforts were made to grow sandal. Synthetic substitutes were tried since 1960, but were never identical to the natural material. Most of the species are over exploited, but the demand for sandal is increasing while the supply is declining. Inconsistent supply resulted in escalating prices, making it difficult for industries to obtain the raw material. Industries emerged after 1990 resulted in overexploitation of this species globally. Therefore, sandalwood should be produced commercially as a short-term rotation crop. Many misconceptions exist regarding the ecological boundaries of growing Sandal. Many countries (e.g. Australia) grow sandalwood to meet global demands. India also attempts to grow it to bring back the past glory.

Mr Ramesh Chandra Mishra presented the relevance of concentrating on planting trees in farms and his works on promoting its cultivation. He emphasized the relevance of Sandal and stated that it can grow anywhere. The disincentives of the past regulations (e.g. declaring it as a royal tree since 1792 in Karnataka, India) still continue in many places. Yet, enough potential exists to grow sandal as it can come

up in a variety of lands. Therefore, forest laws should be made conducive to grow and utilize Sandalwood in households in India.

Dr Jayaraman presented about TEAKNET, an international network of institutions and individuals interested in Teak. Teak, a high quality timber, holds promise to meet the demands for hardwood. It is already successfully cultivated in many countries, but its cultivation needs to be extended to more regions. He outlined the relevance of networking for optimization and sharing of resources. He stated that this network acts as a virtual research and development organization for Teak. There have been recent changes in teakwood production like increased forest ownership of the private sector, smallholders becoming major producers etc leading to planting teak in non-traditional areas.

Thoughts emerged on where to go from here

The closing statement from Dr Eduardo Rojas-Briales, FAO's Assistant Director General and Mr Petri Tuomi-Nikula, the Ambassador of Finland to Italy reinforced the relevance of 'art and joy of wood' theme to the society and emphasized why it should be taken forward.



Photo 16: Panel discussion

The facilitated discussion on the outcomes of the event was led by Dr Joshi, Dr Michael Martin, Dr Pascal Kamdem, Dr Gabriel Hemery, Mr Jim Birkemeier, Dr Saara Taalas, Dr Ranjan, Dr Hakki Alma, Dr Jegatheswaran Ratnasingam and Mr Thang (Photo 16). Dr Michael Martin urged the delegates to share their experiences and take away lessons learnt during the conference to reflect through collective action the social and cultural dimensions of wood in our lives. A few participants explained how the knowledge gathered during the event will be taken forward in their own countries (e.g. bamboo use in Nigeria). A few young participants raised the basic question of what

constitutes sustainable development and sustainable future when the consumption is growing fast in some places. A few participants demanded that definition of what constitutes sustainability related to wood should be further examined considering the benefits of wood use to the society and environment. Because alternatives to wood (mostly extracted underground) are either becoming increasingly scarce or limited in supply by regulations, biological resources like wood, that one can grow and use sustainably, is likely to attain more relevance. Contextually, sustainability concept should be made clearer by more practical ways related to wood (e.g. a Single Oak tree initiative- session 12). Innovative utilization, minimizing wood wastage, recycling of wood etc are good examples of wood use to build a sustainable future which is already demonstrated by many presentations which needs to be technologically transferred to elsewhere to promote such ideas through efficient networking and information sharing. However, many institutions for wood education cease to function in many countries (e.g. US). So, there could be a dearth of professionals to deal with the challenges of technological development and transfer. This needs to be addressed if wood has to be used sustainably across various sectors.

The credentials of wood against consumption of its alternatives need to be better communicated especially in terms of quality of life as wood at its whole life cycle (from tree to till its last possible utilization as a product) could support a good environment within and outside our homes. Participants felt that negative societal perceptions towards wood use should be eliminated by all possible means. The benefits of wood use should be communicated to the general public in a way that touches the heart and mind of people. The concept of 'art and joy' is a good way to address this. Dr Ranjan stated that this concept is generally forgotten. He suggested reversing negative perceptions of people towards wood by demonstrating product prototypes to get the feel of products and making efforts to expand the

imagination and traditional wisdom (e.g. competitions on what diverse products could be made with wood of just one tree). Using

traditional wisdom to use the stem wood assortments (session II) is a good example where the knowledge of wood use in the past could lead to creative ideas. Dr Saara Taalas stressed that the links with wood users should be strengthened further to inspire them for using wood. It is difficult to push the need for wood products. Rather, the usefulness needs to be integrated into the wood products. Designing affordable and acceptable products that suit the future needs of different sections of people is important. Dr Gabriel Hemery suggested that inspiring people, especially by demonstrating, is the way forward to promote wood.

Dr Joshi suggested that the young people should be educated more about the positive impacts of wood use in a holistic manner (e.g. positive impacts of wood use against its alternatives) rather than approaching it partly. Dr Pascal Kamdem suggested that public perceptions are important in this context and they should make connection between wood and everyday life. Educating the public, especially the children, about why wood is good through practical activities, exhibitions etc is important. Social scientists should be involved more to effectively promote wood use.

For promoting wood, as a key to sustainable development, forests should be managed scientifically and not merely by a romantic approach. However, illegal timber removal is a major concern in many countries and certification measures should be in place to make sure that 'good wood' will not suffer from the negative perceptions and the guilt consciousness of using wood. Avoiding logging in biodiversity areas and reorienting more towards production forestry outside the conventional forest areas could also benefit to remove the negative perceptions. Participants felt that if people like wood, they will grow more trees and use them sustainably provided there is a good policy and legal environment. Encouragement should be given to tree growers by the government (e.g. wood credit card). Enough wood should be produced to widen its sustainable use considering the long rotation of trees. Also, policies should govern how to use wood raised through the green planting programmes (e.g. The Green India Mission).

Dr Michael Martin suggested that the art and joy of life could be achieved through multiple ways. So, moving together with collective ideas will make our life much more meaningful. But communicating successfully the credentials of wood and inspiring its widespread use is the key to promote sustainable development with wood. Foresters have not been greatly successful yet with this. Foresters were fractured amongst themselves (e.g. scientists, practitioners etc) and various important players were not involved much in the discussions (e.g. architects, designers etc). Likewise, various useful communication themes were neglected (e.g. social and cultural dimension). Communicating our common vision for the future depends on how we address these issues. People should be encouraged to grow and use the forests sustainably and take forests home through wonderful wood products. As extension of the forests and cultural heritage of our past, these wood products will help to keep our life very close to nature and cultural traditions.

Summary of the deliberations

Some of the ideas presented at the conference are summarised in to three themes below viz. emerging trends in economies and lifestyles, stories portraying the winds of change and wooden paths to a sustainable future.

1 Emerging trends in economies and lifestyles

Changing consumption patterns: Consumption of wood was greatly influenced by industrialization and consequent mass commodity production in the last century. Better value addition is the emerging trend in the 21st century, which is partly building upon the artistic and cultural elements because the society is increasingly embracing local traditions and culture as it progresses. As people become rich, reorientation towards luxury products occur. Societal demands of modular products increases and lifestyle changes provide greater opportunity for wood. Along with traditional parameters like Price, quality, appearance

and durability, other factors like origin, local sourcing, customization and green credentials increasingly influence customer preferences (session 9). Green consumerism encourages the products with green credentials like wood. Preference for quickly delivered local customized products increases over standardised products by mass production. Wood product manufactures innovate themselves through customization of locally produced wood for encouraging widespread local use. Thoughts like 'wood miles', 'wood security' etc encourages products from home-grown wood. Tourism development encourages handicrafts production with international quality standards. These promote cultural heritage, improve rural livelihood and expand exports. Traditional health practices using wood (e.g. panchakarma in Ayurveda) also becomes popular as tourism expands in many regions. As exports increase, the demand for wood-based handicraft products (e.g. wooden toys) increases (session 11).

Increasing relevance to small and medium enterprises: With their lower ecological impacts but greater support to livelihood of people and multiplier effects in the local economy compared to large industries, small and medium enterprises gain relevance (sessions 4 and 8).

More importance to domestic markets: Wood industries are increasingly exposed to the threats like the international financial crisis in some other countries. To counteract the consequent negative impacts of the crisis, governments encourage the industries to target the expanding domestic markets (e.g. China) to prevent industries from closing down and resulting in loss of employment (session 10). Direct marketing of high value products locally gains relevance to add per unit value of wood and create more jobs per unit area of forests (session 9).

Changing marketing opportunities: Market-created product diversification and quality products for high end niche markets appear increasingly. Social and community entrepreneurship and increased connectedness by information technology enhances marketing opportunities. Globalization process enables innovative products and knowledge to pass boundaries much more quickly. Innovative marketing strategies and new communication technologies enable wider marketing (session 9).

More wood, less substitutes: While wood is gaining popularity in some regions to compete with its substitutes that replaced wood in the last century, it is losing out in some other regions due to various issues (e.g. Ghana, sessions 3 and 5). However, increasing global importance to biomass based and environment friendly products is likely to sustain the wood industry because expanding plantations will capture carbon and products will store it over wood's life cycle. Increasing awareness of carbon benefits of wood substitution in buildings encourages wood-based construction in many regions while other natural material (e.g. bamboo) is gaining relevance as a construction material in many wood scarce regions (session 14). Fast growing construction sector presents new opportunities for wood because of emergence of prefabricated engineered wood products, shortage of skilled labour, declining supply of wood's substitute material etc (session 6 and 7).

Increasing wood stock, use of unconventional species and recycling: Wood production is gearing up with the expanding role of trees in climate change mitigation and ecosystem services. Concurrently, the relevance of certification schemes increases as an assurance for sustainability. Industries are adapting to the changes in raw material supply (e.g. low diameter logs). Emerging massive tree growing programmes to green the countries (e.g. Green India Mission), tree growing in farms and technology-based plantation development (e.g. Sandal production, session 15) are likely to enhance wood's availability in near future. Emergence of new uses of plantation timber (e.g. rubber wood for handicrafts and furniture instead as firewood), unconventional species (e.g. palms) and recycled wood reduces the supply gap in many regions. These provide new opportunities for innovative wood products consistent with lifestyle changes.

2 Stories portraying the winds of change

Many stories presented at the event portrayed how wood products remain in business by being competitive and innovative following the above-specified trends. For instance, the furniture export grew rapidly in Malaysia and contributed to developing entrepreneurship in rural areas (session 10). Exports of the handicrafts industry in Jodhpur, India grew quickly in recent years directing benefits to the local economy, employment livelihood using local creativity (session 14). Likewise, the desire for green products

that suit the new lifestyle changes and efficient use of available resources was the key to sustainable furniture development in Vietnam. It portrayed how to meet the growing demands using certified wood, recycled wood and combinations with other material to enhance durability and attractiveness of wood products. Effective design could avoid wastage and enable adapting to the changing situations. They turn wood wastes to attractive products again (session 10). Using timbers sourced from legal or sustainable sources has been a key factor for Deesawat (sessions 4 and 8) which survived a crisis by changing the structure and product types by appropriate designs that suit the contemporary lifestyles. Turning wastes into wealth through employing creativity and sustainability concepts in practice helped it to be successful. By linking commercial, social and ecological aspects, they produce innovative wood products that embody the 'art and joy concept'. Producing high value furniture from residues in China added up to 40 times the value (session 10). Likewise, Timber Green Farm produces high value products from every part of the tree and found it as a successful model (session 9).

Appropriately identifying customer needs and control of supply helped the industries to surpass even recession and stay well in business and expand it further. Demand exists for good quality wood products (e.g. Oakwood flooring in Lithuania, session 9). With intelligent marketing strategies, better possibilities could be found. Providing excellent local service and earning word of mouth sales was found to be very useful for the marketing of wood products of the Timber Green Farm (session 9).

As noted in Finland, ecological values gain importance which is relevant to timber construction (session 13). MGB Architecture designs multi-storey structures with wood that suits modern society needs using creative designs that tries to push the boundaries of wood to sky limits. Staudthaus (a nine story building) portray a good example of how modern buildings could be constructed with wood suiting to customer expectations. The social side of construction with wood also gains relevance to improve the life of the poor as observed in Kenya and South Africa. Simpler and lighter products that even the unskilled labourers/women could use will bring key change to the building process (section 6 and 7).

Wood continues to support livelihood with the development of new designs and innovative products that inspires others to follow the sustainable paths (e.g. toy art in Etikoppaka, session 9). 'Elegant Living' portrayed how culture could be well integrated into the products and innovative wood products could be designed using creativity. It also demonstrated how the raw material needed could be produced by the wood product manufacturers themselves (session 13).

3 Wooden paths to a sustainable future

Reviving wood culture: Efforts are needed to revive the lost wood culture in many parts of the world. The cultural approach to a sustainable future needs to be promoted. Despite the increase of tree cover, the scar left by the mistakes of the last century concerning the selection of the species (e.g. exotic species for plantations), lack of consideration for landscape or social elements etc contributed greatly to the negative attitude towards forestry. Cutting trees is viewed negatively by the public, but wood products are becoming integral part of our modern life with growing understanding of its credentials. There is a need, therefore, to revive the lost wood culture. SFM should partly aim to recover the wood culture by rebuilding better understanding and trust towards wood products (session 12).

Increasing wood supply to small and medium enterprises: Despite having enough forest cover, many regions are facing wood scarcity (e.g. Kerala, session 14). This indicates the relevance of trees outside forests. Sustainable wood supply is crucial for small scale and medium industries because demand-supply gap of preferred species raise questions on the sustainability of the industry (e.g. handicrafts in Etikoppaka, session 9). Popularising trees outside forests (e.g. agro forestry) could be one solution (e.g. Rajasthan, India where most of the industrial demand is met from sources outside the conventional forests, session 14). Many wood resources face over exploitation (e.g. sandal wood) and incentivising growing wood in farms or by private small-scale entrepreneurs is important. Communicating the high financial returns of growing wood would attract more tree growers to ensure sustainable supply of wood. But discouraging policies and legislation need to be suitably amended (session 15) and congenial policy environment and incentives need to be provided to encourage tree growth. Plantations seem to provide

new opportunities to address raw material shortage through substitutes (e.g. rubber wood) which demands adequate research support. Also, wood user communities could be helped to raise plantations with support from research institutions and forest departments to produce their desired raw material. Community forestry programmes could address the inconsistent supply of wood, especially linking with tree planting programmes for greening the countries. Because increased imports could increase the ecological footprint, green planting programmes should select the preferred short rotation species to address the supply gap. Also export policies of wood needs a relook because wood is insufficient for local use in many places (e.g. Cameroon, session 1).

Certification measures: Fear of overexploitation is rooted in the society based on the past experiences of mass exploitation at large industrial scale. Even foresters do not encourage wood for local use fearing illegal exploitation in some regions. Certification could address this. Yet, it was not found to be much popular in many countries, especially for domestic timber (e.g. US, session 13). Certification needs to be enforced especially for tropical timber trade to build consumer confidence. Wood products consumption will see positive changes if the fear of illegal logging could be removed by appropriate regulations that ensure legality. These will not only minimise negative consequences of consumption but also will remove the negative perception towards using wood. However, those measures are likely to affect the small scale industries (e.g. handicrafts industry) and necessary support should be given to them to minimize the negative impacts.

Wood utilization policies: Along with ensuring consistent supply of wood through SFM and tree planting programmes outside the forests with encouraging policies, wood utilization policies are required to develop wood as a sustainable material employing the 'art and joy concept'. In the past, efforts to supply preferred wood to the local communities were neglected and severe restrictions stemming from demands of conservation did not often match well with the livelihood needs of people in many places. Overexploitation of the resource for large scale industrial purposes often results in price hike of the raw material which has negative implications on the livelihood security of the poor people, especially in rural areas. Who constitutes the beneficiary of wood produced by the green programmes and how it will be utilized (value addition) should be governed by proper utilization policies which is lacking at present in many countries (e.g. India, session 10).

Full utilization of wood: 'Full value forestry' could create new jobs. The dead and dying trees and the discarded ones (underutilised species and low diameter logs) should be better utilized by adding value. Using all parts of the trees to add value through "mega value" products using artistic creativity will earn more money with less volume of wood (session 9). Even the crooked parts of the tree could be used well with appropriate designs (session 2). Recycling of wood should be promoted to minimise the natural resource wastage and extend wood's life cycle (session 10).

Contemporary, mindful and sustainable design: The design with the cultural touch (session 4) is one way forward to stay in business and prosper. These will touch the heart and mind of the society and influence the wood use at large. Innovations on creating alternative products using creative imaginations from whatever the wood material available are the need to proceed forward.

Product and process innovations with wood: Using the art and joy of wood theme, these innovations are needed to compete with other material. Wood, with its special characteristics holds much greater potential especially because it has been part of the culture and tradition in many regions. Diverse products that meet the quality standards and design needs are likely to encourage wood use. Competitiveness should be focused to face emerging challenges for enhancing livelihood/entrepreneurship options (session 10).

Designing wood products for a greener society: LCA and carbon footprint labelling (session 13) is likely to encourage wood use positively. It will influence customer preferences for wood. Society's desire to be green could benefit the wood sector provided diverse products that consider the special societal needs are produced. Product and consumer segmentation will shape the wood products' future. Increasing relevance of biomass based and environment friendly products will sustain the wood industry because of carbon

capture and storage over wood's life cycle. Providing excellent local service and addressing local customer needs is one way forward to provide green solutions to homes.

Wood to new heights through greener homes: Prefabricated products will provide opportunities for increasing the potential of wood in the construction sector and shortage of housing in many parts of the world will present an opportunity to construct with wood much faster, quicker and with the involvement of local communities (session 6). The positive image of wood stemming from its closeness to nature, ability to offer peaceful living environment etc could expand wood use in construction. The art of constructing multi-storey building with wood is gaining popularity. The joy of living within these wooden homes will encourage more attempts in green construction. The emergence of new understanding of the potentials of wood, emergence of suitable engineered wood products etc will take wooden buildings to new heights provided that quality is given adequate emphasis with good architecture (session 13).

Enabling environment and actions: Information sharing through networking (e.g. World Wood Network), innovative technologies, innovative marketing strategies and congenial policy and legal environments will yield positive results for the growth of wood products in the near future. The innovations need to be shared more within the industry to foster a faster growth which could be adapted to a variety of environments for sustainable development. As evidenced by the rapid growth of Malaysian furniture clusters (session 10), successful wood-based industry should be built by the right policy interventions and factors of production to benefit the society through different dimensions. Value addition requires financial assistance because weaker sections of the society receive insufficient credits in developing countries. Microcredits that suit the entrepreneurial requirements are therefore important (session 11).

Enhancing expertise to work with wood: Architects and designers are rarely trained to work well with a variety of timbers. For example, timber Engineering is not taught well in Ghanaian institutions (session 7). This will limit the creativity and options for wider utilization of wood. Adequate capacity need to be developed to promote wider wood use.

Strengthening technology absorption and sharing: Considering low technology absorption by the small and medium sector in terms of using unconventional species, seasoning, wood processing etc, links between research outputs and technology absorption need to be strengthened. Research should seek solution to the changing societal and environmental needs. Financial, technical, research and policy support is crucial to favour a sustainable small and medium scale wood industry. Knowledge and technologies of successful enterprises needs sharing through formal and informal networks to enable transfer of technologies to benefit the local economy and environment.

While artisans were found to take the traditional skills across generations, they are going extinct because of lack of interest, low wages etc. Adding value requires human expertise and therefore engaging artisans in business is relevant through up scaling technology absorption by proper engagement, capacity development and communication.

Effective communication and education: The distinction between 'good wood' (sustainably produced) and 'bad wood' (resulting in endangering forests) should be better communicated to remove negative public perceptions about wood and widen its use to enable transition to a wooden path to a sustainable future. Minimising public ill-feeling towards wood is important for wood's future and continued success of sustainably managed forests. Some people perceive wood as an inferior material due to lack of understanding of its credentials and the cultural beliefs. However, communicating the benefits of wood and SFM to the public and professionals constitute a great challenge. Necessary steps are needed to bring back the awareness among the young people about wood and enhance their wood working skills. Formal and informal education, as done in the UK and Japan, could be expanded to other countries to inspire the young people with the potentials and credentials of wood. Efforts like 'a single Oak tree initiative' will be worth emulating because it changes the attitude towards trees for wood (session 12). Wood carving contests and providing hands on experience to people to produce some local products will inspire people for wood carving. Increasing the visibility of wood through various ideas (e.g. celebrating World Wood Day) would also help to communicate the credentials of wood (session 13).

Propagating the 'art and joy concept' of adding value, showcasing successful examples and communicating the green credentials are essential to enrich 21st century homes with wood. Communication should also stress the role of wood to minimise the use of climate change inducing non-wood substances. Bringing together various stakeholders like designers, architects, artists, innovators, environmentalists etc is important to communicate better wood's potential for green growth. Better alliance of foresters with environmentalists to communicate the climate change benefits of wood use will also remove negative perceptions towards wood use.

Wood for livelihood: Wood use provides a unique combination of integrating social dimensions with environmental and economic to benefit the society and environment in long term. Wood is well embedded in language and culture and has relevance in modern lifestyles. Therefore, building on the cultural and traditional traits and green thinking, promoting wider wood use will benefit the livelihood of millions of people through value addition. That will take wood culture forward and help to preserve traditional methods to suit modern day needs. Considering this, wood should be increasingly promoted by governments to support the sustainable livelihood using the best value addition modes possible.

The ideas to ponder for the enablers of the journey to sustainable development

Wood production is increasing in many wood scarce areas due to greening programmes and wood is already surplus in many other regions. But the conventional mass commodity production model is unlikely to sustain the industry. Therefore, careful use of wood at small and medium level employing creativity gains relevance.

a. For policy makers

1. **Encouraging high value innovative products:** Making an alliance with futurists, architects, designers etc is likely to result in innovative products that suit the changing requirements of the society. These products, which embrace the local culture and traditions, enable product differentiation corresponding to customer segmentation. Promoting high value products and redefining the consumption model is likely to change the perception of wood use.
2. **Communicating to the potential wood users:** Popularizing wood through prototypes, case-studies, competitions etc will enable better learning. Thus, communicating credentials of wood to stakeholders and general public (especially who avoids wood for environmental reasons), is important to change the perceptions. Renewability and recyclability with minimum wastage will give wood a greater preference over others. Looking wood use through the lens of art and joy reflects another view of conservation of natural resource by sensible use that meets the needs and aspirations of the 21st century society. The cultural barriers and the lack of confidence on wood by certain sections of the society need to be addressed through proper interventions. Combined efforts of the governments, private and public sector agencies and industries are needed to increase the visibility of wood (e.g. celebrating 'National Wood Day') to generate more awareness amongst potential wood users and thus promote wood use.
3. **Strengthening linkages between wood producers and users:** Sharing knowledge and expertise through professional and social networks is pertinent to enable technology transfer to foster the growth of the small and medium scale industry across international borders (e.g. establishing a Global Wood Network).
4. **Human resource development and retention of skills:** Training artisans and educating children on working with wood is essential to carve a good future with wood. In order to address the dearth of professionals who could push the boundaries of wood with imagination and creativity, more practical aspects on using wood should be integrated in the courses on architecture, design etc. Wood education should be provided in schools focusing on how to use wood better considering that more timber resources are likely to be available in coming years. Incentivising the people who work with wood and developing their capacity to face the likely challenges is essential because they carry the tradition and creativity forward across generations.

5. **Building on the green awareness by addressing information gaps:** Wood has a promising future considering the environmental credentials because the modern society aspires to be greener. However, the information gaps (e.g. LCA) need to be addressed to convince the wood users.
6. **Sustainable wood use as the key to SFM:** This is important because in some parts of the world, tree growers find it difficult to market sustainably produced wood. While wood production is likely to increase in recent future, the distinction between 'good wood' and 'bad wood' should be made clearer to the society to encourage SFM.
7. **Enabling policies for value addition:** Adding maximum value possible before wood products are exported is essential for the growth of the economy and to provide employment opportunities. In order to gain the benefits of economies of scale, clustering the small and medium enterprises is very useful.
8. **Encouraging wood for transition to a green economy:** Widespread use of 'good wood' should be given more attention in policy decisions because it will enable a meaningful transition to a green economy. Policy coherences regarding integrating wood use at intersectoral level is a great need. Standards and codes, regulations and policies etc should be re-examined with better understanding on the wood's credential revealed by the LCAs.
9. **Wood utilization policies:** Wood use policies should be formulated to supply sustainably wood which is crucial for the survival of small and medium enterprises.

b. For the producers of wood products

1. Producers should communicate well wood's green credentials to the public for gaining competitive advantage.
2. Industries should draw inspiration from local traditions and culture to innovate and differentiate their products to gain comparative advantage. Innovating and diversifying to suit the changing lifestyle needs is of great importance.
3. Serving customer needs by creativity and adding value per unit volume of wood is the way forward. Minimizing the wastes and recycling to the fullest extent possible to design the trendy lifestyle products is relevant.
4. Wood products manufacturers need to increasingly connect with designers, architects etc to create the wood products to inspire the people who do not currently use wood.
5. Learning from others and sharing success stories through networks will benefit the industry and enhance wood use.

c. For the general public who remains sceptic on wood use

Turning to wood has several advantages especially to embrace the greener concepts. However, differentiating between good and bad wood is relevant to ensure its sustainable use. Planting more trees and adding value to the wood lays the stepping stones to a sustainable future where the public, as the sensible customer, hold the key through increased wood use.

It is essential to stop thinking of avoiding wood and change the perception that cutting trees is bad (if it is sustainably produced). Wood offers umpteen opportunities to go green and therefore embracing a lifestyle predominant with wood products will save our environment, incentivise better management of forests and support livelihood of millions of people.

Feedback

The feedback from about 90 participants is shown in Table 1. They found the event as very useful and well organised. They gathered useful information and considered it as a great networking opportunity. They expressed interest to attend in similar events. According to many participants, artisan shows portrayed why wood is good. Therefore, integrating them in wood-based events will give hands on experience and portray the theme practicality. The participants expressed high support for developing the 'art and joy' concept and to propagate the ideas gathered in their countries.

Table 1. The feedback of the conference participants

Aspect	Rating ¹
Organisation (registration, payment, logistics, etc.)	4.1
Quality of the presentations, posters, demonstrations	3.9
The content of the technical programme	3.7
The structure of the technical programme	3.9
The cultural/social programme	4.1
I got information that is useful for my work	4.1
It was useful for meeting new people and networking	4.4
It gave me ideas about new projects, business, etc.	3.9
The “art and joy” concept is useful and should be developed	4.3
I would be interested in attending more events like this	4.3

¹On the Likert scale 1-5, 1 being the least liked and 5 the most liked.

Conclusions

The paradigm shift from large scale commodity production to high value products the embraces culture and tradition has a long way to go. The conference attempted to look at this from various angles from production to full value use. It encouraged discussions on how to get there by practical means. High level of participation indicates the relevance of the theme. Innovative ideas shared were useful for increasing the visibility of the wood products sector in the International Year of Forests. However, success lies in how such thoughts are carried forward for future endeavours on the ground and how these will reflect in similar events in future.

The conference emphasized the relevance of diverse value added products that suit the modern lifestyles by keeping wastes to the very minimum, mainly at small and medium scale because of its livelihood and multiplier benefits. The negativity attributed to wood due to large scale industrial use in the past need to be addressed by communicating effectively to the public the credentials of wood (that the foresters often failed to do in the past). Taking a piece of forests to home (as wood products) and getting close to nature within homes is gaining importance in modern hectic life. Contextually, the ‘art and joy concept’ will be increasingly relevant in near future.

Side events

The two side events organized by the WWF-India and Forest Research Institute, Dehradun attracted the attention of many delegates.

1 Responsible wood trade- challenges and opportunities

Global Forest and Trade Network (WWF-India) led the side event "responsible wood trade- challenges and opportunities" with support from the EC-SWITCH Asia programme, European Union on 20 October 2011. The event was open to all registered participants at the conference and exhibition. Dr Sejal Worah welcomed the participants. Mr Angel Llaverro presented the global challenges in responsible forestry and trade. Dr T R Manoharan presented on India's role on the global forest products industry. Mr H K Sen presented the shifting legal landscape and how key markets are waking up to illegal timber. There was a group discussion at the end on how exporters can respond to recent changes in the US, Europe and other countries and how it will affect the global trade. All the presentations are available at <http://www.wood.info/artjoywood/?p=video>.

2 Students’ conference on career in wood science and technology

The Forest Research Institute, Dehradun organised this event with the support of the IWCS, China on 20 October 2011. Commonwealth Forestry Association provided partial financial assistance to this event. This event was open to young researchers and students of wood science and technology worldwide. It provided

an opportunity for them to interact with their peers and broaden their horizons. The side event reflected the opportunities available both in research and job, conditions for research/job, career of a researcher/employee, the obstacles faced, the institutional and organizational prerequisites etc. About 50 delegates (40 students) from India, China, United States and Turkey participated in the event and shared their experiences through presentations, posters and discussions.

Dr Howard Rosen welcomed the participants. Dr Sudipta Dasmohapatra, and Dr S S Negi, presented various facets of career in wood science and technology in US and in India respectively. Dr Pascal Kamdem presented on the myths and reality behind heat treatment. After these invited keynote speeches, Mr Eyyüp Karaodul presented on research, education, industry and consumer regarding wood in Turkey. Mr Amar Jyoti Nath presented on current status of wooden handicraft industry of India with special reference to Western Uttar Pradesh, India. Mr Shravan Kumar presented the challenges and future of plywood industries in India. Finally, Ms Ankita Nandi presented on reed used in the musical instrument – Saxophone. Two posters detailing medicinal woods and wood biodiversity in India were also presented. The presentations are available at <http://www.wood.info/artjoywood/?p=video>.

Photo-competitions held in connection with the event

In order to generate public awareness about the event and wood use in general three competitions were held. At global level, the photo-story and photo competition was organised. At national and local level, poetry and painting competitions were held.

International photo competition

A photograph competition was held as part of this event to popularise the idea behind the art and joy of wood. The competition was open to professional and amateur photographers and entries depicted wood's character and its vital place in people's lives under the following themes.

Living with wood: Wood surrounds us everywhere and constitutes an integral part of our lives. Creative interpretation of "living with wood" was expected.

Working with wood: From large-scale manufacturers to artisans and hobby woodworkers, wood is used by numerous people for a variety of purposes. How one sees "working with wood" was expected.

Wood as never seen before: Wood's character is protean. It is versatile and is used in so many different ways. But wood is also unique - no two pieces of wood are identical. The creative images of "wood as it's never been seen before" were expected.

The winners were invited to receive their prizes in person at the Award Ceremony during the conference at the expense of the conference organisers. The winning entries of the photo and photo story competition are shown in the following pages.

Photo- living with wood

Somenath Mukhopadhy, India, 2010

This canoe built with driftwood helps this polio affected youth to go to sea everyday for fishing and earn his living. The photograph was shot at Ennore beach in Chennai



Photo-working with Wood

Somenath Mukhopadhy, India, 2010

This portrait of an artisan as he makes low-cost furniture with wood for villagers was shot while he was busy making a dressing table in a roadside forest. It illustrates man's relationship with his environment



Photo-wood as never seen before

Mochan Bhattarai, Nepal, 2011

When I'm alive I serve directly. Even when I decay I'm aesthetic. Can your eyes see me?



Photostory- living with wood

Title: **Bozos Tribe**

Photographer: **Joey Anchondo**

Mali, 2011

Bozos are nomadic tribes who live along Mali's Niger River. For millennia, they have lived off the river, and at first glance it is obvious that it is their lifeline. Their lives are spent in camps or semi-permanent strung out along the Niger and they navigate up and down the waters in a perpetual pursuit of fish. Yes, on the surface, it seems that this river is what they rely on most for their livelihoods. However, after looking deeper, it becomes obvious that their lives revolve just as much around the trees and foliage that line the banks of the river as the river itself. In fact, the word Bozo is actually a Bambara (the dominant tribe in Mali) word meaning bamboo house, referring to the portable huts that the Bozos carry with them along the river.

When it comes to wood, the most important item to the Bozos is their boats. In modern times, due to deforestation and desertification, the large hardwood trees that provide the lumber for the boats are no longer available locally. Instead, they are transported from southern Mali. Because of their reliance on boats, they have developed a strong tradition of woodworking, and construct all of their boats with simple hand tools. Their paddles are also carved out of the same type of wood, although bamboo poles are more commonly used to punt the boat along the river.



Young boys carry bamboo poles to a boat in Segou. For fishing, the Bozos use a variety of wood products to assist them. Most important are their fishing traps, made from flexible green sticks and netting. They are used to catch small fish used for food or as bait to catch larger fish.



Boat builders in Nouhoun-Bozo shape wood to be used in the construction of large boats. While Nouhoun-Bozo is a very small village, they are a major supplier of boats to the large river port town of Mopti, about 75 km down river.



A young girl carries a bundle of wood near Djenne



Fish traps sit in the water near a small Bozo camp on the Niger River. In the background, portable Bozo huts made from woven palm fronds can be seen. Although the Bozo's dietary staples are fish and rice, those who live in the more southern parts of the river often replace rice with millet, which is locally grown. Without the use of a mill, the millet must be pounded in a large wooden mortar and pestle. This is a daily chore for many Bozos.



Amadou Mohamed prepares to repair a hole in a boat that he built three years prior in Koulikoro. The repair is made using a small axe, a piece of wood, and no measuring.



Women carry bundles of wood that they have collected in the bush to be transported across the river to their village near Tamani. The significance of wood, however, is not just related sustenance for the body; it is also important as sustenance for the soul. The Bozos are a predominantly Muslim people, and the mosques that they pray in are of the mud and stick style emblematic of the Sahel. Typical of the region, where people are always moving, things are always changing and nothing is permanent, this style of mosque is not the most long lasting. The walls must often be re-surfaced and the large sticks often replaced. Without the use of these logs for construction, building mud mosques large enough for large villages would be impossible.



Men arrive for afternoon prayers at the mosque in Nouhoun-Bozo.



Girls perform the daily task of pounding millet to be used in the dietary staple of tuo, a millet porridge, in Koulikoro. For cooking, as in many parts of Africa, everything is done over charcoal. While the men are out fishing for the day, one of the women's main duties is wood collection. Young and old, they walk deep into the bush, scouring the arid landscape for dead trees and dry wood. The wood will be further dried, and eventually converted to charcoal for cooking.

Photostory-working with wood

Title: **Woodmill**

Photographer: **Dimpal Pancholi**

India, 2010

The head saw, head rig or primary saw, breaks the log into cants (unfinished logs to be further processed) and flitches (unfinished plank with a smooth edge). Logging fells the trees and log bucking cuts them to length. Decking is the process for sorting the logs by species, size and end use (lumber, plywood, chips). Debarking removes bark from the logs. Depending upon the species and quality of the log, the cants will either be further broken down by a resaw or a gang edger into multiple flitches and/or boards. In the twentieth century the introduction of electricity and high technology furthered this process and now most sawmills are massive and have expensive facilities in which most aspects of the work is computerized. Small gasoline-powered sawmills run by local entrepreneurs served many communities in the early twentieth century and specialty markets still today.



Photostory-wood as never seen before

Title: **Tree of Knowledge**

Photographer: **Brian Hooper**

Australia, 2009

The ideas for this project are generated by observations into the way human beings create and relive memories. The outcome from this observation is not a traditional building but an interactive place that allows us to remember the tree and the space around it. As a new experience in its own right the memorial also has the capacity to create new memories for its visitors.

The scale of the structure and the form created by the hanging timbers is based directly on the extent of the tree's canopy from the period around the 1890's. The external timbers are "charcoaled" to create a veil around the memorial space. This finish and its form reference a place of memory and mourning. The "veil" provides hints to the form and movement inside but it does not fully reveal the impact of this space. This experience is saved for the visitor as they enter the shade of the "tree" and the technique personalizes the experience for the visitor because it is something of a secret revealed. The veil and the glass roof also provide the very practical protection from long term direct exposure to wind driven rain and direct sun, which is required for the relic tree. Inside, the sculptural forms of the canopy extents create a vaulted effect appropriate for a place of memorial. For some, this spatial experience will also resonate as a form of veneration to the relic tree and the memory of the events associated with it.

The Tree of Knowledge Memorial is constructed of over 4,913 individual timber members (comprising 3,449 for the suspended canopy and 1,464 for the external façade or "veil"). All the timber is recycled with chain of custody certification, verified by an authorized third party. The root ball was salvaged intact with the trunk and is displayed through a glass floor. This design feature gives the unique and dramatic effect of suspending the viewer above the root ball whilst they are surrounded by the suspended timber above. The structure, including the suspended timbers, is rated to a 50 year maintenance free period, effectively minimizing long term maintenance costs for the Council and community. The design sets out to re-instate the amenity of the original tree and the spaces around it. With the ochre of the original soil re-instating the public plaza, the extent of the original canopy re-defined, a gentle movement once again visible overhead the relic tree and with shadows on the ground, the amenity of the original tree is remembered. This is once again a place where old stories can be told and past events remembered. It is also a place where new ones are created.



Appendix 1- List of oral presenters

Name	Country	Paper
Achmad Zainudin	Indonesia	Jepara: Mirror of Indonesian art wood
Adjovi Edmond	Benin	Typology of wood sculptures in West Africa
Aimi Lee Abdullah	Malaysia	Changes in EU timber consumption
H S Anantha Padmanabha	India	Sustainable supply of Global sandalwood for the industries
Andrea Klein	Austria	The treasure of special stem assortments - Lost knowledge of the past
Andrew Waugh	United Kingdom	A short talk on tall timber buildings
Anoop E V	India	Kerala's withering wood security - the way forward
Arif Nuryawan	Indonesia	The description of marketing mix at three level furniture industries in Medan area, North Sumatera, Indonesia
Brian Hooper	Australia	Tree of knowledge
Criswell Davis	USA	Designing with Sustainable U S Hardwoods
Dustin Tusnovics	South Africa	Building for a better world: how timber architecture can make a difference
Ederson Augusto Zanetti	Brazil	Wood from sustainable sources and the mitigation of global climate change – case study of social interest housing in Curitiba, Parana, Southern Brazil
Emmanuel Appiah-Kubi	Ghana	Wood for housing in Ghana: Why the low interest?
Gabriel Hemery	United Kingdom	Reviving Britain's lost wood culture
Giedrius Leliūga	Lithuania	Customer needs and control of supply and are the keys to success
Guixiang Wang	China	Impression, comparison and understanding: Chinese wood-framed architecture in history
Hakki Alma M	Turkey	Wood carving in Turkey
Howard Rosen	USA	The evolution of wood culture in the USA
Jegatheswaran Ratnasingam	Malaysia	The development of furniture industry clusters in Malaysia
Jim Birkemeier	USA	Full value forestry: New jobs from dead trees on the family farm
Jirawat Tangkijngamwong	Thailand	The way of wood: Finding green pieces in Thailand
S C Joshi	India	The need to rethink the forestry sector perspective in India
Kadiroo Jayaraman	India	TEAKNET – International R & D network on teak
Kanuri S Rao	India	Promoting technology based processing and utilization by the small and medium-sized enterprises (SME's) - the key to develop wood as a sustainable material in India
Kitazawa Hideta	Japan	Enjoyment of Japanese traditional wood carving
T K Kunhamu	India	The wood legacy of Kallai: lessons for the future
Madan Jalan	India	Bamboo – A natural vehicle for the protection of the planet
Mangala De Zoysa	Sri Lanka	Rediscovering traditional wood product industries in Sri Lanka: Promotion of cultural heritage, improvement of rural livelihood and expansion of export earnings

Maria Riala	Finland	Mapping customers' minds with a new technique: the case of housing needs and preferences in Finland
Michael Grabner	Austria	Understanding historical wood utilization - Ideas for the future?
Michael Green	Canada	The future of urban structures
R Michael Martin	Italy	Wood is good
Neelam Manjunath	India	Saga of the poor man's timber
Nobuaki Hattori	Japan	The present state of life cycle and carbon footprint assessment in Japan to visualise eco-friendliness of products including wood
Nguyen Chien Thang	Vietnam	How to develop sustainable furniture
Olga Georgievna Sevan	Russia	Traditional and modern house paintings and arts of everyday life in wood
Pascal Kamdem	USA	Can wood play a role in the sustainable development of Africa?
Rajesh Bhowmik	India	Preservation of tribal culture – a heritage of wooden crafts world: A case study of north-east corner
Raghavan Srinivasan	India	Decision drivers in wood seasoning (due to energy and economics)
V Ramakantha	India	A road map for strengthening solid wood based handicraft sector of Manipur, India
V Ramakrishnan	India	The fourth dimension of wood
Ramesh Chandra Mishra	India	Sandalwood the saviour of ecological balance and super wealth creator
M P Ranjan	India	Design detailing in wood: An appreciation of furniture design by Gajanan Upadhaya
M V Rao	India	Etikoppaka - An Indian village perpetuating the joy of wood through the tradition of toy art
T S Rathore	India	Status of wood consumption in handicraft industries of Jodhpur
O K Remadevi	India	Wooden monuments in India, epitomes of beauty and talent, need protection from a biological perspective
Roshan Shetty	India	Vernacular architecture for sustainable development - A case study of South Canara region
Saara Taalas	Sweden	Bridging life at home and sustainable production
Sangeeta Gupta	India	History and current status of wood culture in India
K S Shashidhar	India	Changing trends in timber usage in Nagaland, India
Shengfu Wu	China	The struggling Chinese woodworking industry: Challenges and solutions
B Siddappa	India	Efficiency resources (forest and credit) use by SHG's for socio-economic transformation of Karnataka economy
Singanpalli Balaram	India	Designing with wood for development
Stephen Tekpetey	Ghana	Lifestyles changes in some urban centres in Ghana: What are existing and potential impacts on wood use in 2011 and beyond?
T P Subramony	India	Bamboo as a modern construction material
Sudipta Dasmohapatra	USA	Consumer purchase trends and perceptions in the USA
V S Venkatesha Gowda	India	Global emerging trends on sustainable production of natural sandalwood

Victor Adekunle	Nigeria	The social, religious and magico-cultural aspects of wood and its versatility for rural and sustainable national development in Nigeria
Xiaomei Jiang	China	The inheritance and development of Hongmu culture in China
Yang Ping	Japan	The promotion of wood culture in Japan
Ying Lin Hung	China	Wooden paths to a sustainable future

Appendix 2 - List of participants

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REDISCOVERING WOOD: THE KEY TO A SUSTAINABLE FUTURE
THE INTERNATIONAL CONFERENCE ON THE ART AND JOY OF WOOD

BANGALORE, INDIA

19 OCTOBER – 22 OCTOBER 2011



PART 2 - SESSIONS FROM 1 TO 15

Session 1

[Wednesday 2nd period 1.5 hours - plenary]

Why we are here? Different perspectives on the role of wood in sustainable development

Speakers



Speakers:
Saara Taalas and Dick Sandberg

Topic:
Bridging Life at Home and Sustainable Production



Speaker:
S Balaram

Topic:
Designing with Wood for Development



Speaker:
Michael Martin

Topic:
Wood is Good



Speaker:
Pascal Kamdem

Topic:
Can Wood Play a Role in the Sustainable Development of Africa?

Bridging Life at Home and Sustainable Production

Saara Taalas¹
and
Dick Sandberg²

¹IKEA Professor, Linnaeus University, School of Business and Design (Saara.Taalas@tse.fi, saara.taalas@lnu.se)

²Professor in Forest Products - Editor-in-chief of the journal Wood Material Science and Engineering, Linnæus University, Sweden

Bridging Life at Home and Sustainable Production



19 Oct 2011

Professor Saara Taalas

Professor Dick Sandberg

LifE/Linnaeus University

Rediscovering Wood: The Key to a Sustainable Future
An International Conference and Exhibition on the Art and Joy of Wood
19-22 October 2011 Bangalore, India

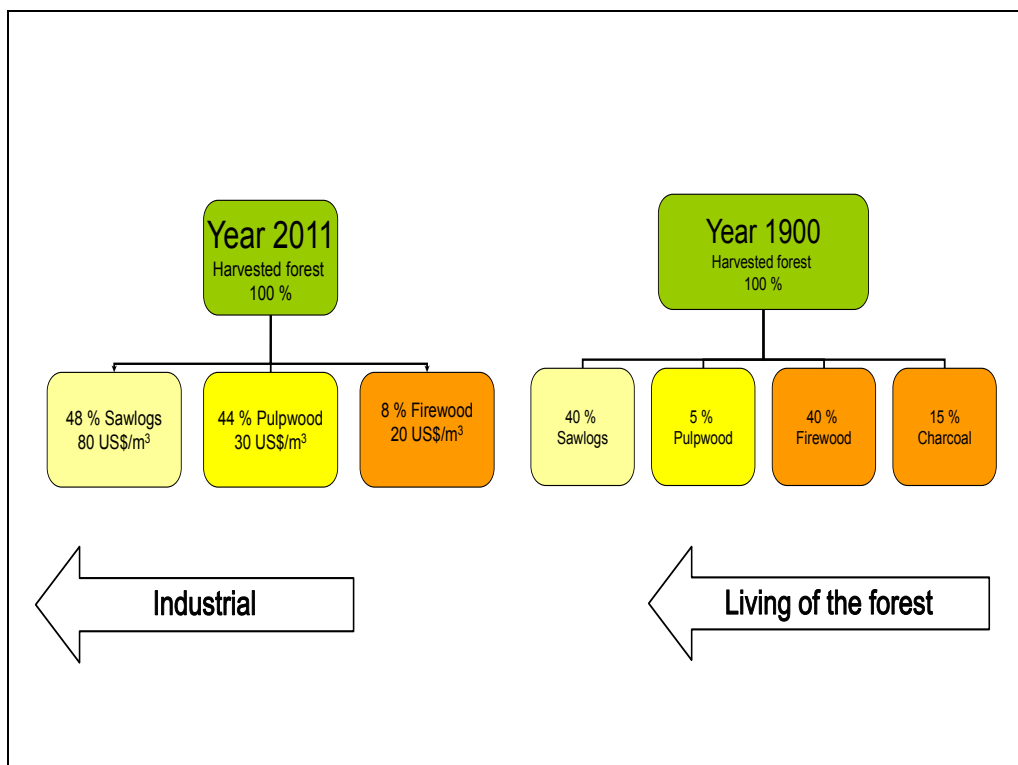
Shifts in Markets

- Consumption – embedded in everyday practices
- From material to immaterial consumption – rearranges relationships to material resources
- Local practices and global audiences– life at home has become one of the fastest growing media genres US and Europe
- Technologies for consumer participation – concepts of good life and desirable futures distributed to global audiences

ConsumptionPractices



SustainableProduction



Visions for Finnish Bioeconomy Business Levels

The lower kills the upper...

1. Living tree: services that can be provided without cutting down the tree. Carbon sinks, berries, game hunting, tourism. ...but, looking from top to bottom, forest industry business can be multiplied
2. Wood products, such as construction and furniture
3. Fiber and pulp products
4. Polymers and chemicals
5. Bioenergy

Material presented with kind permission of
Ahvenainen, Hietanen & Heikkinen.
Smart Forest @ Future Home. Finland Futures
Research Centre 4/2009

Value10xBeforeCut

EveryTreeSoldx100

The **future** is here. It's just not widely
distributed yet

(William Gibson, science fiction novelist)

- Income from day 1 – forests are diverse ecosystems with multiple life spans that create opportunities
- New linkages in forest business and forestry practices
- From single product oriented industries to integrated biorefinery systems

Designing with Wood for Development

S Balaram²

1. WISDOM OF WOOD

Wood is a living entity. It is an organic material which lives even after it has been cut down, because it has an urge to live. Its spiritual quality is realized by wise people around the world. One of them, George Nakashima, a sensitive craftsman, says in 'The Soul of a tree',-

"A Tree provides most intimate contact with nature. A Tree is like an avatar, an embodiment of the immutable far beyond the pains of man. In a sense it (shaping timber) is our karma yoga, the path of action we must take to lead to our union with the divine."

"Each tree, each part of each tree has its own particular destiny and its own special relationship to be fulfilled. We roam the world to find our relationship with these trees."

"Quiet often the shape, size, texture and the extravagancies of graining dictate the design and function of an object. Here the relationship of man to timber prevails as the two live comfortably day after day, without tiring of each other".-(Nakashima, 1988)

Like all true artists, crafts persons working with wood are not mere designer-makers of products but they are seekers of spiritual attainment. They make the wood live again.

2. REVERANCE AND ECO-FRIENDLY USE OF WOOD IN INDIA

2.1. India is one of the very few countries in the world where craft is a living tradition. It is an industry sector where maximum numbers of people are employed, along with whole families.

According to the census of India, in tribal villages there is a custom that one cannot cut down a tree coldly and selfishly. If a man wants to cut down a tree, for building a house or making furniture, the man has to select a well grown tree, worship it first, apologize to it and seek its permission for taking its life for his own survival. Then he also must apologize to the birds, snakes and insects living on the tree for taking away their home, to build his home. He has to apologize to all the animals that benefit by the tree shade, its fruits and flowers for taking away their benefit for his selfish benefit, asking that they may oblige and find an alternative.

Such ecological reverence has been prevalent since ancient times in India, even in the illiterate tribes.

2.2. Trees and plants are considered sacred in Hinduism. Worshipping plants and trees and seeking divine grace is an age old tradition still existing in India. Trees such as peepal, banian and bilwa are grown in sacred places and are worshipped with reverence. Plants such as Tulasi are grown inside the court-yard or balcony of every Hindu household, decorated and ritually worshipped daily.

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Ancient scriptures dating back 5000 years to a time before the invention of paper were written on palm leaf with stylus. Many of such palm leaf manuscripts are not only preserved in museums, but are still in use by some families for religious purposes.

The varieties of wood are innumerable so are their uses. In India Images of Gods are carved in precious woods such as the wonderfully fragrant sandal wood and highly lubricant rose wood for worship. The most popular Hindu God, lord Krishna is known as “Murali Krishna”, where ‘Murali’, the bamboo flute, is an important part of his attire. Even today, the sweet sounding bamboo flute is one of most popular musical instruments in India.

In villages, traditionally wooden shoes are used by many common people in rainy seasons.

2.3. The ecological wisdom of ancient Indian traditions continues in modern life. This wisdom lies in using renewable parts of tree such as leaves; bark; fibres; shells and branches rather than cutting away the whole tree. Cutting the whole tree is like killing greedily the goose which lays golden eggs.

1. Fast growing Bamboo and cane are used in making furniture, containers, vehicles, fences, curtains, fans, bags, scaffoldings and all such applications..
2. Coconut and palm leaves are used for making baskets, toys and mats.
3. Banana leaves, bark and large teak leaves are used as plates for eating.
4. Tree branches are used for making turned wood toys and furniture.
5. Toys and Dolls are made from leaves, fibre, twigs and waste wood.
6. All most all parts of trees such as palm, Banana and Coconut are designed, made and used for many purposes. Some examples are coir products, coconut shell products, palm leaf bags, brooms, mats, Banana bark lamps and leaf decorations.

3. DEVELOPMENT

3.1. Wood For Survival:

Wood is a material zealously treasured yet dangerously exploited by man.

The situation of wood in industrially developing countries, the majority world, is vastly different from the situation in industrialized countries.

In much of the world, wood is one of the most easily accessible resources to people. Countries like India and China reel under the pressure of population explosion, putting great strain on natural resources. These countries are too burdened with providing basic survival necessities such as food, shelter, health and education to their expanding populations to preserve their forest wealth. Faced with a struggle for survival, people resort to any method to acquire wood. Government regulations and laws are inadequate to control keep this situation under control. Wood used for cooking fuel is a daily survival requirement for people living in rural areas, since no alternative source is available. Furthermore, wood is often the only accessible resource for building houses, fences, furniture and other house hold requirements of the poor people.

3.2. Wood for the dead:

In countries like India prevalent religious and cultural practices also put pressure on the resources such as wood. For example, Hindu communities cremate their dead and wood is traditionally used as the fuel for this purpose. Precious wood like sandal wood is burnt by wealthy, while the poor who cannot afford it, burn other woods. This practice is an emotional issue which refuses to change with time. Due to the strong sentiment, the majority of Hindus are reluctant to burn their dead in electric or gas crematoriums even if these are available.

3.3. Wood for Industry:

Industrialization has brought about ever increasing demand on agricultural and forest lands. Apart from population pressure for housing, the rising numbers of airports, stadiums, and express highways are taking up a lot of land which was earlier used for growing crops, fodder and trees. Industries such as paper production regularly and increasingly denude vast amounts of forests.

Globalization also played a major role in the increased exportation of valuable wood. This is shortsighted thinking since it lacks long time vision and consideration of larger issues such as ecology, global warming; the disturbance of rain patterns, desertification, land-slides and disaster prevention.

In the interconnected world in which we now live, where distances have effectively been reduced, the wood resources of one country can have significant effects on large numbers of people of other nations. Forests cover 26.6 percent of world land area and developing countries account for more than half (56.8 percent) of world's forests. But their exports consist mostly of un-processed logs and wood chips, rather than finished products. This contributes to a ominous situation for the future.

4. POSITIVE INDICATIONS

4.1. Green Awareness:

While the scenario is certainly alarming, there are some positive indications. One is the growing awareness among young people, particularly school children and college students, about the greening of modern cities and focus on global warming, acid rain and other ecological issues. This is mainly due to environmental education at school and college level and awareness campaigns by media.

4.2. Green Movement:

The survival needs of communities in developing countries have resulted in many protests against tree felling on a mass scale. In this respect "Chipko Andolan" is remarkable in India for saving the whole forest area. This people's movement took place in 1973 in the hill regions of Uttar Pradesh, where women hugged the trees to prevent contractors licensed by the government from clearing forests. These people were dependent on the local forests for survival. This protest proved to be very effective and as a result the forest was saved. In participating in the protest, those involved risked going against the law, but with the conviction of their moral authority. Many other smaller movements like this have contributed

to saving trees against commercial exploitation by industry. There are many social organizations which are instrumental in preventing felling of trees and promoting planting instead.

4.3. Green guarding:

This involves protection of the ecosystem by those communities living within the forest. India has many forest tribal populations untouched by the industrialization of the modern world. These tribal peoples know that their livelihood depends on the forest for food, for hunting, for shelter, for herbs and other products. Hence they take great care of the trees. They have realized that development in terms of building roads, bridges, etc exploit nature at every level. There are many instances where they have protested the commercial exploitation of the forest wealth.

5. GOOD DESIGN WITH WOOD:

5.1. Developing countries boast extraordinary diversity of forest eco systems and even more extraordinary diversity of uses of forests. Design can play role in positive use of this diversity.

Wood is a natural and highly respected material. It is a status symbol and its use is extremely diversified. Even after wood is burnt as fuel, the remaining charcoal and ash are highly useful. It is the most sustainable as well as biodegradable of all materials. Thus it is the most eco-friendly material on earth. Wood offers vast imaginative opportunities for Designers.

Designers can explore its sensual qualities such as:

- Disease preventive and healing qualities (Neem, Red wood)
- Natural Lubrication (Rose wood)
- Fast growth (Bamboo grows 30% faster than any other tree on earth)
- Fragrance (Sandal wood)
- Colours and textures (Devdhar).

5.2. The thread thin to massive density ranges of wood-generated laminated boards, veneer, particle board, springy board; hay leaves chip board, etc.

Wood can be flexible and multi curvaceous under the influence of steam or when cut to thin sections and glued to a pre-determined form in which grains run in the same direction. A good example is the molded ply-wood chair of Charles Eames which is economical and ecological, Organic and ergonomic, light and elegant. The Indian reed chair 'Moodha' is a similar though lesser known example.

5.3. Greening has three stages:

- i.) Planting trees and protecting existing ones.
- ii.) Processing of wood
- iii.) End products in wood

Designers can play an active role in all three stages. They can persuade people to plant more trees and protect what we have by raising awareness. They can design better ecological and better economic ways of processing wood. Real money is not in logs but in processing wood and developing products in wood. To sell raw material is commercial colonization; especially in the globalised economy.

5.4. Most wood work for buildings is handmade. Hand crafted wooden furniture and products dominate the Indian market. Some well known craft centres are Sankheda, Idar, Chennapatna and kondapalli. Designer input will be very useful to make this hand crafted work relevant to contemporary needs.

5.5. Collecting waste, be it rags or wood from demolished building, is a business in India. There are professional collectors of waste. Reshaping such waste is an exciting challenge for designers.

5.6. Designers can offer the most inspiring uses of materials which are most sensitive and respectful of the environments they come from. They can use new technologies for ecological and economic advantage in a far sighted way. High tech devices such as computers, laptops, Television sets, cycles, cell phones and even cars can be designed in bamboo or canes which are biodegradable.

5.7. Designers and architects can make informed intervention in the global politics of wood, by innovating people centered policies.

5.8. Designers can create sustainable forest management systems by designing innovative strategies for protection, growth and use of wood.

5.9. Products should be designed with use of leaves, twigs, bark, fibres and branches creatively in preference to cutting the whole tree down and then slicing up. This would be a major step towards sustainability.

5.10. Products, buildings and vehicles may be designed using a combination of wood with other natural materials such as stone, metal, shell, leather in order to save wood.

5.11. Traditional practices in many developing countries such as India are abundantly rich with examples of a reverent attitude towards wood. Designers can help reviving such practices which are declining with time. This will make the man wiser.

The real challenge to a designer is to create more with less; to help alleviate poverty by creating beautiful products with abundant low-cost parts from tree such as leaves, bark and branches, encouraging planting trees and discouraging extravagant use of wood.

Real development is not mindless industrialization which kills trees and creates ecological imbalance but mindful design of products and environments which use less natural resources yet create more purpose and beauty, trying not to conquer nature but to nurture and enjoy it.

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Design with Wood and Development

Prof. S. Balaram

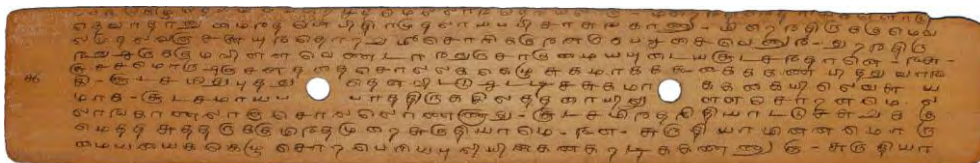
“A tree provides most intimate contact with nature. A tree is like an avatar, an embodiment of the immutable far beyond the pains of man. In a sense it (shaping timber) is our karma yoga, the path of action we must take to lead to our union with the divine.”

-Nakashima

Tree is God



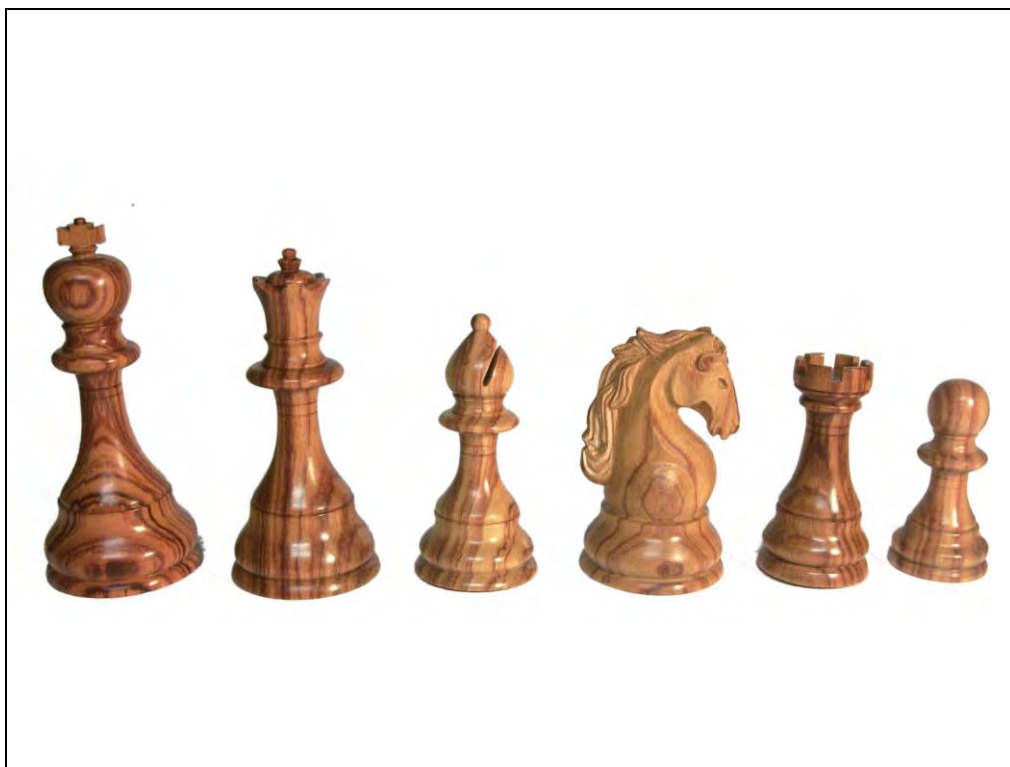


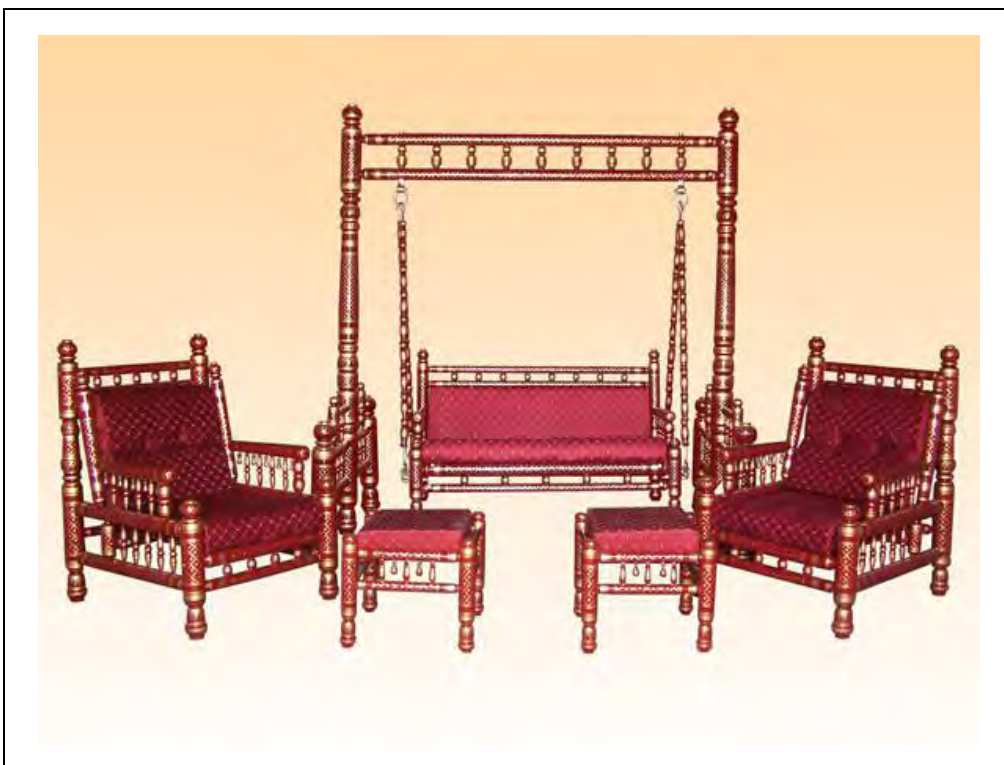
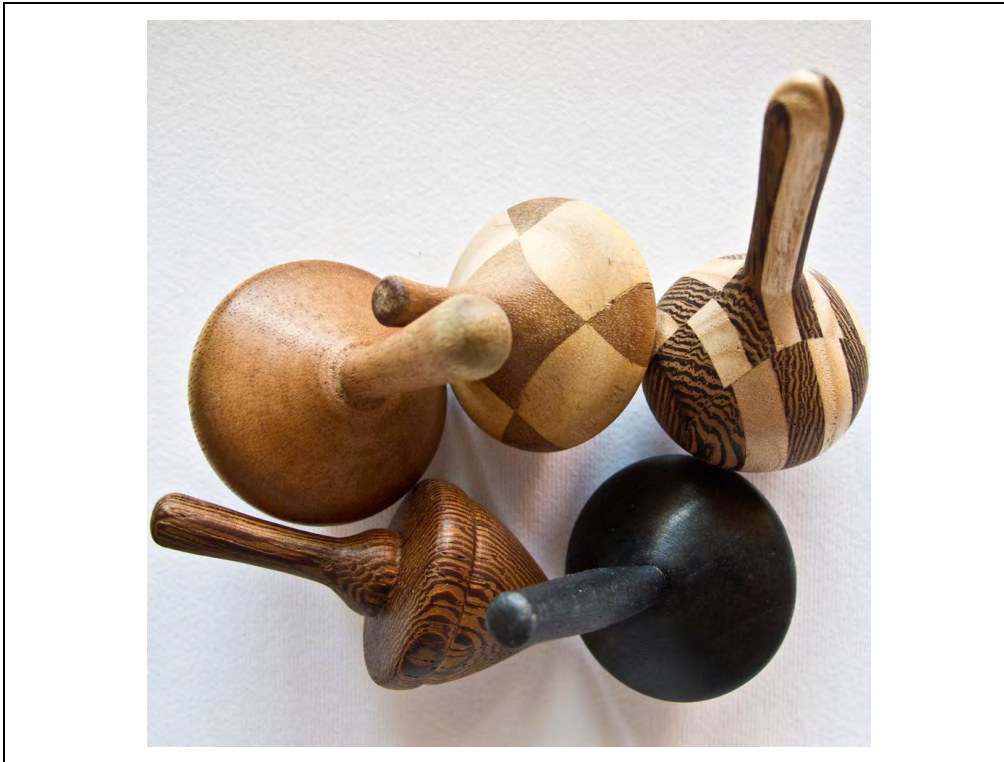


Kauai Aadheenam Test Ola Leaf











Development

- Wood for the Living
- Wood for the Dead
- Wood for the Industry

Positive Indications

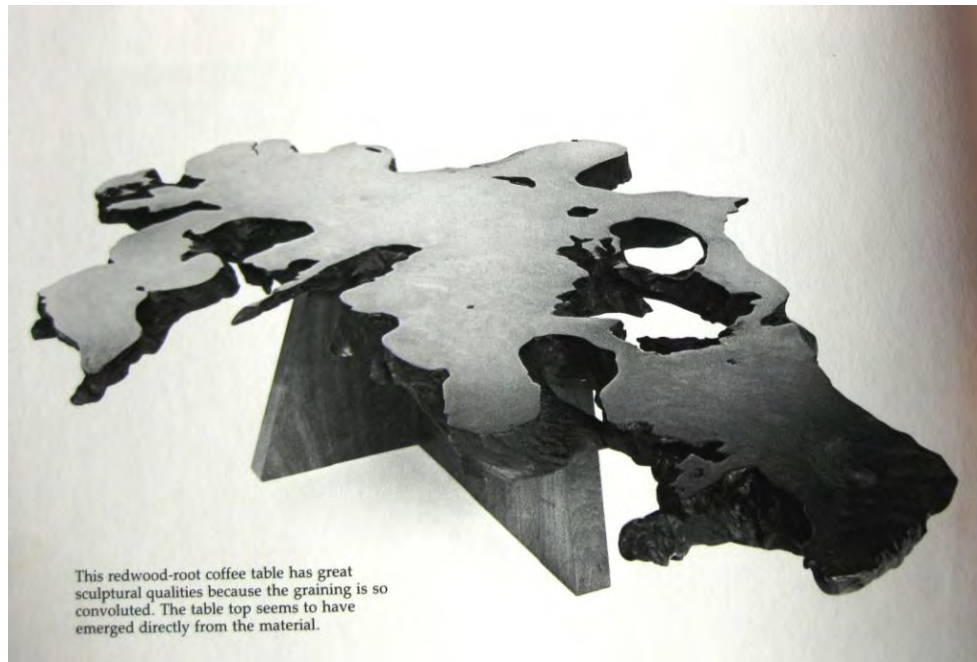
- Green awareness
- Green movement
- Green Guarding

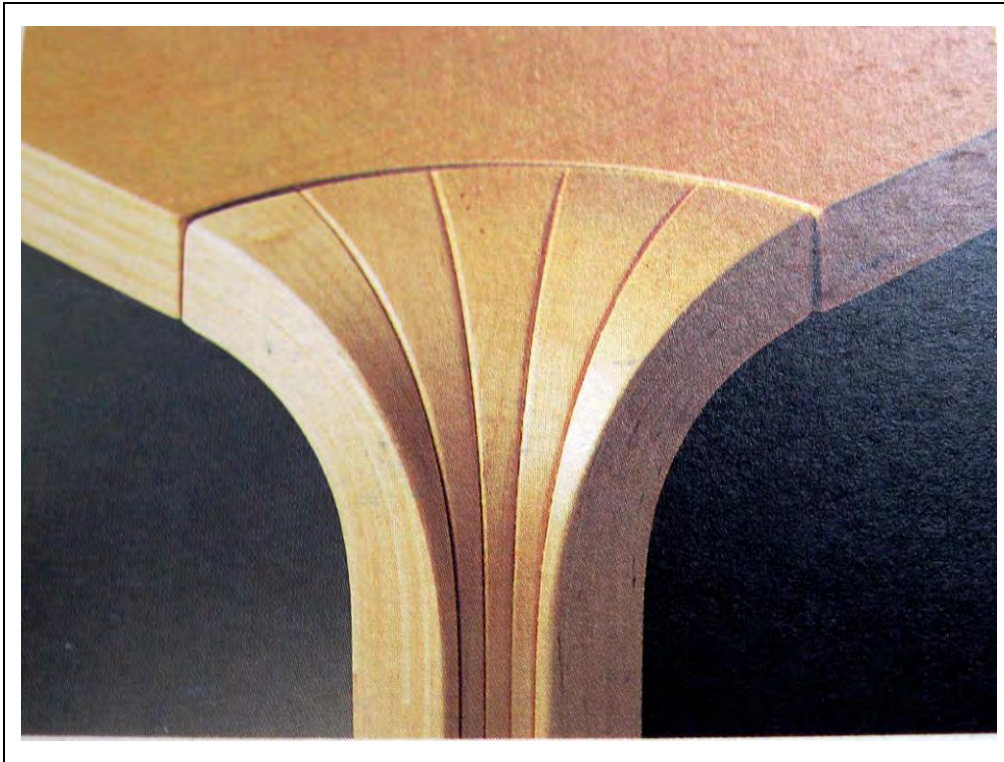
Greening

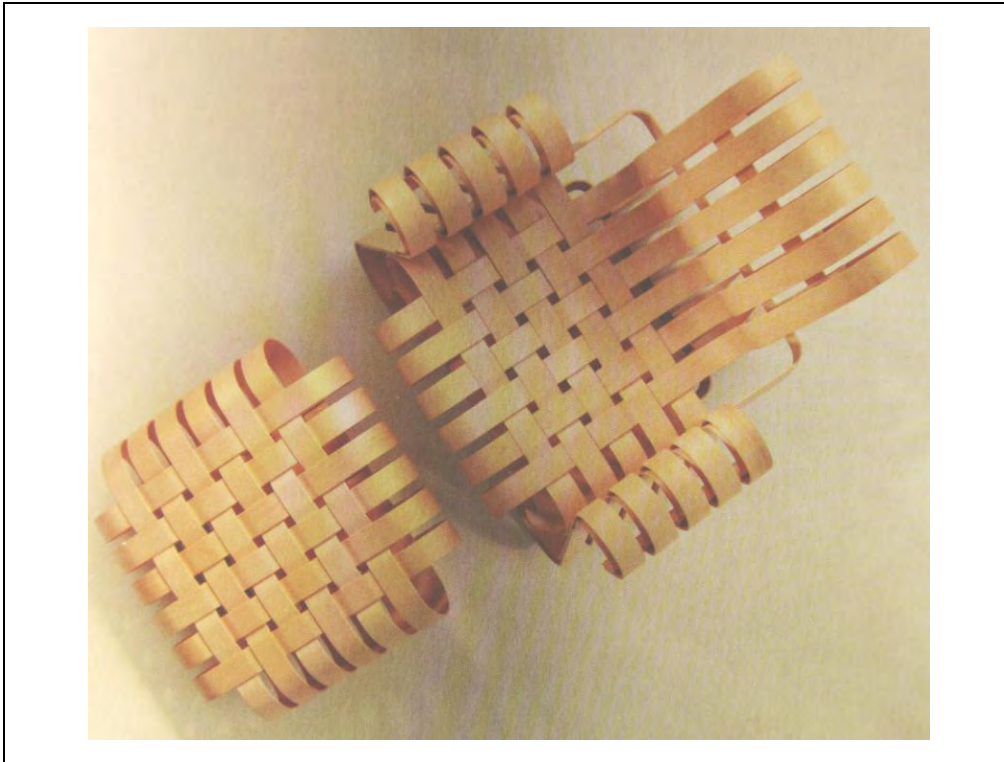
- Planting trees and Protecting existing ones
- Processing of Wood
- End products in Wood

Good Design with Wood

- Fragrant Sandalwood
- Lubricant Rosewood
- Melodious Bamboo
- Tough Teakwood
- Resonant Jack wood
- Healing Redwood





















Mindful Design

- Create products and environments using parts of the tree
- Reuse wood creatively
- Encourage planting trees and discourage extravagant use of wood
- Innovative policy intervention

Not conquer
nature but
nurture and
enjoy nature

Can Wood Play a Role in the Sustainable Development of Africa?

Dr Pascal Kamdem³

Abstract

Wood has been used in Africa for millennia as construction materials, firewood for cooking and heating energy, source of medicine and cosmetics (bark, sapwood and heartwood, oils), weapons for hunting, fishing and fighting, materials for woodcarving, masks and artifacts for dance and ceremony, sculpture for memory and to express human suffering and joy. Strategy to maintain and improve life through the use of wood for a sustainable development of Africa such as creation of durable jobs in woodcarving and the conservation-preservation of existing wooden heritage will be discussed.

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Can wood play a role in the sustainable development of Africa?

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Rediscovering wood: the key for a sustainable future
International conference and exhibition on the art and joy of wood
Bangalore India
October 19 to 22 2011

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- International Wood Culture Society
- Michigan State University

World Forest (FAO)



True size of Africa



- **Population:** about 20 million (UN, 2009)
- **Area:** 475,442 sq km (183,568 sq miles) size of California
- **Life expectancy:** 50 years for men and 52 for women (UN)
- **Official language:** French and English

Statistics

- Forested area : 21,245,000 ha or 46% of land area
- 17.5 million exploitable, rich and diverse, more than 300 species
 - Good for ecosystem but not for industrialization
- 12 million for timber
- 8.5 million non permanent for agro production activities

Forest types: Rain forest evergreen, montane and grassland



Total area: 21,245,000 ha (46% land area)
Forest Timber and conservation: 12 millions ha
Forest Agro pastoral 8.5 million hectares



Republic of Cameroon

- **Main exports:**
 - ✓ 1. Crude oil and petroleum products
 - ✓ 2. timber
 - ✓ cocoa
 - ✓ aluminium
 - ✓ Coffee
 - ✓ cotton
 - ✓ Soccer players (Eto'o; Djitap, Song, Webo, Kameni, Mila, Noah,,,
 - ✓ Brains,... (Manu Dibango and Ryhanna, ...)
- **GNP per capita:** US \$1,150 (World Bank, 2008)
- **GNH:** High (dance, Noah, music,...)

Forestry sector

- Sylviculture
 - Nursery for trees farming
 - Plantation
 - Management and Harvesting
 - Eucalyptus-Teck-Pinus-Khayak-Terminalia,...
- Primary Sector/transformation
 - Logging and Saw milling (Timber and EWP)
 - Low value added
- Secondary Sector/Transformation
 - Furniture-construction-crafts
 - High value added items

Wood Industries

- Sylviculture
- Primary Processing/transformation
 - Logging: road-harvesting and production of timbers
 - Formal and legal Factory with sawmills (60%)
 - Formal and artisanal (60%)
 - Yield close to 30% use of chain saw and portable sawmill (Lucas-Mill-Peterson-Mobark)
 - Informal-artisanal processing (30%)
 - No license
 - use Chain saw
 - low less than 25%yield
 - No considerations on environmental considerations for certification and sustainability

	volume, m3	Timber, m3	Yield, %	Employees direct	companies
Artisanal-Informal	1 million	300,000	30%	3000	1300
Artisanal-formal	700,000	420,000	60%	-	
Fixed sawmill	2.6 million	1.6 millions	60%	20,000	
Total		2.3 millions			

Opportunities

- No Drying-poor quality---Log export
- Limited program of “waste” (sapwood) and recovery for Charcoal-EWP...
- Limited used of non commercial species
- Small diameter logs (forest thinning- clearance for road)
- Only stems no branches-limbs

Wood industries

- Secondary Processing
- Finished or semi finished products for markets
 - About 100 operators from logging to secondary processing for international markets, vulnerable to international crisis
- 294 secondary processing units
 - 132 for export

Logging

- Major component of Forest products industries
- selective and extensive logging
- More than 80 species marketable
- 20 species form the core of logging
- 2 species make up 55% of total production
- Ayous and Sapeli
- 5 species make up 80%
- Ayous, Sapeli, Frake, Iroko and Tali



Logging Cameroon



Illegal logging



Species

Local name

Ayouss/Obeche/wawa/abachi
Frake/Afara/limba
Sapeli/Mahogany
Iroko
Tali
Padouk/African padauk
Doussi
Moabi
Wenge
Bubinga

Scientific name

Triplochiton scleroxylon
Terminalia superba
Entandrophragma cylindricum
Chlorophora excelsa
Erythrophleum suaveolens/ *E. ivorense*
Pterocarpus soyauxii
Afzelia africana/*Afzelia pachyloba*
Baillonella toxisperma
Millettia laurentii. *Millettia stuhlmannii*
Guibourtia demeusei



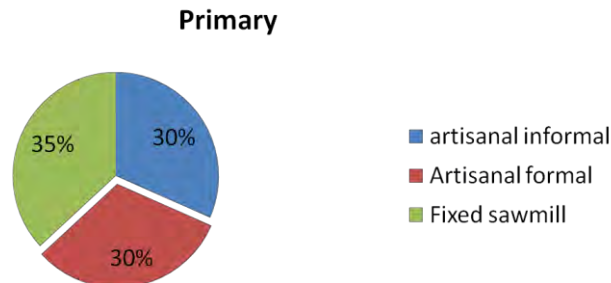
Wood Industries

- 6% GNP
- Volume of wood 2.3 million m³/ year (2005)
 - Equivalent logs and timber
- 2nd Export Products after oil (2008)
 - log export (about 10% ???): 227,000 m³
 - Timber production volume : 657,000 m³
 - Specialty products production volume: 1600 m³
 - 30 % yield from logs to timber-too low
- 1 billions dollars per year
- 20,000 direct jobs
- 170,000 indirect jobs
- Carbon market???

Wood processing

- **600 companies (125 foreigners)**

- Primary and secondary



- Secondary for national and subregional markets
- Furniture, crafts, construction, resawn

Markets (Products)

- Veneer and lumber Logs
- Lumber and plywood
- Furniture manufacturing (Mahogany, Teak, ...)
 - Tables, casegoods, cabinets,...
- Construction
 - Trusses, siding, cladding,
 - Windows and doors
- Interior decoration
 - Panels and architectural woodworking
 - Boats, automotive parts,
- Natural Durable species
 - Sporting goods, handles, flooring, saunas,...
 - Railroad sleepers , utility poles, concrete framing lumber
- Colorful and figured-Grain
 - Crafts, boxes,...

Markets - Export

- Europe
 - France, Italy, Netherlands, Belgium, UK,
- Asia
 - China
 - South Korea
 - Malaysia
- America
 - USA
 - Canada
- Africa

Issues

- Technology (20-40%)
 - very low yield: 20 to 40%
 - Equipment technology and performance
 - Engineering principles
 - Wood science and technology knowledge
 - Wood quality: stain and insects
 - Drying: less than 25%
- Infrastructure
 - Energy-transportation-transformation
- Marketing Strategy
 - Rough lumber-low value products
- Fiscal and social responsibility
- Education
- Conflict of interest

Export: 2 to 5 million cubic per year



Problems Facing the Forestry Industry in Cameroon

- Market Failures
- Policy Failures
- Lack of Technical Expertise
- Technology

Issues

- Education and training in wood science
- Public perception
- Image of Wood technologists-scientists
- Environment and sustainability
- Illegal logging
- Social justice

Can wood play a role in the sustainable development of Africa? Yes if...

- Through education-collaboration-training-laws-fiscality:
- Improve productivity of primary processing (sawmilling)
- Residues into value added products for local end uses: charcoal for cooking and heating
- Uses of several species
- Production of EWP from waste (branches,....sapwood...)
- Technology
 - Drying
- Market driven by export of low value products
- Strategy to improve domestic consumption
- Fiscal and legal incentives
 - Entrepreneurship
 - Duties
 - Finances
 - Ownership laws

How to?

- Leadership of IWCS with Wood Culture tour and wood day in understanding and identifying the weakness and strength of the philosophy of : "Wood is good" through brain storming and exchange sessions with:
 - Industry
 - Community and public
 - Education
 - Bank
 - Gvt
- Wood Science, economy, sociology, education during Wood tour and Wood day
- To understand and improve the sustainable use of wood to alleviate poverty in Africa while conserving our very dear natural resource for future generation.

Thank you
Questions????

Session 2

[Wednesday 3rd period 1.5 hours - Main Hall]

An introduction to wood culture: building on the past

Speakers



Speaker:
Howard Rosen

Topic:
The Evolution of Wood Culture in the United States of America



Speaker:
Sangeeta Gupta

Topic:
History and Current Status of Wood Culture in India



Speaker:
Andrea Klein

Topic:
The Treasure of Special Stem Assortments- Lost Knowledge of the Past



Speaker:
V Ramakrishnan

Topic:
The Fourth Dimension of Wood

The Evolution of Wood Culture in the United States of America

Howard Rosen¹

Abstract

Wood Culture is an interdisciplinary science area which provides a better understanding of the use and social aspects of wood from a cultural perspective. The study of wood culture can provide positive publicity for wood as a sustainable and environmentally friendly material. In the United States (US), there has been a rich history of forest products use since the early settlers came in the 17th century. Forest products have been a major strategic asset and are critical to the social, economic, and ecological well being of the United States. US history includes trees removal for farmland and significant production of timber products, such as log homes, train trestles, fences, and bridges. The management and procurement of wood products was significantly impacted by the formation of the US Forest Service in 1905 under President Teddy Roosevelt. A rich history of wood culture in art, literature, poetry, and drama developed as a result of the importance of forest products to the US economy.

The US is a wood oriented country, ranking third of all countries in volume of standing forest timber. Abundant forest resources and prudent forest management have allowed U.S. industry to make wood the single largest material resource of industrial production. Approximately 330 million metric tons of wood is harvested annually in the United States, which is by far the world's largest industrial timber-producing nation. The focus of this presentation is on the rich history of wood culture in the US and the use of forest products in the development of the country.

¹ USDA Forest Service, 4th Floor, RP-C, 1601 North Kent Street, Arlington, VA 22209, USA
(hrosen@fs.fed.us)

The evolution of wood culture in the United States of America



Howard N. Rosen , PhD, USA
International Wood Culture Society
US Forest Service, Research Use Sciences
Presented at the Rediscovering Wood: The Key to a Sustainable Future Conference
Bangalore, India October 19, 2011

Agra, India February 1969



Wood Culture Definition:

The human use of and activities with wood, as well as attitudes toward wood, wood products and wood-related environments

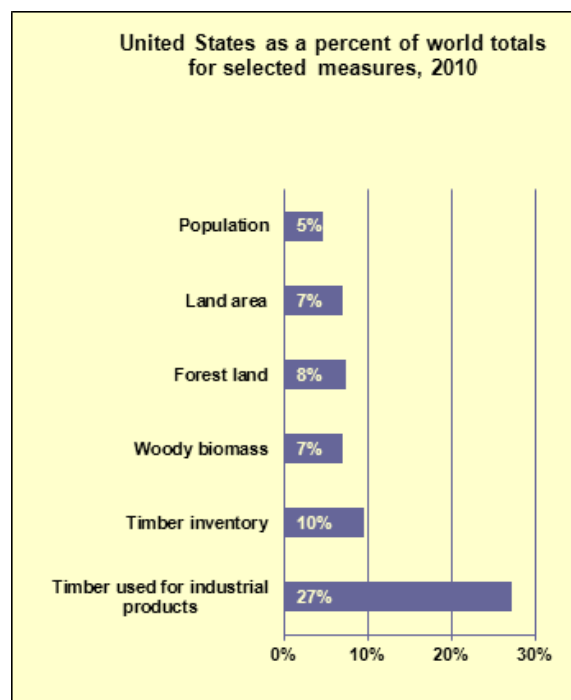
“The value and the way we use wood in our society”

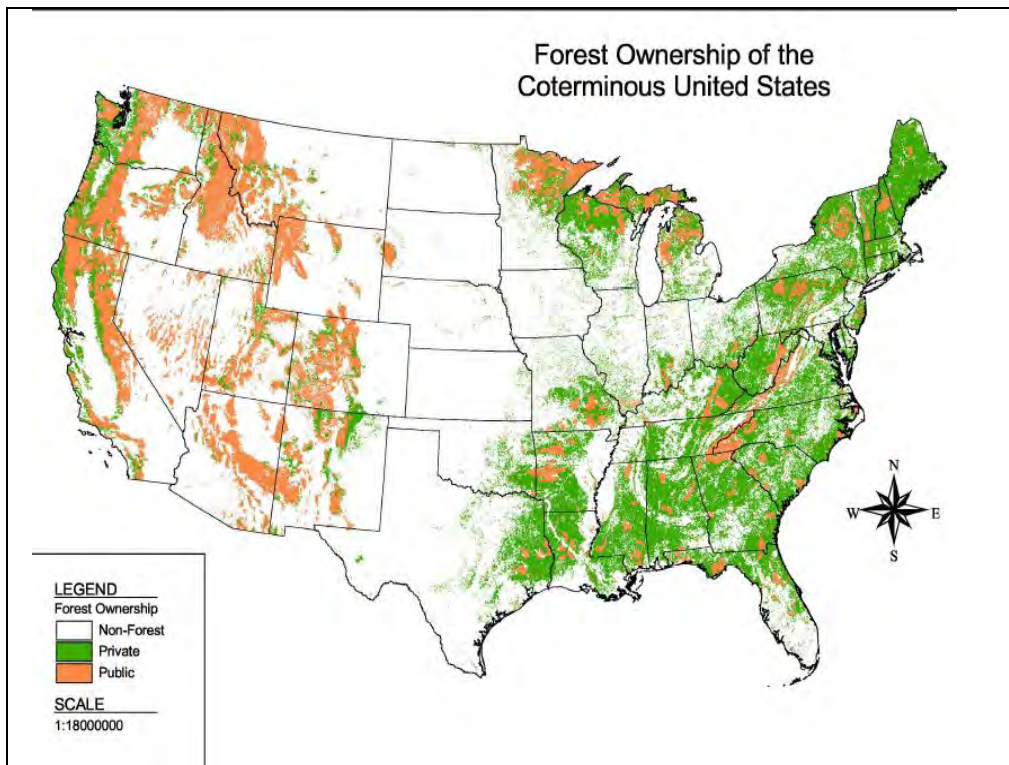
Positive Forest Products Publicity

- **Wood - the environmental material**
- **Wood - the sustainable material**
- **Wood use - the gateway to a sustainable future for mankind**

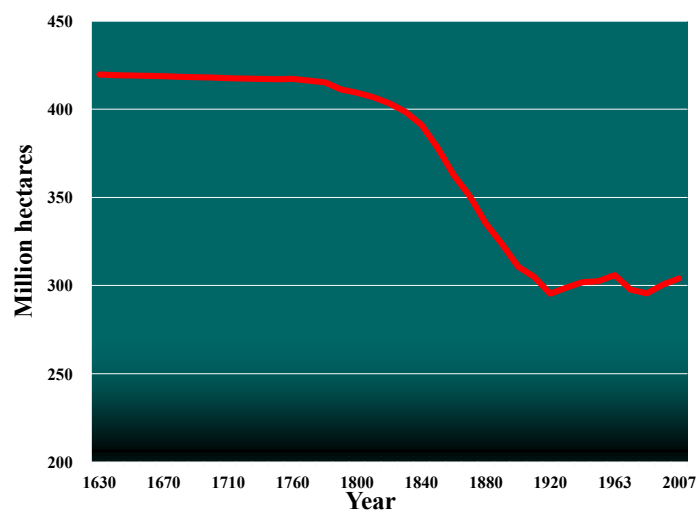
United States Basic Facts

- Population of 312 million people
- Third country in volume of standing timber
- Timber growth still exceeds harvest
- Per capita yearly consumption of wood and fiber products in U.S. (1.8 cu. met.) is 4 times world average
- Use 25% of all energy generated in the world
- Approximately 3% of energy use is from wood or woody biomass

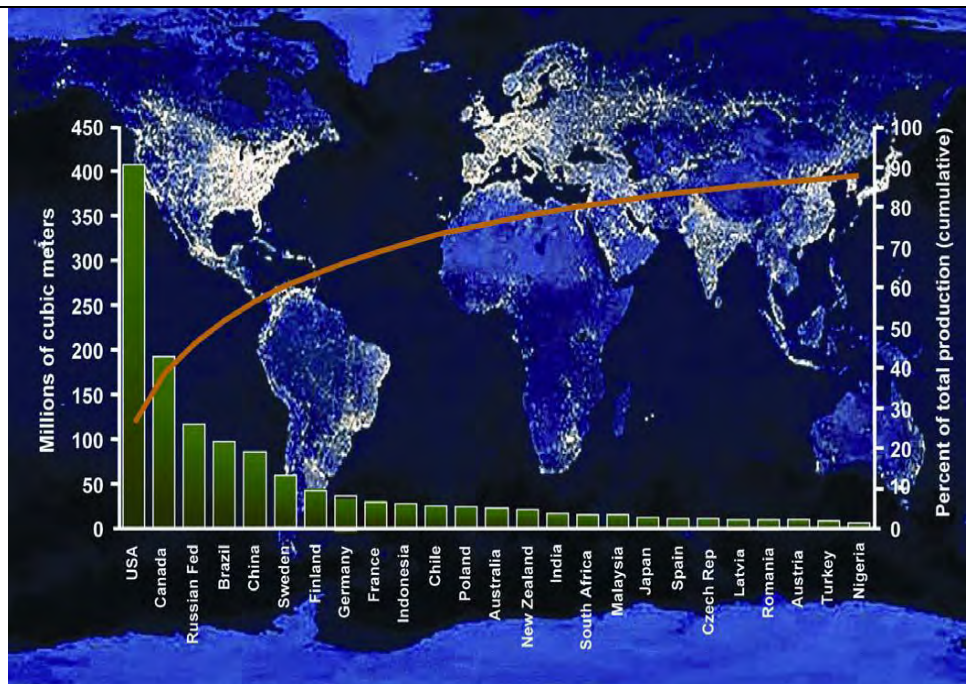
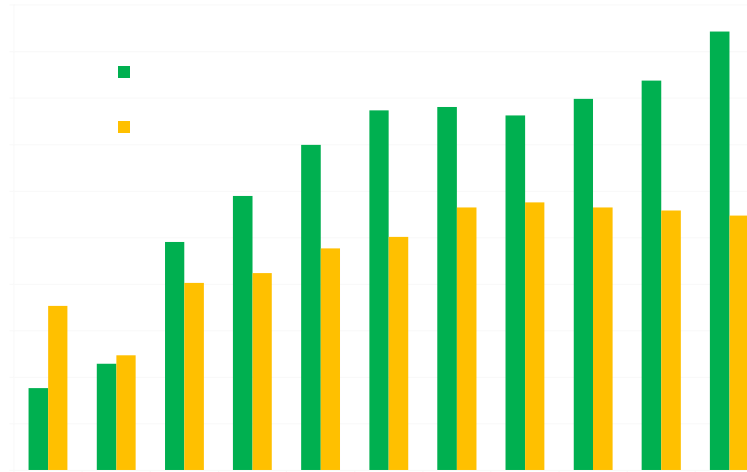




U.S. forest land area



Growth-removals of US Forests



Early English settlers in 1607 at Jamestown, Virginia



Early Clearing of forests and use of wood

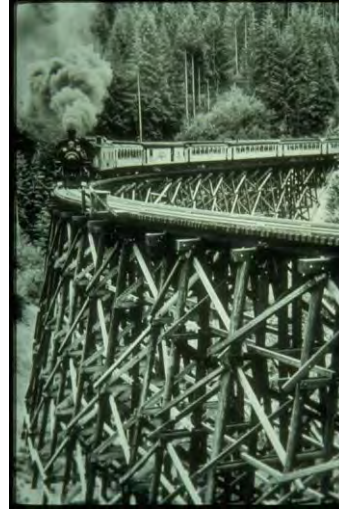


Early uses of timber:

fences



railroad trestles



Harvesting



Old

Modern

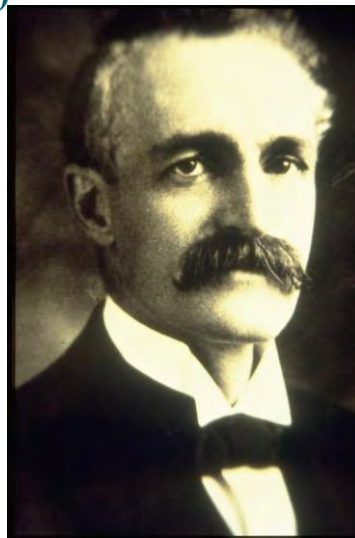


Devastation from clear cutting and fires in early 1900's



***Gifford Pinchot* (1865-1946) First Chief of the US Forest Service (1905-1910)**

**Spoke forcefully of the need for conservation as "wise-use."
Federal forests should be open and accessible to all citizens.**



Teddy Roosevelt (1858-1919) President of US (1901-09)

Pinchot was helped mightily in his efforts through his friendship with Teddy Roosevelt, the first "Conservation President." Roosevelt had a profound effect on the conservation history of the nation.



Literature and Folk Lore – Paul Bunyan and Babe the Blue Ox



Solid Wood Products

Cedar Chest



Birds-eye
Maple Guitar



Walnut Gun Stock

Composite Products



I-joists/Glulam

Engineered wood products



Wood plastic Composites



The Carbohydrate Economy (Cellulosic Biorefinery)



International Union of Forest Research Organizations (IUFRO)

5.10.01 Wood Culture Working Party

Wood Culture is an interdisciplinary science area which provides a better understanding of the use and social aspects of wood from a cultural perspective. Research in Wood Culture improves people's relationship with nature and opens new ways to understand wood from an economic, environmental, and social value perspective.

IUFRO All Division 5 Conference Lisbon, Portugal; July 8-13, 2012

- **Session Title: Importance of Wood Culture on Tomorrow's Resources (2 sessions)**
Coordinators: Howard Rosen (US) & Mario Tomazello (Brazil)
- **Session Title: Cultural Artefacts—Production and Protection**
Coordinators: Wibke Unger (Germany) & Howard Rosen (US)
- **Web address: <http://www.iufro.2012.org>**

International Wood Culture Society (IWCS)

is a non-profit, non-governmental, international network of wood enthusiasts, dedicated to the research, education and promotion of wood culture started in 2007 in the United States.



**Acknowledgement of their financial support
for this talk**



History and Current Status of Wood Culture in India

Sangeeta Gupta²

²Scientist In-charge, Forest Research Institute, Wood Anatomy Discipline P.O. New Forest, Dehradun, Uttarakhand-248006, INDIA (guptas@icfre.org)



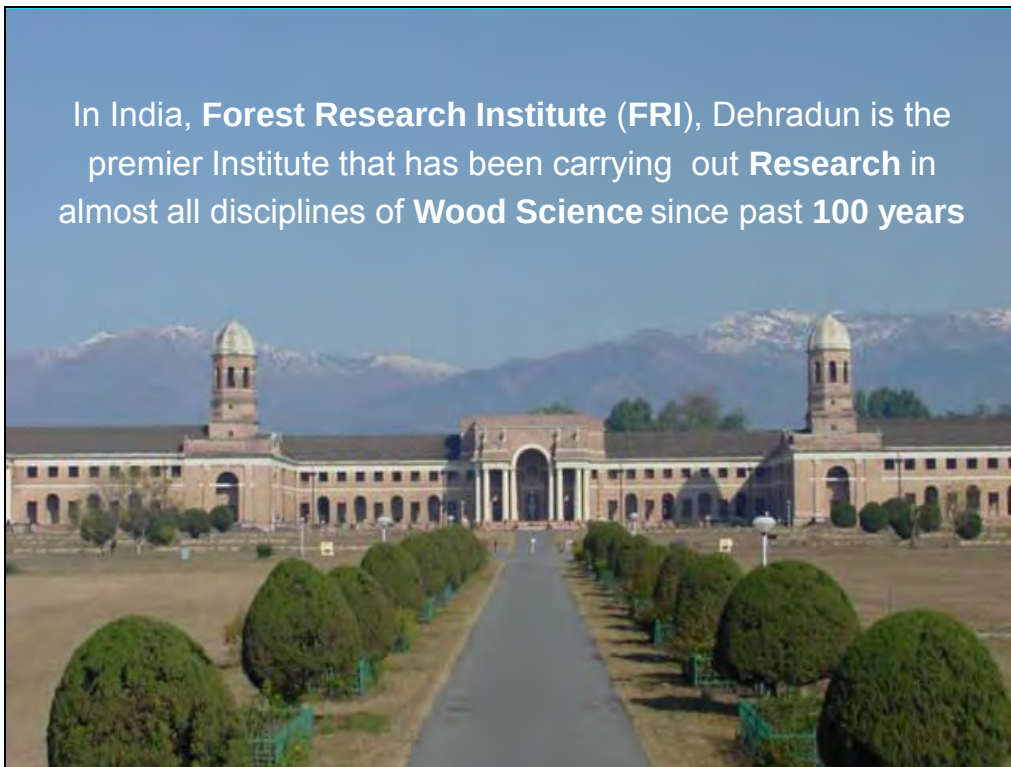
International conference on Art and Joy of Wood
19-22 October, Bangalore, India

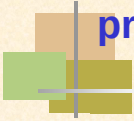


HISTORY AND CURRENT STATUS OF WOOD CULTURE IN INDIA

Dr. Sangeeta Gupta
FOREST RESEARCH INSTITUTE
DEHRADUN, INDIA
guptas@icfre.org

In India, **Forest Research Institute (FRI)**, Dehradun is the premier Institute that has been carrying out **Research** in almost all disciplines of **Wood Science** since past **100 years**





FRI has been rendering yeomen service to the entire nation through inputs on identification, properties, uses, seasoning & preservation of timbers.

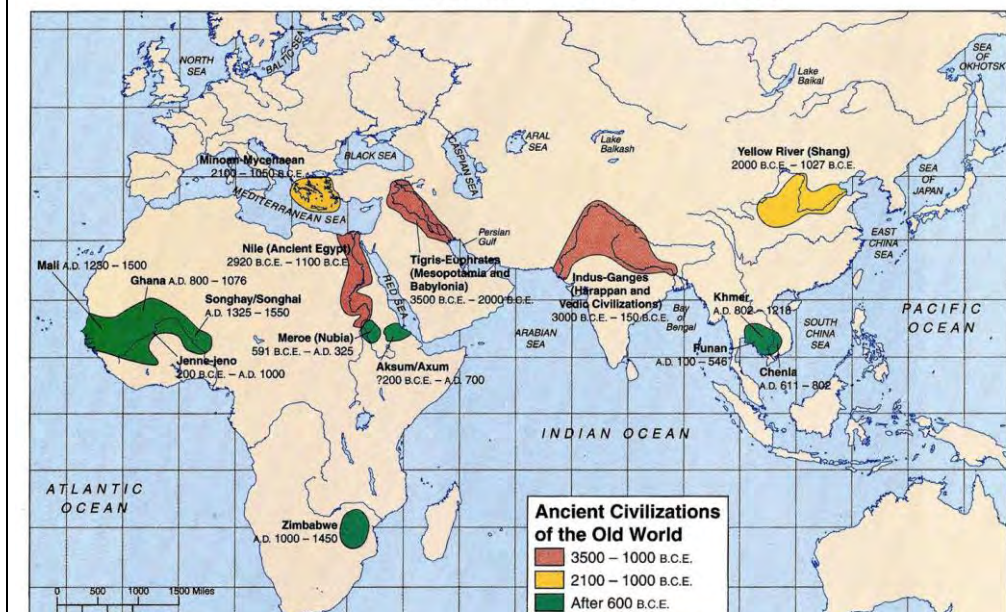
Regular clients:

- **Defense/ Customs/ Port Trust of India**
- **Central Bureau of Investigation (CBI)/Police /Anti-corruption Bureau/ Vigilance Dept.**
- **National Tests Houses/ Forensic Labs**
- **Railways**
- **Housing Corporations**
- **Sports Authority of India**

- 
- **Archaeological Survey of India**
 - **B.S. Institute of Palaeobotany**
 - **National Botanical Research Institute**
 - **Timber based Industries**
 - **Bureau of Indian Standards**
 - **Handicrafts**
 - **Forest Departments**
 - **Electricity Boards**

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Ancient Civilizations of the Old World



Source:

http://qed.princeton.edu/main/Image:Ancient_Civilizations_of_the_Old_World_3500_to_after_600_BCE.jpg

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- **Ancient civilization of Erstwhile India:~ 5000 years.**
- **Written information on wood : ~ 3500 years**
- **Ancient literature - Vedas, Upanishads & Puranas**
Religious text - Ramayana & Mahabharatha
- **Explorations in India started in 1784 by Asiatic Society.**
- **Explorations and excavations later increased after the founding of the Archaeological Survey of India in 1861.**

Vedas/Puranas (second millenium BC)

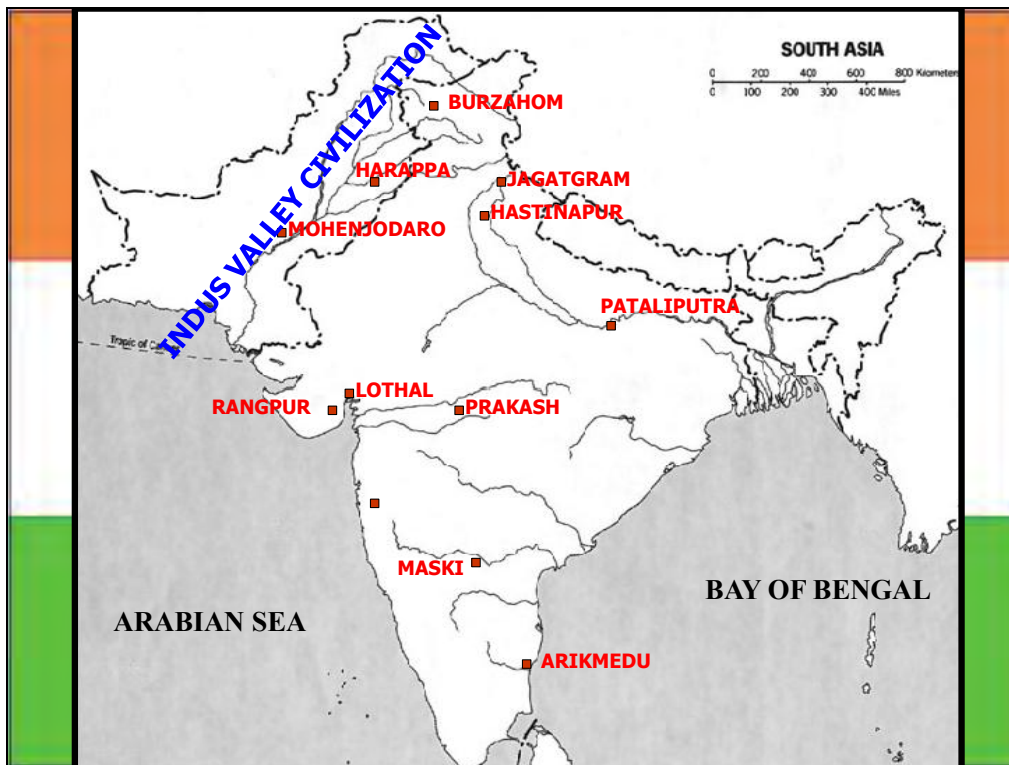
Written record of domestic & religious life of people

- existence of a class of artisans-Vaddhaki (carpenters)
- instructions on choice and handling of wood for boat & ship building
- strong and durable timbers for making thrones of Kings
- mentions about seasoning properties of different timbers
- Woods for sculptures of dieties *Calotropis gigantea* (Erukku) wood root –Ganesha , *Diospyros ebenum* (Black ebony)-Krishna

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**PRE-HISTORIC
2500 BC-100 AD**



sg1



Neolithic site - 2375-1535 BC

Burzahom, Kashmir

Burnt material consisted charred twigs of *Parrotia jacquemontiana*, *Prunus*, *Juniperus* etc.

Parrotia twigs for wicker work & *Prunus* flakes for mud plaster are still used in that area.



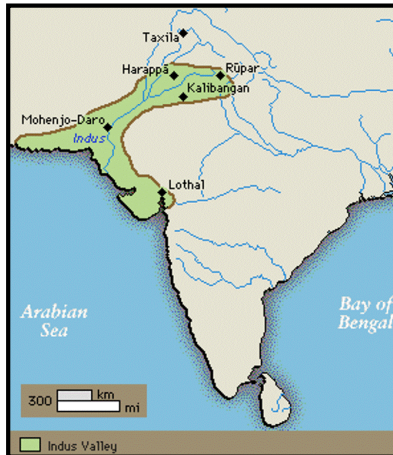
IMMORTAL TRADITIONS

Ref: Purkayastha & Lal, 1976

2500-1750 BC Bronze - Age Sites



INDUS VALLEY CIVILIZATION



Knowledge about Indus Valley Civilization comes from study of the excavated towns of-

- Harappa, Mohenjodaro, now in Pakistan
- Lothal, Rangpur, Surkotada, Dholavira, Kalibangan and Rakhigarhi in India.



2500-2000 BC

HARAPPA: BRONZE-AGE SITE

- I. Wood remains of a coffin - *Cedrus deodara* (Deodar)
& *Dalbergia latifolia* (Rosewood).

Harappans were-

- Well acquainted with the use of **durable and scented** woods for making coffins
- Wood availability.
- Trade connections with the northern & southern regions



Ref: Chowdhury & Ghosh, 1946

2000 BC: HARAPPAcontd.

II. *Zizyphus sp.* used as a mortar for pounding grains.

Timber known for shock absorbing property.

The tree still grows around Harappa.



III. *Pinus roxburghii* & *Cedrus deodara* for house- building.

All are well-known commercial timbers of the present day.



KNOWLEDGE OF WOOD PROPERTIES

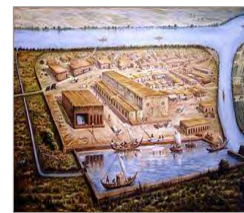


2350-2200 BC

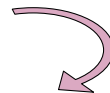
Lothal, Gujarat - port town

First tide dock of the world constructed for berthing and servicing of ships.

- Boat building technology in India- 3rd Millennium BC.
- Wooden artifacts- *Acacia chundra*, *Albizia sp.*, *Adina cordifolia*, *Tectona grandis*, *Soyimida febrifuga* & one *Lauraceae* wood
- *Acacia chundra*- best timber for dock works
Substitute of lignum vitae (*Guaiacum officinale*) of South America.
(Ref: Rao & Lal, 1983 & Rao, 1987)



Ancient Lothal
as envisaged by
Archaeological
Survey of India



KNOWLEDGE OF MERINE WOOD PROPERTIES

2000 BC



Rangpur, Gujarat

◆ Charred remains of *Pterocarpus santalinus*, *Soymida febrifuga* and *Tamarix sp.* *Acacia sp.*, *Albizia sp.*, were found.

◆ Well known woods for construction and agricultural implements.

◆ Presence of *Pterocarpus santalinus* (Red sander) is unusual as it now occurs only in Andhra Pradesh.

Ref: Ghosh & Lal 1963

1700 BC - 800 BC



Chalcolithic site (Copper age)

HASTINAPUR: Charcoal remains of *Dalbergia sissoo* & *Holarrhena antidysentrica*. Both woods have high calorific value.
(Ref: Chowdhury & Ghosh, 1955).

MASKI: charcoal remains of *Acacia sp.* & *Chloroxylon swietenia*.
At present best woods for charcoal & fuel purposes
(Ghosh & Chowdhury, 1957)



Knowledge of Calorific value of woods

200 -300 BC

KARLA CAVES, MAHARASHTRA -

Ceiling of *Tectona grandis* (2200 years)- apparently sound but its cellulose and crystalline nature had considerably reduced

(Chowdhury et al.,1967)

PATALIPUTRA- Ashoka's palace wooden Pillars (2250-350 years old) of *Shorea robusta* (Sal).

Most popular timber for constructional purposes. The good state of preservation of the wood which remained in the ground for over 20 centuries reflects upon the durability of this timber

(Ghosh & Lal, 1958)



KNOWLEDGE OF WOOD DURABILITY

100-200 AD



Dravidians pre- medieval site: Arikmedu



Woods of *Diospyros* sp., *Mimusops* sp. & *Heritiera* sp.



Diospyros sp. used for turnery & carving work.



Mimusops sp. & *Heritiera* sp. are strong and durable timbers used for boat building, construction & agricultural implements



All the three are at present well known commercial timbers of India.

200- 300 AD- Early Historic

KALSI, Dehradun: Asvamedha site-

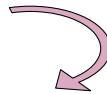
Shorea- for sacrificial stand -strength

Terminalia- for boiling blood or flesh-excellent fuel wood

Mangifera (Mango)- used for lighting 'homa' fire

Cinnamomum- as substitute for true cinnamon.

Mango & Cinnamon still used for yagna



Timeless and Immutable Indian customs.

Ref: Ghosh & Lal, 1961

Wood culture after 5th Century AD can be seen in temples, palaces, artifacts as well as in written records

700 – 1100 AD



Temples of Chamba, H.P.
Constructed mainly of ***Cedrus deodara*** wood

Source: S.M.Sethi

1100-1200 AD



**Mrikula Devi Temple,
Lahaul**

1553 AD



Hidamba Devi wooden temple, Manali, H.P.

The sanctum is covered with a 3-tiered roof constructed of narrow wooden planks of *Cedrus deodara*, one over the other.



Intricate carving on Deodar wood



16-18th century AD



Padmanabhapuram Palace, Kerala 16-18th centuries

- *Tectona grandis* beams
- Interiors carvings on *Dalbergia latifolia*
- Ceiling of *Swietenia mahogany*.
- *Artocarpus heterophyllus* columns.

(Source: Srinivasan, 2004)

16-18th century AD



Malawala Palace, Hyderabad built in 1724 Woodwork of *Tectona grandis*. The palace has a library with a *Juglans regia* carved roof.

Source for photo & text: Hyderabad Heritage structures

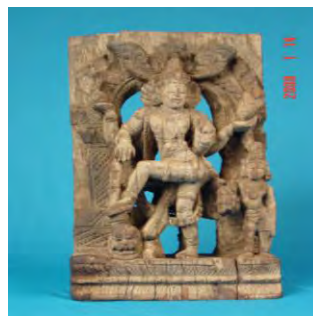


Tipu's Palace, Bangalore constructed in 1791, is a two-storeyed structure with pillars, arches and balconies built in *Tectona grandis* wood.

14-16th Century AD



Four headed and ten handed deity



Deity with child



All sculptures of *Madhuca* species – very strong & durable timber even in contact with soil & water.

16th-18th century AD



TEMPLE CHARIOT -
The octagonal chariot
made of *Shorea robusta* &
Tectona grandis. from
Tamil Nadu, South India.

Source for photo & text:
National Museum, New
Delhi



House Boats-*Artocarpus hirsutus*
(anjili), Teak, Deodar & Bamboo
interiors-walnut carvings



Sculpture-*Ficus*
species -a non-
durable timber
but very easy to
work

**Indian music has an accumulated heritage of centuries.
Origin can be traced back to Vedic days (~2500 BC).**



Tabla

Dholak

Harmonium

Dotara

Tanpura

Woods used- *Tectona grandis*, *Dalbergia sissoo*, *Toona ciliata*,
Dalbergia latifolia, *Artocarpus heterophyllus*, *Juglans regia*, *Diospyros*
ebenum, *Swietenia sp* & *Bamboo*.

MYSTICAL JOY OF WOOD

R1

ERA OF MODERN WOOD SCIENCE

Establishment of FRI Xylarium, 1878 (DDw)

WRITTEN RECORDS:

1858: 'TIMBER TREES' - Dr. E. Balfour

1881: 'A MANUAL OF INDIAN TIMBERS'

- J.S. Gamble

Dealt physical & gross features,
properties and USES of 1450 woods

Knowledge of uses came from LOCALS



19th century AD



Forest Research
Institute Xylarium
(DDw)-Collections

1877-1899

EXCELLENT SCIENTIFIC WISDOM ON WOOD USAGE

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FOREST RESEARCH INSTITUTE (FRI)

CELEBRATED CENTENARY IN 2006

20th century AD



**One of the Asia's biggest Wooden Hall at FRI,
made of *Tectona grandis* (Teak)**



C.S. of *Cedrus deodara*
704 years: 1215-1919
Diameter: 1.4m



Roof of *Pinus roxburghii*



Floor of *Pterocarpus macrocarpus*

sg1

CURRENT STATUS

Indian Woods: ~ 1600 tree species

- **276 commercial timber species (IS:1150)**
- **99 Rare & threatened Trees (Red Data Book, 1990).**
- **4 under CITES: *Pterocarpus santalinus*, *Taxus wallichiana*, *Aquilaria malaccensis*, *Araucaria araucana***
- **~85 medicinally exploited woods (Wealth of India)**
- **Mega diverse country with 16 different forest types and tremendous wood diversity-**
 - All colors varying from light buff to jet black
 - Lightest to heaviest
 - Sweetest to most foul smelling
 - Beautifully figured.
 - Naturally durable woods

INDIAN STANDARDS ON TIMBER ~300

(listing woods suitable for different purposes)

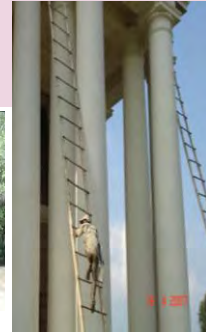
- Indian standard for doors and windows shutters and Frames. IS 12896: 1990
- Timbers for Cooling towers – specification. IS 2372: 1991
- Specification for wooden Sleepers for Railway track. IS 10394
- Specification for Wooden Cross Arms. IS 2203: 1976.
- Timbers for Aircraft Construction. IS 1898: 1990.
- Indian timbers for furniture and cabinets. IS 13622: 1993
- Timbers used in instrument industry. IS 7047: 1973
- Specification for timber for use in coal mines. IS 4424: 1967
- Specification for willow clefts for cricket bats. IS 4422:1985
- Timber species suitable for wooden packaging. IS 6662: 2008.
- Design of Structural Timber in Building-Code of Practice. IS
- Wooden handles for hand Hammers-specification. IS 4953:89
- Pencil slats-Specification. IS 3084:1989

BAMBOO

- Used from time immemorial.
- Vedic craftsman used it for baskets & construction works
- Referred as ‘the cradle to coffin timber’
- 140 species 19 genera
- Covers 13% of forest area.



CCA TREATED BAMBOO
HUT BUILT IN 1955 AT
FRI



Pre-Fab Houses
Mat Board
Corrugated sheets
Doors/Windows



sg1

INDIAN STANDARDS ON BAMBOO

IS 7344:1974 Specification for bamboo tent

IS 9096:2006 Preservation of Bamboo for structural purposes- Code of Practice.

IS 13958:1994 Specification for Bamboo Mat Board for general purposes.

IS 14588:1999 Specification for Bamboo Mat Veneer Composite for general purposes.

IS 15476:2004 Indian Standards on Specification for Bamboo Mat Corrugated Sheet.

IS 22156:2004 Bamboo structural design

IS 22157:2004 Bamboo physical and mechanical properties

IS 1902:1993 Code of practice for preservation of bamboo and cane for non-structural purposes

IS 6874:1973 Methods of test for round bamboos

PRESENT WOOD CULTURE SCENARIO IN INDIA

■ SCENARIO:

DEMAND OF WOOD MUCH MORE THAN SUPPLY

■ CONCERNS:

- ILLICIT FELLING AND TRADE
- PESTS TRADED ALONG WITH IMPORTED TIMBERS
- TIMBER QUALITY
- INAPPROPRIATE SUBSTITUTION OF WOOD (with high energy materials like aluminum/steel or eco-damaging like plastics)

■ RATIONALITY:

- SCIENTIFIC UTILIZATION
- SHIFT FROM SOLID WOOD TO WOOD SUBSTITUTES
- GOVERNMENT INTERVENTION: FOREST & INDUSTRIAL POLICY

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PRESENT WOOD CULTURE SCENARIO IN INDIA

■ SUSTAINABILITY CHALLENGES:

- FOREST CERTIFICATION
- TIMBER MANAGEMENT POLICIES- Formulation & Implementation
- WOOD ALTERNATIVES (natural fibres from crops/ bamboo)
- TIMBER IN STRUCTURAL/CONSTRUCTIONAL ENGINEERING
- EDUCATION/AWARENESS

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GOVERNMENT INTERVENTIONS FOR SUSTAINABLE FORESTRY

- In India, Scientific management of Forests dates back to 1864.
- Complete ban on felling of trees from natural forests since 1996.
- Ban on usage of wood in construction works of Central Public Works Department (CPWD).
- National Working group constituted to frame guidelines on 'Forest certification' for timber and Non-timber forest products.
- Launching of Green India Mission (GIM - one of the 8 missions of India's National Action Plan) in 2008. Targets 20 million ha to be afforested by 2020.
- Subsidy on plantation of sandalwood. 'Grower is the owner' policy adopted.

GOVERNMENT POLICIES FOR ENHANCING TIMBER IMPORTS



- Compulsory licensing removed on import of plywood, veneer, paper etc.
- Import duty reduced on wood logs.
- Investment ceiling raised to Rs. 300 million.
- Reduction of income tax & corporate taxes.
- Excise duty reduced to 16% on all wood based products.
- Custom duties concessions on machinery for production of wood substitutes.

Source: Federation of Plywood & Paper Industry



The Treasure of Special Stem Assortments- Lost Knowledge of the Past

Michael Grabner and Andrea Klein³

Abstract

In former times, there was a huge knowledge of the advantage and proper usage of “abnormal” growth patterns and the utilization of all parts of the tree. People of numerous crafts were ambitiously searching for curved and bended tree stems, branch-stem junctions of specific angles and root-stem junctions.

They were aware of the disadvantages and the loss of strength resulting from cutting out or bending wood for curved timber used in shipbuilding or in many other woodworks. The stiffness of branch-stem junctions for handles or other tools will never be reached by any other manmade wood junction. The high tensile strength one may want to achieve for curved designs will nowhere be higher than by using root-stem junctions.

This used to be general knowledge since ancient times. Even Bronze Age tool handles were made out of branch-stem junctions. In Hallstatt, Austria, it was evident, that people working in the salt mines were carefully selecting the trees where the tool handles were cut out.

Due to the process of industrialization and the wish for standardization and fast processing, hardly any wood deviating from a more or less straight design is used any more. This means, that just a small amount of the mechanical potential is used by humans. This might furthermore lead to a replacement of wood. It is important to realize that there is a specific application for every habitus, for every part of a tree and for every tree species. Being aware of this, you will get out the highest performance of wood for every application.

³ University of Natural Resources and Life Sciences, Peter Jordan Strasse 82, 1190 Vienna, AUSTRIA (andrea.klein@boku.ac.at.)

The treasure of special stem assortments – lost knowledge of the past



Andrea Klein and Michael Grabner
University of Natural Resources and Life Sciences Vienna, Austria

special stem assortments



Due to the ongoing industrialization and the wish for standardization and fast processing, hardly any wood deviating from a more or less straight design is used any more.



- certain mechanical potentials are not used
- replacement of wood in specialized objects



Onomatologia forestalia from 1772 to 1780 about „crooked trees“:

„They have something excellent, which belongs to them, and what straight trees do not have If you have crooked oak trees or other trees, they can comfortably be used for arches. What makes those crooked assortments so valuable is, that every piece has to have its own specific crook with one word, it is not always a fault, if trees are crooked, because many carpentry or wainwrights work require this crooked shape.....“ (after R. Peesch, 1966)



If we look for the basic wood utilisation, we realize, that the tree can be utilised in the same shape as it was growing in the forest (R. Peesch, 1966).



Stone Age....



Exhibition in the Austrian Open Air Museum



Bronze Age, in Hallsatt, Austria...

Wooden tool handles:



Natural History Museum Vienna

Bronze Age, in Hallsatt, Austria...

Wooden bins:

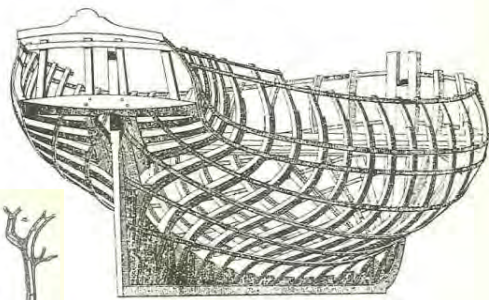


Natural History Museum Vienna

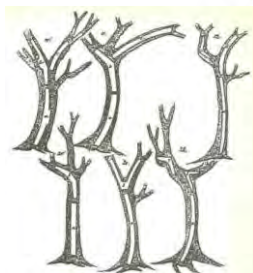
Shipbuilding in the 18th and 19th century



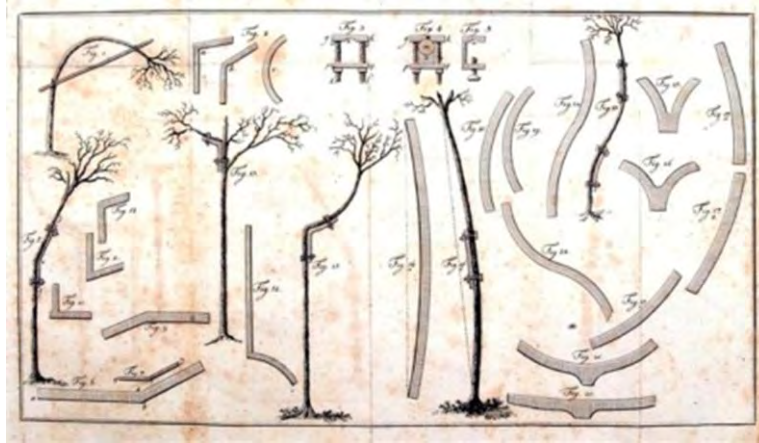
Wasa, Stockholm



Radkau and Schäfer, 1987

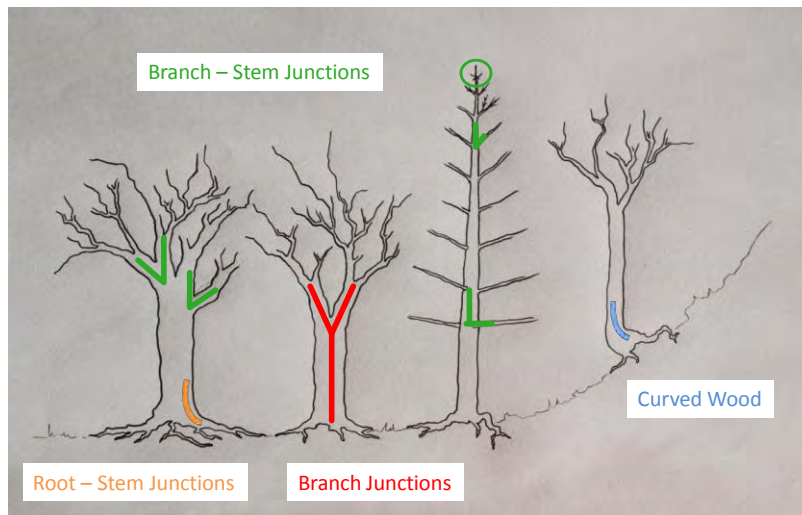


Shipbuilding in the 18th and 19th century



Becker, 1804: About culture, artificial cultivation and felling of wood for ship building

What else was made out of special stem assortments?

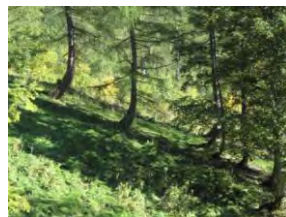


CURVED TREE STEMS



„Tree stems deviating from a straight form, are less strong because, if you want to cut out straight beams you will cut fibres.“ (Knuchel 1954)

BUT....



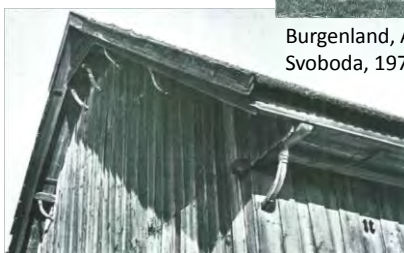
If you want to gain curved beams, you loose strength by cutting it out of a straight tree stem.

CURVED TREE STEMS

....in housing STUDYING OLD PICTURES



Burgenland, Austria, build in 1829
Svoboda, 1975



Wooden barn in Upper Austria
Svoboda, 1978



Aschaffenburg, Framework from the
15th century
Deutscher Volkskundekongress, 1965

special stem assortments

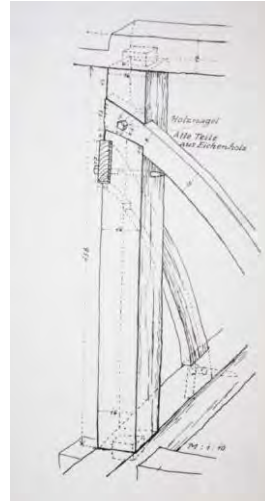


CURVED TREE STEMS

...in housing STUDYING OLD DRAWINGS



Burgenland, Austria; Simon, 1981



special stem assortments



CURVED TREE STEMS

...in housing STUDYING OPEN AIR MUSEUMS



Open Air Museum Stübing



special stem assortments



CURVED TREE STEMSin agriculture



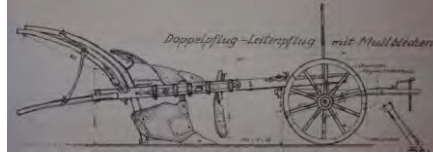
Carriage,
Museum Gutensein, Austria



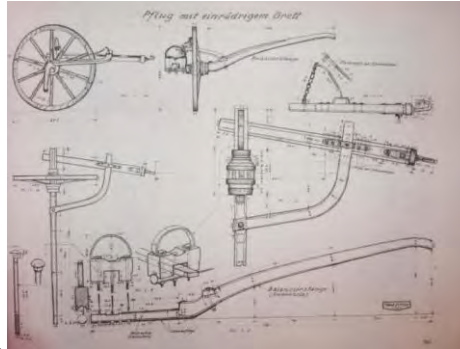
Hay fork



Frame for carrying grain, Museum Gutenstein, Austria



Plough, Burgenland Austria, Simon 1981



special stem assortments



CURVED TREE STEMSfurther usage



Squeezing grapes,
Museum Gutenstein, Austria



Water duct to the wheel, Tirol, Austria, Svoboda 1978

special stem assortments



ROOT – STEM JUNCTION



special stem assortments



ROOT – STEM JUNCTION



Wenzel Repro Vogel, 1996

special stem assortments



ROOT – STEM JUNCTION

...for skids



Skids in the Austrian Open Air Museum and the Museum Gutenstein, Austria

special stem assortments



ROOT – STEM JUNCTION

...some examples

Austrian Open Air Museum and the Museum Gutenstein, Austria

Kopf einer Heindelbank aus Miesenbach;
Foto Klaus Vogel



Benches



Rainwater gutter



horse collar



wain



special stem assortments



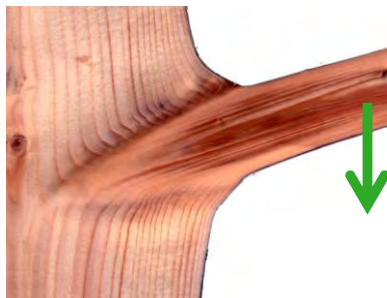
BRANCH – STEM JUNCTION



special stem assortments



BRANCH – STEM JUNCTION



The connection between the stem and the branch has to bear not only its dead load, but also the weight of snow, wind, fruits,....

The natural shape optimization and the fiber orientation lead to a homogeneous strain distribution and therefore to a strong connection. Furthermore, the failure of the connection does not appear suddenly but in steps (Bukhsnowitz et al, 2010).

special stem assortments



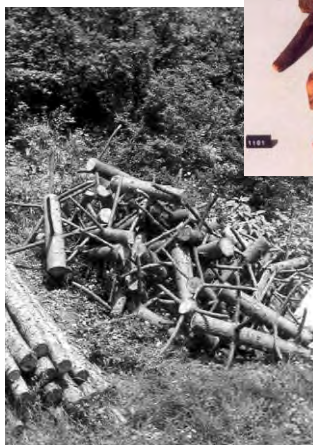
BRANCH – STEM JUNCTIONfor construction



special stem assortments



BRANCH – STEM JUNCTIONfor tool handles



Museum Gutenstein, Austria

special stem assortments



BRANCH – STEM JUNCTIONfor bearing loads



Austrian Open Air Museum Stübing

special stem assortments



BRANCH – STEM JUNCTIONfor small objects

Austrian Open Air Museum and the Museum Gutenstein, Austria



pipe



Standpipe



sputterer



Walking sticks

special stem assortments



BRANCH JUNCTION

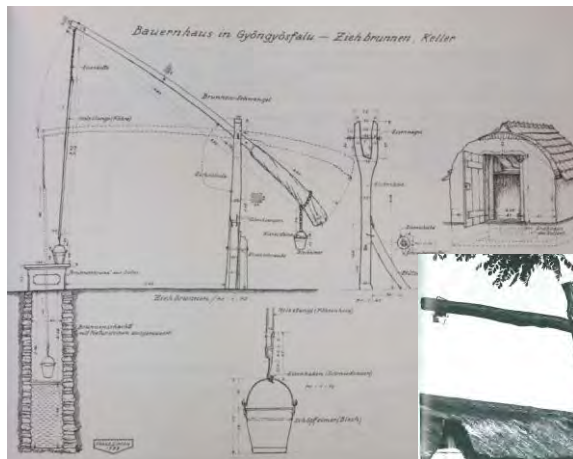


special stem assortments



BRANCH JUNCTION

....for construction



Drawing well in Burgenland, Austria
Simon 1981 and Svoboda 1975



special stem assortments



BRANCH JUNCTIONfor agriculture and others

Austrian Open Air Museum and the Museum Gutenstein, Austria

grinding unit



leader



stilt



skid



catapult



special stem assortments



BRANCH JUNCTIONfor agriculture and others

Austrian Open Air Museum and the Museum Gutenstein, Austria

Rake handle



breaking grain

Door opener



Shaker in a mill



wain

It is important to realize that there is a specific application for every habitus, for every part of a tree and for every tree species.



Thank you!

The Fourth Dimension of Wood

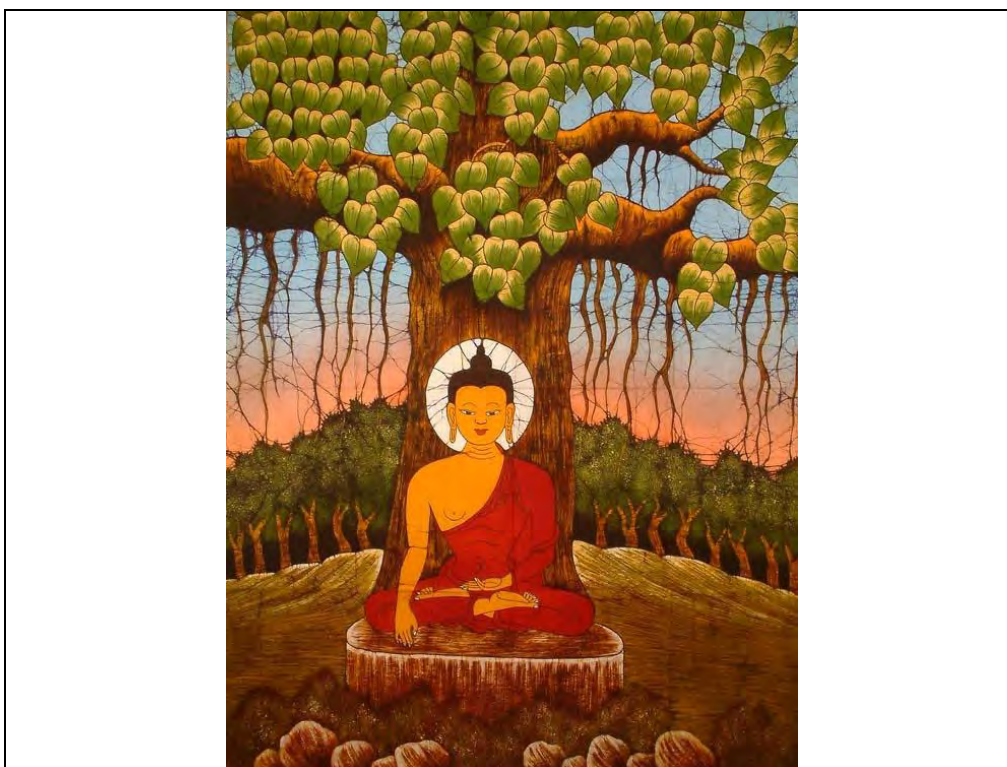
V Ramakrishnan⁴

⁴ Chairman, Leitz Tooling Systems India Pvt. Ltd., (ramu@leitzindia.com)

The *fourth dimension* of Wood

What is the *fourth dimension*?









J.B. Priestley's 'Delight'. It reads:

"Apart from sawing and splitting and knocking a nail in here and there, I have had little to do with wood, yet I never go where wood is being worked, never stand near a carpenter or cabinet maker, without feeling at least a trickle of delight.

To handle newly planed wood, even to look at it or smell it, is to receive a message that life can still be in good heart. The very shavings are crisp confirmation. There is a mystery here.

Is it because wood, no matter how chopped and trimmed and planed, somehow remains alive? I put my hand on the desk on which I am writing now, it is almost as if my palm fell on the shoulder of a brother.

Into this patient material have passed rain and sun, steely mornings in March, the glow of October: it has lived as some secret part of us still lives. And notice how few men who work with wood seem unhappy, defeated. When we write about a carpenter, we call it ***the New Testament*** ”.



Session 3

[Wednesday 3rd period 1.5 hours - Hall A]

The use of wood in different cultures

Speakers



Speaker:
Eric Appau Asante

Topic:
The Effect of Culture and Traditions on the Use of Wood in Ghana



Speaker:
Michael Grabner

Topic:
Understanding Historical Wood Utilization - Ideas for the Future?



Speaker:
T K Kunhamu

Topic:
The Wood Legacy of Kallai: Lessons for the Future



Speaker:
T P Subramony

Topic:
Bamboo as a Modern Construction Material

The Effect of Wood Culture and Traditions on the Use of Wood in Ghana

Eric Appau Asante¹

Abstract

This research sought to raise awareness of some aspects of Ghanaian tradition and culture which have a direct or indirect effect on wood usage in Ghana. A multiple case study approach was adopted. Questionnaire, interviews and observation were the main instruments used to collect data.

The study revealed that in Ghana it is believed that the forest is a living territory managed by a population of venerated spirits and that man is part of the living realm. It also came to light that the forest and other natural reserves are well preserved due to the people's strong adherence to certain traditions within Ghanaian culture. Again the use of wood and the aesthetics of wooden products have several interesting cultural and traditional connotations which could be utilized to strengthen the forest products sector.

Keywords: Ghanaian Culture, traditions, aesthetics, wood usage, preservation

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1. INTRODUCTION

The effect of culture and traditions on the use of wood in Ghana cannot be overemphasized. This study deals exclusively with selected Ghanaian traditional and cultural concepts and practices observed in some of the societies which have not been associated with Christianity or Islam. Discussions featured in this paper have commonly made use of the present tense, suggesting that the practices are still carried out and the ideas still held to this day. Undoubtedly, there are rapid developmental changes taking place in Africa and Ghana in particular and these changes have largely influenced some traditions and beliefs which hitherto helped to preserve the natural environment. It would be wide of the mark to assume that everything traditional has been changed or forgotten to such an extent that no traces of it are still to be found. The traditional concepts still form the essential background of many Ghanaians, depending on the individual ethnic group.

2. THE FOREST IN THE CONTEXT OF GHANAIAN TRADITIONAL BELIEFS

Mbiti (1990) asserts that Africans generally believe that the spiritual universe is united with the physical, and that the spiritual and the physical intermingle and dovetail into each other, making it difficult, or even unnecessary, to draw the distinction or separate them at times. Confirming the above assertion, Yeboah and other key respondents (personal interview) stated that the Akans of Ghana believe that man is not the only creature that is endowed with an immortal soul, but also animals and trees. The three commonly used trees whose wood the Ashantis use for their carvings (Tweneboa or Kodua, Nyamedua and Sese), are said to possess very vindictive spirits. The root of Tweneboa can turn into a venomous serpent to protect itself against any ‘aggressors’ (people who may fell the tree indiscriminately). The three are believed to be capable of moving themselves from one place to another. It is said that such trees can make themselves invisible to man upon realizing that they are in danger of being pestered by him.

Aside from the above, the field research generally revealed that trees, and moreover wood, possess other human abilities such as being able to talk, feeling pain, bleeding and being indisposed. This stems out of a belief in animism; that is the belief that God has given special abilities to both animate and inanimate objects.

2.1 Venerating and sacrificing to the spirits of the tree

Due to the people’s strong adherence to the cosmological beliefs discussed above, it is necessary for artists to appease the spirit of the tree before he fells it. In most cases, fowls, sheep or eggs are sacrificed by the artist to the spirit of the tree. This is done amidst incantations and the performance of libation which are believed to be means of communicating to the tree. He may say: “here is a chicken for you. I am going to fell you and make a product out of you; receive an offering and eat. Please guard me against injury. Do not let me suffer your wrath afterwards; and let me have a good price and patronage for the product”. After this prayers and incantations have been performed, the artist believes that he can fell the tree and make good use of its wood without any casualty. However, traditionally the sacrifice to the spirit of the wood does not end here. It is expected that the spirit who has been deprived of his home will return again into the wood in which it lived before the tree was cut down. The wooden product can also be inhabited by external spirits. It is therefore important that similar sacrifices be performed to the product itself. So the traditional wood

worker in Akan lives continuously in a religious atmosphere. Sarpong (1971) affirms that formerly, a woman observing her menstrual periods could not approach her husband who is producing a wooden product while he is at work. If she kept her state as a secret to her husband who is a traditional wood artist, it is believed that the man would sustain wounds from his tools.

Again, certain religious rites are also performed on the carver or traditional wood workers tools. Wine is poured on them and the blood of a fowl sprinkled upon the tools with incantations, this practice is a means of venerating the spirits inhabited in the tree.

In an earlier study, Underwood (1952), found that a priest must be consulted who may in turn consult the spirits of the trees, ask their forgiveness for what is explained as a necessary act of destruction. It is interesting to note that such a practice is currently observed by traditional wood carvers before an art work is done.

2.2 Some Instances

‘The Big tree’: this site is currently one of the popular tourist attractions in Ghana. It is located at Aprozumasi in the Birim South District of the Eastern Region. Legend had it that the ‘Big Tree’ was discovered by a hunter called Yaw Andor who hailed from Akyem Asanteman. It is said that, on one of his expeditions to the forest, he overheard some people speaking at the site. When he moved close to the place from where the sound was coming, he fainted up on what he saw. On gaining consciousness, he ran to Asanteman and reported to the chief about what he had heard and seen. Following this the chief sent armed men into the forest thinking that they were being attacked by their enemies. The men who were sent into the forest kept their food under the tree, when they returned the following day they realized that, it was the doing of some dwarfs in the area. The elders of the town therefore decided to fell the tree. The first person who attempted to cut the tree died instantly and that scared the rest of the people. An attempt was made again to use a chain-saw to fell the tree. But this also proved futile as the tree rejoined and repaired itself when they had almost cut through. The mark of the chain saw can still be seen on the trunk of the tree today. (Ghana Tourist Division).

Apart from the above instance, there have been several other cases where trees have been felled from forest reserves and strategic locations and by the next morning, the same trees have been found unharmed. Such trees are believed to be habitats of powerful spirits.

3. EFFECTS OF BELIEFS ON WOOD

According to Dauda (2009), “the country's total forest cover which stood at 8.2 million hectares at the turn of the 20th century has decreased to about 1.6 million and it is estimated that the nation's forest depletes by 65,000 hectares every year”. Dauda explained that the country's natural resources were declining both in quality and quantity due to its over-exploitation, poor timber processing methods coupled with illegal logging and chainsaw lumbering. However, part of the problem could be attributed to the neglect of some of the cultural beliefs and traditions which have been discussed above.

It could be said that up until now, the forest and other natural reserves were well preserved due to the people’s strong adherence to Ghanaian cultural traditions. Ghana could boast of

almost 240 forest reserves which have close links with sacred groves and socio-cultural beliefs.

Again, wooden products such as stools, drums, combs, plates and mortars are considered to be sacred. They are therefore kept well during and after its usage. For example, an empty stool is placed on its side or against the wall. The reason for this is to prevent any wandering spirit from sitting on it. Scientifically, this also helps to preserve the wooden product. Wooden sculptures such as the Akuaba doll are also believed be abodes for benevolent spirits therefore they are kept maintained, knowing that they can promote female fertility.

CONCLUSION

The forest can be well preserved if Ghanaians adhere to the relevant cultural practices and traditions that promote it. The use of wooden products such as combs, stools and combs must be encouraged since it portrays the aesthetics of nature and the metaphysical.

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Understanding Historical Wood Utilization- Ideas for the Future?

Michael Grabner² and Andrea Klein³

Abstract

Much of the knowledge of the utilization and the properties of wood as raw material began to get lost with the onset of the industrialization. As a result, old traditions of handicraft-men – important intangible cultural properties – are disappearing. This loss of knowledge was described for the first time at the beginning of the 20th century by a folklorist (Blau 1917) working in Bohemia. He mentioned that this knowledge starts to retreat to higher altitudes of forest lands, where the forests are the main focus of life.

Blau (1917) described, that within a single farming house 12 different wood species were found in Carinthia and even 27 in Bohemia. These findings underline the high diversity of wood utilization in former times.

By studying old books, the description of properties and applications of various wood species can be found. The reasons for the selection of a species are usually not given. To bridge this gap of knowledge, we started to study historical wood utilization at collections of wooden artefacts like buildings, tools, machines, household appliances, furniture and so on. The aim is to set up a database of wooden goods where a description of the artifact itself, its geographic region, age and the wood species are linked. Groups of related applications mainly defined by different requirements are formed. These requirements can be directly linked to wood properties.

First results show, that within the small region of the mountain Schneeberg, 32 different wood species including nine shrubs (mainly for highly specialized products as the rungs of a ladder) were in use. Understanding historical wood utilization will help to use our forests more efficiently – primarily in times of shortage of wood as raw material.

Keywords: Historical wood utilization, wood quality, wood identification

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1. INTRODUCTION

Woody plants are enormously important for and beneficial to mankind, and among them trees have the distinction of being the largest and oldest living organisms on earth. Trees are sources of essential products including lumber, fuel, pulp, food for humans and wildlife, medicines, waxes, oils, gums, resins and tannins (Hinckley and Lassoie 1981, Zobel and Buijtenen 1989, Kozlowski and Pallardy 1997).

Wood was and still is one of the most important multi-purpose and sustainable natural raw materials. It surrounds us from the cradle to the grave. The products vary from toys, tools, housing and fuel to works of art and religious objects (Begemann 1977, Ziethen 2000, Radkau 2007, Wegener 2007). However, the cultural history of wood utilization is not completely written yet, but it is evident that the cultural activity of human beings has always been linked to wood.

As wood was used throughout each epoch (e.g. Stone Age, Bronze Age, Iron Age), we should talk about the Wood Age, which spans the history of human cultural activity (Vorlauf 2007, Radkau 2007).

In the past, due to the rapid degradation of wood, it was not possible to verify the Wood Age (Begemann 1977). Because of improvements in dendrochronology and radiocarbon dating, wooden artifacts are an increasing source of important findings in archaeology. From the medieval period onwards to the present, buildings are an important source of wooden artifacts – buildings, roof constructions, beams and so on (Grabner and Wimmer 1998, Grabner et al. 2004). Just a few findings exist (up to now) from the early medieval period (Grabner 2002). In Central Europe, wooden artefacts from the roman period are mainly wooden well chambers (Grabner 2005), barrels (Hebert and Grabner 2007) or pathways (Pöll et al. 1998).

Forests are the main wood suppliers. Looking at the past, a trade-off between wood utilization and the size of forested area is easily visible. The ancient Mediterranean cultures destroyed almost their whole forest lands due to the high harvesting activities for setting up ships and buildings (Meiggs 1982) - with consequences up to now. A similar demolition of forests also happened in medieval times and later. Wood was necessary for various pre-industrial processes (mainly as charcoal): iron, glass and salt production. Only because of strict forest regulations it was possible to preserve the forests in Central Europe (Johann 1968 and 1998, Wegener 1999, Meiners 2007, Radkau 2007).

Nowadays, sustainable forestry and wood supply are still very important goals for policy makers and society (Limacher et al. 2005, Anonymous 2006). Though, Mantau (2007) stated that within the European Union almost the sustainable amount of wood per year is harvested at the moment, Teischinger (2007) discussed the shortage of wood resources and possible solutions by adapting technologies. Hetsch (2007) concluded to increase the use of wood assortments, which are not in use at the moment, to satisfy the increasing demand of raw material.

A lot can be learned about sustainable forestry and wood utilization from the past – for example the use of currently rarely used species or the use of crooked and bended assortments (Blau 1917).

The EU Forest Action Plan (Anonymous 2006) attempts to enhance the social and cultural dimensions of forests. Within our project, material and immaterial cultural heritage will be analyzed and preserved. Material goods are represented by all preserved wooden artifacts. The immaterial goods are the knowledge of how to use wood (especially which species for which purpose) and how to prepare or machine it (Anonymous 2003). Only fragments of these immaterial goods are available nowadays. Blau (1917) described for his time period (beginning of the 20th century), that knowledge about wood utilization is beginning to get lost. He mentioned that this knowledge starts to retreat to higher altitudes of forest lands, where the forests are the main focus of life.

At the moment, we still have the possibility to save most of these immaterial goods for the future. But it is getting harder and harder, due to extinction of handicraft and especially of experienced craft-men.

As traditions are local (Anonymous 2003), the utilization of wood species for a special purpose will be dependent on the geographic region. The growing area of woody species is limited by climate and site factors. Wood quality is highly variable (Zobel and Bujtenen 1989) and dependent on site factors, too.

2. HISTORICAL RESOURCES

2.1 Old Literature

In literature, figures of the most important wood properties (like wood density) and the common uses are described (for example Bechstein 1812, Wagenführ 2007). A prominent example is the usage of Yew to produce bows and crossbows – due to the excellent elastic performance.

Looking at the old wood-science-literature which is describing the utilization of wood (for example: Andrea 1790, Bechstein 1812, Nördlinger 1860, Möller 1883, Nördlinger 1890, Heß 1895, Thenius 1896, Graef 1905, Laris 1910, Hunziker 1916, Hufnagl 1920, Gayer 1939, Knuchel 1954, König 1956, Schafflützel 1974), no description of geographic regions are given. In ethnographic literature the description of wood utilization is directly linked to the geographic region (for example: Schönwiese 1911, Blau 1917). But information on wood species is rare. Generally, descriptions of wooden goods can hardly be found in ethnology literature.

The data base of the old literature (for example Bechstein 1812) is not known. So we do not know if these descriptions were done just for excellent handicraft-men, or if the same species and techniques were used by farmers to produce comparable goods. So, the results will be important for ethnology, too – to proof, how strong commercial handicraft was linked with handicraft techniques of the farmers.

2.2 Wooden collections

It is possible to study historical wood utilization at collections of wooden artefacts, like buildings, tools, machines, household appliances, furniture and so on. Therefore the collections of museums in Austria were started to be analysed:

1) The Austrian open air museum (“Österreichisches Freilichtmuseum Stübing”), Stübing; Styria. Many different buildings from all Austrian provinces were dismantled and brought to the Museum. So the collections of wooden artefacts, tools and machinery can be allocated to the particular buildings (Pöttler 1992).

2) The museum of Forest Farmers in Gutenstein, Lower Austria (“Waldbauernmuseum”). This museum presents an enormous collection of wooden artefacts of the region of the mountain Schneeberg (Lower Austria). The collection is dominated by artefacts of small forest farmers utilizing wood to produce charcoal, for the calcination of limestone, the utilization of resin and some other specialized handicrafts.

3. METHODS

3.1 Wood identification

Wood species was identified by anatomical features using reflected light microscopy as well as micro sectioning and transmitted light microscopy. Various publications dealing with wood identification are available; for example: Grosser 1977, Bosshard 1982, Sachsse 1984, Wagenführ and Scheiber 1985, Schweingruber 1990, Wagenführ 1999. Due to missing unique anatomical features, in some cases it is just possible to determine the genus – not the species (for example: *Tilia*, *Betula*, *Acer*).

3.2 Dendrochronology

It is well known that the age of a temperate forest tree can be determined by counting the growth rings formed in the lower part of the stem. However, it is less known that the pattern of wide and narrow rings can be compared among trees to establish the exact year in which a given ring was formed (Fritts 1976). The same type of comparison can be made among wood fragments of unknown age and the rings in living trees, in order to establish the date when a wooden piece was part of a living, growing tree (Fritts 1976, Schweingruber 1988). The procedure of matching ring patterns among trees and wood fragments in a given area is referred to as cross dating (Stokes and Smiley 1996). It is used to identify the year in which each ring was formed and to assign exact calendar dates to the rings.

Various reference chronologies are available at the Tree-Ring-Lab of the University of Natural Resources and Life Sciences, Vienna. These chronologies are reaching back to the 12th century and are established for the main tree species (spruce, fir, larch, pine and oak) separated into the main forest growth districts (Alps, alpine forelands and Eastern Austria; Geihofer et al. 2005).

In principle, all wooden goods were checked on the chance of dendrochronological dating (mainly for softwood and oak). Grabner et al. (2006) showed, that dendrochronological dating of small samples can be done – if the exhibit enough tree rings. Samples from wooden houses and big constructions were taken with a dry wood borer.

At furniture or big household tools, ring width was measured directly at the surface with the help of digital photos. A clean and not painted surface is necessary to do so. Usually, the ring width was measured at a cross section of the boards (for example at the top of cupboards) after sanding.

On special goods (like big wooden cups) or art objects no measurements can be done at sanded cross section (like described above). These examples will be measured by the help of x-ray computer tomography (CT) (Grabner et al. 2006b, 2009).

3.3 Description of wooden parts – the data base

The description of the wooden parts is mainly given by the museums. Sometimes folkloristic descriptions are also given in literature describing the collections of the museums. The functionality of wooden parts (tools, machines, parts of buildings) were analyzed together with handicraft-men of the museums. The main interest is describing the requirements on the wooden goods – split into mechanical stress and natural durability. Mechanical stress (static, dynamic, damping-characteristics) is very often the reason to choose a special species. The same is true for natural durability in combination with exterior utilization or in contact with water.

In the data base, the whole description of the objects as well as the requirements is held; completed by information of origin, inventory number, date due to archive information, due to ethnology and dendrochronological date (if possible), special growth characteristics and wood species.

Nemestothy and Beischlager (2009) analysed old literature dealing with the description of wood species as well as with the utilization of these species back to the 18th century. The problem appearing with this old literature is, that in some cases measured figures, but in most of the cases only descriptive texts are available (for example for wood density). Seven key-parameters were defined: density, strength, elasticity, cleavability, swelling, durability and fibrousness.

Niklasová (2009) tested various so called “rarely used wood species” according to the recent standard methods. There is now a possibility to compare figures from old literature and descriptive text from literature to modern testing results.

We are currently working on the set up of a database of wooden goods where a description of the artifact itself, geographic region, age and wood species are linked. Groups of related applications will be formed – for example tool handles or furniture. These groups are mainly defined by different – mainly mechanical – requirements (strength, stiffness and the absorbability of crushes are important for tool handles for example) and can be directly linked to wood properties. The cooperation between handicraft-men of the museums and wood scientists is very important to understand the functionality and the mechanical requirements of different wooden parts (tools, gearwheels, handles, construction timbers and so on).

Wood properties will be described by the detected applications. These results will be compared to the available literature of the same time. Geographical or chronological differences in the selection of wood species for defined applications can be analyzed with the help of the data base. The data base is the scientific background of various questions, like ethnological dating, monument conservation and so on.

4. FIRST RESULTS FROM THE “SCHNEEBERG-REGION”

At the collection of the Museum of Forest Farmers in Gutenstein, located in the “Schneeberg-region” in Lower Austria, 1357 artifacts were analysed (see Fig. 1). Within this small region, 32 different wood species were used. 83.8% were made of hardwood species; just 16.2% of softwood. Ten species belonging to the group of shrubs were detected with an amount of 9.5%.

These species were mainly used as tool handles and specialized parts like teeth of rakes, spindles or transportation tools.

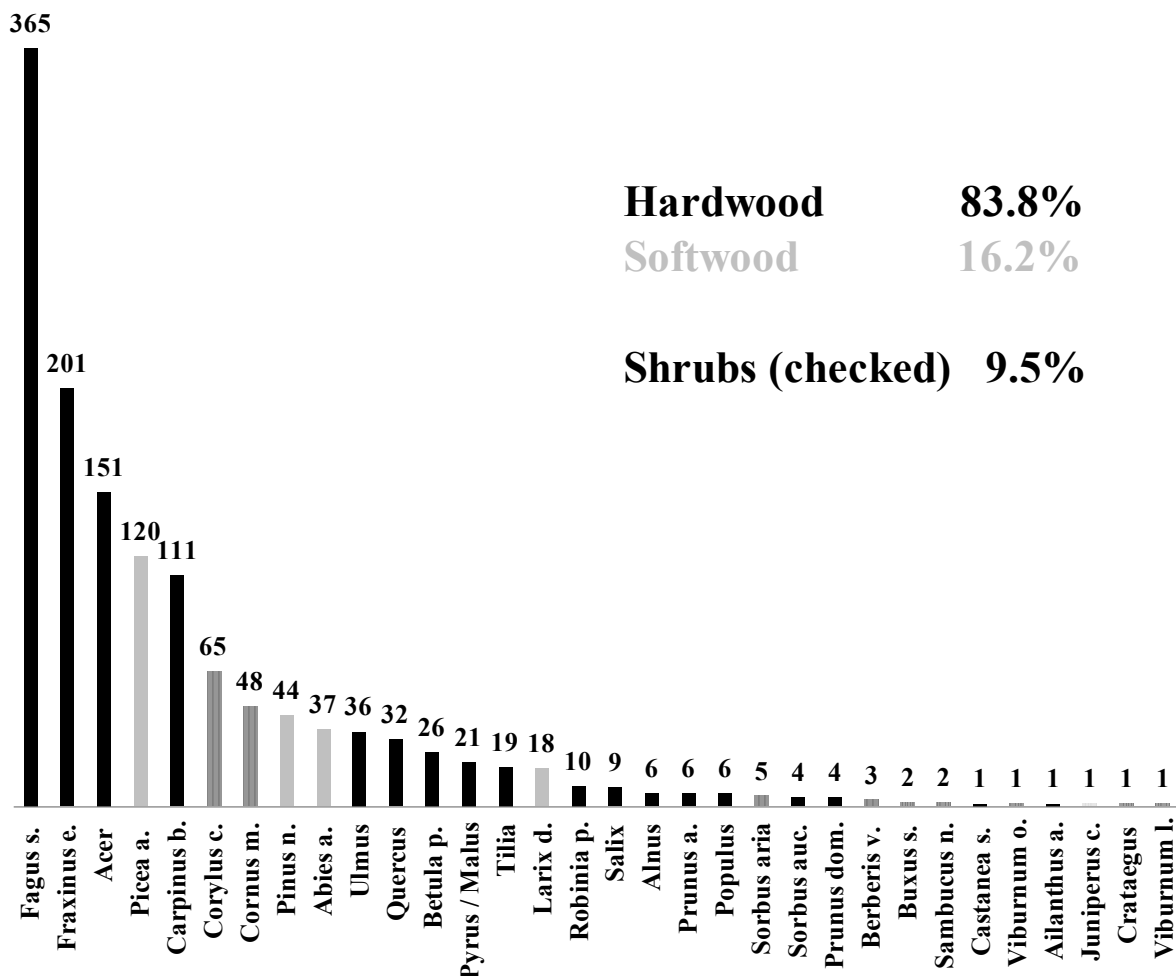


Fig. 1: Wood species found at the Museum of Forest Farmers (numbers)

It was clearly visible, that the different species were used according to the mechanical stress appearing in use. About one third was made out of beech wood. But, these were usually not specialized parts. Looking more in detail to different crafts, the specialized utilization of different species is evident. The amount of Hazelnut-wood was 33% at frameworks for transportation and 50% in basketry. The not bended barrels were made of softwood (Norway spruce and Silver fir); the bended ones were made of oak wood. 50% of the planers were made out of hornbeam.

Especially the wainwright crafts used the more elastic, but mechanically strong species: ash, elm and partially maple.

Sorting the wooden artefacts to a group of objects where “high density is required”, beech – with a high wood density – was hardly found. This group was dominated by shrubs like cornel cherry, hazelnut or barberry.

5. IDEAS FOR THE FUTURE?

The UNESCO Convention for the Safeguarding of the Intangible Cultural Heritage (Anonymous 2003) was ratified by the Austrian government in the year 2009. Article 1 defines: “The “intangible cultural heritage means the practices, representations, expressions, knowledge, skills – as well as the instruments, objects, artifacts and cultural spaces associated therewith – that communities, groups and, in some cases, individuals recognize as part of their cultural heritage.” Article 2 presents the domains – amongst others: “knowledge and practices concerning nature and universe (d)”; “traditional craftsmanship (e)”.

The wooden goods analyzed for the present study are stored within an un-endangered environment. However, problems due to degradation or suboptimal storage are obvious. Measures to protect and conserve these wooden goods have to be set up. Therefore the results achieved at the museums will be of high importance to safeguard wooden goods outside the museums (farming, wooden buildings, roof constructions and so on). Due to the dendrochronological dating of the goods within the museums, a better knowledge of the age of comparable wooden goods will be given. That is also an important basis of monument conservation and for the declaration of historic monuments.

The knowledge of special uses of seldom used wood species is rare. Mantau (2007) stated that within the European Union almost the sustainable amount of wood per year is harvested at the moment. Hetsch (2007) concluded to increase the use of wood assortments, which are not in use at the moment, to satisfy the increasing demand for raw material.

The reprise of knowledge of wood species selection is important for the future of wood utilization. The utilization of nowadays not used species for specialized wooden products can be of technological and economic interest. To develop new products using rarely used wood species, the knowledge of their properties is necessary. This knowledge can be obtained by the analyses of historical applications. The improved knowledge of historical wood utilization will help to create new niche-products; for example the use of Laburnum in gardening.

To give another example: It was started to banish plastic bags made of mineral-oil based composites. So the bag of the future might be the basket – made of wood, as used for centuries.

6. ACKNOWLEDGEMENTS

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UNDERSTANDING HISTORICAL WOOD UTILIZATION – IDEAS FOR THE FUTURE?

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Introduction



***“Old principles of economics and operation,
old inherited skills, knowledge and experiences
together with necessary knowledge
of language and culture
retreat to higher mountains in forest areas”***

Josef Blau (1917)





Introduction

What is meant by “historical wood utilization”?





Everything!



Introduction

What is meant by “historical wood utilization”?



- wood species selection
- wood quality
- dendrochronological dating
- conservation
- rarely used wood species
- crooked assortments
- forestry rules
- the culture of wood and forest utilization
- arts
- crafts
- material and intangible cultural heritage
- the history of wood utilization
- social effects of wood utilization
- economy of wood utilization





Resources to study historical wood utilization



What resources do we have?

Archaeological excavations



Resources to study historical wood utilization



What resources do we have?

Collections in museums:





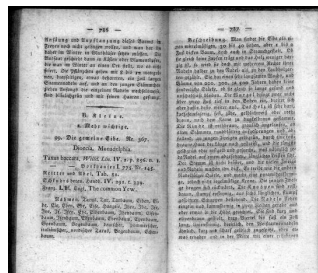
Resources to study historical wood utilization



What resources do we have?

Old literature:

Andrea 1790,
Bechstein 1812,
Nördlinger 1860,
Möller 1883,
Nördlinger 1890,
Heß 1895,
Thenius 1896,
Graef 1905,
Laris 1910,
Hunziker 1916,
Hufnagl 1920,
Gayer 1939,
Knuchel 1954,
König 1956,
Schafflützel 1974



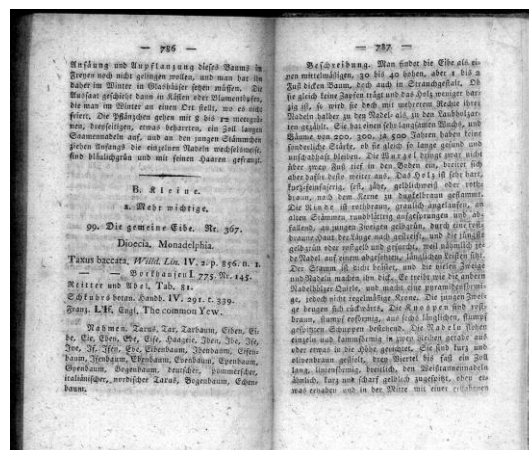
Resources to study historical wood utilization



What resources do we have?

Archives:

like forestry rules,
invoices of amounts of wood
used for buildings or fire-wood
Custom rules (Mautbüchl)





Resources to study historical wood utilization

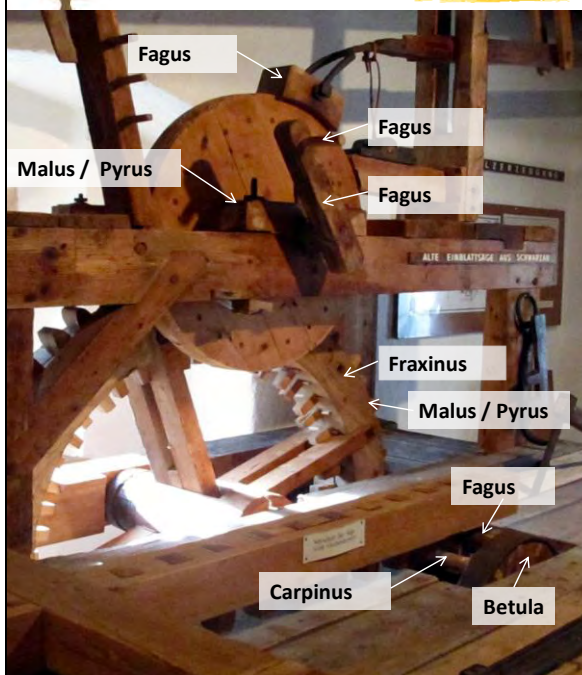


What resources do we have?

Oral history and crafts-men knowledge:



What we have started ...



Wood identification

Which species was used
for which purposes?

Description of load and stress

Which kind of stress is
influencing the wooden part?

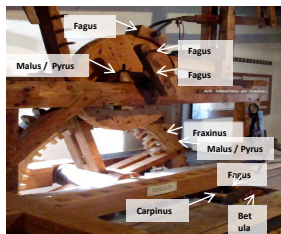
Mechanical stress
Durability
Friction
Damping
...

Dendrochronological Dating

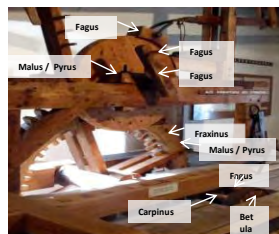
Date of harvesting the trees.



Putting the information together in a database:



Wood species



Load / Stress



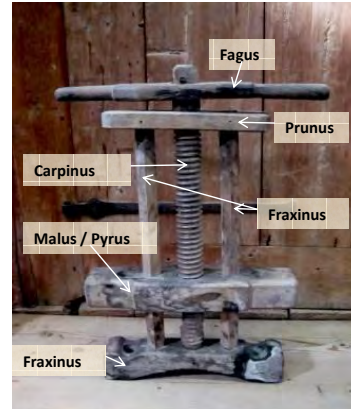
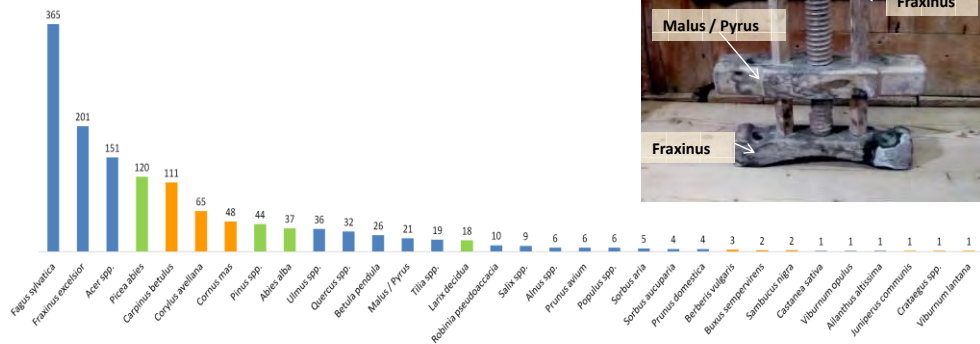
Date

object	part	stress	species	date
wheel	spoke	mechanical, dynamic	ash	1883

→ Describing a species and it's properties by the utilization

Museum of forest farmers (Gutenstein):

32 different wood species
83.8% hardwood
16.2% softwood
9.5% shrubs



Safeguarding material and intangible cultural heritage:

Material heritage:

Intangible cultural heritage:

"The "intangible cultural heritage" means the practices, representations, expressions, knowledge, skills – as well as the instruments, objects, artefacts and cultural spaces associated therewith – that communities, groups and, in some cases, individuals recognize as part of their cultural heritage."

Article 2 presents the domains – amongst others:

"knowledge and practises concerning nature and universe (d)";

"traditional craftsmanship (e)"

in Austria: charcoal production (Köhlerei)
utilization of resin (pitch pine) (Pecherei)

Reprise of knowledge:

baskets in stead of plastic-bags



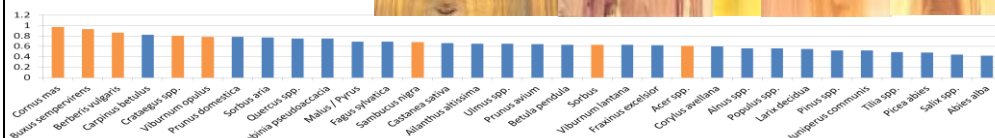
New (old) assortments:

crooked trees for structural timber



Sustainability (?):

utilization of rarely used wood species



Workshop in Stuebing, Austria: 23rd to 25th of September 2011



45 participants; 12 European countries; 8 different scientific fields

The Wood legacy of Kallai: Lessons for the Future

Kunhamu, T.K.⁴, Gopakumar, S. Anoop, E.V. and Gosh, A

Abstract

*The Malabar region of Kerala state, India, has enjoyed a prominent place in international wood trade from time immemorial. The fertile river deltas and floristic richness of the Western Ghats make this region a land of innumerable tree species of economic and ecological significance. Among the timber trade centers in Malabar region, Kallai, in Calicut, stood out as one of the pioneer and premier centers of wood trade that dates back beyond the era of the Zamorins. Kallai, once the 'hub of timber market' in south Asia, dictated international timber prices for several decades. The period 1950-70 was the golden period of Kallai. Bountiful supply of good quality structural timbers such as teak, rose wood, and karimaruthu (*Terminalia tomentosa*) from private and government forests and cheaper transport through the Chaliyar river and heavy wood demand in the national and international market led to the proliferation of saw mills during this time. It is reported that almost 150 large and small saw mills operated along the banks of Kallai river during this period.*

*Many factors contributed to the legacy of Kallai as an acclaimed wood trade centre. The demand for specific wood products such as long teakwood planks of specific sizes for the manufacture and repair of large country boats (used by the Royal British navy) was a major international influence. The teak wood from the nearby Nilambur had high demand in the international market owing to its golden brown colour, strength and durability. In addition, the wood for making railway sleepers in southern India was delivered through Kallai. Kallai was supplying wood raw materials for the packing case industry that flourished in Tamil Nadu and Andhrapradesh during the eighties. The glory of Kallai faded in the late 70's primarily on account of the acute dearth for wood raw materials. Enactment of Land Ceiling Act, vesting and assignment of private forests and increased governmental control on the felling of trees were some of the factors that lead to the shortage of quality timber trees. The scarcity of high quality timber species led to a shift towards the use of second quality timber species such as *Terminalia bellerica* (Thanni)- for small timber use in Tamil Nadu, mango- for plywood and packing case, ben teak (*Lagerstroemia lanceolata*) for lorry body building, *Artocarpus hirsutus* (Anjili) for country boat construction etc.*

*The wood trade history of Calicut is best known for its royal and elegant country boats known as 'Uru' constructed at Beypore, a small coastal town near Calicut. "Uru" built by the traditional shipbuilders known as Khalasis has a centuries old tradition. The uru made from Beypore had high demand in the Middle East and Europe for its exceptional design and stability. However, the Uru trade has faced serious setbacks since the mid eighties. The acute scarcity of quality timbers such as teak, karimaruthu, rose wood (*Dalbergia latifolia*), and pali (*Palaquium elipticum*) was the major factor for this. Yet another reason was the non-availability of wooden spares for the repair and maintenance of urus at the traded countries, primarily due to the stringent government policy on the export and import of wood. Despite this, there is now resurgence in uru manufacture primarily on account of its utility in*

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the tourism sector. This article critically analyses the reasons for the rise and fall of Kallai as a premier wood trade centre and tries to draw lessons on diversification of wood products as well as enhancing the wood availability from areas outside conventional forests areas etc.

Key words: wood trade- structural timbers- *uru* (country boat)- Beypore- Kerala

1. INTRODUCTION

The tropical climate of Kerala in southern India, characterized by high humidity, and rainfall, permits the growth of a wide array of tree species that are of high economic and ecological significance. The fertile river deltas and other areas of the state falling within the western ghats region with congenial edaphic conditions is home to several economically valuable tree species such as the teak (*Tectona grandis*), rose wood (*Dalbergia latifolia*) and sandal (*Santalum album*) etc. The evergreen and moist deciduous forests of Kerala which are rich in tree species that are suitable as structural timbers as well as softwood species suitable for plywood, pulp and other smallwood purposes (Bhat et al, 2010). The wood resources from Kerala were a major attraction for the British colonial forces who ruled the country for centuries, primarily on account of their superior qualities and vast export potential (Tucker, 1988). Historically, Malabar region was a leading trading centre of spices on the west coast of India during the medieval period (Logan, 1887). The Malabar region of Kerala enjoyed a prominent place in international wood trade from time immemorial. Kozhikode (formerly Calicut), the most important city of Malabar enjoyed a prominent place in the international trade in the subcontinent. The most historical event that later changed the socio-political equations of the country was the discovery of sea route to India by the Portuguese navigator Vasco Da Gama who landed at Kappad, a place near to Kozhikode in 1498 (Madan, 1998).

Among the timber trade centers in Malabar, Kallai, a suburban place near Kozhikode, bagged attention as one of the pioneer and premier centers of wood trade that dates back beyond the era of the Zamorins. Kallayi (or Kallai) is a small village on the banks of Kallayi river which links with the Chaliyar river on the south by a man-made canal. The Kallayi wood trade belt spreads over around 35 km on both sides of the Kallayi river. It remained under the Madras Presidency of British India government till 1947 and under Madras state till the formation of the state of Kerala in 1956. The key factors that enabled Kallai the glory as a premier wood trade centre is the plentiful availability of wood raw materials and accessibility to the sea port. The period 1950-70 was the golden period of Kallai. Bountiful supply of good quality structural timbers such as teak, rose wood, and karimaruthu (*Terminalia tomentosa*) from private and government forests and cheaper transport through the Chaliyar river and heavy wood demand in the national and international market led to the proliferation of saw mills during this time. It is reported that more than 150 large and small saw mills operated along the banks of Kallai river during this period (personal communication, wood traders, Kallai, August 13, 2011).

2. HISTORICAL BACKGROUND

Malabar, particularly Kozhikode, was known to world as a trade centre from time immemorial. The landing of Vasco Da Gama at Kappad, paved the way for many foreign aggressors that include English, Dutch, Arabs etc. Prior to the European colonization there

had been healthy trade with Arabs for a long period. The then ruling dynasty of Malabar, the Zamorins, maintained very strong relation with Arab traders, the chief commodities of transaction being spices and wood (Logan, 1887). Kozhikkode became a mighty seaport, where the Arabs and the Chinese met to exchange the products of the west with the east and vice versa. Religious tolerance, good administration, and the friendly attitude of Zamorin to all traders, made Calicut the chief centre of trade in Malabar region. Zamorin gave special concession to Arabs (the Moors) to carry out trade (Ayyar, 1938).

Kallai once the 'hub of timber market' in south Asia dictated the international timber prices for several decades. The first organized wood processing (sawmilling) unit in Kerala was set up at Kallai in 1893 by A. Brown (Muraleedharan and Bhat, 1989). The golden era of Kallai as one of the premier timber market in the world dates back to prehistoric periods which continued till the Second World War. Domestic as well as international trade in wood flourished during the British period. Reports suggest that the teak wood from Kallai was used for the construction of Buckingham palace.

The forests in the southern Kerala were under the princely possession long back. The entire forest lands were under the Thiru-Kochi devaswam. This posed restrictions on the felling and extraction of timber from these forests. However, this was not true with Malabar where private forests flourished till the early 70's. During their reign, the British brought Malabar under the Madras presidency. Large stretches of forest lands in Malabar were under the ownership of land lords and local rulers. Prominent among such private forest owners in Malabar were Maruveetil Nair, Koipathodi, Kuppathodi nayar, P.I Kunhammed kutty, Kunhimayin haji, Kakkodans, M.C. Pothan, Nilambur- Kovilakam, etc. There was no control on the felling and extraction of trees. Trees belonging to quality timber species like teak and rosewood were available in plenty from these private forests. The river Chaliyar enjoys a prominent role in upholding the glory of Kallai as the Mecca of wood trade. Most of the pristine moist deciduous forests were along the banks of Chaliyar river and the round wood were transported as rafts even during summer.

International wood trade was mainly focused on quality saw logs for ship building and for furniture making. The demand for specific wood products such as long teakwood planks of size 30'x2"x2" for the manufacture and repair of large country boats (used in royal navy) was a major international wood trade sector. Lengthy teak wood planks of size 35 to 40" were easily transported from the Nilambur forests in huge rafts through the Chaliyar river. Also, the major source of wood for railway sleeper making in southern India was delivered through Kallai. Yet another wood trade area was the packing case industry which also flourished in Kallai for many decades. The major tree species used for this purpose include Matti (*Ailanthus triphysa*), Bombax (*Bombax ceiba*), Macaranga (*Macaranga peltata*) etc. The demand for packing case was chiefly from Tamil Nadu (Imperial Tobacco company) and Hyderabad.

Kallai was reported to have almost 150 saw mills during the early 60's. M/s Pary & Co, M/s B.S.T Saw mills, M/s P.I. Kunhamed Kutty haji mills, M/s Imbichi Koyaji saw mills, M/s Bichu saw mills, M/s V.K, Sankaran Nair & O. Gopalan saw mills, M/s Standard furniture Co etc. were prominent among them (Personal communication, wood traders, Kallai, August 13, 2011).

2.1 Nilambur teak forests

Nilambur in the eastern part of Malabar is yet another internationally acclaimed centre often christened as the 'Mecca of teak' that helped Kallai in carving its own wood legacy. The teak wood from Nilambur had high demand in the international market owing to its golden brown colour, strength and durability. Plenty of timber trees in the Nilambur forests were subjected to massive felling for quality saw logs during the British regime. Despite this, teak and other timber trees were available in plenty from this region even during the early 1800s. However, the dearth of quality saw logs was felt during the mid 1800s and the authorities started thinking of alternate strategies to make quality teak timber available for continuous supply. These efforts lead to the establishment of the first ever planted teak forests in the history in Nilambur which dates back to mid 1800s. The continuous strenuous efforts of the then Collector of Malabar, Mr. H.V. Connolly along with his staff finally turned successful in planting teak in Nilambur along the banks of Chaliyar river during 1841-46. The contribution by Mr. Chathumenon, Sub Conservator of forests in establishing this first ever teak plantation in Nilambur was immense. To commemorate these two leaders who paved the basis for modern plantation forestry in Kerala, part of their plantations were declared Permanent Preservation plots (PPPs) by the state govt and are named as Connolly's plot and Chathumenon's plot respectively. Since their efforts, teak planting continued, however systematic plantation development initiated only after 1920s.

The plantation forestry programme initiated at Nilambur was later adopted throughout the Malabar and Travancore forests that helped to partly ensure the continuous supply of timber. The bulk of the auctioned trees from the Govt. depot reached Kallai through cheaper mode of river transport in massive rafts called Therappan and Kallai turned out to be the bustling nerve point of Calicut's timber trade.

3. TIMBER INDUSTRY

Kallai shares century old traditions in the transactions involving timbers trees especially teak and rosewood. There was high demand in the national and international market for finished wood products from Kallai. The single most important tree species that was converted to saw logs was teak. The quality of the timber from Kallai is attributable to the high level of salinity in the Kallai river area where wood got *seasoned* in the saline slush for extended periods of time. International wood trade was mainly focused on quality saw logs for ship building and for furniture making. The demand for specific wood products such as long teakwood planks of size 30'x 2"x 2" for the manufacture and repair of large country boats (used in royal navy) was a major international wood trade sector. Lengthy teak wood planks of size 35 to 40" were easily transported from the Nilambur forests in huge rafts through the Chaliyar river. Similarly high quality teak planks of size 30'x 1.5'x 1" were exported to Middle East countries mainly for repair of *Urus* (wooden country boats). This finished wood trade flourished during the early part of the century and continued till the 1970s. It is reported that separate contingent of expert workers were involved exclusively in this activity on a round the clock basis at Kallai. Also there was high demand for 'V' shaped wooden frames to reinforce the basement of boats and *urus*. Wood was also exported to many European countries including Germany, England, Italy and Japan. Also, the major source of wood for railway sleeper making in southern India was delivered through Kallai. In the early 90s it was reported that 25-30 truckloads of sawn timber were transported daily to Mumbai and Pune, which were the major domestic destinations of wood from Kallai.

4. DOWN FALL OF KALLAI

The timber trade in the Kallai belt of Kerala, once the largest trading area in Asia and the second largest in the world, is now facing extinction with timber dealers attributing the crisis to a variety of factors. The Kallayi wood trade belt is now a poor shadow of what it once was. From the flourishing period of 1950s and 60s, when there were more than 150 saw mills engaged in wood trade, the decline started in the 1970s, when only 50 sawmills were active at Kallai, several were about to close and others were about to become storage hangars for processed wood.

A dearth of quality timber was felt in Malabar during the early 50s that triggered the down fall of glory of Kallai. With the introduction of the Kerala Private Forests (Vesting and Assignment) Act, 1971, a large portion of these private forests were nationalized and declared as reserved forests. This led to significant control over the felling and movement of trees. This was the major factor that affected the wood industry in the Malabar region. The Supreme Court ban on clear felling also curtailed the wood flow to Kallai. Adding to this, the stagnation in the construction industry in Mumbai and Pune and a shift to concrete houses caused a steep fall in transport of timber to these centers. Later trade unions strengthened in the timber sector which is believed to have lead to the decentralization of the saw mills to the interior country side.

Timber exports through Beypore port have witnessed a steep fall over the years. For instance, exports, which stood at 7,878 tonnes in 1991-92, fell to 3,784 tonnes in 1992-93 and further to 3,553 in 1993-94. Though it recorded a three-fold increase to 11,774 tonnes in 1994-95, exports dropped to 11,237 tonnes the following year. The worst performance was in 1996-97 when it touched a low of 603 tonnes.

Along with the stagnation in the construction industry came the Supreme Court of India ruling on December 12, 1996, which said that the running of saw mills of any kind, including veneer or plywood mills, was *prima facie* violation of the provisions of the Forest Conservation Act, 1980, and "every state government must promptly ensure total cessation of all such activities forthwith." The court also ordered that there should be a blanket ban on the movement of cut trees and timber from any of the seven north-eastern states to any other state of the country either by rail, road or waterways. This has resulted in a virtual stoppage of timber coming from Nagaland, Arunachal Pradesh and Assam to the state. Moreover, considerable shift in preference among local consumers to the construction of concrete houses has also contributed to the decline of wood industry in Kallai. The major reason cited is the enormous hike in the wood price. After timber arrivals from the other states stopped, traders had to depend more on state government depots where the price of timber escalated manifold.

In the wake of the recession in local wood supply, the industry is also sourcing timber from countries like Malaysia, Nigeria and Myanmar. The open market policy of Late Prime Minister of India, Mr. Rajeev Gandhi paved the way for the import of large number of tree species to Kerala market. They include Burmese irul or Pyinkado (*Xylia dolabriformis*), red sanders (*Pterocarpus santalinus*), Andaman pedauk (*Pterocarpus dalbergiodes*), African pedauk (*Pterocarpus soyauxii*). Despite their cheaper price, the demand for these timbers are less, primarily due to lack of oil content and colour. However, it creates a greater turnover for the traders. The sawn turnover proportion of foreign timber is 85% as compared to 60% in the case of indigenous timber. However, traders experience considerable difficulty in the

procurement of foreign timber as it is imported by big traders at ports like Tuticorin and Mangalore and has to pass through many hands.

Traders feel that the industry, which employs nearly 10,000 people in 50 big mills and 120 small mills in the Kallai belt alone, can be saved if the government slashes sales tax on timber and firewood. The state government has fixed the tax at Rs 12.5 per cent in the last budget.

5. URU TRADE AT BAYPORE

The wood trade history of Malabar is best known for its royal and elegant country boats known as 'Uru' constructed at Beypore, a small coastal town near Kallai, Calicut. "Uru" built by the traditional shipbuilders known as *Khalasis* has centuries old tradition. The *uru* made from Beypore had high demand in the Middle East and Europe for its exceptional design and stability. These have been used by the Arabs and Greeks since ancient times as trading vessels, and even now, *urus* are being manufactured and exported to Arab nations from Beypore. It is built of several types of wood, the main one being teak. The teak was taken from Nilambur forests in earlier times, but now imported Malaysian teak is used.

The name *uru* is associated with the traditional ship building culture of Kerala. And the art and science of making these ships came from the Arab world, some several centuries ago. The Arabs called them *dhow*s and they eventually became the traditional Arabian trading vessels (<http://historicalalleys.blogspot.com/2009/02/dhow-s-of-beypore.html>). Centuries ago, Arab traders traced their way to the spice-scented shores of Kerala. And after coming to know about the availability of good timber in the forests of Kerala and also the presence of skilled crafts persons in ship building, the Arab merchants began to place orders for constructing dhows to the crafts persons of Malabar in north Kerala. Beypore has a 1500 years old tradition of shipbuilding. It once experienced great demand from Western Asia for ships, because of its fame as the home to excellent crafts persons. The *Baraami*'s were the ship builders in Beypore. These *Baramis* can be traced to the Al Mukalla tribe in Egypt and struggle to continue the ship building in Beypore. The carpenter breed called *Khalasis* crafted these wonderful ships. The Beypore area is today home to the *Mappila khalasis*, famous for their expertise in lifting heavy weights.

The *urus* made in Beypore ships were usually around 300 tonnes. The 'keel' is the first part of a Uru to be made. Traditionally it is made with teak wood. Iron and copper nails are used to hold the wood together and the gaps were filled using fine quality cotton. 'Chukkan' is the another important part of Uru construction. Usually 'Chukkan' starts from the keel and height would be the actual height of the Uru. 'Chukkan' provides the total control of the vessel. Then the inside part of the dhow 'deck' and, finally 'aruthi' is made. The manufacturing process is completed with the tying up of the sail 'mat' (paya) to the mast (chamaram). The interesting aspect of Uru making is that no plan, sketch or technical documents are followed during any time of its construction. The construction details are assigned on a day to day basis to the assistants and carpenters by the master carpenter. No electrical tools or heavy machines are used. The basic tools are the indigenous carpentry tools. All heavy lifting is done using elaborate pulley systems. Various types of ships were built in Beypore. Some of them include *Boom*, *Padavu*, *Bireek*, *Kottiya*, *Sambook*, *Bahala* and *Pathemar*. An exciting fact about the shipbuilding industry in Beypore is the way in which the craft are built and the variety which can be found. The flat bottomed *zambuk*, the majestic *bireek* (both Indian and Arabian designs), the boom which boasts of an enormous cargo carrying capacity, and the

bahala with its beautiful and intricate carvings and arches, are all made using traditional tools and techniques ([http://en.wikipedia.org/wiki/Uru_\(boat\)](http://en.wikipedia.org/wiki/Uru_(boat)) accessed on 13/9/2011).

Special methods used from historic times were the use of wooden dowels instead of nails, use of coir rope and tar to seal joints etc. Duarte Barbosa first recorded (around 1500 AD) the manufacture of keeled ships boats carrying 1200 bahares burden (approximately 400 tonnes) in Beypore (Dames, 1989). He also noted that they had no decks. They were classic sewn boats of teak wood (both of which were at that time only available in Malabar – in this context). The caulking was done with shavings off the palm trees and the ships were coated with shark oil or castor oil for waterproofing.

5.1 Launching of Uru

The launching of an *uru* is a festive ceremony, attended by a large number of people. First, a prayer is said by the Qazi. When a dhow was ready for launch wooden planks were kept up to appropriate height. The logs of the Puvathi (*Schleichera oleosa*) tree serve as rollers and are placed on either side. Over these, roller beams (Balus) strong enough to support the ship are kept. The gap between the beams and ship are filled tight with ropes. Then the ship is allowed to slowly move over the rollers with the help of rope and pulleys. In water they are submerged exactly up to the water mark earlier drawn by the Baramy. After the successful launch, a feast is laid out for all who have contributed to the ship building effort.

However, the Uru trade faced serious setbacks since the mid eighties. The primary reason is the transition to steel and fiber boats. Beypore town today is dotted with dozens of shops that sell model ships and one can notice iron anchors lying on either side of the road, which are tell tale signs of this flourishing industry. The acute scarcity of quality timbers such as teak, karimaruthu, rose wood (*Dalbergia latifolia*), and pali (*Palaquium ellipticum*) was the major factor for this. Yet another reason was the non-availability of wooden spares for the repair and maintenance of *urus* at the traded countries, primarily due to the stringent government policy on the export and import of wood. Despite this, there is now resurgence in *uru* manufacture primarily on account of its utility in the tourism sector.

6. WINDS OF CHANGE

As earlier discussed, the cardinal factor for the down fall of Kallai as a wood trade centre was the non-availability of quality timber of teak and rosewood. With the ban on the green felling and the land ceiling act and associated nationalization of private lands, supply of teak and rosewood declined substantially in the Kallai market. However, the industry adjusted with the changing trends by switching over to other second order timber trees such as such as *Terminalia bellerica* (Thanni) and Venga (*Pterocarpus marsupium*) which opened up renewed demand in the small timber sector especially from Tamil Nadu and Andhra Pradesh. Yet another change was the demand for mango for plywood and packing case, ben teak (*Lagerstroemia lanceolata*) for lorry body building, *Artocarpus hirsutus* (Anjili) for country boat construction etc.

When the ban on the green felling exist and the wood share from the govt forests narrows down there is need to improve the wood supply from the private lands and agro-forests. Reports suggest that 60-70% of the structural timber in Kerala is sourced from private homesteads (Krishnankutty, 1990). This stresses their enormous potential in meeting our wood demand. Tree farming initiatives in the non forested areas and agro-forestry practices involving integration of trees in agriculture fields can improve the wood raw material availability (Guillerme, et al. 2011).

8. CONCLUSION

This article analyses the reasons for the rise and fall of Kallai as a premier wood trade centre in Kerala and tries to draw lessons on the need for diversification of wood products. It recognizes raw material scarcity as the key factor for the downfall of wood industry in Kerala. Enhancing the wood availability from areas outside conventional forests is the lead action warranted in this context. Policy interventions that facilitate tree farming in the homesteads and agro-forests can bring forth substantial headway in improving wood supply and bring back the lost glory in wood trade.

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THE WOOD LEGACY OF KALLAI: LESSONS FOR THE FUTURE

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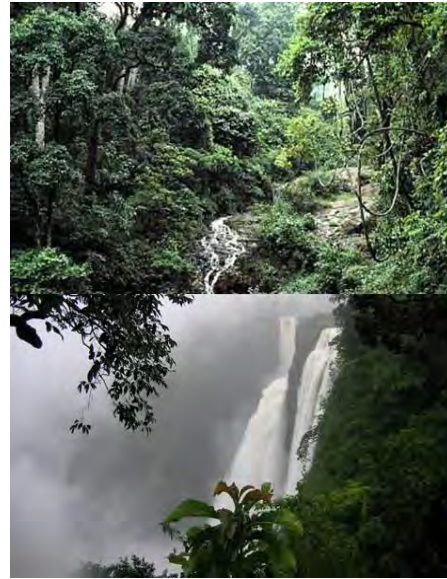
Kerala– The God’s own country

- Lush greenery
- Unique biodiversity
- Warm humid climate
- Land of diverse crops
- Fertile soil



- Evergreen and moist deciduous forests
- Home to several valuable tree species
- Structural timbers, softwood species for plywood, pulp and other smallwood purposes

- Teak (*Tectona grandis*)
- Rose wood (*Dalbergia latifolia*)
- Xylia xylocarpa
- Terminelia tomentosa
- Sandal (*Santalum album*)



Malabar

- North and central Kerala regions
- Prominent in the ancient trade map of Kerala.
- Leading trade centre of spices for centuries
- Kozhikode (Calicut)– trade capital of Malabar prominent place in the international trade in the subcontinent



Glory of Kallai

- ▶ Kallai, a suburban village near Calicut city along the bank of Kallai river
- ▶ Internationally acclaimed premier centers of wood trade
- ▶ Kallai once the 'hub of timber market' in south Asia
- ▶ Dictated the international timber prices for several decades
- ▶ Dates back beyond the era of the *Zamorins*.
- ▶ Kallai wood trade belt–35km either side of river



- ▶ Export centre of timber– finished and raw wood products to middle east, Europe for several centuries
- ▶ 1950–70 was the golden period of Kallai
- ▶ Bountiful supply of good quality structural timbers such as teak, rose wood, and karimaruthu (*Terminalia tomentosa*) from private and government forests– accessibility to the sea port
- ▶ The river Chaliyar – prominent role in upholding the glory of Kallai
- ▶ Cheaper river transport– heavy wood demand in the national and international market
- ▶ Proliferation of saw mills more than 150 large and small saw mills



History

- ▶ Carved unique wood niche– wood trade for centuries
- ▶ Vasco Da Gama at Kappad–1498– gate way
- ▶ Trade with Arabs and Europeans (Dutch and French)
- ▶ Zamorins and Arab traders
- ▶ Kozhikkode– mighty seaport– Arabs and the Chinese – exchanged the products of the west with the east and *vice versa*
- ▶ English east India company–1600
- ▶ Construction of Buckingham palace
- ▶ Battle of Waterloo–British fleet– wood from Kallai

- ▶ Restrictions on the felling and extraction of timber from Thiru–Kochi forests–**princely forests**
- ▶ **Malabar–private forests flourished** till early 70'
- ▶ The first organized wood processing (sawmilling) unit in Kerala was set up at Kallai in 1893 by A. Brown
- ▶ Private forest owners in Malabar were Maruveetil Nair, Koipathodi, Kuppathodi nayar, P.I Kunhammed kutty, Kunhimayin haji, Kakkodans, M.C. Pothan, Nilambur–Kovilakam, etc

Demand for specific products

- ▶ Long teakwood planks of size 30'x2"x2"- manufacture and repair of large country boats (used in royal navy)
- ▶ Lengthy teak wood planks of size 35 to 40'- from the Nilambur forests in huge rafts through the Chaliyar river
- ▶ High quality teak planks of size 30'x 1.5'x 1" were exported to Middle East countries for repair of *Urus* (wooden country boats).
- ▶ High demand for 'V' shaped wooden frames to reinforce the basement of boats and *urus*



- ▶ Major source of wood for railway sleeper- in southern India
- ▶ Packing case industry which also flourished in Kallai for many decades
- ▶ High demand for lesser known trees-Matti (*Ailanthus triphysa*), Bombax (*Bombax ceiba*), Macaranga (*Macaranga peltata*)
- ▶ Wood was also exported to many European countries like Germany, England, Italy and to Japan.

Prominent saw mills

- ▶ M/s Pary & Co
- ▶ M/s B.S.T Saw mills
- ▶ M/s P.I. Kunhamed Kutty haji mills
- ▶ M/s Imbichi Koyaji saw mills
- ▶ M/s Bichu saw mills
- ▶ M/s V.K, Sankaran Nair & Co
- ▶ M/s Gopalan saw mills
- ▶ M/s Standard furniture Co

Nilambur teak forests

- ▶ **'Mecca of teak'** – helped Kallai in carving its own wood legacy.
- ▶ **High demand**– golden brown colour, strength and durability.
- ▶ Dearth for quality saw logs–felt during the mid 1800s
- ▶ **Conolly**–Collector of Malabar–Pioneering efforts– successful in planting teak in Nilambur along the banks of Chaliyar river during 1841–46.
- ▶ Mr. Chathumenon, Sub Conservator of forests



DOWN FALL OF KALLAI

- ▶ Largest trading area in Asia and the second largest in the world
- ▶ 1950s and 60s– more than 150 saw mills– down 50 in the early 80's
- ▶ **Major reason: Dearth for quality timber**
- ▶ Kerala Private Forests (Vesting and Assignment) Act, 1971– **private forests–nationalized** as reserved forests
- ▶ Supreme Court **ban on clear felling**: curtailed the wood flow to Kallai
- ▶ Stagnation in the **construction industry in Mumbai** and Pune and a shift to concrete houses caused a steep fall in demand.
- ▶ **Trade unions** strengthened – decentralization of the saw mills to the interior country side.

Out flow of wood from Kallai

Sl No	Year	Annual exports* (Tones)
1.	1991-92	7878
2.	1992-93	3784
3.	1993-94	3553
4.	1995-96	11774
5.	1996-97	11237
6.	1997-98	603

* Finished wood

- ▶ Supreme court ruling– blanket ban on the movement of cut trees and timber from seven north–eastern states to other state of the country
- ▶ Virtual stoppage of timber coming from Nagaland, Arunachal Pradesh and Assam to the state
- ▶ Shift in preference concrete houses– contributed to the decline of wood industry in Kallai.

- ▶ The open market policy of Late Prime Minister of India, Mr. Rajeev Gandhi– import of large number of tree species to Kerala market.
- ▶ Burmese irul or Pyinkado (*Xylia dolabriformis*),
- ▶ Red sanders (*Pterocarpus santalinus*)
- ▶ Andaman pedauk (*Pterocarpus dalbergiodes*)
- ▶ African pedauk (*Pterocarpus soyauxii*).

- ▶ Imported wood: Cheaper price– less demand– due to lack of oil content and colour– but more outturn
- ▶ The industry, which employs nearly 10,000 people in 50 big mills and 120 small mills in the Kallai belt alone
- ▶ Government to **slash sales tax** on timber and firewood
- ▶ Govt to revamp the **wood export policy**.

URU trade at Baypore

- ▶ The wood trade history of Malabar– best known for its royal and elegant country boats– known as '**Uru**' constructed at **Beypore**, a small coastal town near Kallai, Calicut.
- ▶ High demand in the Middle East and Europe for its exceptional design and stability
- ▶ Arabs and Greeks used Uru since ancient times– as trading vessels
- ▶ Even now, *urus* are being manufactured and exported to Arab nations from Beypore.



- ▶ Grand maritime tradition
- ▶ The *Baraami's*– ship builders in Beypore.
- ▶ *Baramis* – *Al Mukalla* tribe in Egypt and struggle to continue the ship building in Beypore.
- ▶ The carpenter breed called *Khalasis* –crafted these wonderful ships.
- ▶ The Beypore area is today home to the *Mappila khalasis*, famous for their expertise in lifting heavy weights.



URU making

- ▶ Usually around 300 tones. The '**keel**' is the first part of a Uru to be made. Traditionally made with teak wood.
- ▶ Usually '**Chukkan**' starts from the keel and height would be the actual height of the Uru –Chukkan' provides the total control of the vessel
- ▶ The manufacturing process is completed with the tying up of the sail 'mat' (**paya**) to the mast (**chamaram**)

- ▶ Various types of ships were built in Beypore. Some of them include
 - *Boom*,
 - *Padavu*,
 - *Bireek*,
 - *Kottiya*,
 - *Sambook*,
 - *Bahala*
 - *Pathemar*.
- ▶ The ships were coated with shark oil or castor oil for waterproofing.

Launching of Uru

- ▶ A festive ceremony
- ▶ Logs of the Puvathi (*Schleichera oleosa*) tree serve as rollers
- ▶ Over these, roller beams (Balus) strong enough to support the ship are kept.
- ▶ Ship is allowed to slowly move over the rollers with the help of rope and pulleys



Uru industry: set backs

- ▶ Uru trade faced serious setbacks since the mid eighties
- ▶ Proliferation of modern vessels
- ▶ The acute scarcity of quality timbers such as teak, karimaruthu, rose wood (*Dalbergia latifolia*), and pali (*Palaquium elipticum*)
- ▶ Non availability of wooden spares for the repair and maintenance of *urus* at the traded countries
- ▶ Primarily due to the stringent government policy on the export and import of wood.

Winds of change

- ▶ Switching over to other **second order timber trees** such as *Terminalia bellerica* (Thanni) and Venga (*Pterocarpus marsupium*)
- ▶ Opened up renewed demand in the small timber sector especially from Tamil Nadu and Andhra Pradesh and other states.
- ▶ Uru building gaining momentum– demand from tourism sector from many countries
- ▶ Renewed demand:
 - Mango for plywood and packing case
 - Ben teak (*Lagerstroemia lanceolata*) for lorry body building
 - *Artocarpus hirsutus* (Anjili) for country boat construction
 - Ailanthus for matchwood industry

Opportunities

Structural timber availability in Kerala

Source	Teak (%)	All Timbers
Homesteads	63	32%
Estates	0	41%
Forests	34	9 %
Imports	3	18%
Total	100 %	100%

Source: Krishnankutty, 2005

Lessons for future

- ▶ Raw material scarcity as the potential reason for the down fall of Kallai
- ▶ Need for diversification of wood products
- ▶ Wood from natural forests– narrows down
- ▶ Enormous potential– availability from homesteads and agroforests
- ▶ Encourage tree farming– in non forested areas
- ▶ Tree farming– policy interventions

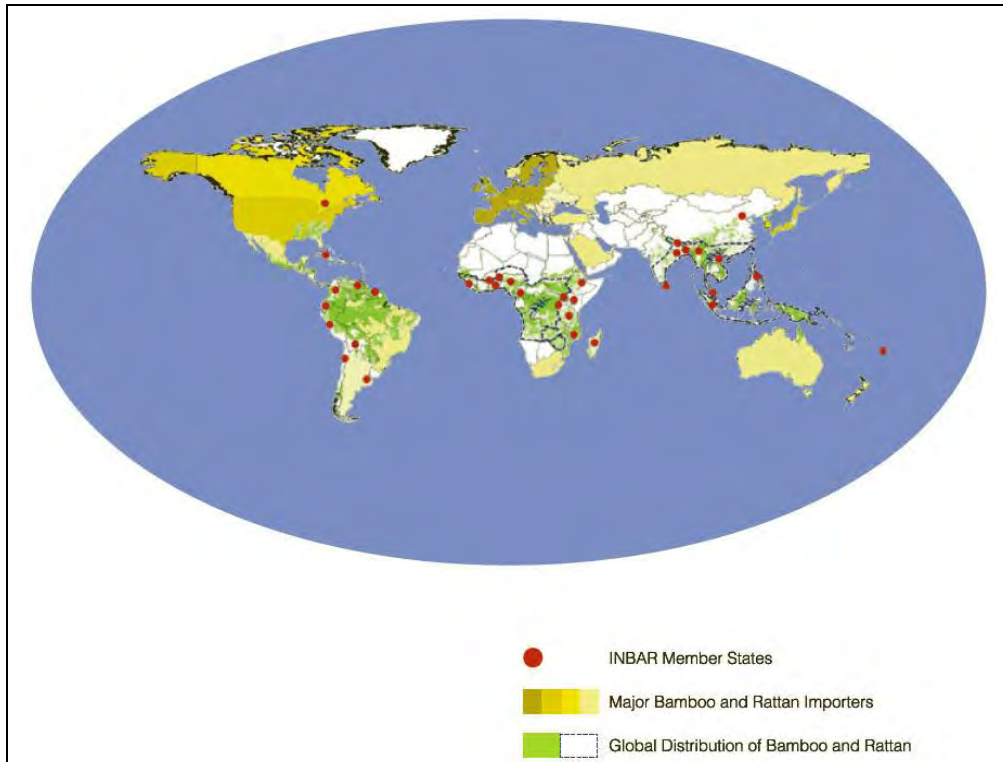
Bamboo as a Modern Construction Material

T P Subramony



● INBAR:	Inter-governmental international organization
● Headquarters:	Beijing, China
● Regional Offices:	India (for South Asia region); Ecuador; Ethiopia; Ghana; China
● Countries (SARO):	- Bangladesh, Bhutan, India, Malaysia, Myanmar, Nepal, Sri Lanka (MCs)
● Member countries:	37





INBAR's Strategy and the MDGs

- Millennium Development Goal 1:
Eradicate extreme poverty and hunger
- Millennium Development Goal 7:
Ensure environmental sustainability
- Millennium Development Goal 8:
Develop a global partnership for development



INBAR Programmes

- Environmental Sustainability (ES)
- Livelihood and Economic Development (LED)
- Trade Development (TDP)
- Global Bamboo Housing Programme (GBHP)
- Non-Timber Forest Products (NTFP)



Multiple applications from Handicraft to Housing





Global Bamboo Housing Programme

- Research and Development
- Disseminate knowledge
- Technology Transfer
- Support the development of markets



Why Bamboo?

Bamboo matures in 3-6 years.

It takes 60 days for bamboo to grow 60 feet.

Earthquake resistant properties
e.g. Costa Rica (7.6 Richter Scale)

High insulating property.

Economical

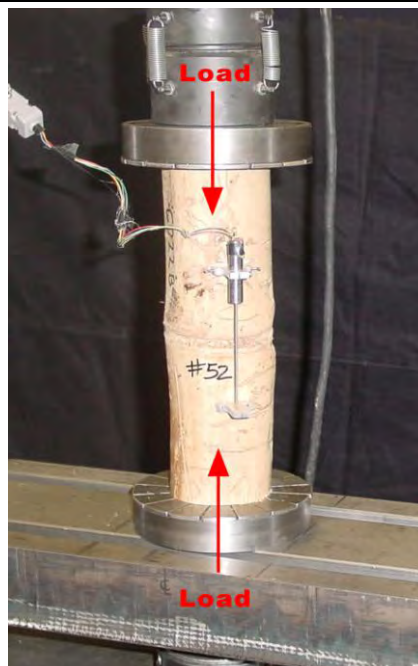


Building Materials	Density	Modulus of Elasticity		Yield Strength		Ultimate Strength		Strength Over Density
	p/cf	ksi	Mpa	psi	Mpa	psi	Mpa	1/ft.
Carbon Fiber	110	21,800	150,305	n/a	n/a	819,463	5,650	1,072,752
Structural Steel	490	29,000	200,000	36,260	250	58,000	400	17,045
Aluminum Alloy	170	10,000	68,947	26,106	180	29,000	200	24,565
Cast Iron	435	27,500	190,000	n/a	n/a	29,000	200	9,600
Bamboo pole	25	2,694	18,575*	n/a	n/a	8,700	60*	50,112
Timber	40	1,600	11,000	n/a	n/a	5,800	40	20,880
Concrete	150	3,000	20,684	n/a	n/a	435	3	418

* Janssen, 1991

Bamboo Pole = 1.5 higher strength than Typical Timber

Structural Feasibility
INBAR



INBAR

Some Modern Examples



A big question



- So what does it take for bamboo to become a mainstream modern material?



Challenges to making bamboo mainstream



- Supply Chain
- Proper Harvesting regime
- Appropriate Treatment
- Appropriate Joinery & Craftsmanship
- Supportive Policy



Challenges to supply chain



Appropriate Treatment



Untreated bamboo

*Cheap, fast, effective:
buy it today, use it today. Biodegrades:
lasts for 1-3 years depending on
exposure.*



Treated bamboo

*Has a 20-30yrs life expectancy if
correctly harvested, handled and
treated, and sheltered from weather in
use. Hence offers a greatly increased
contribution to community resources.*

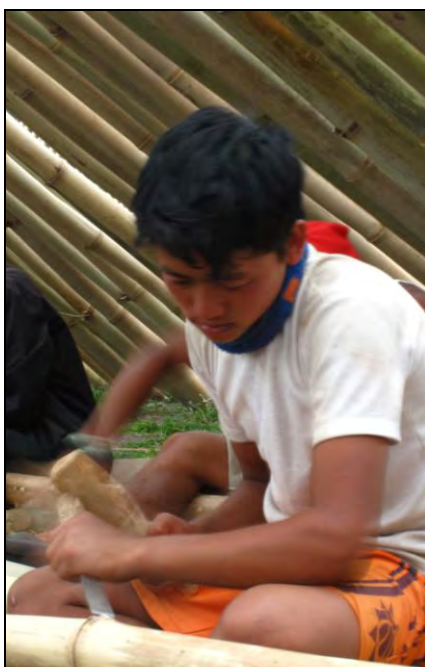
Source: Humanitarian Bamboo , 2009



Appropriate Treatment



Source: abari.org



Appropriate Joinery & Craftsmanship

- Joints often weakest part of bamboo structure
- Joints require specialized skill
- Very labour intensive process
- Few tools dedicated to bamboo

Appropriate Joineries:



Source: Jorge Moran adaptation Simon Velez

Appropriate Policies:



Key Policy Issues

Examples of Good Practice

Standards and Building Codes

2 ISO standards; National building codes approved in Peru & Columbia;

India recently declared it as grass.

Bamboo placed on



Case Study : Post-Disaster Recovery Sichuan,China



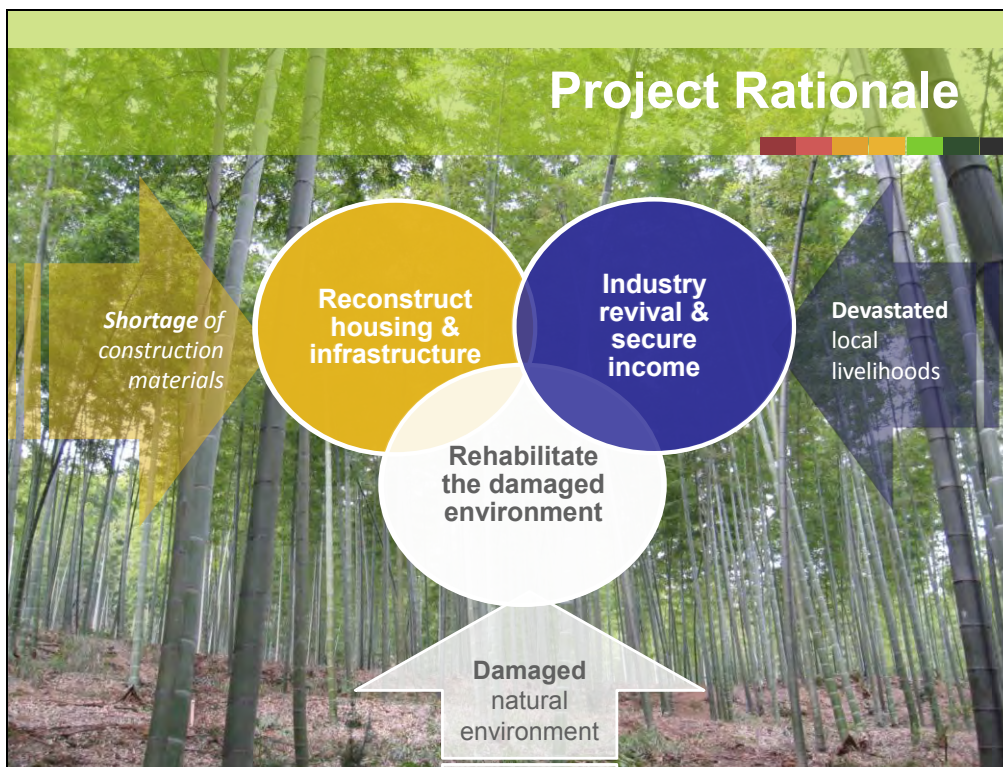
Background



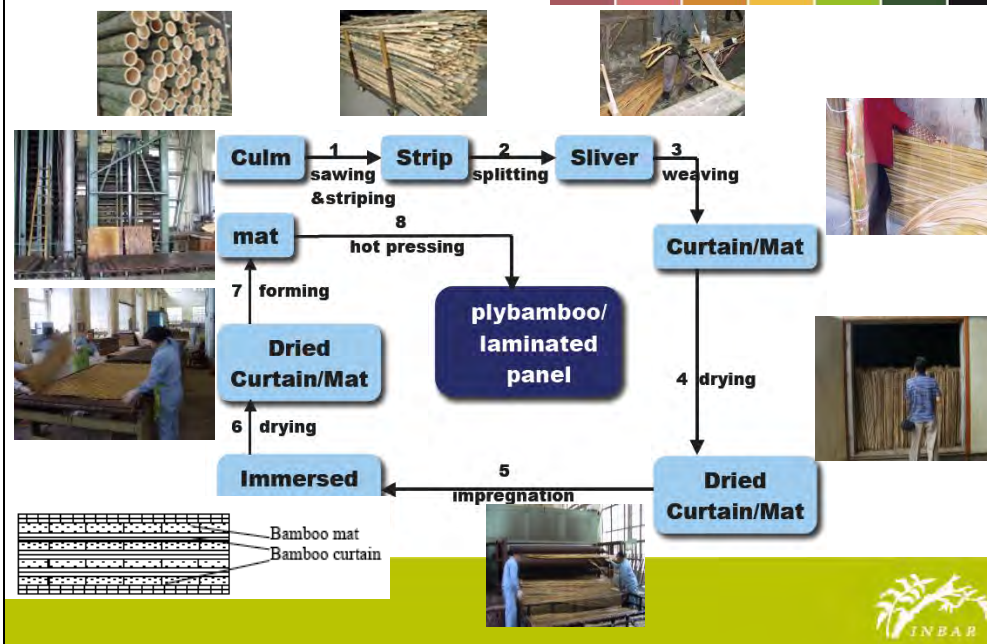
2008 Sichuan Province Earthquake

- 5.5 million people left homeless and displaced
- 370,000 unemployed & 1.15 million deprived of agricultural production
- €21 billion in damages - **huge demand for re-building materials**

Project Rationale



Processing for Bamboo Plywood



Engineered Bamboo House



Zeri Pavilion, Colombia

Amiens Cathedral, France

Bamboo & Architecture
INBAR



Cupola at Casa Alejano, Colombia

Abbey Church of St. Denis, France

Shelter, Colombia

Thorncrown Chapel by Fay Jones, AR

Bamboo & Architecture
INBAR

Session 4

[Wednesday 4th period 2.0 hours - Main Hall]

Artistic aspects of wood use and design

Speakers



Speaker:
M P Ranjan

Topic:
Entrepreneur Development, Design and Innovation in Wood Products / Design Detailing in Wood: An Appreciation of Furniture Design by Gajanan Upadhaya



Speaker:
Jirawat Tangkijgamwong

Topic:
The Way of Wood: Finding Green Pieces in Thailand



Speaker:
Achmad Zainudin

Topic:
Jepara: Mirror of Indonesian Art Wood



Speaker:
Hakki Alma

Topic:
Wood Carving Art in Turkey



Speaker:
Lv Jiufang

Topic:
Wood Aesthetic Pattern Design and its Application

**Entrepreneur Development, Design and Innovation in Wood
Products / Design Detailing in Wood: An Appreciation of
Furniture Design by Gajanan Upadhaya**

M P Ranjan¹

¹ Designer, National Institute of Design (retired), Ahmedabad, India (ranjanmp@gmail.com)

Gajanan Upadhyaya

Furniture Design - An Appreciation

Prof M P Ranjan
Design Thinker & Academic
Ahmedabad, India



ranjanmp@gmail.com
www.designforindia.com
www.ranjanmp.in

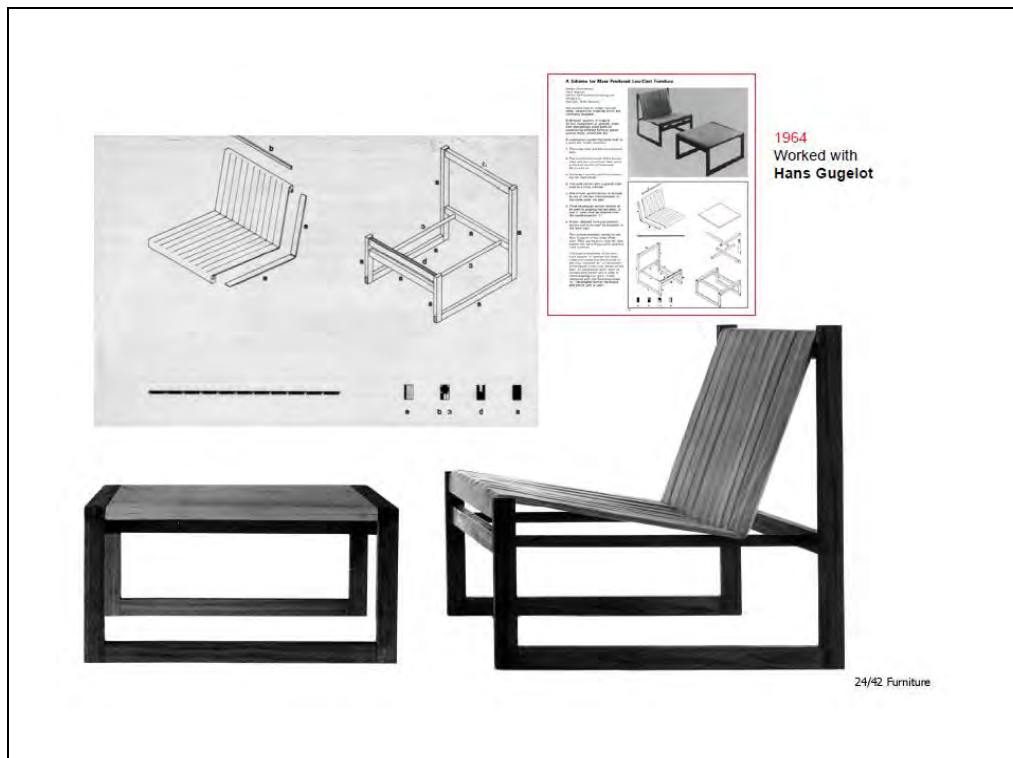


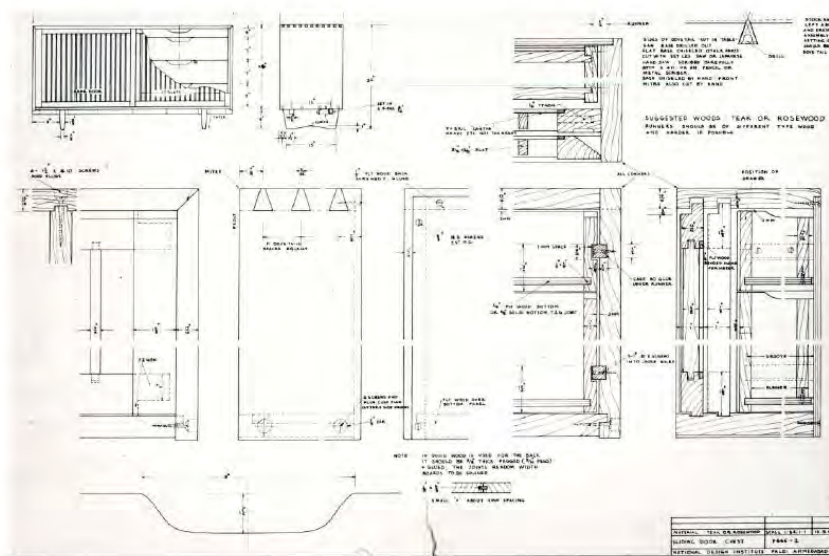
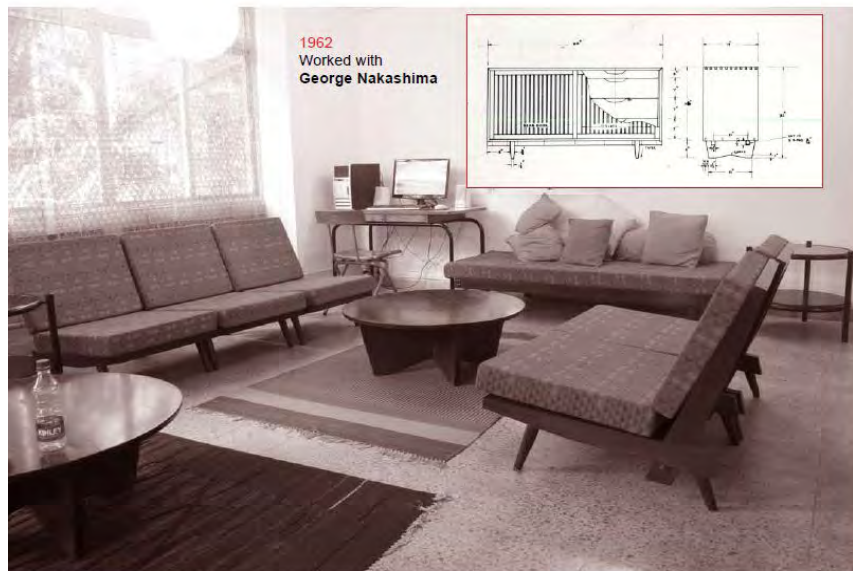
Wood in Furniture Design
Evolution of a Design Master

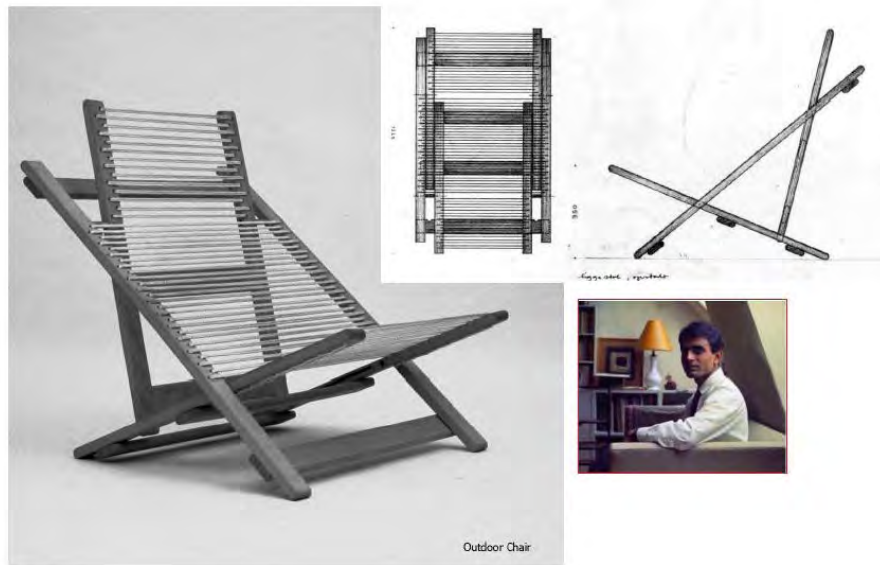


BIO-PROFILE

1934
Born in Village Sarsav
Mehsana, Gujarat
1955
Marriage to Kumudini
Student at MSU Architecture
1960
Architect at
Town Planning Dept,
Ahmedabad
1962
NID as Architect and Designer
1966
Studied at Denmark and
worked there
1974
Return to India
1976
NID as Faculty
1996
Architect at HCP and
Designer at TDW
Ahmedabad

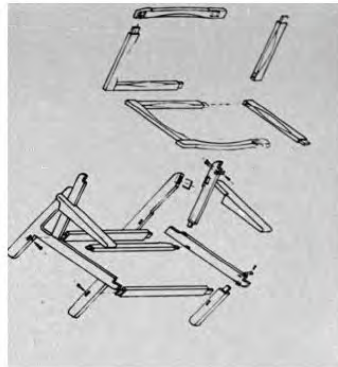
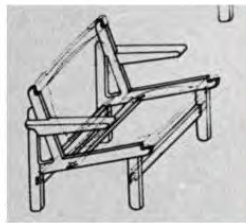


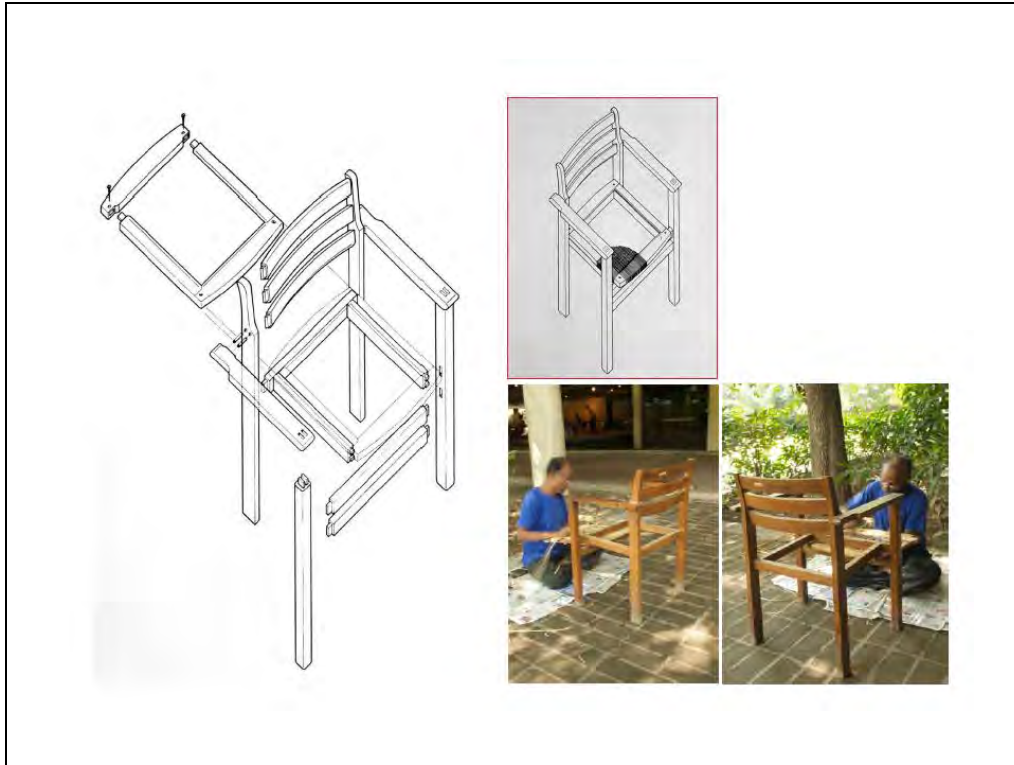


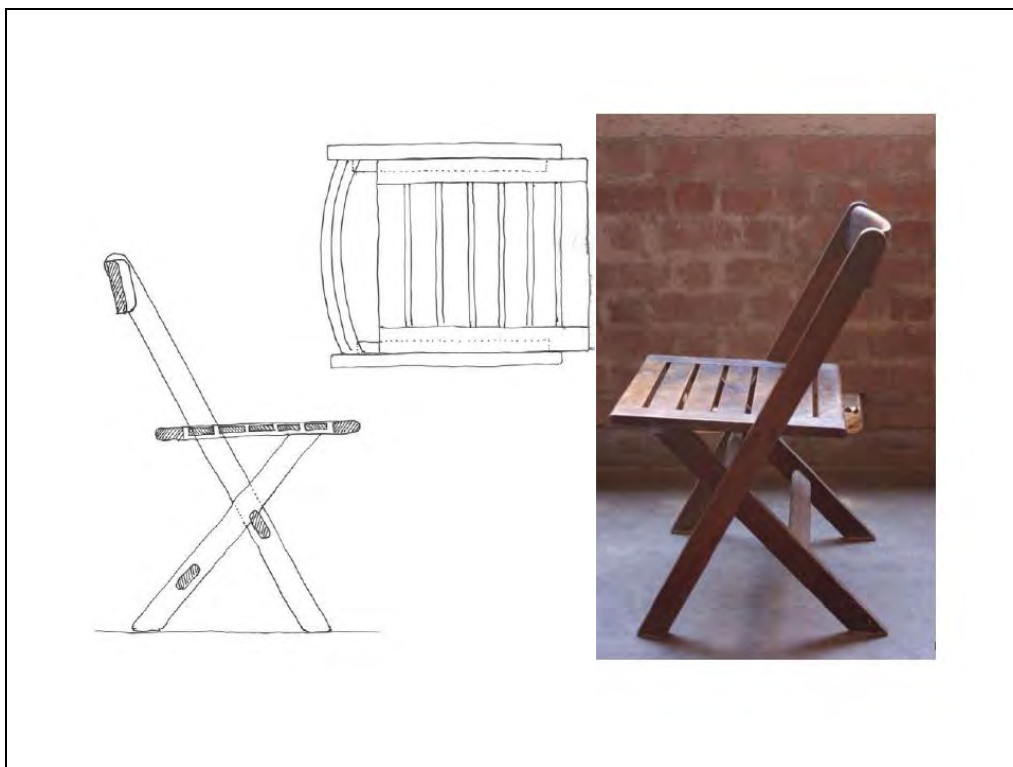


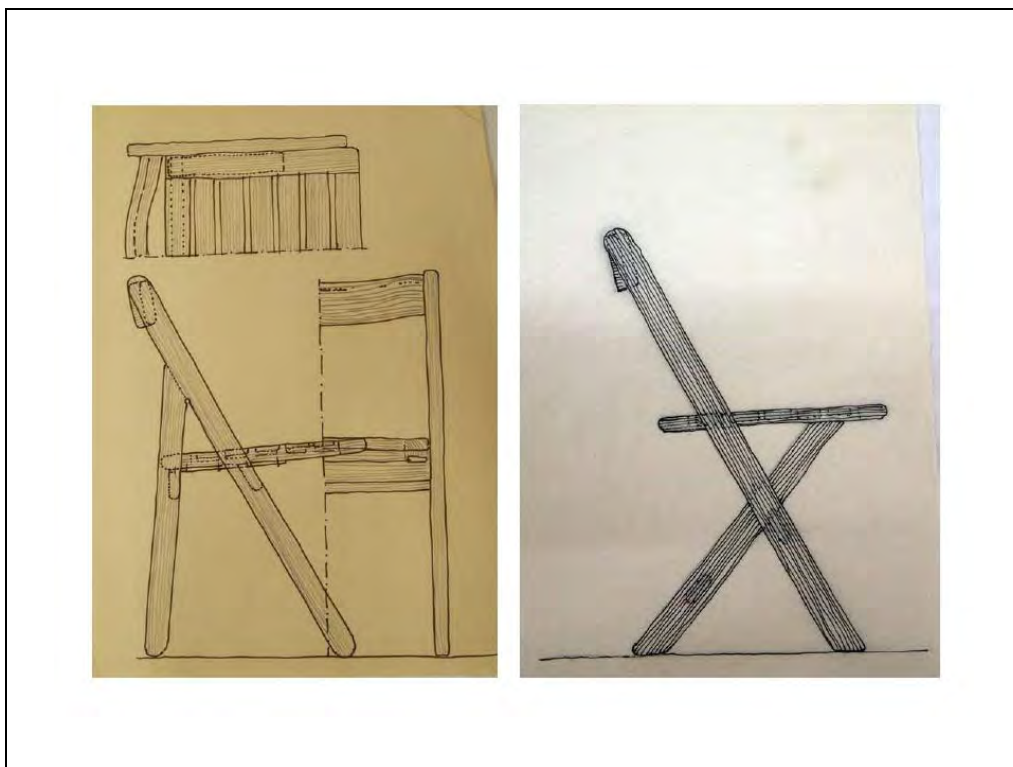


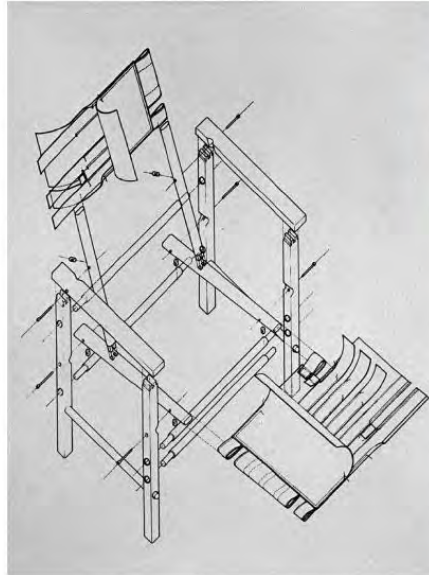
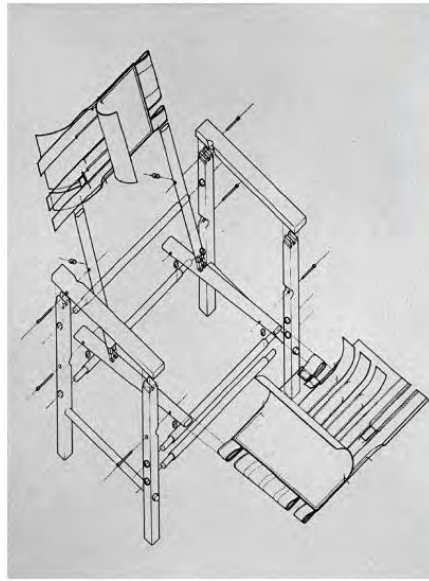
1976
Returned to India
National Institute of Design

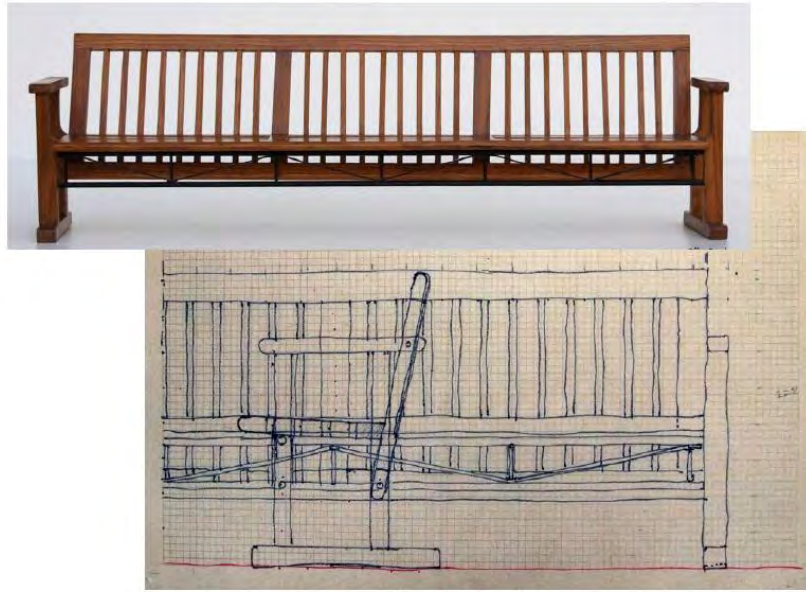


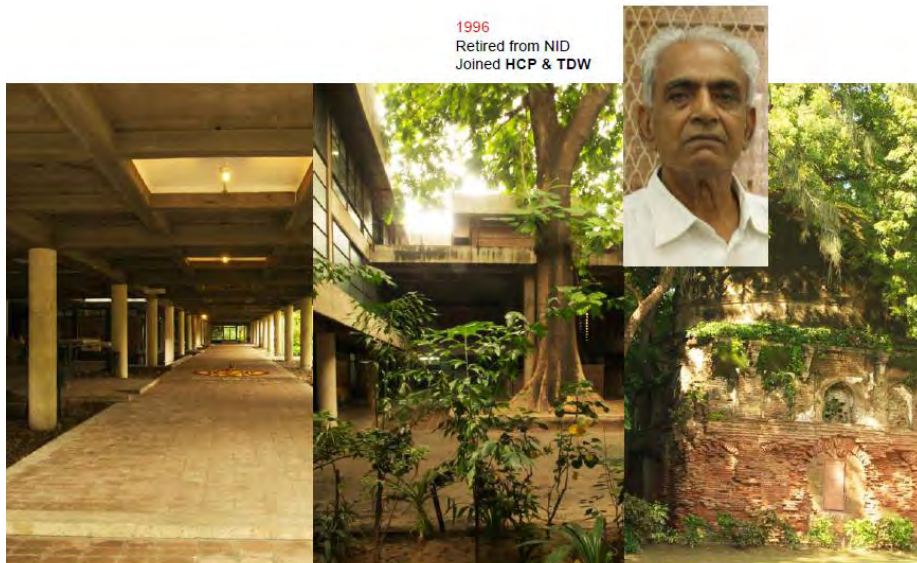


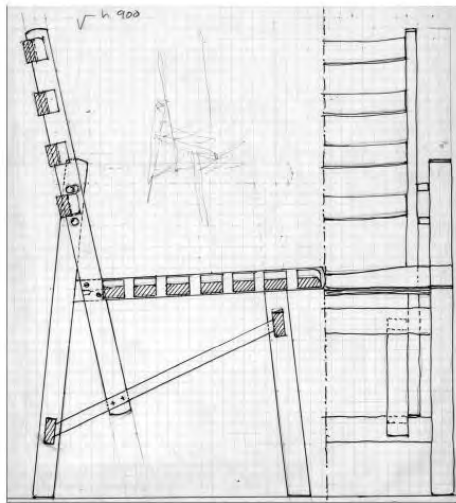








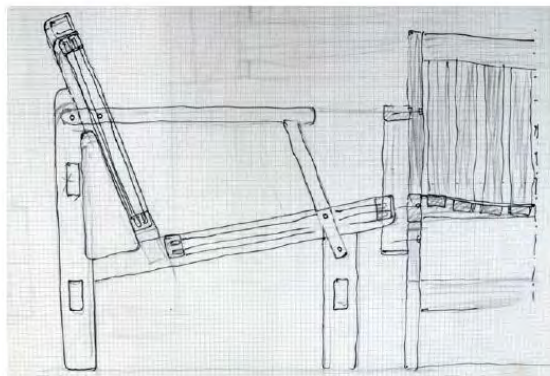


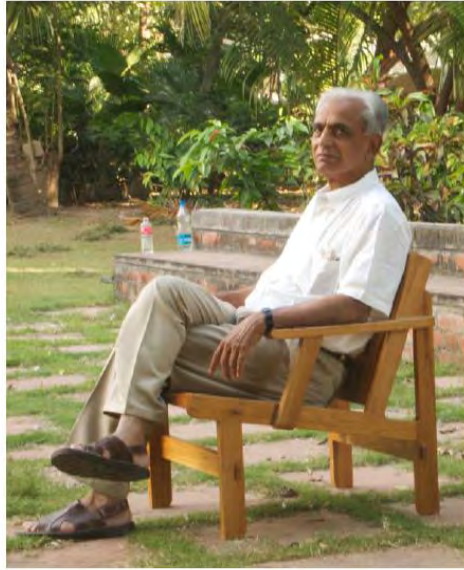


High B







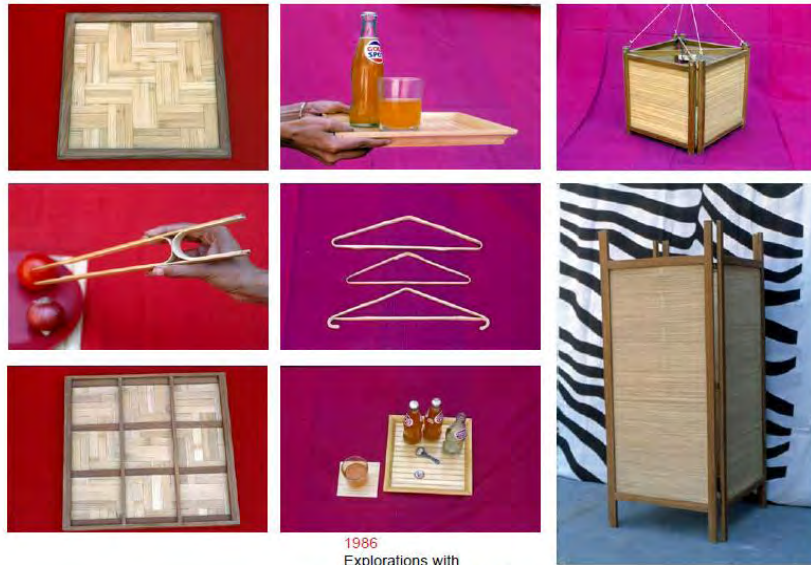






Scale Models
Turned Wood Bed
High Court Bench





1986
Explorations with
Bamboo Splits & Mats



The way of wood: Finding Green Pieces in Thailand

Jirawat Tangkijngamwong²

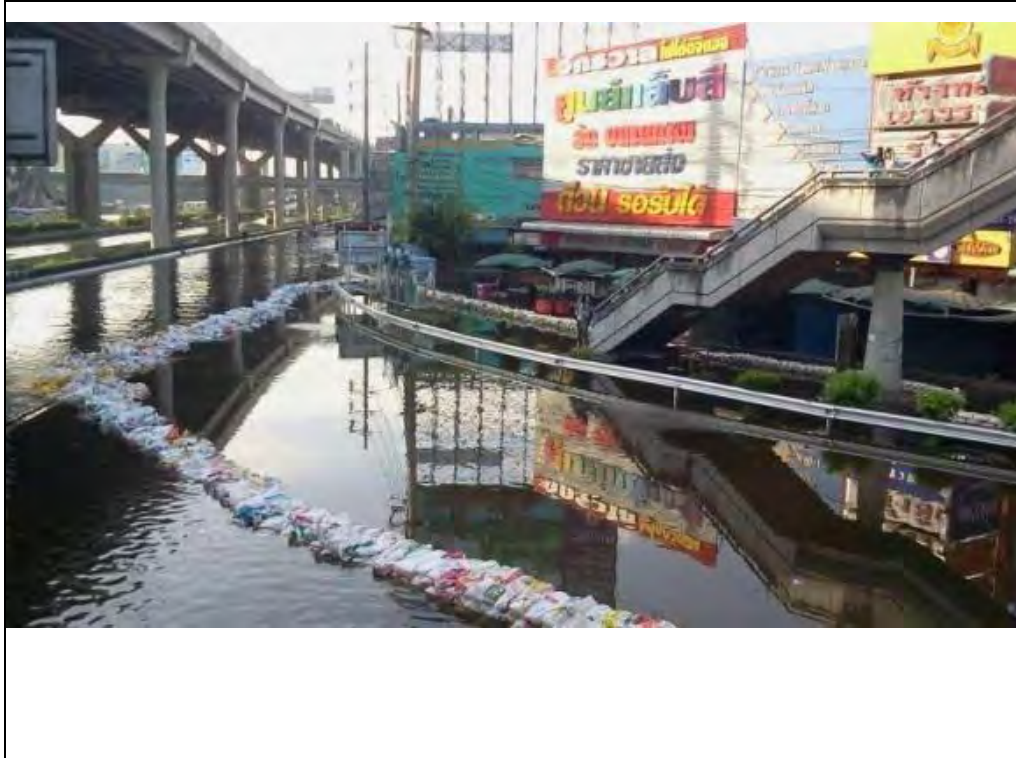
Abstract

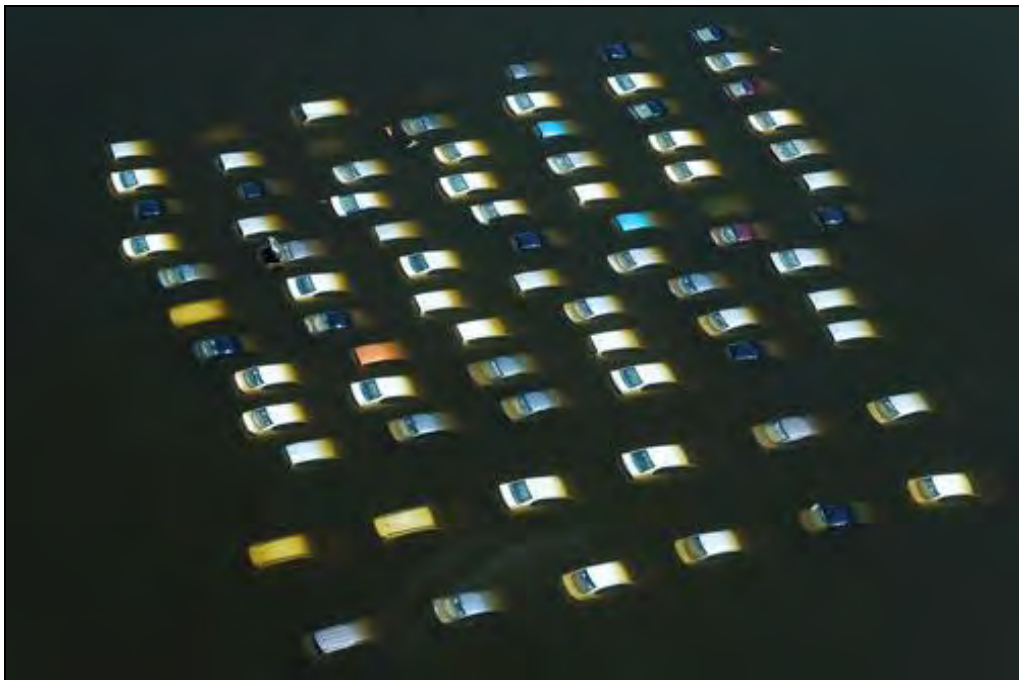
MyThaiDesign.com was established to create a community platform to enable lovers of Thai design, from around the world, to come together to learn about the latest forward-thinking designs and must-attend events in Thailand, as well as to share their leading-edge thoughts and ideas regarding what Thai design means to them. Thai design is diverse. It is modern and contemporary; it is traditional and conservative. It is fresh and admirable. For Thailand, the idea of sustainability is on the tip of everyone's tongue. Green is embedded in the culture. The warm Thai people are "living a green life". The love and warmth that stems from Thailand is contagious and welcoming. Deesawat is a good example. They are the creative and the producer of Thailand specializing on contemporary outdoor design, especially using all solid wood. They admire the preservation of nature and the coolness of living among nature. For years, Deesawat strives not only for producing timbers out of legal or sustainable sources, but also carefully looks into other dimensions to make the company greener. Creativity and Sustainability are at the core of the business. Besides, being awarded and recognized in design excellence, Deesawat also strives to improve the relationship between commercial, social and ecological aspects, with the strong belief that this is the way of wood in the future: sustainable and creative. Deesawat also involves community work in timber and plants network. Join us in celebrating products that are eco-friendly, design-led, and suitable for interiors and exteriors across the globe.

² Thai Furniture Industries Association, Thailand (jirothailand@gmail.com, deesawat@ksc.th.com)



The mother Nature
has taught us that we
should never took
nature for granted.







The warning is painful.

Lessons must be learnt.





We are living on the edge.

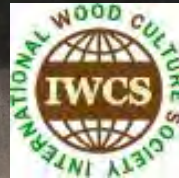
We all can pitch in...
to make the difference.



Sustainable living is the
Sustainable future.

It's real!

The Ways of Wood (Thailand)



Jirawat Tangkijngamwong (jiro)



Jirawat Tangkijngamwong (JIRO)

President

The Thai Timber Association



Vice President

Federation of Thai Industries (Wood Processing Group)



Vice Chairman

Council of Asia Pacific Furniture Associations (CAPFA)

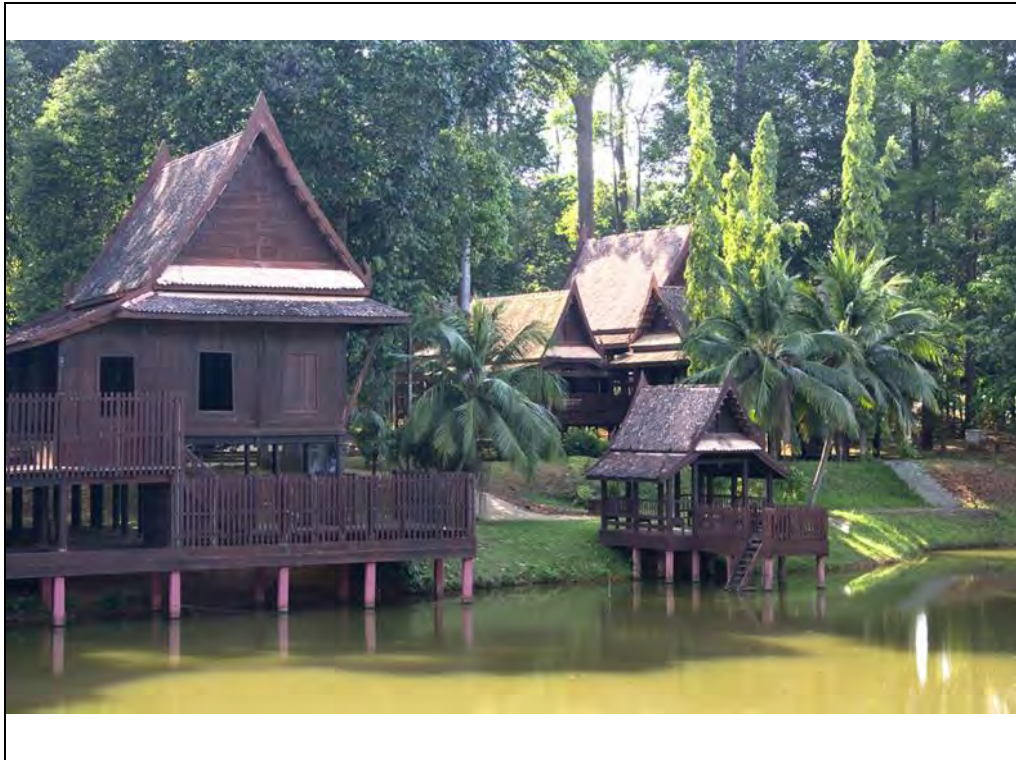


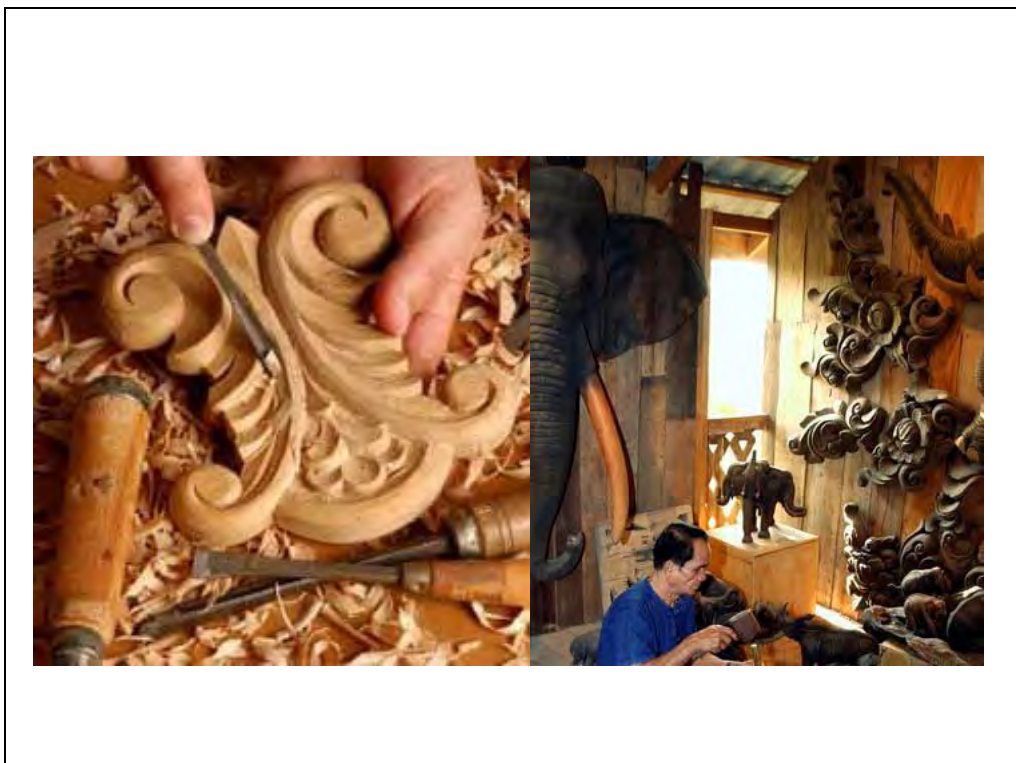
Secretary General

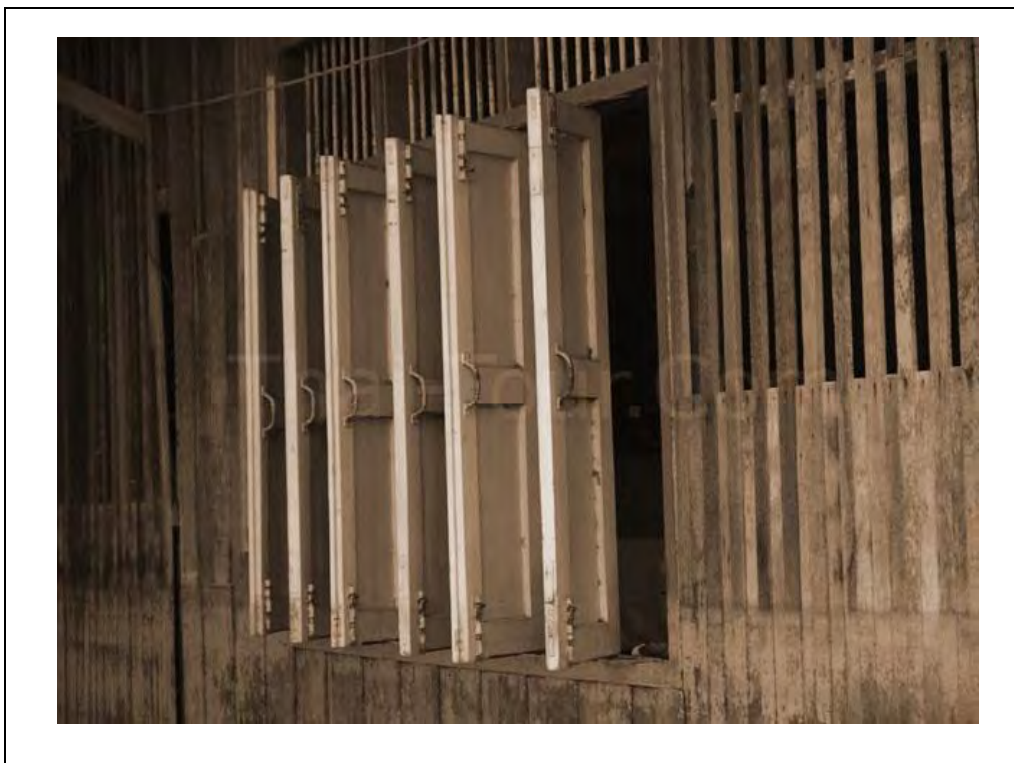
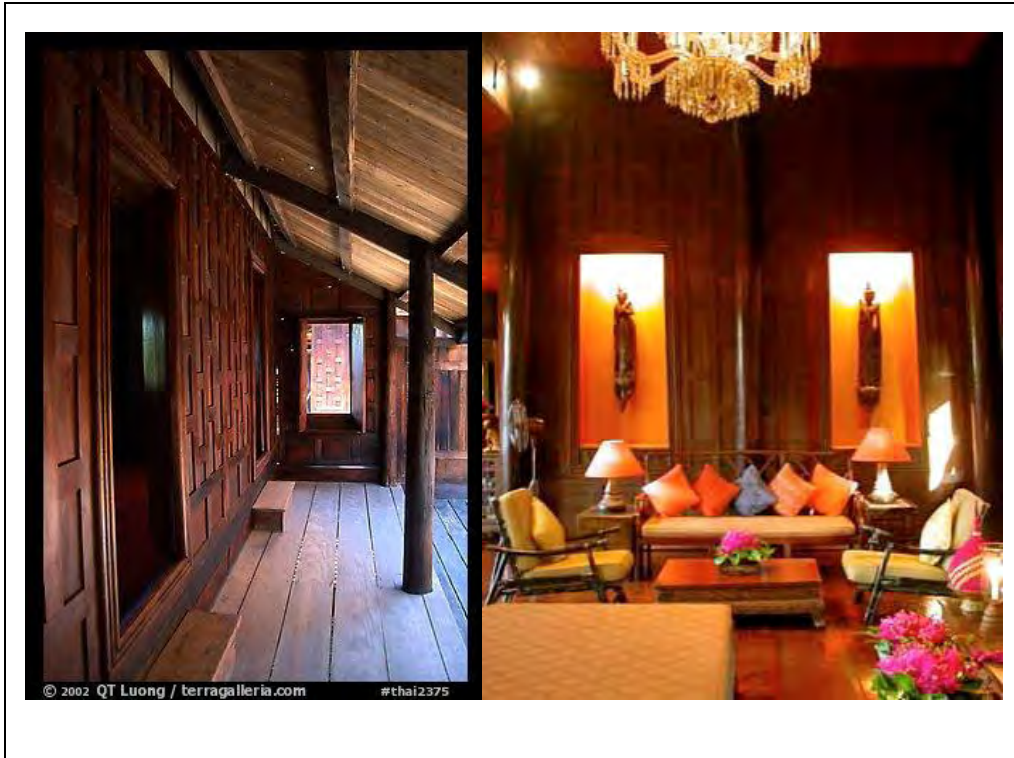
Thai Furniture Industries Association (TFA)

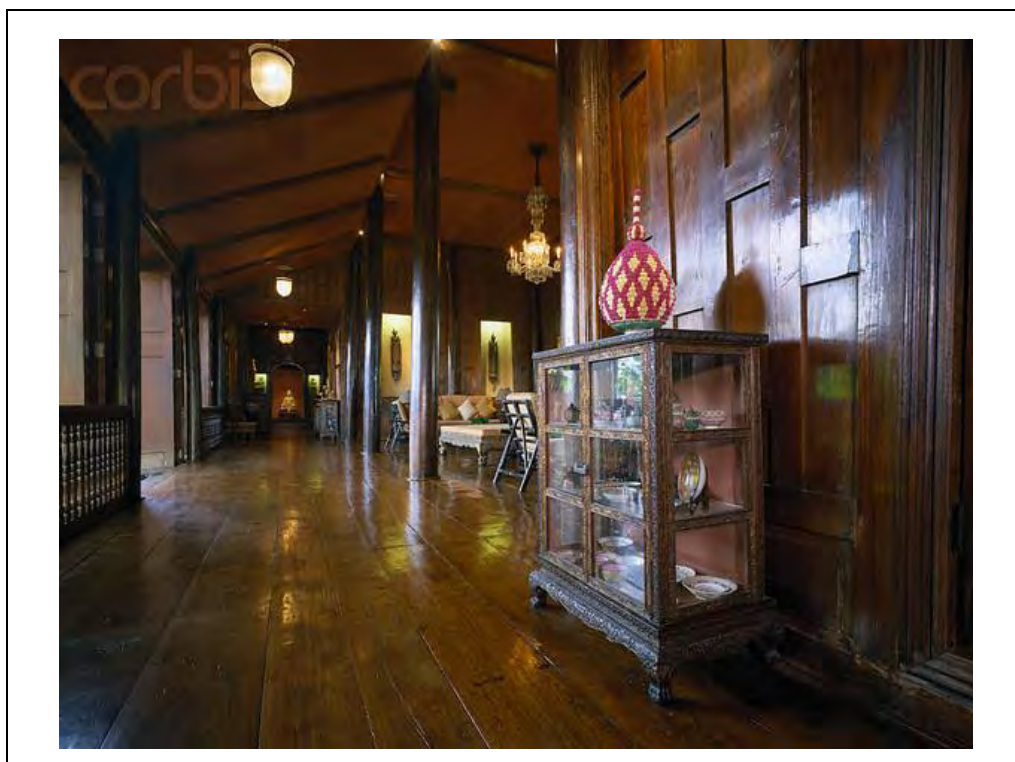
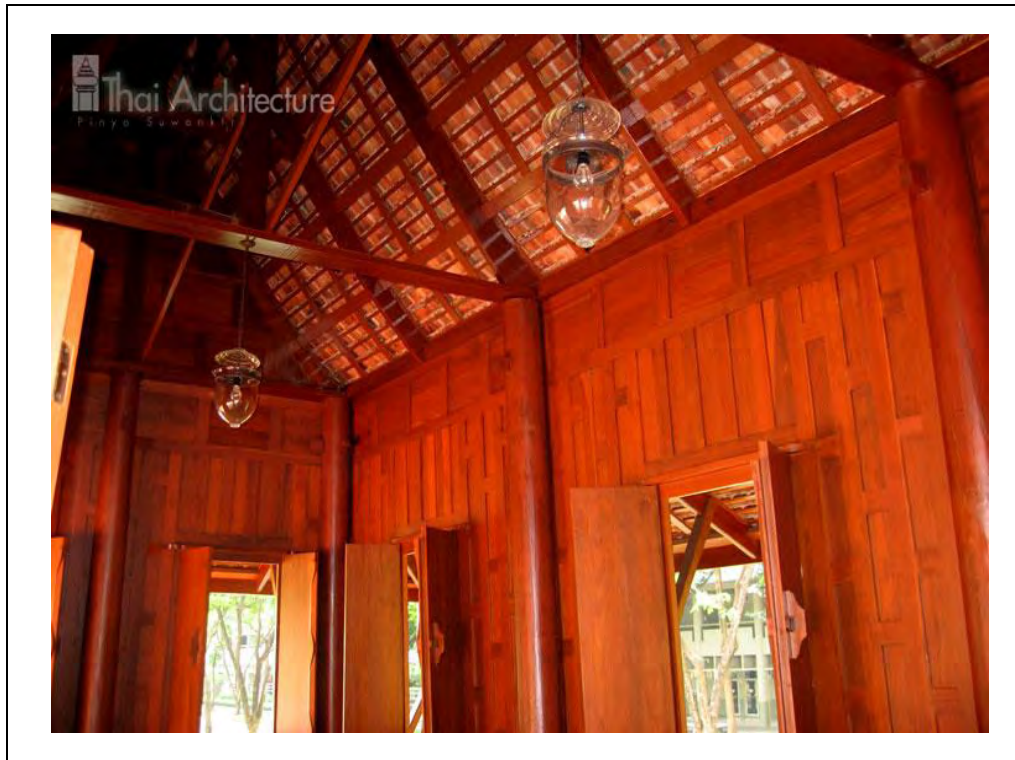














Furniture manufacturers in

1 registered factories

- Large scale 52 factories
- Medium scale 210 factories
- Small scale factories



Furniture manufacturers in

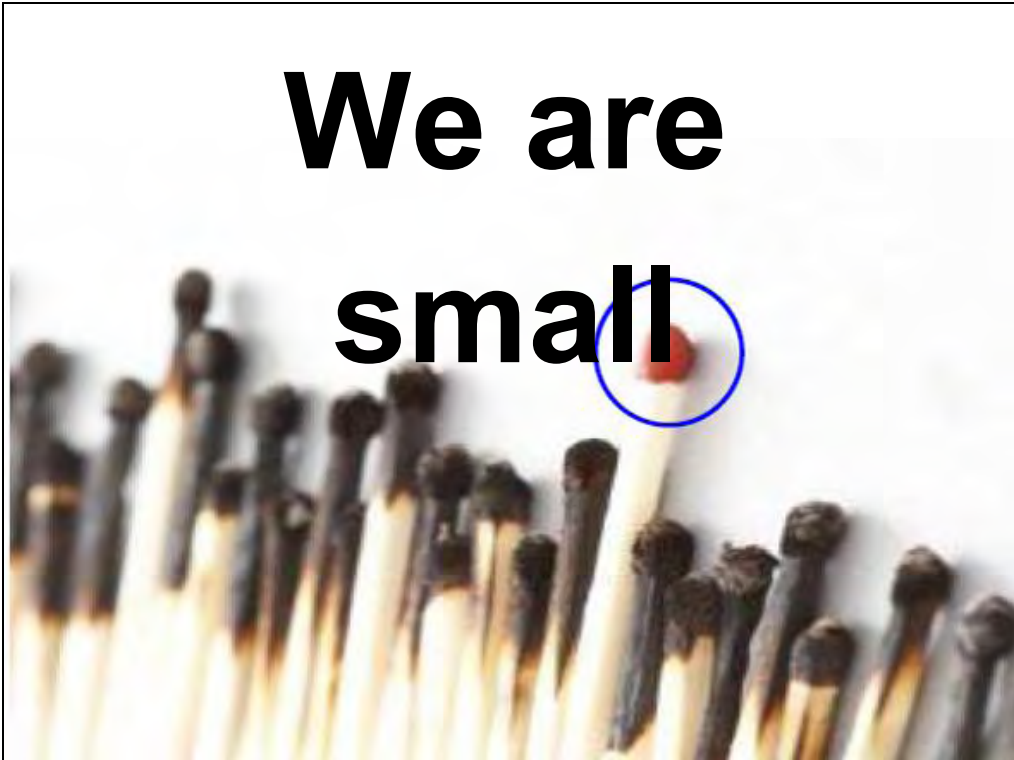
- Public Listed 4 factories
- 170 export-oriented
- 8000 micro industries non-registered



1500 total /176 export

Most of them SMEs

**We are
small**



SME

SME

Slow and Unproductive and
Incompetitive.

Facts

- Forest is 33%
- Commercial plantation: Eucalyptus, Rubberwood and Teak

2010 Sales in the nutshell

- Furniture export US\$ 1000 millions (+17%)
(wood furniture about US\$ 500 millions)
- Wood product export US\$ 1000 millions
(wood sawn timber about US\$ 500 millions)
- Wood construction export US\$ 1200 millions
- Furniture local market US\$ 1400 million
(under estimated/ under invoiced/ otop orders)

FURNITURE & INTERIORS MARKET Thailand

Total Housing Starts		units/year
Total Number of Households		units
Furniture Production	0	million US\$
Total Furniture Imports	40	million US\$
Total Furniture Exports	0	million US\$
Total Furniture Consumption	1,400	million US\$
•Total Commercial Mkt		million US\$
•Total Repair / Remodeling Mkt	500	million US\$

**We are
small**



Facts

- 2010 growth 17% so far
- 70% of export furniture are wood furniture and natural fibres.
- Local/export market is about the same size (US\$ 1400 million US\$)

Natural material oriented (wood,natural fibre)

Rubber wood, Teak Wood
Water Hyacinth, Bamboo,
Coconut

**Make sure it's renewable sources
legally and sustainably managed.**

Situation Today



Slide 43



LOST in the
Shuffle!





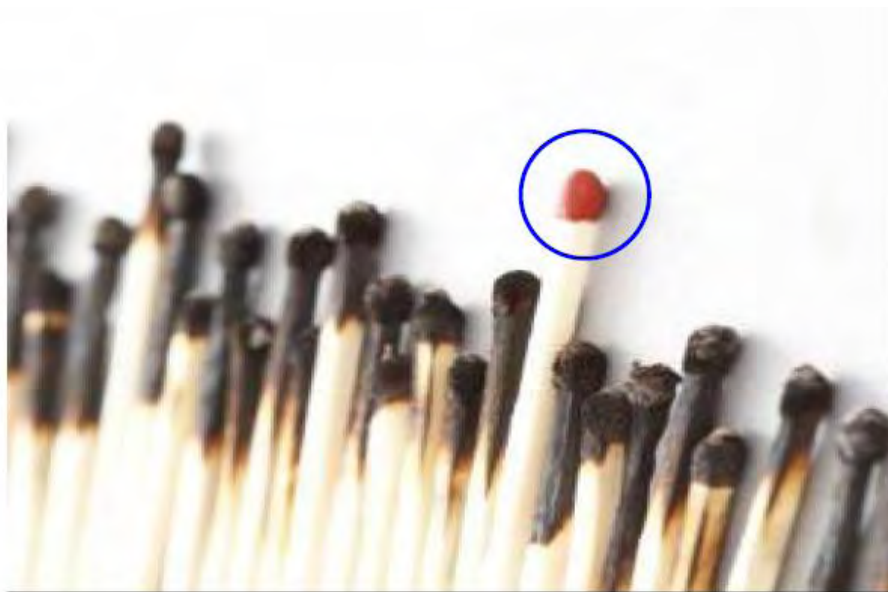




HOW

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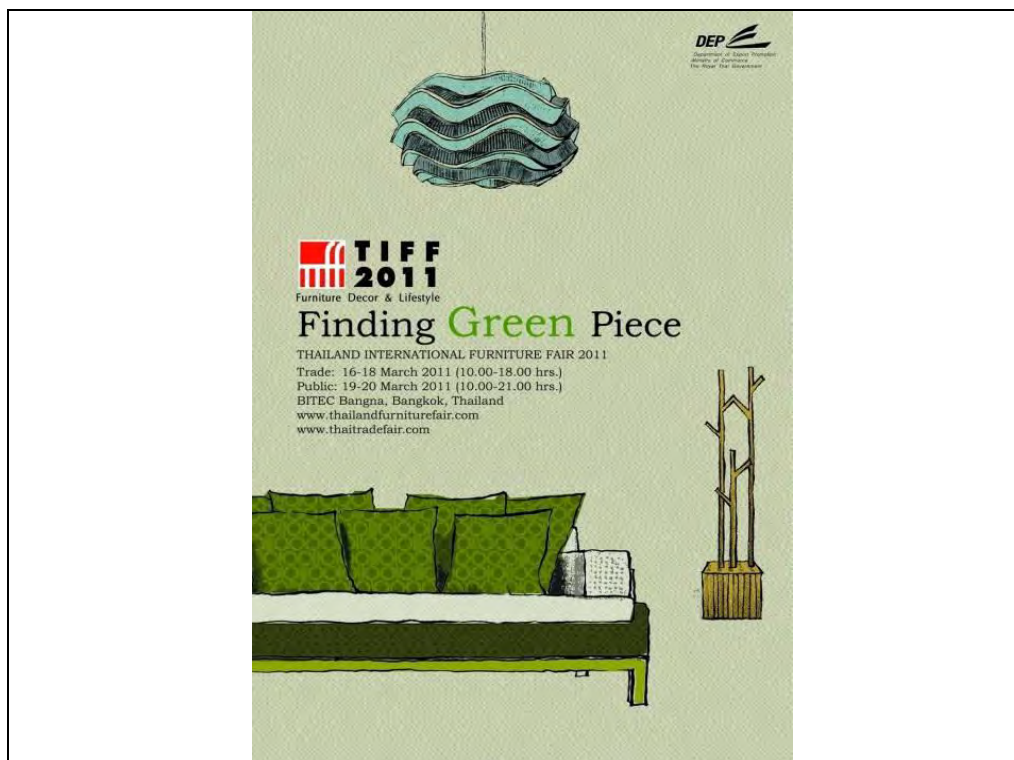
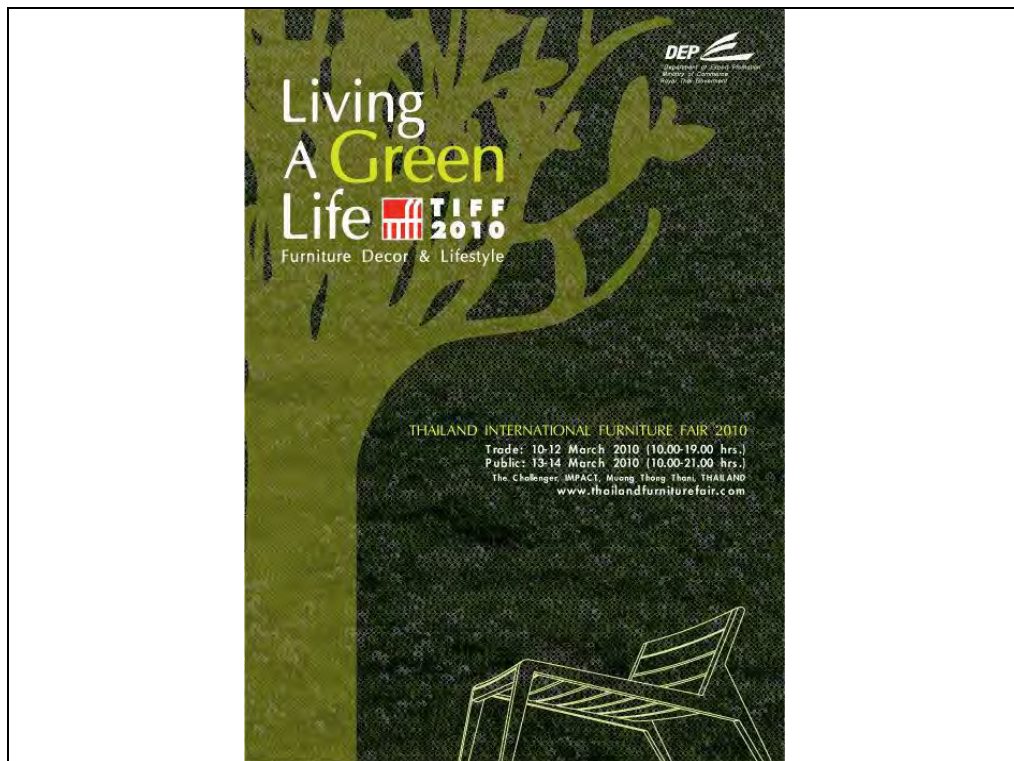




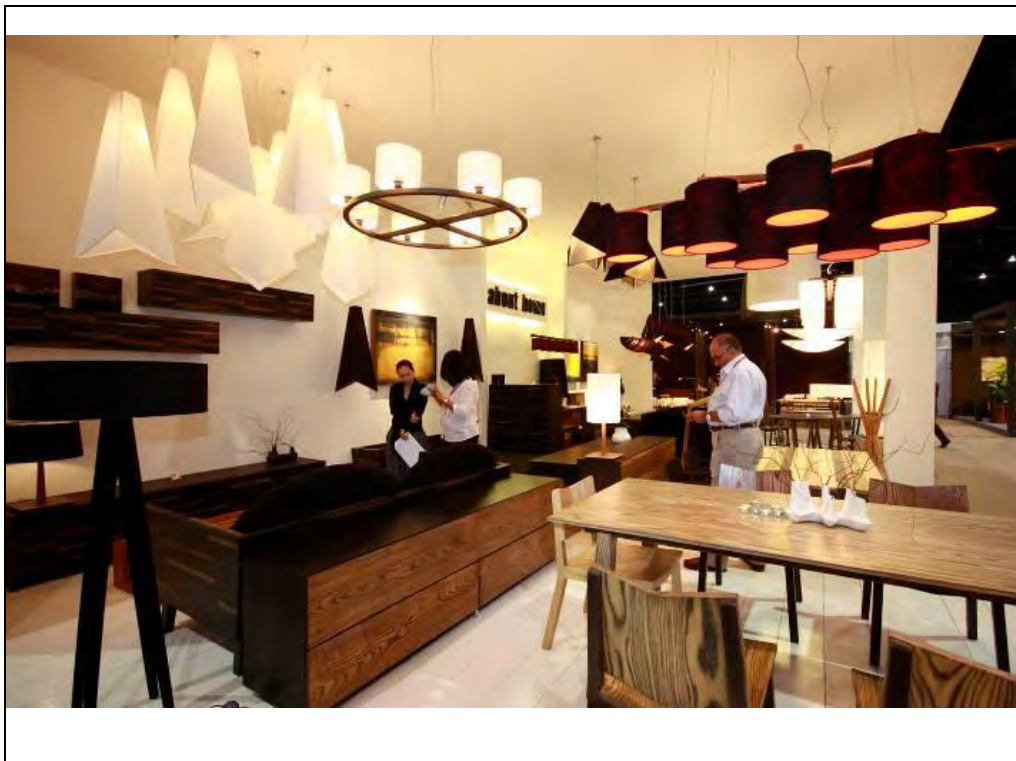
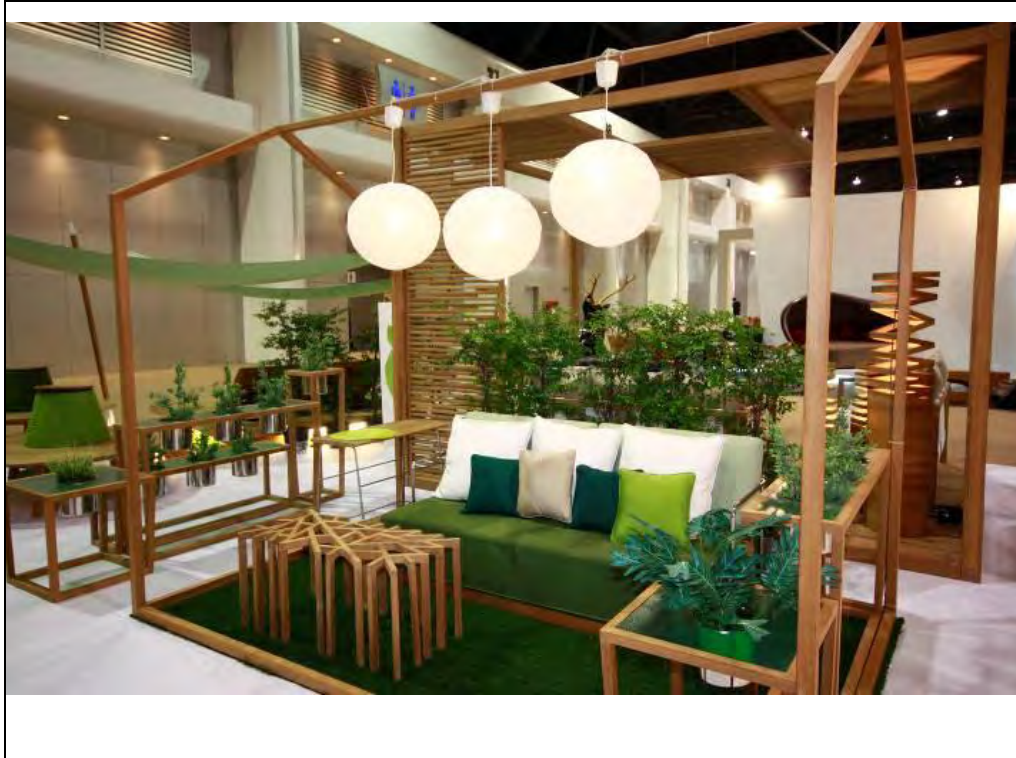
Creativity & Sustainability From Natural Products



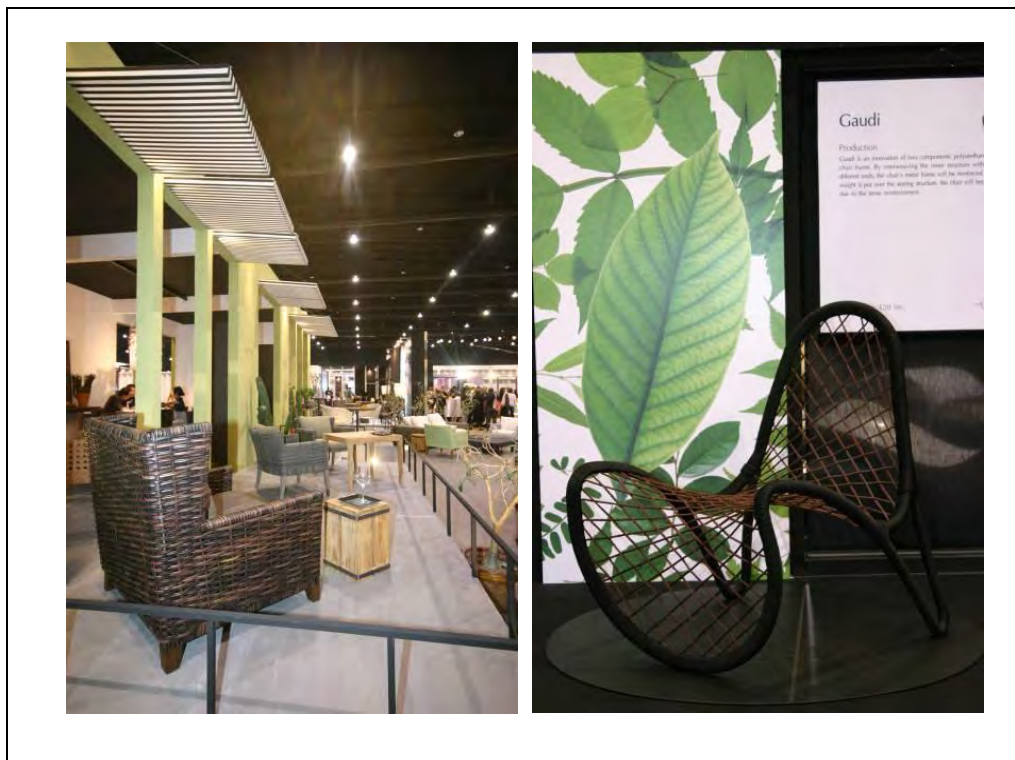
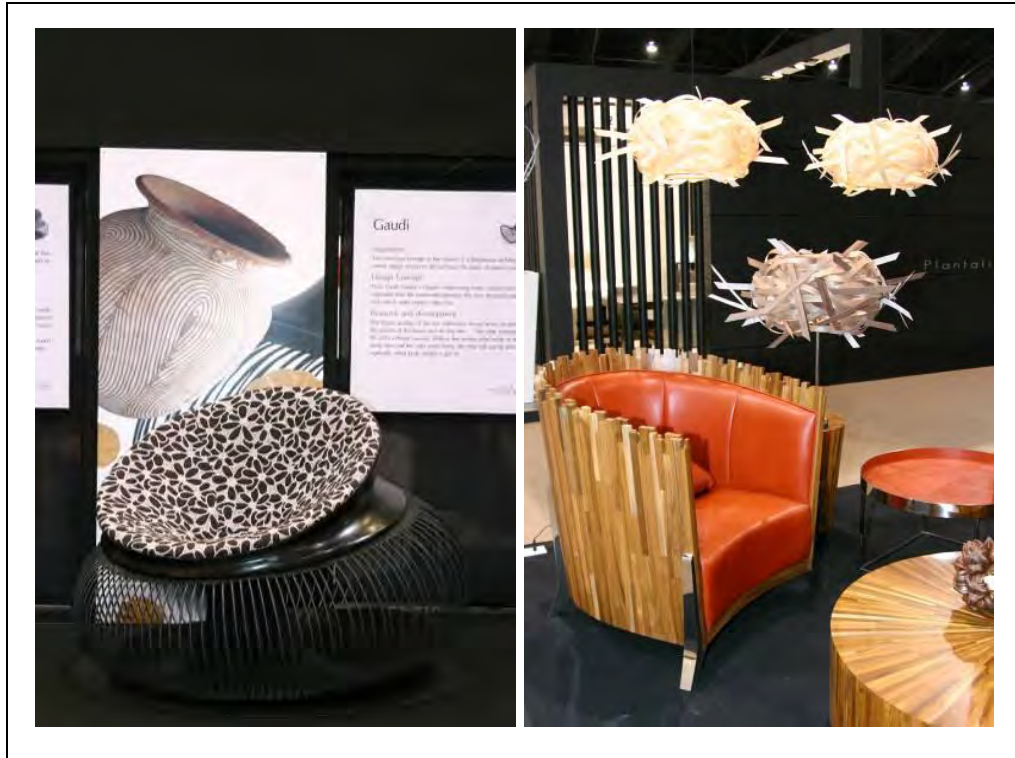


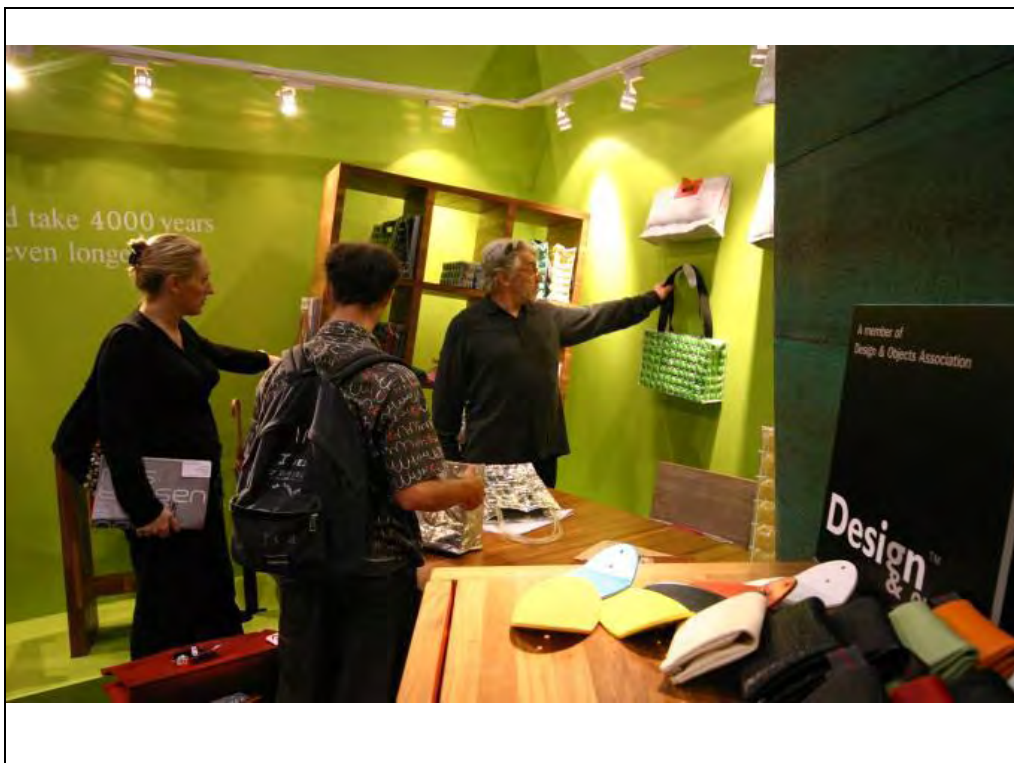
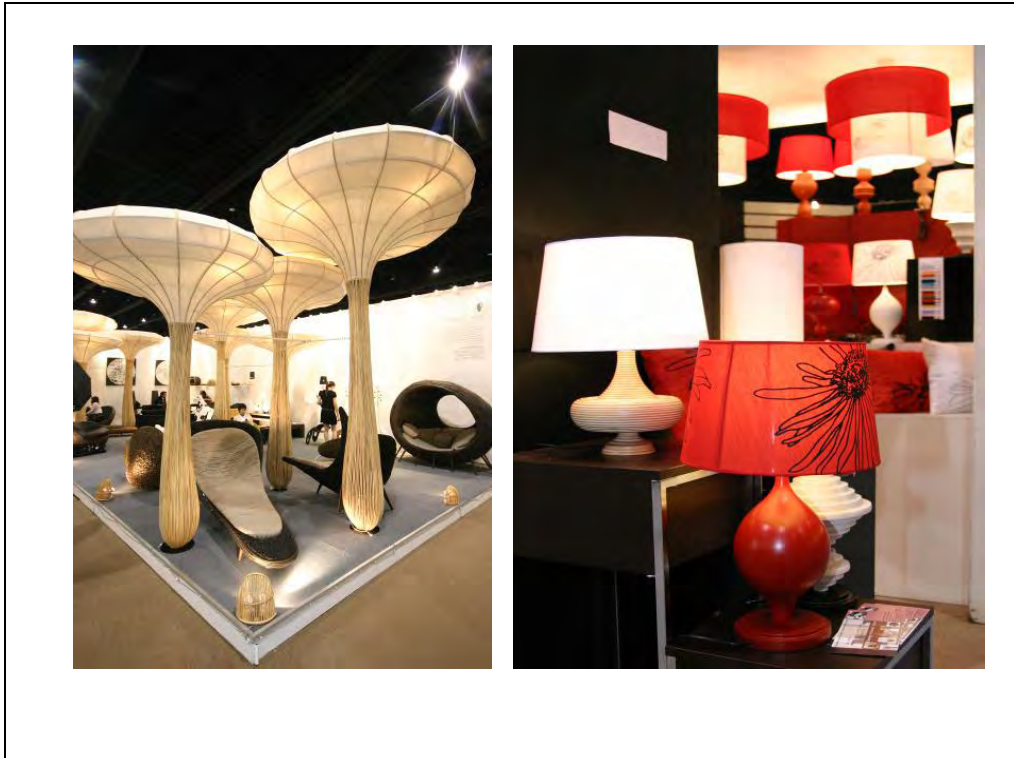






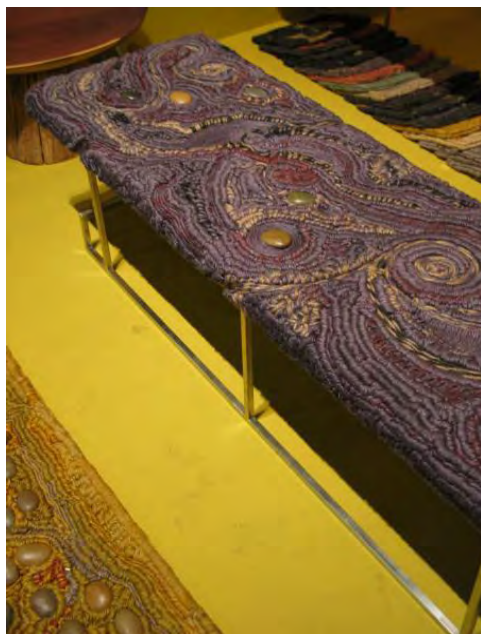


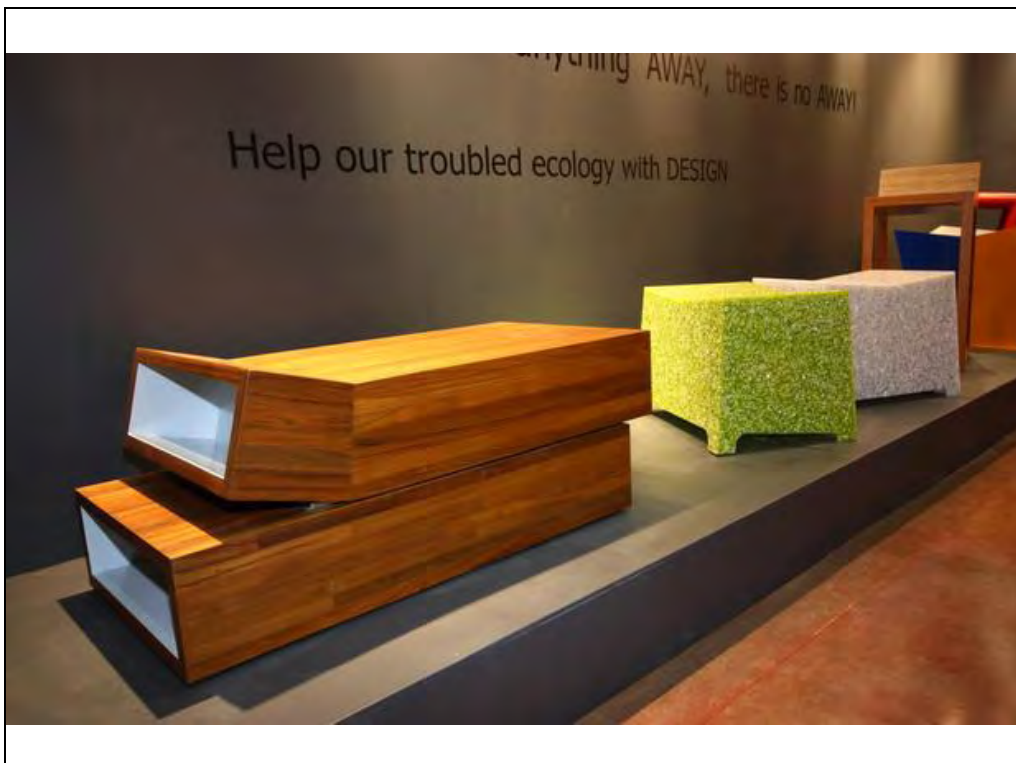
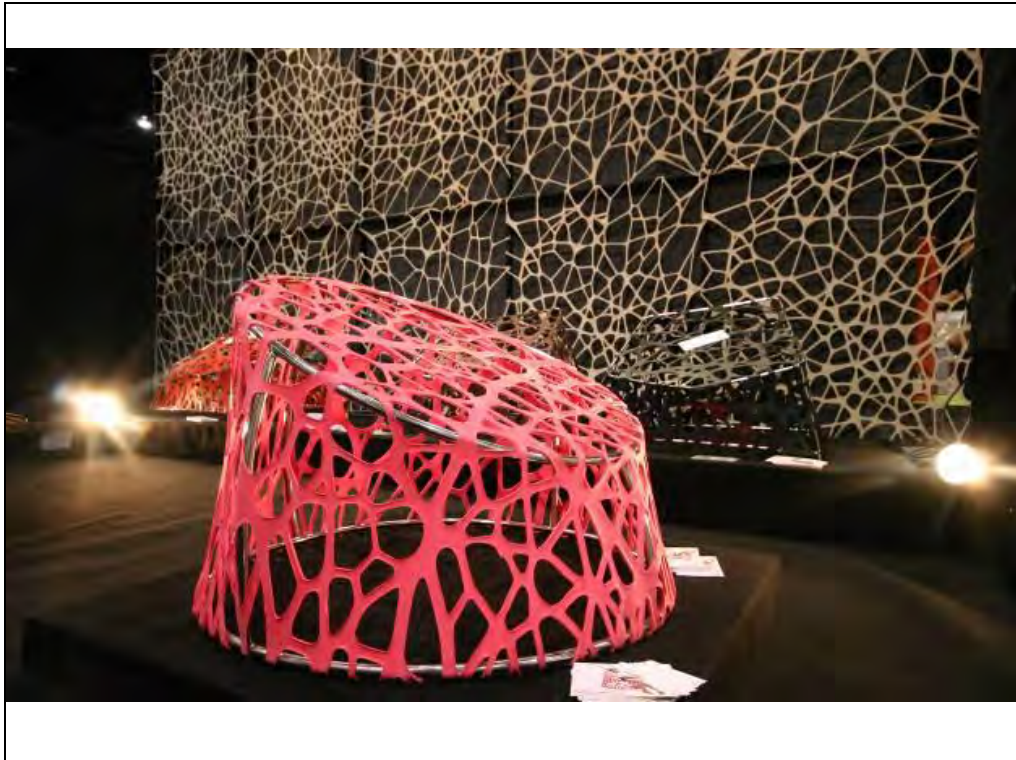


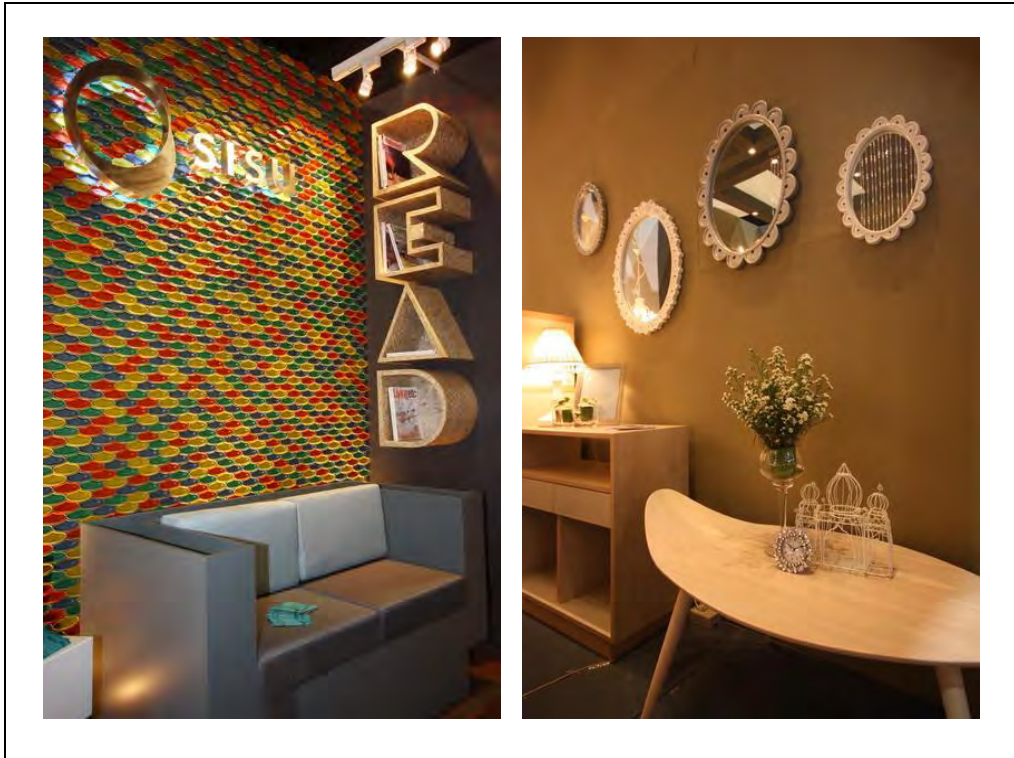




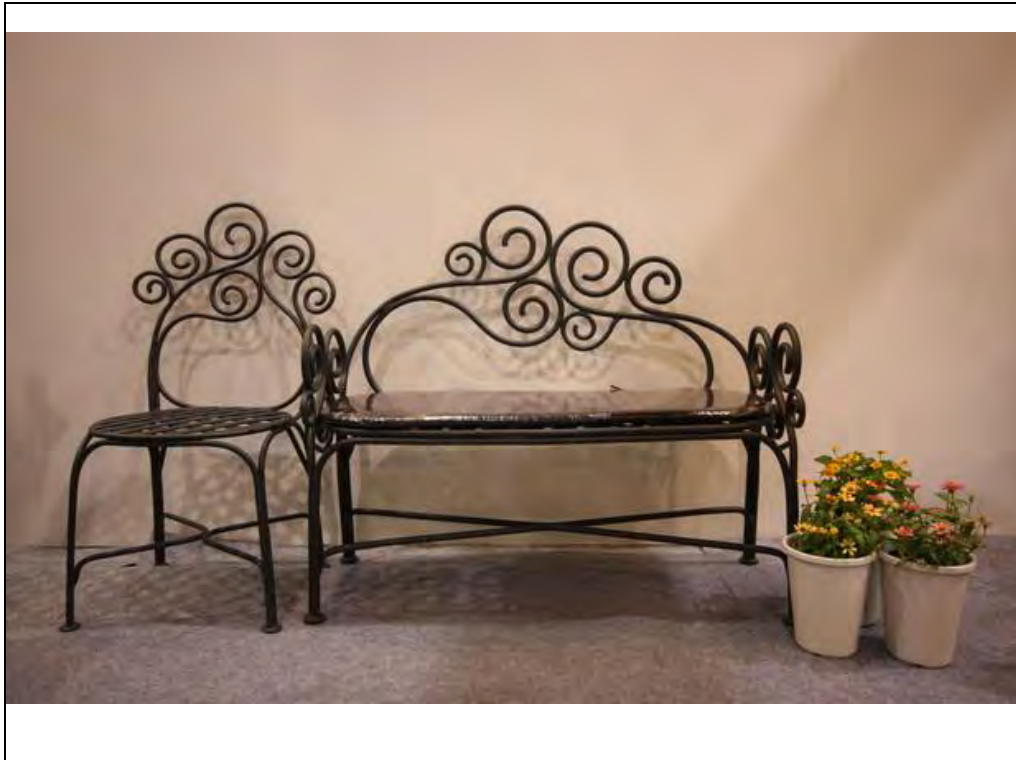


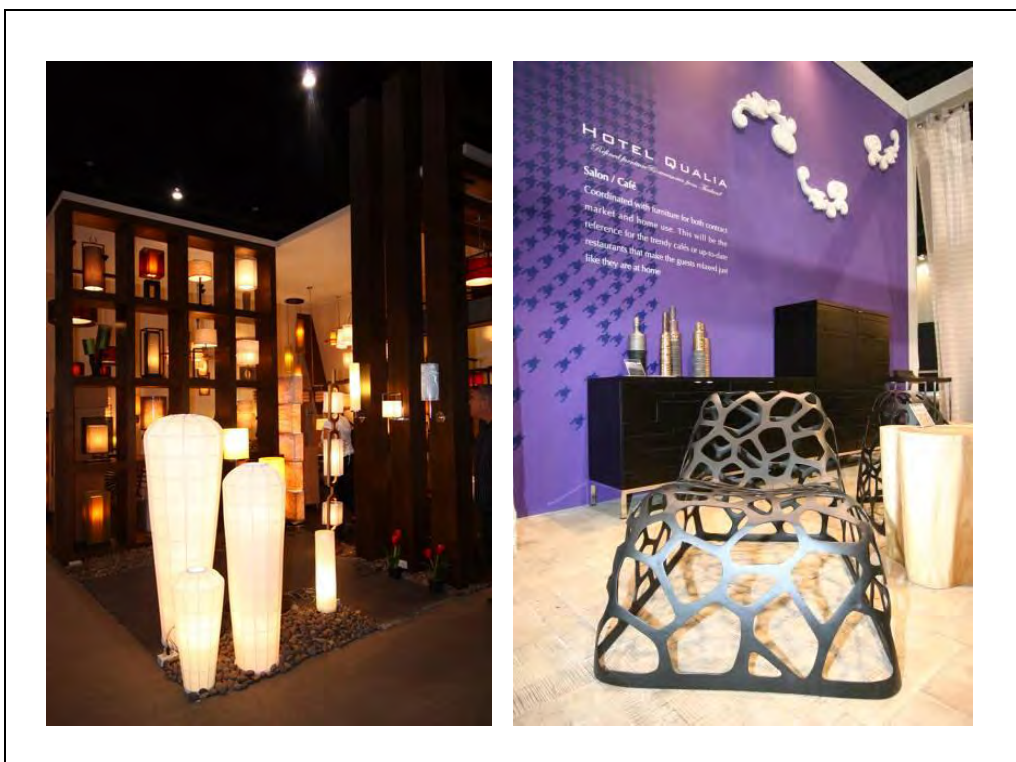


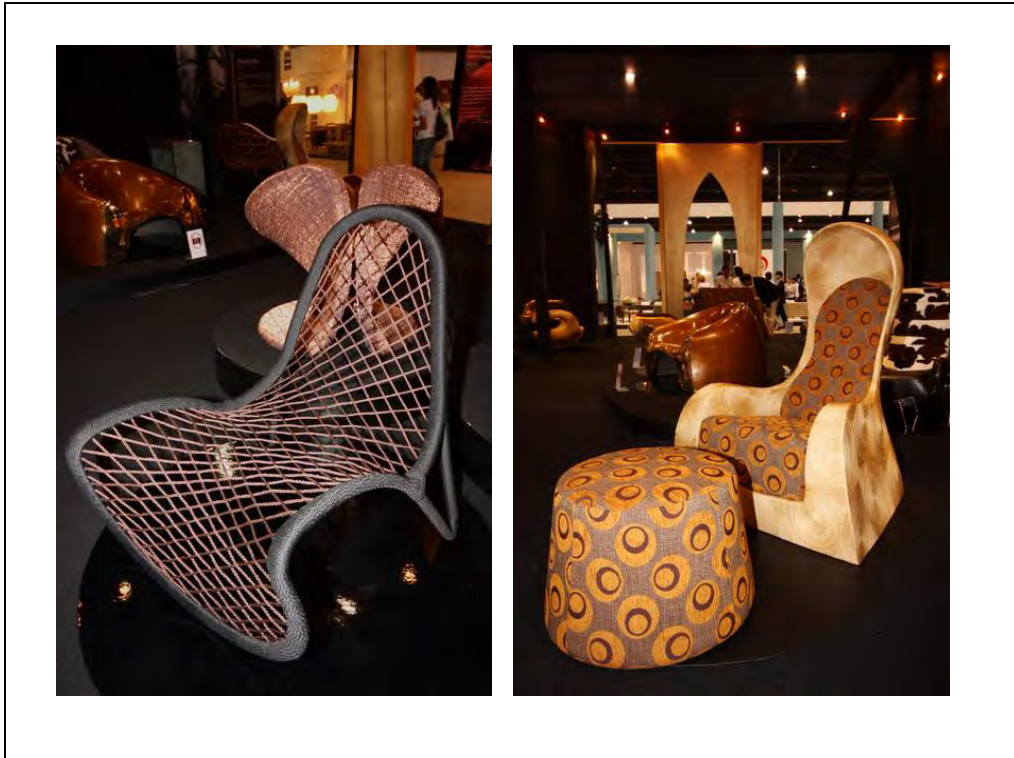




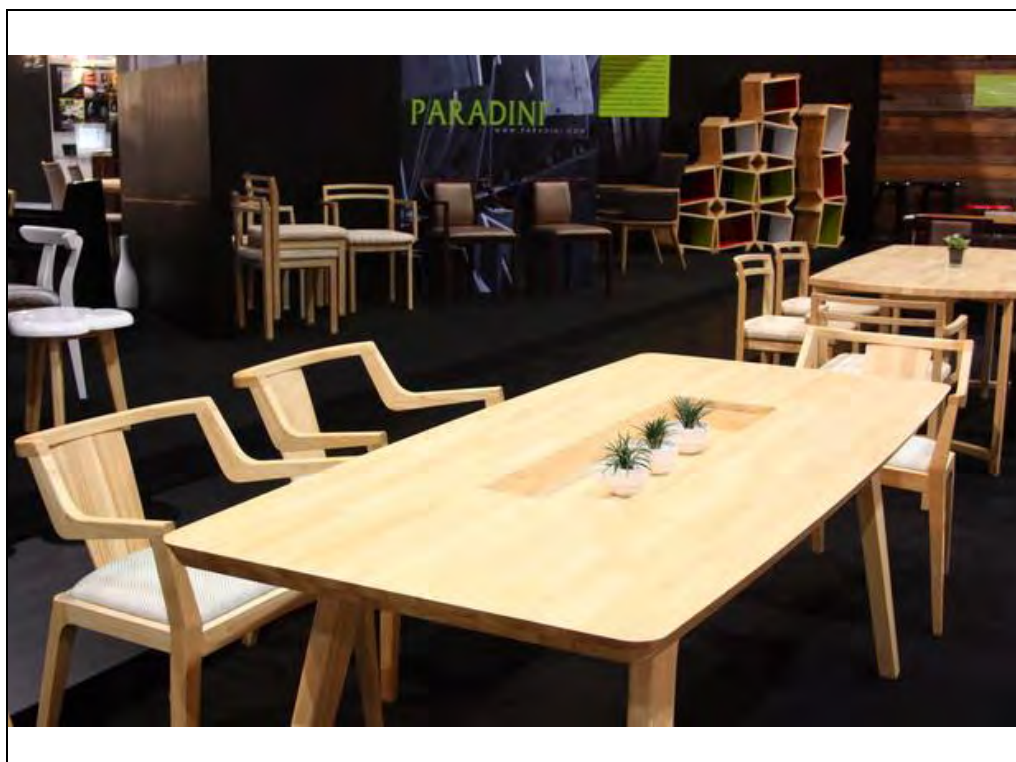
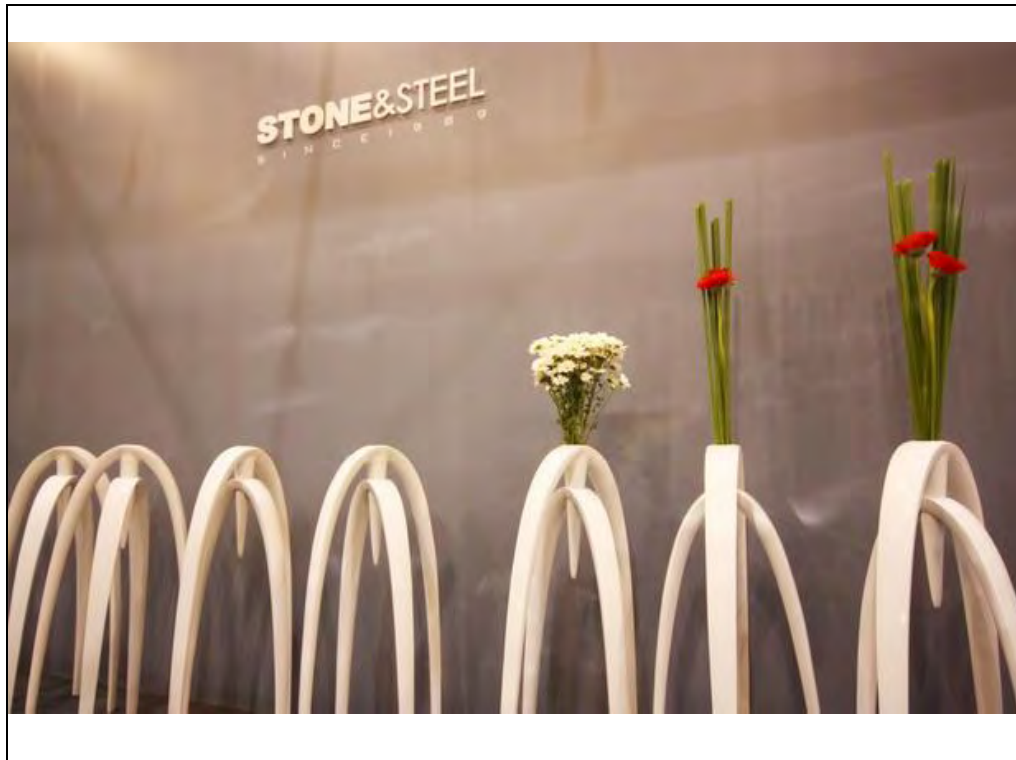


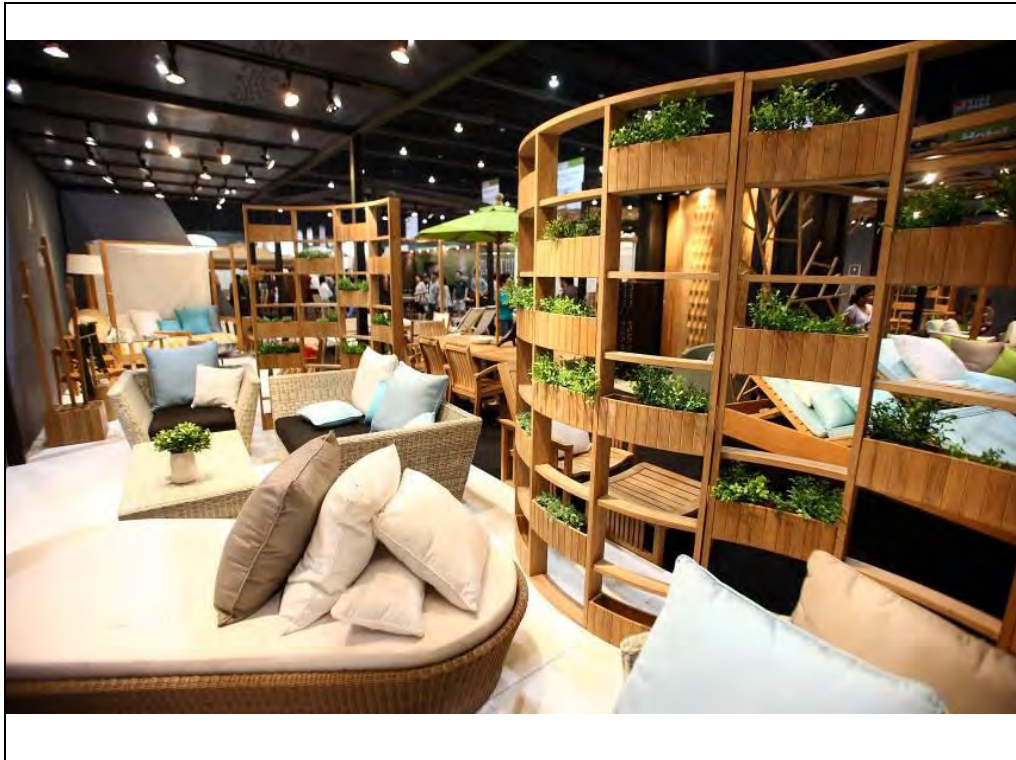


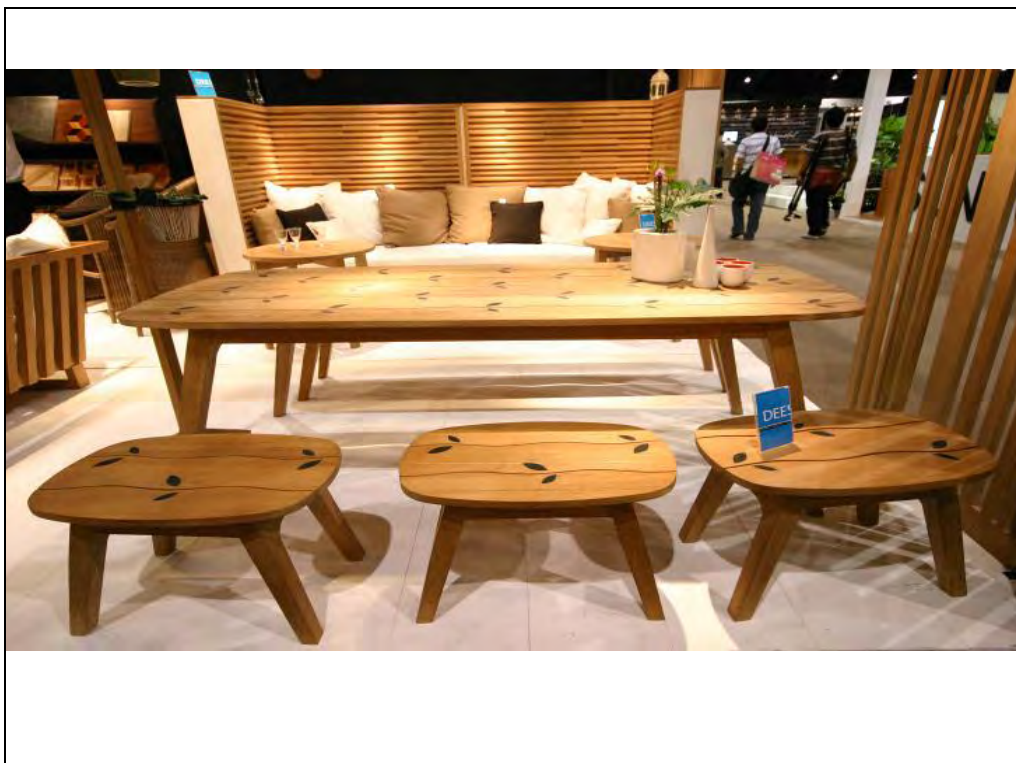


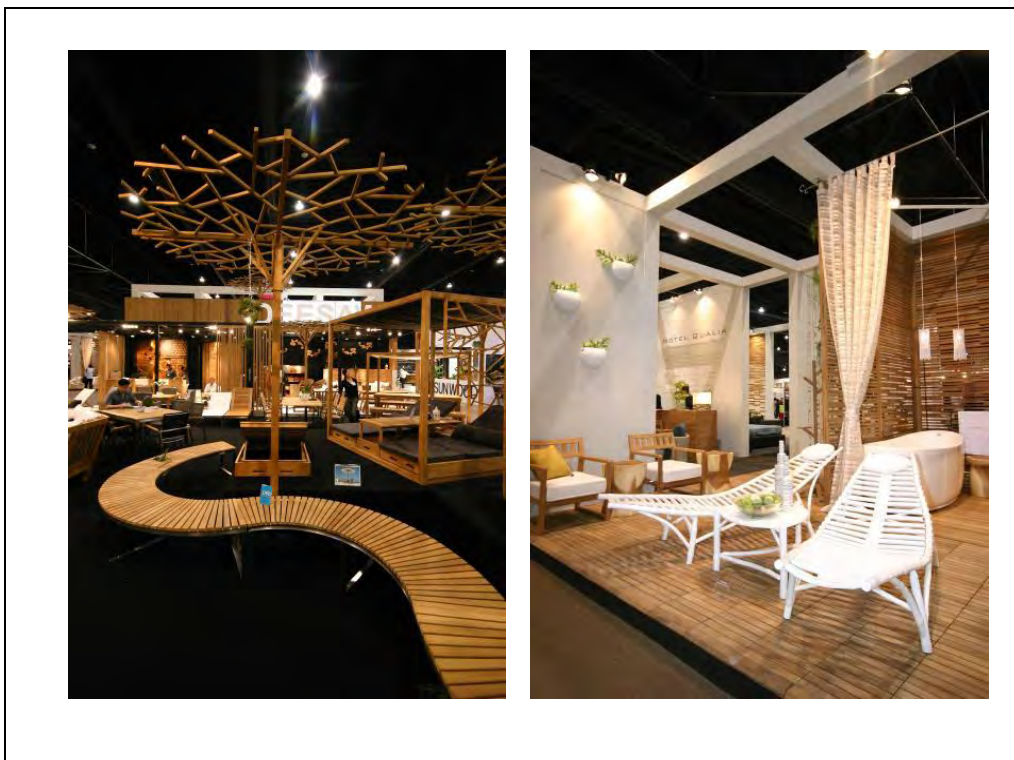
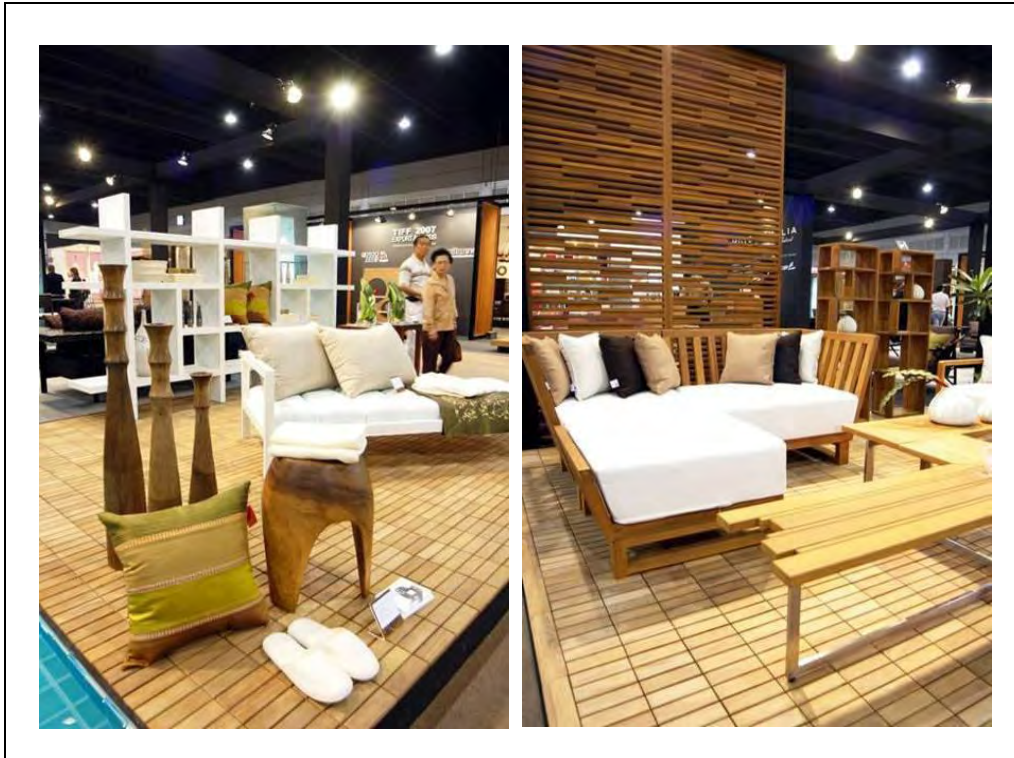


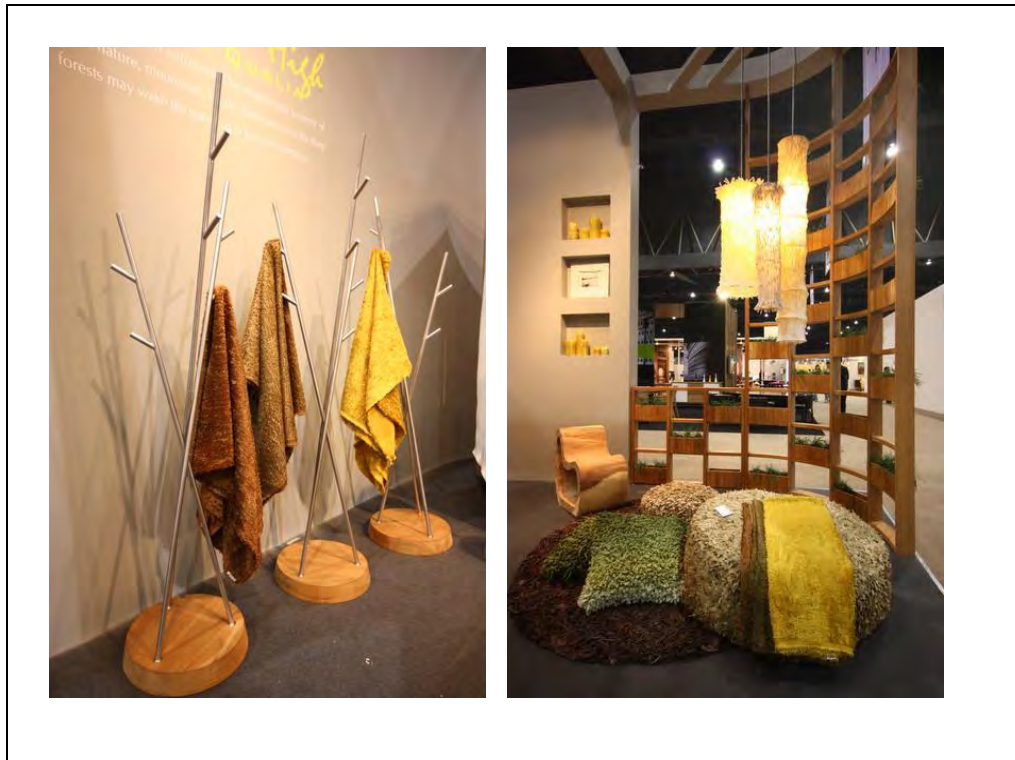






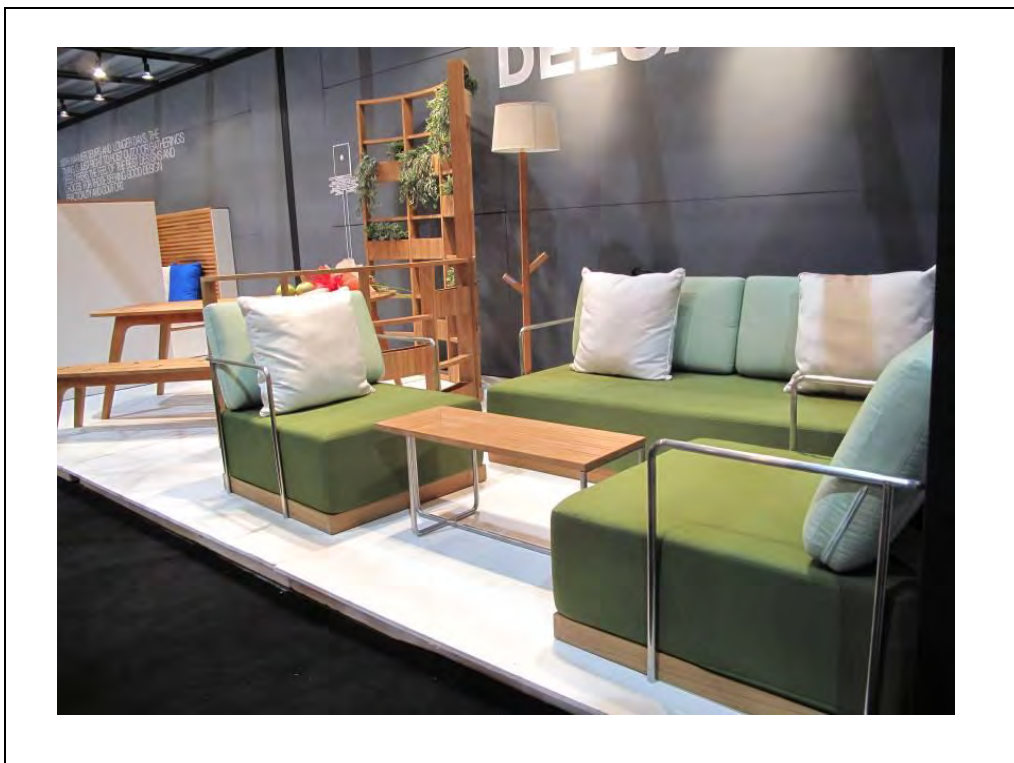
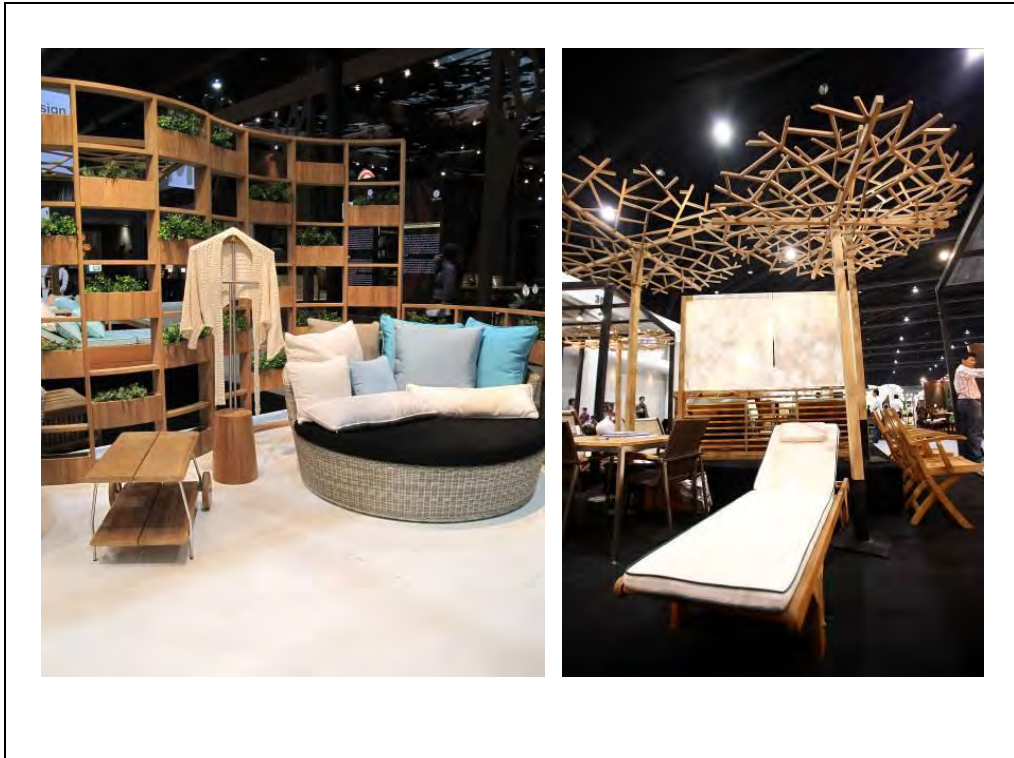


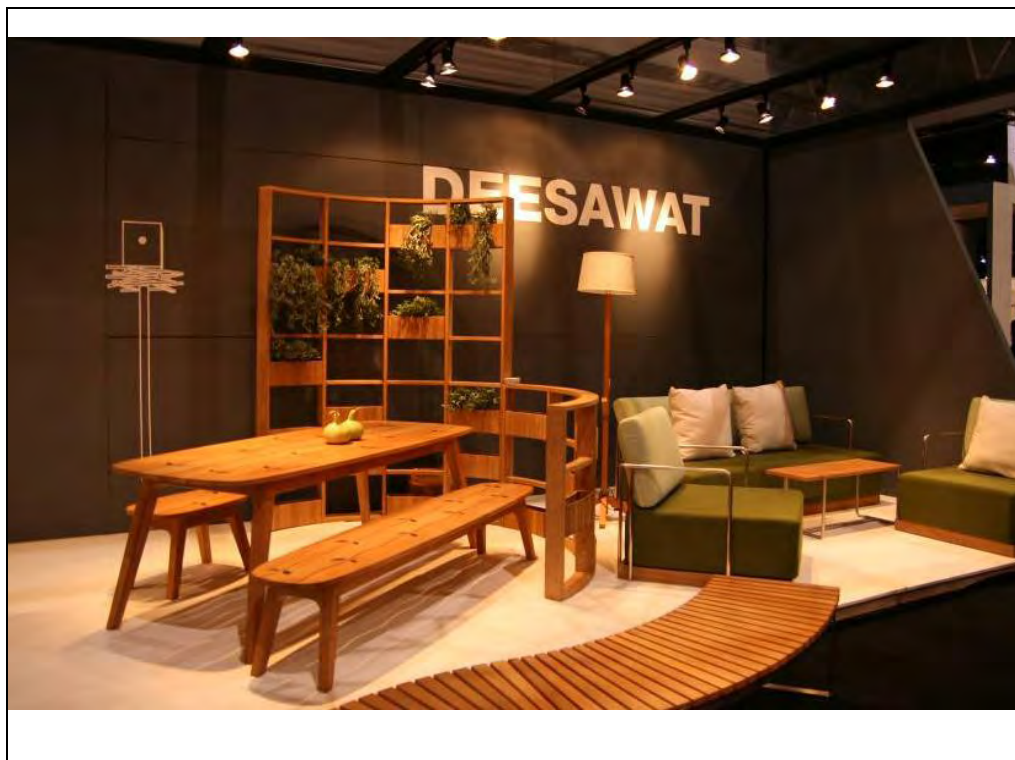
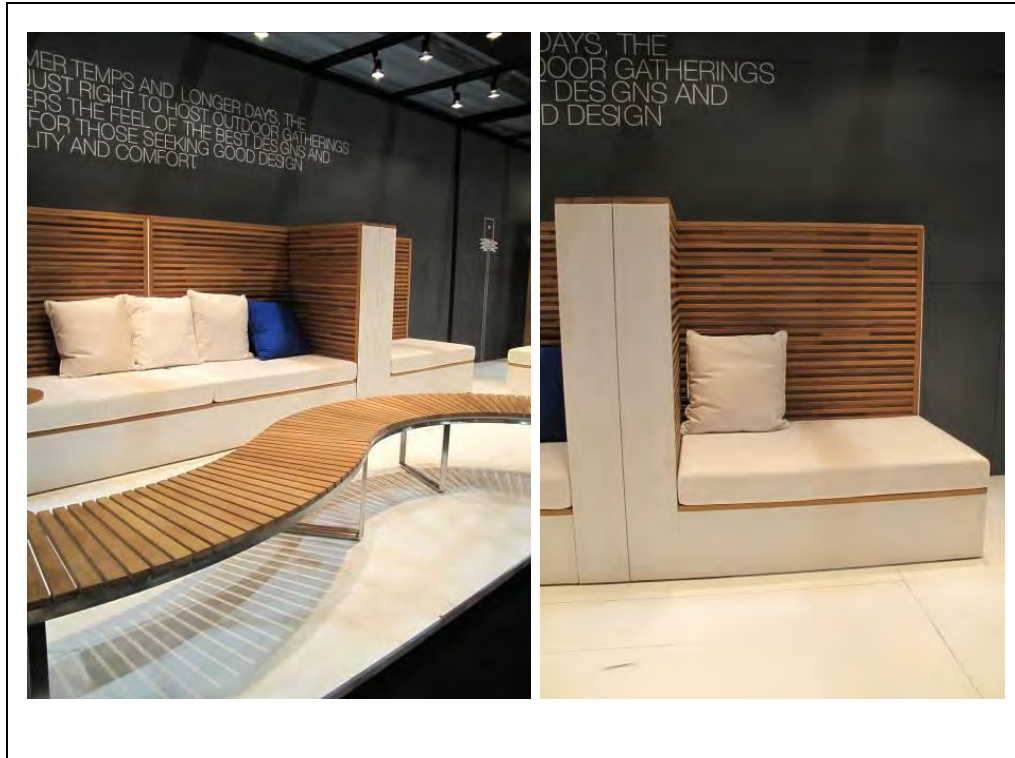




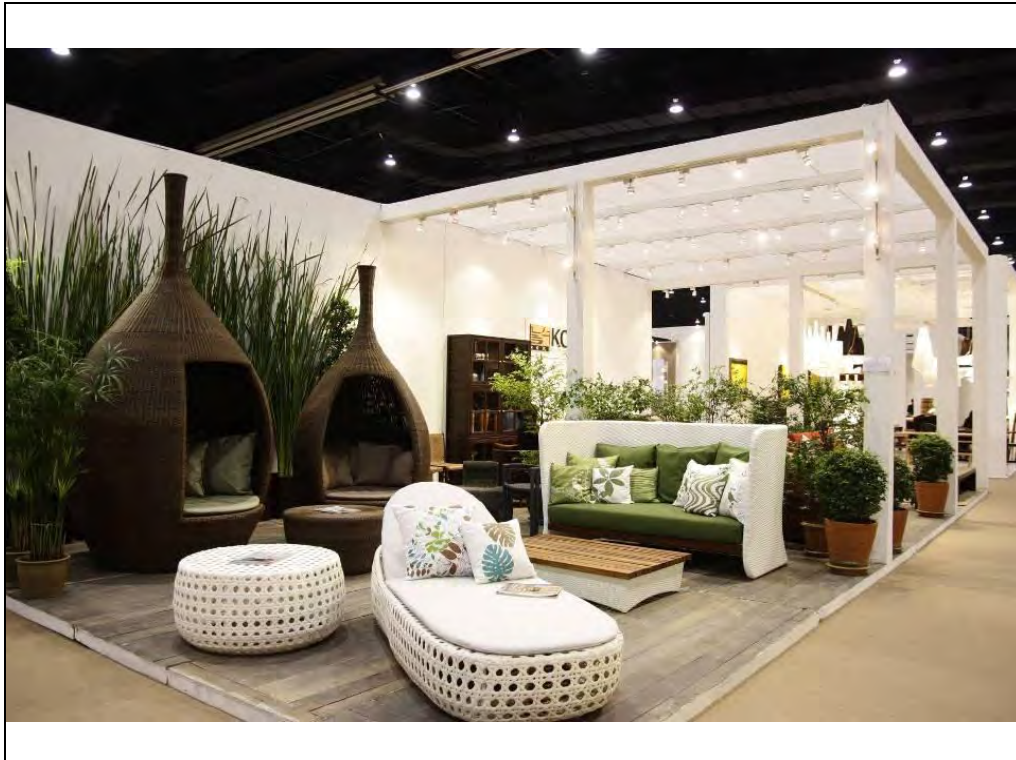


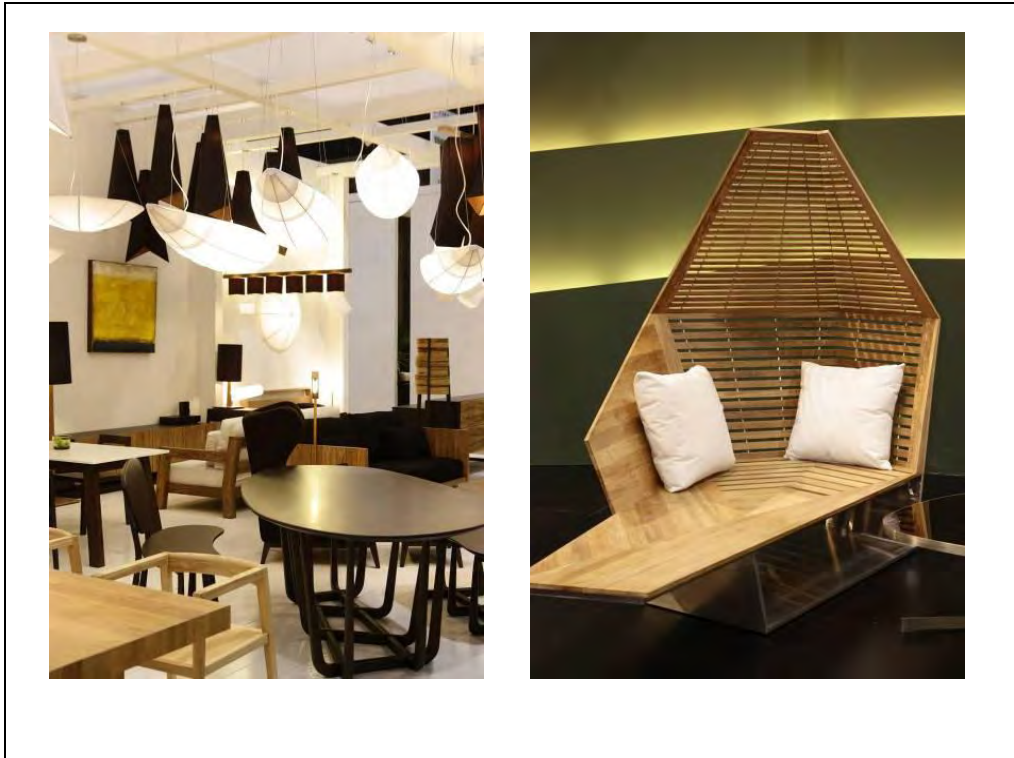


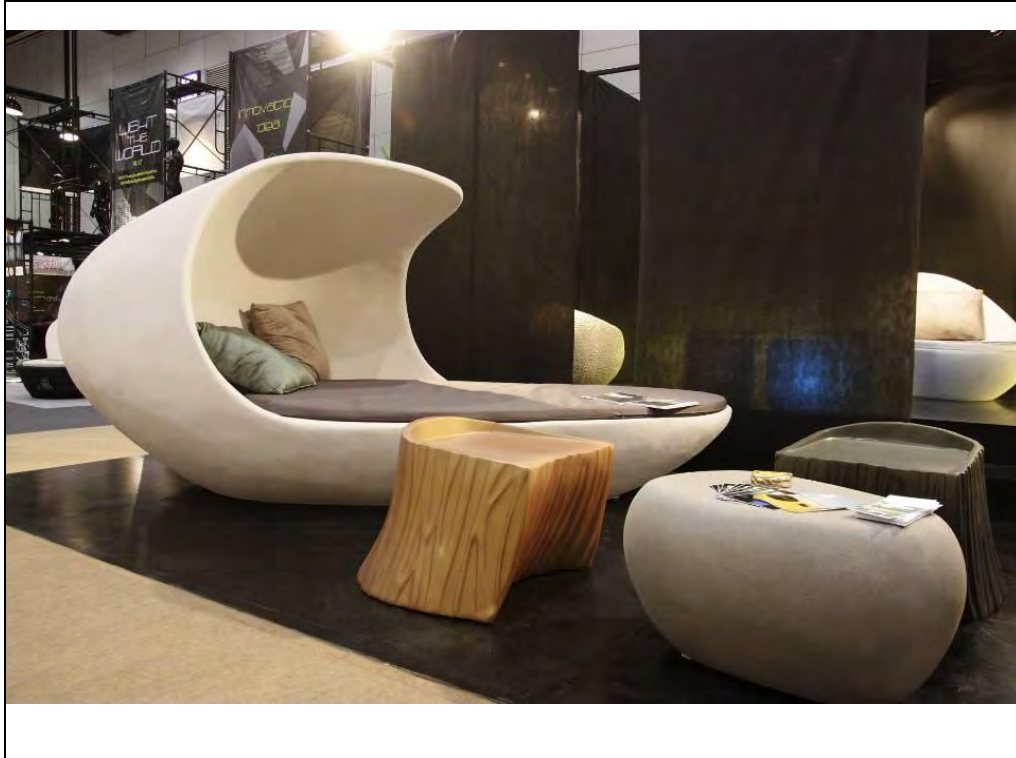


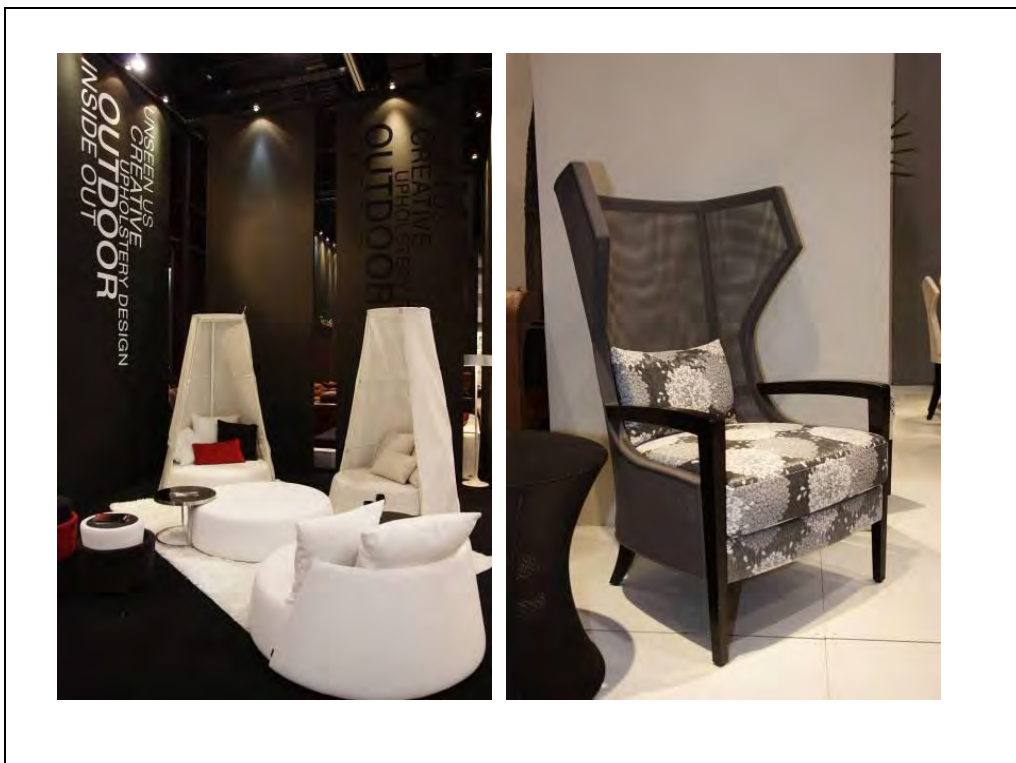














How to let people know??



Mythaidesign.com



Living A Green Life **TIFF 2010**
Furniture Decor & Lifestyle

Coming to Thailand!

Don't miss this Furniture Design Fair with Styles for a Greener Planet.
Only comes once a year!

E-Direct Mail No. 8

TIFF 2010 "Living A Green Life"

Here is your chance to see this remarkable traveling "Furniture for a Greener Planet" exhibition that only comes to Thailand once a year! You'll also be able to meet Thailand's foremost designers, manufacturers and suppliers. There will be lots of activities as well as exhibits of the most creative and innovative ideas that also reflect the highest quality and safety for the environment and man.

THAILAND INTERNATIONAL FURNITURE FAIR 2010

Trade : 10-12 March 2010 (10.00-19.00 hrs)
Public : 13-14 March 2010 (10.00-21.00 hrs)
Venue : The Challenger, IMPACT, Muang Thong Thani, Thailand
www.thailandfurniturefair.com

Hurry to register! This festival comes only once a year!
For the best furniture and home décor
Featuring the most creative designs and ideas
Far beyond your imagination...
All at TIFF 2010

Register Now To attend BUSINESS MATCHING

Pre - Register

Product Hi-light

More information

Exhibitor List

Special Activities

Green Furniture Showcase

The finest furniture for a green life will be only display at the Green Furniture Factory magazine exhibit. The ideas are stylish, innovative and eco-friendly, and clearly demonstrate that Thailand is now among the leaders in the production and export of Green Furniture. This is a must to see because of the quality of materials, meticulous craftsmanship and uniqueness of each design.

Ensure that you have the latest and the greatest possible collections of furniture designs from Thailand that are Inspiring, Original, Green and Admirable.

Visit www.mythosdesign.com today
Join the live conversation on Twitter and Facebook.

Organized by:  Supported by:  

Living A Green Life **TIFF 2010**
Furniture Decor & Lifestyle

The Countdown has begun

For the Green Furniture Exhibition
Only once a Year
In Thailand

E-Direct Mail No. 9

TIFF 2010 "Living A Green Life"

Get ready to see the Green Furniture Caravan. This once-a-year showcase will be filled with exhibits of the most creative and innovative ideas by the foremost Thai designers. Here you will be able to discuss new business opportunities with Thailand's best manufacturers and suppliers. With such a comprehensive exhibition, you're certain to find everything you could hope for.

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Exhibitor List

Special Activities

American Hard Wood Design Camp

TIFF 2010 has organized the American Hardwood Design Camp project to support creative students and give them a stage to display their outstanding work. You don't want to miss seeing these new and innovative ideas as, in the future, these could become top selling furniture and home décor.

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Visit www.mythosdesign.com today
Join the live conversation on Twitter and Facebook.

Organized by:  Supported by:  

Ready to see...



Living A Green Life
TIFE 2010
Furniture Decor & Lifestyle



Thailand's biggest and best
Green Furniture Exhibition
Your only chance
as it comes
Only Once A Year!

E-Direct Mail No.10



TIFF 2010 "Living A Green Life"

This furniture and home décor showcase is Thailand's biggest of the year. Organized by the Department of Export Promotion (DEP) under the Ministry of Commerce, supported by Thai Furniture Industry Club, the Federation of Thai Industries, and Thai Furniture Industries Association, this opportunity cannot be missed. This will be your chance to meet award-winning Thai designers, manufacturers and suppliers as well as see thousands of pieces of furniture and home décor designed and manufactured especially for a greener world.

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Hurry to register! This festival comes only once a year!
For the best furniture and home décor
Featuring the most creative designs and ideas
Far beyond your imagination...
All at TIFF 2010.

Many Activities Not to be Missed

- Business Matching: Chance to expand business opportunities
- DEmark: Design Excellence Award Exhibition
- Waste to Wealth Project: Furniture produced with recyclable materials
- T Style Project by Toshiyuki Kita: World renowned Japanese designer
- Green Furniture Showcase: Innovative designs conceived to protect our planet
- American Hardwood Design Camp: Innovative furniture designs by creative students

Ensure that you have the latest and the greatest possible collections of furniture designs from Thailand that are Inspiring, Original, Green and Admirable.

Visit www.mythailandesign.com today.
Join the live conversation on Twitter and Facebook.

Register Now
To attend
BUSINESS
MATCHING

Pre - Register

**Product
Hi-light**

**Exhibitor
List**

**More
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**Special
Activities**

Organized by:  

Supported by: 

Furniture



Living A Green Life
TIFE 2010
Furniture Decor & Lifestyle

Showcase
in Thailand Soon!
Thousands of amazing designs
to make our world greener!





TIFF 2010 "Living A Green Life"

Thailand's foremost designers will be exhibiting their innovative work. Together with a vast selection of furniture and décor, all manufactured using quality materials and production systems friendly to our environment.

THAILAND INTERNATIONAL FURNITURE FAIR 2010

Trade : 10-12 March 2010 (10.00-19.00 hrs)
Public : 13-14 March 2010 (10.00-21.00 hrs)
Venue : The Challenger, IMPACT, Muang Thong Thani, Thailand
www.thailandfurniturefair.com

Hurry to register! This festival comes only once a year!
For the best furniture and home décor
Featuring the most creative designs and ideas
Far beyond your imagination...
All at TIFF 2010.

TIFF 2010 comes only once a year!

Hurry to register to exhibit your "green" creations! This is also a great chance to meet potential partners and enlarge your business network.

Thailand's Most Important Furniture Show offers you the chance to select from a wide range of imaginative, stylish products; meet the designers, manufacturers and distributors as well as join many special activities that can help your business grow.

Register Now
To attend
BUSINESS
MATCHING

Pre - registration

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here**

Exhibitor

Information

Special

Organized by:  

Supported by: 



Thailand

International Furniture Festival
Blending Nature with Design
Come Only Once a Year



TIFF 2010 "Living A Green Life"
This Furniture Trade Show features creations adored worldwide by Thailand's foremost designers, using a variety of natural materials, including those that can replace wood. This is also your chance to meet designers, manufacturers, traders and entrepreneurs and enlarge your business network.



TIFF comes just once a year!
Exhibiting the best design concepts!
A vast selection of smart and stylish furniture and home décor, all designed to help reduce Global Warming. Here you'll see the results of creative ideas produced with artistry and craftsmanship. A blend of simplicity and refined elegance manufactured with materials using processes friendly to our environment.

THAILAND INTERNATIONAL FURNITURE FAIR 2010
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Exhibitor
List

More
information

Special
Activities

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IMPACT

TIFA



The Best...

Thai furniture designs
that break new ground
in innovation for
a Greener Life



TIFF 2010 "Living A Green Life"
This furniture and home décor fair will unveil the very best, most captivating, innovative designs, certain to please you as well as our environment. Here you will see the most creative ideas and quality products as well as environmentally safe production processes, reputed the world over.



Expand your vision and business opportunities with the most innovative ideas and industry alliances.
This is your chance to meet with designers, manufacturers, traders and entrepreneurs and enlarge your business network. Take advantage of this rare opportunity to examine furnishings, equipment, raw resources, interior design materials, and more as suppliers unveil their latest designs that go beyond all expectations in creative thinking while they help reduce global warming.

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Activities

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TIFA



Living A Green Life
TIFF 2010
Furniture Decor & Lifestyle

Awesome designs! Amazing Ideas!

Thousands of Thai-created
Eco-friendly
'Green' Designs...
What everyone is waiting for!




TIFF 2010 "Living A Green Life"

This furniture and home decor fair features stylish solutions to combat global warming and preserve our climate. The designs are extraordinary. The colors spellbinding. The creativity beyond description. Innovative designs creativity up to development of natural materials to produce new. A vast collection of innovative products, both Thai and from abroad, produced with all forms of natural materials unveils for you a whole new dimension in furniture design and manufacturing.

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For the best furniture and home decor
Featuring the most creative designs and ideas
Far beyond your imagination...
All at TIFF 2010

This is your chance to build closer business relationships!

TIFF comes just once a year to Thailand. It's the biggest gathering and your best chance to meet designers, manufacturers, and the movers of the Thai furniture industry. With as many as 800 booths, here is a sure opportunity to expand your business prospects and success.

Register Now
To attend
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MATCHING

Pre - Register

Product
Hi-light

Exhibitor
List

More
information

Special
Activities







Living A Green Life
TIFF 2010
Furniture Decor & Lifestyle

Furniture for A Green Life

Thousands of
Stunning Designs
Showcase is
Coming Soon!




TIFF 2010 "Living A Green Life"

The Thailand outstanding furniture fair unveils a whole new dimension in design innovations. This year, keep on following reduce global warming trend, manufacturers and designers persist in presenting their newest designs in this event. With the country's high potentials, TIFF 2010 will also offering attractive investment opportunities to discover new networks and success. Come to visit TIFF 2010, you will clearly see and understand just how exceptional Thailand's manufacturers, materials, skilled craftsmanship and suppliers truly are.

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For the best furniture and home decor
Featuring the most creative designs and ideas
Far beyond your imagination...
All at TIFF 2010

"T Style Project" The outstanding Thai designs, displayed by renowned Japanese designer

The winners of the "Contract Market" project held in Japan will be on display in total lifestyle concept. Chosen by Toshiyuki Kita, one of Japan's foremost designers, this impressive collection of Thai export designs clearly show just how outstanding Thai products are when compared to the best of the world.

Register Now
To attend
BUSINESS
MATCHING

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Product
Hi-light

Exhibitor
List

More
information

Special
Activities





The Best in Furniture Design

Living A Green Life Furniture Decor & Lifestyle

TIFF 2010

E-Direct Mail No.6

TIFF 2010 "Living A Green Life"

Thailand's biggest and best furniture & home décor showcase offers you the best chance to expand your business. Here you can meet the foremost Thai designers, manufacturers and suppliers. You can also take a close look at their stylish creations designed with natural materials to help reduce global warming with thousands of designs on display.

THAILAND INTERNATIONAL FURNITURE FAIR 2010

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Featuring the most creative designs and ideas
Far beyond your imagination...
All at TIFF 2010

The Best for a Green Life

The Best Creative Innovations Here, in Thailand!



"Demark" the mark of design excellence

Demark, or the Mark of Design Excellence, showcases award winning designs in two categories: Industrial Handicrafts and Industrial Products. Organized by the Thai government as a special design project, TIFF 2010 will serve as the stage for this outstanding furniture.

Register Now To attend BUSINESS MATCHING

Pre-Register

Product Hi-light

Exhibitor List

More information

Special Activities

Organized by 

Supported by 

Almost Here!

Living A Green Life Furniture Decor & Lifestyle

TIFF 2010

E-Direct Mail No.7

TIFF 2010 "Living A Green Life"

With more than 800 booths featuring the finest furniture and home décor, you can see the most innovative designs created by Thai designers for a greener life. You can also meet and talk to the designers, manufacturers and suppliers, known for their quality, world standard, innovative products. Coming just once a year, TIFF 2010 is a rare opportunity that cannot be missed!

THAILAND INTERNATIONAL FURNITURE FAIR 2010

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For the best furniture and home décor
Featuring the most creative designs and ideas
Far beyond your imagination...
All at TIFF 2010

Don't miss this 'Once-a-Year' Furniture for Greener Living Showcase!



Waste to Wealth Project

Another of the TIFF 2010 supported projects, "Waste to Wealth", organized to support Thai Industrial Technology Development (ITAP), showcases furniture produced from waste products. It unveils for you another avenue to help reduce global warming using recycled materials. These Valued Added Furniture are an important alternative to protect our ecosystem and preserve our environment. These innovative products are certain to be an amazing surprise!

Register Now To attend BUSINESS MATCHING

Pre-Register

Product Hi-light

Exhibitor List

More information

Special Activities

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Supported by 

To wrap up Thai Design

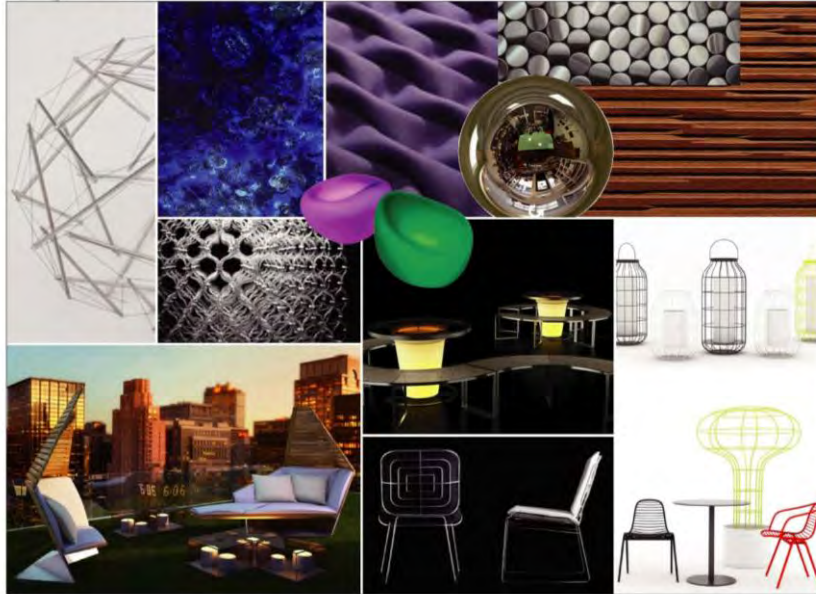
Hybrid & Unison

Contrast, Mixture, Harmony, or Integration of things bring us wonderful effects & results

Key Words

- Combination & contrast of **materials**
- Mixture of traditional **craft** & the newest **technology**
- Harmony of **style & function**
- Integration of international product & **sense of Thai**

Hybrid & Unison



Reflection of Nature

The mother Nature, a treasure house of our inspiration

Key Words

- Inspiration from **nature & everyday life**
- Usage of **natural material** from Thailand
- **Hand craft** with a long history
- Philosophy of **eco-conscious**
- **Sustainable design** for environment

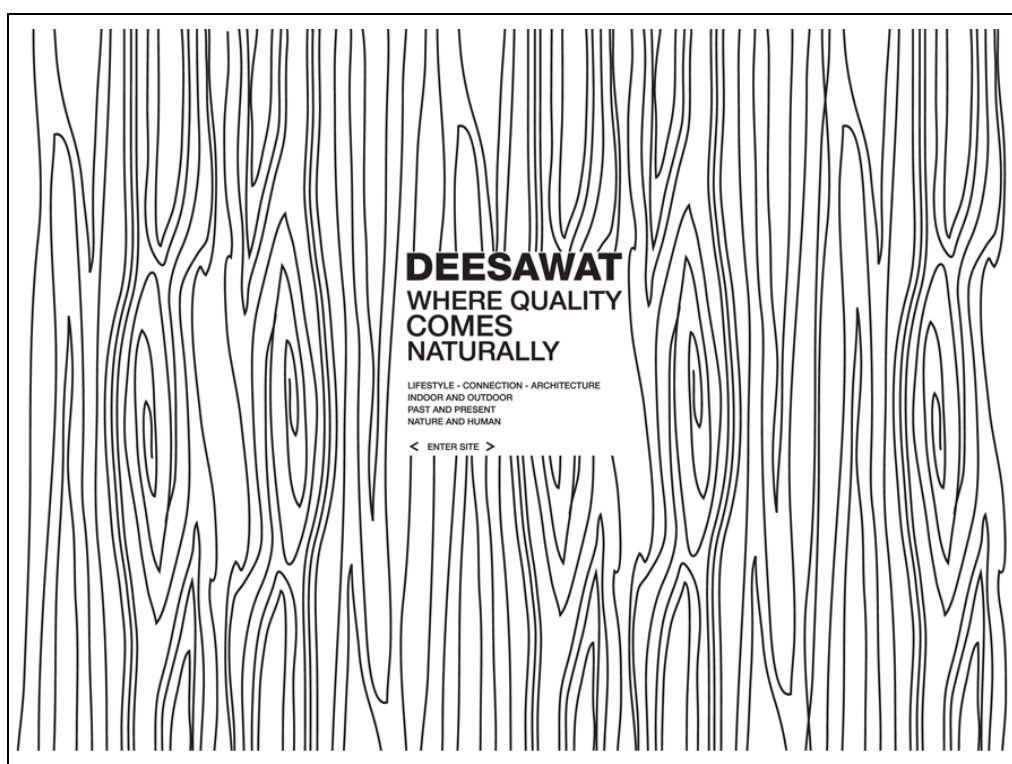


Action / ReAction

We believe our actions, concept and design bring positive reactions to our life.

Key Words

- **Action** of "RE-concept" causes good **Reaction** to the world.
- We have responsibilities for our **Actions** because of its social, environmental, and ecological **Reactions**.
- **Actions** of our functional furniture give us delightful **Reactions**.



Deesawat

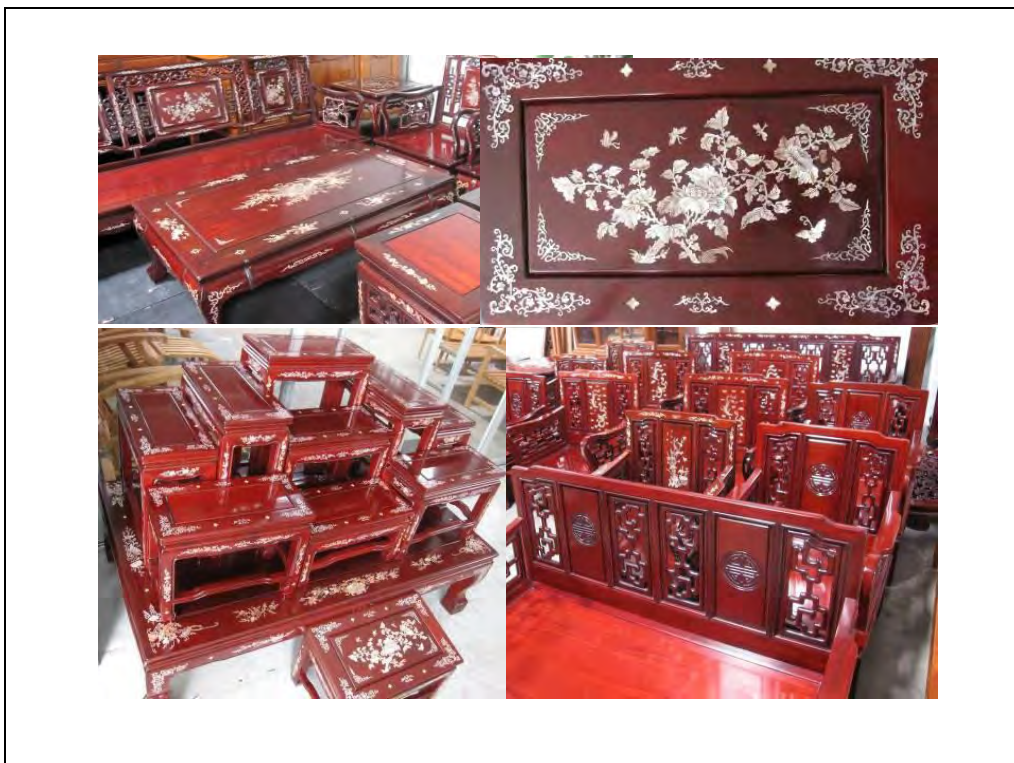
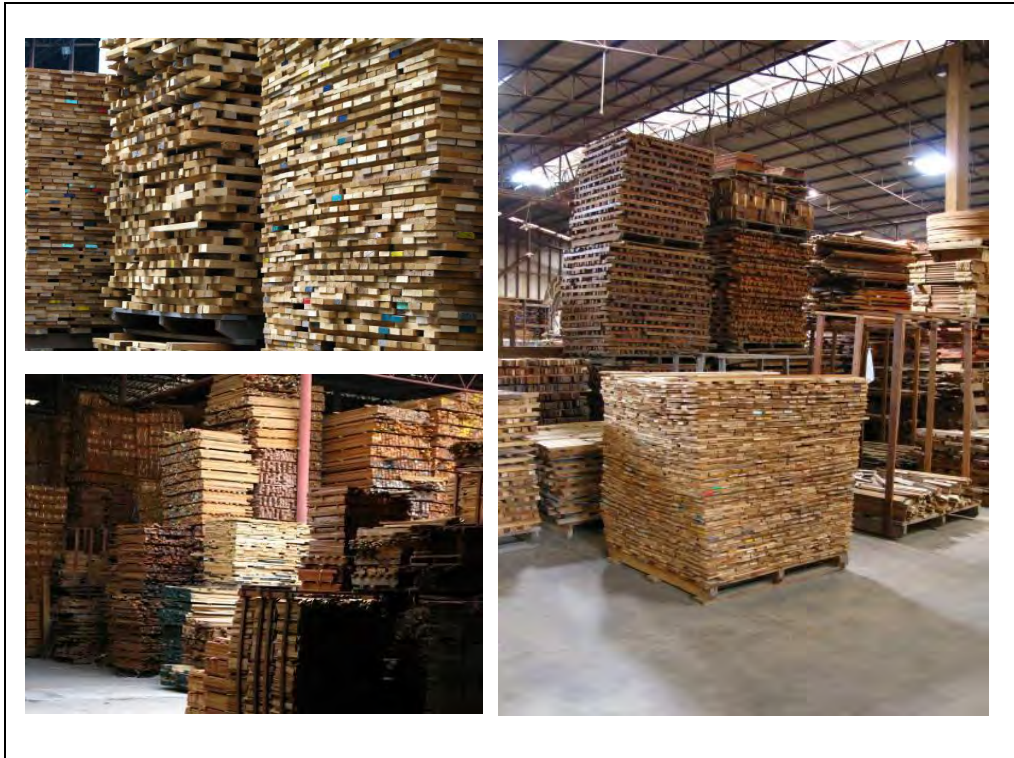


1972
**Saw mill, wood
processor**
BOI

Deesawat



***Rosewood Furniture, flooring, door,
etc***



Deesawat



***Branches: Hong Kong,
Singapore,
USA (New York, Houston, San
Francisco)***

Deesawat



**Deesawat Industries
Co.,Ltd.
Deesawat Design
Co.,Ltd.
Newsawat Sawmill Ltd.**

Deesawat



Crisis

Deesawat



Restructure

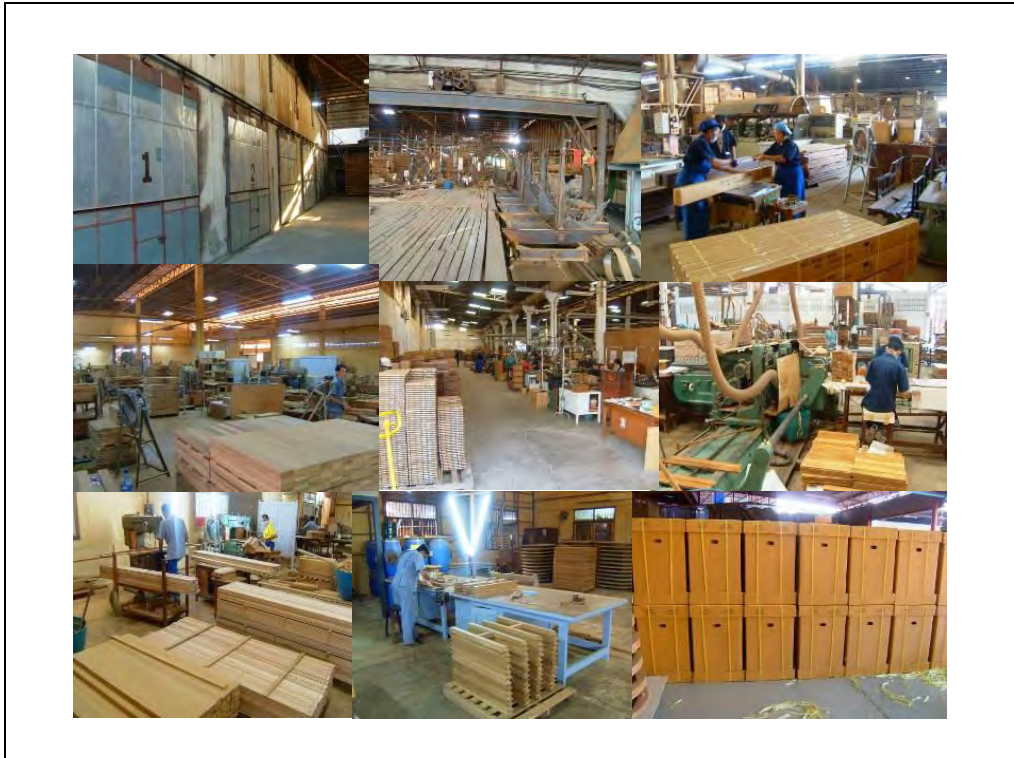


“SME is the key”

Deesawat Team

- Management/ sale/
Design 40
- Production 200





- Awarded Royal Flag
Environmentally
sound factory

Ministry of
Industry

Best SMEs
National Award
2006



Prime Minister's Industry Award (SME)





asia furniture Leadership award

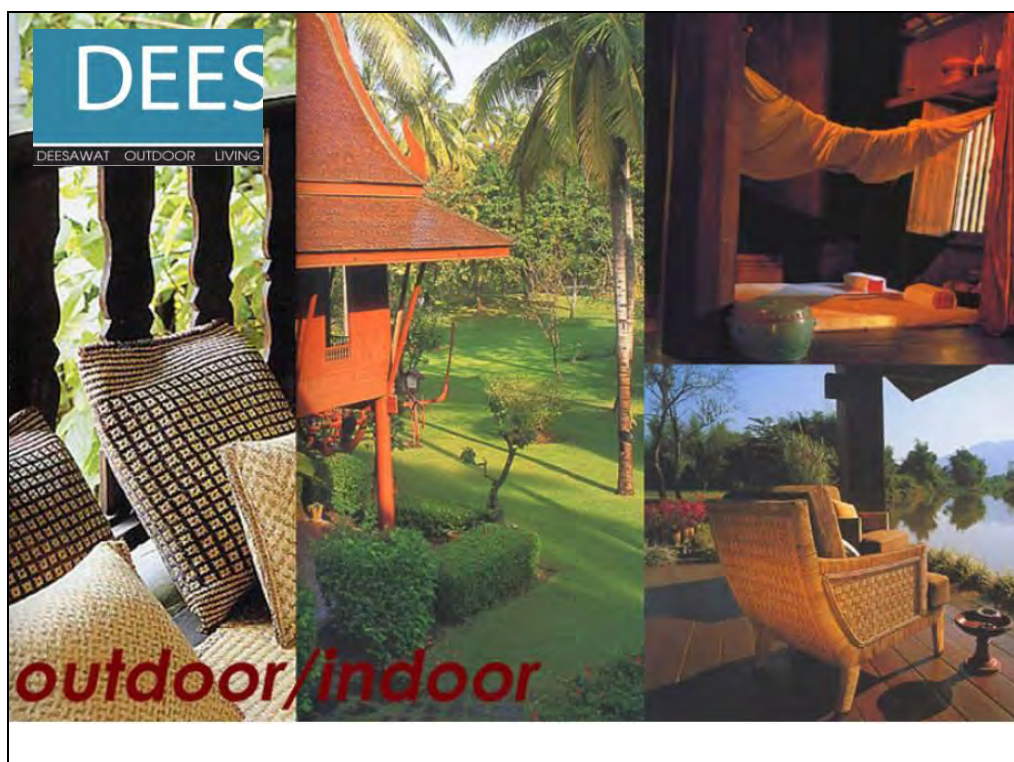


Sustainable Furnishing Council
(SFC)

Greenleader / Green AP









Brand Personality

Expert
Relax
Tasteful





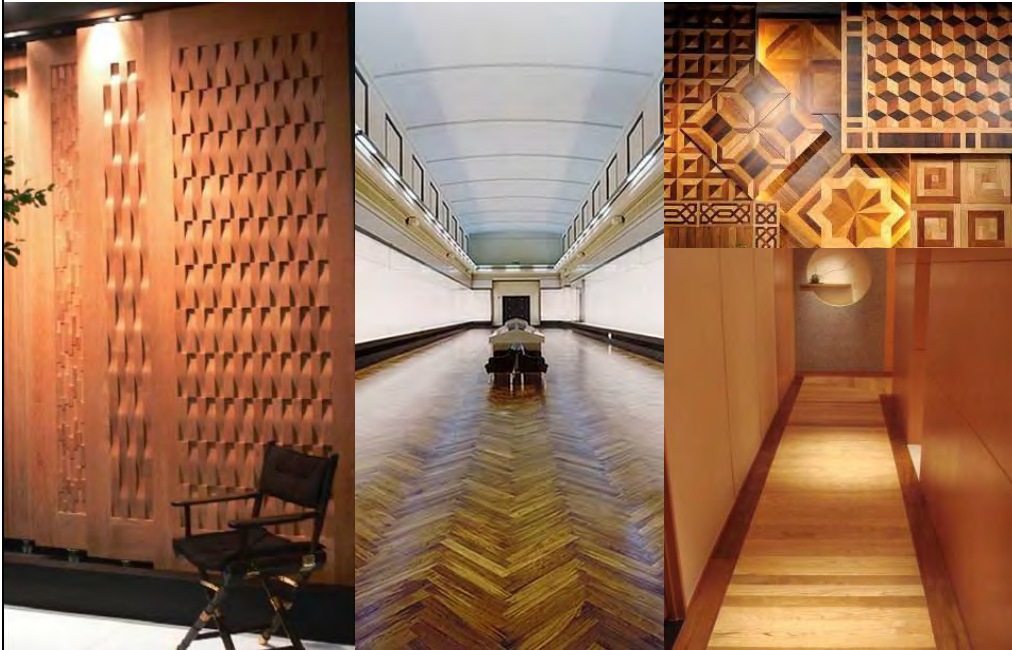
Indoor outdoor lifestyle



Outdoor architecture



Architecture



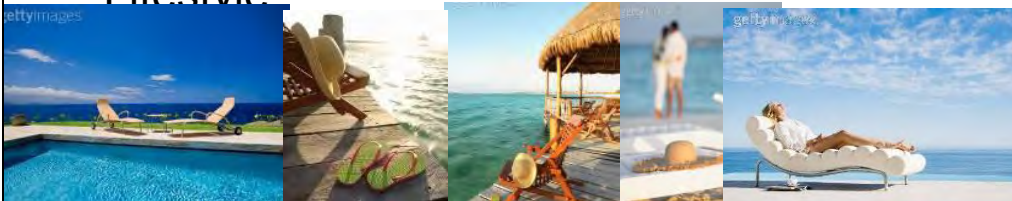
Design theme:
tropical contemporary

casual living

Product



Lifestyle





Deesawat has been awarded G-Mark Design Award 2005 (Good Design Award) from Japan for its MANHATAN stacking chair



Design Export Award 2006
Deesawat has been awarded TIFF Export Award for the category "Best Garden Furniture" by the Department of Export Promotion, Ministry of Commerce in 2006



2006
EXPORT AWARDS
Best Garden Furniture

BOSTON CL



Design Export Award 2007
Deesawat has been awarded TIFF
Export Award for the category "Best
Garden Furniture" by the Department
of Export Promotion, Ministry of
Commerce in 2007

TIFF 2007
EXPORT AWARDS
Best Garden Furniture

BOSTON LEAF BENCH

DEESAWAT

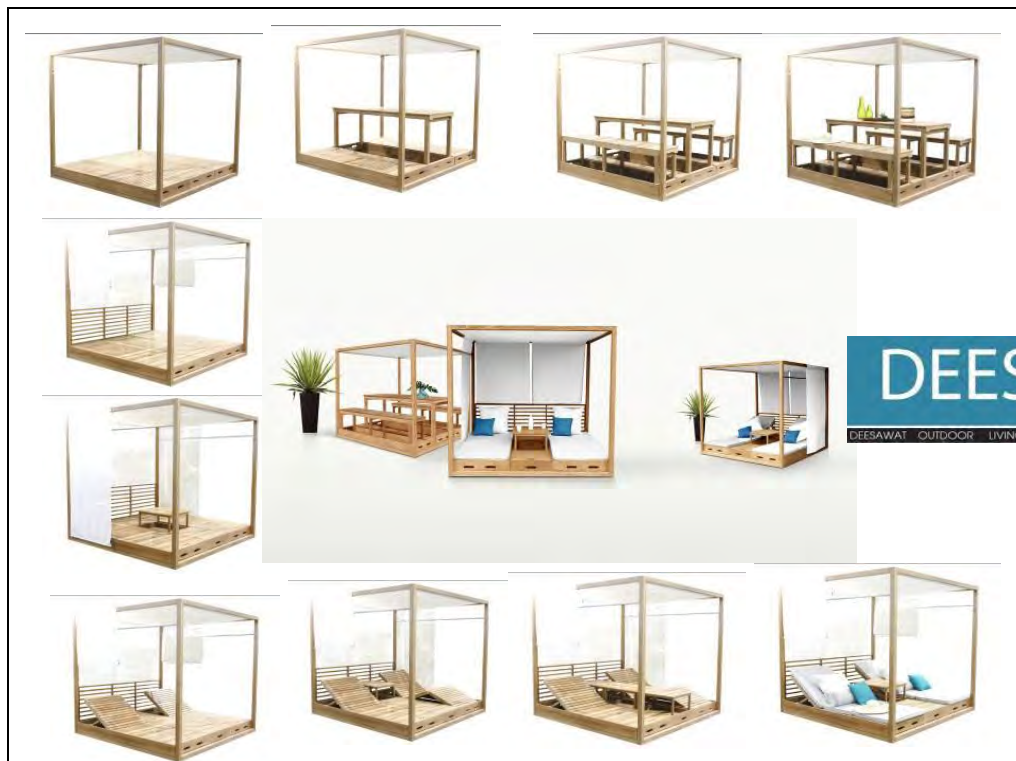
WHERE QUALITY COMES NATURALLY

LIFESTYLE - CONNECTION - ARCHITECTURE
INDOOR AND OUTDOOR
PAST AND PRESENT
NATURE AND HUMAN

OUR PASSION FOR WOOD HAS INSPIRED OUR DESIGNERS
TO DEVELOP MANY FURNITURE COLLECTION IN THE HIGHER
STANDARD OUTDOOR PRODUCTS TO THE WORLD. AND NOW
DEESAWAT OUTDOOR LIVING BY DEESAWAT SHOWCASES NOT ONLY
THE PRODUCTS FOR OUTDOOR BUT RATHER THE OUTDOOR
SOLUTIONS FEATURING THE UNIQUE INTERDEPENDENT
RELATIONSHIP BETWEEN SPACES AND LANDSCAPES CONNECTING
NATURE TO HUMAN ARCHITECTURE. THE ASTONISHING EFFECT
OF BOSTON LEAF DESIGN OFFERS THE COMFORT FEEL OF
OUTDOOR LIFESTYLE IN A CONTEMPORARY LIVING.



DEESAWAT INDUSTRIES CO. LTD.
71/9 MKO 3 CHANGKROK ROAD, LAKSI, BANGKOK
BANGKOK 10112 THAILAND
TEL: (662) 587-1341 FAX: (662) 551-1500
EMAIL: deesawat@nic.jn.com, info@deesawat.com
WEBSITE: www.deesawat.com



DEESAWAT OUTDOOR LIVING

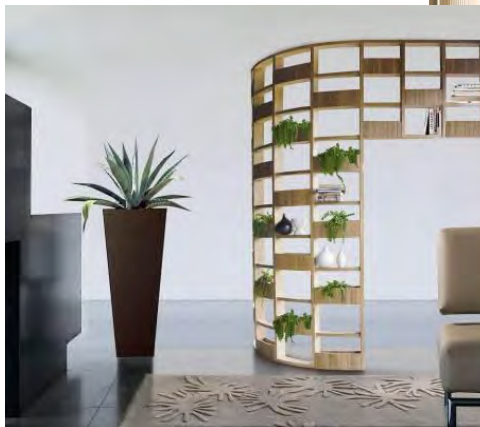
D-Mark Award 2008
G-Mark Award 2008

SUMMER CABANA
IS FLEXIBLE YET PRACTICAL. ORIGINATE FROM THE BASIC PLATFORM WHICH IS AVAILABLE IN 2 OPTIONS:
SUMMER BED AND SUMMER PICNIC. THIS COLLECTION ACCENTUATES CONTEMPORARY DESIGN FOR LIVING
IN ELEGANT SIMPLICITY BOTH OUTDOOR AND INDOORALIKE.

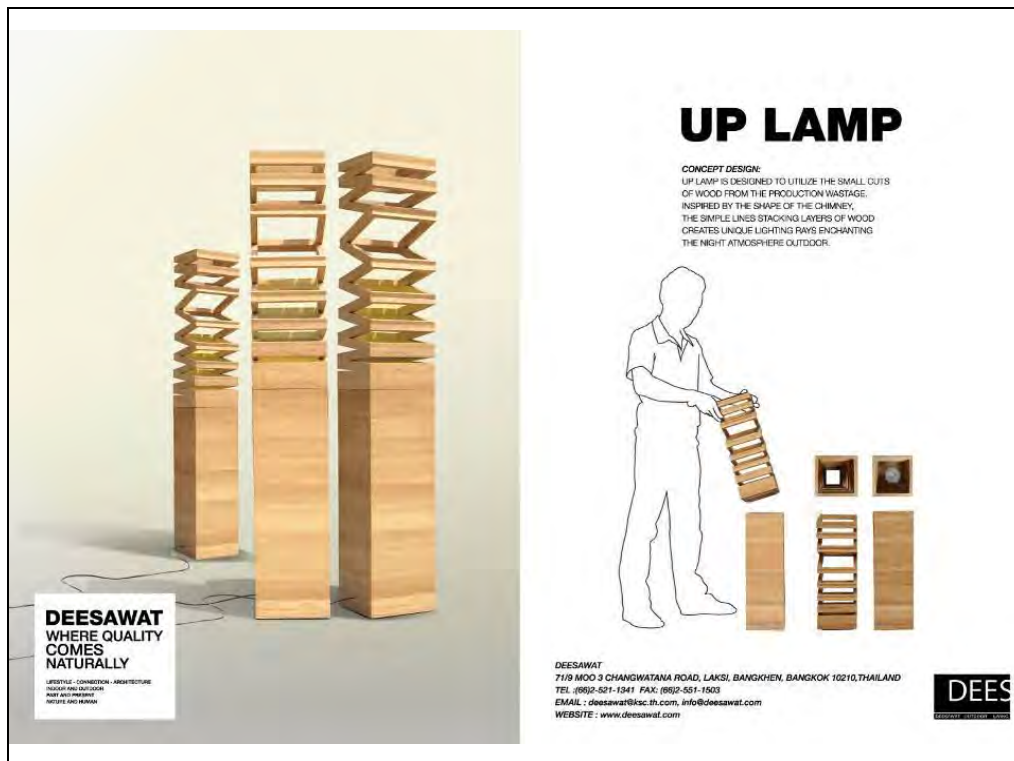
This award is the new recognition for design excellence to be awarded during Prime Minister Export Award organized by the Department of Export Promotion, Ministry of Commerce in 2008. The awarded products will continue as the first rounder for the D-Mark award in Tokyo

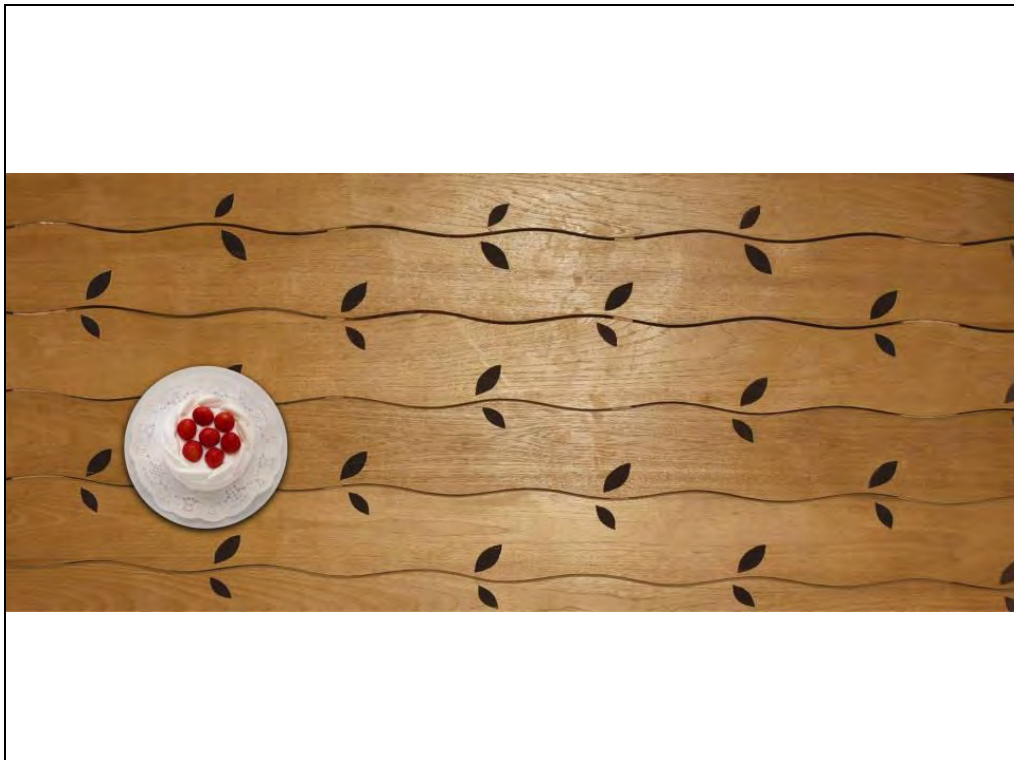


D-Mark Award 2009
G-Mark Award 2009
BODW design for Asia (bronze)



Green Wall : The idea to divide the space could be attached with outdoor spirit. The contoured wall can create the soft and smooth division of room when the owner feel more close to nature







DEESAWAT
WHERE QUALITY
COMES
NATURALLY

LIFESTYLE - CONNECTION - ARCHITECTURE
DESIGN AND CATERING
PART AND PRESENT
NATURE AND HUMAN

WAVE

CONCEPT DESIGN:
OUTDOOR FURNITURE THAT IS INSPIRED BY THE FALLING LEAVES OF FALL. OUTLINES OF FALLING LEAVES ARE APPLIED AS ORNATE DECORATIONS ON THE TABLE AND BENCH SURFACES BY SIKAFLEX INLAY. THE TOPS OF THE TABLE AS WELL AS THE BENCHES ARE CUT AS CURVES, RESULTING IN THE GAPS BETWEEN EACH WOODEN BOARD WHICH SERVE AS BRANCHES FOR THE LEAVES. WELL-CALCULATED DESIGN LEADS TO A HARMONY BETWEEN OUTDOOR SURROUNDING AND FURNITURE.



DEESAWAT
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TEL: (66)2-521-1341 FAX: (66)2-551-1503
EMAIL: deesawat@ksc.th.com, info@deesawat.com
WEBSITE: www.deesawat.com

DEES
DESIGN & CONSTRUCTION

D-Mark 2010 G-Mark 2010



DEES
DEESAWAT OUTDOOR LIVING



Nest Tree :the
sculpture in the
garden for the trees
to grow on and the
birds to rest on





TIERA CIRCLE BENCH

CONCEPT DESIGN:
THE CONCEPT IS TO DEVELOP THE BENCH
WITH THE COMFORT OF THE SHADE.
INSPIRED WITH THE IMAGE OF SITTING UNDER THE TREE,
PARASOL, AND NEST TREE ARE USED TO MATCH
AS INVITING NOTE TO SPEND MORE TIME OUTDOOR.




DEESAWAT
WHERE QUALITY
COMES
NATURALLY

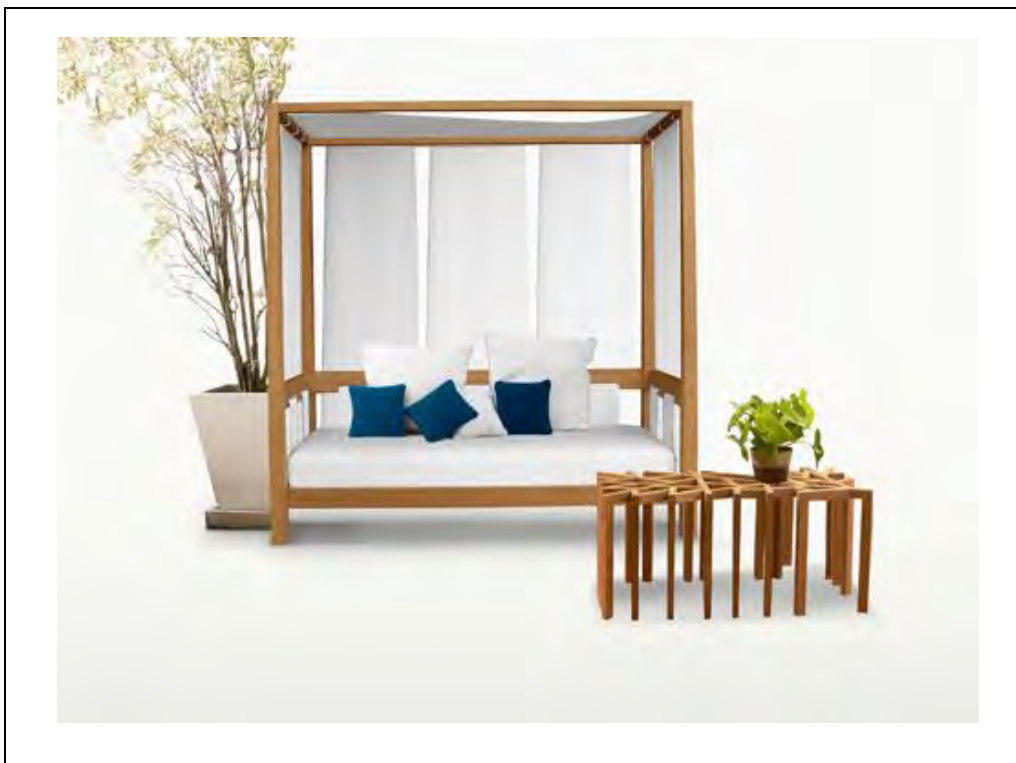
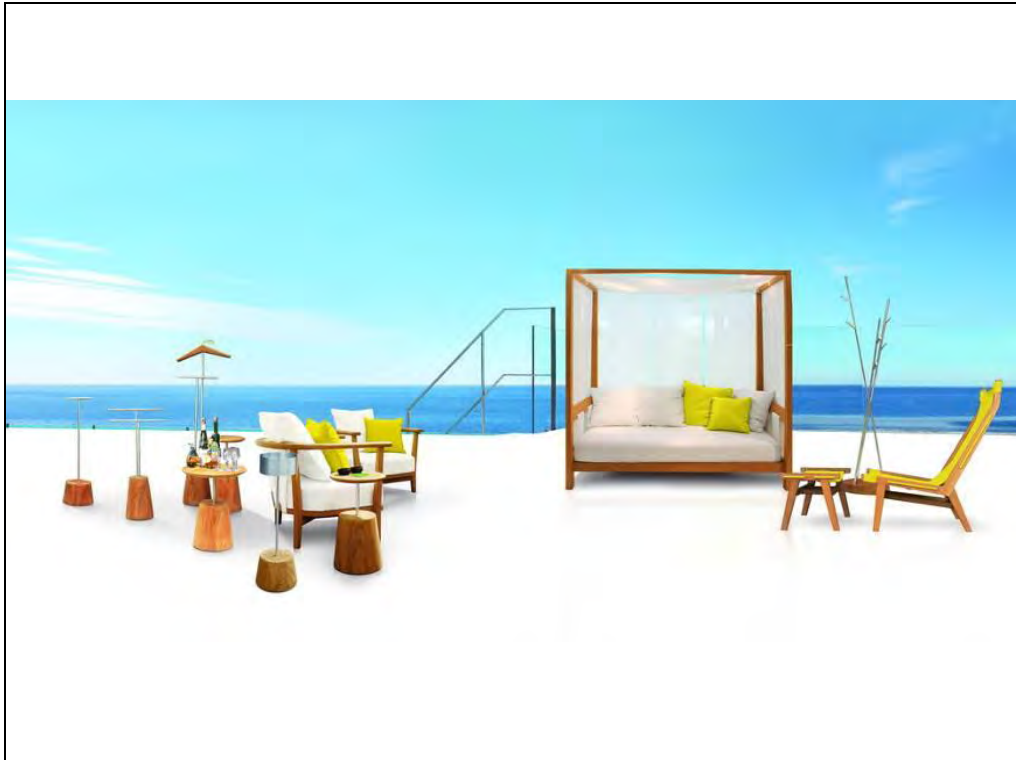
LUMINUS, CONTRACTOR, ARCHITECTURE
DESIGN AND INTERIOR
PROJECTS
NATURAL AND FURNISH

DEESAWAT
719 MOO 3 CHANGWATANA ROAD, LAKSI, BANGKOK, BANGKOK 10210, THAILAND
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EMAIL : deesawat@ksc.th.com, info@deesawat.com
WEBSITE : www.deesawat.com

DEES
DESIGN STUDIO

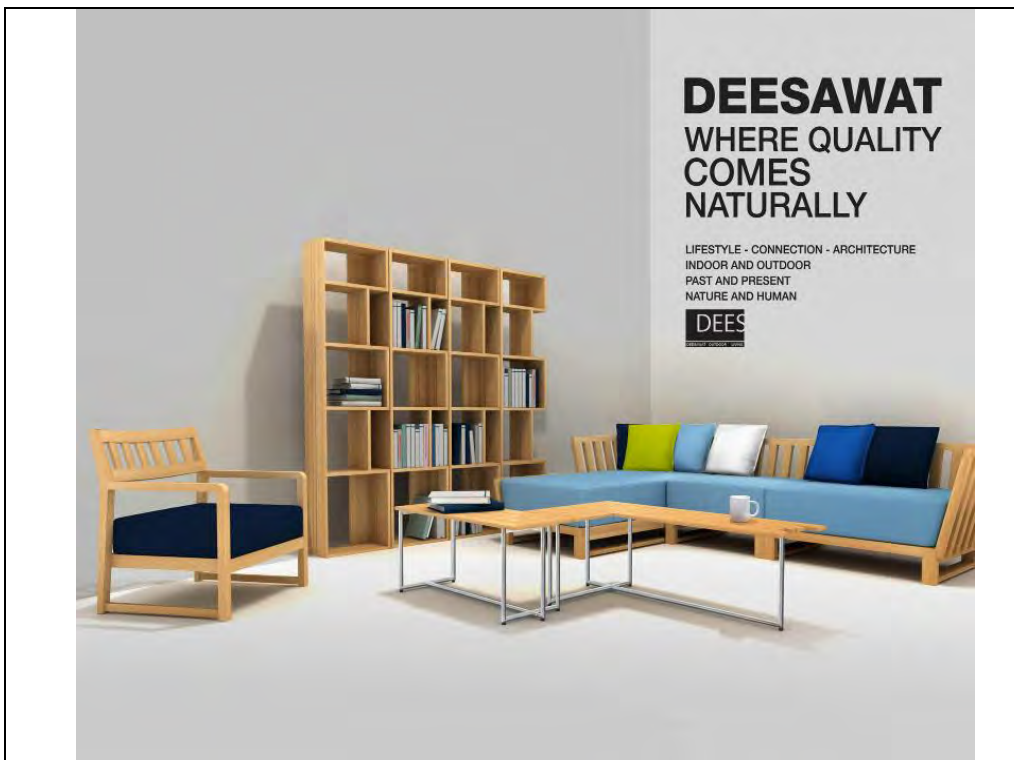


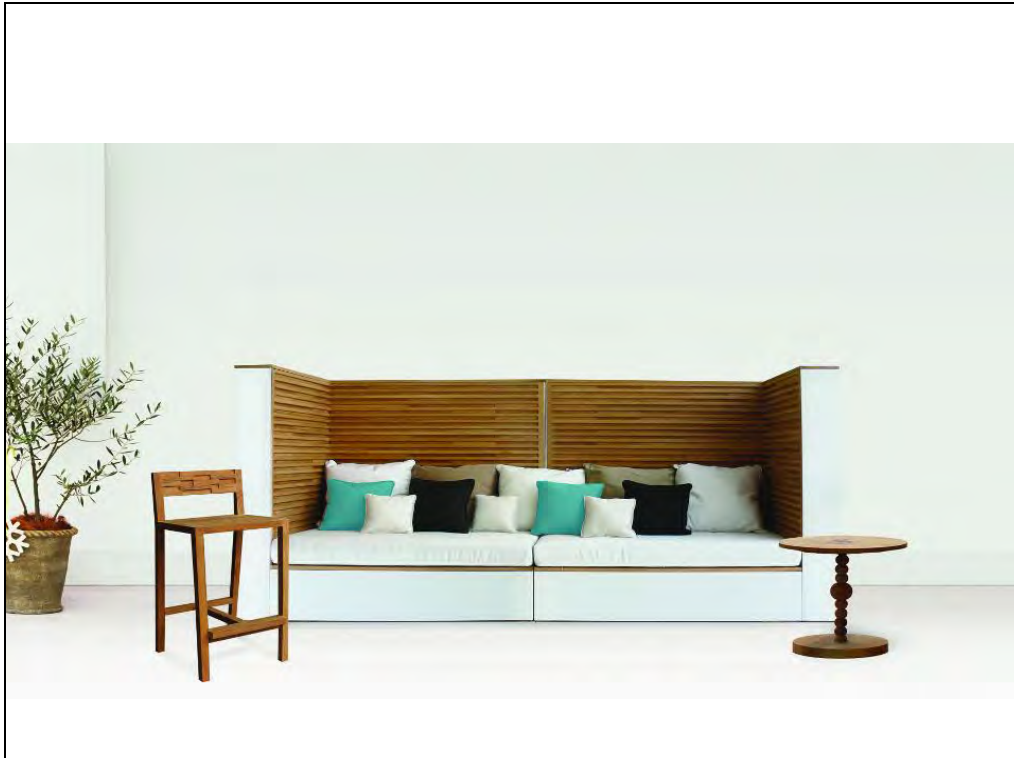




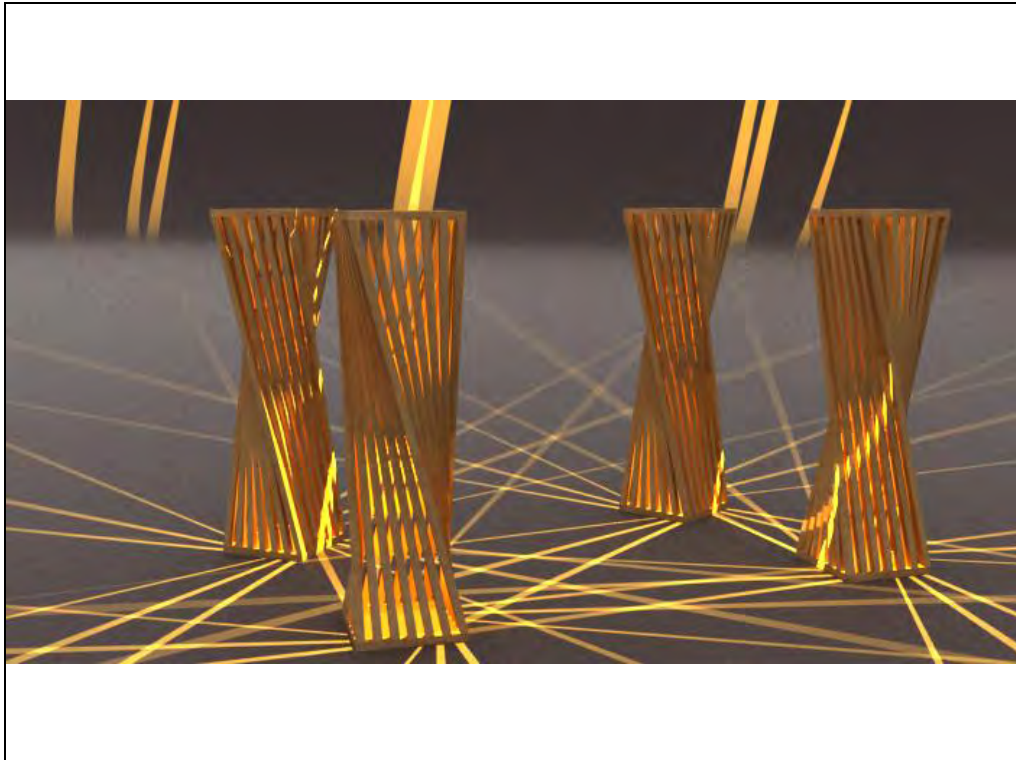













A collection of modern wooden furniture pieces. The central piece is a large, bottle-shaped chair with a red cushion. To its left is a smaller, bottle-shaped chair with a red cushion. To the right is a small wooden table. The pieces are arranged on a white reflective surface.

BOTTLE

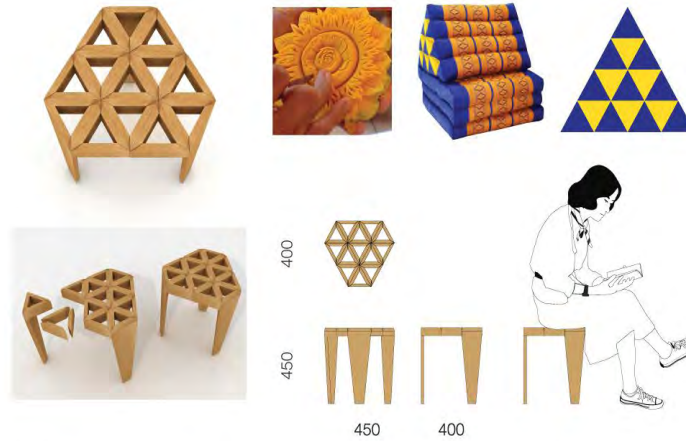
Bottle Collection arises from the shape itself and inspired the Thai traditional called **"COOP"** which emphasizes the instrument to catch the fish and create the private environment for outdoor setting.

Two small images showing the traditional Thai fishing instrument called "COOP". The left image shows a close-up of the instrument, and the right image shows a person using it in a body of water.
A row of glass bottles of various shapes and sizes, including some with red liquid and some with white liquid.



STAR

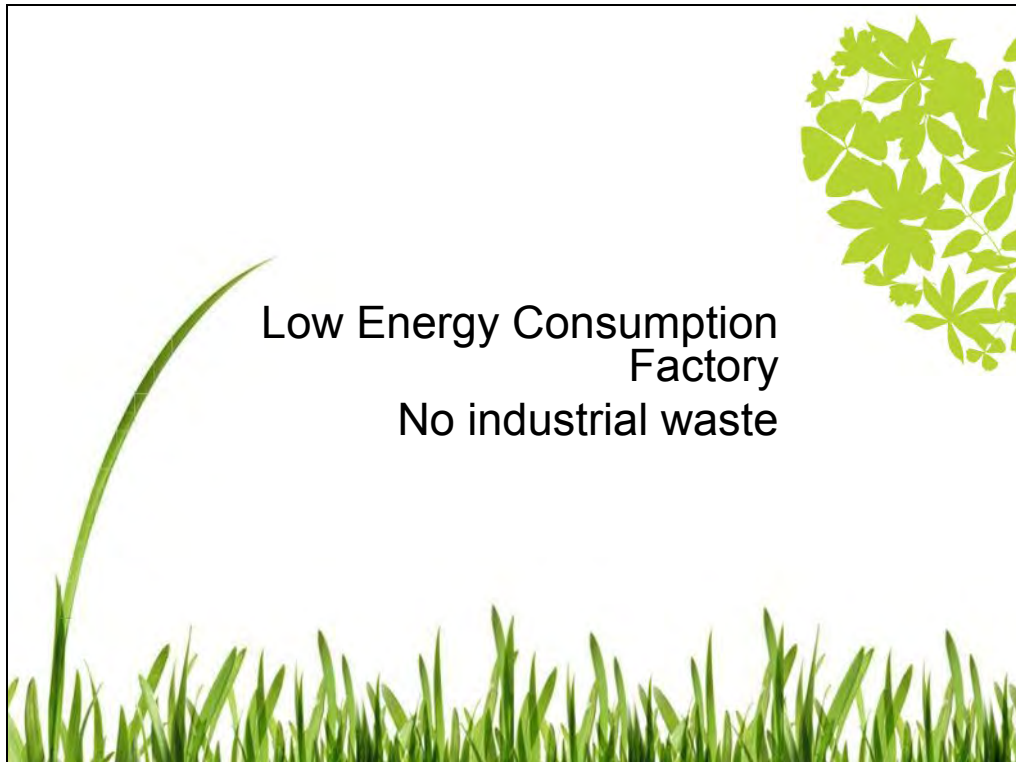
A simply design shape of triangle pillow that comes from the Traditional Thai Design creates the strength and image from bringing Thainess into contemporary design.



DEESAWAT

www.deesawat.com

STAR



Low Energy Consumption
Factory
No industrial waste



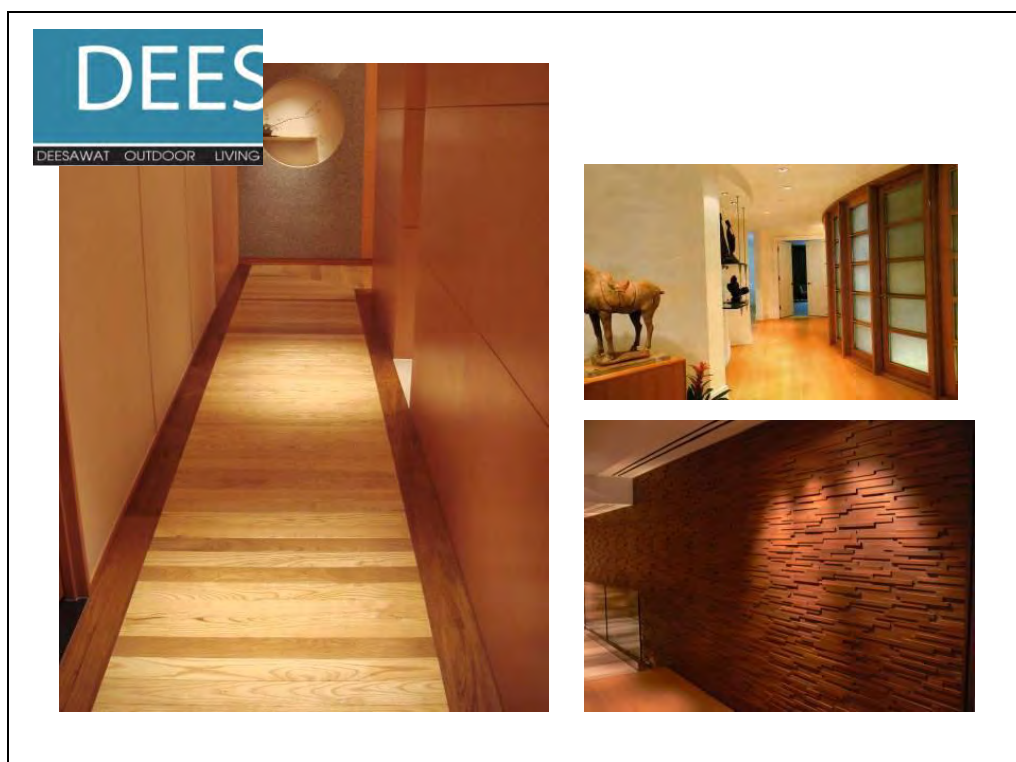
From Waste to
Wealth

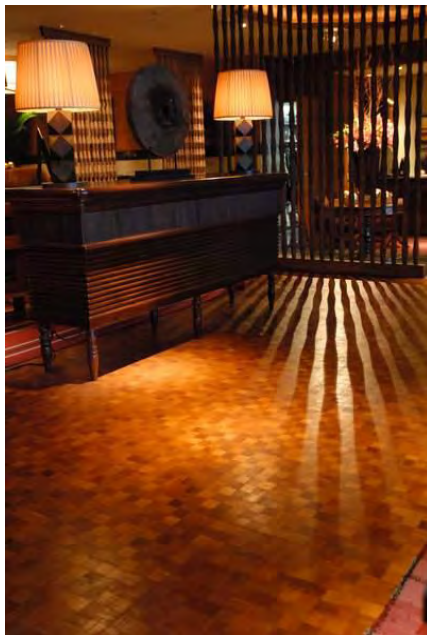
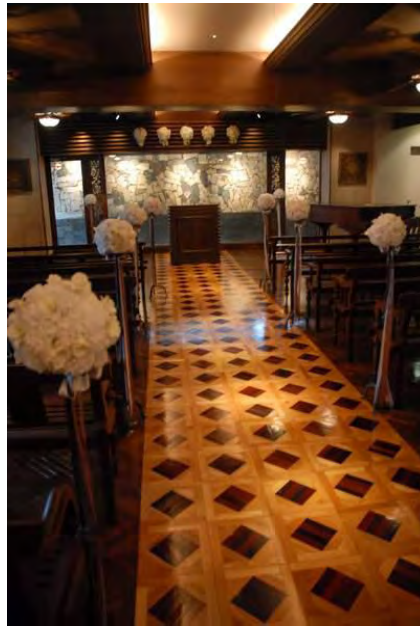
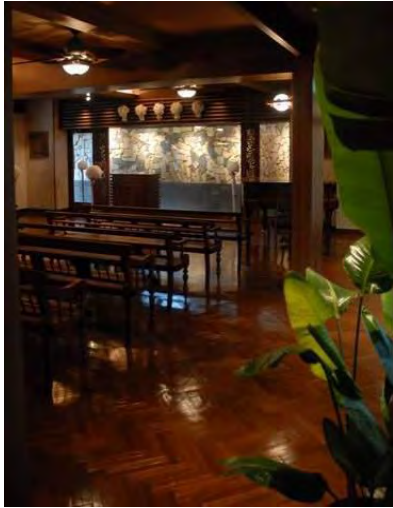
Turn the industrial garbage
into fine furniture

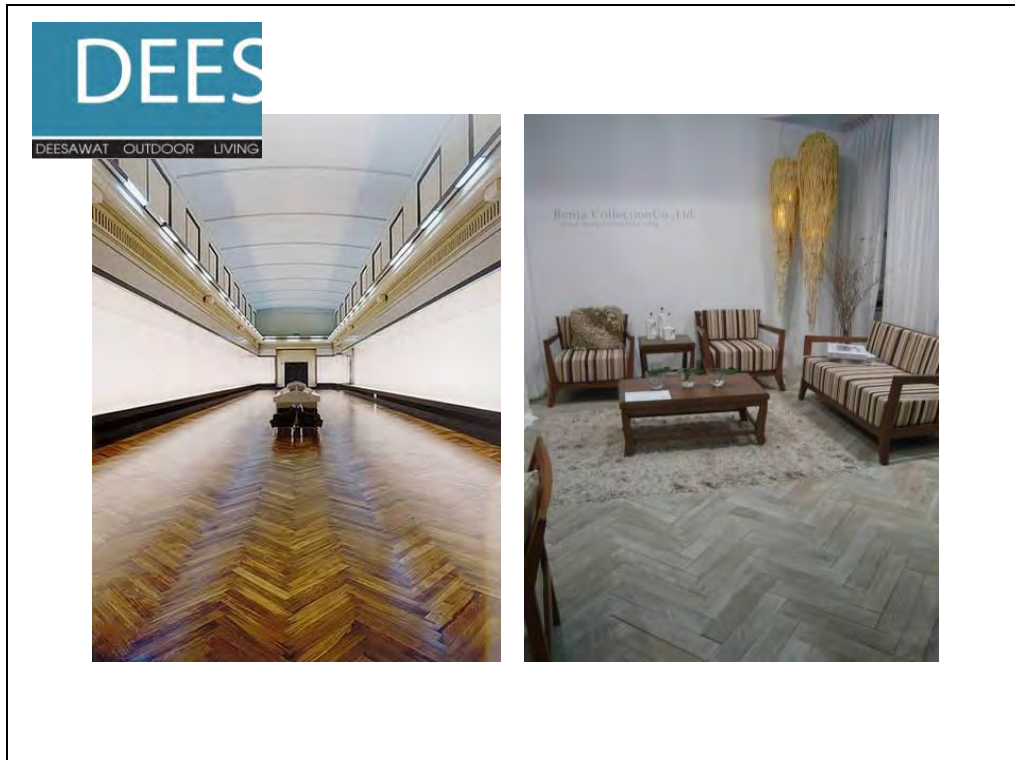




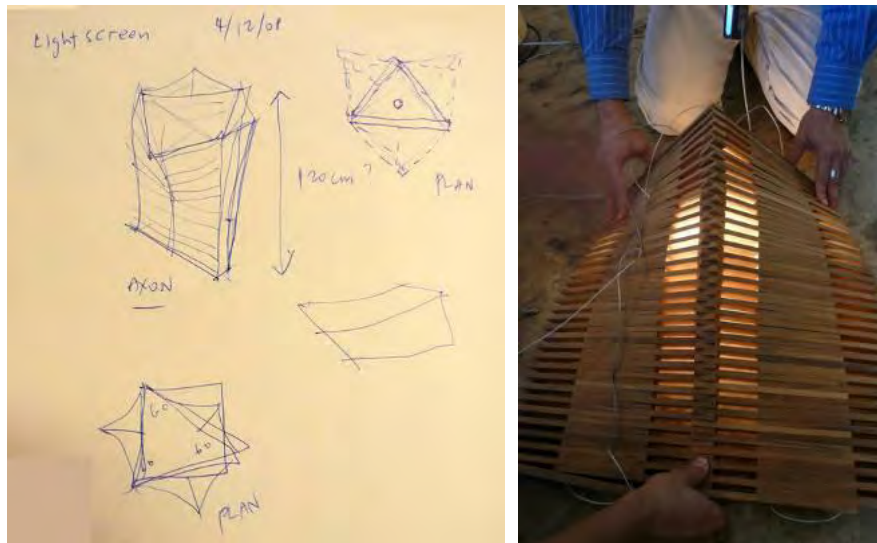


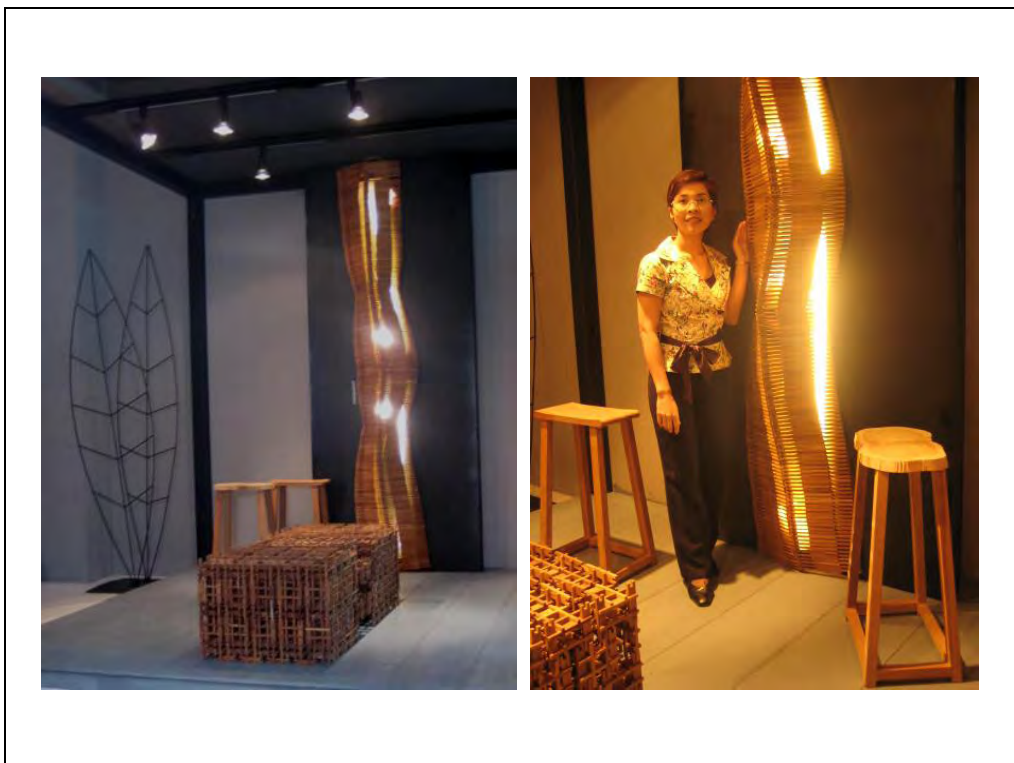
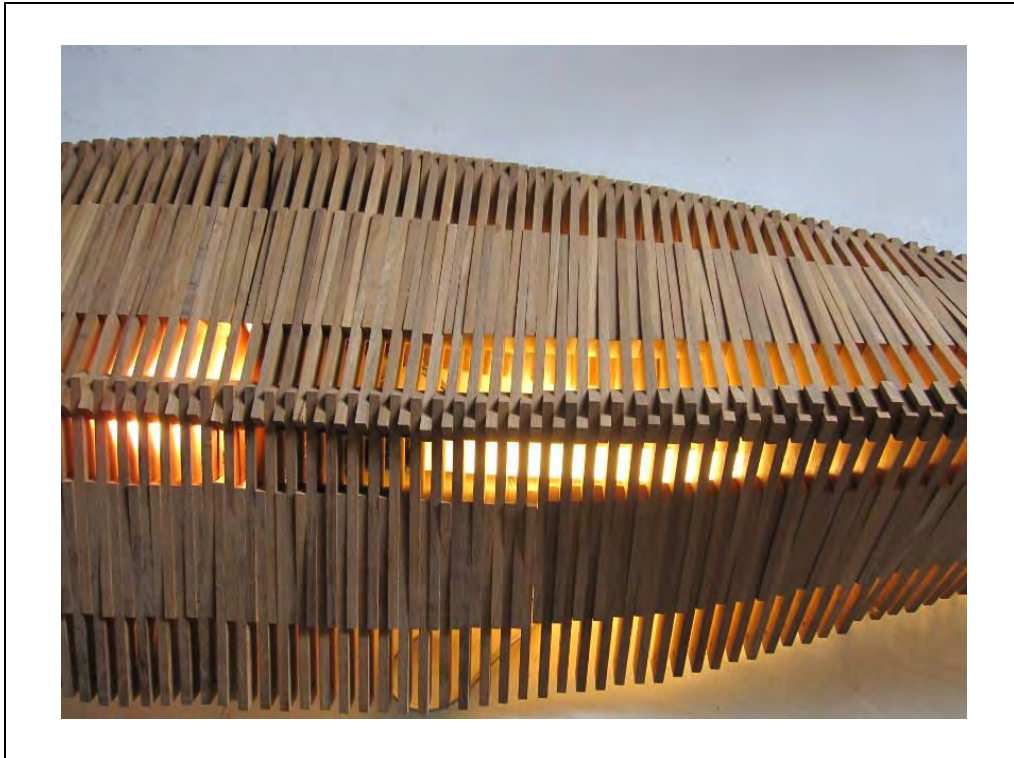






LIGHT SCREEN





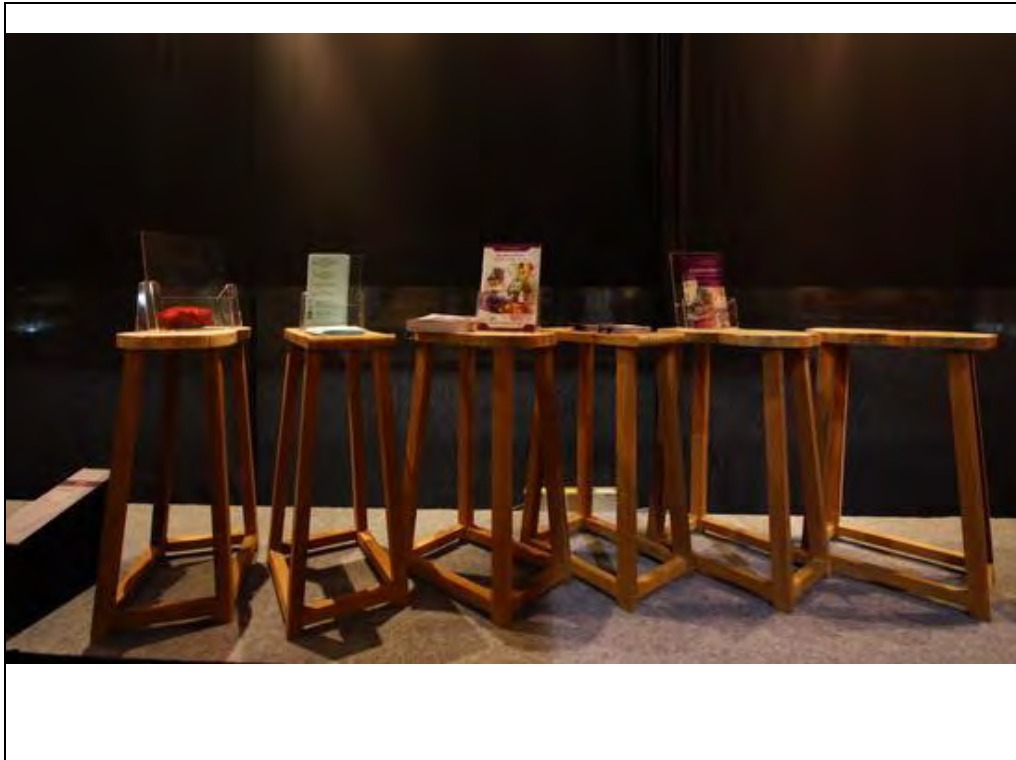


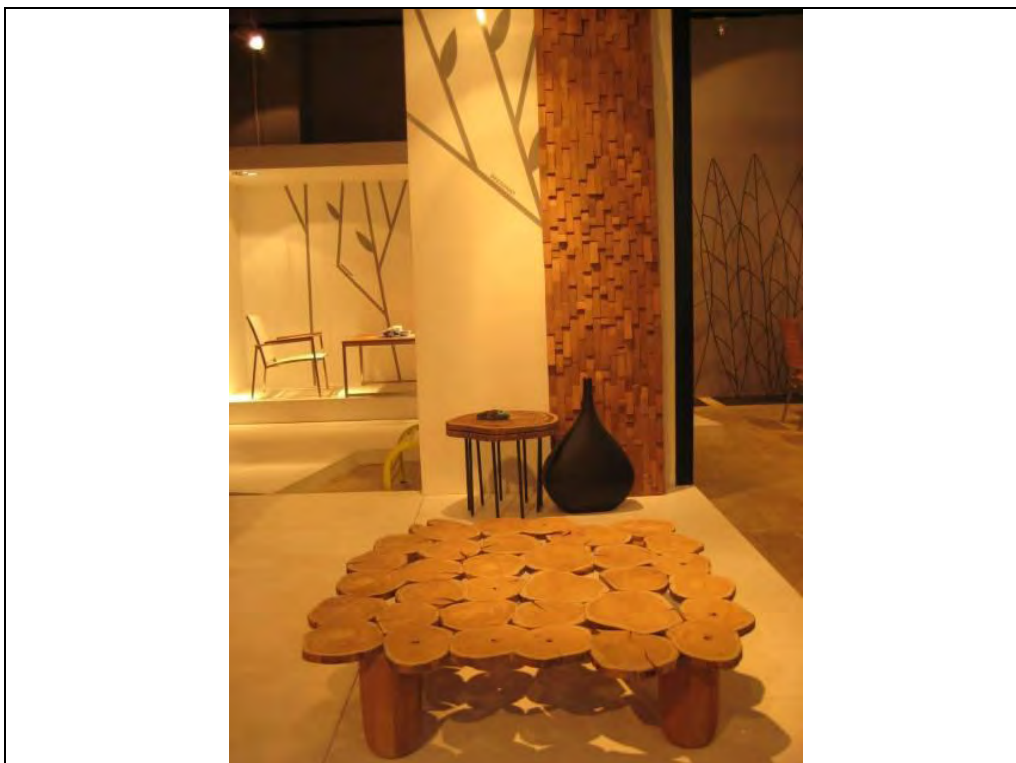
The similar repeated patterns of the leftover timber also appears in our new architectural door and window panel.



Boston curve bench + award

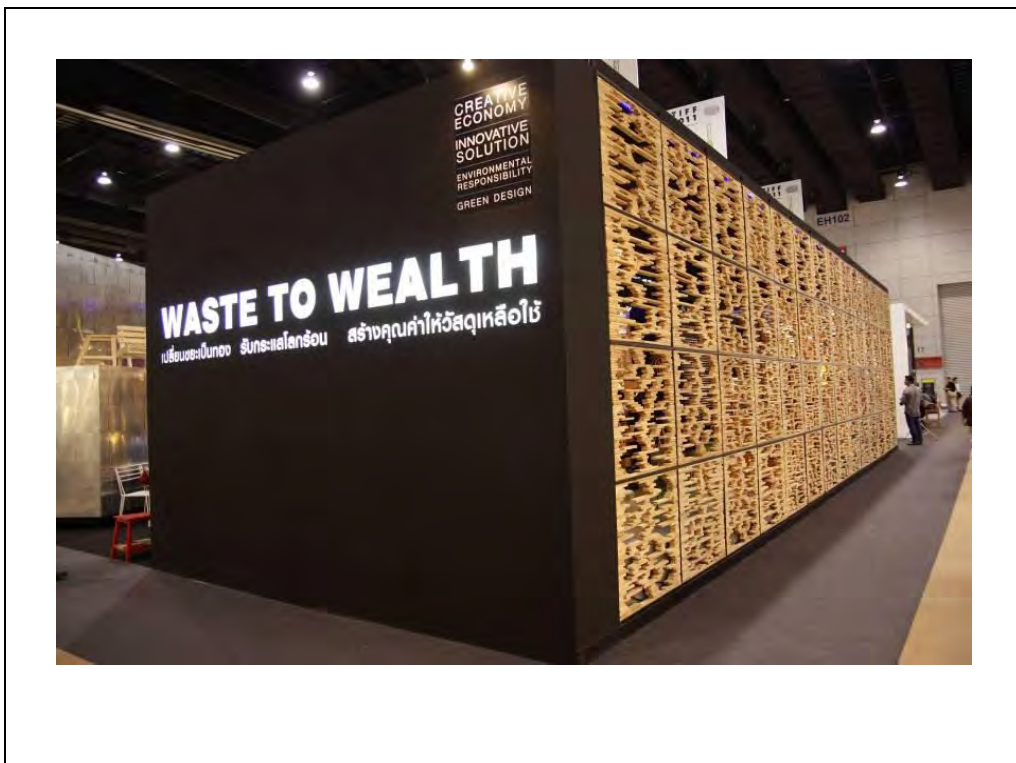












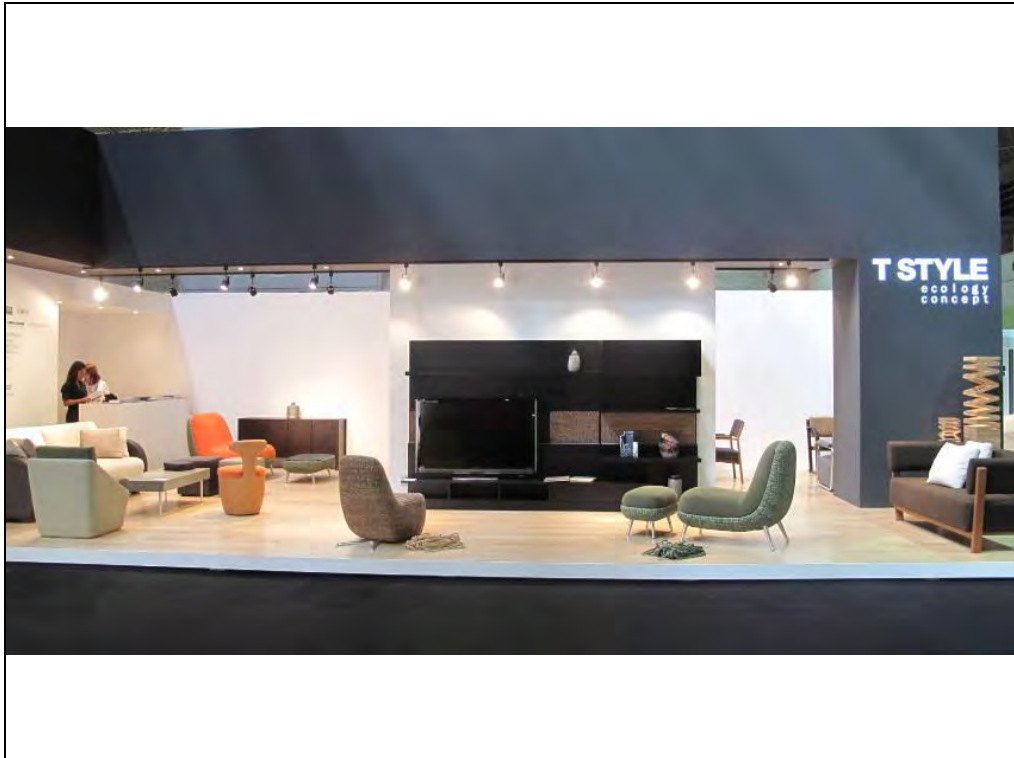


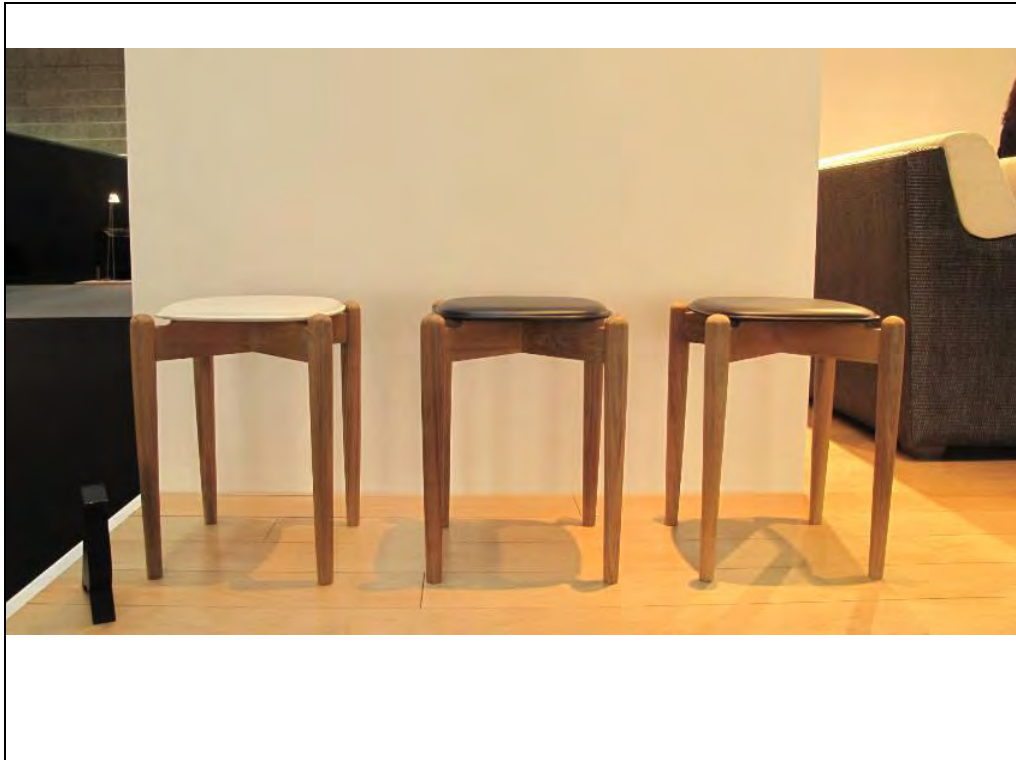


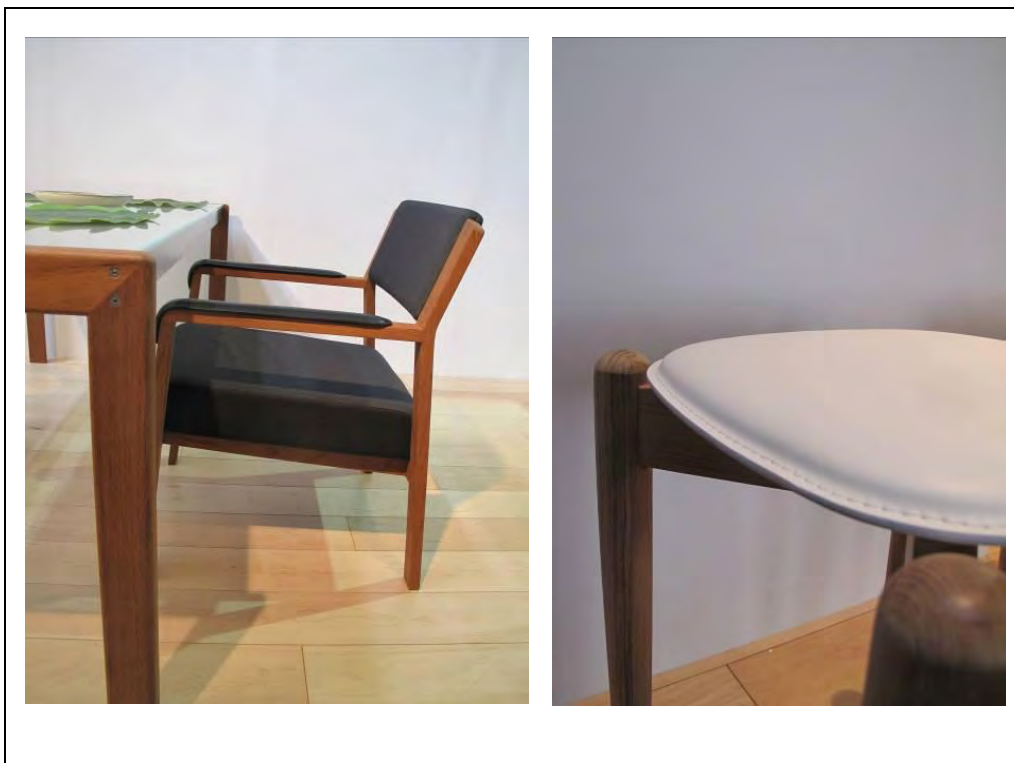


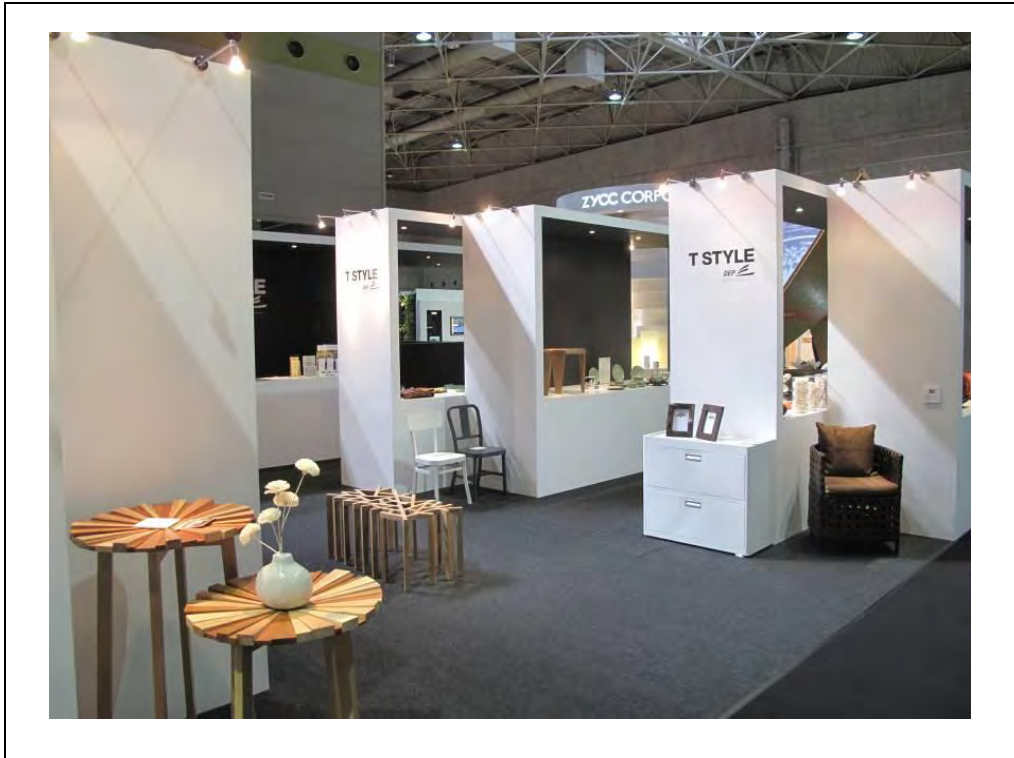
T-style ECOLOGY CONCEPT

Deesawat Industries & others









Project designs













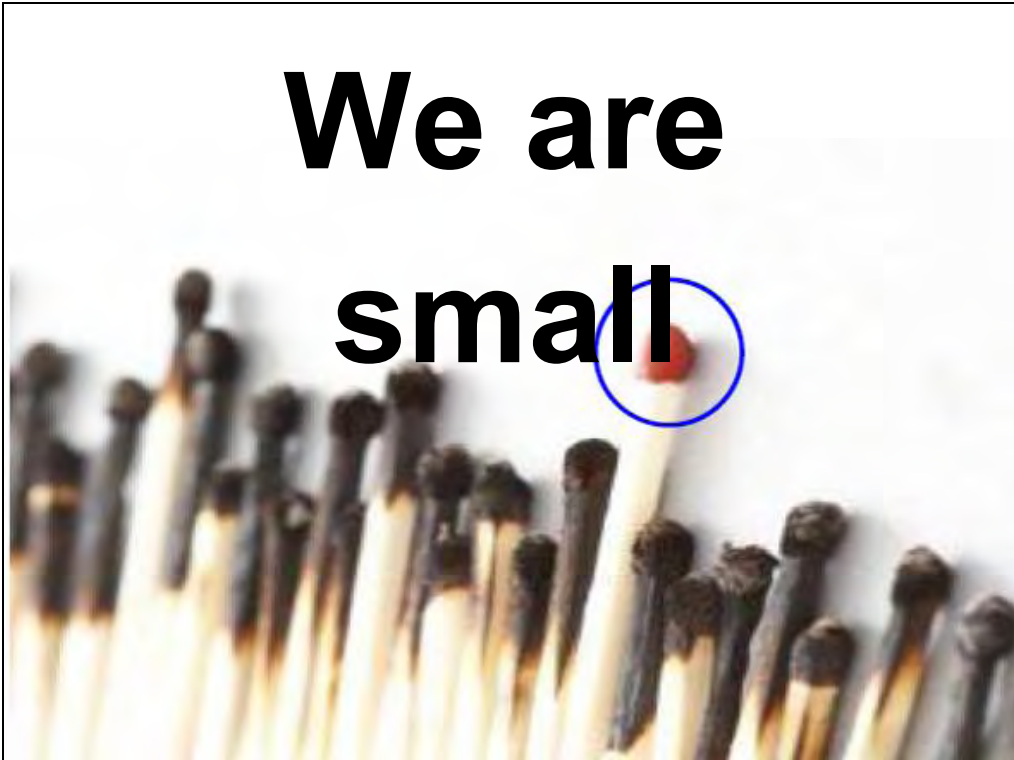


Thai Furniture & Design

Contemporary Design
Sustainable Design
Mindful Design

Global Touch with Cultural sense

**We are
small**



Thai Furniture &
Design
**KNOWN FOR
ENVIRONMENTALLY SOUND
PERSONALITY**

Thai Furniture & Design

**INTERNATIONAL PLAYER
ENTREPRENEURIAL MINDSET
SERVICE MINDSET**

Thai Furniture & Design

**CREATIVE NATION
DESIGN-LED/ GLOBAL NICHE**

Thai Furniture & Design

**CULTURAL PRIDE
WITH GLOBAL SENSE**



**Cultural Pride with
Global sense**

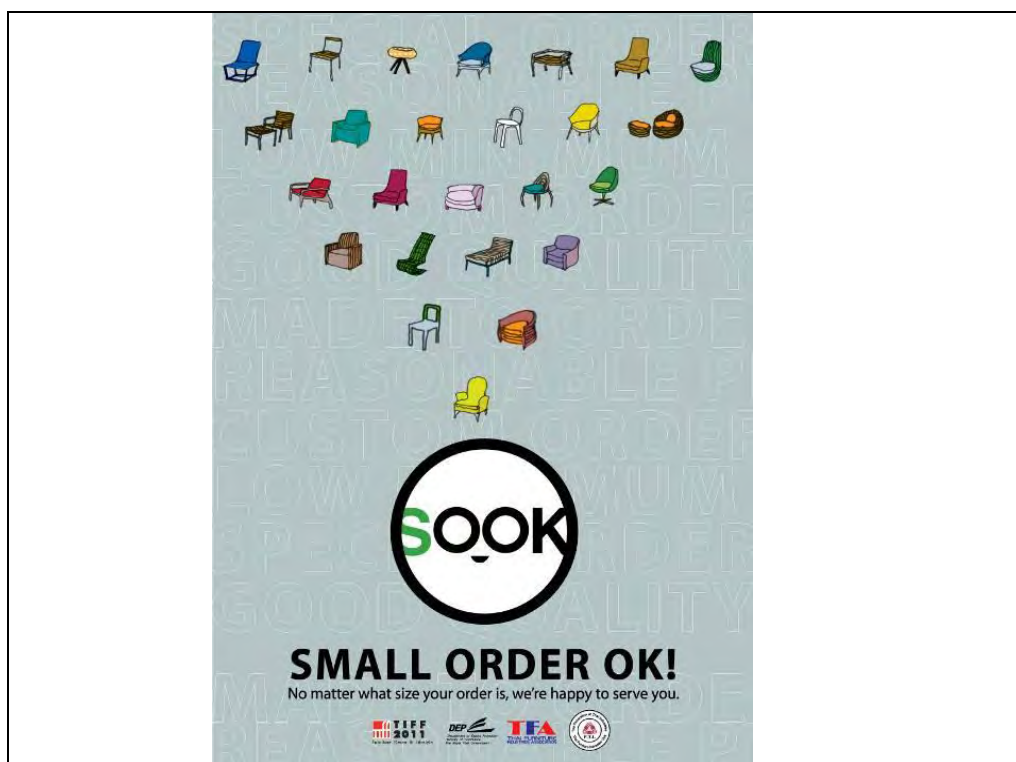


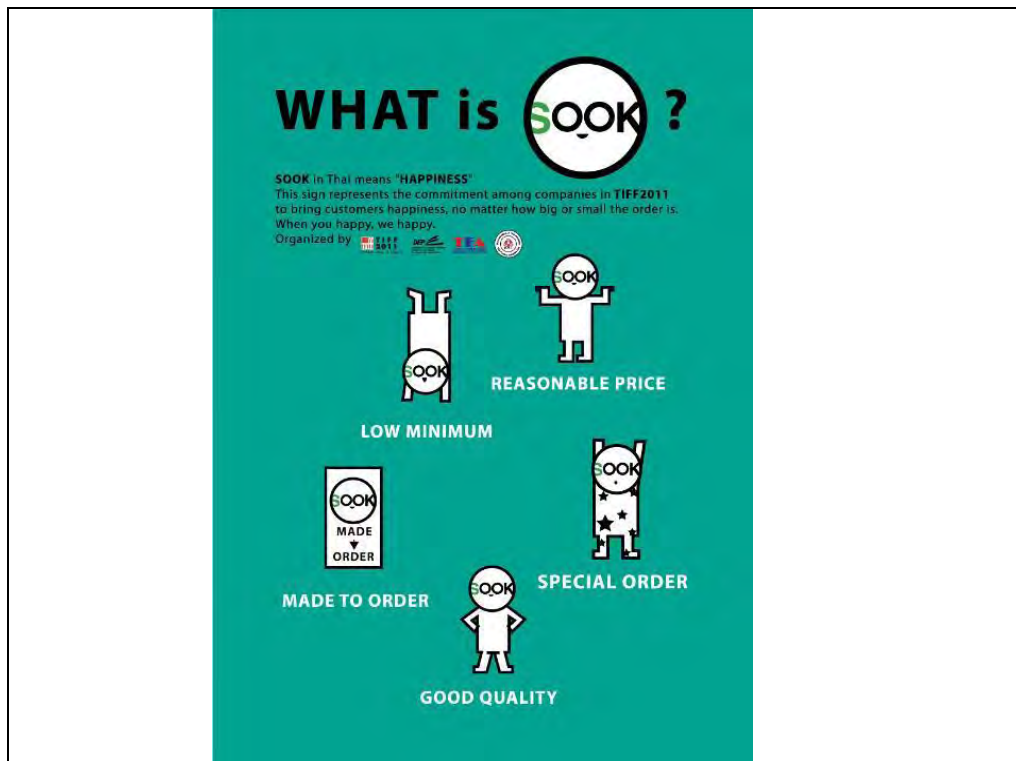
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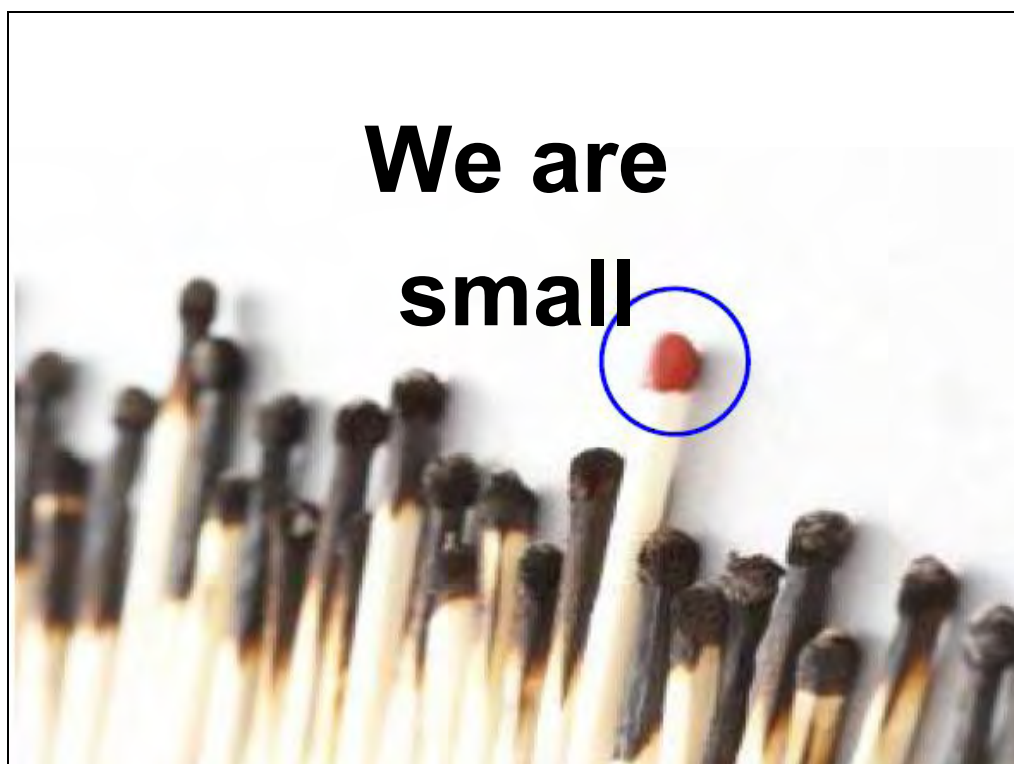
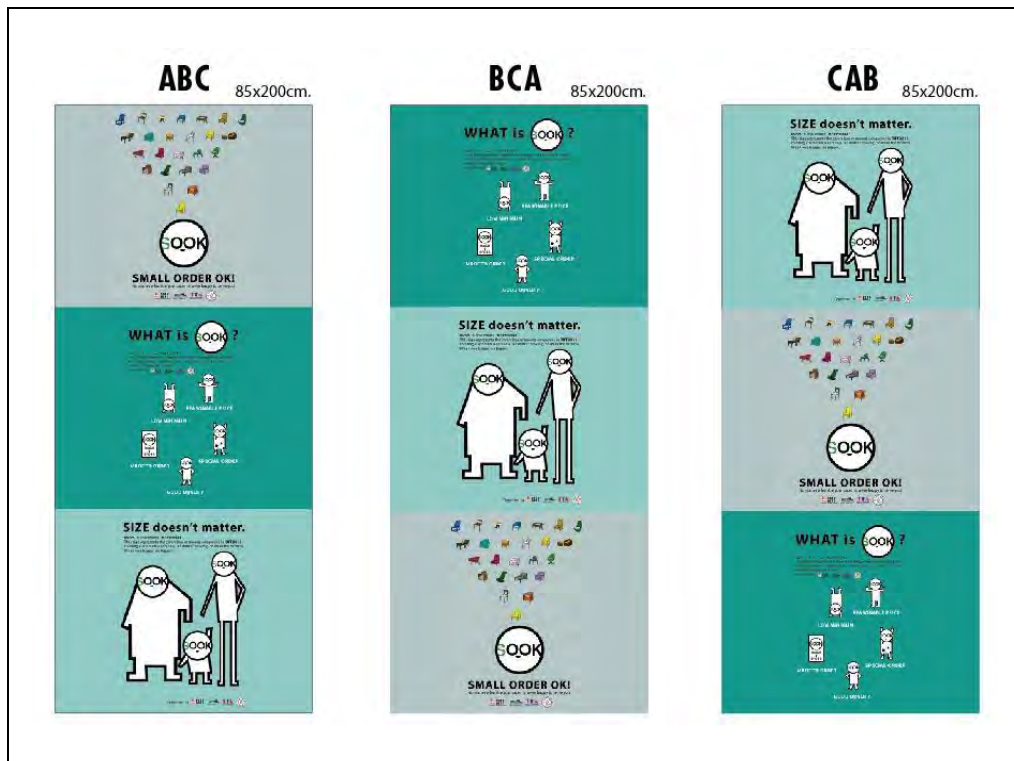




**SMALL
ORDER
OK**









**We are
small**

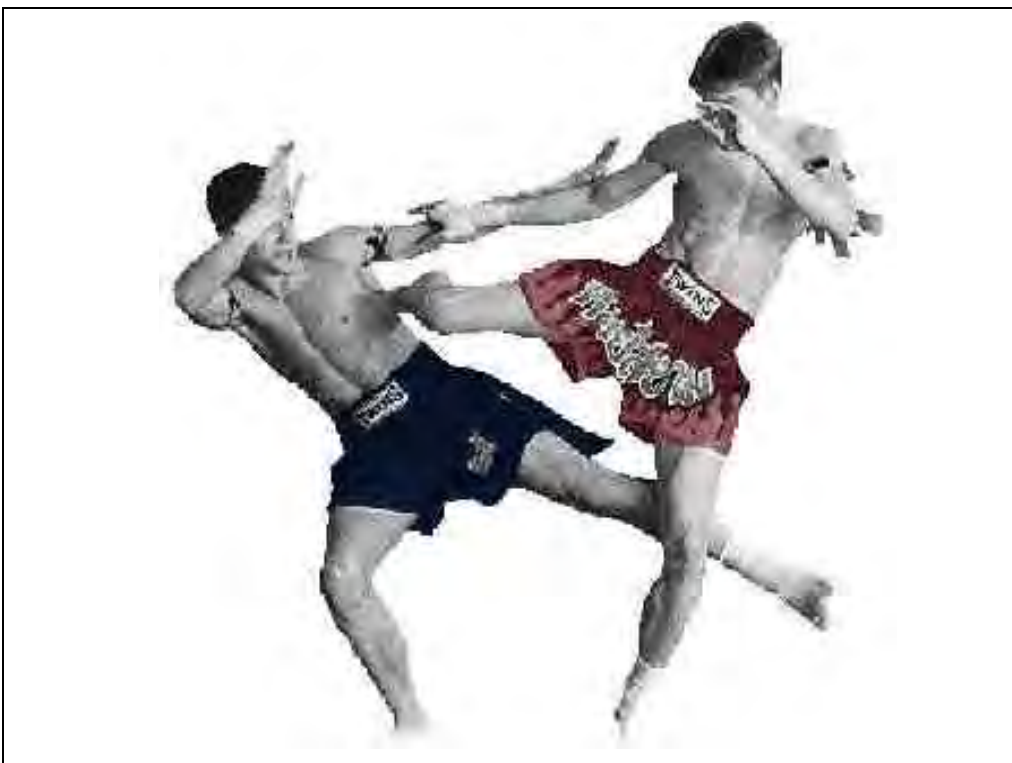
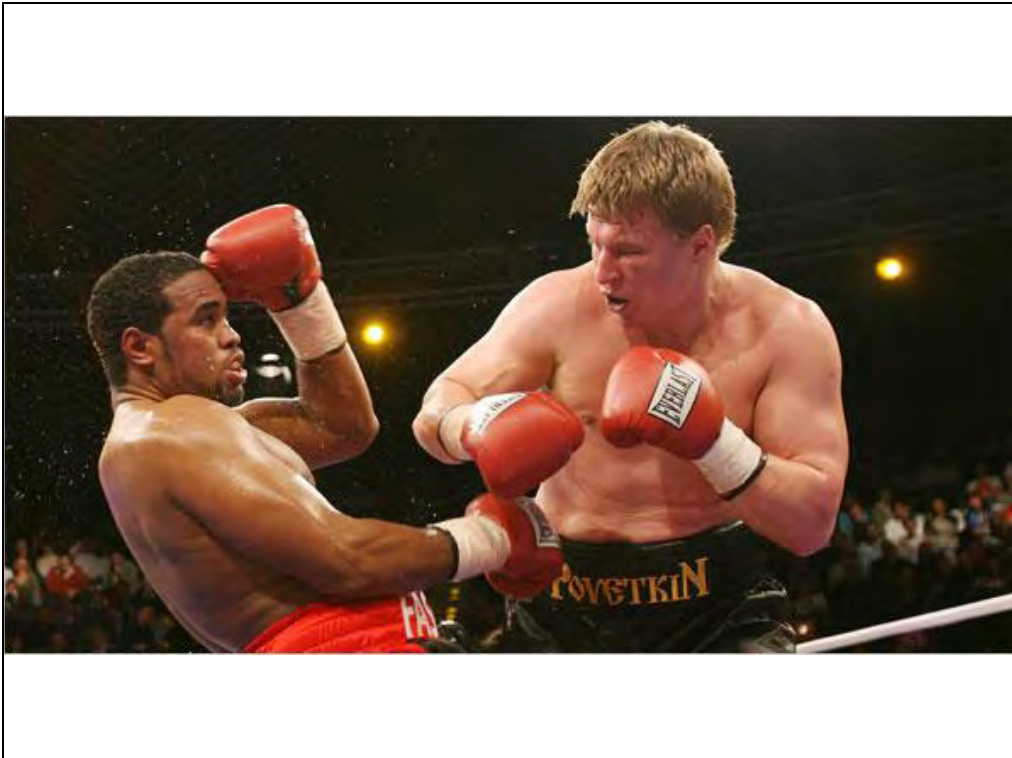
But different



**We are
small**

But different

And sustainable



We believe in
wood and sustainability



It's the time for us to return the
favor of mother nature



Wood is Good



Thank you



Jepara: Mirror of Indonesian Wood Art

Achmad Zainudin³

Abstract

Jepara is well known as the carving town and furniture center of the world, as reflected in the amount of small scale furniture producers. According to CIFOR data, more than 8 thousand small producers are based in Jepara. All of these individuals live and depend on wood.

The wood industry has a central role in Jepara's economic growth and accounts for some 27 % of the region's income. The regional furniture industry boasts around 150,000 people. The Jepara wood industry consumes 950.000 m³/year of log wood.

There are several clusters located at Jepara; Relief (3D carving), sculpture and teak root furniture, wooden doors and frames, indoor furniture, garden furniture, recycled wood furniture and handicrafts.

The Indonesian furniture industry faces challenges as it struggles to secure its place in competitive global markets. Business relations between furniture producers and their buyers are usually unbalanced: buyers set their price and producers cannot negotiate a better deal. Furthermore, the supply of wood is insufficient as well.

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1. BACKGROUND

The wooden handcraft carvings have long been part of Jepara culture. History records the abundance of handcraft carvings in Jepara, central Java, since the seventh century. The skilled carpenters used the timber from the kalingga, majapahit, demak and mataram kingdom. Jepara carvers and furniture makers absorbed the influences of Chinese, Indian, Arabic, European designs, producing intricate design and highly sought items to this day. The seventeenth century port of Jepara, once a bustling centre of maritime commerce, remains today a major of handcrafted items and furniture.

In 1700, Quen Kalinyamat encouraged the workers to produce high quality wooden handcrafted furniture for international trade, as did the Indonesian heroine, Kartini, who helped promote Jeparanese handcraft items to the European market.

As carving is an integral part of Jepara culture, the citizens depend on the sustainability of wooden industries.

2. WOOD CARVING

Wood carving is an art form whereby a picture or motif is engraved on a wooded surface. Carved motifs are often unique to different regions; Jepara, Madura, Pajajaran motifs etc. These may depict curved arches, the cosmos, and many other themes. Determination of the theme is entirely dependent on the artisan. The equipment to create such carvings is relatively simple and includes items such as saws, crabs, and most importantly hammer chisels.

Carving Techniques

Java is a natural archipelago with rich tropical forests providing timber that can be used as a base material for wood sculpture. Carving then involves scraping, chiseling, and incising patterns on the wooden surface.

In Indonesia, carvings have been found dating from as far back as the Early Stone Age. Artifacts from that period are marked with geometric-patterned carvings, such as tumpal, circles, lines, swastika, zig zag, and triangles. Generally such carvings were merely decorative, but could also contain symbolic and religious significance.

Types of carvings include; carved translucent (krawangan), low carving, carving high (arise), and carvings intact. Carving artwork has a variety of functions including:

- a) Decorative functions, namely engraving made solely for decoration and carrying no particular meaning.
- b) Magical functions, namely carving containing certain symbols and serving as a magical object associated with beliefs and spiritual
- c) Symbolic function, namely that in addition to traditional carving as decoration, these examples also serve to symbolize certain things related to the spiritual.
- d) Construction function, namely that in addition to carving as decoration, this also serves as a support structure of a building

- e) Economic function, namely engraving which serves to increase the selling value of an object.

3. CLUSTER

A cluster is a grouping of various companies in the same business sector in a certain area. In a cluster consisting of core companies, and industry related supporting industries, the development of services is not and the development of other services is not focused on the core companies, but has a more holistic approach (Schmitz, 2002).

Wood carving is now prominent in industries such as furniture production. The furniture industry in Jepara serves not only the domestic market, but international demand. This industry has been developing for hundreds of years, forming a geographic cluster of supporting industries. When analyzed in terms of turnover and number of workers, Jepara is the largest cluster in Indonesia.

1. Relief (3d carving)

Jepara relief carvings illustrate various aspects of the daily activities of the cultural community in Jepara. These carvings have a unique appearance because of the layered and three-dimensional carving technique. Artisans strive to imagine and project a life-story through their carving on a piece of wood.

Teak wood is the main raw material for Three-dimensional relief carving. It possesses the necessary characteristics for the creation of these relief carvings. Teak wood is generally harvested from Teak plantations and not community forests.

The process of creating three-dimensional relief carving is very complicated. According to Sutrisno, a relief carving artist and member of the small scale producer association, it would take approximately one year for a craftsman to complete a carving measuring 2.5 meters squared.

Senenan Village, Jepara, is a centre of three-dimensional relief carving consisting of some 180 small-scale entrepreneurs. However, the future of high-quality artwork is coming under threat. Sutrisno states that "the manufacture and use of teak wood as raw material is complex and this product is capital intensive, but it takes a long time to get profit", adding that "the art of relief carving of Jepara is increasingly rare today because many craftsmen began to switch to non-reliefs furniture production".

2. Calligraphy

Decorative calligraphy has been used in combination with wood carving, both two dimensional and three dimensional. Sculpture is more commonly associated with the use of "Stilasi", which refers to a stylized approach of depiction. This style can be employed on wood, metal, clay or stone. The technique usually involves carving images directly onto the material. Printing techniques allow the replication of calligraphic art.

Calligraphy used techniques more frequently associated with carving, such as chisels. The first step is to draw the design on a piece of wood and then following this while carving. A distinction must be made between carved calligraphy and painted calligraphy.

3. Handicraft, statue, root furniture

In Jepara, wood is also widely used for the production of handicraft products, including souvenirs, statues and root furniture. There are some 157 businesses involved in this area. Mulyoharjo Village, Jepara, is known as a centre for the production of wooden statues. In 2008 alone, a total of 1095 workers produced 418,737 works, with a value of Rp. 3.3499 billion.

4. Indoor and Outdoor Furniture

“Furniture” can be defined as a movable object in a room or designated area that is useful for human activities. The term is also frequently applied to architectural elements of a room such as built-in bookcases and cupboards. Although furniture can be made from many diverse materials, the most common is wood. Jepara, with its huge workforce and cluster of supporting industries is the largest producer of furniture, both indoor and outdoor.

5. *Gebyok*

Gebyok art is a traditional form of wooden carving, a part of sacred customs, but also used in modern buildings. *Gebyok* is a type of decorative partition found in a living room, or at the entrance. The size of a *Gebyok* can vary greatly, from just a couple of meters to a dozen, depending on the size of the building and the dimensions of the space in which it is situated. The types of wood commonly used include teak, jackfruit wood and mango wood, with teak being the most expensive.

Although the design is at the discretion of the artisan, original motifs of holy images, plants or foliage are incorporated. In China, animal motifs are included, depicting dragons, deer, birds, etc. The quality of a *gebyok* depends greatly on the materials used and the skill of the artisans. The eventual placement of the *gebyok* is also a matter for consideration, as frequent exposure to water and direct sunlight can be damaging. Pricing for these works of art is difficult to define, as it is heavily influenced by factors such as materials, size and skilled workmanship.

There are some 40 *Gebyok* producers, each employing around 3-5 carpenters and 12-20 carvers, producing 2-3 *gebyoks* per week.

6. Reclaimed wood furniture

There are more than 25 recycled wood producers located at Ngabul (tahunan).

7. Coffin

The production of wooden coffins is centered at Langon, and mostly serves the local market.

Jepara's position at the centre of the wood carving industry is a result of strong differentiation, with carved furniture industrial centers spread across 13 districts of Jepara. According to data on the Jepara trade and industrial department, in 2004 there were 3539 businesses registered with the Department of Industry, Trade and Cooperatives. As of 2010, there were 8088 small-scale businesses, bringing the total of existing furniture industry units to 11597. The figure for total workers employed in this sector stands at approximately 150,000.

Differentiation in Jepara's market positioning as a preeminent centre for carving and crafts should further strengthen the Jepara brand. The local government has been working with entrepreneurs in order to promote Jepara through the organization of exhibitions, both local and international, as well as focusing on innovation by creating alternative products from other wood materials. In addition to maintaining focus on classic designs, there has also been an increasing emphasis on introducing contemporary design.

Jepara

mirror of Indonesia wooden industry

Presented by Achmad Zainudin
Secretary of Small Scale Furniture Producer
Association of Jepara (APKJ)

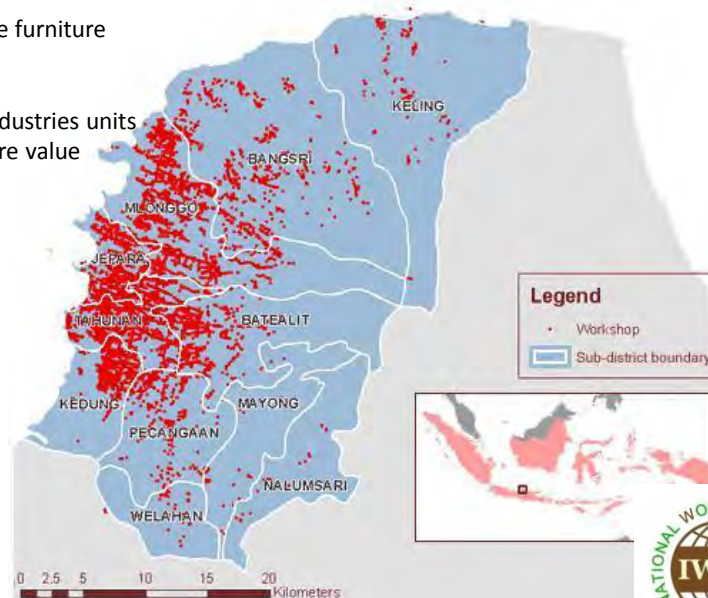


BETTER CRAFTSMEN



8080 small scale furniture
producer

Total : 11597 industries units
Source: Furniture value
chain



BETTER CRAFTSMEN





Largest cluster
Indication geographic certificate
Talented worker



BETTER CRAFTMEN



Wooden door cluster

gemiring, paren, mayong district
material: teak wood and recycled



BETTER CRAFTMEN





Relief 3D carving cluster
located at Senenan, 180 units
teak wood large diameter

APK
KORPRI PENGRAJIN KECIL
Being Craftsmen Better

BETTER CRAFTSMEN

IWCS
INTERNATIONAL WOOD CULTURE SOCIETY

Indoor furniture

Tahunan, widespread in Jepara
material :Teak,mahogany,manggo



APK
KORPRI PENGRAJIN KECIL
Being Craftsmen Better

BETTER CRAFTSMEN

IWCS
INTERNATIONAL WOOD CULTURE SOCIETY

Sculpture, Root furniture, handcraft

Mulyoharjo, kawak(157 units)

material :Teak,mahogany and trembesi



BETTER CRAFTSMEN



Outdoor furniture

mlonggo district ,Jepara





Caligraphy

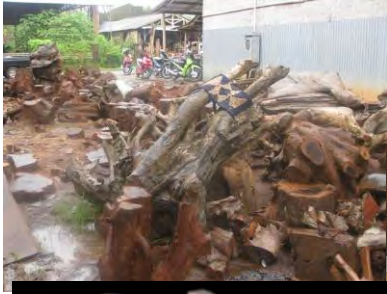
Jepara
material :Teak,mahogany





BETTER CRAFTSMEN





Root furniture,

Ngabul, Tahunan
material :Teak,Sono Keling







BETTER CRAFTSMEN



WOODEN PRODUCT & RATTAN EXPORT VALUE JEPARA REGION

Keterangan	Tahun											
	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Export Value	201.42	200.51	74.74	76.11	111.73	138.4	123.65	115.94	96.67	102.1	93.5	117.19
		-0.91%	125.77%	1.37%	35.62%	26.67%	-	14.75%	-7.71%	19.27%	5.40%	-8.57%
Number of Exporter	221	358	436	451	410	408	286	265	252	259	265	290
		137.00%	78.00%	15.00%	41.00%	-2.00%	122.00%	21.00%	1300%	7.00%	6.00%	25.00%
Export country destination	64	68	71	88	82	84	81	81	89	111	105	105
		4.00%	3.00%	17.00%	-6.00%	2.00%	-3.00%	0.00%	8.00%	22.00%	-6.00%	0.00%

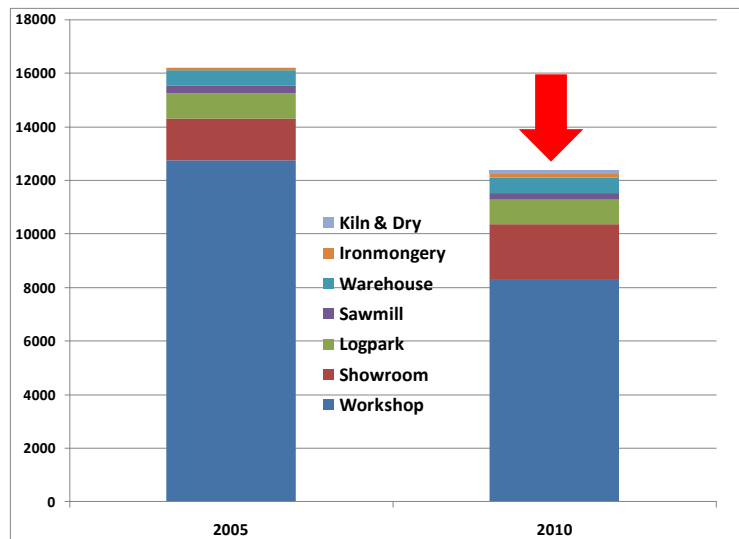
Note * : Million USD
Data Source : Disperindag
Kabupaten Jepara



BETTER CRAFTSMEN



Data source : furniture value chain project, 2010



BETTER CRAFTSMEN



Wooden industry Issues

1. **Wooden sources**
2. **Marketing access and networking**
3. **Human Resources(SDM)**
4. **Design and Quality standard**
5. **Human Resources(SDM)**
6. **Partnership between the actors**
7. **Unhealthy competition(price)**
8. **Environment issue.**



BETTER CRAFTSMEN



Maturnuwun



BETTER CRAFTSMEN



Wood Carving Art in Turkey

Hakki Alma⁴

Abstract

The decorative wooden objects found in excavations in Central Asia show that the Turkish art of woodcarving dates back to the distant past. As in other branches of art, animal motifs with legendary and religious significance were frequently used in the decoration of wooden objects. This tradition known as the "animal style", was gradually abandoned and replaced by vegetal and geometric motifs after the Turks adopted Islam. Extant everyday objects used over the lengthy time segment encompassing both the Seljuk and Ottoman periods are so few as to be practically non-existent. In contrast, architectural accessories of religious structures dating from the Seljuk period, as well as objects used in these buildings, are sufficient in number to give a good idea of Turkish woodcarving. Doors and window shutters, pulpits of mosques, sarcophagi in mausoleums, Koran stands and lecterns display highly advanced woodcarving. Although rare, carvings of animal figures on such objects are interesting as an illustration of the continuity of this tradition. Wood works techniques applied in the wood art of Turkey are as follows: carving, painting, dovetail (kundekari), inlaying and latticework. The most special technique for Turkey is dovetail (kundekari). Wood carving in Turkey is classified into three groups: cutting type, surface carving (superficial and deep), which is the most popular, and natural shape carving. Some carving tool such as needle nose pliers and nail pen is peculiar to Turkish carving industry.

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1. INTRODCUTION

The History of wood carving has, from the remotest ages, seen the decoration of wood as a foremost artform. Extant everyday objects used over the lengthy time segment encompassing both the Seljuk and Ottoman periods are so few as to be practically non-existent. In contrast however, architectural accessories of religious structures dating from the Seljuk period, as well as objects used in these buildings, are sufficient in number to give a good idea of Turkish wood carving during this period. Doors and window shutters, pulpits of mosques, sarcophagi in mausoleums, Koran stands and lecterns display highly advanced woodcarving. Although rare, carvings of animal figures on such objects are interesting as an illustration of the continuity of this tradition. Architectural elements in certain mosques in Anatolia provide considerable information on woodcarving in principalities during the post-Seljuk period. The columns and capitals as well as beams of these mosques, most of which date from the 13th century, exhibit distinct woodcarving. Pulpits of mosques in particular tended to be almost exclusively constructed out of wood.

It is a fact that woodcarving developed following the migration of the Turks to Anatolia, a phenomenon in which the influence of geography and the cultural milieu cannot be denied. Syria and Egypt in particular demonstrated development in this art parallel to that in Anatolia in terms of the techniques employed. In this connection, it is important to remember that at the time Anatolia was very rich (URL1).

The bulk of extant wooden objects from the Seljuk and Ottoman periods are housed in the Ankara Ethnographical Museum and the Istanbul Museum of Turkish and Islamic Antiquities. They consist primarily of such architectural elements as mihrabs (prayer niches), mosque and cabinet doors and display a truly superior level of workmanship. The signatures of the craftsmen even appear on some of the objects.

The wealth of decoration seen on the woodcarving used in Seljuk architecture developed parallel to the architecture of that period. In this regard, it is necessary to remember the highly ornamental facades of mosques, especially during that period. A similar development cannot be traced to the Ottoman period, which is an interesting fact in itself. Apart from a few exceptions, a new simplicity gradually came to predominate wooden architectural elements during the reign of the Ottomans. Although certain new techniques, such as mother-of-pearl inlay, did emerge in the meantime, they did not actually contradict the new trend towards simplification both because they only indirectly represented woodcarving and because they did not produce the same effect for the viewer. In fact, wooden architectural elements in the Ottoman period, with their more stark and simple appearance, took on a more basic and functional air, and more specifically aesthetic elements thereby replaced the exaggerated ornamentation of the Seljuks (Öney 1989).

Wooden houses constitute a little known aspect of Turkish architecture. The facades, eaves and ceiling decorations of traditional Turkish wooden houses constitute fascinating examples of carving and the false inlay technique and exhibit a variety of styles from period to period.

A new approach that gradually gained acceptance in the Ottoman period was painting on wood. From the 15th century onwards, decorations began to be painted on architectural elements as well as on smaller wooden objects. Interesting examples date to the 18th and 19th centuries in the secular architecture of Topkapi Palace and of such urban centers as Edirne and Bursa. Among these examples, the large cabinets, corner cupboards and niches were

influenced by the forms of their counterparts made of marble in the great palaces. Edirne was an important center of woodcarving, and the technique of painting on wood known as Edirnekari spread to İstanbul and other regions throughout the Empire. Using this painting technique, in which green was predominant as a background color, various articles of everyday use such as drawers, boxes and chairs were produced, some of which were lacquered (URL1)..

Among the wooden transport vehicles used by the Palace and the upper classes there are examples of woodcarving that may be regarded as masterpieces in their genre. The caiques and carriages produced in İstanbul fall into separate categories of large-scale wooden objects. The imperial caiques and carriages preserved at present in various museums have special value since they constitute examples of carving and painting techniques. The same can be said of the thrones in Topkapi Palace, which, with their decorations in gold, silver and precious stones, also represent the jeweler's art.

Another genre of Ottoman wood carving was the simultaneous use of metal applique and metal plaques. The wood used for objects of this genre was not highly decorative in itself, the emphasis being rather on the metal accessories. Metal put on doors, window shutters and cabinet doors had existed since the Seljuk period. Plaques of various metals, mainly silver, displaying motifs worked in the repousse technique were mounted on everyday wooden objects such as chests, clogs and dustpans from the 16th century on. This technique was widespread.

Close relations existed between the masters who crafted the wooden elements used in architecture (neccar) and the architects, which was especially evident in the Ottoman period when many architects were former carpenters and masters of intarsia. Mehmet Agha, for example, the architect of Sultan Ahmet Mosque, was a master of mother-of-pearl inlay.

2. HISTORIES OF WOOD WORKS IN TURKEY

2.1 Wood Works Before Islamic Architecture

The decorative wooden objects found in excavations in Central Asia show that the Turkish art of woodcarving dates back to the distant past. As in other branches of art, animal motifs with legendary and religious significance were frequently used in the decoration of wooden objects. This tradition known as the "animal style" was gradually abandoned and replaced by vegetal and geometric motifs after the Turks adopted Islam. During Huns empire the carving was very popular (Akşit 2004).

2.2 Wood Works in Early Islamic Architecture

Various wood works unearthed in the Central Asian tumuli and Pazyryk excavations, have revealed that Turks were interested in this subject since ancient times. In Islamic art and especially in Omayyad and Abbasid wood works, we find a tendency towards a new style. The Syrian and Egyptian stone reliefs of the 10th-13th centuries had influenced the Fatimid wood works and decorations of acanthus and vine leaves peculiar to Syrian region were widely used. For example, the stone reliefs on the front of the Meshatta Palace was revived with nuances in the Omayyad and Abbasid works, was a favourite decoration of this period. The most famous example of Omayyad wood works is the multi-pieced pulpit of the

Kayravan Mosque made in the 11th century and presently kept in the Cairo Museum, and the wood works in the El Hakim Mosque reveal the most interesting examples of Islamic wood works (URL1)..

The magnificent gate displayed in the Metropolitan Museum and the wood works displayed in the Cairo Museum, prove that the Fatimid decorations were oriented towards animal motifs in later periods. These decorations which are thought to be related to native art, include hunting scenes, symmetrical group of birds of animals. This style later influenced the Mameluke art and decorations were enriched with all-over designs. Very few examples of Persian wood work preceding the Seljuk period have survived until the present day. Some wood inscribed with Cufic writing are found in Tashkent and Samarkand Museums and in private collections. Mongolian wood works of the 13th - 14th centuries are also very rare. Wooden doors with Cufic inscriptions show great similarities with stone decorations in the architecture of the period.

2.3 The Seljuk Wood Works

The Seljuks considered wood works very important and they have produced many works of art such as pulpits, reading desks, chests of drawers in addition to the architectural elements ornamenting buildings. Geometrical forms and plant motifs were often used in the Seljuk wood works where carving and latticework were widely applied. The decorations were usually raised and the compositions were completed by Rumi style borders (Fig 1.). The motifs of peacocks, King Solomon's seal and cypress trees were largely used in the Seljuk wood works. The pulpits of the Konya Alaaddin Mosque, Manisa Grand Mosque, Birgi Grand Mosque are the most beautiful pieces of the Seljuk wood works in Anatolia. The Seljuk wood work reveals itself on the wooden sarcophagi. The sarcophagus over Mevlana's grave in the Konya Mevlana Tomb is decorated with embellishments characteristic of the age and is covered all over with lyric poems and couplets (Firat 1996).

2.4 The Ottoman Wood Works

Seljuk wood work influenced the early Ottoman wood works of the 14th -15th centuries and various works began to make use of new techniques and decorative elements. Besides carving and latticework, the dovetail method was widely used and enriched wood works were also made with the addition of auxiliary elements such as mother-of-pearls, tortoise shells and ivory. Floral motifs were often used in addition to Rumi compositions. Beginning in the 16th century, the Rumi decoration on wood works gained a much more complex appearance by uniting with different floral patterns found in the similarly decorated tiles. Although the forms used in the 16th century wood works were continued during the 17th century, new patterns were created in decorations (URL1).



Fig. 1. A Rumi carving style sample for door (URL2).

The most renowned of these are the floral motifs which have lost their original forms in a tendency towards stylization. Plainness was gradually abandoned and a richer embellishment replaced it.

With materials such as mother-of-pearl, tortoise shell and ivory used in the 18th century wood works, the products gained a more colourful appearance. The influence of the Baroque and Rococo styles to be found in almost every branch of Turkish art, has revealed itself also in the wood works of that century. As an inevitable consequence of this, Turkish wood works lost its own characteristics and came under the absolute influence of European art.

Turkish wood works have influenced architecture, with fine examples in old Turkish houses as well as the wooden Afyon Grand Mosque, Sivrihsar Grand Mosque, Beysehir Esrefoglu Mosque. Especially the ceilings of rooms, the shelved niches and cupboard doors have been fastidiously worked. Edirnekari technique, used in ceiling glued with goldy plaks and painted with natural or synthetic dye, is also very famous.

They consist primarily of such architectural elements as mihrabs (prayer niches), mosque and cabinet doors and display a truly superior level of workmanship. The signatures of the craftsmen even appear on some of the objects. Wooden houses constitute a little known aspect of Turkish architecture. The facades, eaves and ceiling decorations of traditional Turkish wooden houses constitute fascinating examples of carving and the false inlay technique and exhibit a variety of styles from period to period. A new approach that gradually gained acceptance in the Ottoman period was painting on wood. Using this painting technique, in which green was predominant as a background color, various articles of everyday use such as drawers, boxes and chairs were produced, some of which were lacquered. Among the wooden transport vehicles used by the Palace and the upper classes there are examples of woodcarving that may be regarded as masterpieces in their genre. The caiques and carriages produced in İstanbul fall into separate categories of large-scale wooden objects. The same can be said of the thrones in Topkapi Palace, which, with their decorations in gold, silver and precious stones, also represent the jeweler's art (Sancaktaroğlu 1977).

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Of all the sultans, Abdülhamid II (1842-1918) probably appreciated woodcarving the most. During his reign, he worked in his own carpentry shop and a distinctive Palace style began to take shape (URL1).

3. THE TECHNIQUES APPLIED IN WOODWORKS IN TURKEY

3.1 Carving

During the carving process, a pointed chisel works out the decoration in raised form by carving the surface of the wood, which involves deep carving, superficial carving, cuttingtype carving (decoupage) and natural shape carvings. This technique was widely used to decorate doors, window shutters, chests and ceiling under dom (Fig 2) used in everyday life. Some of the varieties employed include deep incising of flat and curved surfaces, and carving in two planes. In the case of the latter, an inscription would be added in a second plane over another carved surface decorated with vegetal motifs (<http://newspot.byegm.gov.tr>).



Fig. 2..A sample for superficial carving (URL2).

3.2 Latticework

There is no ground in this technique, but various compositions carved in the form of palmettes, lotus leaves and spiral leaves.

3.3 Painting

Painting (Fig. 3), which first came into use as a decorative architectural element among the Seljuks, underwent extensive development under the Ottomans in the 17th and 18th centuries. At that time, triangular, polygonal and star-shaped plaques painted with vegetal motifs were used on doors and pulpits to give the appearance of "kündekari". After the 18th century, painted fruit and floral designs of European origin were frequently employed as decorative elements in secular architecture (Sogutlu 2004; URL3: <http://newspot.byege.gov.tr>).



Fig. 3. Sample for painting the carved wood (URL2).

3.4 Dovetail (Kundekari) technique

The materials most frequently used in decorative carving are walnut, apple, pear, cedar, ivory and rose. Anatolia was always self-sufficient when it came to wood and even exported this raw material to Syria and Egypt who were less well-endowed in this respect (Yuksel 2002).

"Kündekari" or tongue-and-groove joining is the name given to the technique of placing small pieces of wood side by side to form a design. This technique was first seen in Islamic art in the 12th century. It was employed both by the Seljuks and Ottomans, who enriched it with innovative and more advanced methods. Special attention should be drawn here to the fact that the creation of interlocking patterns in wood is much more difficult than the application of similar patterns on books and metals because such woodcarving is an entirely plastic art (Yuksel 2002).

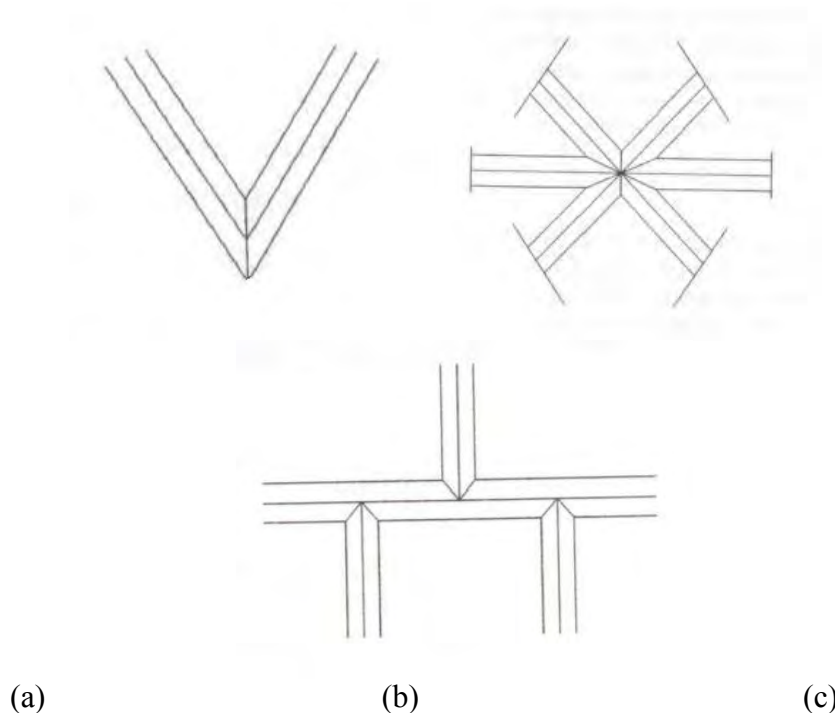


Fig. 4. Joint types for dovetail methods. (a): angel type. (b):multiply type. (c): vertical type.

Kündekari, which was employed more often on the backboards of pulpits and on doors, falls into two categories: genuine "kündekari" and imitation "kündekari". In genuine "kündekari" pieces of wood of various geometric shapes decorated with vegetal motifs are skillfully placed side by side (Fig. 4). The joining of these pieces without any nails or glue requires a high degree of expertise. They are joined in such a way that even if the wood dries up and shrinks the pieces will not fall out.

On the other hand, in imitation "kündekari", a variety of techniques utilizing relief carving in combination with glue and nails, or sometimes using relief alone, were employed to create the appearance of "kündekari" with only a single piece, or very few pieces of wood.

The Ottomans used plain pieces of wood in place of geometric shapes. The mid-sections of double doors, which were traditionally divided into three sections, were often decorated with tiny mirrors surmounted by an inscription in the topmost section. This technique is effectively applied in the Konya Alaaddin Mosque (Yuksel 2002).

The Kündekari technique, of which the earliest examples were found in Egypt, Aleppo and Ana in the 12th century, involves fixing small geometric pieces together with grooves. No nails or other fixatives are used. Thus, the works of art created with this technique have survived until today without being damaged by the environment. The grains of individual pieces were placed crosswise, so moisture or heat would not pass from one to another. As a result, works of kündekari art have maintained their good condition and smoothness throughout the centuries (URL4).

The carving methods used by the Seljuks have been replaced by dovetail works of the Ottomans. This work is done by attaching small geometrical pieces by morticing and tenoning. Since the veins of the pieces come crosswise in this method, no deviations and

deformities occur due to humidity and heat, and the works preserve their proper appearance over centuries (Özdemir 1997).

During the 11th century, walnut or cedar tree next to the walnut tree next to the box by putting works created by putting the contrast form. Real künde-karide is fully three-dimensional shape. They were applied in the gate of the mosque, pulpit, preaching chair, cabinet doors, windows and architectural elements. In this technique there are various geometrical shapes such as stars, octagonal, decagon, diamond, parquet and a lot of geometry applied to classical designs (Fig. 5) (URL4).



Fig. 5. Typical künde-kari wood carving sample for Turkish art (URL5).

3.5 Inlaying

In later periods, inlaying was widely used besides dovetail works. In this method which is divided as inlaying of mother-of-pearl and inlaying of wood, the decorative design is drawn on the finished surface by a pointed pencil and the proper places of the design is engraved and then inlaid with mother-of-pearl, tortoise shell or ivory. In another kind named as "Damascus work", the pieces of mother-of-pearl are surrounded by thin metal work. First observed in the 14th and the 15th centuries, this technique became very widespread among the Ottomans. It consisted of applying in thin plates substances such as mother-of-pearl, ivory or tortoise shell on wood. The edges of the plates were decorated with narrow, raised bands. Such plates can also be applied by first carving out the surface of the wood and then gluing the pieces in place like a mosaic, as in intarsia. The Turks rank first among the various Islamic peoples in their expertise in applying this technique.

Widely used until this century on such furniture as chairs, stools and mirror frames, this art is still practiced today (URL1).

4. CARVING WOOD IN TURKEY

4.1 Flowchart of wood carving

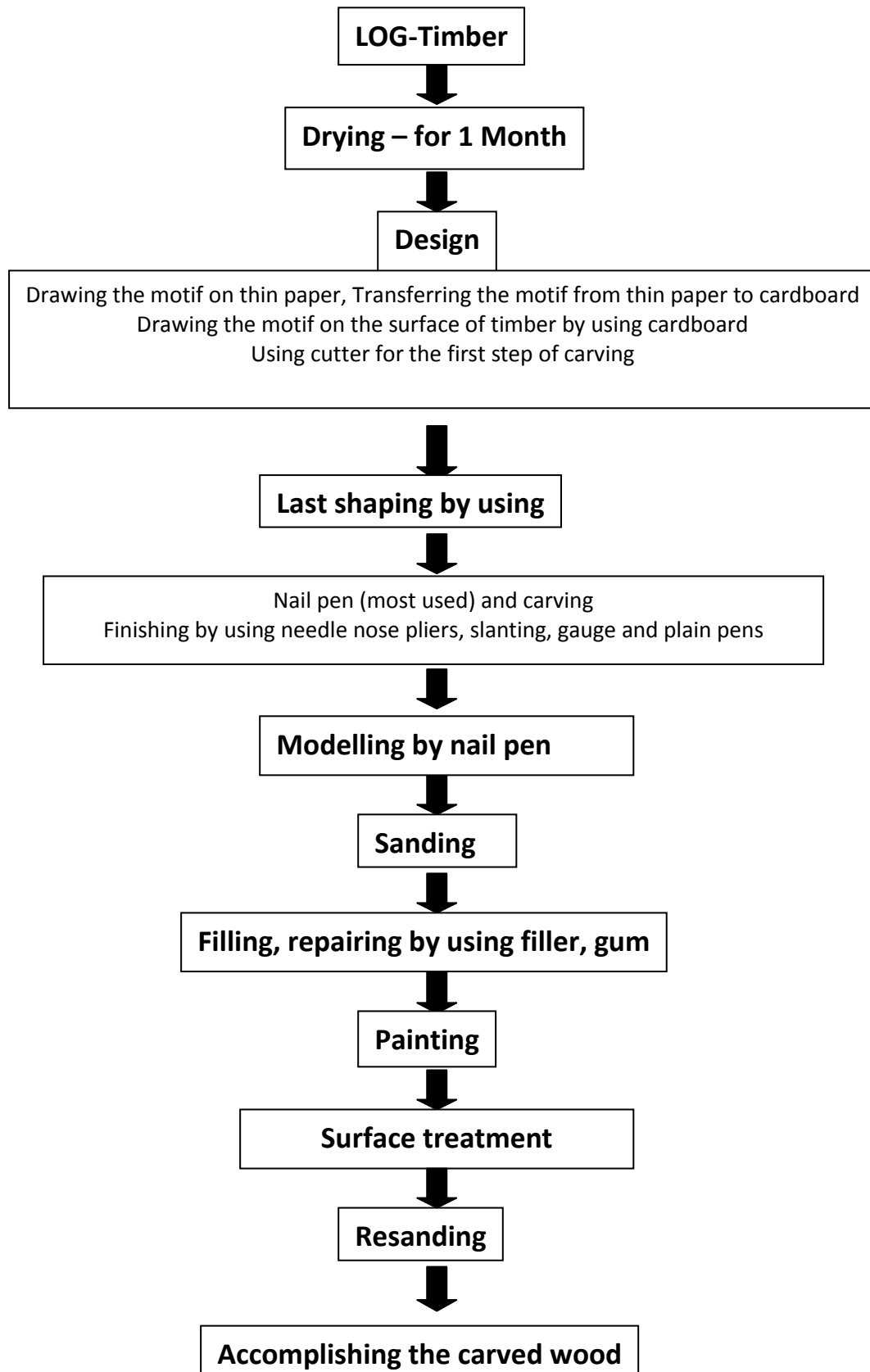


Fig. 6. Flow chart for carving process applied in Turkey.

The wood species used for carving in Turkey is walnut (*Juglans regia* L.) and horn beech (*Carpinus betulus* L.). The most popular wood species for carving is wallnut due to its density and easy workability. Moreover, poplar and pine also are used for making box etc. Carved wood is used for following purposes: Local wood carving survives today in some parts of Southern Anatolia. Diyarbakır is long been known for its damascene canes and Kahramanmaraş for its elaborately carved furniture (URL6).

4.2 Carving Types

Various carving types applied in Turkey are given as follows (Fig 7):

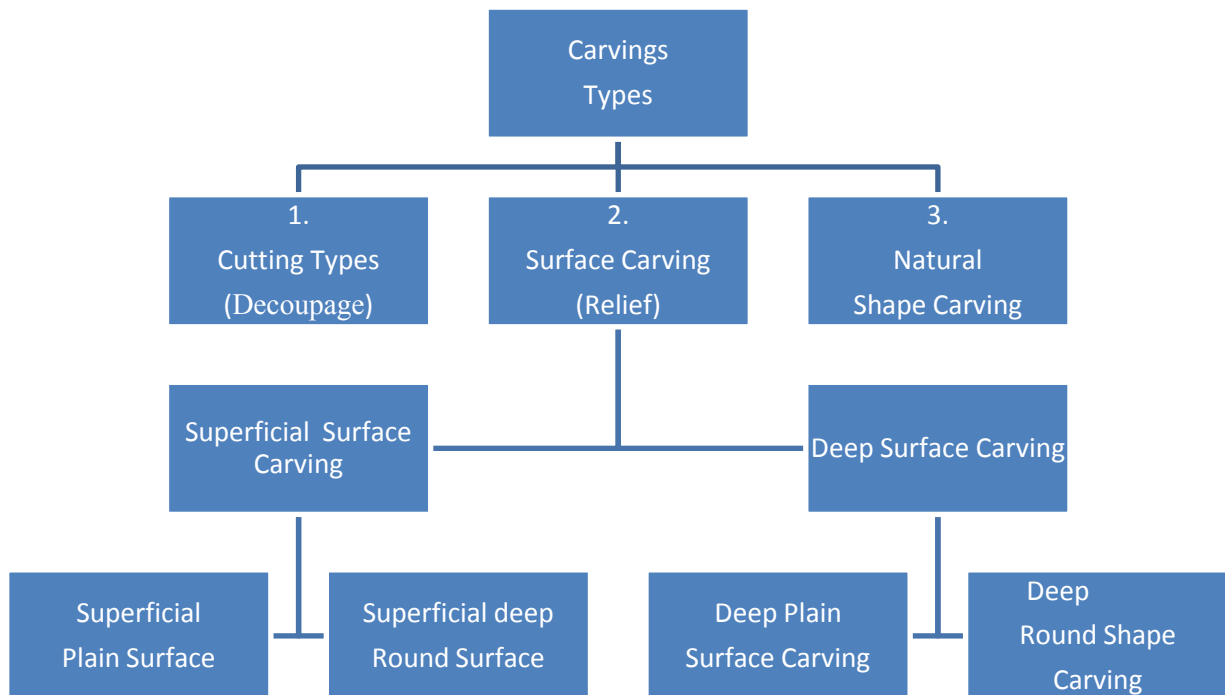


Fig. 7. Carving types applied in Turkey (Sogutlu 2004).

4.3 Cutting type Carving (decoupage)

The motifs drawn on the surface of timber with certain thickness is made by using hair sawmill, mouse tail sawmill or decoupage sawmill.

If the obtained and cut motif is glued on any surface, this piece is called as ‘aplik’ and this work is also called as ‘aplike’.

Aplik work is simple; the motif is first drawn on the thick paper copied on the surface of timber and then the parts to be taken from timber is cut and removed. If one wants to get more than one aplik, one can glue the timbers by putting thin paper in between. After carving and cutting the motifs, the papers are removed.

Finally, the obtained image is fixed on the timber surface and the finishing is continued, such as sanding, filling, repairing, varnishing etc. (Fig. 8).



Fig. 8. A balkony parapet sample for cutting type carving (URL2).

4.4 Surface Carving (Relief)

In order to give certain motion, only to the motif or shape on the surface of timber this carving technique is used. For this purpose triangle or U-shaped tools, so-called “pen” are used. This work can be done on both the finished and untreated surfaces. If wanted, the tiny lines on the surface can be painted. The surface carving is classified into two groups: superficial and deep carvings.

4.5 Superficial Carving

Superficial surface carving (Fig. 9) refers to carving in which the depth does not exceed 3-4 mm from the surface. While executing the desired shape, eg., a leaf, the main lines should not be disregarded. Otherwise, the work may easily result in failure. Subsequent cleaning of the timber curves is not difficult.

This type of work is to be found in various countries after the 14th century. In France, this shape is commonly used during the reigns of Louis 14th-16th. Although this work is not so popular in Britain in the above mentioned term, the Chippendal which is different from Gotik-Berok and Rokuko term applied this work.

In Ancient Turkish and Islamic (Arabesque) fashion, this work was lovingly applied. This type work is remains very popular in Turkey nowadays.



Fig. 9. A niche sample for superficial carving (URL2).

4.6 Deep Surface Carving

As the name suggests, deep surface carving employs a technique using deeper incisions, and thereby creating a more three dimensional feel. In this way, the carved motifs could be described as being more alive. Compared to other methods, this deeper surface carving method adds an extra degree of difficulty in its execution. The most characteristic examples of this can be seen in examples of Gothic art from the 14th century.

The Baroque and Rococo periods of the 17th and the 18th centuries made luxury fashionable. This type of art is very popular in France and holds an important place in the history of furniture and architecture.

The composition of motifs involving sea shells, music tools, flower arrangements, birds and acanthus plants are obtained by this method. They are mainly used in furniture on the surface of buildings and boxes (Fig. 10).

Carving by this method brings about problems with cleaning and also a decrease in the strength of the wood. In Istanbul, these types of motifs can be seen on public buildings, foundation, stones and wood. In national museums in Turkey, furniture may be seen on display from various eras.



Fig. 10. A box sample for deep carving (URL2).

4.7 Natural Shape Carvings

Natural shape carving (Fig. 11) is the most difficult carving type. In order to perform this type of carving, the design carver should have strong knowledge on anatomy and biology sciences. This type of carving is also referred to as statue carving. The motifs are three dimensional. The ancient Assyrians and Egyptians designed their furniture with natural carving art. For example, the [Restart from here](#)

ancient Egyptians used varied shapes of animal and man headed legs, furniture crown, prince and prince's statues, various platforms in their chairs even nowadays this art is still applied. Three-dimensional carving is observable in Ottoman woodcarving. This style of carving, which was generally used to decorate the ceilings of libraries, is as valuable aesthetically as it is technically, and an attempt is being made to keep it alive today (Sogutlu 2004).



Fig. 11. Various samples for natural object carving (URL2).

5. WOOD CARVING TOOLS

Carving tools are made from the different body and tips to comply with arcs.

5.1 Carving Tools' Structure and Features

The body that is mounted to tip as square section like, gets off to edge as different grooves.

5.2 Body Dorsal

It was rectified but was not shined. There is an important that to be rectify properly. Thickness increases to bottom of body, then width scales down trough to bottom of body.

5.3 Bottom of Body

It is at the junction with body and handle.

5.4 Gouge

Gouge surface is properly designed and shined. It was done as gouge that he is not spend more energy when a person is working.

5.5 Tail

It joints body with handle. It is square profile and shows structure.

5.6 Edge (cutter tip)

It is part of edge carving cuts for plain and curve. The carving motif 's cutting and forming that is related with edge. It must be attention to part of edge's tip have to be straight.

5.7 Handle

It has to make from a stable tree for a area exposure to shock, e.g., ash, hornbeam, oak, boxwood, beech, acacia, maple, walnuts and chestnut atc. Handle must be varnished for protecting and must be attached between body and tail.

According to body structure, wood carving tools:

- 1- Plain body carving tools,
- 2- Slant body carving tools,
- 3- Gauge body carving tools.

5.8 Plain body carving tools

They are used for cutting motif's plain corner and motif's slanted corner.

5.9 Slanting body carving tools

They are used when plain body carving tools are not used for motif's handyworks. They are used master craftsman only.

5.10 Gauge Body Carving Tools

The masters are use them from that not doing plain and curve body carving tools very sensitive and delicate.

Table 1. Triangle carving tools are entitled accordingly edge's width.

	Narrow	Medium	Wide
Plain body	39	41	45
Slant body	40	42	46
Gouge body	43	44	--

5.11 Carving Tools Using Furniture and Decoration

- 1/4 - Plain body not groove carving tool 4 mm edge width.
- 6/6 - Plain body groove carving tool 6 mm edge width.
- 11/2 - Plain body groove carving tool 2 mm edge width.
- 18/10 - Slant body groove carving tools 10 mm edge width.
- 13/18 - Slant body groove carving tools 8 mm edge width.
- 24/6 – Gouge body into curved groove carving tools 6 mm edge width.
- 28/12 – Gouge body into curved groove carving tools 12 mm edge width.
- 36/14 - Gutter body outside curved groove carving tools 14 mm edge width.
- 39/12 - Plain body triangle carving tool 12 mm edge width.
- 42/10 - Slant body triangle carving tools 10 mm edge width.
- 43/8 - Gouge body into curved groove triangle carving tools 8 mm edge width.

5.12 Modelling Shapes in Carving

- Assembling motifs side by side
- Apppliaction two different motifs by sequence
- Ranking motifs symmetrically
- Giving narrow and large surface to motifs
- Assembling different motifs together

6. CONCLUSIONS

Various wood works unearthed in the Central Asian tumuli and Pazyryk excavations, have revealed that Turks were interested in this subject since ancient times. Animal motifs with legendary and religious significance were frequently used in the decoration of wooden objects. This tradition known as the "animal style", was gradually abandoned and replaced by vegetal and geometric motifs after the Turks adopted Islam. Wood works techniques applied in the wood art of Turkey are as follows: carving, painting, dovetail (kundekari), inlaying and latticework, respectively. The most special technique for Turkey is dovetail (kundekari). Wood carving in Turkey is classified into three groups: cutting type, surfaca carving (superfical and deep), which is the most popular, and natural shape carving. Some carving tool such as needle nose pliers and nail pen is peculiar to Turkish carving industry.

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URL3: <http://newspot.byegm.gov.tr>

URL4: <http://www.motiftr.com/L/EN/mid/160>

URL5: <http://galeri.uludagsozluk.com/tr>

URL6: www.kentmaras.com



WOOD CARVING ART IN TURKEY

Prof. Dr. M. Hakkı ALMA
University of Kahramanmaraş Sutcu Imam
TURKEY





1. Introduction
2. Histories of Wood Works in Turkey
3. The Techniques Applied in Woodworks in Turkey
4. Carving Wood in Turkey
5. Wood Carving Tools
6. Conclusions



1. INTRODUCTION

- ❑ The History of wood carving has from the remotest ages the decoration of wood as a foremost art.
- ❑ Extant everyday objects used over the lengthy time segment encompassing both the Seljuk and Ottoman periods are so few as to be practically non-existent.



- ❑ In contrast, architectural accessories of religious structures dating from the Seljuk period, as well as objects used in these buildings, are sufficient in number to give a good idea of Turkish wood carving.
- ❑ Architectural elements in certain mosques in Anatolia provide considerable information on woodcarving in principalities during the post-Seljuk period.



- It is a fact that woodcarving developed following the migration of the Turks to Anatolia, a phenomenon in which the influence of geography and the cultural milieu cannot be denied.
- Syria and Egypt in particular demonstrated development in this art parallel to that in Anatolia in terms of the techniques employed.



- The bulk of extant wooden objects from the Seljuk and Ottoman periods are housed in the Ankara Ethnographical Museum and the Istanbul Museum of Turkish and Islamic Antiquities.
- The wealth of decoration seen on the woodcarving used in Seljuk architecture developed parallel to the architecture of that period.



- ❑ Wooden houses constitute a little known aspect of Turkish architecture.
- ❑ The facades, eaves and ceiling decorations of traditional Turkish wooden houses constitute fascinating examples of carving and the false inlay technique and exhibit a variety of styles from period to period.



- ❑ A new approach that gradually gained acceptance in the Ottoman period was painting on wood.
- ❑ From the 15th century onwards, decorations began to be painted on architectural elements as well as on smaller wooden objects.
- ❑ Interesting examples date to the 18th and 19th centuries in the secular architecture of Topkapı Palace and of such urban centers as Edirne and Bursa.



-
- ❑ Among the wooden transport vehicles used by the Palace and the upper classes there are examples of woodcarving that may be regarded as masterpieces in their genre.

 - ❑ Another genre of Ottoman wood carving was the simultaneous use of metal applique and metal plaques.



-
- ❑ Close relations existed between the masters who crafted the wooden elements used in architecture (neccar) and the architects, which was especially evident in the Ottoman period when many architects were former carpenters and masters of intarsia.



2. HISTORIES OF WOOD WORKS IN TURKEY

2.1 Wood Works in Before Islamic Architecture

- The decorative wooden objects found in excavations in Central Asia show that the Turkish art of woodcarving dates back to the distant past.
- As in other branches of art, animal motifs with legendary and religious significance were frequently used in the decoration of wooden objects.



2.2 Wood Works in Early Islamic Architecture

- Various wood works unearthed in the Central Asian tumuli and Pazyryk excavations, have revealed that Turks were interested in this subject since ancient times.
- In Islamic art and especially in Omayyad and Abbasid wood works, we find a tendency towards a new style.



- The magnificent gate displayed in the Metropolitan Museum and the wood works displayed in the Cairo Museum, prove that the Fatimid decorations were oriented towards animal motifs in later periods.



2.3 The Seljuk Wood Works

- Seljuks considered wood works very important and they have produced many works of art such as pulpits, reading desks, chests of drawers in addition to the architectural elements ornamenting buildings.
- Geometrical forms and plant motifs were often used in the Seljuk wood works where carving and latticework were widely applied.

2.4 The Ottoman Wood Works

- ❑ The Seljuk wood works influenced the early Ottoman wood works of the 14th -15th centuries and various works were started to be made by new techniques and with new decorative elements.
- ❑ Beginning with the 16th century, the Rumi decoration on the wood works gained a much more complex appearance by uniting with different floral patterns found in the similarly decorated tiles.

The Seljuk Wood Works In Konya Alladdin Mosque To, Turkey

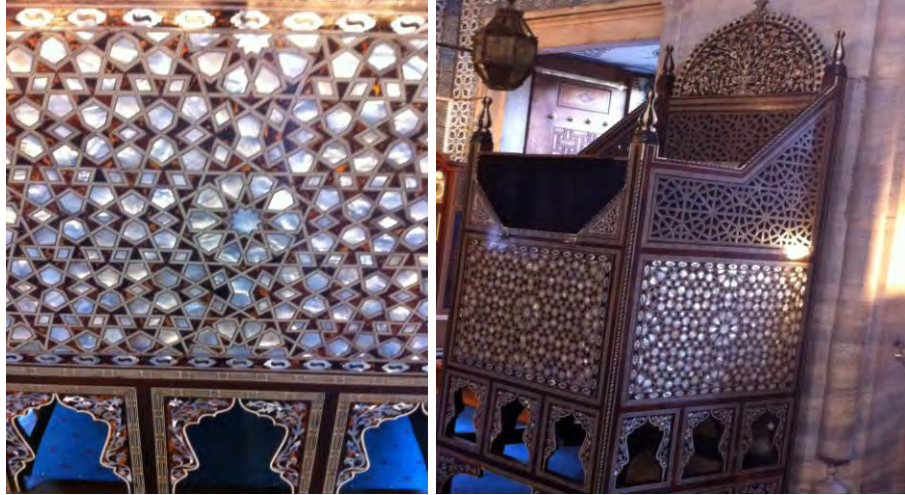




Fig. 1. A Rumi carving style sample for door (URL1).

- ❑ With materials such as mother-of-pearl, tortoise shell and ivory used in the 18th century wood works, the products gained a more colourful appearance.
- ❑ Of all the sultans, Abdülhamid II (1842-1918) probably appreciated woodcarving the most. During his reign, he worked in his own carpentry shop and a distinctive Palace style began to take shape (URL1).

Chair Decorated With Mother Of Pearl



Box decorated with mother of pearl



3. THE TECHNIQUES APPLIED IN WOODWORKS IN TURKEY

3.1 Carving

- In the method of carving, a pointed chisel works out the decoration in raised form by carving the surface of the wood, which is deep carving and superficial carving, cuttingtype carving (decoupage) and natural shape carvings.



Fig. 2..A sample for superficial carving (URL2).

3.2 Latticework

- There is no ground in this technique, but various compositions carved in the form of palmettes, lotus leaves and spiral leaves.



**Latticework in
Seljuk**

3.3 Painting

- Painting, which first came into use as a decorative architectural element among the Seljuks, underwent extensive development under the Ottomans in the 17th and 18th centuries.



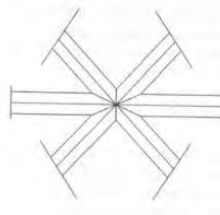
Fig. 3. Sample for painting the carved wood (URL2).

3.4 Dovetail (Kundekari) Technique

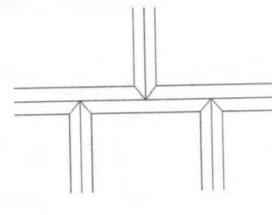
- ❑ The materials most frequently used in decorative carving are walnut, apple, pear, cedar, ivory and rose.
- ❑ "Kundekari" or tongue-and-groove joining is the name given to the technique of placing small pieces of wood side by side to form a design.



(a)



(b)



(c)

Fig. 4. Joint types for dovetail methods. (a): angel type. (b):multiply type. (c): vertical type.



- ❑ The Ottomans used plain pieces of wood in place of geometric shapes.
- ❑ The Kündekari technique, of which the earliest examples were found in Egypt, Aleppo and Anain the 12th century, involves fixing small geometric pieces together with grooves.
- ❑ The Kündekari technique, of which the earliest examples were found in Egypt, Aleppo and Anain the 12th century, involves fixing small geometric pieces together with grooves.



- ❑ The carving method used by the Seljuks have been replaced by dovetail works of the Ottomans.
- ❑ During the 11th century, walnut or cedar tree next to the walnut tree next to the box by putting works created by putting the contrast form.



Fig. 5. Typical kundekari wood carving sample for Turkish art (URL5).

3.5 Inlaying

- ❑ In later periods, inlaying has been widely used besides dovetail works.
- ❑ In this method which is divided as inlaying of mother-of-pearl and inlaying of wood, the decorative design is drawn on the finished surface by a pointed pencil and the proper places of the design is engraved and then inlaid with mother-of-pearl, tortoise shell or ivory. In another kind named as "Damascus work", the pieces of mother-of-pearl are surrounded by thin metal work.

4. CARVING WOOD IN TURKEY

4.1 Flowchart of wood carving

- ❑ The wood species used for carving in Turkey is walnut (*Juglans regia* L.)and horn beech (*Carpinus betulus* L.).
- ❑ Carved wood is used for following purposes:
Local wood carving survives today in some parts of Southern Anatolia.

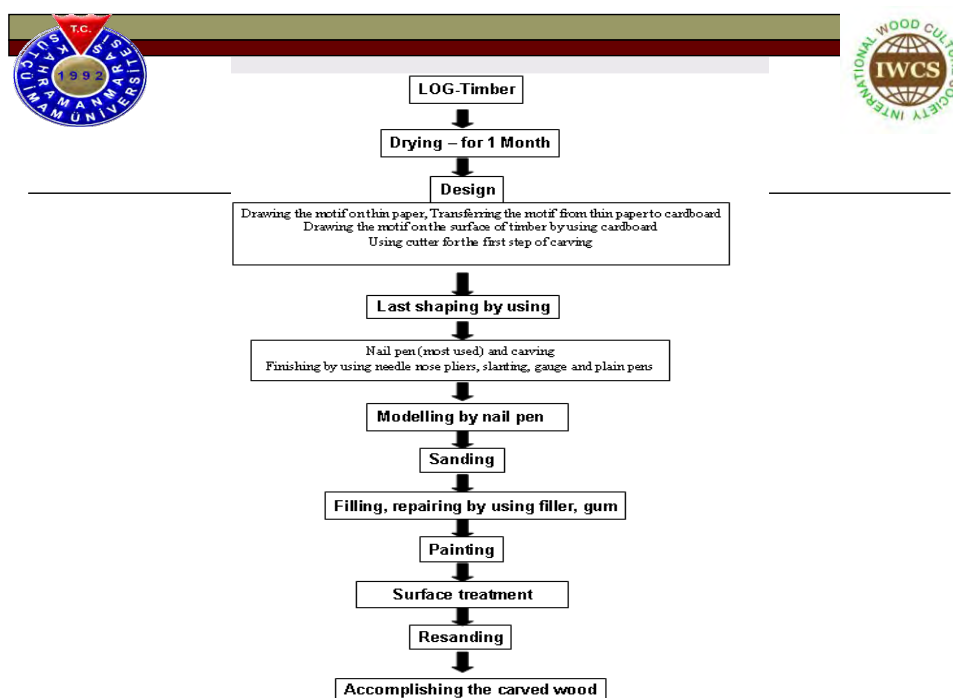


Fig. 6. Flow chart for carving applied in Turkey.

4.2 Carving Types

- Various carving types applied in Turkey are given as follows.

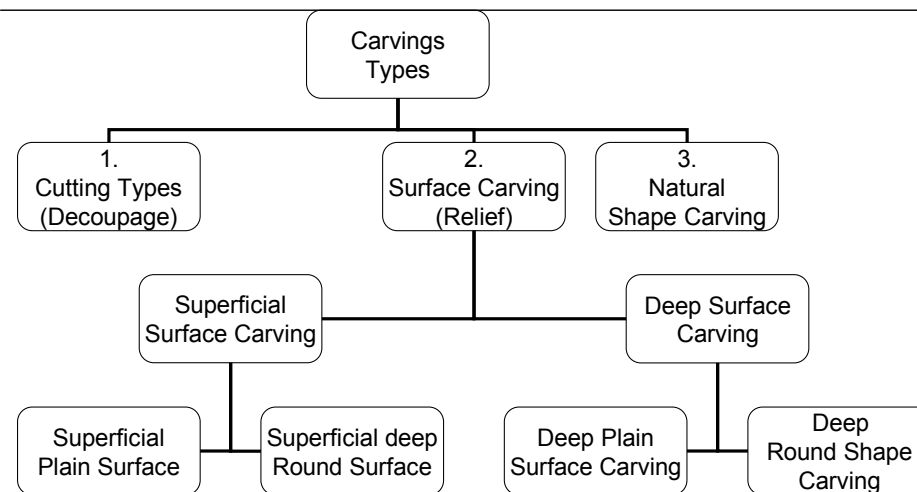


Fig. 7. Carving types applied in Turkey (Sogutlu 2004).

4.3 Cutting type Carving (decoupage)

- ❑ The image drawn on the surface of timber with certain thickness is made by using hair sawmill, mouse tail sawmill or decoupage sawmill.
- ❑ If the obtained and cut motif is glued on any surface, this piece is called as 'aplik' and this work is also called as 'aplike'.



Fig. 8. A balkony parapet sample for cutting type carving (URL2).



4.4 Surface Carving (Relief)

- ❑ In order to give certain motion, only to the motif or shape on the surface of timber this carving technique is used.
- ❑ For this purpose triangle or U-shaped tools, so-called “pen” are used.



4.5 Superficial Carving

- ❑ Superficial surface carving (Fig. 8) is the carving whose depth does not exceed 3-4 mm from surface.
- ❑ Shape to be done, e.g., leaf, side should be done without disregarding the main lines. Otherwise, the work is easily failed.
- ❑ In Ancient Turk and Islamic (Arabesque) fashion, this work was lovely applied. This work is very popular in Turkey nowadays.



Fig. 9. A niche sample for superficial carving (URL2).

4.6 Deep Surface Carving

- ❑ The highly depth surface carving is much more depth of less depth surface carving. The procemed motifs are worked much more alive.
- ❑ Compared to other methods, relief resulted from deep carving is much more difficult. The most characteristic example of it could be seen in the Gothic fashion done in the 14th century.



Fig. 10. A box sample for deep carving (URL2).

4.7 Natural Shape Carvings

- ❑ Natural shape carving is the most difficult carving type.
- ❑ In order to perform this type of carving, the design carver should have strong knowledge on anatomy and biology sciences.
- ❑ In the mean time, this type of carving is called on statue carving. The motifs have 3 dimensions.



Fig. 11. Various samples for natural object carving (URL2).

5. WOOD CARVING TOOLS

- ❑ Carving tools are made from the different body and tips to comply with arcs.

5.1 Carving Tools' Structure and Features

- ❑ The body that is mounted to tip as square section like, gets off to edge as different grooves.



5.2 Body Dorsal

- ❑ It was rectified but was not shined. There is an important that to be rectify properly.

5.3 Bottom of Body

- ❑ It is at the junction with body and handle.

5.4 Gouge

- ❑ Gouge surface is properly designed and shined. It was done as gouge that he is not spend more energy when a person is working.

5.5 Tail

- ❑ It joints body with handle. It is square profile and shows structure.



5.6 Edge (cutter tip)

- ❑ It is part of edge carving cuts for plain and curve.

5.7 Handle

- ❑ It has to make from a stable tree for a area exposure to shock, e.g., ash, hornbeam, oak, boxwood, beech, acacia, maple, walnuts and chestnut atc.



5.8 Plain body carving tools

- They are used for cutting motif's plain corner and motif's slanted corner.

5.9 Slanting body carving tools

- They are used when plain body carving tools are not used for motif's handyworks.

5.10 Gauge Body Carving Tools

- The masters are use them from that not doing plain and curve body carving tools very sensitive and delicate.



General Classification of wood carving tools:

1. Plain carving tools,
2. Gauge carving tools (full and partially open, and closed type).
3. Nail shape carving tools (U and V profile).
4. Special carving tools
 - Tools whose handles are curve type
 - crow nose-like carving tools
 - Spun-like carving tools
 - Slanting (oblique) body type

Carving Tools in Turkey



Table 1. Triangle carving tools are entitled accordingly edge's width.

	Narrow	Medium	Wide
Plain body	39	41	45
Slanting body	40	42	46
Gouge body	43	44	--



5.11 Some Carving Tools Using Furniture and Decoration

- ❑ 1/4 Plain body not groove carving tool 4 mm edge width.
- ❑ 6/6 Plain body groove carving tool 6 mm edge width.
- ❑ 11/2 Plain body groove carving tool 2 mm edge width.
- ❑ 18/10 Slanting body groove carving tools 10 mm edge width.
- ❑ 13/18 Slanting body groove carving tools 8 mm edge width.
- ❑ 24/6 Gouge body into curved groove carving tools 6 mm edge width.
- ❑ 28/12 Gouge body into curved groove carving tools 12 mm edge width.
- ❑ 36/14 Slanting body outside curved groove carving tools 14 mm edge width.
- ❑ 39/12 Plain body triangle carving tool 12 mm edge width.
- ❑ 42/10 Slanting body triangle carving tools 10 mm edge width.
- ❑ 43/8 Gouge body into curved groove triangle carving tools 8 mm edge width.



5.12 Modelling Shapes in Carving

- ❑ Assembling motifs side by side
- ❑ Appliation two different motifs by sequence
- ❑ Ranking motifs symmetrically
- ❑ Giving narrow and large surface to motifs
- ❑ Assembling different motifs together



6. CONCLUSIONS

- ❑ Various wood works unearthed in the Central Asian tumuli and Pazyryk excavations, have revealed that Turks were interested in this subject since ancient times.
- ❑ Animal motifs with legendary and religious significance were frequently used in the decoration of wooden objects .
- ❑ Wood works techniques applied in the wood art of Turkey are as follows: carving, painting, dovetail (kundekari), inlaying and latticework, respectively.
- ❑ Wood carving in Turkey is classified into three groups: cutting type, surfaca carving (superfical and deep), which is the most popular, and natural shape carving.



**THANKS FOR YOUR
ATTENTION**

Wood Aesthetic Pattern Design and its Application

Lv Jiufang⁵, Wu Zhihui and Liao Xiaomei

Abstract

This paper aims to study the characteristics of the macro-patterns of the natural wood, extracts the beautiful design elements from the point of the aesthetic principles, then according to the design principles, constitutes a break up or a combination of the aesthetic design of these elements to form kinds of rhythmic and decorative beauty of new wood grain patterns, and makes use of it to all kinds of life instruments in order to enrich the visual effect of the products, so as to enhance the value-added product design.

Keywords: *aesthetics of wood, wood pattern, graphic design*

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1. INTRODUCTION

Timber in addition to its practical value as a material substance, it also has a very important aesthetic value. With social progress and technological development, research and its application of the aesthetic value of wood have been paid more and more attention. Trees with abundant natural resources, because of its cell arrangement and distribution of different forms, the formation of patterns varies widely, and because different kinds of timber also has the appearance of physical defects, the formation of the pattern is changing unpredictably, and beautiful. Therefore, we can imagine, thousands of timber bears the rich patterns for us to study and enjoy.

This paper is based on the patterns of the natural wood, from which to extract the beautiful aesthetic design elements, then according to design principles, to develop a variety of rhythmic and decorative beauty of the wood aesthetic patterns, which have been composed by making use of computer technology to re-mix synthetic or reconstructed. These aesthetic wood patterns are composed by the natural aesthetic elements from wood, which are attractive and matched with the modern man's pursuit of 'return to nature, back to nature' philosophy of life, so they have a strong appeal and affinity for modern people. They can be widely used in industrial product design, interior design, textile design and other fields, and which can not only enrich the visual artistic effect of products, but also meet people's physical quality of life and the pursuit of a higher level of spiritual life.

The next part will be analyzed and discussed from three aspects of natural wood patterns, aesthetic principles and pattern design and its application. The first step is to extract the aesthetic elements from the natural patterns of wood, then regarding these aesthetic elements as the basic materials to combine with pattern design methods and artistic style to develop the creation and applied research of the aesthetic patterns of wood.

2. FIRST, THE EXTRACTION AND ANALYSIS OF AESTHETIC ELEMENTS OF WOOD

Although the wood anatomy has been widely in-depth research and analysis of macro-structure of wood, in the past it is only discussed from the perspective of identification of wood or wood material from the perspective of the application materials. Today we re-examine and analyze the structure of wood from the aesthetic point of view, which will get unexpected results. For example, in the past for wood identification, wood chips are cut in the wood tangential, lateral and radial section on these three criteria. However, in the aesthetics of wood, we can cut the slice of wood to get richer wood patterns at any angle and any direction. The steps of refining wood aesthetic elements are as follows:

1.1 Selection of wood

To select the timber with beautiful patterns or special defects, slice it from different angle or direction, then filter the sections with beautiful patterns as the objects for photographing.

1.2 Photographing

To take the digital photos of wood which has perfect and clear patterns with the professional camera.

1.3 The aesthetic analysis of these photos

To extract the wood aesthetic elements from the photographs according to the aesthetic principles and rules, and file them into different categories for the collection.

3. SECOND, THE CREATIVE DESIGN OF THE WOOD AESTHETIC PATTERNS

It is based on the extracted timber aesthetic elements as the basic materials, to recreate the aesthetic patterns according to the art and design theory and computer graphic design processing technology, and finally get the artistic innovation aesthetic patterns with beautiful effect of wood.

2.1 The design techniques of Wood aesthetic patterns

The most popular way to design the aesthetic patterns of wood is reconstruction. Under the condition of being dispersed, reconstruction is to link the design elements together organically or to optimize the combination of elements as part of the process of elimination interference, in order to intercept a valuable part of the elements, resulting in creation of new design elements needed. In other words, it is the way to obtain a new form which is from an objective or abstract images in the decomposition of the basic elements, according to different methods and means of re-combination and construction. Reconstruction includes two kinds of homogeneous and heterogeneous. Isomorphism between the elements is the same combination of reconstruction, has been optimized to produce new elements. Isomerism means to combine and re-build the heterogeneous elements of different qualities to generate new elements. In addition, it can also be homogeneous or heterogeneous combination of elements and then construct to produce new elements. Here takes the rosewood, striped ebony, and the Philippine ebony's plate pattern of electronic photos for example, the use of icons to show the way to design the wood aesthetic patterns' process.

2.2 The illustrations of Wood aesthetic patterns' design

Example 1: Take the rosewood for example, first to analyze the surface pattern features of rosewood board, to extract concise aesthetic elements of the basic graphics, then use the design principles and modern computer graphics technology to design. The following is the design steps:

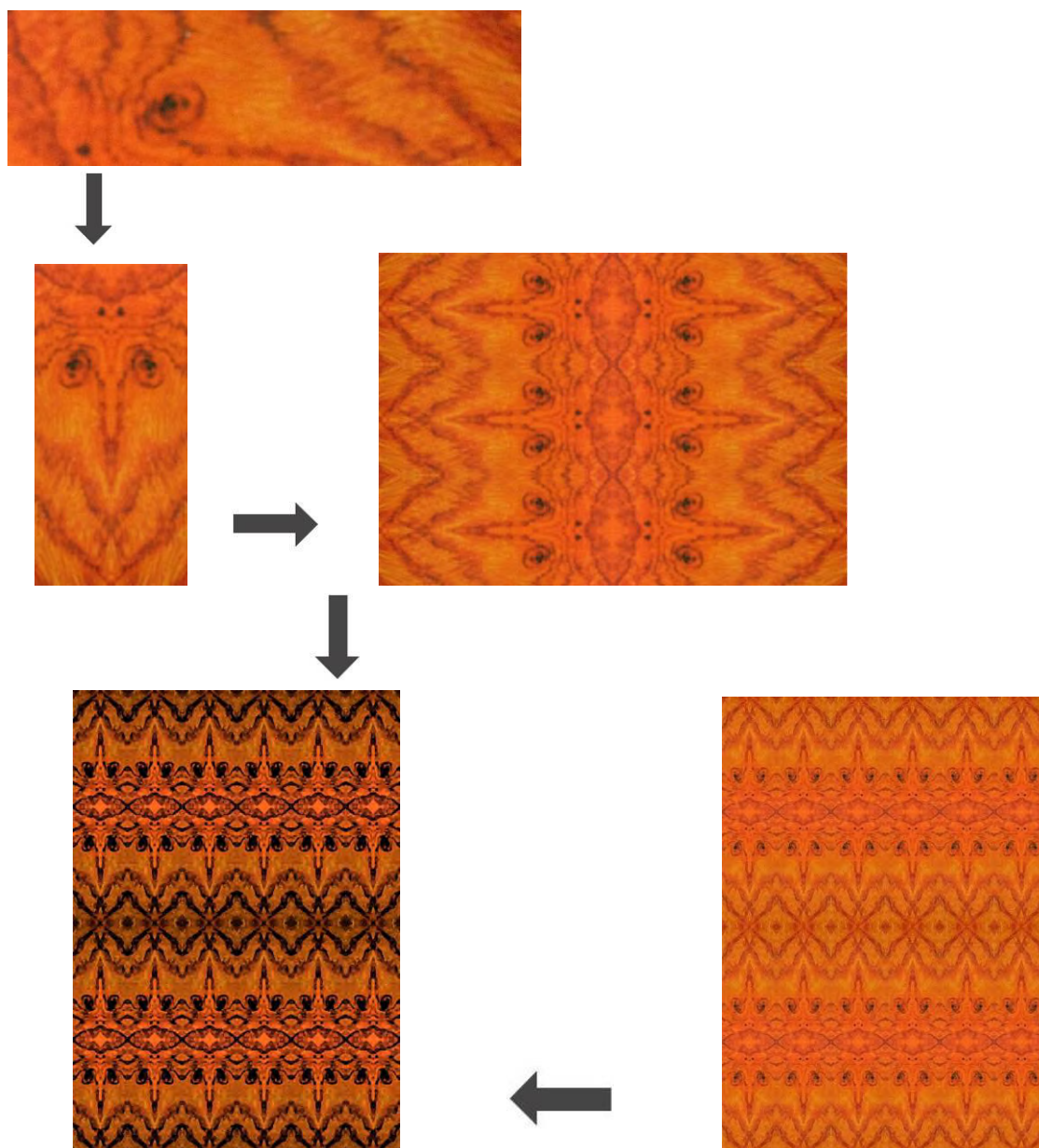


Fig.1 Design steps for aesthetic patterns of rosewood

To intercept the pattern elements on the rosewood board and combine them by stitching to form a 'sheep's head' logo, then use photo shop's filter tool to create two different styles of design, which are the patterns with both dry brush and watercolor effect (Shown in Figure 1).

Example 2: Take the striped ebony for example, first to analyze the pattern features of the striped ebony, and extract the concise aesthetic elements, then use the design principles and modern computer technology to design the patterns. The following is the design steps:

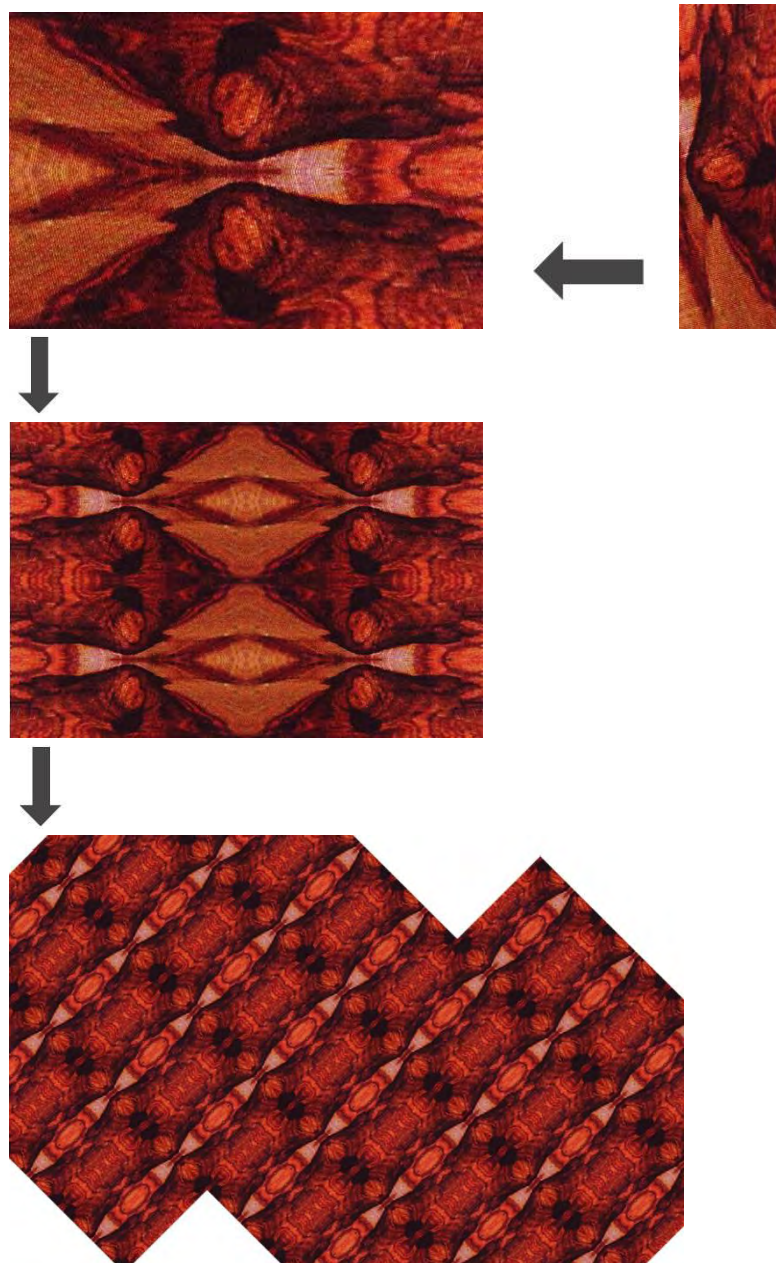


Fig.2 Design steps for aesthetic patterns of ebony

Example 3: Take the Philippine ebony for example, to analyze the pattern characteristics of the Philippines ebony and extract two concise aesthetic elements, then to create two different but similar style patterns from different angles with the divergent thinking, and the colors of the creative designs are faithful to the original timber deep color, which shows rich religious color and mysterious feelings. The following is the design steps:

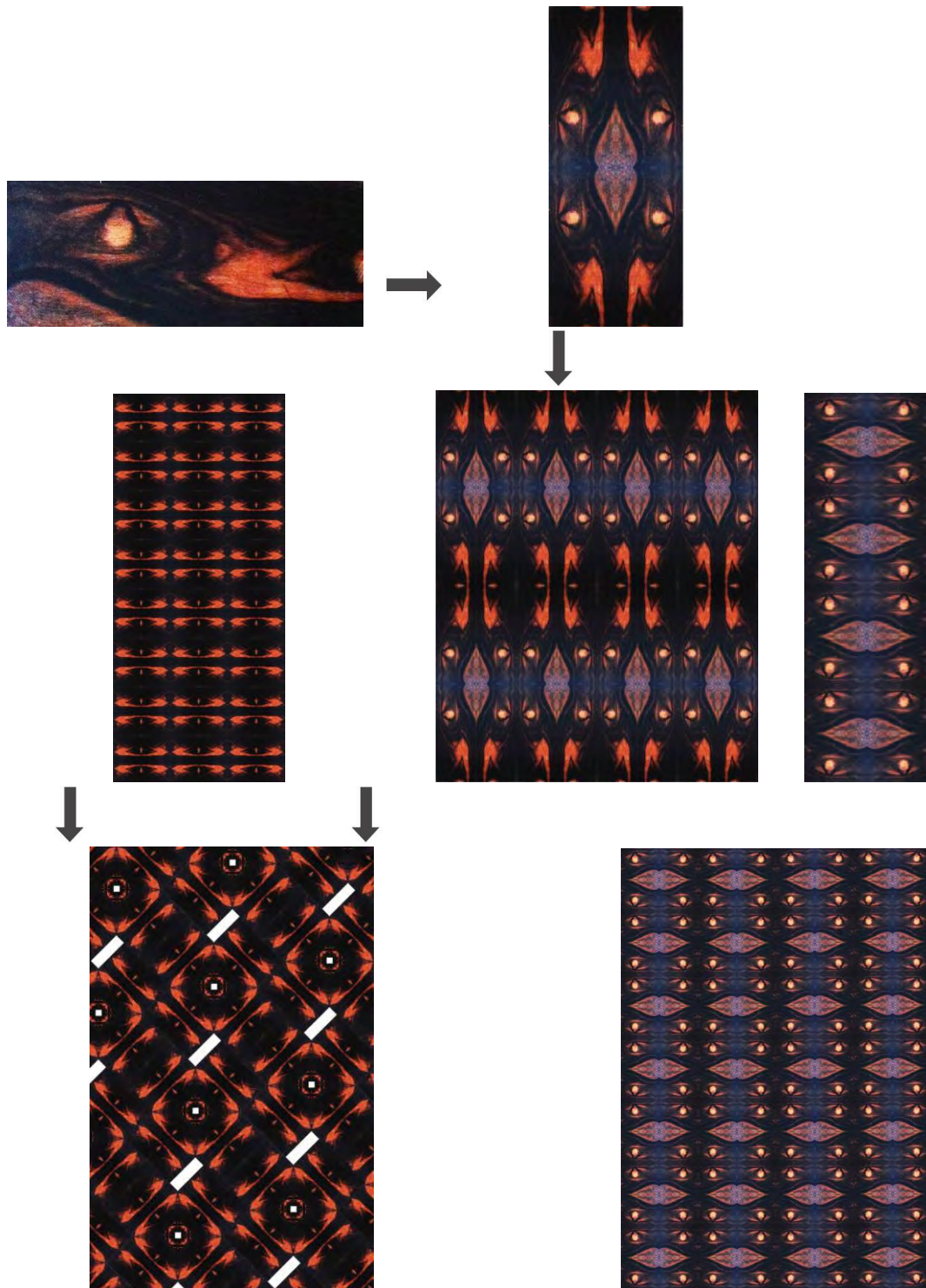


Fig.3 Design steps for aesthetic patterns of Philippine ebony①

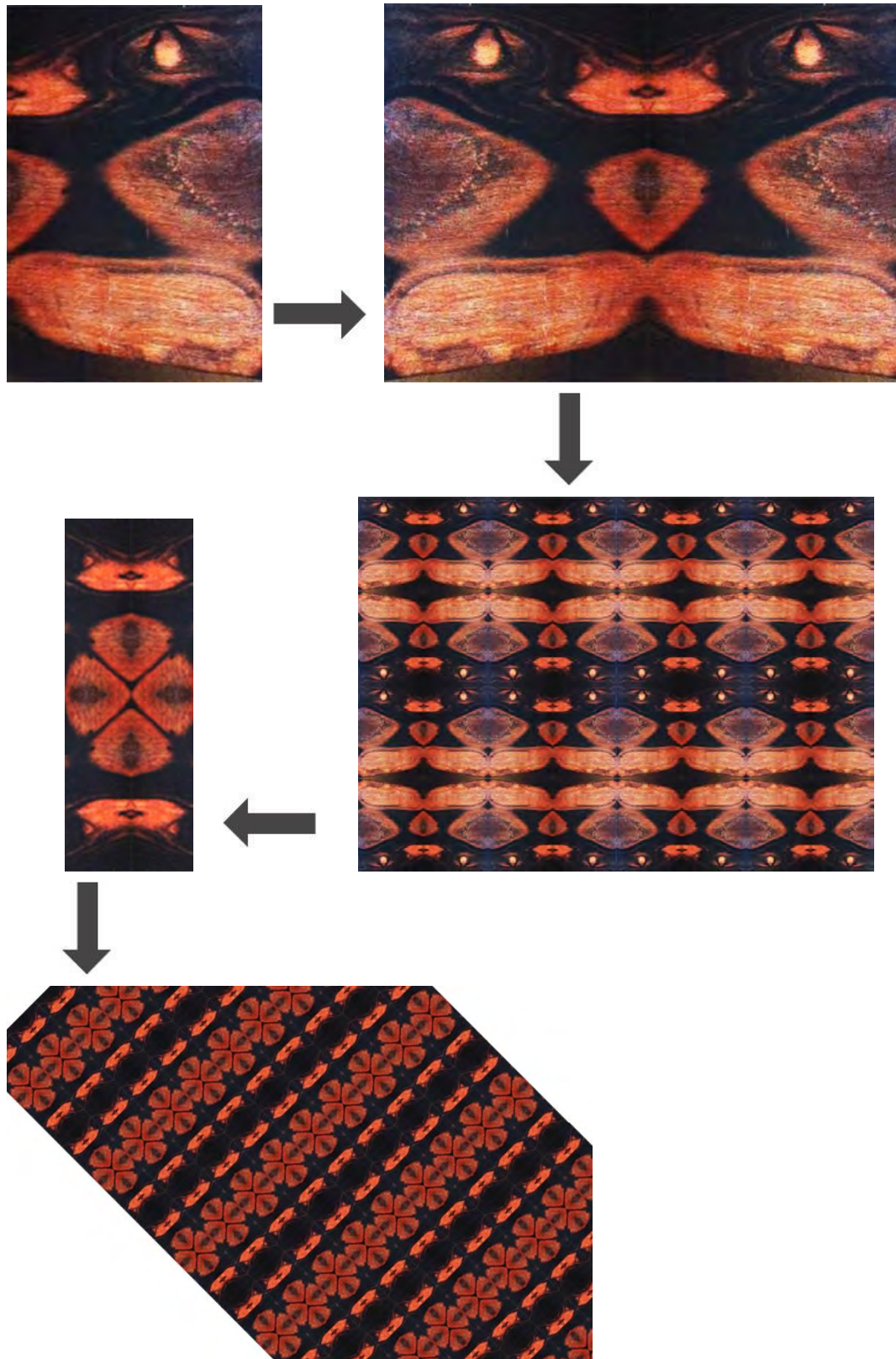


Fig.4 Design steps for aesthetic patterns of Philippine ebony②

4. THIRD, THE APPLICATION OF WOOD AESTHETIC PATTERNS IN PRODUCT DESIGN

1.

Wood aesthetic patterns used in the subject of art and design have broadened the space and scope of the artistic design. Through previous research and design work, a series of different styles of wood aesthetic patterns have been created. These new patterns will be widely used in the field of art and design such as costume design, jewelry design, industrial design, interior design, product design, which definitely enhances the added value in products. Some examples have been shown as below:



Fig.5 Costume design with the aesthetic patterns



Fig.6 Lamp design with the aesthetic patterns



Fig.7 Tea-set design with the aesthetic patterns



Fig.8 Tea-set design with the aesthetic patterns

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Session 5

[Wednesday 4th period 2.0 hours - Hall A]

The use of wood in different cultures (continued)

Speakers



Speaker:
Victor Adekunle

Topic:
The Social, Religious and Magico-Cultural Aspects of Wood and its Versatility for Rural and Sustainable National Development in Nigeria



Speaker:
Xiaomei Jiang

Topic:
The Inheritance and Development of Hongmu Culture in China



Speaker:
O K Remadevi

Topic:
Wooden Monuments in India, Epitomes of Beauty and Talent, Need Protection from a Biological Perspective



Speaker:
Adjovi Edmond Codjo

Topic:
Typology of Wood Sculptures in West Africa



Speaker:
Stephen Tekpetey

Topic:
Lifestyle Changes in Some Urban Centres in Ghana: What are the Existing and Potential Impacts on Wood Use in 2011 and Beyond?

The Social, Religious and Magico-Cultural Aspects of Wood and its Versatility for Rural and Sustainable National Development in Nigeria

Victor Adekunle¹

Abstract

Wood is the most versatile material that has ever been known and a material that has contributed immensely to the development of nations that are richly endowed with it. Nigeria is a tropical country with a good productive wood resource base (forest). This study therefore assessed the social, religious and magico-cultural roles of wood and its contributions to rural and sustainable national development. Data on religious and socio-cultural roles and other important utilization patterns were collected through the use of questionnaires, discussion with key experts and observation. The data on the roles of wood for sustainable development and increasing higher-value wood, now and in future, were collected from records and the relevant literature. This study elaborates on wood utilization from religious perspectives, trees and national identity, different cultural products from wood, traditional herbal medicine, wood and fetishism, musical instruments from wood and the aesthetic products of wood. Specific wood species involved in each of the utilization patterns were identified. For other utilization patterns, wood is relied on as the only source of industrial and domestic cooking, the only source of lumber, poles, stakes, handles for farm tools, hunting tools, shelter, canoes, and household utensils. On national development and sustainable future, the study reviewed the development of wood industries in Nigeria, employment and trade in wood and wood products as sources of rural and urban income. It assessed the present status of the various large and small-scale wood industries in Nigeria and their contributions to national development. Finally, the paper proposes some recommendations on how wood use and sustainable development can be strengthened with the view of promoting higher-value wood use at the local and national levels Nigeria.

Key words: Magico-cultural, Wood utensils, Joinery, Sustainable development.

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1 INTRODUCTION

The importance of forest ecosystems to human society has long been recognized for the production of the many and varied ecosystem services upon which life is based (food, fiber, fuel, water filtration, climate change, nutrient cycling, pollination, pest control and disease) and the promotion of the natural resources base upon which economic activities are founded (Swallow *et al.*, 2007). They reported moreover, that healthy ecosystems are particularly important to the rural poor of the developing world, people who often live in very close connection to their natural surroundings. Angelsen and Wunder (2003) noted that timber, non-timber forest products (NTFPs) and animal protein from the forest ecosystem are all used by the rural poor for subsistence, and also as a source of income and employment. It was estimated that 90% of the world's poor depend on forests for at least a portion of their income (World Bank, 2000). In Africa, 600 million people have been estimated to rely on forests and woodlands for their livelihoods (Anderson *et al.*, 2006), and in India, 50 million people are estimated to directly depend on forests for subsistence alone. However over the year, the number of communities and dwellers that depended on wood has increased. Kaimowitz (2003), Shackleton and Shackleton (2004), UNEP, (2006) Vedeld *et al.*, (2007) and FAO (2008) reported on the importance of wood and other forest resources to local communities and national development.

Man has always relied on wood for survival. His shelter, farm tools, weapons (bows and arrows, and clubs) and house hold utensils were made from wood. Historical records show that civilization and the continual existence of man in the world today would not have been possible without wood. The early great explorers who brought civilization to Africa, Nigeria inclusive, made their voyage with wooden canoes, an ocean-going vessel. In view of this, Oluyeye (2007) reported that the early migration and later exploration of the world would have been hindered with the inability without wood to cross large bodies of water. In the bible, Noah, his immediate family members and some privileged animals escaped the 40 days flood in an ark made exclusively of wood. These same animals later began the new world after the destruction of the old one with the flood. The roof of King Solomon's temple was made of cedar woods, the inner portion was decorated with cedar boards and the floor was covered with pine wood.

Wood is the most versatile material in the world and it is a blessing to any nation that is richly endowed with its resource base, that is, forests. It can always be relied upon for sustainable development as a renewable natural resource, it can easily be converted into any shape and size with little effort or energy and using simple tools, it can be joined and fastened together with nails, screws and bolts and nuts and it retains its colour, shape and strength for a long time. It is highly durable and beautiful in its natural form. Fuwape (2007) captured the versatility of wood in his inaugural lecture titled 'Wood: from cradle to the grave'. He noted in the lecture that man begins to rely on wood from the very day he is born and continues to use wood till the day of his death. He claimed that the first food eaten immediately after a child is born is cooked with wood and he also begins to sleep in a wood cradle, when he begins his education, he starts by writing on wooded slate, he moves ahead to write with pencils or pens on papers, both pencil and paper are also wood products, after graduation, the certificate he receives is made of paper, if he is lucky to get job, the money he receives as wages is also made of paper and when he finally dies, he is buried in a wooded coffin. This shows how indispensable wood is in the survival of man on earth.

The development of forest resources management in Nigeria could be divided into three phases. These phases are the reservation phase, between 1899 and 1930, the exploitation phase between 1930 and 1960 and the development phase from 1960 to date. The first phase was pioneered by the colonial authorities. It involved the demarcation and establishment of tracts of forest land as reserves, provision for their protection and control of wood extraction. This began in 1899 under Mr Thompson, a serving British Forest Officer transferred from India to Nigeria (Enabor, 1981, Adekunle, 2005 and Oyebo, 2006). During the second phase, there was an increase in forest exploitation because many Nigerian timber species were accepted in international market after extensive testing of their samples. The third phase witnessed a large scale afforestation projects and plantation establishment through Taungya system to augment wood supply from the natural forest. Today, all the wood is from the forest ecosystem. This study is on the social, cultural, spiritual and traditional aspect of wood. It also examines the contribution of wood to health care delivery system, development of wood industries in Nigeria and the roles of wood in rural, socio-economic and national development. Recommendations on how to promote higher-value wood use are given. The Nigeria total land cover according to FAO, 2005 is shown in table 1.

2 METHODOLOGY

2.1 The study area

This study was carried out in southwest Nigeria. It is one of the six geopolitical zones in Nigeria and it has seven states. The major vegetation type of this region is the tropical rainforest ecosystem. The mean annual rainfall is 1500mm while the mean temperature is 28°C. The soil type is the alfisol class, well drain and fertile. There is favourable weather condition throughout the year. There are two distinct climates (rainy and dry seasons) The rain season is for nine months and only three months of dry season. This account for why the forest contains most of the important indigenous hardwood species which are of high economic value in the timber industries.

2.2 Data Collection

Data on the social and cultural aspect of wood were collected with a well structured questionnaire administered to twenty randomly selected respondents in ten communities in Ondo state, Nigeria. The questionnaire was designed to collect information on the cultural, health, religious and traditional importance of wood, various species involved in each of the functions, cultural products from wood and the sources of employment and rural income from wood. Information was also collected from key informants on the species used for curing some common ailments. The available records and files in forestry office and literatures were consulted to obtain additional information on the development of wood industries and role of wood in national development.

3 RESULTS AND DISCUSSION

The results of this work are discussed under different subheadings according to the information obtained. All the respondents and the key informants are males, mature adults and bread winners. They all supported the wide use of wood for various purposes.

3.1 Religion, social, health and magico-cultural aspects of wood in Nigeria

3.1.1 Religion:

The Holy bible of the Christian faith stated that vegetation, which include plants by extension the forest, was created by God on the third day of creation (Genesis 1:3). Man was the last to be created, on the sixth day. So, it implies that the trees are older than man. The creator, in His wisdom, deliberately did this because of his fore knowledge that man will always depend on the forest and wood for survival. So, since creation, man has always depended on wood and wood products for livelihood. In addition, most of the roles played by wood in human life today were predicted in the bible. For instance, in Ezekiel 47:12, it was written that “the trees of all kinds (species) will grow and their leaves and woods and fruits will serve as food and for healing”. The importance of wood in religion could be dated back to the time of Jesus. He was presented with three gifts at birth and two of them were wood products (frankincense, the gum from the wood of *Boswellia thurifera* and myrrh, a fragrance extracted from the wood of *Commiphora myrrha*). He was nailed to a wooden cross (but the species used to construct the cross is yet to be identified) and a crown of thorn woven from a species identified as *Zizyphus spina-Christ* was placed on his head. During his entry into Jerusalem, branches of trees and leaves were used to welcome him. In view of this, churches are decorated with wooden cross. It is now part of worship for Christians to carry wooden cross about as object of worship. Also, during Christmas and Easter periods, churches and Christian homes are well decorated with branches of wood and palms. Prominent species of wood for these decorations are *Casuarina equisetifolia*, *Pinus caribean*, *P. Ooacarpa* and *Calistris robusta*. Wood also provides materials for worship in Nigeria. The beads (tashbia), equivalent of ‘Jap-Mala’ in India, usually counted by Muslims during their five times daily prayer are made from the seeds of *Balanites aegyptica*. The equivalent, called rosaries, of the Roman Catholic Church worshippers are made from the seeds of *Atrus precatorius* (Etukudo, 2000).

Many forests are venerated and separated for religious purposes in Nigeria. These forests are referred to as sacred groves or black forest. They are protected though taboos and local laws. So entrance and any form of activities are prohibited in such forests except the priest during festivals. Prominent among these in southwest Nigeria are Igbo Olodumare and Oshu Oshogbo that have become world heritage centres. There are also several wood species such as *Melicia excelsa* (Iroko), *Adasonia digitata* (Igi-ose), *Newbodia levis* (Akoko), *Ceiba pentandra* (Araba), *Dracenia mannii* (peregum), *Diospyrus spp* (igi-dudu or black wood), etc that are revered and worshipped as gods. These trees are worshipped with the blood of goats, chicken or pigeon at specific times of the year. Prayers for protection and request are made during the worship period. The wood of some of these trees are also believed to be the abode of both evil and good spirits. Cutting them is dreaded, so they are usually left where ever they are found. They are very common in market and town centres, traditional worship places and the sacred groves. Specifically, *Adasonia digitata* wood is believed to be the home of the ‘Abikus-Ogbanjes’, referred to as *spirit child* or *wanderer child*. ‘Abiku-Ogbanje’ refers to a child who dies and returns again and again to plague the mother (Maduka et al., 1987). They are called *familiar spirit* in religious cycle. A poet avowed in one of his poems on ‘abikus’ that they live in the wood of this tree: “Coming and going these several seasons, Do stay out on the ‘baobab’ tree, Follow where you please your kindred spirits, If indoors is not enough for you” (Clark, 2011). A common saying among the Yorubas (one of the three most populous tribes in Nigeria) holds that “an iroko tree that is not destroyed when young will require a daily oblation when it becomes a mature wood in future”. This confirms the belief that *Melicia excelsa* is a tree that is worshipped.

3.1.2 Cultural aspect of wood

For the cultural aspect of wood, *Newbodia levis* is highly recognised and used during the installation of kings and conferring of chieftaincy titles. Different kinds of drums for traditional, festival, cultural and social purposes are made from the wood of several species. The wooden part of the skin drum (Gbedu) and the talking drum (Gangan) are made from the woods of *Pterocarpus osun*, *Millicia excelsa*, and *Cocos nucifera*. The thumb piano (Duru) is made from the wood of *Alstonia congensis*, *Holarrhena floribunda* and *Pychnathus angolensis*, the musical bows and violins are made from the woods of *Anoistrophyllum secundiflorum* and *Malacanthia alnifolia*, the wooded harp, wooden bell and gong (Agogo) are carved from the wood of *Alstonia congensis* and *Pterocarpus osun* and the wooden flute (fere) from the woods of bamboo (*Oxytenanthera abyssinica*). Wood is used for the construction of beautiful coffins used in burring dead bodies in Nigeria. Production of coffins is now a very lucrative business in due to the exorbitant cost of the product. The high cost is due to the cultural importance of coffins in burial ceremonies and funeral rites.

The most popular local gin in Nigeria (Ogogoro) is produced from the distillation of palm-wine (emu), the liquid extract from the woods of *Elaeis guineensis* and *Raphia hookeri*. These liquors (palm wine and local gin) are of high social and cultural importance in SW and SE Nigeria. They are drunk in social functions like funeral, naming, and wedding ceremonies. They are items used in sacrifice especially to appease traditional gods and ancestral fathers and for offering prayers. The worshiped of Ogun, the god of iron (one of the most popular traditional gods), by its devotees is done with palm wine, local, palm leaves and dog sacrifice. There are many sheds and local bars where these liquors are sold and where people spend their leisure time, relax and drink, and in the process, they discuss business, settle grievances and make friends. Trade in these wood extracts is a source of job opportunity to many rural women in these geopolitical zones. Apart from the use of these extracts in socio-cultural activities, they are the most important and potent solvent for preparing traditional medicine practice (Etukudo, 2000). They are useful in distilling, mixing and boiling wood stems and barks during herbal preparations.

3.1.3 Wood in ethno-medicine and health care delivery system

The role of wood in providing health care delivery system among the rural communities and urban poor in Africa is becoming more popular (Adekunle, 2001). The list of several plants of medicinal importance in Nigeria and the various ailments they cure has been provided by some authors (Adekunle, 2001). The preference of ethno-medicine by rural respondents is because of its availability and affordability. It is very cheap and readily available unlike orthodox drugs and modern medical facilities. Secondly, it has stood the test of time according to them. Thirdly, it is very effective in the treatment of sickness like sickle cell, impotence in men, madness and epilepsy which cannot be cured perfectly and completely by orthodox medicine. The extract from the wood stems of species like *Enantia chloratha*, *Alstonia booneii*, *Khaya spp*, and *Pterocarpus osun*, when mixed or distilled with local gin, palm wine or water are used to cure malarial fever, stomach disorder, diuretic, diaphoretic, emetic and several other ailments. Specifically, the wood of *Securidaca longepedunculata* is reported to have the ability of curing several common ailments (Omrwa, 2009). When the wood is chewed and the aqueous solution is swallowed, it has the ability of curing erectile dysfunction; as a result, it got its local name (magani bura ntashi) from this singular function. The wood of *Hymenocardia acida* has been reported to have the ability of regulating fertility and controlling estrous cycles in women and female animals (Abu & Chinedu, 2011). The

powdery substance from the wood of this species is used by Fulani women for beautification, hence the naming of the plant as 'Fulani powder'. The extract from the bark of *Pterocarpus osun* and *Alstonia boonii* were reported to be very efficient in curing cough and chest infection when imbibed directly. The wood of *Xanthoxyllum zanthozylioides* (orin-ata) cures sickle cell anaemia, wood stem of *Garcinia cola* and *Mussalaria accuminata* is noted for curing tooth infections and gum disorder. *Mussalaria accuminata* (pako-jebu) is the most widely used chewing stick for cleaning the teeth in Nigeria for those who cannot afford the cost of tooth paste and tooth brush. A single study like this is not sufficient to list all the common wood species believed to have some ethno-medicinal potentials.

3.2 The resource base of wood

The only source of wood is the forest, as renewable natural resource. No matter how beautiful wood and its products are, without the forest, they become unavailable and their beauty is lost. So, it is paramount that this resource base is well managed for the continuous production of wood products. Forests can broadly be divided into natural and artificial or man-made. The natural forest is endowed by nature and it is the home of all tropical indigenous hardwood species in Nigeria. It is categorized into forest reserves and free areas in the country. Forest reserves are forestland conserved and managed by the government. They are protected by laws and edicts and entrance and activities such as logging, hunting, farming and collection of minor forest products are controlled by the government. The available records in the Federal Department of Forestry, Abuja show that Nigeria has a total of 1160 constituted forest reserves covering a land area of about 1075km². Their management is directly under the respective state government where the reserves are located. These reserves are allocated to timber contractors or concessionaires annually, for wood extraction, after the payment of appropriate levies and due. The free areas are all other woodlands out the reserves. They belong to communities or indigenous individuals. Government's control on the free areas is limited to the collection of fees on wood that are felled from the area. Plantation began in Nigeria to augment the wood supply from the natural forest. Species in Nigerian plantations are mostly exotic species like *Tectona grandis*, *Gmelina arborea*, *Eucalyptus spp*, *Pine spp* and *Ciderella odorata*. Some of the few indigenous species in the plantations are *Triplochiton scleroxylum*, *Nauclea dedderichii*, *Mansonia altissima* and *Terminalia supaba*. The most abundant species in Nigerian plantation is *Gmelina arborea*. Over a million hectares of this species has been established in the country under various afforestation programme of the government, especially as raw material for pulp and paper production (Onyekwelu and Stim, 2002). Since the objective of establishing the plantations of *Gmelina* (pulp and paper production) was not met, it is now harvested as sawn timber in Nigeria for all construction and productions purposes.

Nigeria is a tropical country with three major ecological zones namely the fresh water swamp/mangrove and the rainforest in the south and the savannah in the north. The rainforest is 2% of the total forest in the country and it is the source of more than 70% of the total sawn wood in the country. About 90% of the plantations established in Nigeria from the first half of the 20th century to the 1970s have the provision of industrial wood as their primary objective. Currently, the contribution of forest plantation to global wood supply is on the increase (FAO, 2008). Although forest plantations account for less than 3% of the world's total forest area, they supply over 20% of the global wood supply (FAO, 2004). Today more than one million hectares of plantation has been established in the country (Onyekwelu, 2002).

3.2.1 Sources of threat to wood resource base in Nigeria

There is a serious threat today to the forest ecosystem, the wood resource base, due to many anthropogenic activities. It was reported that natural forest is disappearing at an alarming rate of 3.5% (about 350,000 – 400, 000 ha) per annum (Oyebo, 2006). Prominent among the drivers of deforestation are; (i) the wanton conversion of forestland to farmland of arable and permanent crops by landless farmers. This is common because of the availability of fertile land under forest cover, (ii) increased rate of encroachment to expand the enclaves. (iii) Weak forest laws, coupled with poor enforcement due to corruption and ineptitude of some forest officers, (iv) population increase which led to increases in the demand for forest land and wood products for daily survival, (v) other anthropogenic activities such as collection of NTFPs, setting the forest on fire by hunters when looking for bush meats, grazing, urban development and road construction, (vi) institutional problems including lack of capital budget by the state government for forest management, inadequate staff for forestry work, lack of patrol vehicles for forest monitoring and control of illegal activities in the forest, (vii) ignorance on the part of rural communities who see the forest as a natural gift that can be used anyhow and indiscriminately, (viii) urban and rural development (ix) logging activities.

3.3 Wood and national development

3.3.1 Wood and socio-economic development:

The socio-economic development of many rural communities could be linked with wood and wood related activities. Wood and forest, by virtue of their nature are located in the rural areas and working on them is also carried out in these local areas because of its bulkiness and cost of transportation. As a result, many rural communities in Nigeria gradually transformed into urban cities due to the presence of very active wood based activities in those communities. Example of such communities are Ore in Ondo state, Shasha in Osun state, OritaJ4 in Ogun state and Epe in Lagos state. Today, these communities are enjoying the presence of rural infrastructures like electricity, portable water, government and private health facilities, schools and communication system. Many roads constructed by loggers for the purpose of wood extraction and haulage serve as feeder roads for transporting food items from villages to urban markets by farmers. Some of these former extraction routes have now become major roads that are laid with asphalt by the government. This has gone a long way to make transportation more convenient.

The survival of rural dwellers and the urban poor depends on finding enough wood to cook their meals. Wood is the only source of fuel for domestic energy in the rural communities. Other sources of energy such as electricity, gas and kerosene and stoves are either not available or very erratic in supply where available. They are very prohibitive and beyond the reach of the masses. So, their last resort is fire wood. FAO (2006) claimed that 72,711m³ volume of wood are remove from the forest annual as fuelwood. Wood is highly valued for industrial cooking. It is the only source of energy for bakeries and small-scale confectioneries in the country. Trade in wood and involvement in wood related profession and activities are sources of employment to many rural people, thereby serving as their major or only source of family income. Felling of trees for fuelwood and charcoal production is now rampant. Sale of firewood and charcoal has become a very lucrative business especially whenever there is scarcity or increase in cost of kerosene, which is a common phenomenon in Nigeria. The incessant increase in the prices of petroleum products (kerosene inclusive) in the country therefore, has made more people who were using kerosene stoves before to abandon their

stoves for fuelwood. Table two shows the sources of energy for domestic cooking and mode of fuelwood utilization as indicated by the respondent in Ondo state, Nigeria.

3.3.2 Wood and employment generation

Employment opportunity in the wood industries and many other wood-based activities has gone a long way to reduce the mass unemployment in the country and enhance job security. It is practically not possible to estimate the total number of workers associated with wood. What I have done in this paper is to provide the list of various wood and wood related operations that have provided gainful employment to many citizens in the country. Wood based activities that provide job include; (i) those working in tree nurseries and plantations, private plantation developers, forestry staff of different cadres (Vocational, Technical and professional, and administrative) and auxiliary staff, (ii) timber contractors and forest reserve concessionaires, (iii) timber fellers (power saw operators) and their supporters such as skidders, loaders, timber truck drivers, (iv) those in wood industries, (iv) wooden electric poles, plank and firewood sellers, (v) small-scale wood based industries like wood carving, production of farm tools and house utensils (pestle, mortars, wooded plates, ladles, wooden spoons and grinders), production of souvenirs, (vi) carpentry, furniture making and joineries, (vii) sawmill workers, machine operators and saw doctors, (viii) traditional healers (Babalawo) and herbal sellers, (ix) food vendors in wood industries, sawmills and other wood workers.

3.3.3 Contributions of wood to Gross domestic product and national income

Wood is one of the major products that have contributed meaningfully to Nigeria foreign exchange earnings and Gross Domestic Products (GDP), especially before the country experienced the oil boom in the 1970s. Sawn logs and timber were major items of export from the country throughout the colonial era (Oluyeye, 2007). The contribution of forestry to GDP in 1958 was estimated at 6.1% and the value of exported wood in 1960 was above 16.2 million naira (presently about 104,000 USD but could be higher). During this period, wood was Nigerias 7th most important export product and more than 786,560m³ (10% of GDP) of wood were exported (Adeyoju, 1976). Oseni (1978) reported that more than 50% of the income from the forest was directly from timber trade. According to the report of the Central Bank of Nigeria, in 1995 alone, about 961.6 million naira accrued from timber export only to the government of Nigeria (CBN, 2006). Despite the ban on wood export by decree in Nigeria, Nwokabia (1997) reported that about eleven million metric cubic of teak wood was exploited from Nigeria in 1995 only. This period was during the military rule in the country. The Central Bank of Nigeria (2006) also put the contribution of forestry to Nigeria's GDP using 1984 factor cost at 1.27% in 1996; 1.24% in 1997; 1.22% in 1998; 1.2% in 1999 and 1.189% in 2000 and 73.46 billion naira in 2006. Akande (2006) reported that 650, 000 ha of forest reserves are allocated to concessionaires annually in Nigeria and he puts the annual forest extraction for sawn timber at 1.4 million m³/year. Adekunle et al 2010 reported that a total of 111,377 timber stems, belonging to 62 different indigenous hardwood species of tropical rainforest ecosystem, distributed among 16 families, were logged and converted to sawn timber in Ondo State between 2003 and 2005. In Oyo and Ogun States, the annual volume of wood logged as sawn timber stood at 960, 883 and 27,261.07m³ respectively (Tables 3 & 4). The annual income that accrues to every state in Nigeria from the volume of wood harvested is very enormous. The amount of income from wood by the government was compiled and reported by Agbeja (2007) for the states in southwest Nigeria between 1999 and 2005. Apart from money generated from logging activities, income is also generated by

the government through annual dues paid by timber contractors and concessionaires, levies on sawmills and annual renewal fees, sawmill registration, tariffs on sawn wood removed from free areas, taxes from plank sellers and wood industries. Table 5 is on the total amount of revenue generated by forestry subsector in Oyo state Nigeria for a 4-year period. The table shows that the highest amount was from sawn timbers.

3.3.4 Contributions of wood to achieving the millennium development goals

The United Nations Millennium Development Goals (MDGs) agreed upon by world leaders in 2000 have eight goals with 18 targets and over 40 indicators that could help to monitor and achieve these goals. The common objectives of these goals, aimed to be achieved by 2015, are to provide a framework to meet the basic needs and rights of millions of people in the developing world. The role of wood and wood based industries in achieving most of these goals is central. Wood activities and wood industries are sources of gainful employment to millions of people as noted earlier. These serve as sources of income to prevent extreme poverty and hunger to achieve the first goal (Eradication of extreme poverty and hunger). Additional income from wood has the potential to reduce poverty reduction (Thies and Pfeil, 2007). For wood's contribution to the attainment of MDG 2 (Achieving Universal Primary Education), forest resources can either be an asset, a cost, or a combination of both to education (Barrow *et al*, 2005). Income from wood-based assets are used in the payment of school fees, woods provide materials to construct school buildings, school chairs and tables for pupils and students. In addition, the paper used for manufacturing books and pencil for writing are wood products. Monela *et al*. (2007) noted that 36% of families use income from the sale of wood products for the payment of education cost.

The report of Barrow *et al* (2007) indicated that restoration of woodland around the community has reduced the time taken to collect fuelwood by up to four hours and thus has the potential to free up time for women and children to engage in other productive activities that can improve gender empowerment and equity, thus, achieving the third goal (Promotion of Gender Equality and Empower Women). In developing countries, fuel collection and cooking for the entire household are seen as the sole responsibility of women. Availability of fuelwood could enhance the potential of women in fulfilling these social roles. The role of wood in achieving goals 4-6 (Goal 4- Reducing Child Mortality, 5- Improving Maternal Health, and 6- Combating HIV/AIDS, Malaria and Other Diseases) has been discussed earlier. This has to do with the contribution of wood to health care delivery. Wood products are good sources of herbal products that are relied on by rural communities for healing. One of the major services of the forest ecosystem is environmental sustainability. The judicious use of wood and wood products, reduction in wood wastage and adequate wood pre-treatment to extent its life span could go a long way to reduce the pressure on the forest ecosystem thus ensuring that the forest is available to continue its environmental services to achieve the 7th goal (Ensuring Environmental Sustainability). Also, wood in service holds carbon in perpetuity (carbon sink) and prevents it from escaping into the atmosphere, thereby contributing to reduce the effect of one of the drivers of climate change. Forest partnerships between developing and developed countries are now being established all over the world (Olagoke & Adekunle, 2008). These initiatives will help to achieve Goal 8 (Building a Global Partnership for Development) by promoting education and research in wood and wood utilization. The partnership could also lead to capacity building in wood for developing countries for strengthening and promoting higher-value wood use at the local and national levels.

3.4 Development of wood industries in Nigeria

3.4.1 Timber logging operations:

The knowledge of logging first came to Africa in 1881, when a French Forester, Contede Vasselot de Regne was appointed superintendent of forest by the Cape Government. Logging was done manually in the past with the use of axe to cut the trees. This method is very labour intensive, and leads to time wastage and also the waste of much of the wood itself. The use of power chain saws is popular today. This reduces waste, energy and time. The cost and maintenance of the machine could be expensive and it requires the service of a well trained and skill operator. Logging includes skidding and transportation of the logs to the log yard. Logging is the first operation in wood utilization process.

3.4.2 Sawn wood production or sawmilling

This is the first wood industry in Nigeria and the most active wood industry today. It started as pit sawing in the country in 1782 by the Portuguese (Abdullahi, 2005). It involved the manual use of the tinny saw to split the fell logs on the site by two people. This method became burdensome and was no longer sustainable due to the increase in the demand for wood. As a result, it gave room for the development of mechanical conversion of wood with the use of motorized band and circular saws. Oluyeye (2005) reported that the first mechanical sawmill was established by African Timber and Plywood Industry at Koko and the second by the Railway Department at Ebute Meta, Lagos, between 1900 and 1910. The number of sawmills in Nigeria has grown significantly, but most of them are small to medium size non-integrated one-man businesses. The result of this study revealed that there are 403 registered sawmills in Ondo State only which employed about 4,030 people. The setback to sawmill industries in the country is the poor conversion efficiency and the high volume of waste generation from the converted logs. It was estimated that more than half of the in-put logs usually become wood waste or residues in form of sawdust, edgings, fitches and slabs. The reasons could be due to the machine types, poor maintenance of saws, lack of training for the machine operators and carefree attitude of most Nigerian workers.

3.4.3 Plywood and particleboard industry

The first kind of this plant in Nigeria was established in 1948 at Sapele by AT&P and according to Wellwood (1966) it was the largest of its type in the world at the time of its establishment. By 1996, there were other nine plywood mills and six particle board plants in Nigeria (Oluyeye, 2007). Though all of them were operating at low capacity, they were integrated industries. It is sad to report today that most of these large plywood and particle boards industries had folded due to poor management.

3.4.4 Pulp and paper

The first pulp and paper mill (Nigerian paper mill limited) located in Jebba, Nigeria, was commissioned in 1969. It was regarded as the largest paper mill in West Africa by Ogunkanmi (1987), with capacity of producing a total of 65,000 metric tons of paper and pulp per annum. Another pulp and paper mill (Nigerian Newsprint Manufacturing Company) located at Oku-Iboku, near Calabar in Cross River State, Nigeria was established. The mill had a rated capacity for 100,000 metric tons of newsprint per annum. The third paper mill in the country, located at Iwopin, Ogun state, was established by the Nigeria National Paper

Manufacturing Company. It was designed to produce about 100,000 metric tons of fine cultural papers for printing and writing, at full capacity. Many hectares of *Gmelina arborea* plantations were established in three states of the country with loans from International Bank for Rural Development and African Development Bank to serve as source of raw materials for the mill when it eventually take off. The states are Ondo, Ogun and Enugu. Unfortunately, it did not commence operation at all due to corruption, political and technical reasons. The two functioning ones (Oku-Iboku and Jebba pulp and paper mills) had also closed down. Presently, there is no functional pulp and paper mill in the country. The services of foresters and other workers in these moribund factories were dispensed with, with immediate effect and they were made to return to the labour market (Adekunle, 2008).

3.4.5 Small-scale wood based industries in Nigeria

There are so many small scale wood based industries scattered all over Nigeria and the list cannot be exhausted. The most wide spread in this category are the wood furniture, joinery and carpentry industries. They are in the country in very large number, operating from very small workshops and sheds. Only the few of them in large cities and those integrated with sawmills industries owned by the large scale afforestation projects could be regarded as large scale wood furniture industries. These industries are involved in the production of window and door frames, furniture items (upholstery chairs, tables, shelves, wardrobes, wall paneling and floor tiles, prefabricated wooded houses etc) and carpentry works (construction of house roofs). Other small-scale wood industries in the countries are those involved in wood carving, construction of canoes and paddles, production of souvenirs and house hold utensils like mortar, pestles, wooden plates, ladles and spoons and production of farm tools handles.

3.4.6 Wood Preservation industries

Wood is highly susceptible to biodegradation due to abiotic and biotic factors. The abiotic agents, according to Agrawal et al. (1990) include physical decay, thermal degradation, light (Ultra violet light responsible for photochemical actions in wood) and atmospheric pollutants (dust, dirt and gasses). The biotic agents are all micro and macro organisms that can cause bio-degradation of round wood or sawn timbers. The action of these agents is due to the fact that wood, by its nature, is an organic material, made up of 70% cellulose which is good material for biological agents. The major insect is termite while the microorganisms as noted by Clubbe (1980) include bacteria, fungi and actinomycetes. In order to prolong the life span of woods and its products from these agents of degradation, the development of wood preservative industries became very relevant. Three major wood preservatives (i.e. organic or inorganic chemicals toxic to the biotic agents) are oil based preservatives (commonly refer to as solignum in Nigeria - coal tar and creosote), water borne preservatives (metal/copper chrome-arsenates, boron, sodium pentachlorophenate etc) and organic solvent preservatives (pentachlorophenol, cuprinol etc). The common methods of application are the non-pressure (spraying, dipping or brushing) and the pressure (the use of pressure impregnation plants) treatments. However, this wood industry is still in its infancy in Nigeria. This could be due to the high cost of the chemicals involved and the machine for pressure treatment method which are imported and highly expensive. Electric poles and house roof components are always preserved with these chemicals to prolong their useful life. Plates 1-10 show some of the products from wood, wood conversion machines, planks in sawn wood of different dimensions (planks) in the plank market and logs in the sawmills and log yards.

4 CONCLUSION AND RECOMMENDATIONS FOR THE PROMOTION OF HIGHER-VALUE WOOD USE IN NIGERIA

This study examined the versatility of wood, the various aspects of wood utilization, traditional and cultural importance, its contributions to national and rural development and the development of wood based industries in Nigeria. In addition, various products from wood and the species for construction were assessed and the resource base of wood was also discussed. The following suggestions are very relevant for the promotion of higher-value wood utilization in the country: Sustainable forest resources management will ensure the continuous supply of the wood. For wood to be always available as a renewable natural resource, judicious use and involvement of all stakeholders in afforestation programmes should be encouraged, otherwise wood famine is imminent due to the rate of utilization in the country. Extension services, adequate training and informal education is required for rural communities, small-scale wood industry operators, wood loggers, and sawmillers. This could improve their skills and expertise to make wood products more valuable. Incentives or credit facilities should be provided to small-scale wood industrialists to expand their business, and purchase more efficient wood working tools. Those willing to plant trees should be provided with improved planting materials and technical assistance. Integrated wood industries will go a long way to utilize the waste generated during wood conversion. Re-use of the moribund wood industries will also promote higher-value wood use. An introduction of higher efficient logging and wood conversion equipments is required to improve efficient and productivities.

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Table 1: Nigeria Total Forest Cover ('000 ha) as at 2005

Forest types	Total area (ha)	% of forest cover	% of total land area*
Forest	11, 089	12.18	12.18
Primary forest	360	2. 94	0.36
Modified natural forest	10,414	93.9%	11.43
Plantations	349,	3.1	0.43
Other wooded land	5, 595	50.45	6.14

*Nigeria total land area is 91, 077, 000 ha Source: Data from FAO (2006)

Table 2: Respondents sources of domestic energy in Ondo State, Nigeria

Sources of energy	%	Mode of fuelwood consumption	%
Fuelwood	63.6	firewood	94.2
Electricity	10.5	charcoal	4.5
Kerosene	21.2	sawdust	1.3
Gas	4.7	Total	100
Total	100		

Table 3:Summary Statistics of Timber Exploited in Oyo State between 2004 and 2007

Parameters	Forest Reserves	Free Areas	Total
No. of Species	51	67	67
No. of Stem	26754	29189	55943
Volume (m ³)	2340195	1503337	3843532

Table 4: Summary of Timber harvested from the reserves in Ogun State during the 4-year period

Variables	Years				Total for the 4-year period	Average /year
	2004	2005	2006	2008		
Number of stems	91	302	385	102	880	220
Volume (m3)	25615.1	269.6	165.6	1210.6	27261.07	6815
	4	9	3	1		
Number of spp	29	66	58	32	69	46
Number of family	18	32	28	19	42	24

Table 5: Estimate of Revenue Generated from Forestry Sub-sector in Oyo state Nigeria between 2004 and 2007

Source of Income	2004	2005	2006	2007	Total
Logging activities	3,887,693.40	3,430,351.00	3,419,785.40	4,307,056.00	15,044,886.20
Fines	238,380.00	296,965.00	300,300.00	266,600.00	1,102,25.00
NTFPs	1,167,220.00	2,060,830.00	634,950.00	262,800.00	4,125,800.00
Others	4,641,170.00	3,424,430.00	3,824,670	3,795,350.00	15,685,620.00
Total	9,934,463.40	9,212,576.40	8,179,705.40	8,631,806.00	35,958,551.20

Values are in Nigerian currency, Naira (N1 = \$157)

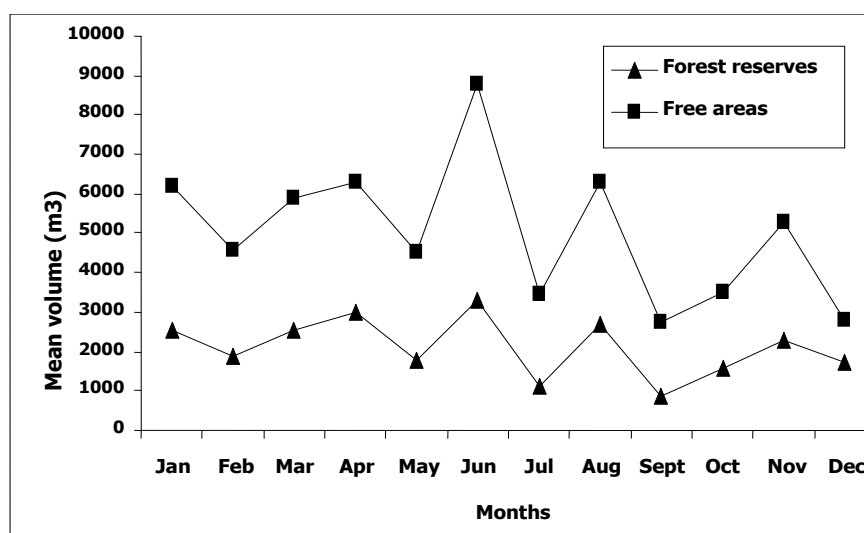
Fig. 1: Volume of log harvested on monthly basis in Ondo State, Nigeria (Source: Adekunle et. al. 2010)



Plate 1 a: wood in roof of classroom construction



Plate 1b wood in the roof of a residential building



Plate 2: stakes of wood planks



Plate 3: Stacks of firewood



Plate 4a: round logs awaiting primary conversion in the sawmill



Plate 4b: logs in the log yard



Plate 5: Circular saw



Plate 6: horizontal Band saw



Plate 7: Wooden part of talking drum

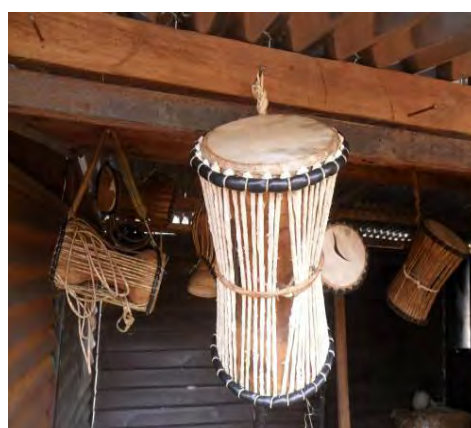


Plate 8: The talking drums (Gangan)



Plate 9: Canoes constructed from wood



Plate 10: Coffin made from wood for burrial rites

Inheriting and Development of Hongmu Culture in China

Xiaomei Jiang²

Abstract

This paper discusses Hongmu wood usage in as a material for Ming & Qing dynasty Furniture. There is a current upsurge in interest in these wood products. The paper attempts to explain this phenomenon. Moreover, this paper deciphers the definition and taxonomy of Hongmu in the current market, its sources for the sustainable utilization of Hongmu resources and Chinese government advocacy of cultivating precious species including Hongmu. The paper also suggests that a wider variety of precious woods be used in the manufacture of Chinese classical furniture, rather than relying solely on Hongmu.

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The inheritance and Development of Hongmu Culture in China

—International Conference and Exhibition on the
Art and Joy of Wood



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2011.10.19

Outline

- Connotation of Hongmu culture
- Reason that most Chinese like Hongmu
- Definition and classification of Hongmu
- Inheritance and development of Hongmu cultural



1. Connotation of Hongmu culture

1. Connotation of Hongmu culture

The Hongmu is the **carrier** of the Ming & Qing Furniture, viz. broad noun of the woods for making these furniture, which bearing the weight of Chinese national culture & element in Ming and Qing dynasty.



1. Connotation of Hongmu culture

1. Connotation of Hongmu culture

The upsurge of the Hongmu products shows the inheriting and development of Hongmu culture in China now.



2. Reasons that most Chinese like Hongmu

2.1 Historically:

Chinese classic furniture has a history of more than a thousand years. The Ming and Qing furniture stands for the peaking development of Chinese furniture.

The Ming dynasty furniture pursues rhythm with its model plain and elegant.



2. Reasons that most Chinese like Hongmu

2.1 Historically:

Dalbergia odorifera(降香黄檀) is the first choice used in Ming dynasty furniture which grows in Hainan province, China, with fine and smooth structure, higher density ($0.94\text{g}/\text{cm}^3$), beautiful figures & good odor.



2. Reasons that most Chinese like Hongmu

2.1 Historically:



Dalbergia odorifera (降香黄檀)

2. Reasons that most Chinese like Hongmu



The beds from the Forbidden City(Palace Museum)

2. Reasons that most Chinese like Hongmu



Chair & tree grate from the Palace Museum

2. Reasons that most Chinese like Hongmu

2.1 Historically:



A cabinet and a folding screen made by *Dalbergia odorifera* in Ming dynasty

2. Reasons that most Chinese like Hongmu

2.1 Historically:



beautiful figures & good odor

2. Reasons that most Chinese like Hongmu

2.1 Historically:

The Qing dynasty, *Pterocarpus santalinus* (紫檀木 red rosewood) became the pet of imperial family. The emperors like the wood because of its deep purple color, larger density ($1.26\text{g}/\text{cm}^3$) and excellent properties.



2. Reasons that most Chinese like Hongmu

2.1 Historically:

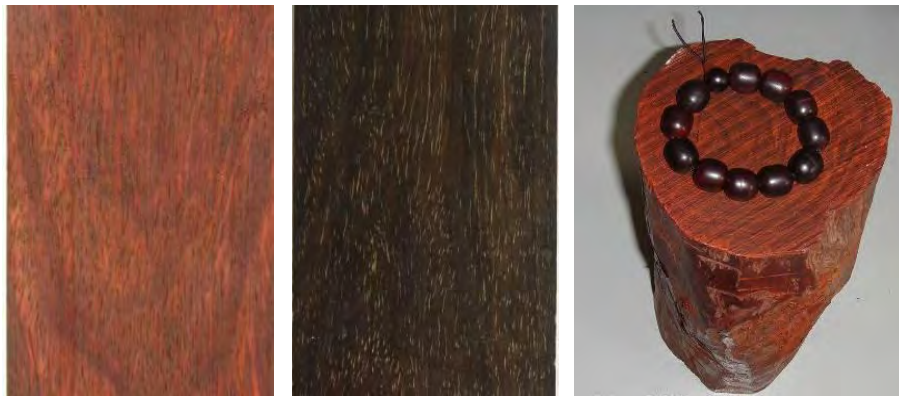
The Qing dynasty furniture pays more attention to the amount of space occupied with its model magnificent and expensive.

The decoration of Ming and Qing dynasties furniture can be called classic in Chinese furniture with its artistic achievement highly known in the world furniture.



2. Reasons that most Chinese like Hongmu

2.1 Historically:



Pterocarpus santalinus (紫檀木 red rosewood)

2. Reasons that most Chinese like Hongmu

2.1 Historically:



The furniture made by *Pterocarpus santalinus* from Palace Museum in Qing dynasty.

2. Reasons that most Chinese like Hongmu

2.1 Historically:



Throne and folding screen made by *Pterocarpus santalinus* wood and with enchasing jade.

2. Reasons that most Chinese like Hongmu

2.1 Historically:



The table and chair made by *Pterocarpus santalinus* from Palace Museum in Qing dynasty.

2. Reasons that most Chinese like Hongmu

2.1 Historically:



The cabinets made by *Pterocarpus santalinus* in current market

2. Reasons that most Chinese like Hongmu

2.2 Nationally:

Since ancient times, Chinese people have paid more attention to the quality of art carrier in contrast to westerners. The carrier's quality often related with rareness, expensiveness, attractiveness for visual, touch and odor etc.

2. Reasons that most Chinese like Hongmu

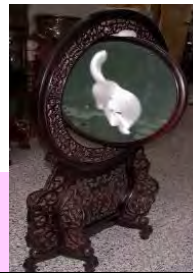
2.2 Nationally:

Chinese people love wood and jade, which are both obtained from nature. The five elements, "gold, wood, water, fire, earth", is the substance view of ancient Chinese people.

2. Reasons that most Chinese like Hongmu

2.2 Nationally:

From ancient wood building to wood furniture, to all kinds of crafts, exquisite patterns are carved. High quality wood feels like jade after repeat polishing.



2. Reasons that most Chinese like Hongmu

2.3 Ideologically:

Ming and Qing dynasty furniture is the culture engraved on the Hongmu, it reflects Chinese "**Confucian way**", such as "**stable, peaceful**", the "**nature and man in one**" and "**round sky and square earth**" concepts.

2. Reasons that most Chinese like Hongmu

2.3 Ideologically:

At the same time, every piece of furniture has the meaning of happiness by way of curving patterns, such as landscape, birds and flowers, historical story, auspicious symbols.



2. Reasons that most Chinese like Hongmu

2.3 Ideologically:



stable, peaceful



round sky and square earth

2. Reasons that most Chinese like Hongmu

2.3 Ideologically:

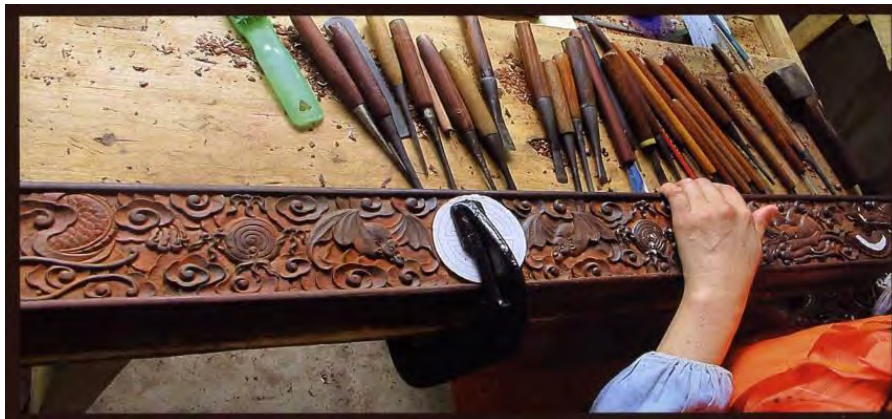


The carvings on the wood building in the Qing dynasty



2. Reasons that most Chinese like Hongmu

2.3 Ideologically:



The Chinese auspicious symbols are sculpting by hand

2. Reasons that most Chinese like Hongmu

2.3 Ideologically:



birds and flowers

2. Reasons that most Chinese like Hongmu

2.3 Ideologically:



historical story



2. Reasons that most Chinese like Hongmu

2.3 Ideologically:



Auspicious symbols

2. Reasons that most Chinese like Hongmu

2.4 Scientifically:

Strict structure and reasonable design are in accordance with human body engineering, such as chair back with "S" curve, which make people feel comfortable.

Due to the wood is very hard, which makes it unable to use nails.



2. Reasons that most Chinese like Hongmu

2.4 Scientifically:

Just because of the tenon and mortise structure, which builds the traditional Chinese furniture framework, makes it independently stand in the furniture world. We should say that “**tenon and mortise structure**” is the soul of Chinese traditional furniture.



2. Reasons that most Chinese like Hongmu

2.4 Scientifically:



Chair back with "S" curve

The collage consists of seven line drawings illustrating the assembly of a wooden frame with decorative moldings. The drawings show various steps: attaching a decorative bracket to a corner, fitting a molding piece into a groove, securing a molding with a nail, and assembling the main frame structure with multiple moldings.

[illegible]

2. Reasons that most Chinese like Hongmu

2.5 Artistically:

The furniture structure line and the fine wood texture are in accordance with the line art of Ink painting and calligraphy, which agrees with the Chinese aesthetic interest. Each Hongmu product has the uniqueness of natural beauty. Various life-like carvings give vitality to the furniture, which make it highly artistic and ornamental.

2. Reasons that most Chinese like Hongmu

2.5 Artistically:



The table & chairs with carved pictures

2. Reasons that most Chinese like Hongmu

2.5 Artistically:



The bed & sofa with artistic sculptures

2. Reasons that most Chinese like Hongmu

2.5 Artistically:



The beautiful hongmu sculpture & the folding screen

2. Reasons that most Chinese like Hongmu

2.5 Artistically:



artistic & carved patterns

2. Reasons that most Chinese like Hongmu

2.6 Practically:

Hongmu furniture is indispensable for human living.

Overall, Chinese people have deep feelings of Hongmu culture, cause she is the symbol of Chinese national culture.



3. Definition and classification of Hongmu

Since the reform and opening up, people's living standards are highly improved with the high-speed development of national economy. Hongmu products start to own by common people, which makes the Hongmu market very prosperous, while it is still



3. Definition and classification of Hongmu

unknown how many species are contained in hongmu timbers. In order to make the development of Hongmu market more healthy, the Chinese National Standard "Hongmu" was implemented in 2000.



3. Definition and classification of Hongmu

Hongmu includes 33 species, belonging to 8 groups or 5 genera

- *Pterocarpus* spp. 紫檀木
- *Pterocarpus* spp. 花梨木
- *Dalbergia* spp 香枝木
- *Dalbergia* spp 黑酸枝木
- *Dalbergia* spp 红酸枝木
- *Diospyros* spp. 乌 木
- *Diospyros* spp. 条纹乌木
- *Millettia* spp./*Cassia* spp. 鸡翅木

3. Definition and classification of Hongmu

The main source of Hongmu:
relying on imports, such as

Pterocarpus santalinus (紫檀木 Zitan) from India;
Pterocarpus spp.(花梨木 Hualimu) from Southeast Asia,
Africa and Latin-American;
Dalbergia odorifera (香枝木 Xiangzhimu) from Hannan
province of China;
Dalbergia louvelii & *D. melanoxylon* (黑酸枝木 Black
Suanzhimu) from Madagascar & East Africa



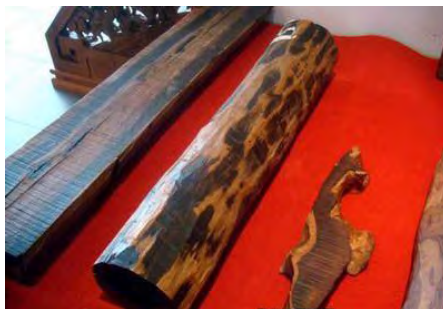
3. Definition and classification of Hongmu

The main source of Hongmu: relying on imports, such as

D. latifolia, *D. oliveri* & *D. cochinchinensis* (红酸枝木 red Suanzhimu) from Southeast Asia, *D. retusa* from South & Central America;

Millettia spp./*Cassia* spp.(鸡翅木 Jichimu) from Southeast Asia, & Africa;

Diospyros spp.(条纹乌木 Tiaowenwumu) from shoutheast Asia, like Sulawesi island of Indonesia, some are from Papua new Guinea.



***Pterocarpus
santalinus* from
India 紫檀木**



***Dalbergia* spp.
红酸枝木**



Dalbergia louvelii
卢氏黑黄檀



D. melanoxylon
东非黑黄檀



Dalbergia odorifera
香枝木



Millettia spp. from
Africa 非洲鸡翅木

4. inheritance and development of Hongmu culture

Firstly, we should make the Hongmu resource sustainable development, then design Hongmu furniture and products rich in more newly and beautifully modern style; to allow our Hongmu culture to be better inherited and developed.



4. inheritance and development of Hongmu culture

4.1 Chinese government advocated the strategy of making best use of both domestic and overseas precious resources. The project **“precious trees’ breeding”** has been implemented to adapt to the sustainable utilization of Hongmu resources.





Trees from *Pterocarpus indicus* plantation (印度紫檀)



Seedlings & trees of *Dalbergia odorifera* (降香黄檀)

4. inheritance and development of Hongmu culture

4.2 Some experts also suggested that wood species for making Chinese classical furniture should be enlarged by **applying other precious woods instead of Hongmu** to meet the demand of various consumers.



4. inheritance and development of Hongmu culture

4.2 Some exported woods from Africa and Latin-America are also adopted by the current market, such as *Swartzia* spp., *Guibourtia* spp., *Intsia* spp., *Gluta* spp. & *Melanorrhoea* spp. and *Bulnesia* spp.. Besides, the woods of *Entandrophragma* spp., *Toon* spp. were also used to make Chinese classic furniture.



4. inheritance and development of Hongmu culture



The Chinese classical furniture using not- Hongmu is getting good results.



Wooden Monuments in India, Epitomes of Beauty and Talent, Need Protection from a Biological Perspective

O K Remadevi³ and S C Joshi

Abstract

Conservation of natural resources and national heritages is a major challenge of our times, from both environmental and cultural perspectives. The most dominant material culture of any country is produced by trees in the form of wood. Wooden Monuments not only lock in within them carbon stocks, but also the cultural heritage of any country. Quality and beauty of wood blended with the skills of dedicated architects of India have created many wooden monuments, which have stood the tests of time, associated with the vagaries of climatic changes and biological agencies. Though they have a major influence on the strength and life of the structures, biological threats are not very much apparent. The art of wood protection was known to the ancestors and it was mostly from the angle of prevention and in some cases with environmental friendly materials. Still, many monuments suffer the attack of microbes and insects and it is a really a difficult puzzle for Archaeological Survey of India and Other National Museums to keep the vintage structures in their past glory and preserve them for posterity. A study into the wooden monuments of the country from a climatological and archaeological perspective, covering aspects of biological status- durability, deterioration by insect borers, termites and decay fungi along with wood identity, anatomy, strength and properties will go a long way in protecting the monuments and at the same time revealing the untold story of their life cycle over many decades. Quantification of degradation, identification of wood species, chemical preservatives used etc. need in situ assays and laboratory experiments. A thing of beauty is a joy forever and upkeep of the beauty for perpetuating the joy over ages is a task facing the wood lovers of the country and the world.

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FUTURE OF THE PAST MATERIAL CULTURE

The explosion of technology development in the latter half of the twentieth century has provided archaeologists, historians, and managers with powerful tools for analyzing and preserving the material culture of the past. It has also created new challenges. We have to assure that the remnants of our past will have a future. Although we possess greater capability than ever before to preserve and protect the past, and have a deeper interest in preserving it, the entire global scenario in the changing climatic context is under greater stress. The major threats to historic resources include air and water pollution, looting, vandalism, population growth, unplanned development, neglect and war (Holloway, 1995). Even tourism, generally promoted by the managers of historic sites as well as local communities, constitutes a major threat in many cases. But the threats by biological factors are not very much apparent, though they have a major influence on the strength and life of the structures. Effective archaeological management demands detailed information on not only the spatial distribution of artifacts but also the degradation state of the materials present. Though many of them are pure stone structures, in the religious and kingly abodes, many wooden structures imparted the architectural splendour and aesthetic symphony. Changes in the degradation state, quantification of degradation, identification of wood species used, chemical preservatives used etc. need in situ assays and laboratory experiments.

HISTORY AND NATIONAL IMPORTANCE OF MONUMENTS

Archaeological and historical pursuits in India started with the efforts of Sir William Jones, who formed the Asiatic Society on 15th January 1784 in Calcutta. Many Acts were enacted for better preservation and maintenance of monuments and also to prevent illegal trafficking of antiquities and art treasures. Some important acts include the following; Ancient Monuments and Archaeological Sites and Remains Act, 1958 ; Antiquities and Art Treasures Act, 1972 ; The Treasure Trove Act, 1878 and the Ancient Monuments Preservation Act, 1904. The Ancient Monuments and Archaeological Sites and Remains Act of 1958 was framed for legal issues associated with the conservation of historical and archaeological monuments in India. This is an act to provide "for the preservation of ancient and historical monuments and archaeological sites and remains of national importance, for the regulation of archaeological excavations and for the protection of sculptures, carvings and other like objects." According to this Act, an "ancient monument" means any structure or monument, or any tumulus or place of interment, or any cave, rock-sculpture, inscription or monolith which is of historical, archaeological or artistic interest and which has been in existence for not less than 100 years. Archaeological Survey of India (ASI), protect monuments ("protected monuments") which are ancient and are declared to be of national importance. There are 3,650 ancient monuments and archaeological sites and remains of national importance, which are protected by ASI. Overall, there are around 8,000 monuments protected by the government, which include temples, mosques, tombs, churches, cemeteries, forts, palaces, step-wells, rock-cut caves, and secular architecture as well as ancient mounds and sites which represent the remains of ancient habitation. There is no comprehensive database on archaeological resources, sites and antiquities in India and many monuments are fast disappearing without any record for the posterity. Therefore there is an urgent need for proper accounting of our resources by which an appropriate archaeological heritage resource management and policy can be formulated. The honorable Prime Minister of India made an announcement on Independence Day, 15th August, 2003 for setting up of a National Mission

and the National Mission on Monuments and Antiquities was launched on 19th March 2007 with its activities throughout the country for a stipulated time frame of five years.

WOODEN MONUMENTS IN INDIA

A monument is a type of structure either explicitly created to commemorate a person or important event or which has become important to a social group as a part of culture and heritage. The cultural heritage of India's five-thousand-year old civilization is reflected by a number of monuments- Forts, palaces, temples, mosques and churches scattered throughout the country. Indian Architecture evolved over a period of time, and incorporated definitive influences from its various rulers, Hindus, Muslims or British. Monuments and Architecture are inseparable and monuments depict the plentiful supply of materials in the past and the talent and creativity of our ancestors and the rulers of the past dynasties. Wood has been used since Paleolithic times for building purposes and it is reflected in many monuments. Indian architecture concentrates immensely on the religious and spiritual aspects and dates back to 2500 BC. In 300 B.C., Chandragupta Maurya had built many buildings, palaces and monuments with wood; one wooden fort was 14.48 km long and 2.41km wide, along the Ganges in Bihar. The fort has fully perished and only a couple of beams of teak have survived. Millions of temples, forts and palaces are spread out across the length and breadth of India. There were days when wood was in plenty and scarcity was unknown. Wood is an essential part of architectural designs in palaces, temples and community places throughout history. Wooden sculptures and art works in monumental structures depict the creativity of artists in historic past. Teak, rosewood, and sandalwood were used for carving sculptures, doors, ceilings etc. in many monuments in India. The wooden sculptures which now exist are very fine monumental specimens of ancient woodcarving techniques. No doubt, the Indians are sculptors of proven merit and skills. Wood art has significantly contributed to the artistic history of India.

1. Palaces in India

The palaces in India are the epitomes of sheer opulence and comfort. These were built in some of the most beautiful cities of the country, offering a visual treat to visitors. They showcase a brilliant range of architectural style and artistry, reflecting an elegance of style which speaks of the bygone golden era of intrigue, valor, glory, deceit, romance and splendor. Some of the palaces have been renovated as luxury hotels offering a whiff of royalty. There are many monumental structures in India where wood has been bountifully used for creating structural elegance or for decorative purposes. In Punjab, old havelis and palaces bear carved doors and windows. But today wood carving tradition and very famous wood inlay technique is continued only in Hoshiarpur. The workers from Hoshiarpur specialize in inlaying intricate design that are primarily based on floral motifs.

Some of the well known examples are presented here.

- a. Padmanabhapuram Palace, a magnificent wooden palace of the 16th century, is located in Thiruvananthapuram, at the end of Indian mainland. This old palace of the Rajas of the erstwhile Travancore (1550 to 1750 AD) is a fine specimen of Kerala's indigenous style of architecture and is an enticing piece to any lover of art and architecture. Sri Padmanabhaswamy temple, located nearby is also with ceiling made of well-seasoned wood, abounding in carvings. On the eastern side of Padmanabha Swamy Temple,

installed in 1833 during the reign of Swathi Thirunal, is the Meshan Mani (clock). It has on its dial, a man's face with two goats on either side. Crafted from mahogany, every time the clock completes an hour, the man opens his mouth and the goats hit his cheeks.

- b. The Dharia Daulat Bagh or Tipu Sultan's summer palace in Srirangapatna was built in 1784 mainly of teak wood. The beauty of this palace lies in its simple and elegant architecture. Every pillar and wall is profusely painted with variegated colors, made of vegetable dyes. The biodeterioration reported there consisted of the presence of wood wasps as well as fungal decay, mainly by white-rot or wet-rot fungi. Mould and lichen attacked the canvas and mural paintings.

2. Temples and architecture

Andhra Pradesh has a tradition of manufacturing woodcarvings for religious centers. The Tirupathi dolls of red wood were made primarily for sale to pilgrims. In south Karnataka interesting form of life size wood carvings of Bhuta figures made from single wood pieces are found in religious locations. From the northwest coast, the temple of Somnath is famous for its beautiful wooden skills. The doors of this temple are famed for their magnificence and are highly valued as sacred relics. The wooden idol of Lord Jagannath, Balaram and Subhadra in Puri (Orissa) are unique and made of neem wood. The building of idols of three deities takes place once in 12 years in the month of Aashaadh with extra days in the calendar.

I. Temples in Maharashtra

Trishundya Ganapati temple is a temple located in Somwar Peth, Pune in Maharashtra is dedicated to Lord Ganesh. It was built during reign of Peshwa. The temples derived its name from the idol of Ganesh, which has three trunks and hence the name 'Tri-Shundya' which means three trunks. The idol is of wood and the temple made of stone has beautiful carvings on its exterior. It is the only one of its kind in the entire country

II. Temples in Himachal Pradesh

Dhungri or Hadimba Temple in Kullu is constructed in pagoda style displays the finest example of wood carving on it. Bijli Mahadev is a temple situated at an altitude of 2,435 metres, the temple is ideally located offering a commanding view. 20 mt high wooden pole stands are installed in front of the temple believed to be for seeking blessings from the sky.

III. Temples in South India

The State of Kerala had also one of the richest traditions in woodcarving. The temples are with carved pillars and beams and almost every house from this state have a carved family temple with intricate patterns of designs on the ceilings and pillars preserving the woodcarving style of sculpturing in Kerala. Normally in many temples, there is a wooden Dwaja Sthambham (flag pole) which is given a great deal of importance. They are treated in gingelly oil for about a year. The idols in these temples are normally made either of stone or wood, the preferred wood is that of the jack fruit tree. Abhishekam is not performed for such statues but the statue is coated with saffron mixed in oil. This ensures a very long life for the wooden statues. Kozhikkode Tali Mahadeva Temple has a two storied sanctum which has works of art in terms of stone sculptures and wood work with scenes from the puranas. In front of the sanctum is a chamber with intricate woodwork. In the temple of Kottarakkara

Manikandeswaram Temple, the idol of Vigneswara, is a magnificent one carved in wood by the famous artist, Perumthachan. As a part of the daily ritual, smearing of oil is being carried out. As a result, the idol has been turned to black. It is 3 feet high, with a small trunk and four hands, carrying coir, hook, rice cake, and plantain fruit.

IV. Wooden Chariots in Indian temples

In Southern states of India like Karnataka, Tamil Nadu and Andhra Pradesh, the tradition of woodcarving finds its best expression in the form of chariots which are carved skillfully in wood. It is mainly used by temples for taking out the deities in procession on festive days. Chariots figure prominently in the Rigveda, proving their presence in India in the 2nd millennium BC. With its historic and mythological residues, Hampi in Karnataka is in the list of UNESCO's World Heritage sites. The Hampi is capital of the Hindu empire, Vijayanagara, which ruled the south India during 14th to 16th century AD. The ruins of Hampi, as it is known today, are a vast open museum of history, architecture and religion. In a largest religious festival in Hampi, the image of the god and goddess are kept on the temple car (the giant wooden chariot) taken in the procession along the main chariot street.

a. Rath yathra – A journey towards salvation

Chariot festival is observed in Puri, one of the four greatest places of pilgrimage in India. Here three chariots, one each of Lord Jagannath, Lord Balaram and Subhadra Devi are brought on the streets of Puri and drawn by thousands of devotees. Balaram's chariot is 44 feet high, Devi Subhadra's chariot is 43 feet high and Lord Jagannath's has a height of 45 feet. Each year the three chariots are built with wood collected on Vasant Panchami day and there is not a single piece of iron used in it.

b. Heritage village and wooden Chariot

Kalpathy is a heritage village in Palakkad, Kerala state. Kalpathy Viswanathswamy temple is one of the oldest Shiva temples in Malabar, built in A.D.1425. The major festival is the annual Kalpathy Ratholsavam in which a highly decorated wooden chariot is moved by a croud of devotees through the streets.

3. Wood work and wooden statues in Churches

India is a secular country and many religions and beliefs exist in the country. Just like temples, churches built by Christians also adorn the nook and corner of the country. Many churches and cathedrals were built during 16th and 17th century AD at Old Goa. The paintings in the churches are on wooden borders and fixed between panels having floral designs. Excepting a few which are in stone, the statues are mostly in wood delicately carved and painted to adorn the altars. They depict mostly the saints, Mother Mary and Jesus on the cross.

Wood degradation in monuments

A study into the wooden monuments of the country from a climatological and archaeological perspective, covering aspects of biological status- durability, deterioration by insect borers, termites and decay fungi along with wood identity, anatomy, strength and properties in relation to chronological and climatological changes would go a long way in protecting the monuments and at the same time revealing the untold story of their life cycle

over many decades. Protection of large wooden monuments located in the open poses real problems to the conservation agencies in India. As wood degrades, the reflection coefficients become more negative, resulting in the hypothesis that the more degraded wood becomes, the easier it should be to detect. Exposed timbers, when heavily degraded, can be acoustically transparent and so undetectable by acoustic methods. Application of new methods of detection of wood degradation is a real challenge and in India the modern methods are not in vogue and nondestructive tests is not very popular as in other countries elsewhere.

Wood degradation by weathering

There are many agencies of degradation. Wood exposed in exterior conditions undergoes severe weathering deteriorations. The degradation is caused by a combination of factors present in environment (sunlight, moisture, heat, atmospheric pollution, chemicals and biological agents). This results in physical and chemical changes manifested by discoloration, loss of brightness, roughening, cracking, and physical deterioration of wood surfaces. Weathering is a surface phenomenon as penetrability of UV and visible rays are limited to 75 and 200 microns. Water as dew or rain degradation goes to depths of 0.05 – 2.5 mm. High temperature reduce RH and causes reduction in equilibrium moisture content and hence results in shrinkage of surface layers. Weathering lead to degraded cellulose in 20 – 30 years, loss of colour, luster and erosion of 6 – 13 mm per century.

Fungal Degradation

Wood, being of organic origin, is metabolized by many fungi for food. Even the most durable wood species may fall a victim to fungal attack due to photodegradation and depletion of wood extractives. The discoloration of wood in the presence of moisture is caused by growth of fungi. The most commonly observed fungi are mildew and stain fungi which have very modest ecological requirements and are quite resistant and adaptable. Fungal degradation is a rapid process which can destroy the entire wood. Surface checking and cracking along with photodegradation and weathering exposes new surfaces for rapid fungal attack and degradation.

Borers and Termites

Borers and termites are other agents which can destroy inadequately protected wood. Most of the wood species used for monuments namely, deodar, teak, sal, etc. are durable in nature. However, their durability fades with time due to depletion or modification of the extractives present in such wood species. Chemical treatments for long term protection are thus needed even for such wood species.

Protection from Biodeteriogens

India, being a land of rich cultural heritage, is a treasure house of historic buildings and monuments. India has been included in the World Heritage listing by UNESCO. In addition, until 2005 approximately 67,000 listings covering 200 places and 25 states in India were completed outside the World Heritage listing. The Archeological Survey of India (ASI) functions as an attached office of the Department of Culture, Ministry of Culture, is responsible for preserving designated ancient monuments of national importance. ASI has declared more than 3600 monuments to be of National importance. Its major activities are

maintenance, conservation and preservation of centrally protected monuments and sites, the chemical preservation of monuments and the raising of awareness of heritage.

In situ protection of wood used in structures poses a real challenge. Naturally resistant timbers are teak (*Tectona grandis*), Chandan (*Chenopodium album*), anjan (*Pennisetum cenchroides*), arjun (*Terminalia arjuna*), irul (*Xylia dolobriiformis*), Champak (*Michelia champaka*), rosewood (*Dalbergia sissoo*), mesua (*Mesua ferrea*), white cedars (*Cedrus deodara*), jarul (*Dalbergia oogeinensis*). Many historic monuments have been built using these woods. Continued exposure to climatic and biotic factors initiates their deterioration and unless protective measures are taken, they will become degraded. A large number of chemicals are available for restoration of damaged objects and their future preservation. Polyethylene glycols and various monomers have been used for impregnation of wood to make them dimensionally stable. These bulking treatments can keep the wood fairly dry and protect it from fungal attack. There are several chemicals/ formulations, which can prevent fungus and insect attack in exposed structures. The choice and use is however, limited as some of these may stain the wood and thus alter its natural colour. The most effective wood preservatives like creosote oil may not be acceptable as it would stain the wood blackish brown. Painting with fungus resistant paints also masks the natural wood surface and may not be acceptable for many situations.

Chemical treatment of wood

Incorporation of toxic chemicals in the wood structure is necessary for complete protection of wood. Chromic acid treatments on wood surface enhances resistance to photodegradation, fungus attack and reduce swelling. Ammoniacal copper-chromate, ammoniacal copper-chrome-arsenate, Acid-copper-chromate, are all well known preservatives for treatment of wood. Treating the wood surface with resorcinol solution prior to treating with acid-copper-chromate improved permanence as well as imparted a natural brown colour. Wood species which leach extractives can be stabilized by coating with dilute solutions of copper and chromium salts. Penetrating finishes and water repellent preservatives have been found suitable for long time protection. Pigmented semi-transparent stains containing UV absorbers have also been developed for this purpose. Drying oils such as boiled linseed oil and mineral spirit based thinners form the base of such penetrating finishes. Pentachlorophenol dissolved in mineral solvents and containing paraffin wax is an excellent wood preservative for long term protection of wood against mildew, fungus insects and water. Water repellent preservatives are better for an overall protection. Film forming finishes include, lacquers and varnishes act as moisture retarders and UV barriers. Specially formulated paints containing preserving chemicals can protect wood against decay. Such finishes are normally effective for a period of two to three years. Since it is not possible to impregnate chemicals without pressure, soil fumigants like chloropicrin, methyl-isothiocyanate and N-methyl-dithiocarbonate can be encapsulated in gelatin for slow release of the chemical and can be expected to be effective for a period exceeding 20 years.

Chemical treatment increases the life of wood by several years by protecting against white ants and insect borers. The commonly used preservatives are (i) coal tar creosote (diluted with crude oil or fuel oil in a ratio of 1:1.) (ii) ASCU (CCA): The wood can be treated with preservatives by brushing, dipping or hot and cold open tank process and under pressure. For dipping, the wood should be kept for 48 hours in the cold preservative. In the hot and cold method, the wood is kept alternately in the heat (about 105°C) and cold (room temperature)

preservative for a few hours. Pressure treatment is done in the treatment plant; the timber should be dry and dipped in the pure chemical for 48 hours.

Presently wood has become a valuable commodity which is extremely expensive. But there were times when wood was available in plenty and scarcity of wood was rare. In the history of India, wooden sculptures play an important role. A material like wood provided an excellent medium for artists in India to express their creativity. Wooden sculptures and toys are very popular for their intricate carving works and meticulous finishing. Sandalwood, Rose wood and Softwood are commonly used by artists in making sculpture. Throughout the history of Indian art, woodcarving seems the most luxurious kind of art. Wood sculpture was produced from many centuries back. The well-known example of wooden sculpture can be said as carved on temples. The Hindu temples in ancient period were marvelously decorated with doors, ceilings and various fittings carved in teak and other kind of woods. This carving was marked with typical patterns of extreme richness and minute elaboration. Some of the architectural remains from Kashmir and Punjab are from as far back as the 3rd or 4th century.

The real challenge before us is to plan the necessary measures of conservation with a view to ensure the survival of this built cultural heritage and unique symbols of our civilization for centuries to come. There is a need to give more thrust to the scientific research in conservation options based on preliminary investigation which includes the knowledge of physical nature of the object (attack of insects, state of decay) and of the factors which induce its decay. The field of conservation therapy needs to be based on correct diagnosis. Rational and scientific approaches must start with a study of structural integrity, determining the causes of deterioration, planning the corresponding remedial measures, selecting compatible repair and restoration materials and meticulous execution with the help of qualified contractors.

Challenges and need for research to develop Strategies for monument protection

1. Assess the status of health of wooden monuments in relation to their strength and durability.
2. Isolate and identify the biological deteriorants in cases where the damage is identified.
3. Identify the wood species and assess its anatomical, physical and mechanical properties in relation to climatic and physical environment.
4. Assess the protection practices employed and in vogue with respect to chemical contents and surface protectants used.
5. Develop a wood protection strategy to preserve the monuments and prolong their life.

Wooden Monuments in India, epitomes of beauty and talent, need protection from a biological perspective

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MONUMENTS IN INDIA

- A monument is a type of structure either explicitly created to commemorate a person or important event or which has become important to a social group as a part of culture and heritage and **in existence for not less than 100 years**
- The cultural heritage of India's five-thousand-year old civilization is reflected by a number of monuments- Forts, palaces, temples, mosques and churches scattered throughout the country
- Indian Architecture evolved over a period of time, and incorporated definitive influences from its various rulers, either Hindus, Muslims or British.

Monuments and Architecture

- Architecture concentrates immensely on the religious and spiritual aspects and dates back to 2500 BC. Millions of temples, forts and palaces are spread out across the length and breadth of India.



A retrospect



- There were days when wood was in plenty and scarcity was unknown.
- Wood is an essential part of architectural designs in palaces, temples and community places throughout history.
- Wooden sculptures and art works in monumental structures depict the creativity of artists in historic past.
- **Teak, rosewood, sandalwood** were used for carving sculptures, doors, ceilings etc. in many monuments in India.

Wood for architectural excellence



The most dominant material culture of any country is contributed by the trees in the form of the material, wood. Wooden Monuments not only lock within them the carbon stocks, but also the cultural heritage of our country.

Palaces in India

- The palaces in India are the epitome of sheer opulence and comfort. These were built in some of the most beautiful cities of the country, offering a visual treat to visitors.
- They showcase a brilliant range of architectural style and artistry, reflecting an elegance of style. All this speaks of bygone golden era, of intrigue, valor, glory, deceit, romance and splendor.
- Some of the palaces have been renovated as luxury hotels offering a whiff of royalty.



Wooden Palaces



On the eastern side of Padmanabha Swamy Temple, installed in 1833 during the reign of Swathi Thirunal, is the Meshan Mani (clock). It has on its dial, a man's face with two goats on either side. **Crafted from mahogany**, every time the clock completes an hour, the man opens his mouth and the goats hit his cheeks.

A magnificent wooden palace of the 16th century, Padmanabhapuram Palace lies at the land's end of mainland India. An enticing piece to any lover of art and architecture -this old palace of the Rajas of the erstwhile Travancore (1550 to 1750 AD) is a fine specimen of Kerala's indigenous style of architecture



Padmanabhapuram Palace

Tipu Sultan's Palace in Srirangapatna

- The Dharia Daulat Bagh or Tipu Sultan's summer palace was built in 1784 mainly of teak wood.
- The beauty of this palace lies in its simple and elegant architecture
- Every pillar and wall are profusely **painted with variegated colors, made of vegetable dyes.**
- The biodeterioration consisted of the presence of wood wasps, as well as fungal decay, mainly by white-rot or wet-rot fungi. Mould and lichen attacked the canvas and mural paintings.

Temples and architecture



Sri Padmanabhaswamy temple. The ceiling is pure artistry in itself and is made of well-seasoned wood, abounding in carvings



The Golden Temple in Amritsar, India

Temple wood art

- Sun temple-The temple is in the form of chariot, the legend has it that the ' Sun-God', used to ride on this divine chariot across the heaven.

From the northwest coast, the temple of Somnath is famous for its **beautiful wooden skills**. The doors of this temple are famed for their magnificence and are highly valued as sacred relics

Wooden Carved Wheel - Sun Temple



Jagannath Temple, Puri

- The wooden **idol** of **Lord Jagannath**, **Balaram** and **Subhadra** in **PURI** are unique and made of **neem wood**.



- The building of **idols of three deities** take place **once in 12 years** in the month of Aashaadh with extra days in the calendar.

Wooden Chariots

- Chariots figure prominently in the Rigveda, evidencing their presence in India in the 2nd millennium BC

- With its historic and mythological residues Hampi in Karnataka is in the list of UNESCO's World Heritage sites.

- capital of the Hindu empire, Vijayanagara, who ruled the south India during 14th to 16th century AD.

- In a largest religious festival in Hampi, the image of the god & goddess is kept on the temple car (the giant wooden chariot) in the procession along the main chariot street.



RATH YATRA – A journey towards salvation



- Chariot festival is observed in Puri, one of the four greatest places of pilgrimage in India.

Here three chariots, one each of Lord Jagannath, Lord Balaram and Subhadra Devi are brought on the streets of Puri and drawn by thousands of devotees.

Balaram's chariot is 44 feet high, Devi Subhadra's chariot is 43 feet high and Lord Jagannath's has a height of 45 feet

- Each year the three chariots are built with wood collected on Vasant Panchami day and there is not a single piece of iron used in it.

Heritage village and wooden Chariot



Nice wood work in a chariot used for Kalpathy festival

- Kalpathy is a heritage village in Palakkad, Kerala.
- One of the oldest Shiva temple in Malabar, Kalpathy Viswanathswamy temple was built in A.D.1425.
- The major festival is the annual Kalpathy Ratholsavam
- A highly decorated wooden chariot is moved by a croud of devotees



IDOL made of wood

- **Trishundya Ganapati Temple**

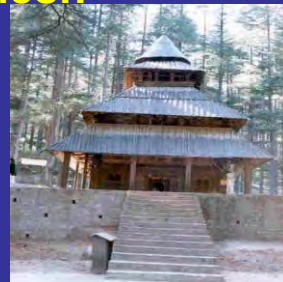
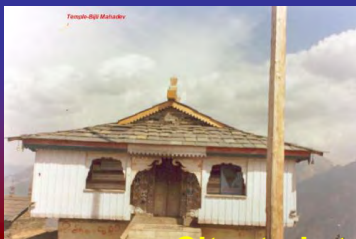
Trishundya Ganapati temple is a temple located in Somwar Peth, Pune dedicated to Lord Ganesh. It was built during reign of Peshwa.

- The temples derived its name from the idol of Ganesh, which has three trunks and hence the name 'Tri-Shundya' which means three trunks.
- The idol is of wood and the temple made of stone has beautiful carvings on its exterior. It is the only one of its kind in the entire country.

Temples in Himachal Pradesh

Dhungri or Hadimba Temple in Kullu

Bijli Mahadev Temple



This temple constructed in pagoda style displays the finest example of wood carving on it

Situated at an altitude of 2,435 metres, the temple is ideally located offering a commanding view. 20 mt high wooden pole stands are installed for seeking blessings from the sky

Wood in monuments- temples in Kerala

- Normally there is a wooden Dwaja Sthambham (flag pole) which is given a great deal of importance. They are treated in gingelly oil for about an year.



The idols in these temples are normally made either of stone or wood, the preferred wood is that of the jack fruit tree.

Abhishekam is not performed for such statues but the statue is coated with saffron mixed in oil (chandattam). This ensures a very long life for the wooden statues.

Wood in monuments- temples in Kerala

- The two storeyed sanctum has works of art in terms of stone sculptures and wood work with scenes from the puranas. In front of the sanctum is a chamber with intricate woodwork.

[Kozhikkode Tali Mahadeva Temple](#)



[Kottarakkara Manikandeswaram Temple](#)

The idol of Vigneswara, is a magnificent one carved in wood by Perumthachan. As a part of the daily ritual smearing of oil is being carried out. As a result, the idol has been turned to black. It is 3 feet high, with a small trunk and four hands, carrying coir, hook, rice cake, and plantain fruit.

Wood work and wooden statues in Churches

- Many churches and cathedrals were built during 16th and 17th century AD at Old Goa.

- The paintings in the churches are on wooden borders and fixed between panels having floral designs

- Excepting a few which are in stone, the statues are mostly in wood delicately carved and painted to adorn the altars.

They depict mostly the saints, Mother Mary and Jesus on the cross.

Agencies of wood degradation

- Weathering – chemical, mechanical and light energy factors.
 - Solar radiations – UV (Visible and IR), moisture (dew rain, humidity), temperature and oxygen.
 - Pollutants – SO₂, Nitrogen dioxide, Ozone.
- UV – Colour change to yellow, brown and later gray.

Weathering is a surface phenomenon as penetrability of UV and visible rays is limited to 75 and 200 microns.

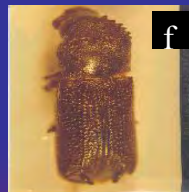
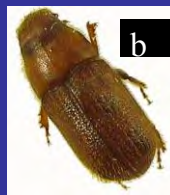
Water as dew or rain – exposes surfaces and degradation goes to depths of 0.05 – 2.5 mm.

High temperature reduce RH and causes reduction in equilibrium moisture content and hence shrinkage of surface layers. Air moisture/ fluctuating RH also cause shrinkage. Winds of sand and dirt cause mechanical abrasion – sand blasting effect.

Weathering lead to degraded cellulose in 20 – 30 years, loses colour, luster and erodes 6 – 13 mm per century.

Biodeterioration of wood in monuments

Decay
Termite attack
Insect borers
Wood inhabiting bees/wasps



Insects damaging timber

a) Platypodid, b) Scolytid, c) Buprestid, d) Lyctid,
e, f, g) Bostrychids, h) Cerambycid, i) Xylocopid & j)
Termites

FUNGAL ATTACK

- Even the most durable wood species found resistant to decay fungi may fall a victim to fungal attack due to photodegradation and depletion of wood extractives, that contribute to resistance.
- Fungal degradation is a rapid process and if favourable conditions continue, can destroy the entire wood.
- Surface checking and cracking along with photodegradation and weathering exposes new surfaces for the fungal attack, leading to more rapid degradation.
- Wood coming in ground contact is prone to soft-rot attack and this effect is more pronounced in hard woods.



Borers and Termites



- Borers and termites are other agents which can destroy inadequately protected wood.
- Most of the wood species used for monuments namely, deodar, teak, sal, etc. are durable in nature.
- However, their durability fades with time due to depletion or modification of the extractives present in such wood species.
- Chemical treatments for long term protection are thus needed even for such wood species.



Protection of Monuments

- India, being a land of rich cultural heritage, is a treasure house of historic buildings and monuments. As many as 26 cultural and natural sites in India have been included in the World Heritage listing by UNESCO. In addition, until 2005 approximately 67,000 listings covering 200 places and 25 states in India were completed outside the World Heritage listing.
- Archeological Survey of India The Archeological Survey of India (ASI) functions as an attached office of the Department of Culture, Ministry of Culture, is responsible for preserving designated ancient monuments of national importance
- ASI has declared more than 3600 monuments to be of National importance.
- Its major activities are maintenance, conservation and preservation of centrally protected monuments and sites, the chemical preservation of monuments and raising of awareness of their heritage

Preservation and maintenance of monuments

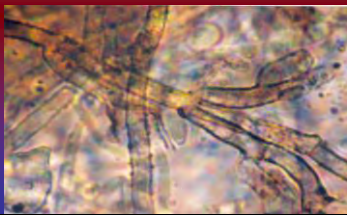
- Archaeological and historical pursuits in India started with the efforts of Sir William Jones, who formed the Asiatic Society on 15th January 1784 in Calcutta.
- The following Acts were enacted for better preservation and maintenance of monuments and also to prevent illegal trafficking of antiquities and art treasures.

Ancient Monuments and Archaeological Sites and Remains Act, 1958

**Antiquities and Art Treasures Act, 1972 ;
The Treasure Trove Act 1878 and the Ancient Monuments Preservation Act, 1904 are also in vogue in addition to the above mentioned legislations.**

Protection from biodeterioration

- It is important to determine which biocidal compounds, or which combination of products, will be the best suitable to combat/prevent the biodeterioration
- Apply termite bait technologies for combating the termite infections in the walls and wooden structures
- **Identification and isolation of fungi and termites** and assess the efficacy of the treatments



Our monuments need protection

- The real challenge before us is to plan the necessary measures of conservation with a view to assure the survival of these built cultural heritage and unique symbols of our civilizations for centuries to come
- There is a need to give more thrust to the scientific research in conservation options based on preliminary investigation which includes the knowledge of physical nature of the object (attack of insects, state of decay) and of the factors which induce its decay.
- The field of conservation therapy to be based on a correct diagnosis



Scientific approach



- Rational and scientific approach starts with a study of structural integrity, determining the causes of deterioration, planning the corresponding remedial measures, selecting compatible repair and restoration materials and meticulous execution with the help of qualified contractors.

METHODS OF PROTECTION

- **FUMIGATION FOR ERADICATION OF INFESTATION.**
- **BORATES FOR REMEDIAL TREATMENTS OF WOOD IN SERVICE.**
- **SPRAYING, DIPPING OR PRESSURE IMPREGNATION OF ORGANO PHOSPHATE OR PYRETHROID INSECTICIDES.**
- **TREATMENTS WITH PRESERVATIVES-CCA,CCB**

Challenges and need for research

- **Identify the wood species and its anatomical and physical properties in relation to Climatic and physical environment**
- **Compare the biological and mechanical properties in respect to age, species, situations and any treatments adopted**
- **Develop a wood protection strategy to preserve the monuments and prolong their life.**



Typology of Wood Sculptures in West Africa

Edmond Adjovi⁴

Abstract

In Africa, the royal courts, traditional religions and initiation rites make widespread use of wooden statues and masks. They use these sculptures to symbolize the “immaterial”: genies and figures of mortal or immortal ancestors. West Africa boasts a wide variety of wooden statues that can be found not only in local markets but all over the world. This presentation will highlight some of the different styles and particular points of this rich cultural heritage.

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International Conference and Exhibition on the Art and Joy of Wood

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Typology of wooden sculptures in West Africa

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INTRODUCTION

Context And Method Of Collecting
Information

Western Africa is constituted by two categories of countries:

The first one concerns those who spread out in sea border and arrange big rain forests example: Nigeria, Côte d'Ivoire, Ghana

The second groups includes the countries which has no outlet on Ocean, and are regions of savannas or deserts example: Niger, Burkina, Mauritania, Mali

The Inhabitants who live in these countries use differently the nature to express their enjoyment and life, because the natural and cultural landscape is varied.



This variation of landscape obliges the inhabitants to use differently the nature to express their life and enjoyment and protect themselves from bad weather.

So, the inhabitants who settled around the close forests and savannas use the wood under natural and sawed-off shape for shelters and under sculptured shape to express their enjoyment in past and present life, contrary to the nomads who rarely express themselves in the wood.

When we want to speak about some wood as materials creating the freshness, giving the enjoyment and participating in the identification of societies, we turn to the sculpture.

This sculpture, while resulting from western Africa which we are going to expose in the present communication according to the plan below:



1) Origin

2) Some wood used in the sculpture, the local method of treatment and finish of sculptures

3) Types of sculptures and their symbolic interpretation

4) Conclusion

Informations are collected from

-The book: IDOWU A. E., Art Standard for schools and colleges, Wisdom Seed, Lagos 2002.

-specialist of Arts in the village of Arts in Benin ,Nigeria and Ghana.



THE WEST-AFRICAN SCULPTURES

Origin

The agrarian and initiatory rites, the religions of the country, the royal courts are the main foundations of the West African sculpture. The main genres remain masks and statues

These arts expressed themselves especially in the wood, the ivory, the "bronze", the terra-cotta, the gold and the silver. We know some of the most famous styles; their naming also correspond to ethnonymes: senoufo and dan in Ivory Coast, bambara and Dogon in Mali, baga of Guinea, mosi in the Burkina Faso, Guèlèdè in Benin and Nigeria for example.

It is in Nigeria where we find the biggest historic depth. The researchers proved that there was a relationship between the diverse styles which succeeded one another in this country for 2000 years at least.

THE WEST-AFRICAN SCULPTURES

Some wood and colours used in
the sculpture



N°	Espèces et essences forestières		Caractéristiques	Provenance
	Nom scientifique	Noms vernaculaires		
1	<i>Acacia albida</i> Del. – Légumineuse mimosacée	<i>Cad, Gao, Balanzan</i>	Soft wood, yellow color	Quite the parts(parties) of dry Africa
2	<i>Adansonia digitata</i> L. - Bombacée	<i>Baobab</i>	Soft, spongy wood, full of water)	In all tropical Africa: Sahel- Sudanese region of western Africa
3	<i>Azela bipidens</i> Harms - Césalpiniacées	<i>Doussié</i>	Hard and heavy wood, perfect wood becoming brown red in the light	Nigeria, Côte d'Ivoire, Ghana
4	<i>Azela africana</i> - Césalpiniacées	<i>Lingué</i>	Hard and heavy wood, perfect wood becoming brown red in the light	Nigeria, Côte d'Ivoire, Ghana
5	<i>Brachystegia cynometroides</i> Harms. - Césalpiniacées	<i>Naga</i>	perfect brown wood, middle hard wood,	Liberia
6	<i>Canarium scchweinfurthii</i> Engl - Burseracées	<i>Aiélé</i>	soft and light wood	Sierra Leone
7	<i>Chlorophora excelsa</i> Benth et Hook, <i>Chlorophora regia</i> A. Chev- Moracée	<i>Iroko</i>	Light and middle heavy wood	Wood of Forest semi- decidues

N°	Espèces et essences forestières		Caractéristiques	Provenance
	Nom scientifique	Noms vernaculaires		
8	<i>Coelocaryon preussii</i> wARB - Myristicacée	<i>Ekoune</i>	Bois mi-dur , mi-lourd	Libéria
9	<i>Cordyla pinnata</i> Milne- Redhead - Césalpiniacée	<i>Metondo, Dimb</i>	Bois mi-dur , mi-lourd	Mali, Burkina Faso, Côte d'Ivoire, Gambie, Guinée, Ghana, Bénin, Togo, Nigéria
10	<i>Diospyros crassiflora</i> Hiern. - Ebenacée	<i>Ebène</i>	Bois dur de couleur noir	Bénin, Nigéria
11	<i>Entandrophragma cylindricum</i> Sprague	<i>Sapelli/Sapele</i>	Bois mi-dur , mi-lourd	Côte-Ivoire
12	<i>Entandrophragma utile</i> Sprague - Méliacée	<i>Sipo/Utile/Assie</i>	Bois léger et tendre	Côte d'Ivoire
13	<i>Eribroma oblonga</i> Mast -Sterculiacée	<i>Eyong</i>	Bois mi-dur, mi-lourd	Libéria
14	<i>Isobrerlinia doka</i> Craib - Césalpiniacée	<i>Sau</i>	Bois mi-dur, mi-dur	Dans toute l'Afrique occidentale
15	<i>Kaya ivorensis</i> A. Chev., <i>Kaya anthotheca</i> . DC. - Méliacées	<i>Acajou d'Afrique</i>	Bois tendre et léger	Côte d'Ivoire
16	<i>Kaya senegalensis</i> A. Juss - Méliacée	<i>Caïlcedrat</i>	Bois lourd et dense	Sénégal

The colors which choose the artists as the tint(coloring) of sculptures are bound(connected) to their symbolic feature.
The manufacturing of colors is obtained other time by means of the local materials.
Today, the artists use of the commercial paint(painting) (for example shoe polishes for shoes).

.

Colors usually met in the sculpture are:

- The white is the symbol of the revival, the purity, the innocence, the light. This color is obtained with some Kaolin, the shell of snail, egg, excrement of lizard.
- The black represents the death, the witchcraft, the evil. The manufacturing is made by means of leaves or barks of lianas.
- The red represents the fire, the blood, the sun, the fertility and the power. It is obtained by means of Kola.
- The yellow represents the peace, the serenity, the fortune, the hope, the fertility, the eternity, but also the decline and the announcement of the death.
- The blue represents the coolness, the ground rest.

THE WEST-AFRICAN SCULPTURES

Types and symbolic interpretation

The African artist does not make a work for the representation, imitation, but gives meaning and of symbolism. We cannot separate the plastic value of the works of his social or religious, cultural, political, economic, historic, therapeutic context.

So, two particular points are brought to light through sculptures: the aestheticism and the function of the object.



MASK

The mask, symbol of the existence of an intermediary between the reality and the supernatural. The mask is a means of control of the magic religious of every society. The multiplicity of his shape and aspect explains this fact. So every model corresponds to a particular circumstance of the life of the group. There are used for the dance, the marriage and the funerals.



**Mask from Benin and
Nigeria « Guèlèdè »**

The mask " Guèlèdè " (the secret of the women) native of Benin and Nigeria represents an ancestor insuring the connection of the human world and the invisible, is wooden light polychromatic which concerned the summit of the head, its facies being directed to the sky.



MASK FROM MALI

MASK BAMBARA: The Babamra are the MANDE speaking tribe of Mali. Their pre_occupation is farming. They believe in the, god FARO,,regarded as the river god of rain and fertility,It became a god of annual worship. The mask Bambara represent the creation of god and the guide of the universe.



Bambara

MASK DOGON : the dogon of Mali reside in south of Timbuktu. Dogons believe the mask has a life force NYAMA which comes from human and animals to them after death. They are used during Burial to chase away the soul of the dead person to avoid harming others.



Dogon

MASK FROM IVORY COAST,

MASK DAN: The origin of the Dan is from the forest of Gulf of Guinea. The Dan use many forms and aspects of masks. It represents half animal and half human, which is used for the celebration of marriage and funeral.

This form of mask is used particularly for marriage.



MASK FROM BURKINA FASO

The masks from Burkina-Faso, are used for some functions: they are the object of cult and art. These masks are generally used in dry season.

For example, The mask OISEAU » 'BIRD' is used to call upon rain and the mask « SOLEIL » is used to call upon sun to shine when rain falls much



OISEAU



SOLEIL

STATUARY

The statuary serves to like the manes of ancestries. It is as intermediary between the living and died (the power which it represents). It is an idol, which embodies a spirit, a genius. It establishes a link between the visible world and the invisible world.



STATUES OF TWINS

The sculpture is made to represent the dead twins to replace the dead ones.

In Benin and Togo, .The sculpture is being adored by the mother. The mother of the twins placed the sculpture by her side when eating and also put some the food on the lips of the wooden sculpture believing that the twins is eating with her. she also gose along with the sculpture to every where .



STATUES OF ASHANTI

The Ashanti Art can be categorized into forms of art. These are the metal and wood work. The wood sculpture here is relegated to the miniature, it is basically in abstract form used by small girl and the charming brass weights formerly used in hanging over the sale of gold dust.



STATUES OF BAULE

Baule is from Ivory Coast, it has some cultural lineage with the FANTA and ANYI of Ghana. It is believed that Baule have creative power to prevent miscarriage and to insure fertility and also to promote well being of owners.



STATUES OF SENUFU

The senufu tribe occupies part of Ivory Coast and some part of Mali. They are governed by a secret society called LO SOCIETY.

Their main function is to ensure that the creation Myths, custom, and moral norms are obeyed in the community. It promotes members to the higher rank, it depends on the test carried out after a period of seven years.



HISTORICAL TREE

This work of art is in Ouidah. Ouidah is an historic city situated on the sea border having 47 kilometers from Cotonou (Republic of Benin). This work of art is in Ouidah.

This sculpture demonstrates that a dead timber can "be resuscitated" and to be used to redraw the history of a society. It shows environmental aspects of the use of the wood in the sculpture: instead of eradicating the dead tree and transforming it into wood, the municipality of Ouidah had the brilliant idea to transform it into scenes of history of Benin and Ouidah.



Photo

Scenes presented by the tree report functions of the African art namely:
Social and cultural function: scenes 1 and 2 symbolize the religious practices (Vodoun and the Christianity) as well as the place of the man and the woman in the society.

Historic function: scenes 3 and 4 symbolize the draft of the slaves (started of slavery and the liberation of an unchained (given rise to slave). On the scene 3 there is also a symbol of the national unity " pierced care of king Guézo "

Therapeutic function : the scene 4 shows the tray (plateau) of divination " Fâ " used to determine the nature of the problems and their potential solutions.

- Political function: on the scene 5 is sculptured the " Zangbeto " divinity of preservation of order;



Scene 1



Scene 2



Scene 3



Scene 4



Scene 5

FURNITURE

The sculpture also plays a political role:

- The enthronement of the head of the village, the kings is made with sculptured seats. Sat relaying on an animal which characterizes the power of every king or head of the village.

Doors attics Dogon carry symbolic representations such as:

- Masks of the protective spirits;
- The representations of the pregnant women who evoke fertilizations of the earth (ground);

The effigies of ancestors deprived reminding the dead parent owner of field



Seat of King



Seat of head



Traditional Door

TOM-TOMS

The wooden sculpture is used as musical instrument to call upon the spirits and make masks dance. Tom-toms are associated to religious ceremonies, in particular to celebrate the burial, accompany rites of initiation.



GAME

The wooden smart game sculptured most repent in western Africa is the "Awale". It shows how many times the sculpture can play the role of entertainment in a society. This game contains six cavities on each side dug in the wood. These cavities are intended to contain seeds.

At first, we distribute forty eight seeds in twelve holes at the rate of four seeds by hole. As in the chess, only two players can be in confrontation. A tour takes place in the following way: the first player takes all the seeds of one of the holes of his camp then he gets into all the compartments which follow on his row then on that of his opponent following the sense of rotation. If his last seed grave in a hole of the opposite camp and that there are now two or three seeds in this hole, the player gets back these two or three seeds and puts aside them. Then he looks at the previous compartment: if she is in the opposite camp and contains two or three seeds, he gets back.



WOODEN SCULPTURE FOR FOOD

This wooden sculpture is used to pound yam in Africa. It is mostly used in Togo, Benin, Nigeria and Ghana to prepare a traditional food called « pounded yam » in Ghana and Nigeria, it is called « Agun » in Benin and Togo.

The mortar cover is used to pound yam in the mortar in order to make the yam soft for eating.



CONCLUSION

Wooden offers a wide different types of sculptures which are found both in markets in west African countries as well in the greatest international exhibits.

According to the style, sculptures play a social, political, economic, historic and therapeutic role. So for example, masks and statuary provide the protection and the cure infertility. They are sometimes used as trophy to encourage the farmers to produce advantageously. Tom-toms have to function to make dance statuary and call upon the spirits and lead the religious rites.

In West-Africa, we meet a new shape of the sculpture which takes into account the environmental aspect of the use of the wood, that makes us tell story of a society by a dead tree.

Lifestyles Changes in Some Urban Centres in Ghana: What Are the Existing and Potential Impacts on Wood Use in 2011 and Beyond?

Stephen Tekpetey⁵ and Emmanuel Appiah-Kubi⁶

Abstract

In recent times in major city centres in Ghana, the design of houses and ceilings patterns have changed drastically with reduced wood use. Metal doors and plastic T&G are rapidly replacing the use of wood panelling in most private and public building projects. This trend has been linked to a number of factors which include increased wealth status, desire for aesthetic satisfaction and the scarcity of wood in the urban centres. However, the greater and sustainable use of wood is believed to make a significant and valuable contribution to Ghana's desire for a greener future. In this study, the pattern of roofing and ceiling in some private and public buildings constructed in the last five years in three centres: Kumasi, Accra and Tema were assessed using semi-structured questionnaires and field observations. The reasons for the choice of the ceiling and panelling materials were highlighted. Among other things, it is recommended that artistic wood materials should be developed to enhance the use of wood in most building projects in Ghana and other countries where the trend exist.

Keywords: urban centres, wood, ceiling materials, greener future

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1. INTRODUCTION

Wood, a renewable natural resource, has accompanied man's developmental process for centuries in many countries including Ghana. Wood, in its natural state, can be used for many forms of construction (Jayanetti, 1998). As a construction material, wood is strong, light, durable, and flexible and can be easily worked with. In contrast to the substitutes for wood in structural purposes such as brick, metal, concrete and plastics, wood can be produced and transported with little energy consumed and the products are renewable (Koch, 1991). It is also a structurally sound material. Wood is still the major energy source for the majority of the world's people, and burning of wood for fuel is still the major use of wood. In terms of volume of wood used, it was reported that the world population used about 3.4 billion m³ (or tonnes) of wood in 1996 with a continual increase annually since then. Global industrial consumption of wood averages 0.29 m³ per person per year (Sutton, 1993).

There are huge differences in wood consumption between countries. In the USA, for example, per capita consumption exceeds 2.0 m³ per person per year. Consumption in Australia is about half this level, whereas in China and India per capita use is less than 0.1 m³ (Sutton, 1993). Though information on the actual consumption is not readily available, the annual consumption of wood in Ghana can be related to the Annual Allowable Cut (AAC) of about 2 million cubic metres with some authors quoting about 3.5 million cubic metre of wood consumed annually. As the population increases in Ghana and the world at large, wood demand is expected to increase. Sutton (1993) indicated that rising expectations and improving living standards of the developing countries, especially in Asia, seems certain to increase wood use. The world demand for wood products is expected to increase significantly if developed countries are sincere about their commitment under the 1992 Climate Change Convention to hold atmospheric emissions of fossil carbon (Koch 1992, Sutton 1993).

Ghana's population has increased significantly since the 1920s when formal censuses were introduced. Along with the increased population has come the increasing concentration of the population in settlements of 5000 or more people. Urban centres in Ghana are officially defined as settlements with populations of 5000 or more (Owusu, 2005). In 1921, it was reported that 7.8 % of Ghana's population lived in urban centres. That rose gradually to about 43.8 % in 2000. As of 2000, Kumasi and Accra alone accounted for about 34% of the total urban population though there were about 350 urban centres in the country. More importantly, there has been continuous increase in the number of urban centres in Ghana over the last decades.

Using Ghana's official urban definition, three main classifications of urban centres can be made: small towns, medium-sized/intermediate towns, and large towns/cities. At the top of Ghana's urban hierarchy are the large towns/cities of Accra, Kumasi, Tema and Sekondi-Takoradi, with populations of 250,000 or more (Owusu, 2005). This is followed by the intermediate (medium-sized) towns with populations of 50,000 to 250,000, typified by the regional capitals. Exemplified by district capitals/administrative centres are the small towns with populations between 5000 and 50,000.

Rapid urbanization and globalization is accompanied by changes which exposes many individuals to risks and different patterns of resources use. For instance, fast paced economic transition has also resulted in reduced physical activity levels, decreased hours of rest and increasing levels of stress. More often than not, urbanization, with its attendant lifestyle changes, places much pressure on natural resources and infrastructure.

In recent times in major city centres in Ghana, the design of houses and ceilings patterns have changed. Metal doors and plastic T&G and other non-wood materials are rapidly replacing the use of wood in windows, doors and paneling in most private and public building projects. This trend has been linked to a number of factors which include increased wealth status, awareness of emerging products for buildings, the desire for aesthetic satisfaction and the scarcity of wood in the urban centres. However, the greater and sustainable use of wood is believed to make significant and valuable contribution to Ghana's and the world desire for a greener future. This study is aimed at assessing the existing and potential threat to the use of wood in roofing and ceiling of houses in selected urban centres in Ghana.

2. METHODOLOGY

The pattern of roofing and ceiling in some private and public buildings in urban centres in Ghana were observed. In all 100 housing units at Kumasi; 99 at Accra 100 and 53 at Takoradi were randomly sampled for the study. In all 252 housing units were randomly selected in the study areas (Fig. 1). Semi-structured questionnaires were administered and field observations were made. The information required included the type of ceiling materials used for their houses and what informed the choice of such material. The owners and occupants of private, public and students hostels were contacted during the survey. The data collected was analyzed using SPSS version 16. Photographs of some ceiling materials in the urban centres were taken.



Figure 1: Map of Ghana showing the Urban centres (Source: Owusu 2005)

3. RESULTS AND DISCUSSION

3.1 Types of Ceiling Material in study areas

The survey of the selected urban centres in Ghana revealed the different ceiling materials. The materials used included plywood, polished and unpolished wooden Tongue and Grooves (T&G), Plastic T &G, POP and concrete. The use of these materials varies in private and public buildings and from one urban centre to another. In Kumasi, results revealed that majority of the houses surveyed use plywood and wooden T& G. About 48% of respondents use plywood and only 6% uses plastic T and G. Some of the buildings as shown in Fig 2 exhibit a combination of more ceiling than two materials (especially plywood and plastic T&G). However, less than 10% of the respondents use the combination of ceiling materials. Similar trends were observed in the other two urban centres of Ghana, however Takoradi recorded a combination of concrete and plywood as ceiling materials in private houses sampled in the survey than the two other urban centres.

All wood substitutes in ceilings, door and door frames of housing structures are far less environmentally friendly than wood. Wood substitutes like plastic and synthetic rubber often involve pollution with the atmospheric release of carbon from the extraction and production processes than that generated from wood and wood products. A major shift from the use of wood, and an increased use of wood-substitutes like plastics, would increase overall energy requirements in a developing country like Ghana.

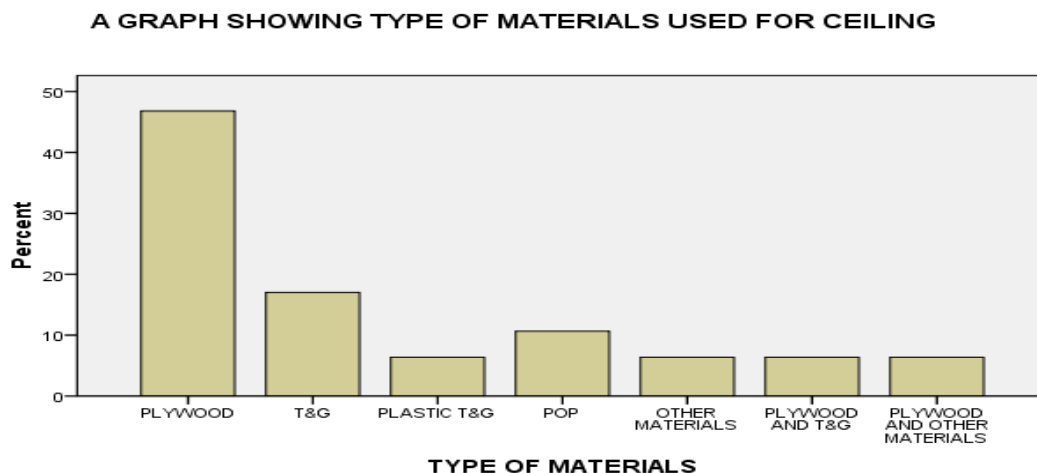


Figure 2: Types of ceiling materials used in building in Kumasi, Ghana.

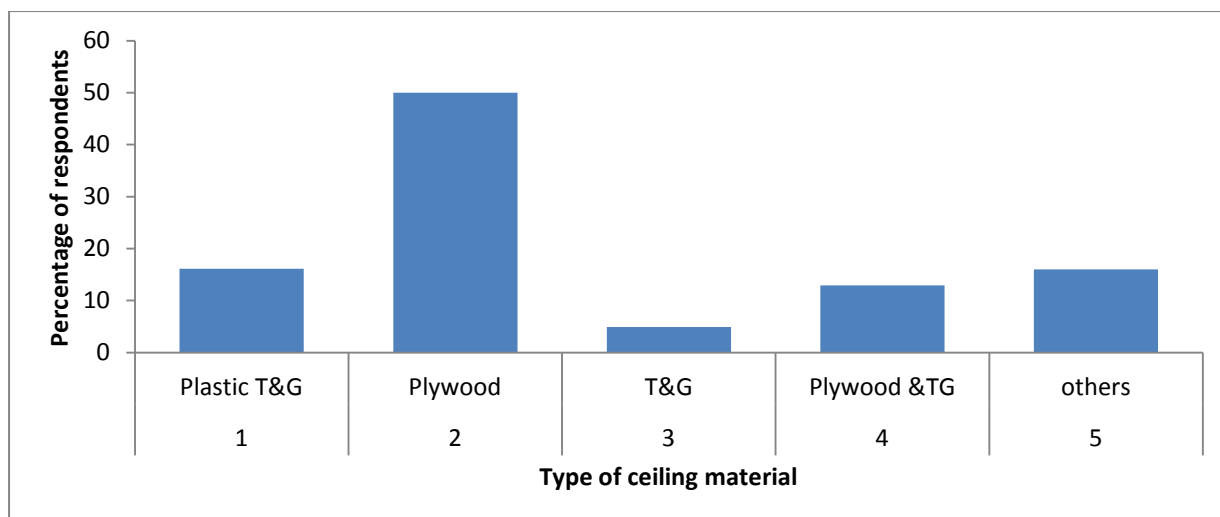


Figure 3: Types of ceiling materials used in Accra, Ghana

Figure 4 shows the reasons respondents gave assigned to the choice of ceiling materials on the Ghanaian market in the selected urban centres. The majority of respondents in Kumasi, Accra and Takoradi use plywood or plywood with other ceiling materials because it is cheap and attractive. Other reason that was given by respondents was that plywood was the only ceiling material that was on the market when they were building the structures. A combination of plastic T& G and plywood is because of the need to replace damaged parts of ceiling with a more attractive and emerging plastic T&G.

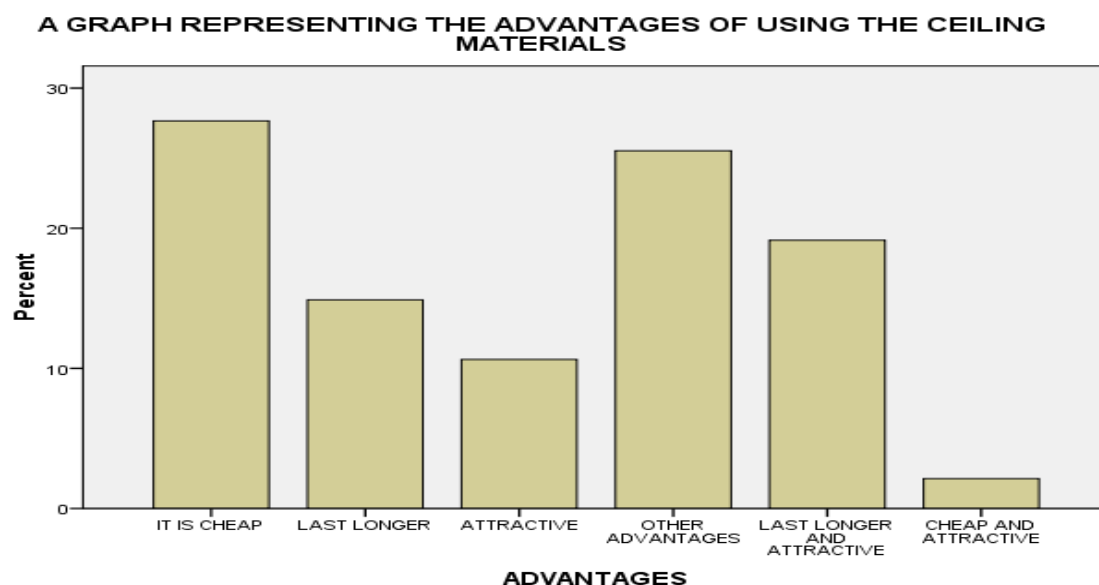


Figure 4: Reasons for choice of ceiling materials

3.2 Some Photographs of Ceiling materials in Selected Urban centres in Ghana



Figure 5a: Wood panel in building Ghana.



Figure 5b: A concrete ceiling at Accra,



Figure 6a: Plastic T&G ceiling in Kumasi, Ghana

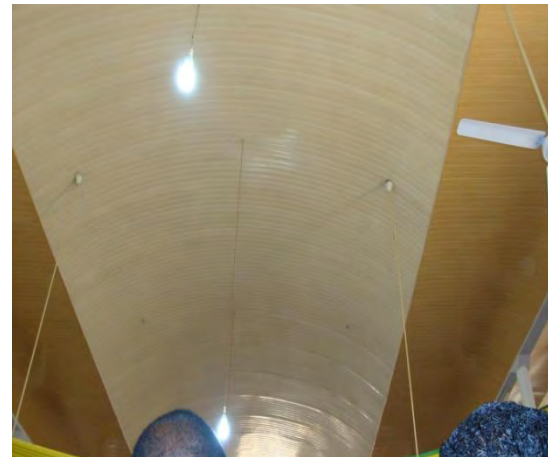


Figure 6b: Plastic T&G Ceiling

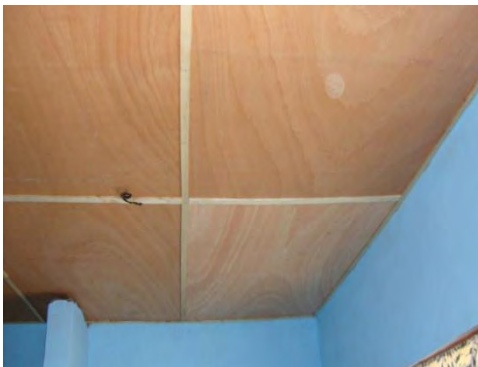


Figure 7: Wood as a ceiling material at FORIG, Kumasi, Ghana

Analysis of the data also revealed that over 85% of respondents in the selected study sites have not changed the ceiling materials since the buildings were constructed. Many of the respondents are aware of the aesthetic values of plastic T&G and POP as ceiling materials and would replace the existing ceiling materials in their private apartments with any of the new materials because they are attractive and would not deteriorate rapidly like plywood and wood products.

As the world population increases, the question about urbanization and the need to provide decent accommodation will demand the use of ceiling materials. The choice of material for

roofing and ceiling is influenced a number of factor: taste of consumer, their purchasing power, availability and awareness of desired materials and the policy direction on the use of renewable natural resources like wood. In the wake of concern of the adverse impact of climate change especially in developing countries like Ghana there is the need to build a greener future with the use of wood and other materials bamboo as ceiling materials.

4. CONCLUSION AND RECOMMENDATIONS

Wood as a ceiling material is gradually being replaced by plastic T&G in some urban centres in Ghana. The trend, attributed to a number of factors like dwindling wood supply, is likely to increase in the coming years as Ghana's population and the global population increase with dwindling commercial forest tree base. Though attractive, its use has some technical disadvantages like heat retention, and increasing carbon emission into the atmosphere. There is therefore the need to sensitize populace about the benefits (cooling and carbon storage) of using wood as a ceiling material instead of the other emerging alternatives. There is however the need to improve the design of wood panel, durability and availability of wood for these purposes in Ghana and other parts of the world where the trend in the use of plastic materials exist.

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**Lifestyles Changes in Some Urban Centres in
Ghana: What are Existing and Potential Impacts
on Wood Use in 2011 and Beyond?**

**AJW International Conference 2011
19-22 October, 2011**

**Stephen Larrey, Tekpetey
Forestry Research Institute of Ghana (CSIR-FORIG),
Kumasi, Ghana
Email: stekpetey@csir-forig.org.gh**

Outline of Presentation

- Introduction
- Objective
- Methodology
- Results and Discussion
- Conclusions and Recommendations
- Acknowledgement

Introduction

Wood is good



Introduction

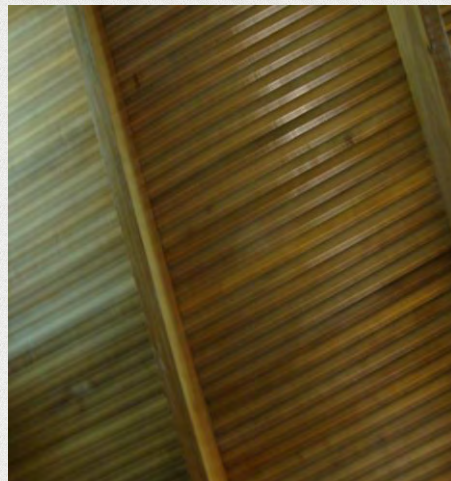
- Wood and wood products have been associated with human survival over the decades.
- Wood is used as firewood, roofing and ceiling material, for furniture, carvings/art works etc
- In Ghana, the export of wood products contribute significantly to the economy.

Introduction

Ceiling designs using wood in Ghana



Introduction



Introduction

- In recent times, other designs and ceiling materials are gradually replacing the use of wood and wood panels in ceiling in Ghana.

Objective of study

- This study is aimed at assessing the existing and potential threats to the use of wood in roofing and ceiling of houses in selected urban centres in Ghana.

Study Areas



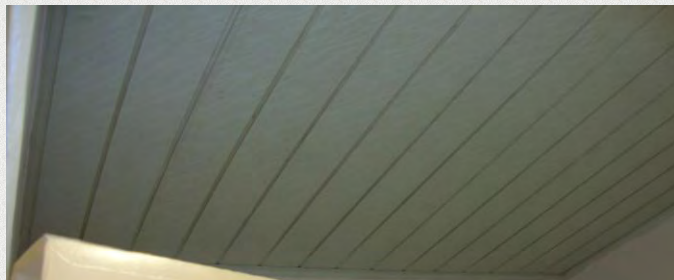
Ghana has a total land area of 23.9 million hectares.

Southern Ghana has a high concentration of urban centres.
(Urban centres are settlements with pop. of 5,000 and more.)

Methodology

- About 252 housing units were randomly selected in the study areas.
- Semi- structured questionnaires were administered and field observations made.

Emerging trends



Emerging Designs

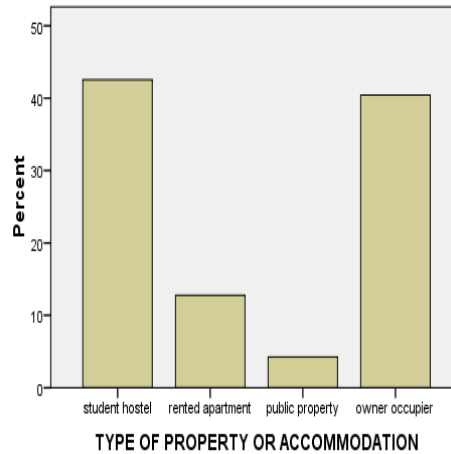


Results and Discussion

In Kumasi, the type of accommodation:

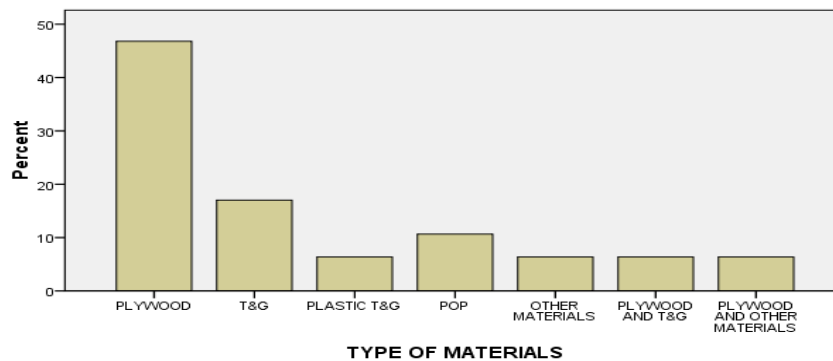
- Owner occupiers(42%)
- Hostels (41%)
- Rented apartment(14)
- Public property (3%)

A GRAPH SHOWING THE RESPONSE TO TYPE OF PROPERTY OR ACCOMMODATION



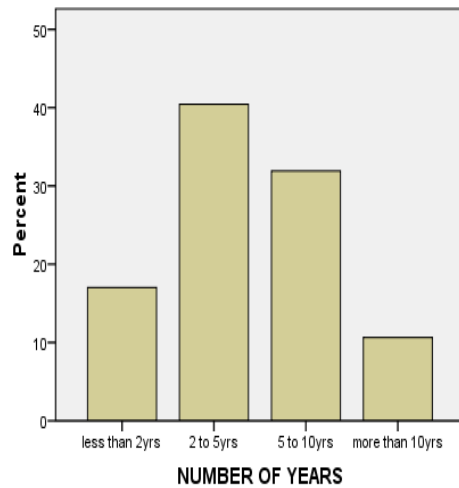
Results and Discussion

A GRAPH SHOWING TYPE OF MATERIALS USED FOR CEILING

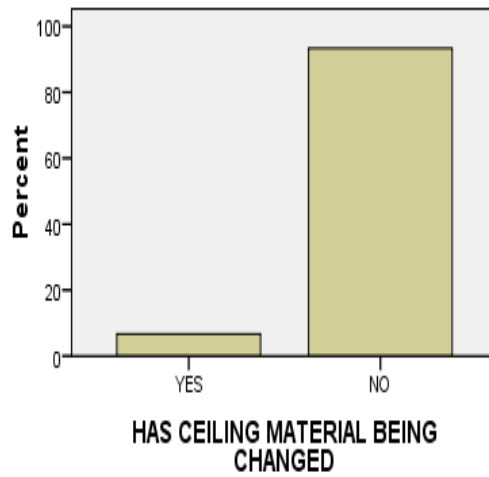


Results and Discussion

A GRAPH SHOWING THE NUMBER OF YEARS A PERSON HAS OCCUPIED THE PROPERTY

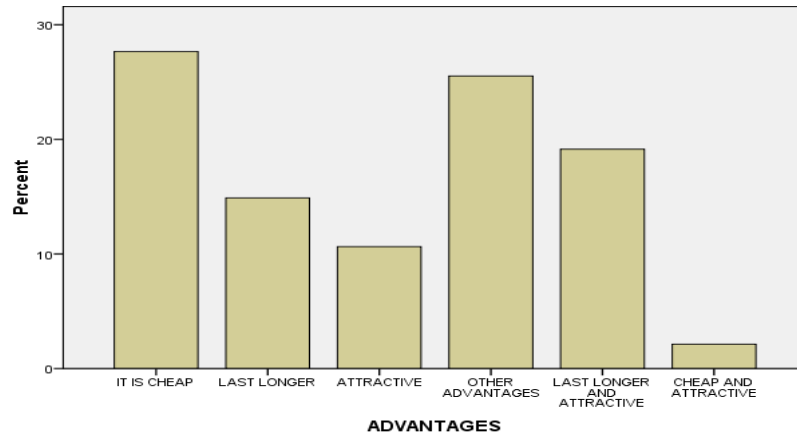


A GRAPH SHOWING RESPONSE IN ANSWERING Q9

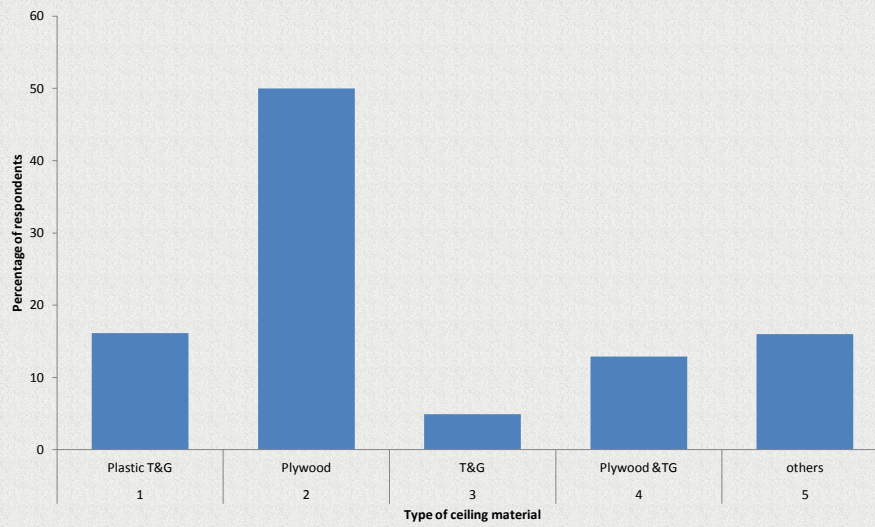


Results and Discussion

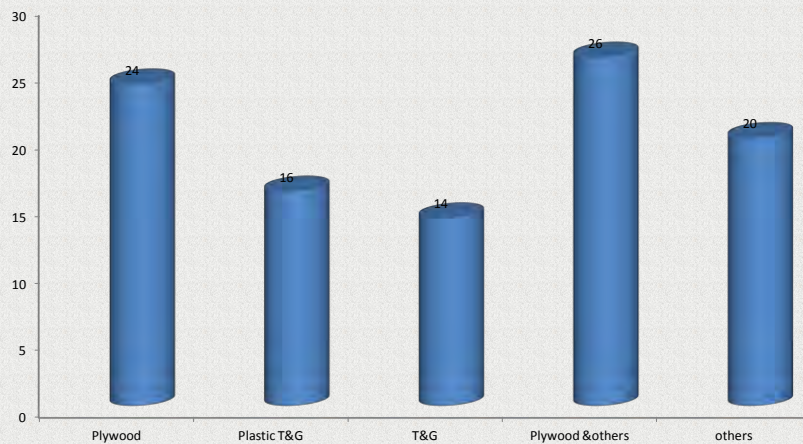
A GRAPH REPRESENTING THE ADVANTAGES OF USING THE CEILING MATERIALS



Results and Discussion



Results and Discussion



Results and Discussion

Table 1: Average cost of ceiling materials in Ghana

Type of Ceiling material	Average Price(US\$)	Average Price (GhC)
Plywood	10 - 23	15-35/m2
Plastic T&G	19 - 26	30-40/m2
POP	32- 64	50-100/m2
T&G (polished)	16	24 /m 2
(unpolished)	12	18/m2

Results and Discussion

- Most Ghanaians are becoming wealthier.
- In Ghana , private remittance inward transfers through the banks in 2008,for instance, amounted to US\$8.7 billion, which represents 26.8 percent increase over 2007.

October, 2008	November,2008	December,2008
US\$654.8 million	US\$608.0 million	US\$990.2 million

Threats to the use of wood

- Use of Plastic T&G(panels) in Construction
- Dwindling timber species
- Low satisfaction in the durability, attractiveness, design of plywood and wood panels among respondents in Ghana.

Conclusion & Recommendations

- Wood as a ceiling material is gradually being replaced by Plastic T&G in some urban centres in Ghana.
- There is the need to sensitize populace about the benefits (cooling and carbon storage) of using wood as a ceiling material instead of the other emerging alternatives.
- There is the need to improve the design of wood panels, durability etc.

Acknowledgments

- Special thanks for the organisers of the AJW 2011 conference for granting me financial and technical support to attend this important conference.
- Management of CSIR-FORIG for their technical assistance

Thank you all



Session 6

[Thursday 1st period 1.0 hours - plenary]

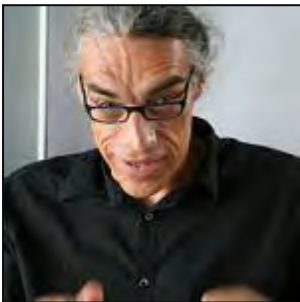
Wood in architecture: what can be done?

Speakers



Speaker:
Michael Green

Topic:
The Role of Wood in the Challenge of Housing in the World



Speaker:
Dustin Tusnovics

Topic:
Building for a Better World: How Timber Architecture Can Make a Difference



Speaker:
Andrew Waugh

Topic:
A Short Talk on Tall Timber Buildings

The Future of Urban Structures

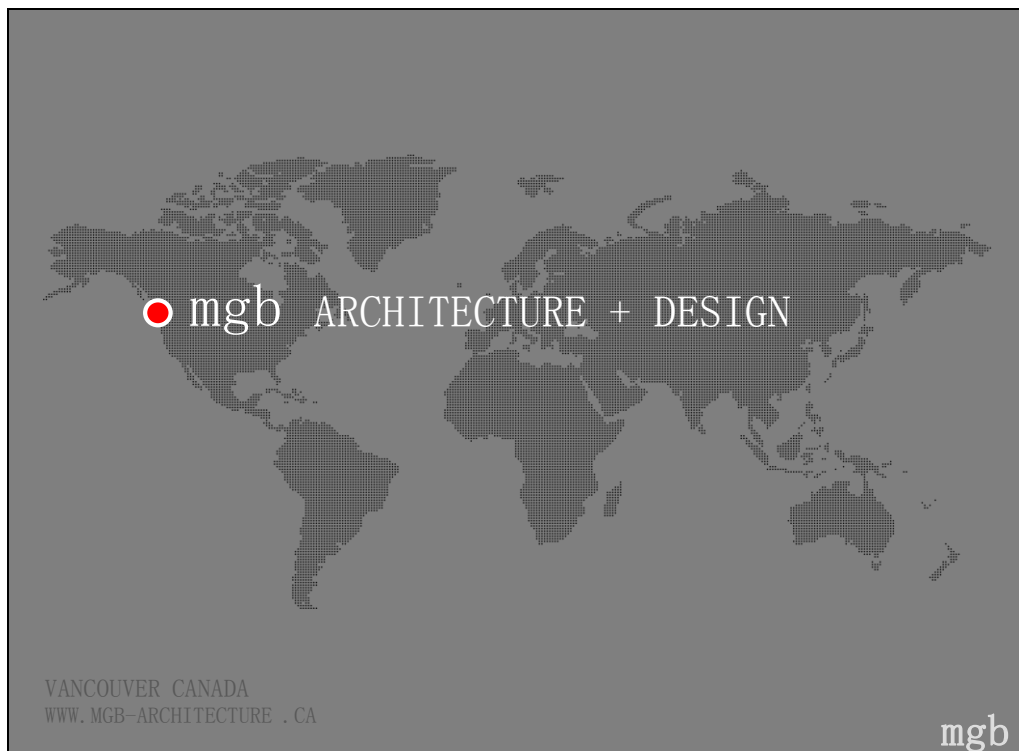
Michael Green¹

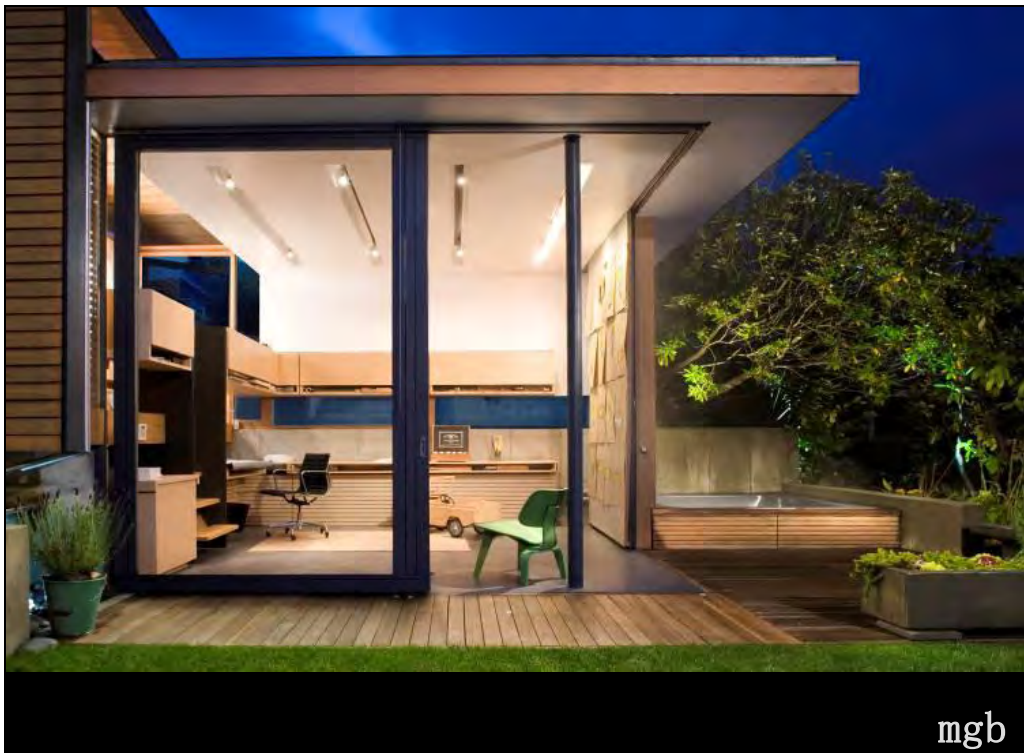
¹ Architect, MGB Architecture (mgreen@mgb-architecture.ca)

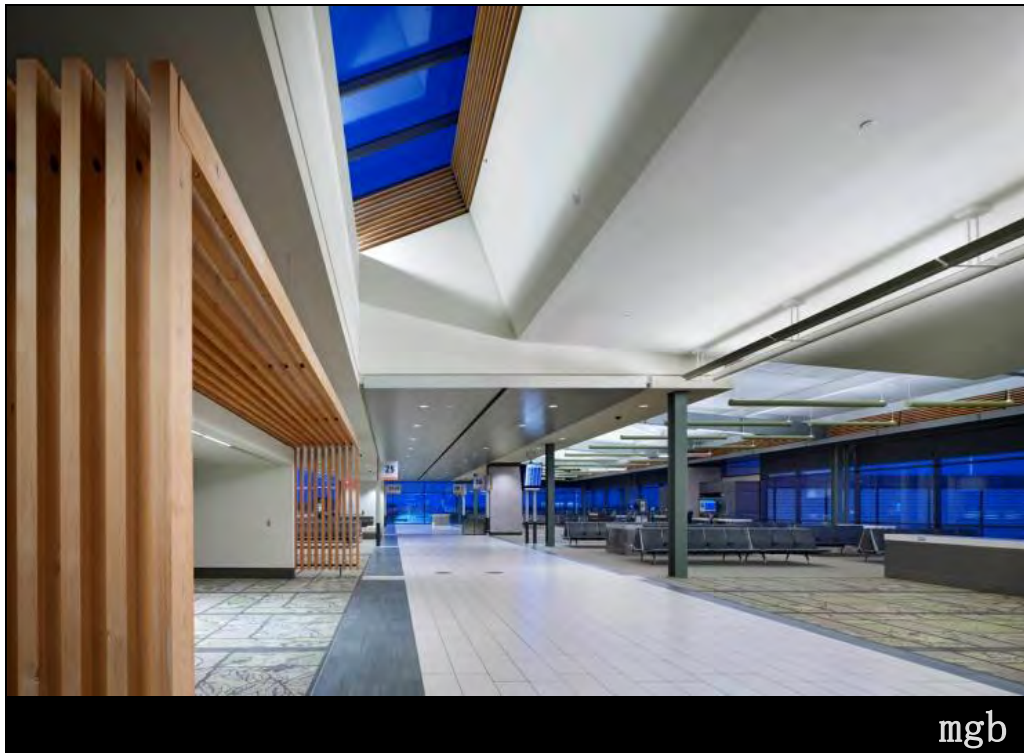
EVOLUTION | REVOLUTION

THE FUTURE OF URBAN STRUCTURES
ART AND THE JOY OF WOOD
UN FAO 2011 CONFERENCE
MICHAEL GREEN

mgb







“I’ D PUT MY MONEY ON SOLAR
ENERGY..... I HOPE WE DON’ T HAVE TO
WAIT UNTIL OIL AND COAL RUN OUT BEFORE
WE TACKLE THAT”

THOMAS EDISON

mgb

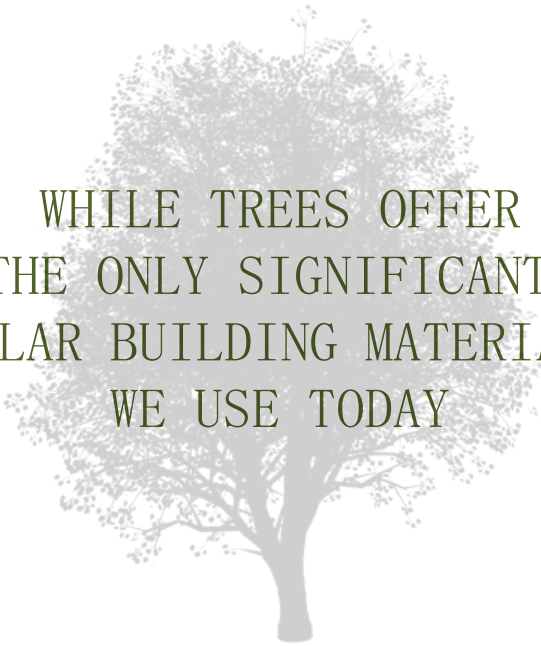
80

mgb

TRILLIONS SPENT

ON GREEN ENERGY

mgb



WHILE TREES OFFER
THE ONLY SIGNIFICANT
SOLAR BUILDING MATERIAL
WE USE TODAY

mgb

MAN CAN NOT COMPETE WITH PHOTOSYNTHESIS

mgb

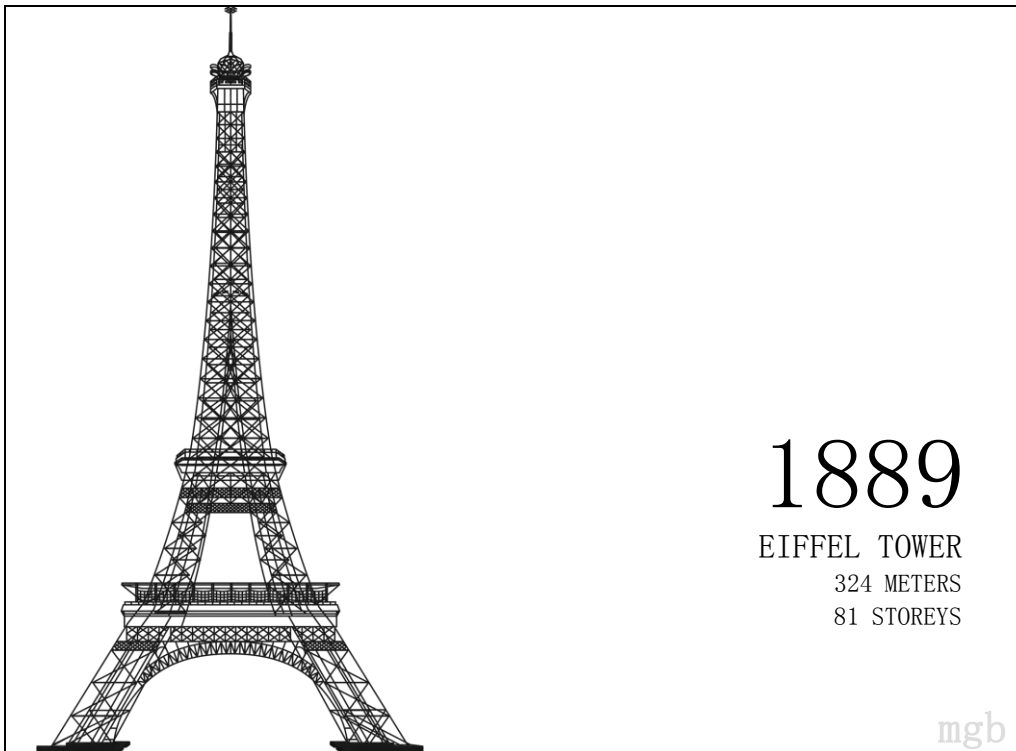
EVOLUTION

WHAT CHANGED?
FROM LOG CABIN TO BURJ DUBAI

mgb

INDUSTRIAL REVOLUTION

mgb



IN THE 20TH CENTURY
THOUGHT LEADERS
WERE PURSUING
STEEL + CONCRETE
INNOVATION

mgb

WOOD BECAME ‘REGIONAL’
AND ‘RESIDENTIAL’
AND INNOVATION SLOWED

mgb

2008
BCBC

4



12 M

mgb

WHY CHANGE NOW?

mgb

CLIMATE CHANGE

mgb

CARBON + ENERGY

mgb

AND IN THE NEW GLOBAL
CLIMATE CONVERSATION
WOOD IS OUR BEST CHOICE

mgb

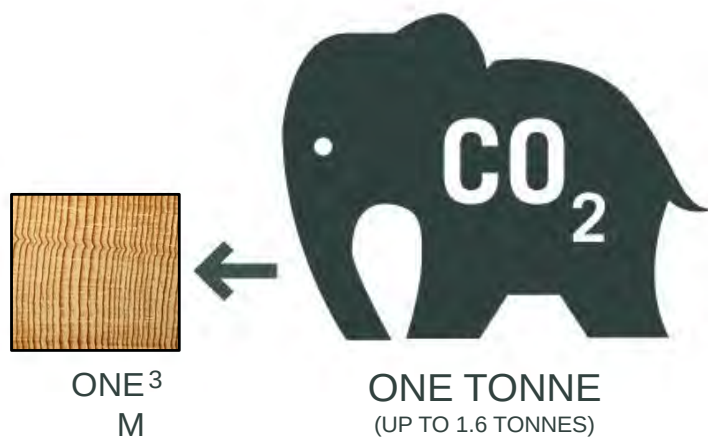
IF...

IT IS SOURCED FROM SUSTAINABLE FOREST PRACTICES

AND...

WE DESIGN WITH MORE RAPIDLY RENEWABLE WOOD SOLUTIONS

mgb



mgb

WHAT ARE WE UP TO?

mgb

+30

mgb

NEW WOOD PRODUCTS AND
INNOVATION ARE CHANGING
THE POSSIBILITIES

mgb

MASS TIMBER

mgb

CLT

CROSS LAMINATED TIMBER
12 X 3 METERS



LSL

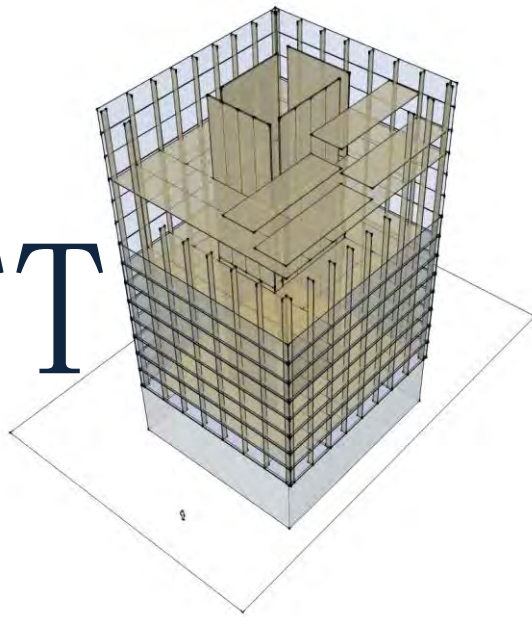
LAMINATED STRAND LUMBER
20 X 2.4 M



LVL

LAMINATED VENEER LUMBER
20 X 2.4 M

FFTT



mgb

A NEW ALTERNATIVE TO
STEEL + CONCRETE IN TALL
BUILDINGS

mgb

WHY?

mgb



SOLVING ONE HUMAN NEED FOR SHELTER
WILL CAUSE A BIGGER HUMAN CHALLENGE
THROUGH CLIMATE CHANGE

THE WORLD WILL BE
70% URBAN
BY 2050

mg**b**

IN 2025

70%

of Chinese will live in cities with more than 1 million people

46%

of Indians will live in cities with more than 1 million people

SPEED OF URBANIZATION BY 2030

CHINA

221
number of cities with more than 1 million people



China will add
400
million city dwellers



INDIA

68
number of cities with more than 1 million people

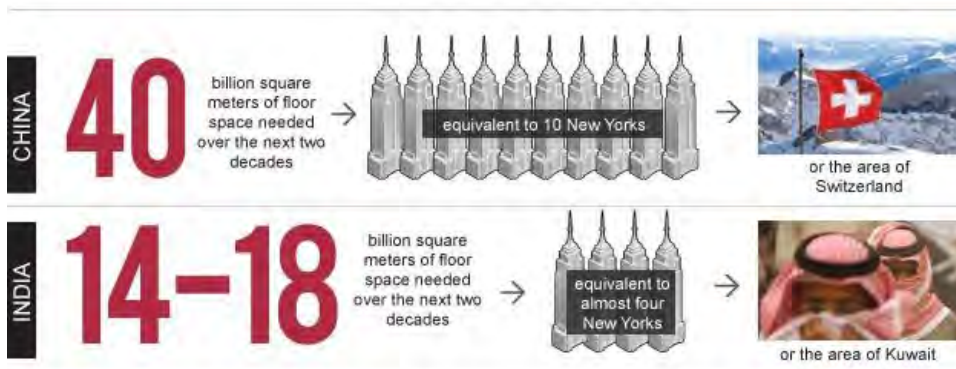


India will add
215
million city dwellers



SOURCE: CHINA-MIKE.COM

mgb



SOURCE: CHINA-MIKE.COM

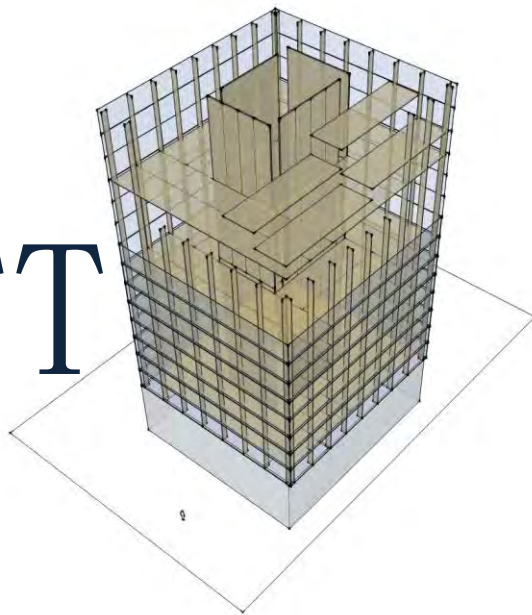
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REVOLUTION



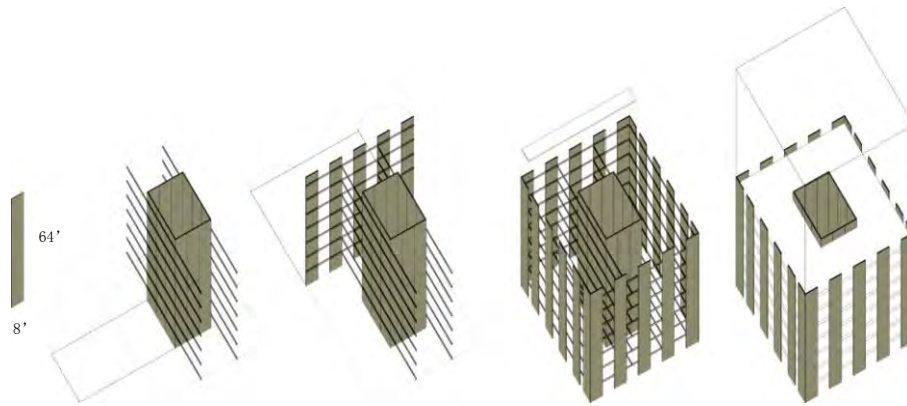
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FFTT



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FFTT



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FFTT



Option 1

Option 2

Option 3

Option 4

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FFTT



A
6 TO 15 STOREYS



C
6 TO 30 STOREYS



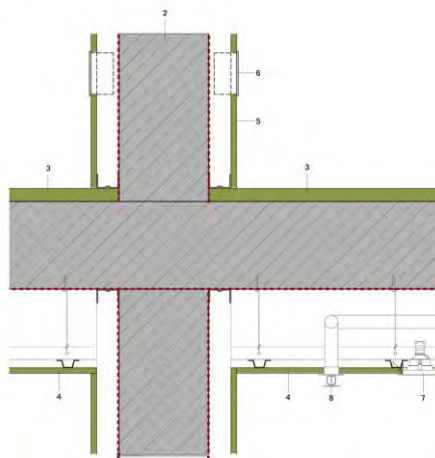
B
6 TO 20 STOREYS



D
30+ STOREYS

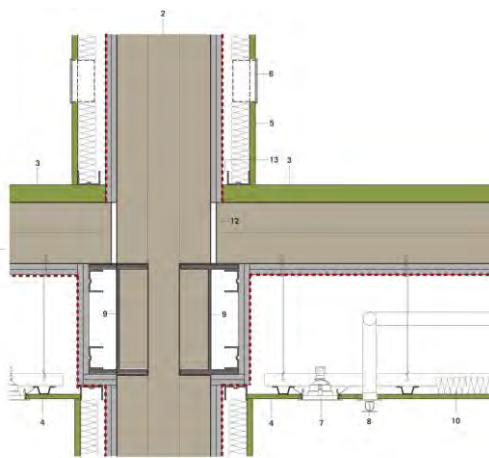
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Typical Details



- 1 Cast in place concrete floor (2HR FRR)
- 2 Cast in place concrete wall (2HR FRR)
- 3 Finish floor
- 4 Finish ceiling
- 5 Furring and finish wall
- 6 Electrical outlet
- 7 Pot light
- 8 Sprinkler

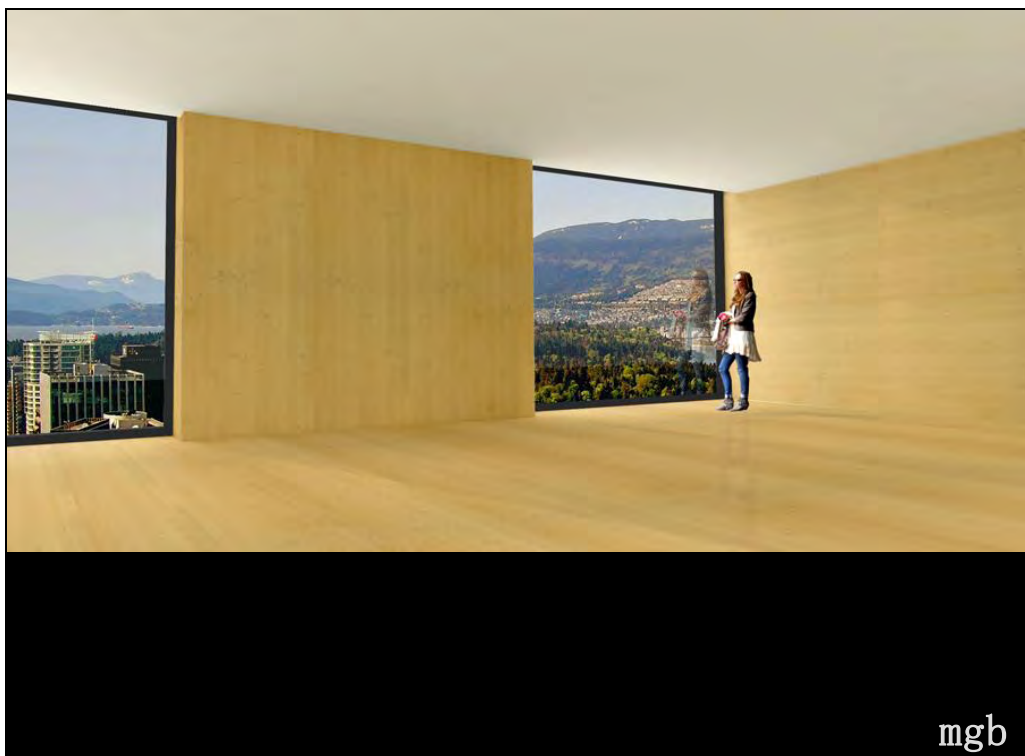
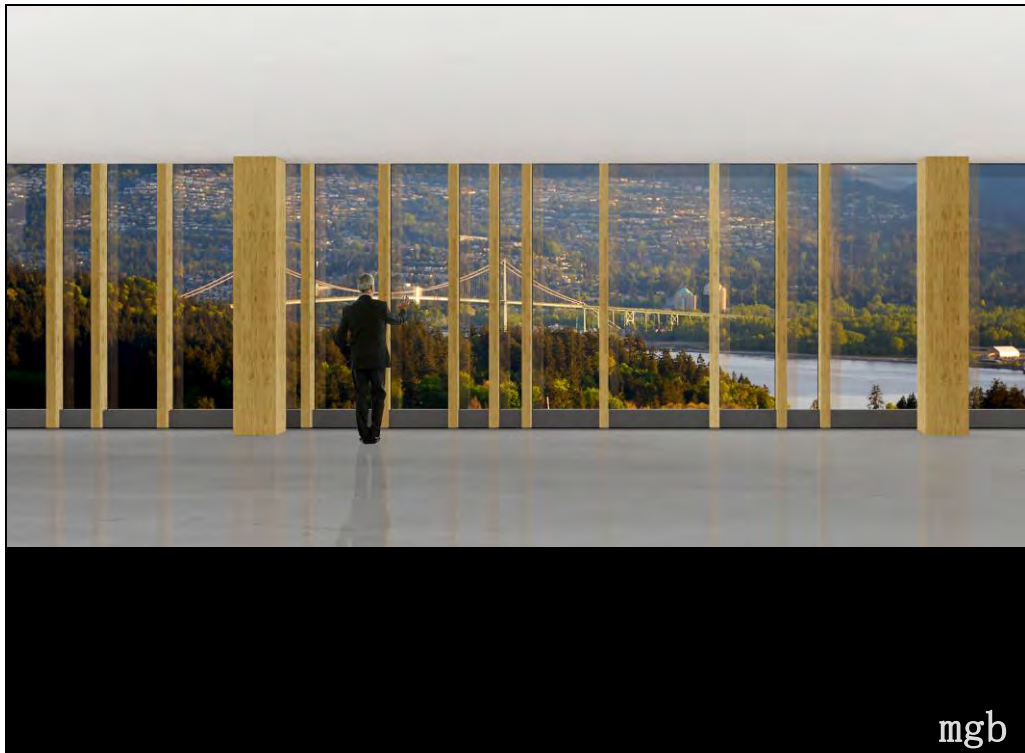
Typical concrete tower typical load bearing interior partition



- 1 2 layer (VL or LVL + 2 Layer 5/8" type II gypsum board (2HR FRR)
- 2 3 layer (VL or LVL + 2 Layer 5/8" type II gypsum board (2HR FRR)
- 3 Finish floor
- 4 Finish ceiling
- 5 Furring and finish wall
- 6 Electrical outlet
- 7 Pot light
- 8 Sprinkler (plastic pipe)
- 9 Steel beam
- 10 2" loose mineral wool insulation for sound absorption (ceiling)
- 11 2" dense mineral wool insulation for sound absorption (wall)
- 12 Airspace to reduce sound transmission between floor and wall
- 13 Gap between drywall and stud to reduce sound transmission

Tall wood case study typical load bearing interior partition

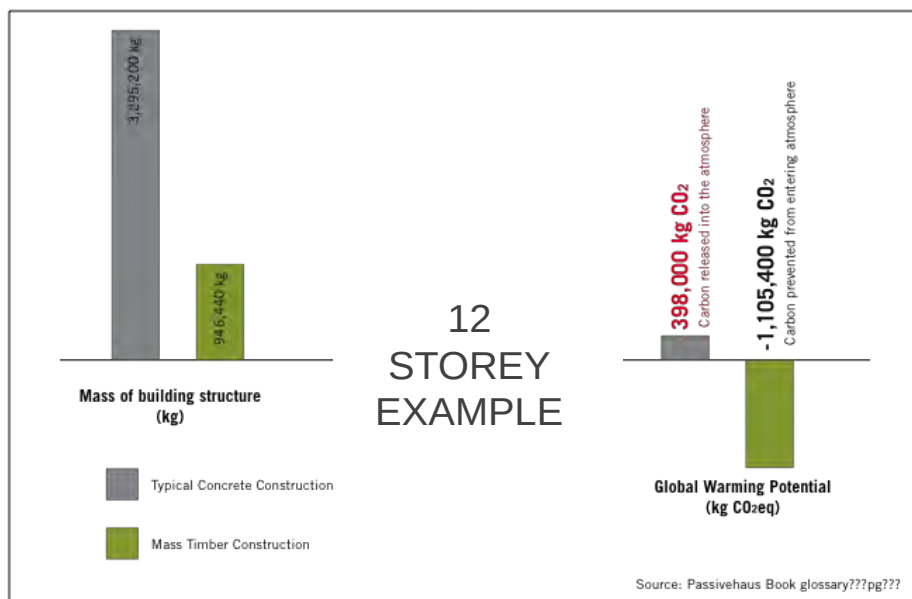
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FOOTPRINT

F²TT VERSUS CONCRETE

mgb



Environmental Impacts - Concrete vs Mass Timber
initial and long term impacts

mgb

COST

FFTT VERSUS CONCRETE

mgb

COST

Building Model	Vancouver	Northern BC	Interior BC	Fraser	Vancouver Island
12 Storey Concrete Frame	\$283	\$320	\$303	\$283	\$302
12 Storey FFTT Charring Method	\$283	\$311	\$297	\$283	\$297
12 Storey FFTT Encapsulation	\$288	\$317	\$303	\$288	\$303
20 Storey Concrete Frame	\$292	\$330	\$312	\$292	\$311
20 Storey FFTT Charring Method	\$294	\$323	\$308	\$294	\$308
20 Storey FFTT Encapsulation Method	\$300	\$330	\$315	\$300	\$315

mgb

Building for a Better World: How (Timber) Architecture Can Make a Difference

Dustin A. Tusnovics²

Abstract

With his 1921 design for a glass high-rise on the Friedrichstrasse in Berlin, Ludwig Mies van der Rohe defined the modernist paradigm. Going against the neoclassical conception of architecture, he separated the shell from the core and the skin from the bones creating an environment whose transparency signified freedom and honesty. This architecture fully exploited the available technical possibilities in construction and was premised on HVAC systems that were only developed later. The technological development was harnessed with the goal of emancipating humankind and ushering in a just society that could provide decent housing for the workers. This is why the functionalists proudly declared, “the ethical necessity of the New Architecture can no longer be called in doubt.” (Gropius, 1935)

It was with the same humanist interest in mind that Giancarlo de Carlo, in the revolutionary year of 1968, openly questioned the values of a society that would not hesitate to spend billions of dollars on wars and moon projects, and demanded the right to ask “why housing should be as cheap as possible and not, for example, rather expensive...” (Quoted by Frampton, 1982) Still, today, housing is not particularly cheap and we are still designing buildings after the same Miesian paradigm, and it is costing us dearly. The building sector is the largest consumer of energy, and its share increases if we also consider the indirect energy, the grey energy, involved for building materials, transport and eventually dismantling or recycling of buildings. If we look at the entire life cycle of each element of a built structure we will see that architecture, in a broad sense, is responsible for two thirds or more of the world energy consumption.

The success of modern architecture has put an enormous stress on resources. Now it is the turn of Miesian architecture to face a crisis. This crisis is also an opportunity for today's architects to prove their worth by switching the paradigm – and heading for the use of more renewable resources, in particular the increased use of timber based products.

This paper aims to describe why, the public at large accepts the necessity to reduce energy consumption, but does not support the usage of alternative or less energy intensive building materials; social aspects leave most people indifferent and cultural aspects are ignored since they are always subject to interpretation and judgement; affordability and appropriateness are seldom talked about; and building technology is seen as too complex to comprehend and therefore decisions are left to specialists.

Keywords: architecture, paradigm shift, cognitive, sustainability, timber, ethics

² Architect, SPACEMATTERS architecture & urbanism, Johannesburg, RSA, (dt@archcom.at)

1. PARADIGM SHIFT

The situation can be described in terms of Thomas S. Kuhn's (1962) classic study of how science evolves. In Kuhn's theory a paradigm describes the basic assumptions within the ruling theory of science. With 'paradigm' he means more than just the dominant theory. The concept refers to the entire worldview, the abstract structure that sets the limits of thought. During periods of normal science, researchers do not question the paradigm but gradually and cumulatively work out its implications. According to Kuhn, however, all paradigms contain anomalies, which will gradually surface as normal science patiently proceeds. Once the problems in the paradigm become unbearably clear, a scientific revolution follows: this requires a change in the worldview like the switch of Gestalt. (Kuhn, 1962)

Global warming, coupled with frequent natural catastrophes and the current economic recession have alerted many people to the necessity of sustainable practices in every domain of society. Architecture is no different. The old paradigm of modern architecture has been forced into a crisis by the increasing realization that we need sustainable and energy-efficient architecture. What we as architects must bear in mind is that the decision to reject one paradigm is always simultaneously the decision to accept another, "and the judgement leading to that decision involves the comparison of both paradigms with nature and with each other." (Kuhn, 1962) While the old paradigm was centred on single buildings, the new one will necessarily deal with the built environment as a system.

One of the most influential early definitions of sustainability was offered by the Brundtland Report in 1987. It focused not only on ecology but addressed sustainability in all aspects of human life, thus shifting the interest from One Earth to One World. The report defined sustainability as follows: "Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs." It contains within it two key concepts: the concept of 'needs' (see chapter 6 – Cognitive Urbanity), in particular the essential needs of the world's poor, to which overriding priority should be given; and the idea of 'limitations' imposed by the state of technology and social organization on the environment's ability to meet present and future needs." The limitation issue can be reasonably addressed with the increased usage of renewable building resources, as timber for example.

Despite the persuasive case that the Report made, it was not able to effect radical change. Two decades later, the number of people living in slums has increased substantially. The UN Slum Upgrading Facility reports in its SUF Handbook (2006) of one billion slum dwellers today and it is projected that in the next 30 years, the global number of slum dwellers will increase to about 2 billion. (UN Challenge of Slums, 2003) This illustrates the difficulties of providing housing in the poorer communities of the world as the population keeps rapidly growing. Ian Banerjee (2006) has calculated that until 2030 we should be building a city for one million people every week. The growing number of civil action organizations testifies of the ineffectiveness of governments on such urgent issues as poverty, environmental protection, human rights and democracy. (UN State of World's Cities, 2008)

2. ARCHITECTURAL PRACTICE

This is where architects need to get involved and, in so doing, demonstrate the true value of architecture. A paradigm shift is called for – 'sustainability 2.0' as it were. (Salmon, 2009) The constantly rising energy demand and the increasing costs call for radical initiatives. An

example is the Wireless House concept (Wimmer, 2009) that aims to create an energy-network independent solution for an energetically self-sufficient house. It focuses on the whole system 'house', integrating the demand side as well as the production side, but not developing a singular technical solution. This approach will have far-reaching consequences in housing, in both, industrialized and developing countries.

But it is widely assumed that the problem is not a purely technical one. Brian Cody, for one, defines energy efficient architecture as “a triad from minimum energy consumption, optimal room climate and architectural quality.” (Cody, 2005) In including the concept of architectural quality in the definition of energy efficiency, Cody’s parallels the Brundtland Report’s extension of sustainability into the social realm. On the home page of the Academy of Applied Arts in Vienna Cody stresses the importance of architectural values, insisting that “the world cannot be changed with reason and insight, but with staggering design”; hence, they call for an “architecture with an exceptional aesthetic power to convince.” (Akademie f. Angewandte Kunst, 2009) In both cases, Cody introduces an essentially subjective, aesthetic element in the equation, thus cancelling any possibility of a scientific and measurable concept of either sustainability or energy efficiency. If the experts are offering such heterogeneous definitions, it is not very surprising that the general public seems to be confused about sustainability. Today it is evident that the public at large accepts the necessity to reduce energy consumption, but does not support the usage of alternative or less energy intensive building materials for they are often more expensive; social aspects leave most people indifferent as the example of the South African RDP (Reconstruction and Development Program) shows and the new townships are realised far away from our vision, and cultural aspects are ignored since they are always subject to interpretation especially when referring to ‘rich’ and/or ‘poor’; what is necessary and what is not; affordability and appropriateness are seldom talked about

like spatial qualities seem more often not to affect the state of mind; instead we still have ‘cheap’ as a synonym for ugly and oppressive; and building technology is seen as too complex to comprehend and therefore decisions are left to so called specialists, that are not necessarily interested in raising the architectural quality.

It is this dilemma that often has made use of the so-called alternative or new building technologies a field of ongoing experiments.

3. MEASURING SUSTAINABILITY

The need for a scientific and measurable definition of sustainability has been recognized. (Detail, 2009) The development of sustainability assessment tools such as the American LEED, or the English BREEAM, as well as the Indian IGBC, all accredited by the World Green Building Council, are a step towards a scientific approach. However, these tools need to be evaluated in the future as they only consider single buildings according to a defined use. Office buildings are the main focus at the moment, and the results leave many questions open. The future will be the evaluation of the ‘house’ and in particular the urban conglomerations. Today’s assessment tools are clearly aimed to demonstrate the ‘reduction’ of energy consumption of buildings and are basically used for marketing, focusing on demonstrating achieved ‘qualities’ towards clients and users, gaining better prices for rent or selling, increasing the acquisition capacity of architects and planners, serving as a

communication tool for enterprises of investors and owners aiming to demonstrate their engagement in the field of sustainability, as the main page of the German DGNB puts it.

In order to overcome the debacle within the ongoing sustainability discussion, we need to comprehend the complexity and diversity of the involved issues of the field of architecture and respond to real-world needs, as the provision of housing. This is only possible with an open 'cognitive system', an idea that led to the cognitive city concept, a 'learning framework' for urban habitat transformation. (Tusnovics, 2007)

An approach that can accelerate change in practice and institutions, as required by the Brundtland Report (1987), can be found in the transdisciplinary research method defined by Pohl und Hirsch-Hadorn in 2008. (Tusnovics, 2009) Transdisciplinary research is needed to compensate for the uncertainty of knowledge in socially relevant fields or when the concrete nature of the problems is disputed, and particularly challenging those concerned and involved, like the example of housing within existing urban settings, and the establishment of a sustainable building industry.

We are still focusing on 'keeping' the existing by 'reducing', instead of shifting towards a concept of 'changing' the existing by, for example, re-using. Wilfried Wang (2009) recently proposed a similar approach in a lecture entitled 'Paradigmenwechsel' giving emphasis to the 'old' tradition of reuse and transformation of buildings. In the future, evaluation and assessment tools will consequently shift from short term to long-term observation periods. Not only the actual phase of 'use' of a building will be considered but also the production phase and particularly the 'after' use period and this is where the employed materials will have to prove what they are worth. Timber, for one, has been defined as 'parked energy' "as you can burn the building material once it is dismantled, generating energy at a later stage". Timber is also a 'container' for CO₂ from the atmosphere, and for this Julius Natterer (2004) suggests an ever-increasing use of timber in the building industry to reduce the age of our forests, as the ultimate protectors of nature, preventing erosion and increasing CO₂ absorption.

4. PROJECTS AND 'EVALUATABLES'

From 2004 to 2008 I was Head of School for the faculty 'Timber Construction and Design' at the University of Applied Sciences in Salzburg. A faculty set up by the Austrian Timber Industry to promote and develop specialists able to increase development, the use and the application of timber and timber based products in the building industry.

The course had a strong focus on practical experience and therefore the students were offered projects that would be combined with a real building experience. I will be discussing some of the projects we got involved in hereafter.

4.1. BGH – Timber-construction and Design, Salzburg, Austria

Timber has a long tradition and is well integrated in the industry taking second place after tourism in the Austrian economy. Yet also Austria needs specialists to bring timber and timber based products from today's approx. 35-40% to cover 60-65% of the entire building sector and the involved materials as in the Scandinavian countries.

One of the ways decided by the Timber Industry was to train young specialists at University level to act as professional link between the industry and the users, the planners and specifiers, the municipalities and the lawmakers and to bring acceptance further.

The curriculum of the Salzburg based course I had the great opportunity to assess and further develop was focussed on four specialisations all equally necessary in the market. Technical – Creative – Economic and Communication: the basic studies in the first two years were equal for all students, as each needed to know and understand what each competency meant and how to interact with each other – the entire curriculum was project oriented and envisaged various phases of interaction as teams focused on resolving all four aspects that make up a project as it would occur in the professional life.

Out of this specific focus we decided to offer students every year the chance to choose from three above discussed projects. For the second year students one would be a poverty relief project in Africa, which was to be realised during the winter holiday break ‘in situ’.

This engagement has been a chance for me to do a lot of research and field work and to engage with the assessment of the needs of the underprivileged communities and the incredible challenge for affordable housing realised with appropriate materials and need based design.

4.2. Montic Skills Training Facility, Magagula Heights, Zonk’Iziswe, South Africa

This project was the first involvement in a ‘Design & Build’ project that brought me and 27 Students from Europe to South Africa in 2006, We designed and prepared over 8 months to build the structure for a Skills Training Facility on the premises of the Montic School, a public primary school in the small informal settlement of Magagula. The skills envisaged were cooking and sewing as well as wood- and metal-working. The project therefore comprised a kitchen and a sewing room in one wing and an open workshop in the second wing linked by an open pergola structure that forms the fourth side of the paved courtyard of the school.

The primary building material for the structural elements was locally sourced South African pinewood, from which the students realised the frames including the roof structure for all buildings. The choice of material had two reasons. Firstly, the students were from the then Salzburg based course on Timber-Construction and Design. The other reason was that we needed to realise the entire building in five weeks only.

When used in the right way, timber architecture is a fast way to realise structures and having designed all the joining details with SA-standard dimensions (different to European) and after eight months of preparation at the University, we were well equipped to build fast. We had brought a lot of skills with us and shared them with the 27 volunteers from the local informal settlement that helped realise their centre. The crucial part of the idea was that the ‘builders’ of the structure would then be equipped with skills and could then transfer the skills for wood and metal working to the rest of the community.

4.3. Slum-upgrading – Modular Timber-Units, Mathare, Kenya

In the second year of my engagement with Salzburg, we decided to engage with a partner institution in Nairobi and develop a prototypical solution for a street kids centre. Unfortunately the time scheme we Europeans had was not flexible enough to cope with some of the problems we encountered and we had to redefine the project focusing on the informal settlement of Mathare. Mathare Valley is one of the most devastating and desperate places on the African continent. It is made of a series of slums that have grown together to host some 500.000 people with a high grade of drug problems and alcohol abuse coupled with a violence and criminality due to the bad condition of the buildings and the density of the entire area. It requires an experimental approach on how to alleviate the enormous ecological problems and hygienic conditions for the density of the shacks and the non-existence of any kind of sewerage system.

The challenge is to develop housing schemes on the very premises of where people are living today for the reduced space resources available as well as for respect for the often well functioning social structures that have been established out of the need of living so close to another. The developed projects were to envisage “modern” and sustainable building techniques combined with the “traditional requisites” such as space that allows the enlarged families interaction. Other aspects that we wanted to address in the design of the dwellings were the flexibility and transformability of space especially as we would be hosting the same amount of people as before but with two or three storeys to host them.

An amazing brief for students and with the experience from the year before and authentic cooperation with local people that came to visit us in Salzburg, we started to develop single units and combinations of these envisaging the needed density. Appropriate materials were openly discussed as a major challenge and the solutions varied from timber frames to be filled with non-perishable waste, timber structures covered with plastic and/or metal shingles made out of bottles and cans, and basically the main building element would again be timber.

4.4. Lesedi Nhahle Training Crèche, Haenertsburg, South Africa

Similar to the skills training facility two years earlier we got invited to develop a training crèche that would constitute a model Kindergarten, realised with elements that can be easily copied. The aim was to showcase how good architecture would show what sustainability is in a well-designed building. How heating and cooling can be resolved without air-conditioning and heating or how to use locally available materials as much as possible.

The building realised had a roof of 400 m² and was again built entirely by my Salzburg based students. From the foundation to the roof including all the furniture elements needed for the project to be considered operative, we had seven weeks to go.

The orientation of the building was set out to capture the sun in winter especially in the early morning (north-east facing) to warm the spaces and the roof's cantilever and inclination was designed to keep out the summer heat (the height and the cantilever designed to keep out the sun standing at 80°). Being the roof a separate layer above the ceilings of the rooms enables a cross ventilation that adds to the cooling as a natural air-conditioner. Each and every part of the entire project was realised again locally by 31 students from Europe and only 3 local volunteers in the time frame we had. Again we did all preparations in Salzburg over 9

months, developed all joinery details, all 2-D and 3-D details had been well designed and put on paper.

Light - fast – clean is a good way of describing a building realised in timber. It would be practically impossible to realise anything similar in that time frame with any other material than wood.

4.5. Ideas for an evaluation tool based on more social involvement.

I believe that New and Alternative Building Materials and Technologies will be a key in the change of building process. Timber and timber based products must play a fundamental role in this process. Yet, I believe that we need to develop timber products to be simpler to use.

I have been consulting some timber industries to get their initial ‘product’ through a redesign process. Good ideas are not complex technological inventions only, for instance an insulated roofing element, it must be easy to use, to mount, to join, to seal and to extend. We need good technologically sound products that for a building kit that anybody can learn to use, otherwise we have an exclusive club of timber freaks. The clear goal must be a broader acceptance and that can easily achieved with clearer and easier application methods. Timber is standing up against bricks and steel and concrete – any of these products we ‘all know’ how to use today. That is where timber needs to win and fight for its share in the building industry.

Of course we will employ more natural and local resources, ideally renewable ones that can be harvested with non-invasive exploiting methods. We will have to understand and respect coherent cultural applications and learn from these. In Sumatra you would have a problem if you wanted to build with anything but bamboo, in New York that would be a real sensation and would require some convincing arguments.

Timber and timber based products today face all kinds of prejudice, I have been dealing with these aspects in Austria and I am facing similar criteria in South Africa. I am sure it will not be much different in India. We need to show the capacities of timber, we will need to understand where timber is the better material and where other materials are better and employ the best material for the job. The technological aspects will need to be communicated, the economic advantages need to be evidenced, and the actual material qualities need to be understood. Timber burns! But it burns safely as we know how fast a section or beam burns until it collapses, and that makes timber much more predictable than it seems. Timber dislikes water! So when used, we need to protect timber from water, or make sure that if it does get wet, that it can dry off again.

The trend towards more lightweight materials is very valuable as it enables women to actively participate in the entire building process. In the African culture men are often in charge of the erection of the structure and women do the filling. Obviously our future building materials will be non-harmful for the end-user. Building materials will have a more than one life cycle (in the sense of usage), once the first usage cycle is over, it may be re-used in another different building or it will be used as energy source or it will be simply reintegrated into the natural cycle of that material.

But besides these considerations that we can give for future materials we will also need to change the assessment concept to one that takes social and community criteria serious and will be integrated in the BREEAMS and LEADs of the world. Today these aspects are not

part of the evaluation, currently they are entirely based on the reduction of firstly - energy consumption and secondly - economically viable materials that will achieve that, leaving the third side of the sustainable triangulation, the social aspect, untouched. I am elaborating and developing criteria, my “evaluatables”, which could be for example:

- **Involvement:** was the community part of idea, brief, design, realisation and finally the evaluation?
- **Participation:** was the user part of idea, brief, design, realisation and finally the evaluation?
- **Life condition:** were community conditions considered, melioration aspects envisaged and implemented?
- **Sanitation:** have cultural aspects been considered, have they been meliorated and implemented
- **Health:** have cultural aspects been considered, have they been meliorated and implemented
- **Opportunity generation:** how and what new opportunities have the community gained through the project?
- **Social cohesion:** how has this aspect reflected in the project; prior existing/non existing?
- **Demographic change:** does the project take this in consideration?
- And further we could look at **Integration, tolerance, gender, work opportunities**, etc.

I am currently trying this assessment method on my own projects. But this is material for a few more papers to be elaborated.

5. TIMBER IN NUMBERS

As a reflection we could start of with an analysis of the ecological footprints of countries (Nation Master, 2011), where the United Arab Emirates lead with 15,99 followed by the USA with 12,22, Austria at position 27 with 5,45, South Africa at 4,04, India at position 108 with an almost equilibrated value of 1,06 and finally at last position we find Bangladesh at 141 with a value of 0,6 times the allowed footprint of 100 % as defined by the Global Footprint Network

We are today looking very much at the so-called BRICS countries (Wikipedia, 2011) with Brazil, Russia, India, China and recently also South Africa, where the ecological challenge of the future lies and gets evident looking at the Oil consumption where the USA lead with 18.690.000 bbl/day, followed by China, down 50%, at 8.200.000 bbl/day and India at position 4 with 2.980.000 bbl/day. South Africa is at position 28 with a consumption of 579.000 bbl/day and the small Austria (approx. a fifth of SA's population) with 247.700 bbl/day.

This evidences that in the year 2010 the world population was projected to use 150 % of the resources the earth can generate in one year!

These numbers are relevant when looking at the use of alternative resources, as geothermal power, wind and eventually timber with great potential for future development.

For Geothermal Power the BRICS countries are in the lead with China 8.724 GWh/yr and the USA in position 2 with 5.640 GWh/yr. India takes position 15 with 699 followed by Austria at position 21 with 447 GWh/yr.

Wind energy gives a different picture, based on the investment that is needed. Germany leads with 16.828,8 MW followed by Spain 50% behind arriving at 8.263 MW. India takes 5. Place with 2.985 MW and China is 10 with 764, followed directly by Austria and 606 MW. South Africa holds position 37 and 16,6 MW.

The numbers on the forests show a third dimension of the equation. Russia has the biggest forest in numbers, 8.097.900 km², being 49,37% of the Russian territory. Brazil still is the second biggest forest with 4.776.980 km². India has the 10th biggest forest (677.010 km²) with 618,6 km²/1.000 people or 22,77% of its territory covered with forest. Austria is the 77th in forest size (38.620 km²) but reserves 4.690,7 km²/1.000 citizens.

Austria, with its relatively 'small' forest of approx. 38.000 km² generates very interesting numbers from an economical point of view. The Austrian timber industry today comprises 1.513 businesses with 27.413 employees generating a production value of 6,87 billion € per year thus being the second biggest industry after tourism. Export accounts for 70% of the production and three quarters of which go into the EU.

These statistics show that the BRICS countries have a great potentiality to make the leap towards a more sustainable energy policy as well as a great chance to re-implement timber not as a simple alternative building material but as the building material with the correct decisions and the right mind set, the chances for change are very big.

6. COGNITIVE URBANITY PROCESS

Following the discourse on measuring sustainability, the complexity of the issues (see the 'evaluatables') and the dynamics of modern processes (i.e. housing) are clearly in search for a model, that will reflect these intrinsic challenges for real assessment. Needs Based Design (Brundtland Report, 1987), is a design approach based on the understanding of human needs and enabling high living standards within cultural and natural boundaries. The approach is inspired by the principles of an appropriate technology where human needs and natural boundaries are in the centre of developing technical solutions. However, this complex task requires a strong transdisciplinary approach where 'technology' needs to be seen as a tool for problem solving, not as the solution in itself.

The need for sustainable, affordable and environmentally sound housing is among the major problems worldwide with approximately 2 billion people in need of a real house. (UN Challenge of Slums, 2003) It is therefore of high importance to reduce environmental strain, promote and initiate resource efficient and appropriate solutions for the building sector, resulting not only in reduction of environmental pressure, but also in improvement of living conditions and poverty alleviation respecting existing cultural conditions. This aim needs to be supported by exchange of knowledge and best practise incorporating high-end technology as well as locally available indigenous know-how and resources. Timber use as shown above involves issues of how it is created, harvested and used. It then is processed and sorted into various qualities that eventually lead to different components in the timber industry. Then it is engineered from half-products to high-tech finished products that then need to be sold to

the right client or user. In the implementation phase we need to make sure that timber is used where best suitable and also protected in such a way that its durability, normally 80 years, is assured and guaranteed.

The key question is to find appropriate strategies in addressing the ‘framework’, enabling practical action and outlining possibilities to evaluate the results.

Transdisciplinary principles will help address problem definitions that directly focus on actual ‘needs’. (Brundtland, 1987) The use of common sense is beyond disciplinary language and stabilises the stakeholder management-processes during the transformation progress towards innovation. I have elaborated more in detail on the Cognitive Urbanity process in a few papers so far. (Tusnovics, 2009, 2010)

Transdisciplinarity as such is not going to remove the core problem in the Brundtland type definition of sustainability but it helps involving both physical and social dimensions and compensates the uncertainty of knowledge in this field. While there exists a broad consensus among scientists, at the very least, concerning the physical, ecological, biological and other scientific issues relating to sustainability, the social, cultural and political aspects continue to be debated, and the fact that the latter aspects cannot be objectively measured does not help.

Wolfgang Welsch (2003) finds that the concentration on human(-ist) interests is at the root of our present problems with urbanism and architecture. He recognizes that “. . . stunning buildings are being constructed here and there,” but goes on to argue that “this is already a sign of the dilemma. The emphasis is on show pieces (which can very well serve as architects’ business cards), but the context, the urban and environmental as a whole are being taken into account far too little.” Welsch continues by recalling the urge of modernist architecture and their call for a new paradigm which did not lead to “. . . paradise but rather to disaster in aesthetic, urban, social and ecological regard.”

The anthropocentric idea, intrinsic to concepts that urge for ‘human measure’ as meter for everything and an architecture that is to ‘serve humanity’ leading to belief in the creation of a ‘city that would perfectly satisfy us’. “And yet, such a perfectly human city never emerged out of the anthropic model.” Welsch wants to develop a paradigm “of human existence no longer aligned to citizenship in the first place but to our primordial world-connectedness and our relatedness to other beings”. The idea of the trans-human perspective in urbanism and architecture is a chance to reconsider so-called ‘human needs’ and to avoid traditional ‘humanistic’ concepts. Urbanism will no longer be considered an exclusively human ambience.

7. FROM UNIT TO UNITY

Patrick Curry (2007) remarks that the concept of ‘ethics’ is not something optional or something to be addressed after one’s belly is full, debts settled, and lodging secured. Rather, ‘ethics’ cuts directly to the core of all human activity. This applies also to the practice of architecture. Sustainability cannot be considered a solving instrument or a technical appliance; rather, it is a way of doing things that focuses on complex systems and long-term processes instead of single buildings and isolated aspects.

The projects listed and the ‘evaluatables’ in chapter 4 demonstrate the logics and lacunas that need to be taken into account when envisaging a wider implementation of alternative and/or new building technologies and in particular timber in the building sector. Recent studies show that the interest in these alternative and/or new building technologies is growing, but the experience also shows the challenges involved. All parties involved will need to make usability more simple and clear, finding usage for locally available natural and primarily renewable resources that need to be ‘elaborated’ through non-invasive exploiting methods. Building materials traditionally come from a cultural background and we will need to revisit some of them maintaining coherence in that cultural application and further developing these traditional skills and knowledge. Furthermore we will need to go for more light weight materials to facilitate the involvement of women in the building process, with simple-to-use product designs that enable unskilled labourers to employ these building materials and technologies which if widely accepted are bound to generate entrepreneurial models to eventually also uplift the living conditions of the underprivileged dwellers of the many of the informal urban aggregations where the biggest number of ‘home-builders’ is to be found and it is these people that will need to profit from an appropriate technology accompanied by a need based design generating a broad appreciation for new and/or alternative building materials.

With the cognitive project rules (Tusnovics, 2009, 2010) or similar principles, it is possible to compare alternative solutions in their complex context of ecology, economy, community, urbanism, technology, culture and politics. This will ultimately make a narrow definition of sustainability obsolete, or as Ardeshir Mahdavi (2009) recently remarked: “What is ‘sustainability’? Let us talk about ‘good architecture’; it is based on good sense and an approach that will be sustainable anyhow.” The value of architecture is less about striking aesthetics or impressive technology than about its ability to enable involvement, generate awareness, deal with uncertainty, accept complexity, comprehend diversity and respect the needs of the future.

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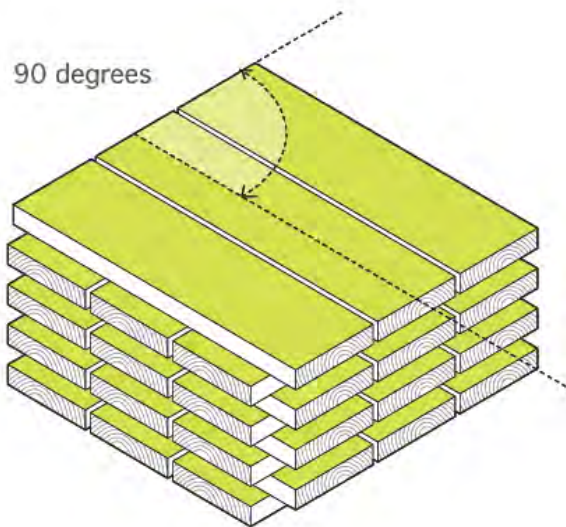
A Short Talk on Tall Timber Buildings

Andrew Waugh³

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Thistleton



KLH Cross-laminated Panel

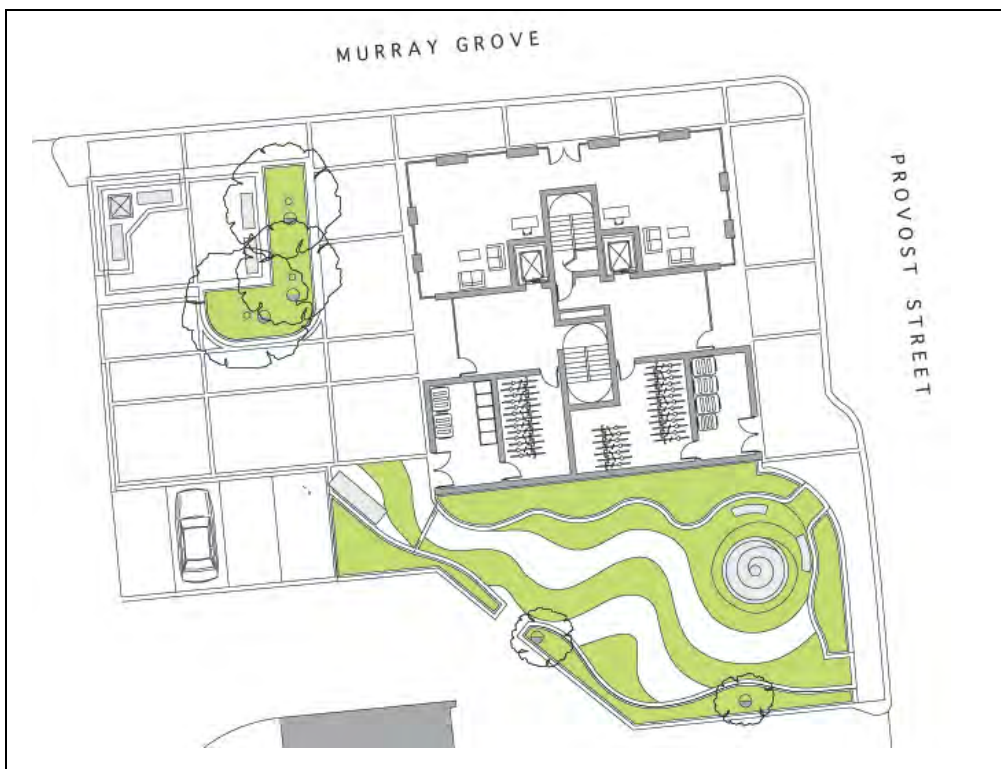
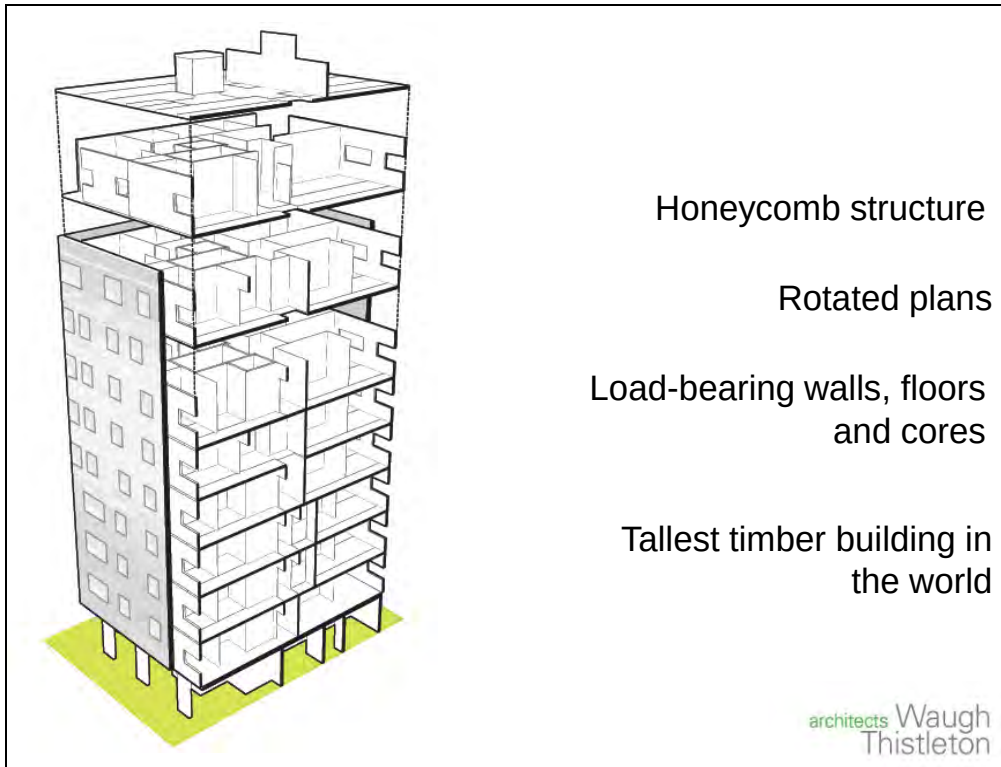
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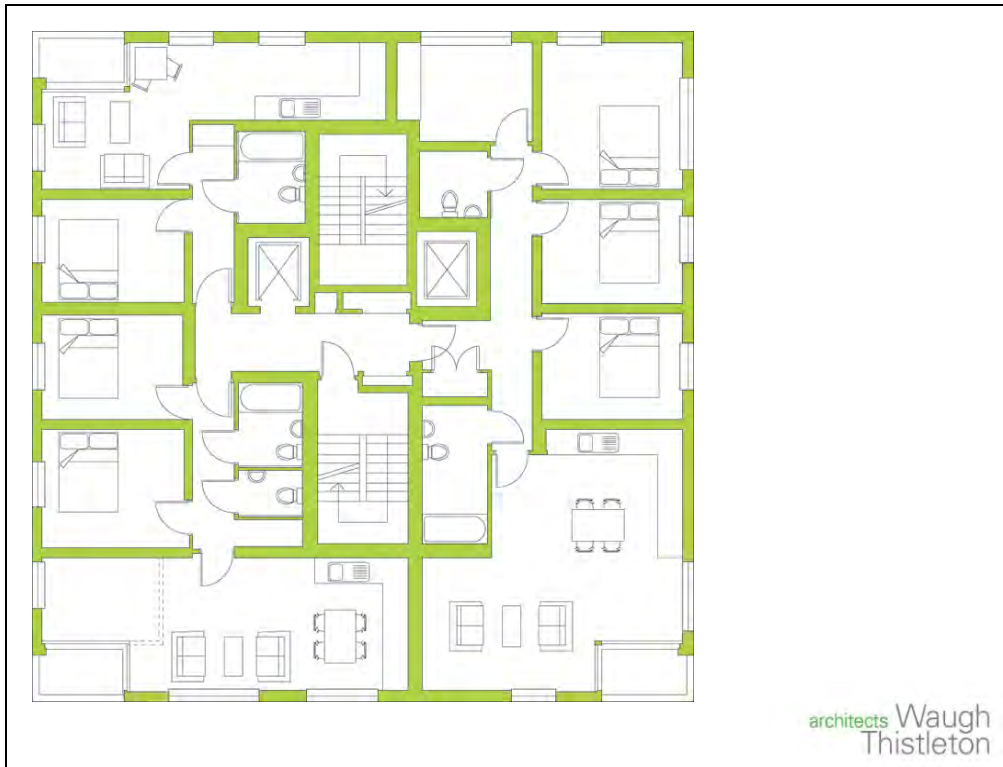


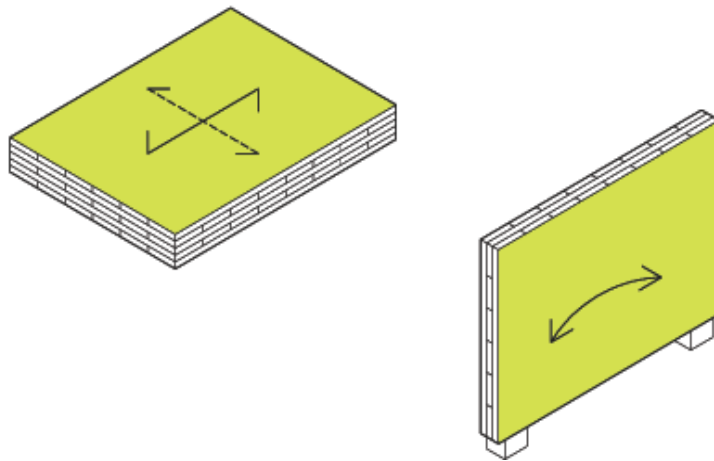
1 cubic metre of timber stores
0.8tonnes of Carbon



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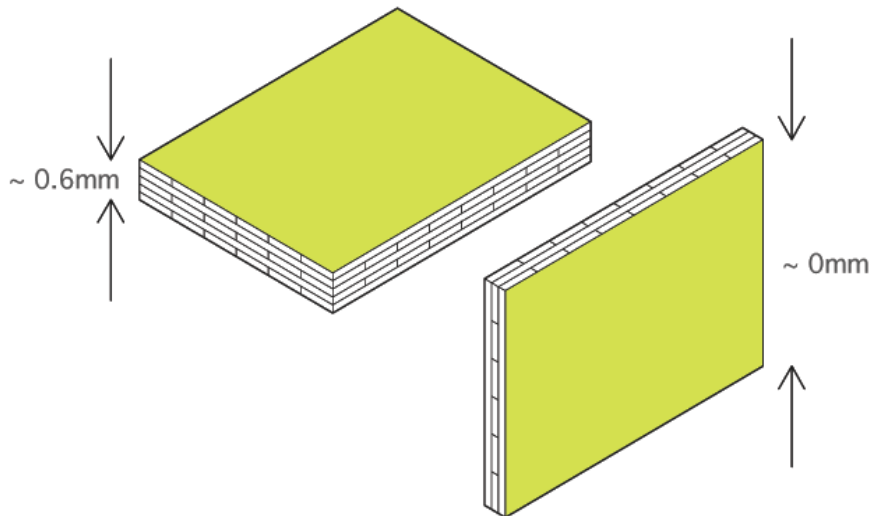






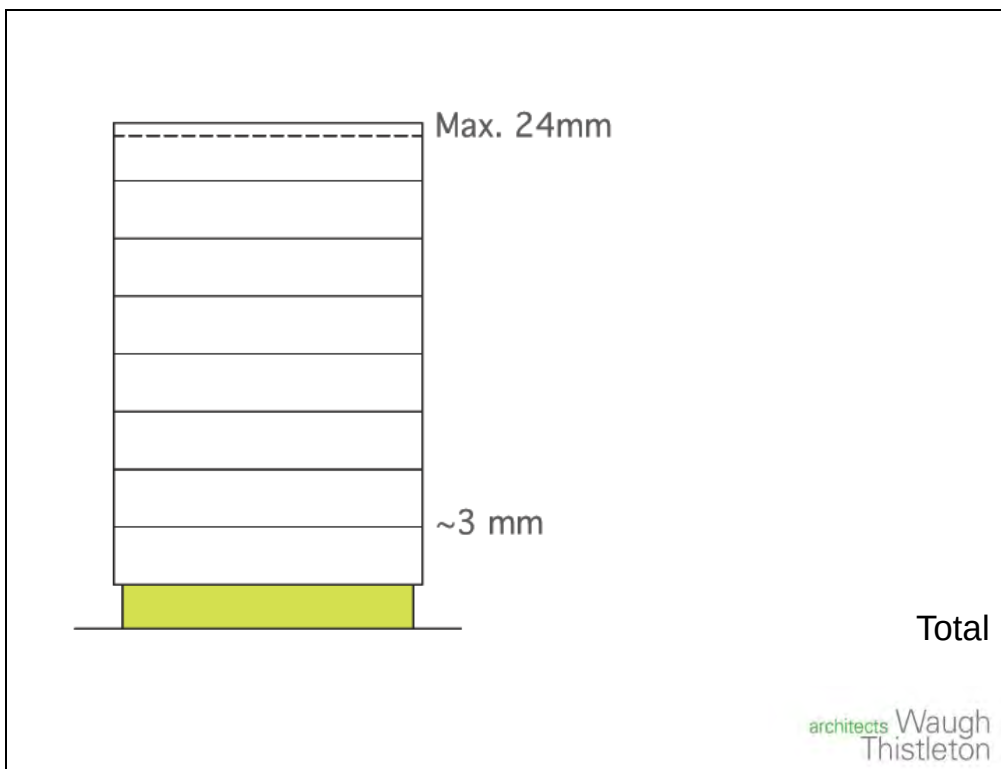
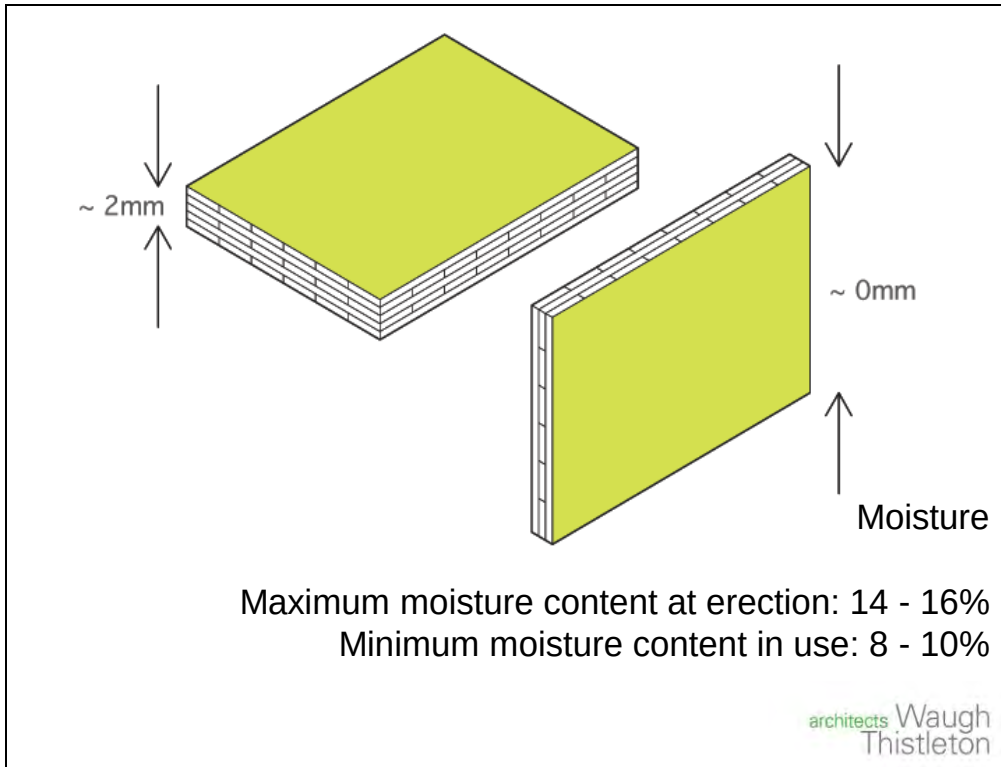
3D advantages of KLH
Horizontal panel - 5 ply

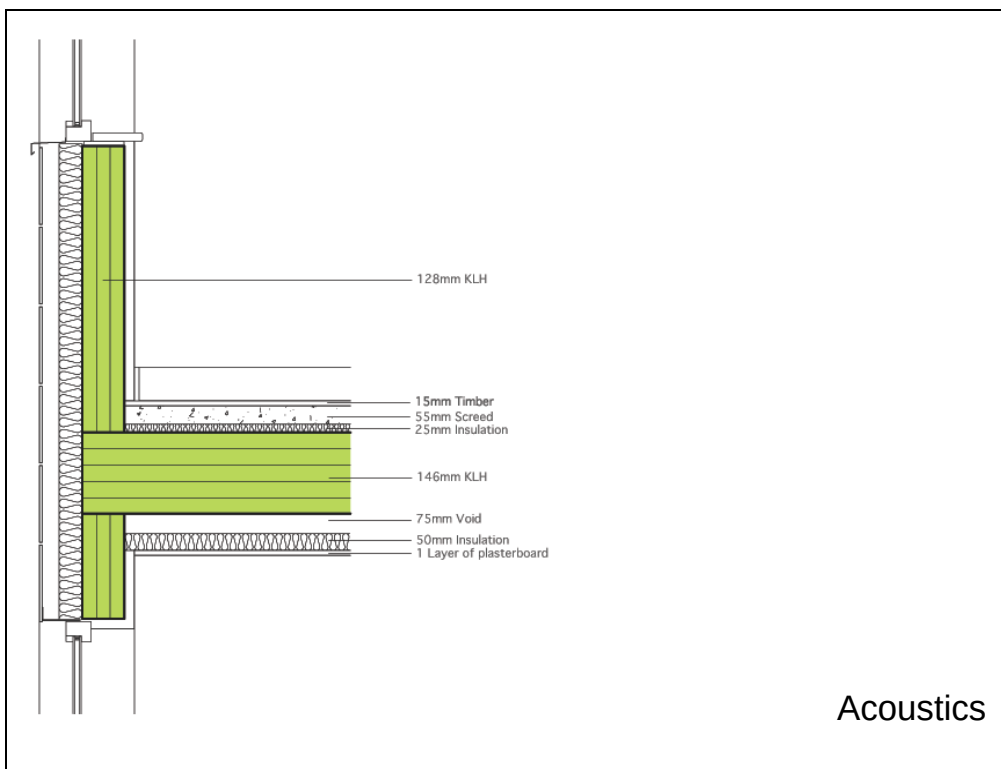
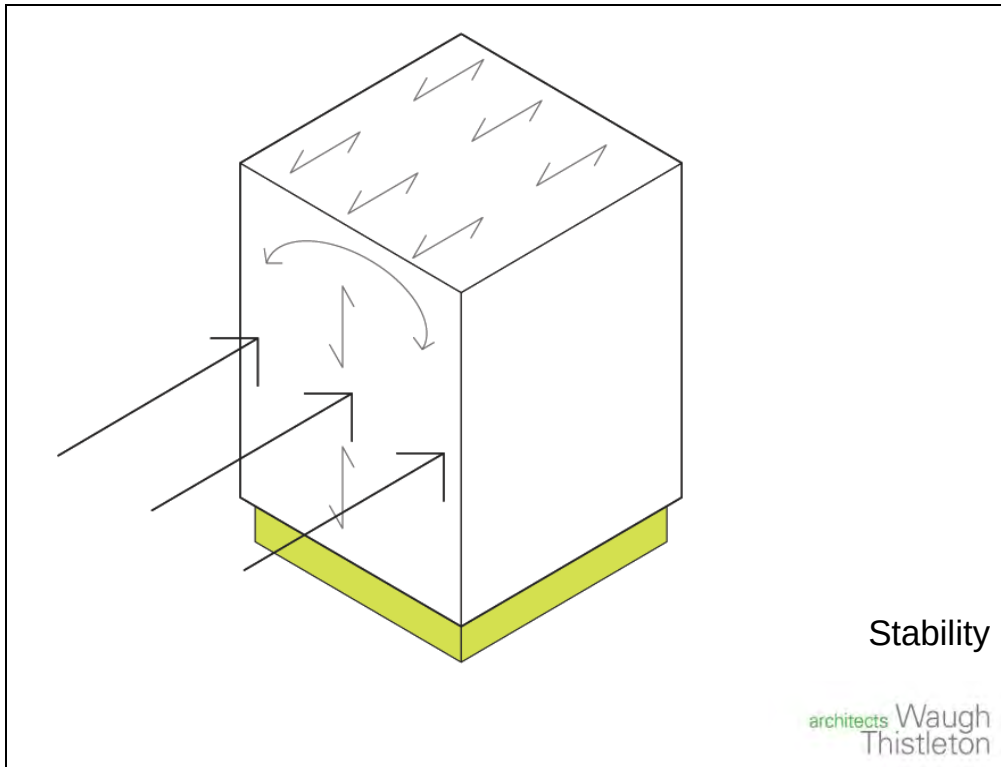
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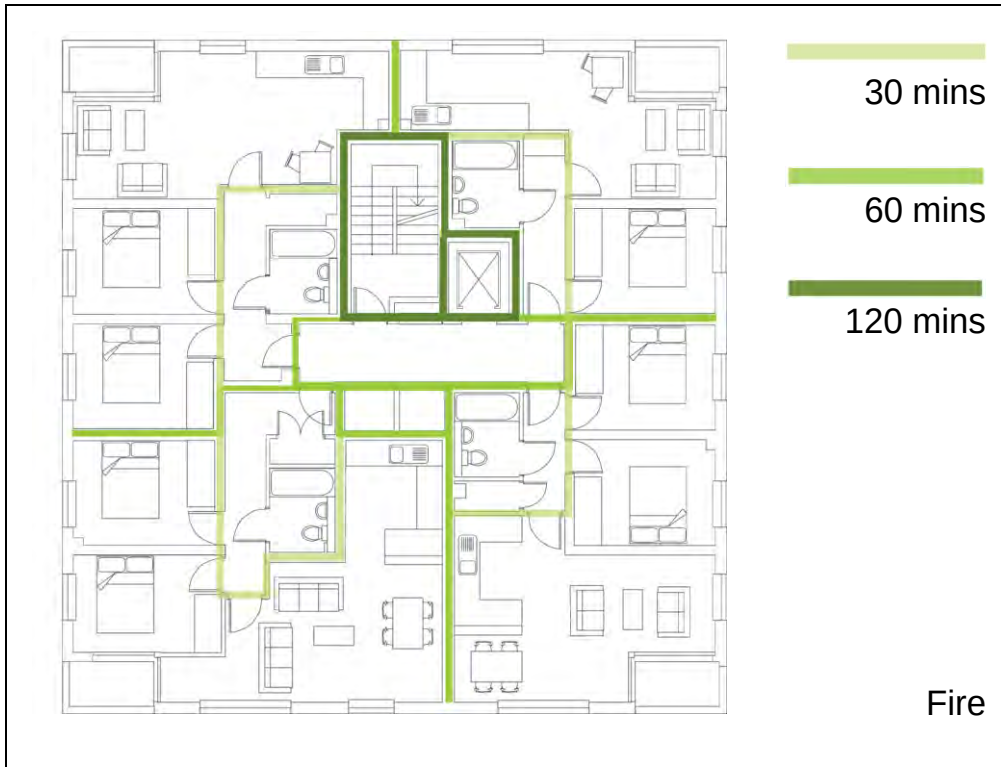


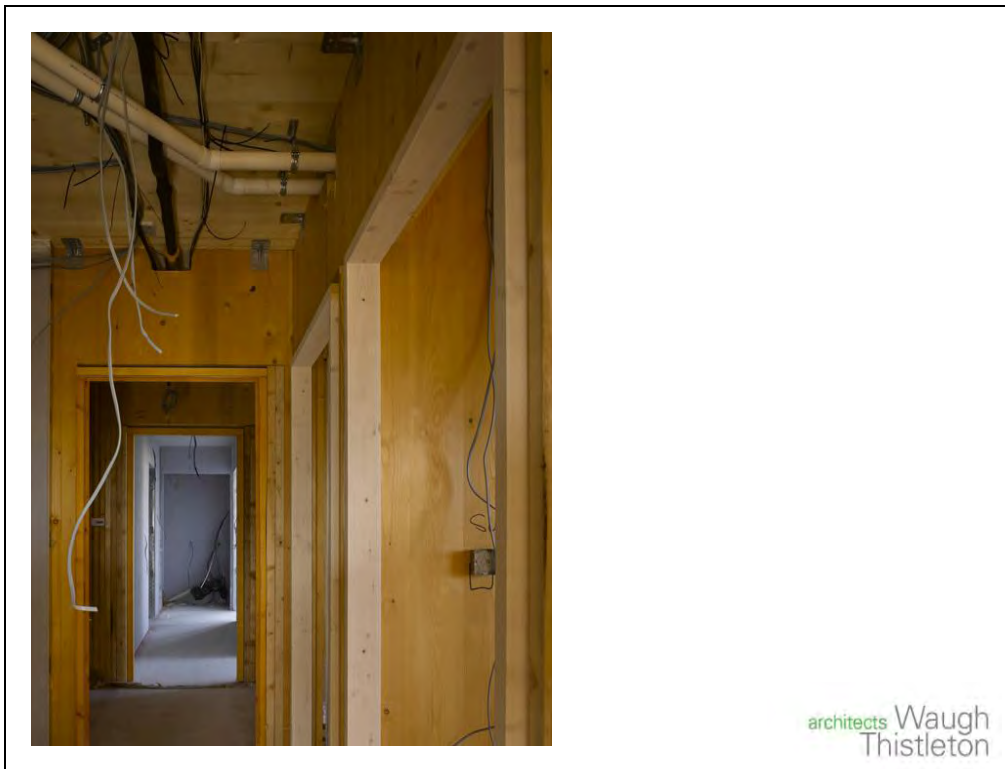
Creep - shortening due to compression under load

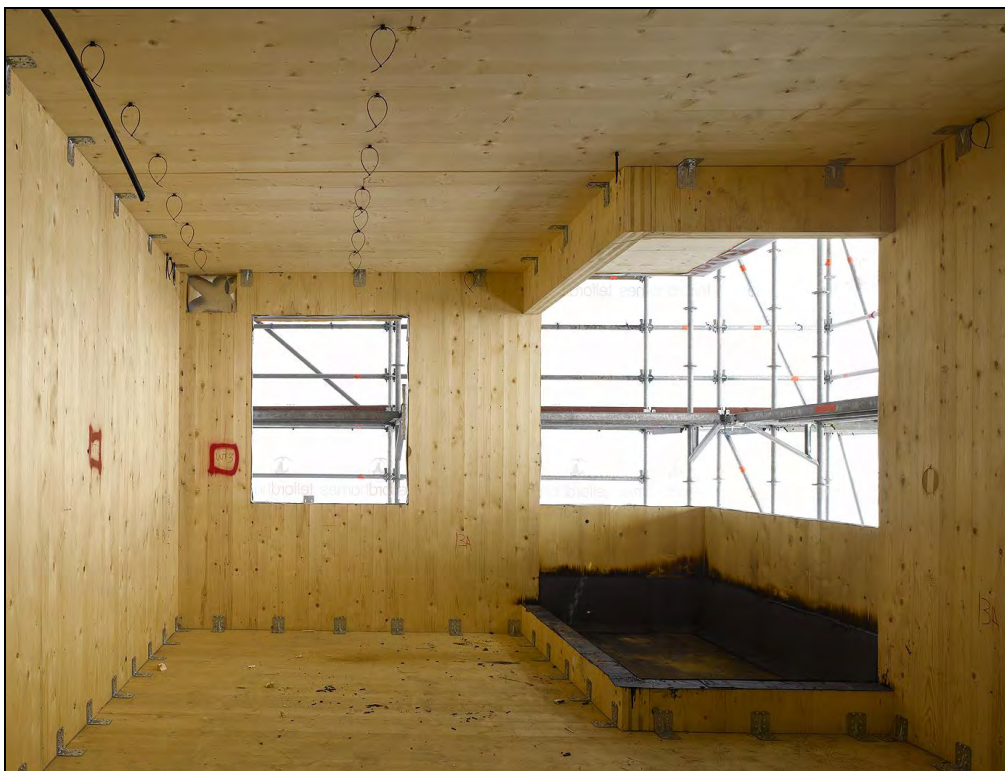
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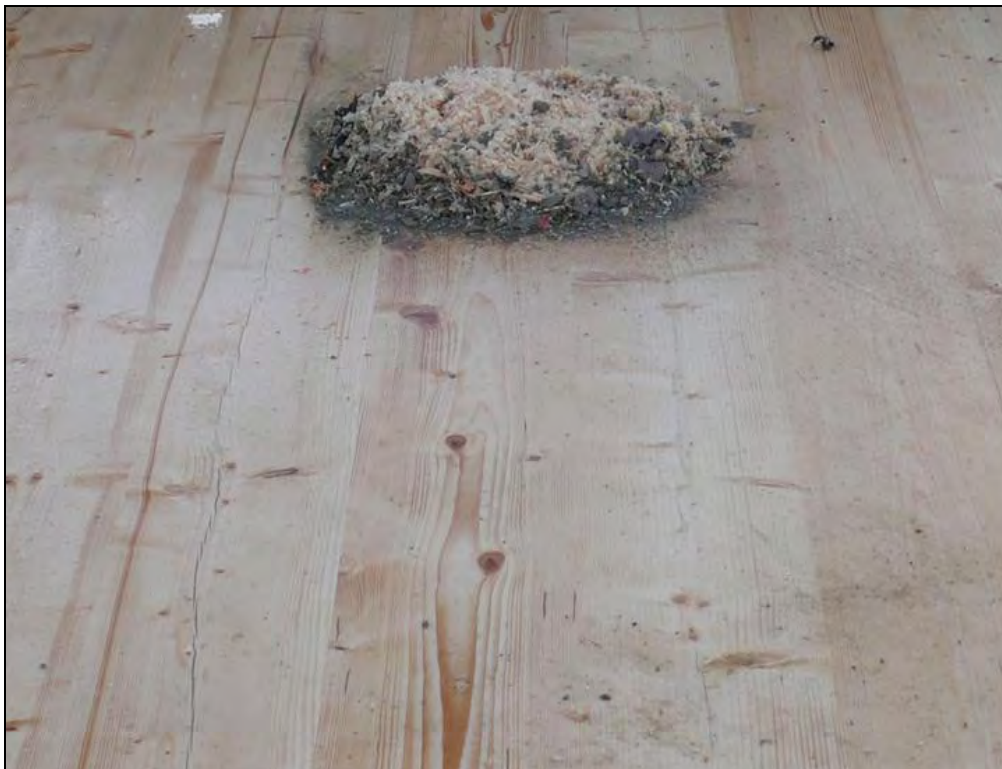
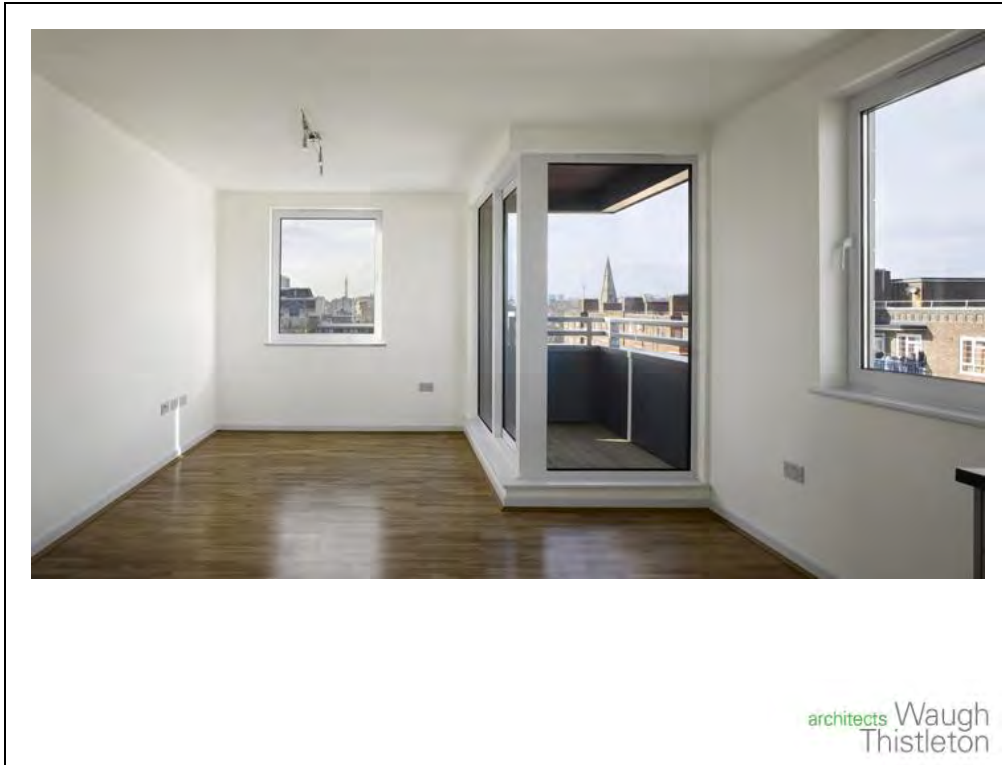






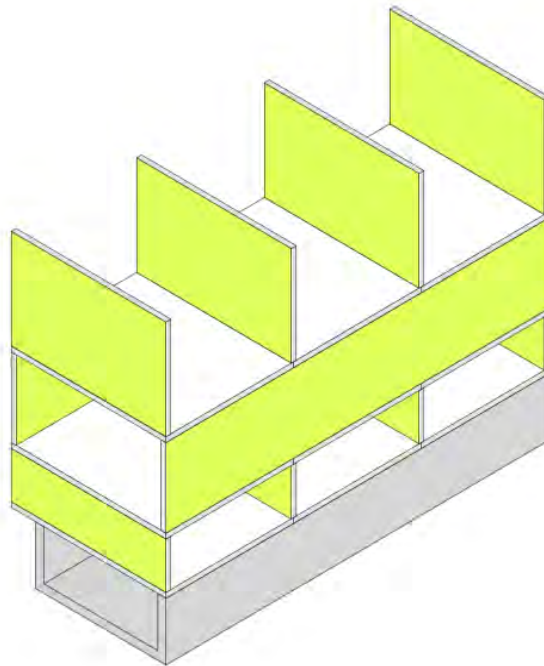








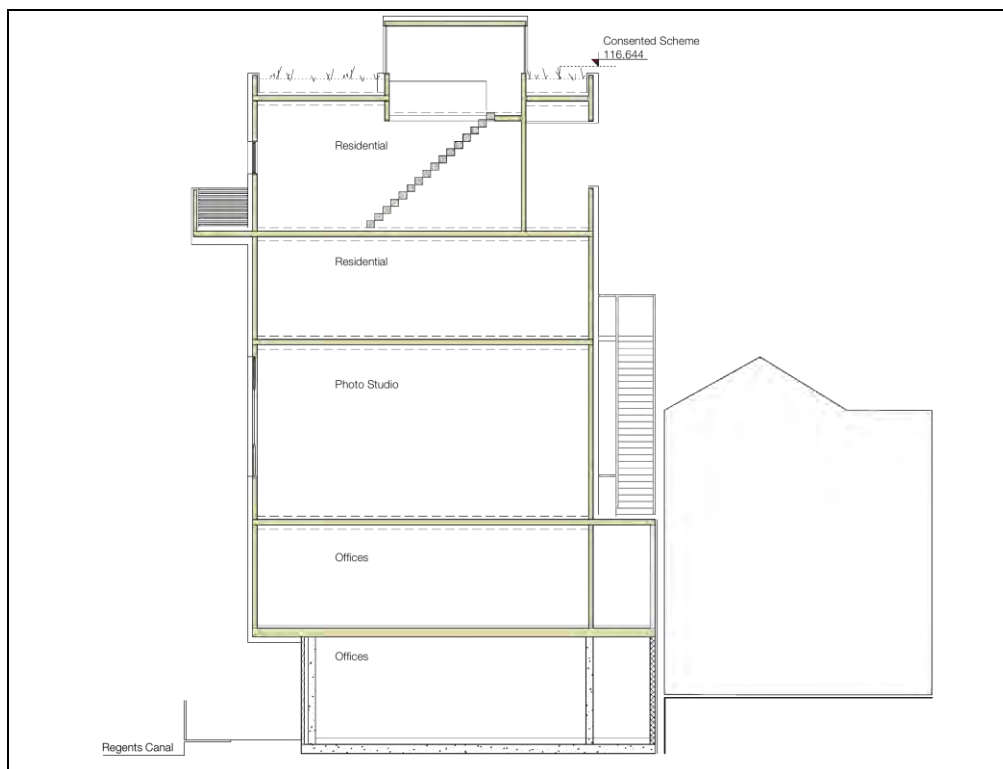
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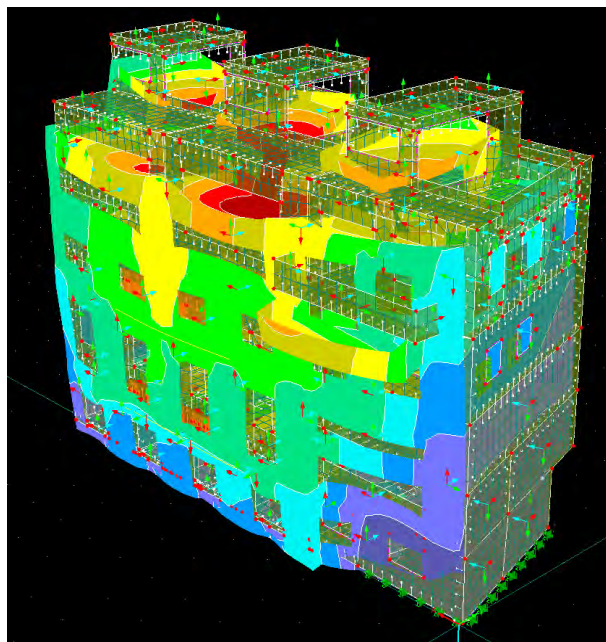


Whitmore Road



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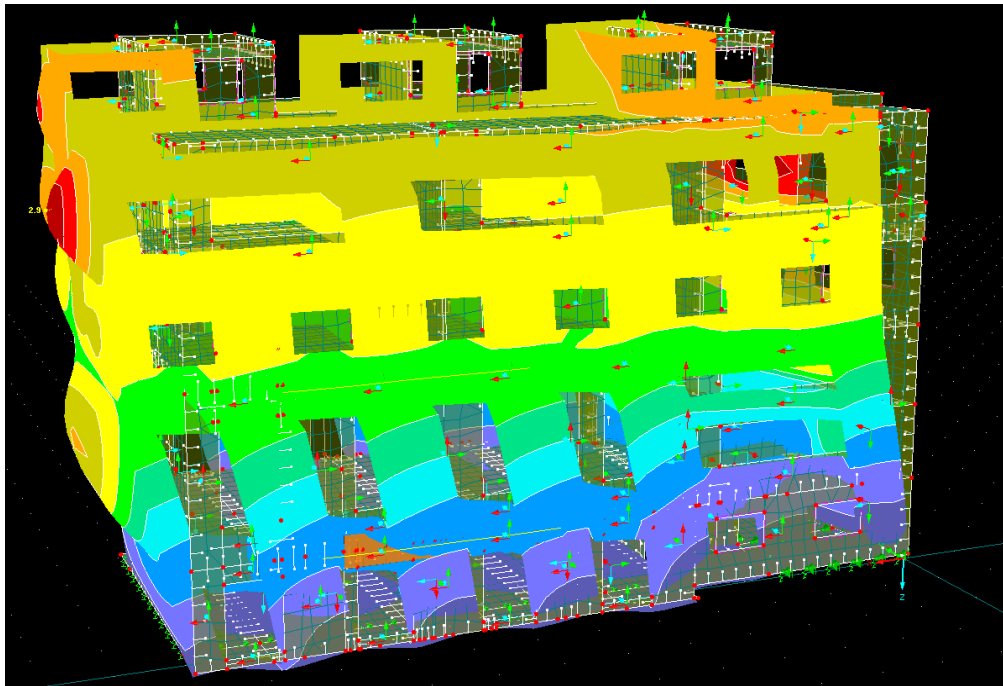




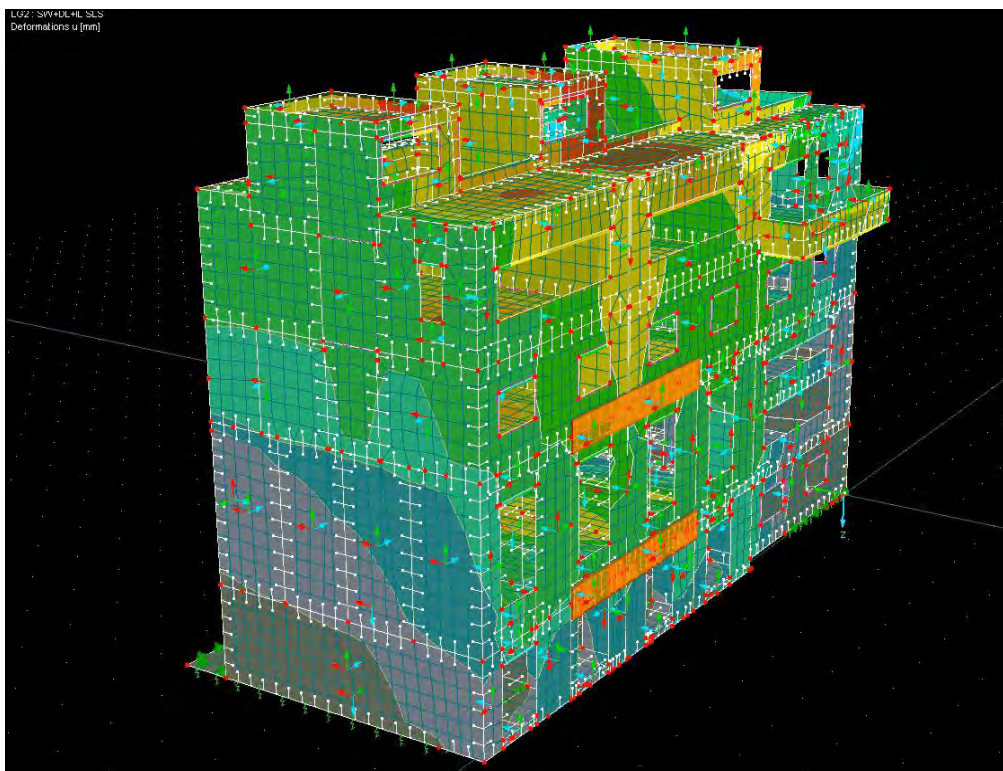
Overall deflection

Self weight
Live load
Dead load

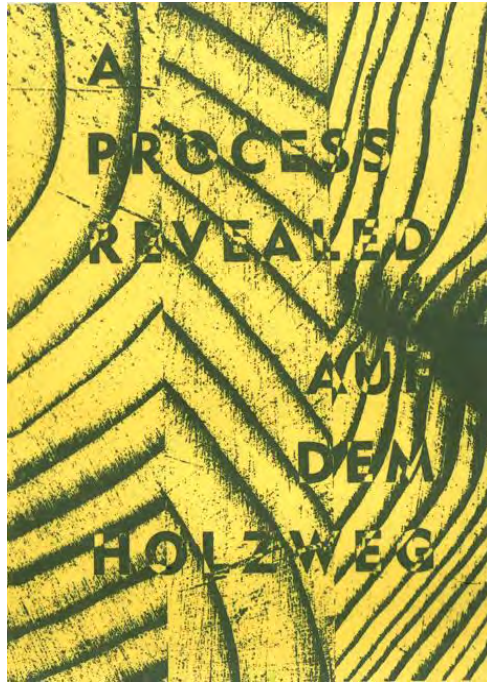
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Horizontal displacement from wind load







architects Waugh
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Session 7

[Thursday 2nd period 1.5 hours - Main Hall]

Wood in architecture: what can be done?
(continued)

Speakers



Speaker:
Ederson Augusto Zanetti

Topic:
Wood From Sustainable Sources and the Mitigation of Global Climate Change – Case Study of Social Interest Housing in Curitiba, Parana, Southern Brazil



Speaker:
Emmanuel Appiah-Kubi

Topic:
Wood for Housing in Ghana: Why the Low Interest?



Speaker:
Roshan Shetty

Topic:
Vernacular Architecture for Sustainable Development - A Case Study of South Canara Region



Speaker:
Neelam Manjunath

Topic:
Saga of the Poor Man's Timber

Wood From Sustainable Sources and the Mitigation of Global Climate Change – Case Study of Social Interest Housing in Curitiba, Parana, Southern Brazil

Ederson Augusto Zanetti¹ and Casagrande E²

Abstract

Global climate change is a natural phenomenon being accelerated by human actions that generate Greenhouse Gases - with GHG levels increasing, especially CO₂. Amongst sectors which can contribute to reducing emissions by 2030, the construction and forest sectors have significant advantages: the first holds the largest contribution potential while the second the fastest response to an increase on Certified Emissions Reductions - CERs prices, together they can play a major role on reducing the global climate change acceleration. In Parana state, the sector produces almost 35 million m³ / year (57% energy, 43% industrial), corresponding to 8% of GDP, creating up to 750,000 direct and indirect jobs. The government initiated the Program for Timber Productive Sector of Parana State - PFM100, which is responsible of planning the next 100 years of developments within the sector. The main goal of the program is to overcome possible barriers to and support implementing strategic policies to increase the production and use of industrial wood within the state. Located at the South of Brazil, the state holds a current deficit of 314,200 popular homes, and Curitiba, the State's capital, holds a deficit of 50,000 homes. In order to estimate the contribution of increasing wood usage within popular homes, a comparative study was conducted, involving a 52 m² model traditionally built by the Parana State Housing Company - COHAPAR and an alternative model from the Wood Products Laboratory of the Brazilian Forest Service - LPF/SFB. The LPF/SFB wood house model uses 62 construction items, being 56% of which wood materials, against 67 items applied at COHAPAR model with 29% steel materials. The LPF/SFB model resulted in an emissions reduction of 12,1 tCO₂eq / unit just by replacing high emission's associated raw materials, it elevates demand of forest biomass in circa of 60 % and generate another 8 tCO₂eq / unit for energy production with the use of solid residues. Besides those effects, the use of residues avoids methane emissions at landfills. In terms of CERs, the cumulative effect of increasing Sustainable Forest Management production or reforestation, replacing raw materials, producing energy from residues and avoiding methane emissions from landfills, result in estimated 83 tCO₂eq / unit, or US\$ 830 in terms of carbon credits. A list of regional occurring species was elaborated, confronting raw materials for LPF/SFB wood framed house model, resulting on 25 species for being used at State level and 16 species recommended for use at Curitiba area.

Keywords: GHG, carbon, construction, forest, wood, emissions reduction

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1. INTRODUCTION

The Green Economy emerges as an alternative for sustainable consumption habit promotion. The concept involves production and service chains that avoid, minimize, control and compensate environmental impacts from atmospheric pollution, liquid effluents and solid residues.

Global climate change is a natural phenomenon being accelerated by human actions that generate Greenhouse Gases - with levels increasing, especially CO₂. Because of this human influence, the United Nations Framework Convention on Climate Change – UNFCCC has contributed to the creation of mechanisms for emissions compensation around the globe. Amongst sectors which can contribute to reducing emissions by 2030, the construction sector is a large GHG contributor, with 30-40% of all global emissions - while the forest sector could give a fast response to an increase in Certified Emissions Reductions - CERs prices. Together they can play a major role on reducing the global climate change acceleration. When addressing the issue of wood framed houses as replacements for traditional cement-iron, there are positive impacts also on the energy and residues sector.

Trees sequester carbon while they are growing and keep it within wood for different periods of time, depending on its end use. Used in construction, the carbon may remain stored in wood for over hundreds of years, while increased reforestation may result in even greater benefits through absorption of CO₂. In fact, the area planted with trees can further take out more of it from the atmosphere. Furthermore, using wood to replace emission-intensive raw materials, such as cement and iron, might increase the greenhouse mitigation potential of wood products. The combined effects of using solid residues of production process for energy and increasing yields at forest stands further enhance the social, environmental and social benefits of using wood in construction.

Wood is an adequate alternative for construction, it is a renewable raw material, well adaptable to framing process – dry and quick assembling features (reducing in circa of 30 % the construction time span), has a good weight to mechanical resistance ratio, it can be immediately placed at structures, is a light and environmental friendly option when compared to other building items. However, despite all those comparative advantages, wood is still little used at construction. The main reason for this apparent resistance against wood include lack of tradition on this kind of construction, lack of knowledge from professionals involved in construction about the material and its qualities and, lack of Research & Development – R&D driven to technologies capable of meeting population expectations and needs. There is a noticeable lack of good projects for wood building systems which can offer functional and technological quality. Research into that has covered, among others, monitoring quality of construction process and thermal and acoustic comfort evaluation. Modular constructions can increase versatility and feasibility of this alternative construction for the whole population. Besides all the previous, wood produces residues along production chain and those can be further used or placed for energy production.

Traceability and certification are important issues surrounding the use of wood within construction as a strategy to fight global climate change, just as much as the need to improve technologies to improve application and enlarge life span of such raw materials. It works towards a system for supporting legal accountability of forest resources and follow its products along the production chain. When the wood can then be audited at any step of the production chain and at any given moment, supplying technical, legal and tenure data and

information, it can be used to reduce overall contribution of land use change to carbon emissions. The proportion of the carbon in the logs that ends up in finished products and residues depends on various factors such as species, site conditions, harvesting technique, log grading and efficiency of conversion in wood processing plants. It is important to understand the flows of carbon from harvested logs into different residues (bark, sawdust, off cuts, shavings) and product streams. Different product groups have different service lives, with domestic house framing typically having long service lives. Disposal is a critical stage in the life-cycle of forest products, in terms of their ultimate greenhouse impact. The methods for estimating parameters for accounting the carbon along the production chain may include factors based on national industry averages of volume of forest products manufactured and fate of the products after disposal.

Forest certification is a form of assuring environmental, social and economical compliance of forest products and services, and there are national certification schemes present in several countries (ITTO, 2008). In Brazil it is covered by the Brazilian Program of Forest Certification – CERFLOR, developed within the framework of the Brazilian System of Conformity Analysis – SBAC. CERFLOR aims to certify “good” forest management practices in both exotic and native stands; it is managed by the National Institute of Measuring and Industrial Quality – INMETRO, and associated with the Program for Endorsement of Forest Certification Schemes - PEFC.

Brazil has a large forest resource base from both natural and introduced species. The large natural grown stock of hardwoods results in products typically long-lived. It is possible to maintain, or even increase, the volume of carbon stored within living biomass while increasing the level of carbon stored within wood products, by adoption of sustainable management practices. Large consumption of industrial wood favors forest cover increase at country level (FAO, 2007), and yield gains at forest sites are result of silvicultural treatments implementation towards production intensification (Nilsson, 2007). Using forest products intensively and extensively practicing Sustainable Forest Management increase the average volume of a forest stand and annual yields. For the recognition of wood material role to mitigate global climate change, efforts are being made to include the so called Harvested Wood Products – HWP. The IPCC has coordinated discussions on potential accounting approaches and methods for estimating carbon in forest products (UNFCCC, 2011) as long as Sustainable Forest Management certified practices are adopted (UNFCCC, 2009). Voluntary markets long-lived wood products carbon accounting involve 100 years life cycle traceability (CCX, 2009).

2. CASE STUDY – SOCIAL INTEREST HOUSES

The Construction sector worldwide invests over US\$ 3 trillion / year, employs 111 million people - 90% on micro firms (less than 10 persons) and 75% in developing countries (UNEP, 2009). Around 2025, the world will demand another 11,5 billion m² of space for residences, 6 billion m² for industries and 5,4 billion m² for commerce. In the UNECE region (56 states in Europe, the Commonwealth of Independent States (CIS) and North America), buildings are responsible for over a third of total energy consumption; by and large in the residential sector (20-30% of total final energy consumption on average). Demographic, economic and cultural changes will only increase the pressure of housing on energy consumption and will be accompanied by even higher levels of GHG emissions. On the other hand, evidence suggests that it is the buildings sector and, particularly, the residential sector that could

generate some of the greatest energy savings. Using wood is an essential part of this savings, especially for low income populations. On the planet, 70 to 75 % of the population, circa of 4 billion people, live with less than US\$ 3,000 yearly, moving US\$ 5 trillion. In Brazil there is a deficit of close to 8 million homes – 84% of low income, and demand for another 27 million new units until 2025, while the sector investments will grow from today's US\$ 97 billion to over US\$ 263 billion in 2030.

In Brazil the forest sector is robust, generating around US\$ 20 billion / year on revenues, with US\$ 9,3 billion exports in 2008, close to 6 million ha of plantations and 1,6 million directed created jobs (Rochadelli et al, 2008). In Parana state, the sector produces almost 35 million m³ / year (57% used for energy, 43% industrial), corresponding to 8% of GDP, creating up to 750,000 direct and indirect jobs. The Parana state government initiated the Program for Timber Productive Sector of Parana State, which is responsible of planning the next 100 years of developments within the sector. The main goal of the program is to overcome possible barriers to and support implementing strategic policies to increase the production and use of industrial wood within the state.

At wood housing, both small and large scale, righteous species choice (preference for local ones for lowering transport costs), technological developments (preservation, fungicides etc), environmental constrains (Wind, Sun, rain etc), applications - use recommendations (maintenance), building project (detailed) and skillfulness on handling Wood materials are essential for a good project (Chesnost, 2008). New products and technologies contribute to increase applicability of this raw material, be it by durability increase (anti-fungi treatments, anti-insect treatments, water absorption increments etc), be it by enlarging co-products and sub-products generation with high technological inversion (wood oils, cellulosic ethanol, liquid Wood etc).

In Brazil, non-renewable raw materials consumption at construction alone is estimated at 2 t / year / person (Estuqui Filho, 2006). For producing 1 m³ of aluminum 6,3 tCO₂eq are emitted, while steel production generates 8,1 tCO₂eq for each m³; timber sequestrates at least 0,3 tCO₂eq for producing 1 m³. For being transformed into finished products, timber uses 2800 GJ, cement 4800 GJ and steel 6700 GJ (Estuqui Filho, 2006). In Australia, house framing on steel generates emissions of 2,7 tCO₂eq against 0,4 tCO₂eq for same structure on wood (FI, 2009). In France, accounting for HWP carbon can generate over US\$ 200 million / year (Chesnost, 2008). Construction use of HWP contributes with three major effects to mitigate climate change: carbon sequestration (by trees); direct effect on replacement of high emissions associated raw materials and; indirect effects of replacing those materials. Raw materials manufacturing for houses using more Wood requires less energy, produces less GHG, allows recovering and use of residues from logs, primary and secondary processing, at construction and demolition sites, which together result on a larger production of energy than what gets spent along the production chain. With this, using HWP at construction creates carbon sequestration at wood framed houses (Gustavsson, 2005).

The Green Office (Escritório Verde) at Federal Technological University of Paraná - UTFPR is a model for integrated solutions for sustainable construction. It is an enterprise-School on socioenvironmental management and sustainable construction systems, aiming at construction Certification. The office itself is a model for sustainable and certified building, and the future headquarters of Curitiba's Regional Center of Expertise Integration for Sustainable Development Education (CRIE) (EV, 2011).

2.1 Objective

In Brazil, total social interest housing deficit is of 8 million units. In Parana State, located at the South of Brazil, there is a current deficit of 314,200 popular homes, and Curitiba, the State's capital, holds a deficit of 50,000 homes. This paper examines the total mitigation potential of wood framed houses in substitution of conventional houses used in Curitiba, Parana, Brazil. It also estimates overall impact at production chain.

2.2 Material

The comparative study is performed involving conventional house model, of 52 m², regularly build by state construction company (Companhia de Habitação do Paraná – COHAPAR), identified as “house type R1 and R1A – CF52”, and the alternative Wood model build by Forest Products Laboratory of Ministry of Environment (Laboratório de Produtos Florestais do Ministério do Meio Ambiente – LPF/MMA), called “popular housing in wood”, also with 52 m².

2.3 Method

In order to estimate the contribution of increasing wood usage within popular homes, a comparative study was conducted, involving a 52 m² model traditionally built by the Parana State Housing Company - COHAPAR and an alternative model from the Wood Products Laboratory of the Brazilian Forest Service - LPF/SFB. The first step was to acquire primary data from raw materials used for building both models and, secondary data on emissions factors and carbon contents of those raw materials from literature (Annex 1).

For performing the study, material's list from both house models were obtained and emissions associated with each construction material were calculated using the total of raw material multiplied by an emission factor, specific to each of them. After this it was possible to obtain the potential of emissions reduction associated with material replacement. The next step was to evaluate which amongst the existing forestry carbon methodologies could be used to expand the estimate of direct and indirect effects of replacing high emissions associated raw materials by wood. Identified routes of estimating carbon mitigation potential were applied to obtain the total potential contribution of this kind of initiative to contribute for reducing emissions for the construction sector.

By analyzing each raw material applied contribution to generate GHG emissions, each model performance in terms of carbon was established. Another task performed was to estimate, based on raw materials volumes and emissions factors, the impact of using more wood along social interest housing's production chain. Both residues and yields could be approached and the final result is an inference on carbon benefits generated along the whole production chain of social interest housing construction.

3. RESULTS

The first result obtained was the raw materials list, being 67 items used at COHAPAR model and 62 items in LPF/MMA. Iron products were the main material. Wood materials are the most important ones at LPF/MMA model, answering for 56% of the list, while COHAPAR model has Iron at the top of the list, with 29% participation, in terms of items. LPF/MMA

model also reduces appliance of other materials as ceramics, and sandpaper, besides using less bricks, both resulting on lower emissions associated and higher carbon sequestration potential per built unit.

Raw materials were grouped according with its natural resource origin into Wood, Iron, Sand, Ceramic, Cement, Paint, Stones and Others. Each group is associated to a specific emission factor, which made it possible to obtain the total emissions associated and the carbon sequestered at each model, as well as its impacts along production chains.

COHAPAR's 52 m² model, applies to total amount of 5.8 m³ of HWP, while LPF/MMA model uses 9.2 m³ which represents an increase of more than 50%. Due mainly to that, stored carbon, by unit, is 1,7 tCO₂eq larger at LPF/MMA model. By lowering energetic demand along the production chain, the total emissions associated reduction is of 10,4 tCO₂eq / unit, when using LPF/MMA model. Altogether, circa of 12,1 tCO₂eq / unit are reduced by changing to Wood framed houses. LPF/MMA model emitted 2,5 tCO₂eq / unit (and stored 4,6 tCO₂eq / unit) while COHAPAR had 12,9 tCO₂eq / unit of emissions (and stored 2,9 tCO₂eq / unit).

Global benefits of using wood at construction related to climate change are associated with carbon stocks of forests and HWP, reduction of emissions from fossil fuels by enlarging biomass availability (including residues) and inducing productivity. Considering the whole HWP production chain, the use of LFP/MAA model generates a demand of 24.4 m³ / unit only from forestry biomass. This will result on an increasing level of reforestation within the region, improving overall carbon stocks of 58,9 tCO₂eq / unit. It is also reasonable to expect further improvements on alternative fuels production, since wood production chains generate residues that can be easily used for producing energy. Even after the lifetime span is over.

By applying social interest housing technical proposal within LPF/MMA model, besides reducing emissions from replacing raw materials, there will be larger availability of wood residues for renewable energy production, resulting from primary and second processing of 17,1 m³ of logs. When those wood residues are used for producing renewable energy, they do not go to landfills, avoiding methane emission that would result from its deterioration, saving 11,4 tCO₂eq .

The LPF/SFB model generated another 0,6 tCO₂eq / unit emissions saving for energy production with the use of solid residues. In terms of credits, the cumulative effect of increasing Sustainable Forest Management production or reforestation, replacing raw materials, producing energy from residues and avoiding methane emissions from landfills, result in estimated 83 tCO₂eq / unit, or US\$ 830 per house in terms of carbon credits.

A study, involving wood framing, steel framing and COHAPAR social interest houses with 41 m² resulted on 2,1 tCO₂eq for the first, 3,9 tCO₂eq for the second and 7,8 tCO₂eq for cement-iron model (Kobiski et al, 2011).

3.1 Tree biodiversity

For establishing a silvicultural program that can supply locally raw material demand for social housing, an exercise was performing, involving studying regional species which can be used for building those houses. A list of regional occurring species was elaborated, based on previous research done at the overall Parana state and Curitiba and Metropolitan Region

(Parana State Capital). That list was compared with the raw materials list for the LPF/MMA wood framed house model, resulting on 25 species for being used at State level and 16 species recommended for use in the Curitiba area.

This study was performed considering forest biodiversity at regional scale, by applying different species according with material destination within the wood house model. Using this approach, for Parana state's regions 1 and 2 (Center-South of the country – 99 municipalities with the lowest income in the state), the listed species included Pinus sp and Eucalyptus sp and other 23 native tree species (Annex 2), while in Curitiba besides the two introduced ones, 14 other species could be applied (Annex 3). Most of them are grown in agroforestry and silvipasture systems, and this project aims at increasing their plantation area within the region, taking advantage of pasture and degraded areas surrounding municipality.

By implementing diversified Forest resource base and foreseen the use of those trees as industrial raw materials suppliers for construction of social interest houses, forest plantations are directed to biodiversity cultivation, emissions' reduction, economical development and social integration. This requires a massive inclusion of local and global actors. The issue of fire has to be addressed, to include fire combat planning for each house unit and condominium, according with governmental and bank regulations. This will increase assurance and secure people's investments as well.

4. MITIGATION POTENTIAL

Brazil, Russia, India and China are growing economically, and consequently this leads to increase their contribution to carbon emissions. Alternative fuels, especially wood biomass, can play an important role to lower those countries emission's rates. In order to balance and trade carbon within the BRIC region, as well as many other services provided by agro ecosystems (water quantity and quality, soil conservation etc), those countries can collaborate to establish a regional forest product and services working group, studying ways for benefiting their economies, environment and society. The global market on forest products reached US\$ 207 billion in 2007, and it is expected to surplus US\$ 270 billion by 2030. Global production of wood, in 2010, is estimated to be 5.7 billion m³, from this total 75% should be produced in Asia, North America and Europe, being 1.9 billion m³ of industrial round wood and 2.2 billion m³ of wood energy. Latin America on its turn is estimated to produce just 19% while Africa for only 4%. Europe and North America concentrate the production of industrial round wood while the developing regions (Africa and Latin America) concentrate the wood production for energy proposes. There are large deficits of industrial round wood in North America (close to 200 million m³ / year) and Asia (around 50 million m³ / year), with moderate deficit in Europe; Africa has a small surplus and the Latin America region large volumes (over 200 million m³ / year) available for international trade (FAO, 2007).

In Parana state there is a forestry strategy for the next 100 years. Towards it the state shall promote, by organizing seminars and training and offering technical assistance, the increase of municipalities' awareness regarding the necessity of planting forest for industrial wood production. By using a larger number of species within the social interest houses building process, and linking the silviculture program with the state and municipalities demand for

those houses, it allows a virtuous cycle involving forest plantations and industrial wood consumption, contributing to lower the overall state ecological footprint.

HWP present a large potential for mitigating global climate change effects in Brazil, with further contribution for reducing national emissions, by reducing their increasing consumption from Land Use Change emissions (Grêt-Regamey et al, 2008). For HWP, requirements are based on the necessity of tracing products from source to final disposal – there are large uncertainty amongst wood materials deterioration periods at landfills, which implicates on GHG emissions and losing of permanence characteristics. Nevertheless, residues recycling for producing alternative energy also generates carbon credits, considering as the baseline fossil fuel emissions and applying an average value for Power generation from biomass residues (Perez-Garcia, 2008). Since 2003, many countries have been elaborating over mechanism adoption by producing and consuming societies should implement to avoid illegal harvesting and trade. This initiative is called FLEGT – Forest Law Enforcement and Governance at Trade, and it foresees voluntary adoption of countries in order to show their political commitment with solving this problem.

Under the UNFCCC, parties report the carbon sequestered by forests in their national greenhouse gas inventories, if they have the required data. The use of sustainably-harvested wood in construction results in several benefits to the society, economy and environment. It is essential now to obtain public recognition for the long-term storage of carbon in forest products by adopting traceability, certification and life cycle assessment approach to the process. Adopting these practices will give recognition to the role of forest products in mitigating greenhouse emissions, and consequently further promote the use of forest products in the country and the overall image of the sector globally.

Sustainable Originated Wood Utilization Network – RUMOS (“RUMOS” in Portuguese means “Directions”), is a proposal for an institutional effort, involving several Brazilian organizations. The aim is to inform the public about the social, economical and environmental benefits of using wood. Its objectives are aligned with similar initiatives in the planet (Annex 4). By integrating forestry from different countries around the objective of promoting wood as form of reducing global climate change effects, the sector provides the basis for increasing public awareness of the benefits of using this raw material. Furthermore, by integrating wood promotion networks, there is an appropriate forum for discussions and coordination of a global system for accounting and certifying forestry carbon, bringing the sector to a new level of participation at international agreements, increasing the strength and influence of its common proposals and positioning.

4.1 BRIC

In 2003, Goldman Sachs’ associates published a research report that first coined the term “BRIC economies”, referring to Brazil, Russia, India and China can become the largest spenders in the planet, with the highest growth rates (Armijo, 2007). With their growing economies, BRIC countries are expected to reduce poverty and increase consumption levels, turning the region into a very interesting trade partner on the coming years. Within this context, forestry sector can play an important role once a favourable business environment is generated.

Each BRIC country has its own legislation regarding to the utilization of its forest resources. Thus, In order to provide adequate conditions for taking advantage of their regional forest

characteristics it is necessary to make adjustments that can contribute in such way that lead to an increase its forestry sector more competitive.

Ministry of Environment – MMA, Ministry of Agriculture, Pasture and Supply – MAPA and Brazilian Forest Service – SFB, are the main responsible for the forest sector in Brazil. In Russia, Ministry of Natural Resources – MNR and the Federal Forest Service – FFS assume that role, while in India the Ministry of Environment and Forests – MoEF, the State and Federal Forest Service – FS, administrate country's forest policy. In China, the State Forest Administration – SFA, is the main institution working within the forest sector at the national level.

Brazil follows the Tarapoto System of SFM practices and the forest management and wood products can get certified either by Forest Certification System Project for Endorsement of Forest Certification schemes - CERFLOR/PEFC or by the Forest Stewardship Council – FSC. Russia follows Montreal principles for Sustainable Forest Management of forest resources, and the Russian National Council for Forest Certification is also recognized by PEFC, making both, the RNCFC/PEFC and FSC certification available at the country. India follows International Tropical Timber Organization - ITTO Process and the national forest certification system by the Program for Endorsement of Forest Certification schemes – PEFC (PEFC, 2008) and FSC (WWF INDIA, 2008). China is a country that follows the Montreal Process for SFM practices, and the Federal Government already established a national system for forest certification, recognized by PEFC as well as the Sustainable Forest Initiative – SFI and the FSC.

Russian National Council for Forest Certification, recognized by the PEFC system, has the largest requirements, with 280 indicators, the China Forest Certification Council, also recognized by PEFC system, ranks second with 112 indicators. Brazil Forest Certification – CERFLOR, recognized by PEFC system, demands compliance with 87 indicators and Bophal India System, recognized by PEFC, is based on 48 criteria of Sustainable Forest Management.

4.2 Harmonization

Harmonization is legally understood as cooperation between governments to make laws more uniform and coherent, making them able to facilitate free trade and protect citizens. Steps to achieve integration start by clear statement of country's local issues and a joint process of developing mutually agreed initiatives at regional scale.

The unilateral actions of developing National Forest Programs – NFP, can be integrated into a BRIC Forest Plan, which considers local potential and synergies between countries to guide a regional process of turning this into environmental, social and economical benefits. Eventually it could be issued a BRIC Certification Systems allied to a regional carbon trade system. The aim is to capture local forest sector characteristics and work with them into a regional forum, resulting on an integrated proposal of joint action into global markets. It should be discussed a harmonization of BRIC's forest legislation in order to make its forest sector more competitive at the international market.

BRIC countries can gain a lot from developing a harmonized Forest Certification System, starting from the relevance it will have on influencing all other systems within the region and including acceptance as an international standard, recognition of equivalence between all

forest certification schemes within the region, further promoting and tidying regional cooperation, produce standards with an inclusive approach based on bottom-up decision making process and unilateral recognition of their scheme, which enhances the potential of negotiating as a block in other agreements.

Governments should look for ways to recognize the role of mutual recognized forest certification schemes and make the process of obtaining them easier to comply with, especially from the producing country's side. Certification schemes should not be forced to compete but rather supported on taking advantage of their similarities to coordinate efforts into the direction of consolidating their role for sustainable trade development.

Montreal Process, adopted by both Russia and China, presents a level of compliance of almost 60% with the ITTO System of India, and 40% with the Tarapoto System, making the Brazilian efforts into direction of harmonization the most needed. Areas of C&I considered at the comparison included Biological Diversity, NTFP, Forest Related Services, Soil and Water Conservation, Social and Cultural Aspects and Values, Forest Employment, Forest Ownership and Policy and Institutional Frame Conditions (Rametsteiner, 2006).

By building and consolidating a process of harmonizing their certification systems, BRIC countries provide the necessary tools for accessing carbon credits markets at global scale. Sustainable forest management operations, harvested wood products and residues recycling have larger opportunities at both regulatory and voluntary markets when already certified by third parties. BRIC countries can position themselves to assimilate global climate change effects and fight poverty together, by proposing fresh and joint ways of mitigating its effects towards their forest sectors, presenting a cost-effective solution fit for the region's shape.

5. CONCLUSIONS

It was observed a highly positive impact of replacing conventional cement house model by an alternative wood concept. Only on raw material used at each unit, carbon savings of 12,1 tCO₂eq. Besides that, it was possible to identify further carbon mitigation benefits along the production chain, including increasing forest productivity (sequestration), supplying biomass (residues) for alternative fuels production and lowering emission from residues disposal and those associated with the use of high emissions related raw materials (cement, iron, bricks etc).

All together, each unit generate around 83 tCO₂eq considering the baseline of keeping the conventional cement model. . LPF/MMA model emitted 2,5 tCO₂eq / unit (and stored 4,6 tCO₂eq / unit) while COHAPAR had 12,9 tCO₂eq / unit of emissions (and stored 2,9 tCO₂eq / unit).

To further promote wood production and consumption for Green Economy competitiveness gain, harmonization of BRIC countries forest legislation and SFM C&I are suggested. This could enforce traceability, certification and carbon credits generation and trade.

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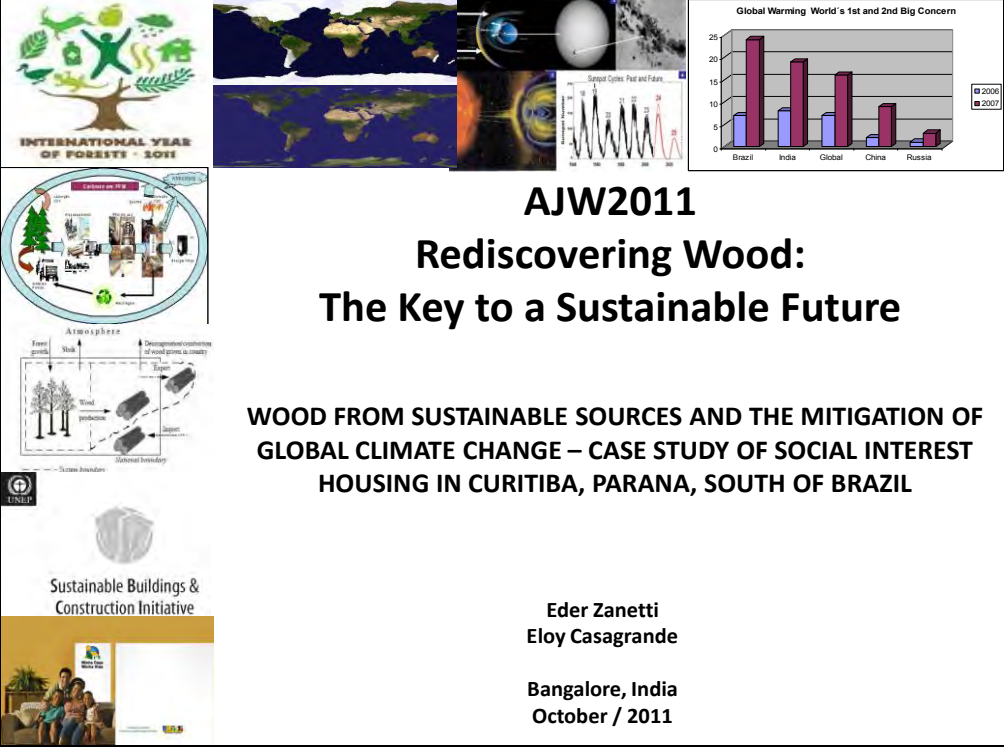
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AJW2011

Rediscovering Wood: The Key to a Sustainable Future

**WOOD FROM SUSTAINABLE SOURCES AND THE MITIGATION OF
GLOBAL CLIMATE CHANGE – CASE STUDY OF SOCIAL INTEREST
HOUSING IN CURITIBA, PARANA, SOUTH OF BRAZIL**

**Eder Zanetti
Eloy Casagrande**

**Bangalore, India
October / 2011**

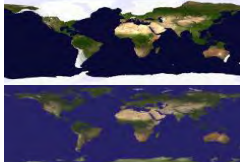
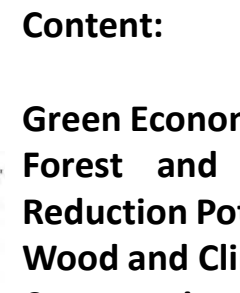
Support and Data

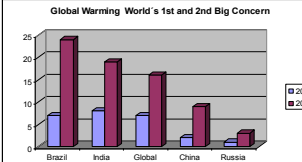
- **FAO**
- **UFPR**
- **UTFPR/PPGTE-PPGEC**
- **LPF/MMA**
- **Embafort**
- **STCP Engenharia de Projetos**
- **Green Farm CO2FREE**







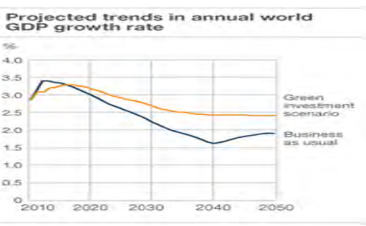


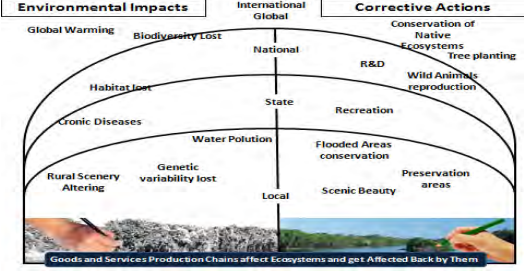
Content:

- Green Economy and Global Warming**
- Forest and Construction Sector Emissions Reduction Potential**
- Wood and Climate Change Mitigation**
- Comparative Study: Cohapar X LPF/MMA**
- Curitiba Tree Species Diversity**
- Forests and Green Economy**
- Harmonization and Networks for Wood Promotion**
- Conclusion**

Green Economy

- **Production and Consumption of Environmental Goods and Services and Payment for Ecosystem Services**
- **Should become the largest share of international trade by 2050**

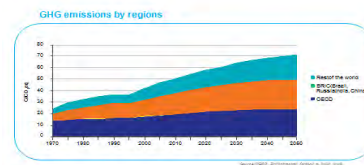





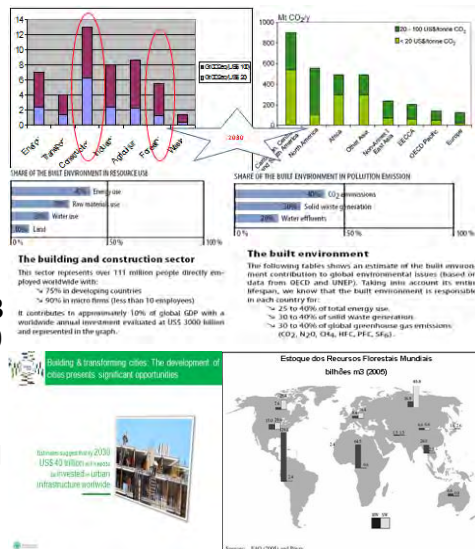
Partially
Avoidable
with
Sustainable
Forestry

- **Burning of fossil fuels;**
- **Disposal of residues;**
- **Burning of biomass direct to atmosphere**

-
- Countries using more industrial wood see increase on forest cover**
- Simple Cycle: Past and Future**
- ANNUAL NET CHANGE IN FOREST AREA 1990-2000**
- THE WORLD'S FORESTS**
- Degradation: Greenhouse gas emissions keep rising**



- **Forest sector respond faster to an increase on carbon prices;**
- **Construction sector has the major potential contribution to reduce GHG emissions (2030 scenario by IPCC2007);**
- **Use of industrial wood in developing countries is reduced – specially in Brazil;**
- **Construction sector invests US\$ 3 trillion / year, employes over 100 million people (75% at developing countries and 95% in companies with less than 10 workers) – social and economical contribution**



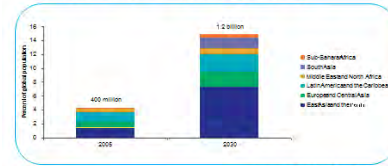
Wood and Climate Change

- World stocks of wood are increasing – increase on income, increase on industrial wood stocks;
- Transfer of wood from sustainable forest management to industrial products does not implicate on emissions of GHG;
- Use of wood residues for production of energy replaces burning of fossil fuels and reduces emissions from degradation at disposal sites;
- The longest life-span of products generates largest benefits;
- Brazil tropical hardwoods hold carbon by long periods and the country has the largest world stock of hardwoods

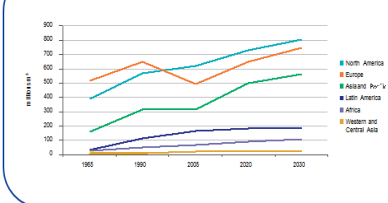


Growth: The global middle class is rapidly expanding

Population in low- and middle-income countries earning US\$ 4,000-17,000 per capita (purchasing power parity)



Consumption of industrial roundwood by region – 1965-2030



Green Office UTFPR (Escritório Verde)



Integrated Green Construction Solutions



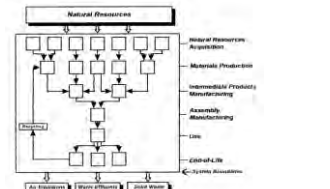
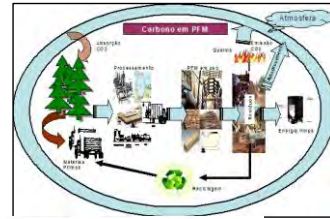
- Bioclimatic oriented architecture project – Scenery approach
- Green roof (local vegetation in the building at two modules);
- Natural lighting using smart skylight system;
- Thermodynamic solar heating system for water and internal environment;
- Eco-designed furniture;
- Air cooling and humidity control system;
- Use of low environmental impact materials:
 - Gravel draining terrain permeabilization and external flooring from recycled materials
 - Certified internal wood flooring
 - Plastic wood (wood dust + recycled paper)
 - Carpet from recycled material
 - Share of internal walls, external covers and furniture on bamboo
- Wood-framed construction using double-glazed OSB panel walls;
- Temperature and acoustic isolation with recycled PET and tires;
- Wood-framed windows and specially developed double glass;
- LED for energy efficiency;
- Solar panels supplying up to 70% of energy consumption (addition of an electric car charging system under analysis);
- Rain water collection system for sanitary and cleaning appliance with UV treatment;
- Elevated flooring made from recycled material
- Smart grid systems of logic automation and security

CASAGRANDE, E. (2011)

- Federal Technological University of Paraná - UTFPR
- Carbon Neutral construction at Paraná State
- Enterprise-School on socioenvironmental management and sustainable construction systems
- Certification
- Green Office (Escritório Verde) – Model for sustainable and certified building
- CRIE – Curitiba:
 - Regional Center of Expertise Integration for Sustainable Development Education
 - Member of a 80 similar centers network
 - United Nations University (UNU) approved
 - Responsible for educational projects implementing

Comparative Study I

- **Production chain carbon estimates of two Social Interest House Units – 52 m²;**
 - Paraná State Housing Development Company – COHAPAR and;
 - Wood Products Lab of the Environmental Ministry – LPF/MMA
- **Carbon Emissions:**
 - **Construction materials:**
 - Cement; iron (steel); sand; bricks; transportation
- **Carbon sequestration and storage:**
 - **Forests:**
 - Above and below ground biomass:
 - **Harvested Wood Products:**
 - Wood parts:
 - Flooring; doorframes; windowframes etc
 - **Residues (negleteable):**
 - Recycle;
 - Energy;
 - Landfill

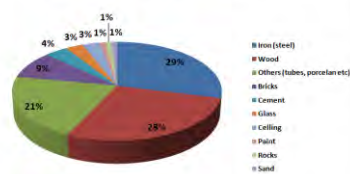


52 m² Social Interest House

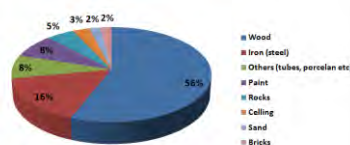
- **Combined: 12,1 tCO₂eq/unit**
 - **Less material, less emissions:**
 - LPF/MMA: 2,5 tCO₂eq
 - Cohapar: 12,9 tCO₂eq
 - **Wood – larger stock:**
 - LPF/MMA: 4,6 tCO₂eq
 - Cohapar: 2,9 tCO₂eq

Comparative Study 52 m ² Social Interest Houses						
Carbon of Wood Materials and Production Chain						
Item	Description	m ³	Wood materials		Production chain	
			Gross emissions (tCO ₂ eq)	Carbon sequestration (tCO ₂ eq)	wood (m ³)	log (m ³)
LPF/MMA	wood	9,1	2,5	4,6	13,1	32,8
COHAPAR	Cement X Iron	5,1	12,9	2,9	8,2	20,6
Balance			3,4	-10,4	4,9	12,2
						24,5

Cohapar Model - 67 items

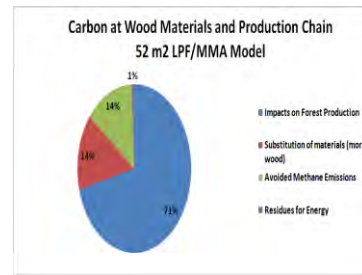


LPF/MMA - 62 items



Production Chain Environmental Impacts

- Impacts on Forest Production:
 - Wood from Sustainable Sources;
 - Transference of biomass to wood products allows increase of carbon sequestration and storage with same area
- Substitution of Materials (more wood):
 - Replacing materials with high associated GHG emissions;
 - Increase production of residues of biomass along production chain
- Avoided Methane Emissions:
 - Keeping residues for being displaced at landfill;
- Residues for Energy:
 - Substitution of fossil fuel burning



LPF/MMA 52 m2 Social Interest Houses
Carbon of Wood Materials and Production Chain

tCO2eq					
Item	Impacts on Forest Production	Substitution of materials (more wood)	Avoided Methane Emissions	Residues for Energy	Total
Unit of 52 m2	58,9	12,1	11,4	0,6	83
					830



Comparative Study II – Framed Houses

Production chain carbon estimates of two Social Interest House Units – 41 m2;

Paraná State Housing Development Company – COHAPAR and; Wood Products Private companies

Carbon Emissions:
Construction materials:
Cement; iron (steel); sand; bricks; transportation

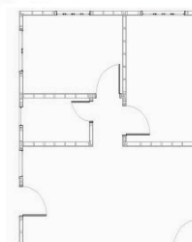
Tabela 1 - Comparativo de Emissões

DESCRIÇÃO DOS SUBSISTEMAS	Emissão de CO ₂ (kg)		
	COHAPAR	STEEL FRAMING	WOOD FRAMING
FUNDAÇÃO	1.293	1.161	1.161
ESTRUTURA PRINCIPAL	914,6	1.354,5	0,00
VEDAÇÕES EXTERNAS	1483	91,68	91,68
VEDAÇÕES INTERNAS	2878	99,78	99,78
FORRO DE PVC	197,5	197,5	197,5
COBERTURA	1.021	1.021	580,2
EMIÇÃO DE CO ₂	7.787,75	3.925,25	2.129,81
REDUÇÃO		50%	73%

Fonte: O autor (2011)



COHAPAR

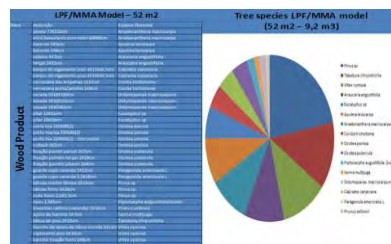
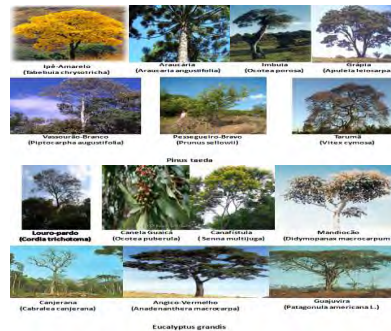


Wood Framing

Kobiski et al, 2011

Curitiba Tree Species Diversity for Wood House

- Natural and introduced species for industrial wood production;
- Use according with silvicultural and mechanical characteristics:
 - Cutting Cycle;
 - Density;
 - Workability;
 - Life-span;
- Commercial value of wood products at regional markets



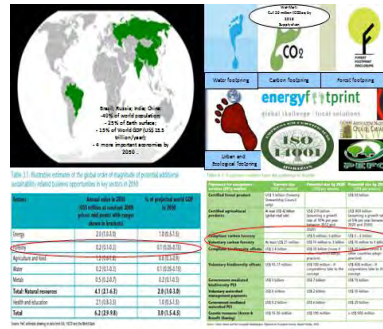
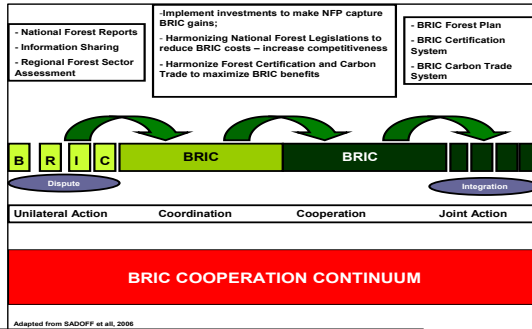
Forests and Green Economy

- Action Plan (UNECE):
 1. Production and Consumption of Wood from Sustainable Sources
 2. Low Carbon forest sector
 3. Green Jobs at forest sector
 4. Evaluation and PES from forests
 5. Forest sector governance and monitoring

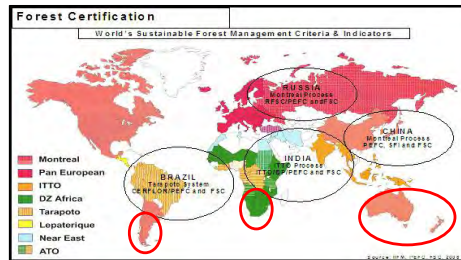


BRIC WOOD NETWORK

Step towards a Global Wood Network (+ UNECE+Mercosul)



- Mutual recognition and block transactions increasing
- Increase overall stocks of wood products
- Implement measures to account for trade on products and services:
- Ecosystem Services**
- Global Wood Network creation



World Wood Culture

Wood for a Better Planet Initiative - WBPI

Wood for a Healthier Planet Initiative - WHPI

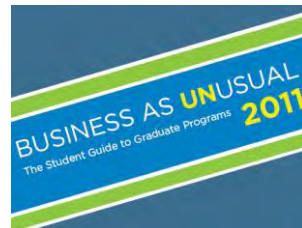
Wood for the World Initiative - WWI
Wood for the World Initiative - WWI

Conclusion

- Wood from sustainable sources hold strong potential for reducing global warming and poverty:
 - Construction
 - Forestry
- Wood production and consumption cope with Green Economy:
 - Income generation
 - Job creation
- Major opportunities for BRICS (South Africa) countries:
 - Network for promoting wood production and consumption
 - Harmonizing SFM C&I



Lahtvee, 2011



Thank you!

eder.zanetti@fulbrightmail.org

Wood for Housing in Ghana: Why the Low Interest?

Emmanuel Appiah-Kubi and Stephen Tekpetey³

Abstract

Timber, a renewable natural resource, has structural, non-structural and decorative advantages as a housing material. In Ghana, the use of timber for the construction of houses has faced many challenges in recent years. Existing timber houses constructed tens of years ago and are still standing, attest to timber's durability and its potential as a housing material. The call and desire for housing construction using timber has not been realized. This paper therefore reviews and highlights the reasons why there is low interest in the use of timber for housing in Ghana. Interviews and semi-structured questionnaires were administered to the general public, timber processing firms and timber-constructed households. Data were analysed using a descriptive statistical method. Overexploitation of timber in reserves, lack of design and detailing, and the inadequate expertise and skilled tradesmen in the timber construction industry are some of the technical reasons that account for the low patronage of timber for housing in Ghana. The public indicated some psychological reasons such as timber would be consumed easily by fire, and wood's susceptibility to insect attack and decay. There is also the perception that wooden houses are for the poor and those who cannot afford other materials such as concrete and steel. More research needs to be conducted to enhance the use of timber in housing through efficient processing methods, increased value-addition to wood products and advanced techniques in the timber housing industry. More expertise and skill tradesmen in timber construction need to be trained. Education and sensitization of the general public on accepting wood as a housing material needs to be promoted.

Keywords: wood, housing, low, interest, construction

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1. INTRODUCTION

Timber is one of Ghana's most readily available natural resources. The natural forest resources occupy an area of some 81,306 square kilometers, approximately one-third of the entire country and hold more than 400 indigenous hardwood species (Anon, 1996; Usher and Ocloo, 1979). In spite of the abundance of this natural resource very little of it is used structurally for construction in Ghana due to the prejudice against its use and lack of technical data on its properties such as strength and durability of most of the species, especially the lesser known ones.

Timber is a structurally sound material and compares favourably with concrete, steel, and stone and a variety of other materials in terms of strength per unit mass. Timber in its natural state can be used for many forms of construction (Jayanetti, 1998). As a construction material, wood is strong, light, durable, and flexible and easily worked with. In contrast to the substitutes for wood in structural purposes such as brick, metal, concrete and plastics, wood can be transported with little energy consumed and its resource is completely renewable (Koch, 1991). It can be produced from sustainably managed forests to achieve both economic and environmental benefits. It has high resistance to heat flow, that is, it is a good insulator and has low thermal capacity. These characteristics make it an inherently suitable material for building in hot humid climates like Ghana. Like both steel and concrete, timber can provide attractive buildings and greater durability and also design structures of almost any size with it.

In recent times, timber houses have been regarded as old fashioned and face replacement by other modern materials. Interest in using timber as a housing material has dwindled and is now almost inexistent. It is very difficult to locate a house built principally of timber or a house built with about 70% of materials being timber. Timber is at best used for roofing and ceilings, and also for making doors and windows in a building. There is therefore a low interest in using timber as a principal material for housing in Ghana. There are several factors accounting for this low interest in building with timber. Baiden et al. (2005) explored the key barriers inhibiting the use and potential of timber for housing construction in Ghana. They classified the barriers into two categories: technical and psychological barriers. The technical barriers included the absence of skilled tradesmen, lack of design and detailing by architects and engineers, the dwindling timber resource and the ineffective treatment of timber. Psychological barriers such as the fear of possible damage by insects and fungi and destruction by fire came up as a result of some of the technical barriers which had not been resolved. However, continued research into the efficient processing and utilization of Ghana's timber resource and the promotion of lesser known and lesser utilized species continue to address some of these challenges. Efficient treatment and preservation methods for different species of wood are available to ensure durability and resistance of wood members to insect and fungal attack in their service life. Available data on mechanical and machining properties of various species provide consultants in the construction industry with design properties for design and detailing. In spite of these interventions, the interest of the general public in building houses with timber is still very low. The current study therefore seeks to determine the reasons why interest in building with timber in Ghana is low after these interventions.

2. MATERIALS AND METHODS

The study was conducted in the Kumasi Metropolis in the Ashanti region of Ghana. The Kumasi Metropolis has a large number of timber processing firms and also has significant number of timber-constructed houses which were built decades ago and are still occupied.

Two hundred (200) members of the general public were randomly selected. Interviews were conducted at the timber processing firms, and also for personnel (architects, engineers) in the industry. Semi-structured questionnaires were administered to the general public some of which lived in timber-constructed households. The questionnaires sought to find out whether respondents had seen a timber house before or not and their opinions on using timber for the construction of their houses. Information gathered during the interview and questionnaire administration included reasons for not using timber and recommendation on timber housing. Data were analysed using a descriptive statistical method.

3. RESULTS AND DISCUSSIONS

3.1 Responses from General Public and Timber constructed households

Sixty-five percent (65%) of the respondents indicated that they have seen a timber house before as compared to about 35% who had not. The state of timber houses as identified by those who indicated to have seen a timber house is shown in Figure 1. It was observed that, of those who agreed to have seen a timber house, 55% described the state of the houses to be in a fair state, 25% judged them to be in a good state and 20% described the state of the buildings to be poor (Figure 5).

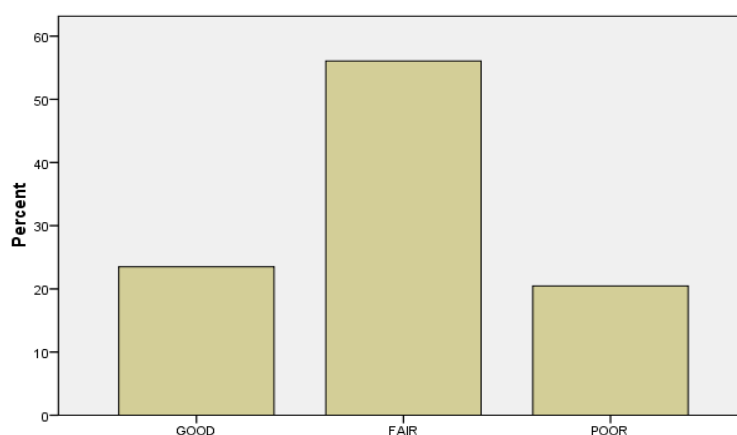


Figure 1: The state of timber houses seen by respondents

Out of the 200 respondents, only 22% had lived in a timber house compared to 78% who had never stayed in a timber house. Of those who lived in a timber a house, it was observed from Figure 2 that, about 38% of the respondents have stayed in timber houses for about 11 to 20 years. 30% had stayed in for about 1 to 5 years and 15% for more than 20 years. Only 5% of the total respondents had stayed in timber houses for just below 1 year.

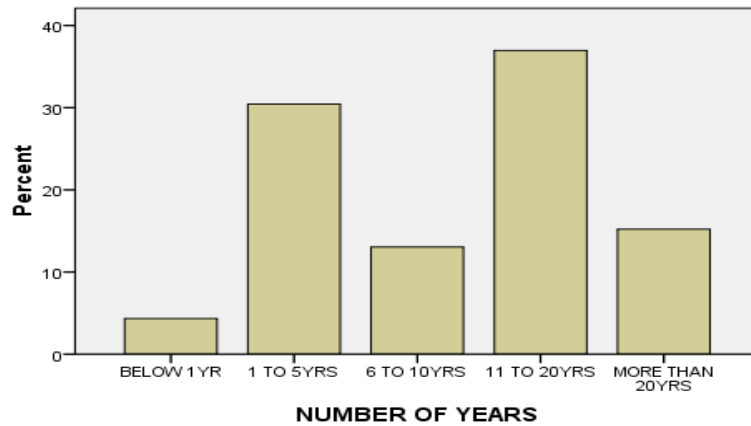


Figure 2: The number of years respondents had stayed in a timber house

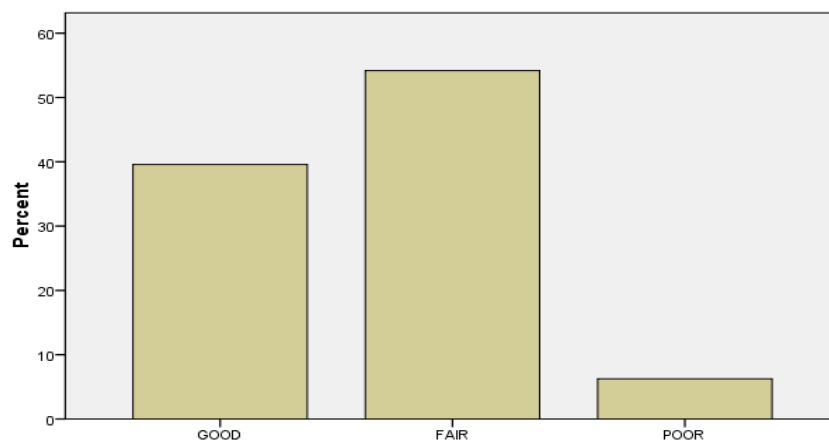


Figure 3: The condition of timber houses respondents are occupying

Further analysis of the data revealed that 55% of the respondents who lived in a timber house described the condition of the building to be in a fair state as shown in Figure 3. Forty per cent (40%) of the respondents described the buildings to be in a good state and the remaining 5% described the building to be in a poor condition. It can therefore be concluded that, most of the existing timber buildings in the Kumasi metropolis are in a fair condition.



Figure 4: A timber house in a good state



Figure 5: A timber house in a poor state

Table 1: Respondents reasons for not using timber for housing

Reasons	Frequency	Percentage out of 116 respondents (%)
Easily consumed by fire	105	91
Very costly	70	60
Not readily available	80	70
Easy break through by thieves	95	82
Susceptibility to insect attack and decay	94	81
Timber houses are for the poor	62	53
Timber houses are for those who cannot afford other materials such as concrete and steel	79	68
Serious destruction by flood as compared to blocks or bricks houses	97	84
Difficulty in acquiring lumber	87	75

Out of the 200 respondents 116 (58%) indicated that they would not consider building their houses with wood or live in house built with wood. Several reasons were given for this decision. 91% of them said they would not build their houses with wood because it is easily consumed by fire. Over 80% of the respondents indicated reasons such wood is susceptible to insect attack and decay, faces serious destruction by flood compared to brick or block houses, and its safety. There was 75% indication that there is difficulty in acquiring wood for construction so one would bother about building with wood. This reason supports earlier findings by Appiah-Kubi et al (2011) that local carpenters do not obtain their wood from sawmills because of the bureaucracies associated with obtaining wood from the mills. Some respondents (53%) also believe that timber houses are for the poor and so do not want to dream of building with timber. Most of the timber structures in Ghana are not aesthetically pleasing compared to the magnificent concrete and steel structures.

Table 2: Reasons for using timber for housing

Reasons	Frequency	Percentage out of 84 respondents (%)
Readily available	58	69
Hot or Cold weather does not affect timber frame housing	67	80
Less costly	59	70
Provides good ventilation	77	92

Out of the 200 respondents, 84 of them (42%) indicated their interest in building their house with wood. They gave several reasons for the decision. Ninety-two percent (92%) of respondents indicated that wood provides good ventilation, 80% indication that hot or cold weather does not affect timber frame housing and 69% indication that wood is readily available and less costly. In 2005, only 17% of the 200 respondents according to Baiden et al. (2005) would recommend timber housing in Ghana and indicated reasons such as it was attractive (42%), faster to build (29%) and easy to work with (29%). The reasons indicated by the public in this current study means that the public is gradually getting to understand the properties of wood as a material.

Baiden et al (2005) established that about 83% of the public would not live in timber houses. Even though the gap between the two has narrowed over the years through interventions (research and promotion), there is still a considerable majority of people who would not live in a wooden house or build their house with wood for the reasons aforementioned.

3.2 Responses from technical personnel

Interviews conducted at the wood processing firms in the metropolis indicated that, almost all the firms do not supply the local market (carpenters) with wood because of reasons such as the high cost of production, the demand from the export market and the need to get foreign exchange. The majority of wood used domestically in Ghana is obtained from illegal sources (chain-sawn lumber). The timber processing firms (saw millers) therefore do not encourage

the use of wood for domestic housing in order not to put pressure on the dwindling wood resource.

The availability of information on physical, mechanical and machining properties of wood species in Ghana has not influenced the choice of architects and engineers in material selection during design. They still design and build in concrete and steel, with glass and plastics for furnishings. Wood is mainly used for roofing, ceiling, making doors and windows in construction. There is inadequate training in the design and detailing of timber structures hence the capacity gaps in building with timber. Very little is taught in Timber Engineering in Ghanaian educational institutions to promote efficient utilization of wood hence the lack of expertise in the timber construction industry.

It was observed that foresters in Ghana do not encourage local housing with wood because of the overexploitation of timber in reserves by illegal operators for domestic needs.

4. CONCLUSIONS AND RECOMMENDATIONS

In spite of wood's many favourable advantages as a housing material, it is not generally being used for housing construction by professionals in that they do not recommend it to clients. Previous study done by Baiden et al. (2005) confirmed that the general public is widely not interested in living or building their houses with wood.

The public indicated some psychological reasons such as timber would be consumed easily by fire, faces serious destruction during flooding and wood's susceptibility to insect attack and decay. There is also the perception that wooden houses are for the poor and those who cannot afford other materials such as concrete and steel. Most of the timber structures in Ghana are not aesthetically pleasing compared to the magnificent concrete and steel structures.

Overexploitation of timber in reserves, lack of design and detailing, and inadequate expertise and skilled tradesmen in the timber construction industry are some of the technical reasons that still remain and account for the low patronage of timber for housing in Ghana. The reasons indicated by the public in this current study means that the public is gradually getting to understand the properties of wood as a material.

It is therefore recommended that more research needs to be conducted to enhance the use of timber in housing through efficient processing methods, increased value-addition to wood products and advanced techniques in the timber housing industry. Furthermore, more expertise and skill tradesmen in timber construction need to be trained. Education and sensitization of the general public on accepting wood as a housing material needs to be promoted. Plantations of fast growing species and the promotion of non-timber forest products (NTFPs) such as bamboo should be intensified to supplement dwindling timber resource. The availability of enough resource would encourage the use of wood for housing.

5. ACKNOWLEDGEMENTS

The authors express their profound gratitude to Joseph Asante, a statistician, for his support in collecting and analysing the data during the study. Many thanks to the Food and Agricultural Organisation (FAO) for providing support to actively participate in an International conference on the Art and Joy of Wood Conference in Bangalore, India.

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REDISCOVERING WOOD: THE KEY TO A SUSTAINABLE FUTURE
The International Conference and Exhibition on the Art and Joy of Wood
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WOOD FOR HOUSING IN GHANA: WHY THE LOW INTEREST?

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WOOD FOR HOUSING IN GHANA: WHY THE LOW INTEREST?

Emmanuel Appiah-Kubi

OUTLINE OF PRESENTATION

- Introduction
- Objective of the study
- Methodology
- Results and Discussions
- Conclusions
- Recommendations
- Acknowledgements



INTRODUCTION

- Timber, a renewable natural resource, has structural and decorative advantages as a housing material.
- Timber is one of Ghana's readily available natural resource
- Wood can be transported with little energy consumed compared to other materials in structural applications such as brick, metal, concrete (Koch, 1991).
- It has high resistance to heat flow which makes it a suitable material for building in hot humid climates

INTRODUCTION

- Wood in its natural state can be used for many forms of construction (Jayanetti, 1998)



INTRODUCTION

- Existing timber houses are still standing, which attest to timber's durability and its potential as a housing material.
- In recent times, timber houses have been regarded as old fashioned and face replacement by other modern materials – steel, plastics, concrete, glass
- Very little of wood is used structurally for construction in Ghana due to the unfounded prejudice against its use and lack of technical data on its properties such as strength and durability of most of the species, especially the lesser known ones (Usher and Ocloo, 1979).

INTRODUCTION

- Baiden et al (2005) explored the key barriers inhibiting the use and potential of timber for housing in Ghana. They classified the barriers into two;
 1. Technical barriers - the absence of skilled tradesmen, lack of design and detailing by architects and engineers, the dwindling timber resource and the ineffective treatment of timber
 2. Psychological barriers - the fear of possible damage by insects and fungi and destruction by fire
- Efficient treatment and preservation methods for different species of wood are available to ensure durability and resistance of wood members to insects and fungal attack

OBJECTIVE OF STUDY

- The objective of the study is to determine the reasons why interest in building with wood in Ghana is low.

METHODOLOGY

- The study was conducted in Kumasi in the Ashanti region of Ghana



METHODOLOGY

- Interviews were conducted at the timber processing firms, and also for personnel (architects, engineers) in the construction industry
- Two hundred (200) members of the general public were randomly contacted
- Semi-structured questionnaires were administered and interviews conducted
- Data were analyzed using descriptive statistical methods

RESULTS AND DISCUSSIONS

- 65% of the respondents had seen timber house before whilst 35% who had never seen a timber house their lives
- 55% of those who had seen a timber house, described the state of the houses to be in a fair state, 25% judged them to be in a good state and 20% described the state of the buildings to be poor

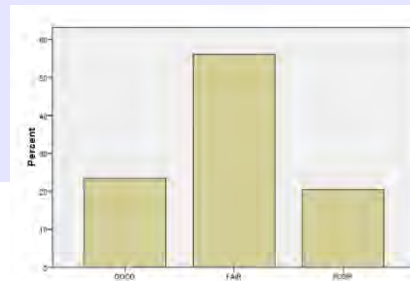


Figure 1: The state of timber houses seen by respondents

RESULTS AND DISCUSSIONS



Timber house in a good state



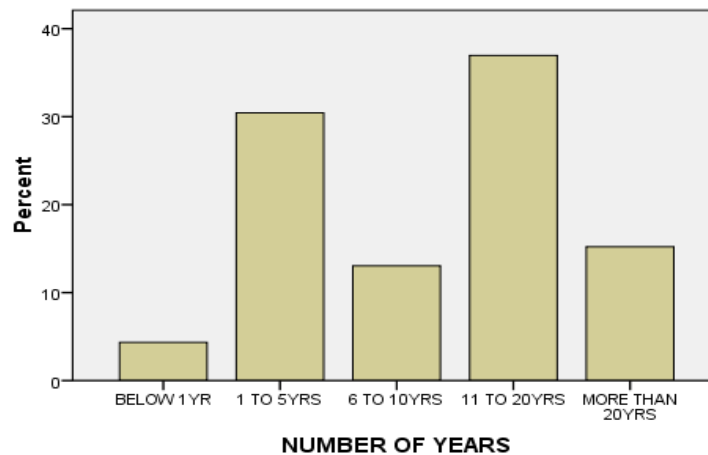
Timber house in a fair state



Timber houses in a poor state

RESULTS AND DISCUSSIONS

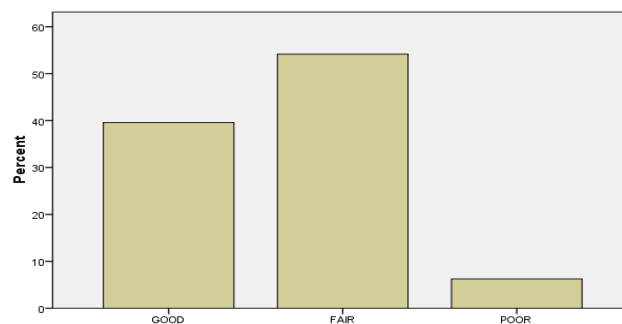
- 22% of the 200 respondents lived in a timber house compared to 78% who had never stayed in a timber house.



The number of years respondents had stayed in a timber house

RESULTS AND DISCUSSIONS

Most of the timber buildings in Kumasi are in their fair conditions



The condition of timber houses respondents are occupying

RESULTS AND DISCUSSIONS

- 58% of the respondents indicated that they would not consider building with wood or live in house built with wood.

Table 1: Reasons for not using timber for housing

Reasons	Frequency	Percentage out of 116 respondents (%)
Easily consumed by fire	105	91
Very costly	70	60
Not readily available	80	70
Easy break through by thieves	95	82
Susceptibility to insect attack and decay	94	81
Timber houses are for the poor	62	53
Timber houses are for those who cannot afford other materials such as concrete and steel	79	68
Serious destruction by flood as compared to blocks or bricks houses	97	84
Difficulty in acquiring lumber	87	75

RESULTS AND DISCUSSIONS

- 42% indicated their interest in building their houses with wood

Table 2: Reasons for using timber for housing

Reasons	Frequency	Percentage out of 84 respondents (%)
Readily available	58	69
Hot or Cold weather does not affect timber frame housing	67	80
Less costly	59	70
Provides good ventilation	77	92

RESULTS AND DISCUSSIONS

- Interviews conducted at the wood processing firms in Kumasi revealed that, almost all the firms do not supply the local market (carpenters) with wood for housing for the following reasons:

1. the high cost of production,
2. demand from the export market
3. the need to get foreign exchange
4. dwindling timber resource



RESULTS AND DISCUSSION

Professional (architects, engineers) interviewed revealed the following reasons:

- There is inadequate training in the design and detailing of timber structures hence the capacity gaps in building with timber in Ghana
- lack of expertise in the timber construction industry.
- the overexploitation of timber in reserves by illegal operators for domestic needs

CONCLUSIONS

- The public indicated some psychological reasons such as the fear that wood can be easily consumed by fire, faces serious destruction during flooding and wood's susceptibility to insect attack and decay
- There is also the perception that wooden houses are for the poor and those who cannot afford other materials such as concrete and steel



CONCLUSIONS

- Overexploitation of timber in reserves, lack of design and detailing, and inadequate expertise and skilled tradesmen in the timber construction industry are some of the technical reasons that still remain and account for the low patronage of timber for housing in Ghana

RECOMMENDATION

- More research needs to be conducted to enhance the use of timber in housing through efficient processing methods, increased value-addition to wood products and advanced techniques in the timber housing industry
- More expertise and skill tradesmen in timber construction need to be trained
- Plantations of fast growing species and the promotion of non-timber forest products (NTFPs) such as bamboo should be intensified to supplement dwindling timber resource
- Education and sensitization of the general public on accepting wood as a housing material needs to be promoted

ACKNOWLEDGEMENTS

- Many thanks to the Food and Agricultural Organization (FAO) for providing financial support and making it possible to present the findings of the study at the Art and Joy of Wood Conference in Bangalore, India

Vernacular Architecture for Sustainable Development - A Case Study of South Canara Region

Roshan Shetty⁴ and Shantaram Patil⁵

Abstract

Wood is a historic, classic and durable building material that has long life, good tactile warmth, aesthetics and a natural flair to buildings for thousands of years. Wood has many attributes that make it a smart environmental choice. It is the only major building material that is renewable, recyclable & sustainable over the long term and it is a natural choice when it comes to climate change. Wood has been widely used as a building material in the vernacular architecture. The vernacular architecture in the South Canara region of Karnataka state has evolved over time to reflect the environment, cultural and historic context. These houses were built in response to actual needs using the natural resource wood that is available locally and which fitted well into the environment. It was influenced by a wide range of different aspects of human behaviour and environment, thus leading to different building forms for almost every different context. The building forms were greatly influenced by the lifestyle of the occupants and the way they used their shelters. These houses are the witness of the skills in the workmanship and craftsmanship of ancestors. The restoration and conservation of the vernacular houses, temples, wood crafts and artefacts of the South Canara region is undertaken by the Heritage Village, Hasta Shilpa Foundation, Manipal, South Canara. Understanding the principles of vernacular architecture and learning fundamental lessons from them and adapting these in the contemporary architecture. This paper illustrates how the essence of vernacular architecture can be used to protect the culture and the tradition of wood in the current urban context for a sustainable future. Thus the heritage villages serve as an inspiration for the future posterity and contribute to sustainable development and present new opportunities for development of the wood.

Keywords: wood, vernacular architecture, sustainable development, environment.

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1. INTRODUCTION

It is believed that the vernacular houses in the South Canara region have sustained for more than 4 to 7 centuries. The Vernacular houses were made of predominantly locally available building materials in the region i.e. mud and wood. A wide species of wood like bhogi, jack, teak etc. were extensively used for the construction. The vernacular architecture is climate responsive and is a reflection of the customs and lifestyles of a community. They were environmentally fit and well suited to the surrounding nature. Vernacular Architecture was based on the knowledge of traditional practices and techniques of our ancestors. They were self-built and reveal a high regard for workmanship, craftsmanship and quality.

The vernacular architecture of the South Canara has rich cultural and heritage value. These built forms, which are of region-specific, are a result of centuries of experimentation which are shaped by social, cultural, religious and technological influences. These were continuously refined by trial and error based on the changes in societal characteristics and technology. As a result, these built forms have served their purpose very well, being extremely sustainable and appropriate to their setting and satisfying the functional and aesthetic aspirations of the users. But there has been a rapid change in the built form the last few decades due to growth and the development of the society and thus there has been a drastic change in the past and the present built form. The regional architecture has an incredible potential for influencing the current architectural trends in that region. The various aspects of the heritage dwellings as a special value conveying a specific image, also understanding and interpretation of these as heritage site has been well discussed by Ajai Chandran and Krishne Gowda (2010).

1.1 Wood - A renewable resource

The qualities of wood as a historic, classic and durable building material that has leant longevity, good tactile warmth, aesthetics and a natural flair to buildings for thousands of years has been discussed by Barbara Horwitz-Bennett and C. C. Sullivan (2008). Wood is one of the oldest materials that have been used in the construction and probably the most versatile.

Wood is the only renewable source for building materials. It comes from forests that are continually being replanted as they are harvested. This practice ensures a plentiful supply of wood for construction and for innumerable of other uses. Young forests grow vigorously and store greater quantities of carbon. As trees mature, this rates slows down. Harvesting older trees helps keep the forests young while at the same time locking up carbon in our buildings. From this perspective, it is better to harvest a forest before it is over mature. Sustainable forest management practices ensure that the carbon absorbing properties of the forest are preserved. In addition, energy generation from wood residues like leaves, tree waste etc. reduces the need for fossil fuels.

1.2 Wood as a green building material

Wood is very warm material. Massive wood has a great warmth capacity. That is, there is a lot of accumulating mass. In vernacular houses, wood balances out the temperature changes in different times of day keeping the interior temperature comfortable. In summer the atmosphere is pleasantly calm and in winter smoothly warm. Wood also possesses significant, positive environmental attributes. Wood is the only single major renewable

building material, and it also requires less energy to manufacture than any other building material. The selection of environmentally responsible building material is an aspect of sustainable building. Wood is thermally efficient and easy to insulate.

Wood offers advantages in construction applications such as warmth and beauty, flexibility, durability, workability, high strength to weight ratio, good electrical insulation, low thermal conductance and excellent strength at low temperatures. It has high shock absorption capacity. It can be easily bent or moulded to relatively sharp curative. Life Cycle Assessment also demonstrates that the environmental profile of wood offers a clear advantage over other major building materials. Wood structures are also recognized to be among the safest building structures in an earthquake and in areas that face a risk from high winds.

1.3 Wood for sustainable development

“Sustainable development is a development pattern which focuses on efficient resource use to meet human needs while preserving the environment so that these needs can be met not only in the present, but also for future generations to come” as quoted by Brundtland (1987) . Wood restores the carbon dioxide and then purifies the air we breathe. Wood plays a positive role in a healthy ecosystem. It not only adds oxygen into the air but also absorbs the carbon dioxide greenhouse gas we add to the atmosphere through our daily use of energy from fossil fuels. Wood is a naturally perfected building material. Man-made building materials simply add harmful pollutants to our environment in the process of manufacturing, while dynamic nature of a growing forest helps the environment for years before the wood becomes a building material. Using wood for the construction will keeps this natural cycle unbroken and maintains healthy forests, and thus promotes a better environment for earth’s inhabitants.

Sustainability is also about maximizing the resources that are locally available so as not to waste, damage or exhaust them. The longevity of buildings makes it even more important to use sustainable construction to maximise the efficiency of the building and the quality of life for future generations. The studies of vernacular Architecture for sustainable development are discussed by Ashwani Kumar and Navneet Munoth (2011).

2. VERNACULAR ARCHITECTURE AS A SUSTAINABLE BUILT FORM

The vernacular houses in the South Canara region of Karnataka comprises of the dwelling as well as other buildings relating to environmental context, using local available materials and utilising traditional technologies, have evolved over time to reflect the environment, cultural and historic context. These houses were built in response to the actual needs using the natural resource wood and fitted well into environment.

It was influenced by a wide range of different aspects of human behaviour and environment, thus leading to different building forms for almost every different context. The houses have various devices that are built into their design promotes the cooling of interior spaces and also facilitate the flow of breeze. The aspects of energy efficiency of vernacular houses and passive cooling measures are discussed in the paper by Anantha Krishna et al. (1993).

The building forms were greatly influenced by the lifestyle of the occupants and the way they used their shelters. These houses are the witness of the skills in the workmanship and craftsmanship of ancestors. The buildings reflected the thoughtful process of the ancestors

and the way of their life, culture and tradition. The vernacular architecture was built to meet specific needs of the people, accommodating their values, economies and ways of living of the culture by the people. The materials, construction techniques and various components of Vernacular Architecture are discussed below.

2.1 Materials and construction techniques

Mud and wood, the locally available materials were used for the construction extensively in the region. These materials were used for superstructure in the majority of the buildings. The walls were of mud mortar and were supported on granite foundation (Ref Fig 1). The thickness of the walls ranged from 40 cms to 80 cms in the ground and the upper storey.

The wooden columns and the beams acted as the structural members (Ref Fig 2) and the mud walls also took the load of the roof in some places and acted as barriers in some spaces of the house. The wooden columns are very stout and taper from bottom to top, carrying heavy wooden beams, which in turn support secondary beams, battens and wooden planks.

To prevent warping of the planks, used for false ceiling, a layer of mud is placed over them and finished with mud plaster to a smooth surface. The wooden beams transfer their weight to the columns with the help of the brackets attached to the capital of columns. The wooden columns are placed at close intervals of approximately 2.5 metres to carry load of the roof. The wooden floor and the wooden ceiling consist of battens and planks supported on wooden beams. The extensive use of mud and wood has helped in achieving considerable heat insulation inside the house.



Figure 1: The front elevation of the vernacular house of South Canara



Figure 2: View of the balcony

2.2 Detailing and ornamentation in wood

Wood has been extensively used as a building material. The extensive use of wood, which is an easily workable material, has led to a profusion of detailing and ornamentation in the houses. The houses reflect high order of workmanship and craftsmanship prevalent in the region about centuries ago. The higher the status of the owner of the house the more elaborate are the carvings and decorative features. The massive, heavily carved wood work is

supported by heavy wooden column which is beautifully carved shows the workmanship and craftsmanship of the ancestors (Ref Fig 3). The sloping, lean to roof over the front open veranda has many layers of wooden components.

The decorative rafters, which form the bottom most layers, are supported on wooden beams. The wooden planks of 25mm to 50mm thickness are laid out over the rafters and a layer of mud covers these planks and over the mud layer will be another set of rafters. These rafters support wooden battens and mangalore tiles. This method of roofing requires plenty of wood, thus it is very effective in reducing the transmittance of solar radiation absorbed by the roof. An interesting pattern of wood work can also be seen decorating the ceiling in the open veranda also.



Figure 3: Interior view of the vernacular house



Figure 4: The wooden swing seat hung from the wooden ceiling

There are large overhangs of tiled roof which protects the enclosure and external walls. Wooden inverted 'L' shaped brackets are inserted into the wall at an interval of 2.5 meters so as to project about 1.2 meters on the aide of the wall. Wall plates sit on the brackets and the rafters, in turn, are support on the wall plates. On the inner side of the walls is a corridor, which is also covered on an identical overhang. This roofing over the high wall not only serves to protect wall from rain and Sun but also provides a similarity in roof form, with the rest of the house. The wooden swing-seat is also a part of the vernacular house (Ref Fig 4).

2.3 Doors and windows

The window has a solid wooden frame and can be closed on the inside by two heavy shutters, one folding up, and the other down or folding from either side (Ref Fig 5). The lower shutter becomes a window seat, with a pair of legs, hinged in wood, swinging out to support it as it is lowered. The upper shutter is held by wooden catches. Some windows have barred windows, closed internally by sliding panels. The door is smaller in size and has a solid wooden frame around it. The wooden bolts, which also have a locking system, are widely used for securing two leafed doors from inside (Ref Fig 6).



Figure 5: Wooden doors



Figure 6: Wooden bolts

2.4 Corridors

Most of the corridors on the periphery of the house have wooden frame work from the ground floor to the upper storey. The sloping roofs have large overhangs from the corridor which are supported by the wooden pillars (Ref Fig 7 & 8).



Figure 7 Slender columns in the corridor



Figure 8 View of the corridor

2.5 Columns and beams

The wooden columns and the beams are the major components of the vernacular houses and acted as the structural members that took the load of the roof. The wooden columns are very stout and taper from bottom to top, carrying heavy wooden beams, which in turn support secondary beams, battens and wooden planks. The massive heavy wooden columns are elaborately carved with decorative features. Not only the columns are beautiful and

intricately carved and designed, but also the beams and the struts. Wooden columns and struts are usually carved with geometric and stylized figurative motifs and show the workmanship and craftsmanship of the ancestors (Ref Fig 9 & 10).



Figure 9: Decorative wooden column



Figure 10: View of the heavy and the slender wooden columns

2.6 Staircases

These wooden stairs were used for vertical movement from the ground floor to the upper storey and to the attic. The stairs are a flight of wooden treads and risers between solid wooden side planks (Ref Fig 11 & 12). They are held together by mortice and tenon joints and by wooden peg.



Figure 13 View of the courtyard



Figure 14 View of the wooden ceiling

2.7 Courtyard

A courtyard in the vernacular house is the central open space and used by women for their work and for many other purposes also. Living spaces are organised around the courtyard and are of wooden ceiling. The roof drains into the central area and from there out of the house. Wall motifs of animals are seen in the inner walls of the house. The interior courtyard also acts as a ventilator and illuminator for the interior (Ref Fig 13 & 14).



Figure 11: View of the staircase



Figure 12: The treads are held by planks on either side

3. CONCLUSION

The vernacular architecture is not only to study about the past history, culture and traditions, but also should contribute to the present and future needs of the built form. We should understand, appreciate, preserve, conserve the cultural heritage of the region and also enhance the environmental quality of the vernacular architecture which has been handed over to us for generations from our ancestors.

As wood is a natural perfected building material, it has got various environmental benefits over other man made building materials. One should understand the low impact of the vernacular houses on the environment over the other modern buildings. There is a need to grow more forests, from this there is enough production and supply of wood and wood products for the construction industry. Growing more forests not only helps in supplying the raw materials (wood based products) for construction but also gives us raw material for furniture. Forests also help to protect the land from erosion, strong winds and waves. It helps in absorbing CO₂ and supplies O₂, thus purifying the atmosphere. This quality of forests also helps sustainable development. We need to ensure that the treasure we have i.e., the forests will be there for our future generations and helps the natural cycle to be intact also.

The design principles and approaches of the vernacular houses should be implemented for the building we design and build. By this the vernacular houses become an essential factor for the sustainable development. Thus these vernacular houses of the region will serve as an inspiration for the future posterity and contribute to sustainable development and present new opportunities for development of the wood. Thus the vernacular houses and the wood provide a sustainable livelihood.

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Vernacular Architecture for Sustainable Development – A Case Study of South Canara Region

By



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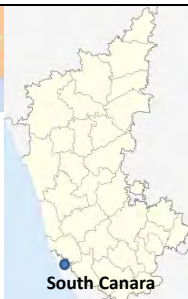


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REDISCOVERING WOOD: THE KEY TO A SUSTAINABLE FUTURE
The International Conference and Exhibition on the Art and Joy of Wood
Bangalore, India, 19-22 October 2011



LOCATION / GEOGRAPHY

South Canara is a coastal district in the state of Karnataka. The Arabian Sea bounds it on the west and Western Ghats in the east. Major rivers flow through the region which all join Arabian sea. Vast areas of evergreen forest covers the region, but now has been depleted due to rapid and unplanned urbanization and hectic commercial activities. South Canara has an area 4,866 square kilometres, and a population density of 390 persons per square kilometre. There are 354 villages in the district.

CLIMATE

The climate in Udupi is hot in summers and pretty good in winter. During summers (from March to May) the temperature reaches up to 40 °C and in winters (from December to February) it is usually between 32 °C and 20 °C.

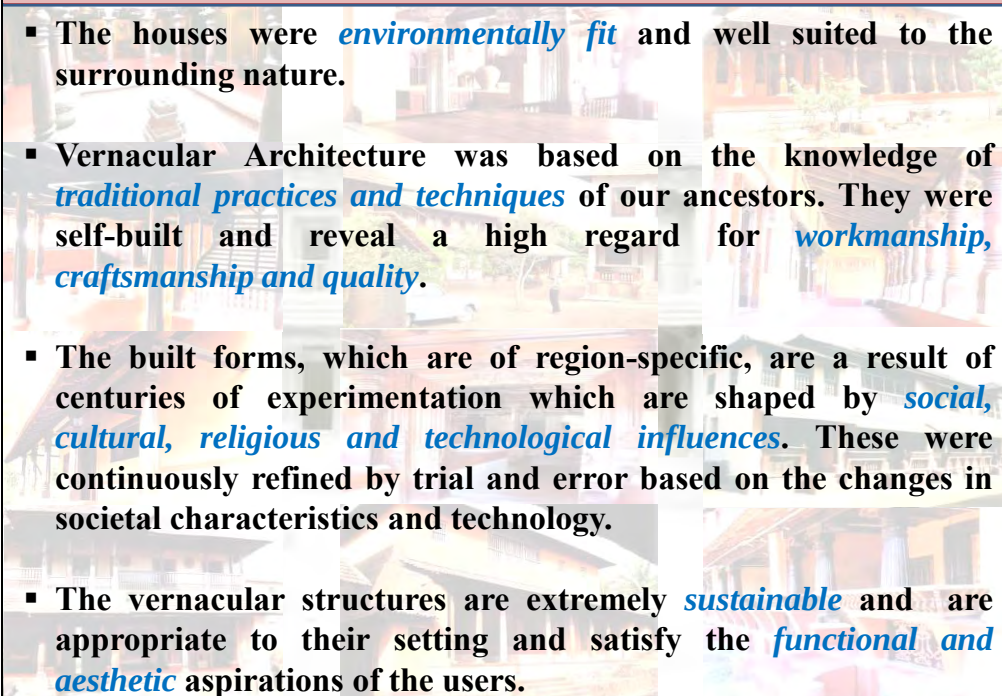
The monsoon period is from June to September with one of the rainfall averaging more than 4000mm every year and heavy winds.

VEGETATION

South Canara is a very beautiful, scenic, and picturesque place, containing lush green vegetation, forests, and fertile crop fields. The Udupi district has thick evergreen forests in the eastern part. They form part of Sahyadri or Western Ghats of India. These forests have wide range of flora and fauna. A wide species of wood like Bhogi (Teak), Karmara (Ebony), Wild Jack, jack and many other native trees grow in the region.

Vernacular Houses of South Canara	
- Vernacular houses have sustained for more than 4 to 7 centuries. - The vernacular architecture of the South Canara has got rich cultural and heritage value. - They were predominantly made of locally available building materials i.e. mud & wood. - A wide species of wood like Bhogi (Teak), Karmara (Ebony), Wild Jack, jack and many other native trees were extensively used for the construction of these houses. - The vernacular architecture is climate responsive. - The houses reflect the customs and lifestyles of the community.	- The houses were environmentally fit and well suited to the surrounding nature. - Vernacular Architecture was based on the knowledge of traditional practices and techniques of our ancestors. They were self-built and reveal a high regard for workmanship, craftsmanship and quality. - The built forms, which are of region-specific, are a result of centuries of experimentation which are shaped by social, cultural, religious and technological influences. These were continuously refined by trial and error based on the changes in societal characteristics and technology. - The vernacular structures are extremely sustainable and are appropriate to their setting and satisfy the functional and aesthetic aspirations of the users.

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Vernacular Houses of South Canara		
	Regions cultural wealth expressed in the form of traditional buildings, objects of art, craft and other artefacts of aesthetic interest, dating several hundred years ago.	
	Traditional Houses of different community . . .	
	Kunjur Chowkimane . . . <i>The Brahmin priests house</i> Hungaracutta Bansaale Mane . . . <i>A trader's house</i> Harkur Olaginamane . . . <i>The Bunt house</i> Vaderhobli House . . . <i>The Bunt house</i> Byndoor Nelyadi House . . . <i>The Bunt house</i> Yerukone House . . . <i>The landlords house</i> Hengavalli Korra House . . . <i>The landlords house</i> Bhatkal Muslim House . . . <i>The muslims house</i>	
		
		

KUNJUR CHOWKIMANE



Elegant main entrance of the house



The courtyard



Low wooden ceiling

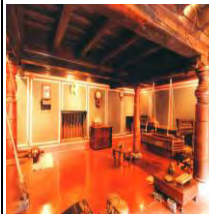


Wooden windows

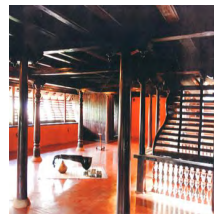
It is a two-storied house, with a hipped roof sloping down into the central courtyard. This allows not only light to flow into the central core, but rain as well, and the water is collected and drained off through an outlet provided at the floor level.

Large wooden windows punctuated and openings covered by a wooden plank for the shutter which doubles up as a seating when it is opened.

On reaching the first floor, the whole space expands into a large hall with a low wooden ceiling and has wood partitioned rooms in the corners .



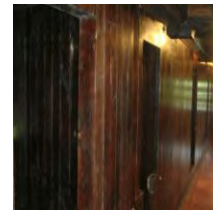
Elegant interior of the house



The first floor of the house.



wooden column supports the wooden swing

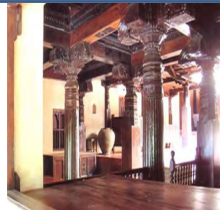


wood partitioned rooms

HUNGARACUTTA BANSAALE



Main entrance of the house



Elegant interior of the house

BANSAALE refers to a trading house and warehouse. The houses were built along the coastal towns / riversides to facilitate trade between production and consumption centres. Trade happened through river and sea.

The structure of the Hungaracutta Bansaale mane was planned in such a way as to facilitate and merge the dual purpose of its function as a workplace and residence very effectively. The front portion facing the harbour, logically became the business block while the trader's residence portion was located at the rear separated by a court left open to the sky.

The main roof slopes down covering a tapered wood pillared portico on either side of the main entrance.

As the *Bansaale mane* was located on the banks of the river facing the sea it was roofed with steep slopes and deep overhangs to ensure the drainage of the monsoon effectively so that the commodities stored remained dry.

Robust circular and square columns with heavy brackets carved with geometrical patterns span the whole interior of the business area providing the customer an impression of awe coupled with stability and prosperity, indicating the status of the trader in the local community

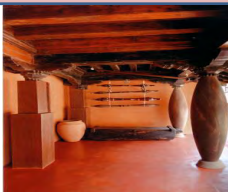


Intricately carved wooden column



Corporate office of the trader

VADERHOBLI HOUSE	BYNDOOR-NELYADI HOUSE
 The <i>juglies</i>; the upper one has robust square-shaped pillars with a bell-shaped capital and a bracket assembly that support a planked ceiling resting on thick beams and joists, the lower jugli has tapering octagonal columns. Frontage of the house The hall opens into a narrow balcony covering its entire length, with a square projection with ornate columns.  Rear side of the house A lean-to-roof projecting from the wall -- the rafters being unusually deep and curved, rest on slender columns and covers the walkway running across its length.  Balcony of the house	 Entrance door leading to the courtyard The outer verandah serves as the social space, where visitors, traders who call on the landlord are met, and the family uses the inner space as a living area.  Frontage of the house The usage of rosewood for the columns and much of its structural components coupled with intricate precise carvings made by traditional wood carvers or <i>gudigaras</i>, indicates the prosperity of the family.  Main entrance

YERUKONE HOUSE	HARKUR OLAGINA MANE
 Main entrance The <i>hebbagila chavadi</i> serves as the meeting forum. The close relative would wait on the same verandah by his side. The trader, would sit at the same level but on the opposite verandah. The public or an acquaintance would sit on the lower verandah and, the farm-tenant would stand just beneath the lower verandah. Each class of people had a designated place in the <i>chavadi</i>  Doorway The front block is rectangular in plan, sitting on a high plinth with pillared two-tiered verandahs running along its length on both the faces of the house, separated by a wall.  View of the house	Hebbagila chavadi is a high verandah on two sides of both the exterior and interior, separated by a large wide door, which was kept open through the day. The verandah on both exterior and interior were lined with wooden pillars.  portion of the portico The unique feature is that the columns of the front verandah are modelled to resemble the mridangam, a percussion instrument associated with the folk art form of Yakshagana and Carnatic music  Frontage of Harkur Olaginamane with a chain of drum-shaped load-bearing wooden columns

HENGAVALLI KORRA HOUSE



Frontage of the house



Front verandah of the house

High quality timber were used for the house construction. The Korra family used ample amount of timber to build this house few decades ago. The entire load of wooden logs was brought to the site for turning on wooden lathe to make circular columns to support the outer verandah of the house

The whole spatial arrangement in the interior is compact and a low wooden ceiling further enhances the coziness of the space. A small wooden staircase leads to the first floor where rooms are created by partitioning of the whole floor

The house consists of an outer pillared verandah, attached to an 'L'-shaped *jugli* of the main house. This verandah with its stout wood-turned columns, placed successively along its length creates an impressive colonnade. A high ceiling panelled to the lean-to-roof resting on these columns adds volume and richness to this *jugli*.

The 'L' shaped *jugli* with square-shaped columns, accessed from this verandah, serves as the space for the family to have get-together. A small independent room at the end of the 'L' is used to store implements and tools associated with agricultural operations, the principal occupation of the house owners. A long ledge all along the southern wall serves as a seat or to lie down and has a storage facility at the base.



Upper jugli of the house



Wooden pillar

BHATKAL NAVAYATH MUSLIM

HOUSE



The exterior of the Bhatkal Navayath Muslim House

Two cylindrical pillars with richly carved brackets define the entry into the fore-part, while two half-pillars rest touching the wall on both ends.

Navayath pocket present a delightful spectacle of wood-rich houses each blending with the other in the most harmonious way. The ornate main door has couplets from the Holy Quran engraved on the lintel, placed centrally to the width of the house.



The front jugli of the house

A well-made wooden ceiling rests on a beam running across the entire width of the house, taking support from these four pillars. The most unique element which has no precedence in any other vernacular architecture of Karnataka, are the seats positioned between the full and the half-pillar on both the sides.



A latticed

The seats finely shaped and successively placed vertical elements that hold a corniced handrail, which provides the user, an armrest.



Intricate carving

A small lean-to-roof with delicate rafters offers protection to the wooden seats and *jugli* in the verandah.



Ornamental window

Wood . . . A natural resource

QUALITIES OF WOOD

- Wood is a historic, classic and durable building material.
- Wood has good tactile warmth, aesthetics and longevity.
- Wood is one of the oldest materials that have been used in the construction and probably the most versatile.
- Wood is the only renewable source for building materials.

Wood . . . A renewable resource



Courtesy: APA_Green_Building_Brochure

- Wood is the only single major *renewable building material*, and it also requires less energy to manufacture than any other building material.
- It comes from forests that are continually being *replanted* as they are harvested. This practice ensures a plentiful *supply* of wood for construction and for innumerable of other uses.
- Young forests grow vigorously and store greater *quantities of carbon*. As trees mature, this rates lows down.
- Harvesting older trees helps keep the forests young while at the same time locking up carbon in our buildings. From this perspective, it is better to *harvest* a forest before it is over mature.

Wood . . . Green building material

- **Life Cycle Assessment (LCA)** shown that wood offers clear environmental advantages over other building materials.
- LCA has assessed the overall effects of building material on the environment which includes all activities from material extraction/harvesting through manufacturing, transportation, installation, use, maintenance, disposal and reuse.
- When considering environmental impact using Life Cycle Assessment, wood outperforms steel, concrete and glass *in the following ways*:

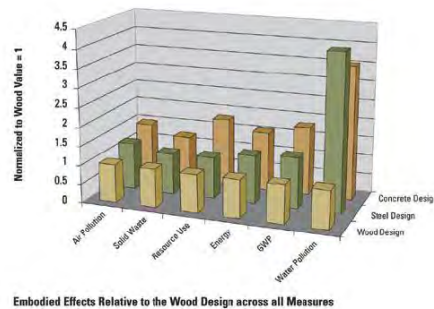
Embodied energy in production

Emission of greenhouse gases

Release of pollutants into the air

Generation of water pollutants

Production of solid wastes



Embodied Effects Relative to the Wood Design across all Measures

Courtesy: Sustainable Building Series 01

Wood for sustainable development

What is sustainable development . . . ?

“Sustainable development is a development pattern which focuses on efficient resource use to meet human needs while preserving the environment so that these needs can be met not only in the present, but also for future generations to come”.

Quote by Brundtland (1987).

Wood for sustainable development

- Wood **restores** the carbon dioxide and then purifies the air we breathe.
- Wood adds oxygen into the air but also absorbs the carbon dioxide **greenhouse gas**.
- Man-made building materials simply add harmful pollutants to our environment in the process of manufacturing. while dynamic nature of a growing forest helps the **environment**.
- Using wood for the construction will keeps this **natural cycle** unbroken.
- Maintains healthy forests, and thus promotes a better environment for earth's inhabitants.
- Sustainability is also about maximizing the resources that are **locally available** so as not to waste, damage or exhaust them.
- The longevity of buildings makes it even more important to use sustainable construction to maximise the **efficiency** of the building and the **quality** of life for future generations.

Advantages of wood over other building materials . . .

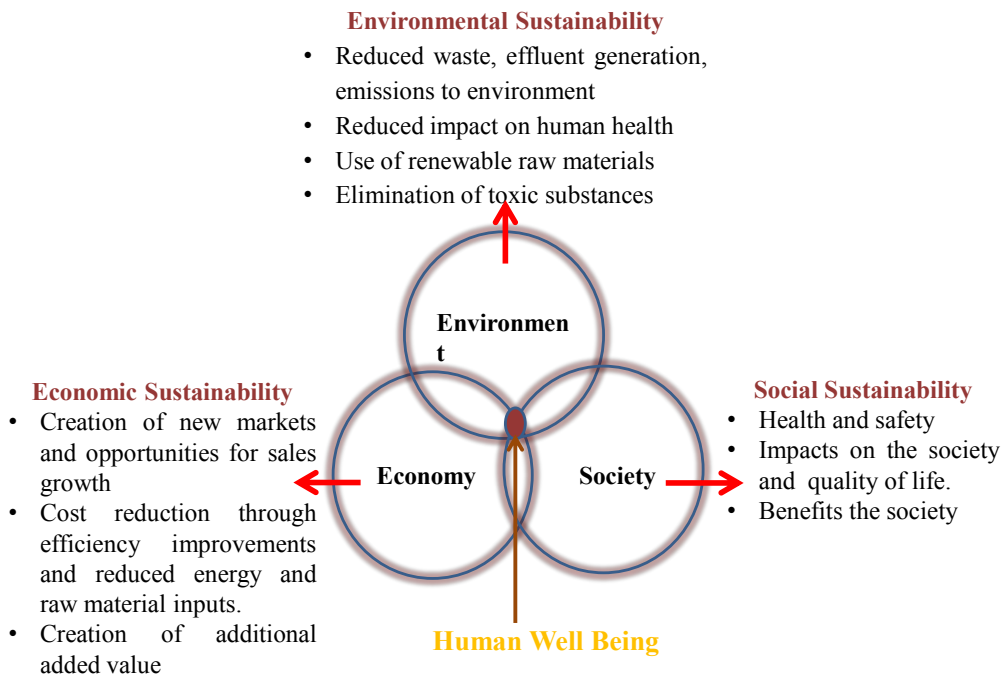
- Wood is energy efficient building material when compared to other building material.
- The manufacturing process for wood is more energy efficient than the manufacturing process of any other structural building material, and a building constructed with wood will be energy efficient as well.
- Wood balances out the temperature changes in different times of day keeping the interior temperature comfortable.
- Wood also possesses significant, positive environmental attributes.



Courtesy: APA_Green_Building_Brochure

- Wood requires less energy in the manufacturing process than any other building materials like cement, glass and steel.
- The selection of environmentally responsible building material is an aspect of sustainable building.
- Wood is thermally efficient and easy to insulate.

Wood for sustainable development



Sustainable construction

According to an OECD Project,

"Sustainable building" can be defined as those buildings that have minimum adverse impacts on the built and natural environment, in terms of the buildings themselves, their immediate surroundings and the broader regional and global setting".

Vernacular Architecture as a Sustainable Built Form

- The vernacular houses were built relating to environmental context, using local available materials and utilising traditional technologies and have evolved over time to reflect the environment, cultural and historic context.
- It was influenced by a wide range of different aspects of human behaviour and environment, thus leading to different building forms for almost every different context.
- The houses have various devices that are built into their design
- The building forms were greatly influenced by the lifestyle of the occupants and the way they used their shelters.
- These houses are the witness of the skills in the workmanship and craftsmanship of ancestors. The buildings reflected the thoughtful process of the ancestors and the way of their life, culture and tradition.
- The vernacular architecture was built to meet specific needs of the people, accommodating their values, economies and ways of living of the culture by the people.



Mud and wood, the locally available materials were used for the construction extensively in the region. These materials were used for superstructure in the majority of the buildings. The walls were of mud mortar and were supported on granite foundation. The pitched roofs are of wooden rafter covered by mangalore tile.

The wooden columns and the beams acted as the structural members and the mud walls also took the load of the roof in some places and acted as barriers in some spaces of the house

Vernacular Houses





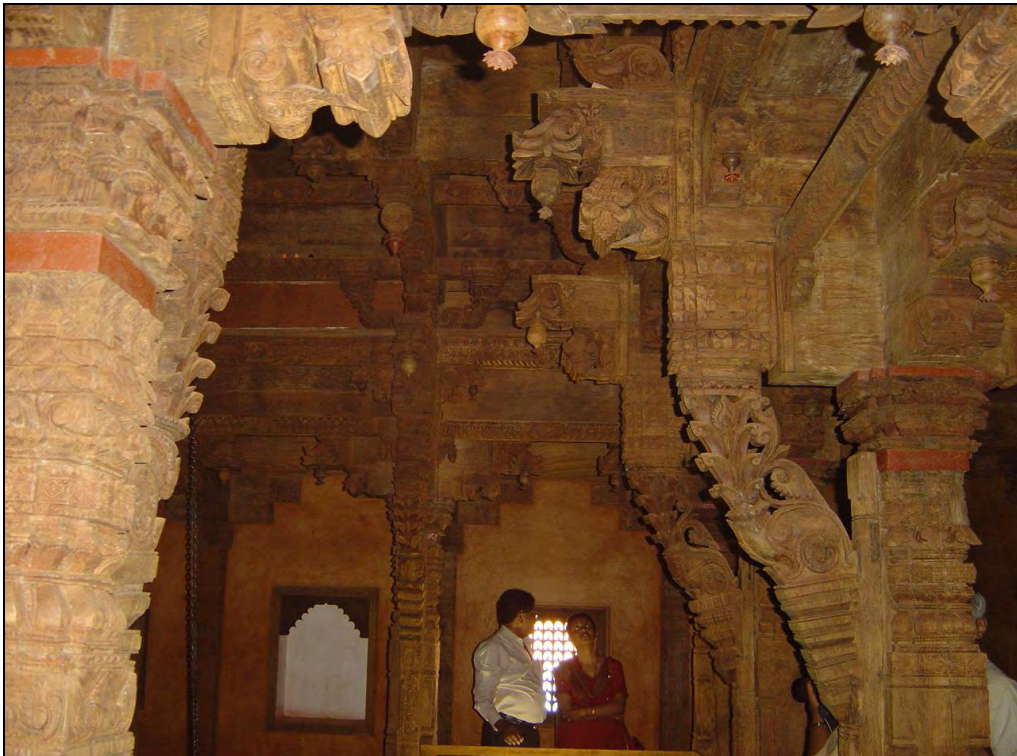


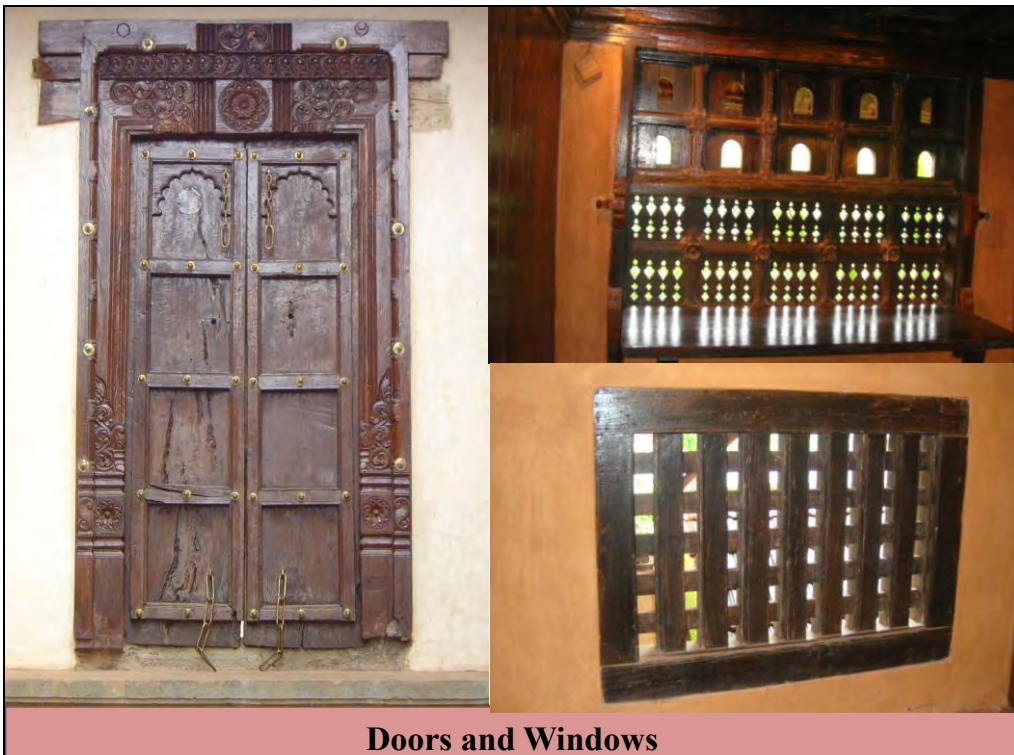


- Wood has been extensively used as a building material.
- The extensive use of wood, which is an easily workable material, has led to a profusion of detailing and ornamentation in the houses.
- The houses reflect high order of workmanship and craftsmanship prevalent in the region about centuries ago.
- The higher the status of the owner of the house the more elaborate are the carvings and decorative features.
- The massive, heavily carved wood work is supported by heavy wooden column which is beautifully carved shows the workmanship and craftsmanship of the ancestors

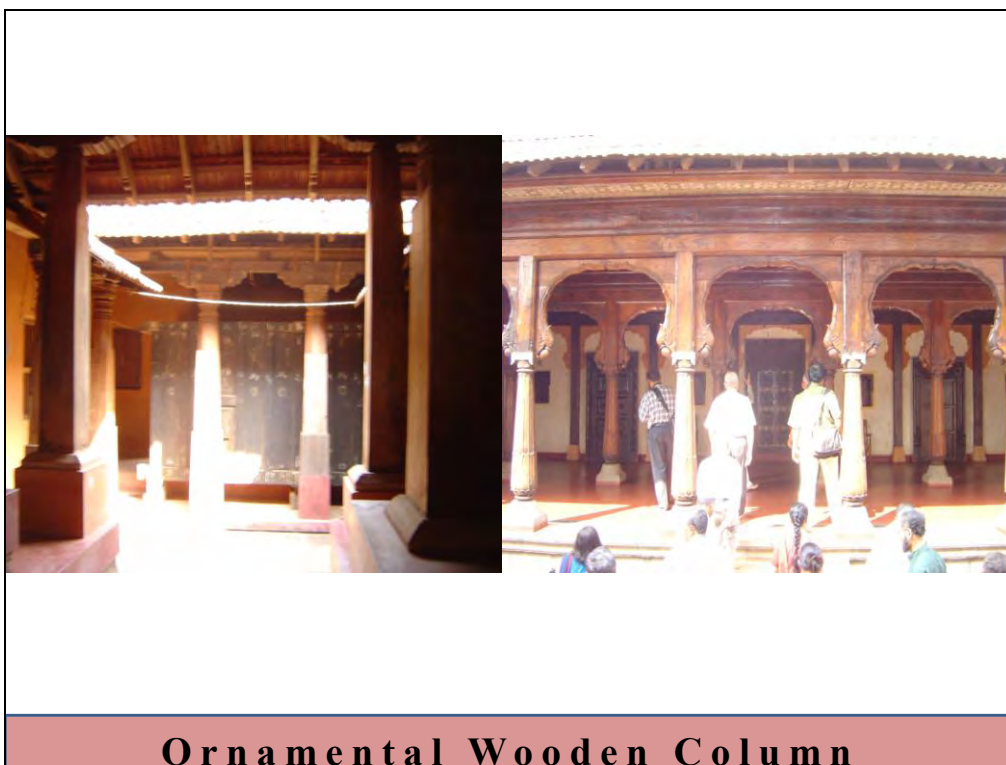
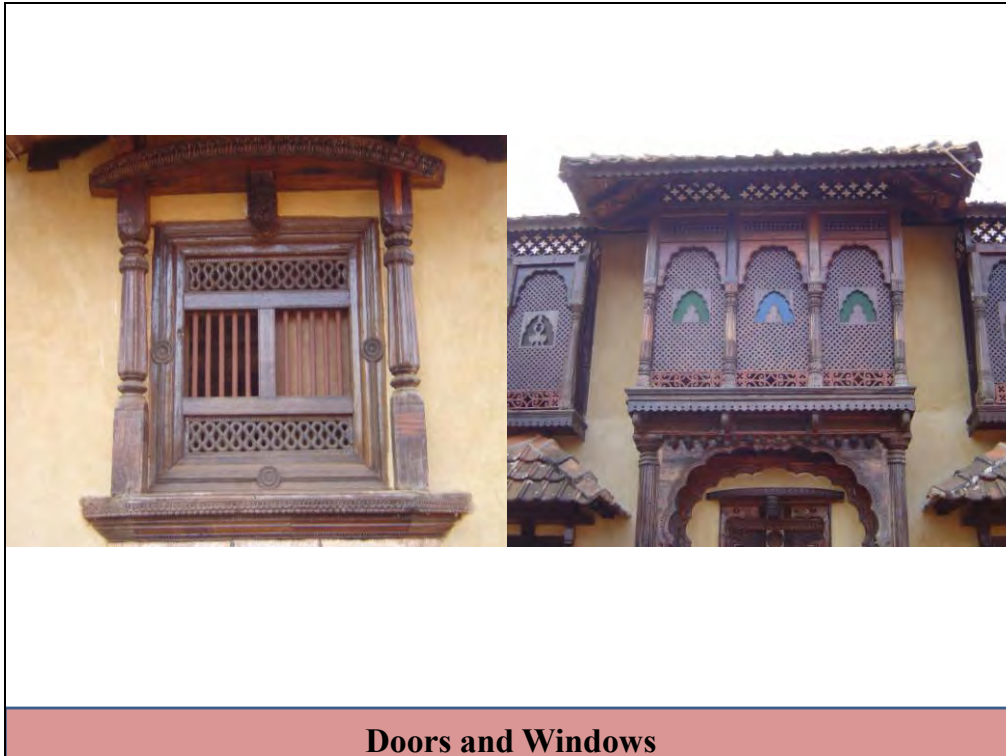
Detailing And Ornamentation In Wood

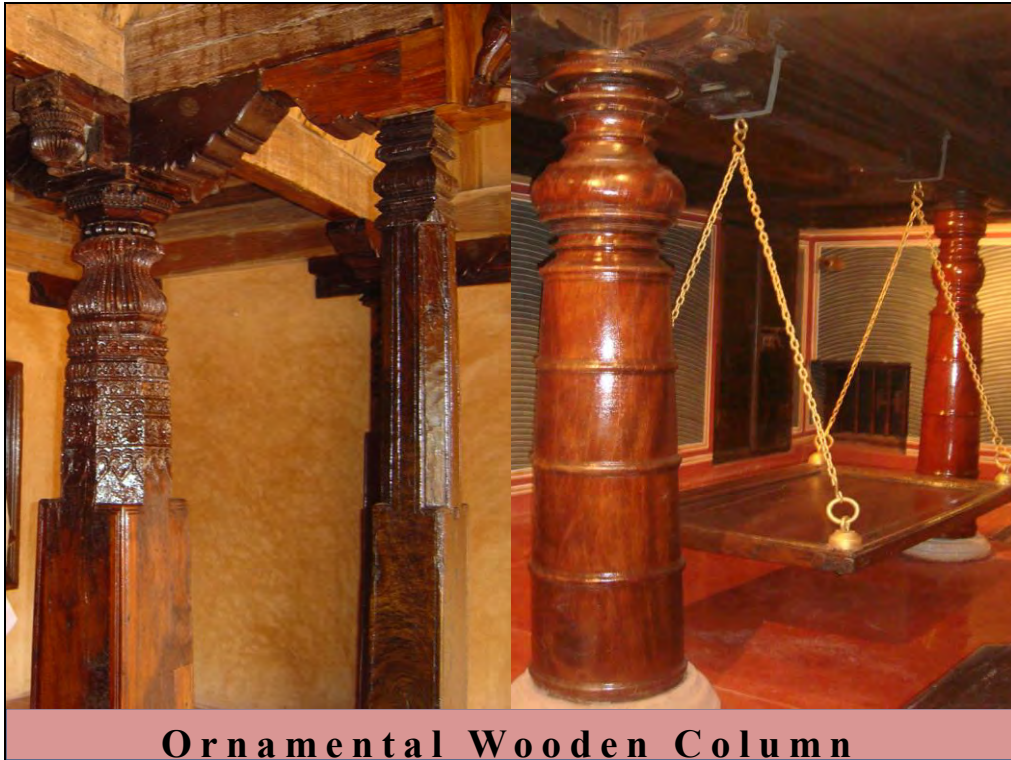




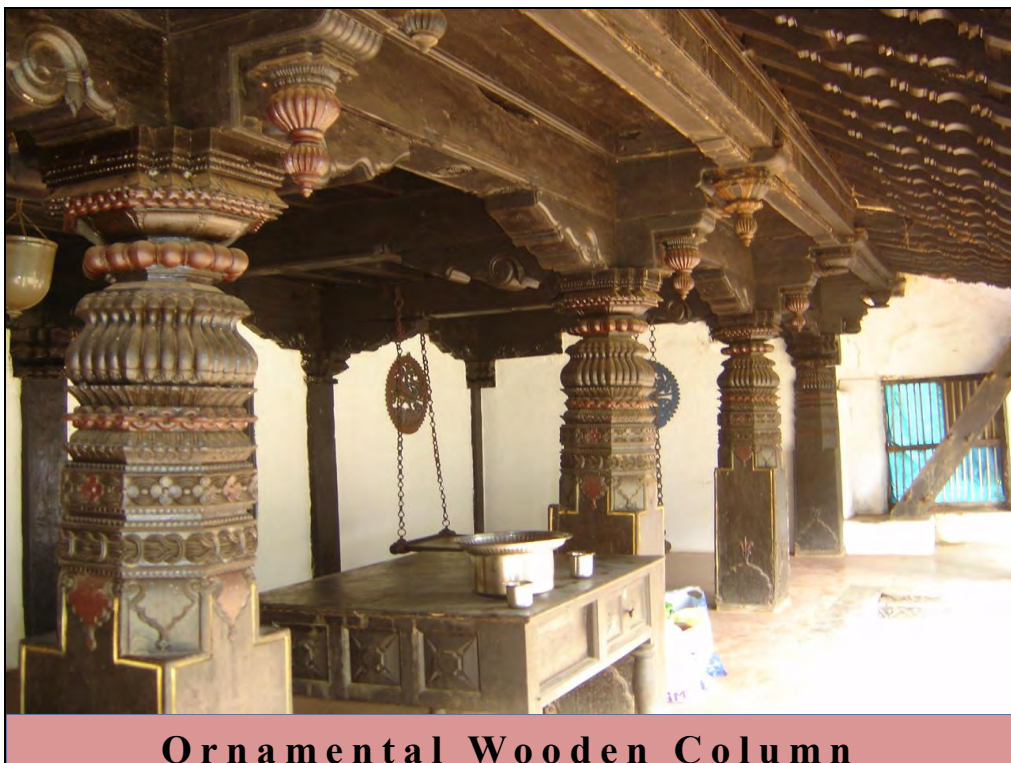


Doors and Windows





Ornamental Wooden Column



Ornamental Wooden Column



Ornamental Wooden Column and beams



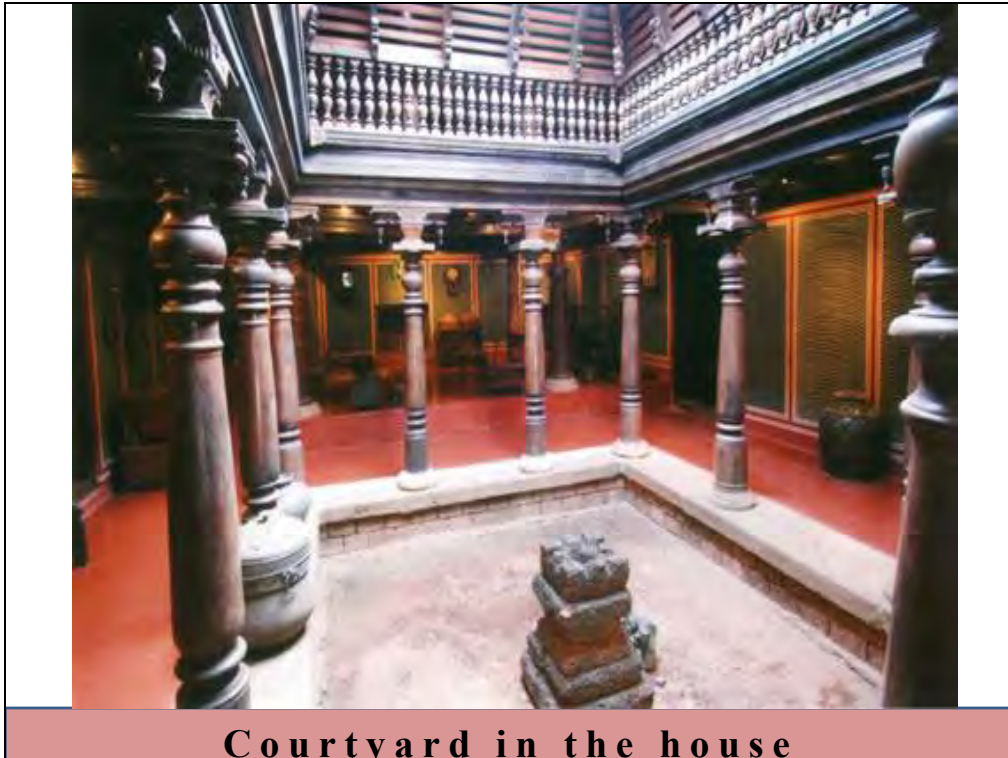
Ornamental Wooden Column and beams



Intricately carved Wooden Column



Portico of house



Courtyard in the house



Wooden ceiling



Interiors of the house

Conclusion . . .

- The regional architecture has an incredible potential for influencing the current architectural trends in that region.
- The vernacular architecture is not only to study about the past history, culture and traditions, but also should contribute to the present and future needs of the built form.
- We should understand, appreciate, preserve, conserve the cultural heritage of the region and also enhance the environmental quality of the vernacular architecture which has been handed over to us for generations from our ancestors.
- The design principles and approaches of the vernacular houses should be implemented for the building we design and build.

Conclusion . . .

- Vernacular house have low impact on the environment over the contemporary buildings.
- There is a need to grow more forests, from this there is enough production and supply of wood and wood products for the construction industry.
- We need to ensure that the treasure we have i.e., the forests will be there for our future generations and helps the natural cycle to be intact also.
- The vernacular houses of the region will serve as an inspiration for the future posterity and contribute to sustainable development and present new opportunities for development of the wood.

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Saga of the Poor Man's Timber

Neelam Manjunath⁶

Abstract

Once upon a time, millions of years ago, in prehistoric times, man discovered a giant grass in the wild forests- bamboo! It became the Kalpavriksha for him. He built his house with it, protected it with Bamboo forts, used it as firewood, made weapons, cloths, musical instruments etc and after death was carried and buried with it. He developed a Bamboo Civilization with indigenous technologies for various uses, like transportation, handmade paper, water distribution pipes, medicines, housing, etc.

Fast forward to 18th century, the British Empire has colonized half of the world, the Industrial Revolution is unfolding and modernization is accelerating. Machines are being used more and more, for every task. Wood processing became easier and replaced Bamboo in many applications. Steel and cement was discovered. Man started using factory produced materials. Bamboo usage declines, with only the poor using it because they could not afford the new processed materials. As a result this Kalpavriksha came to be labeled as the poor man's timber.

Now in the 21st century, the world is gripped by fear of Human civilization being wiped out due to environmental degradation and global warming. Conferences, seminars, workshops and rallies across the world are talking about the ill effects of industrialization and urging the world to 'return to nature'. And in this call for return, the so called poor man's timber is now being hailed as the wonder material by the Global community, especially for the building construction sector - the largest polluter in any country. A bamboo renaissance is taking place!

The technology of construction with Bamboo is the greatest contribution that the South and the Eastern world can give to Sustainable Development.

I will be presenting three of our projects which underline the return of this wonder material as the most modern and fashionable material today, namely; Bamboo Symphony, Bangalore; House of Five Elements, Bangalore; and the Police Bhevan, Bangalore.

Keywords: Bamboo, Sustainability, Material and Technology'

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A BAMBOO RENAISSANCE IS TAKING PLACE!

The world is turning towards regional technologies and two definite categories of development are emerging - one based on the principle of recycling and the other on the use of natural materials capable of being used without requiring industrial processing. Mud and bamboo figure prominently in this second category of development.

Bamboo is a premiere building material in the new architectural movement with sustainability and an integrative approach as its two important criteria. This is high science and simple technology. Bamboo plays a key role in the lives of 1/5 of the world's population even today. However, in many places expensive wood, steel, concrete, glass etc have replaced bamboo.



Figure 1: Bamboo Tree

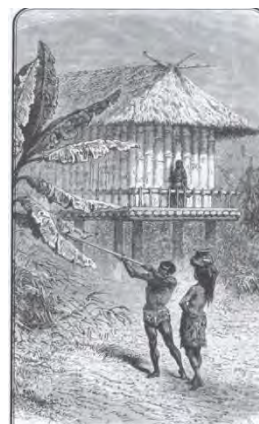


Figure 2: Bamboo house in Ancient times



6.



Figure 3: Poor people's bamboo house

Figure 4: Bamboo bridge

Figure 5: Bamboo fishing platform

Figure 6: Prehistoric Tools



Figure 7: Various uses of bamboo in historic times



Figure 8: Bamboo in paper making



Figure 9: Bamboo water-pipe in Hongkong before 1983



Figure 10: Bamboo Innovations in building construction technology

I will be presenting three of our projects which underline the return of this wonder material as the most modern and fashionable material today. These are: Bamboo Symphony, Bangalore; House of Five Elements, Bangalore; and the Police Bhevan, Bangalore.

All these three buildings represent are our effort to reverse this trend and replace steel, concrete etc with bamboo.

1. House Of Five Elements, Bangalore:

This house is a residence with a built up area of 10,000 sqft. The building has been used for various experiments with natural building materials, low energy materials and construction technologies etc. The entire construction was done by unskilled workers, with labor training provided during construction. In this building Bamboo has been used in combination with other building materials like mud, stone etc and the new age material- waste. All the load testing of the bamboo roof and other design tests were done by us on site before the final execution. Excavated soil from site has been used for production of stabilized mud blocks for the house. Stones from the excavation have been used extensively for landscaping.

The main usage of Bamboo in the house is in the following components:

1.1 Bamboo ply for all the doors and 1" bamboo round poles for ventilators;

1.2 Bamboocrete walls in the entire first floor and partition wall in the house A prototype of Bamboocrete wall from prefabricated panels was made before using it in the First floor;

1.3 Bamboo mat corrugated sheet roofing with gypsum board false ceiling;

1.4 A double curve shell roof on bamboo structure. The bamboo roof is a 3500 sq ft double curve concrete shell roof with a span of 8.5m-10m and length of over 45m, covers the core area of the house from east to west, with verandahs on both sides and a courtyard in between. It has been designed as a lightweight roof (2" RCC slab) with minimal reinforcement supported on two curved triangular bamboo beams simply supported on bamboo columns of

varying heights following the curve of the roof. A grid matrix of 1" bamboo splits at 6" centre to centre hold the screed concrete in place. It is based on the principle that "a material can bear more loads when it is curved". A tarpaulin which is painted on one side is placed before concrete above the split bamboo mat, which acts as a water proof member in place of plastic. Thorough documentation of project workshops, tests, training programmers has been done for dissemination of information to propagate the Low energy or Zero energy concept of Sustainable Communities. The cost of construction of the house is extremely low because of the use of local materials and construction technologies; effective usage of 100% construction waste, efficient infrastructure design etc. The project has already been presented in many National and International Forums.



Figure 11: Glimpse of House of Five Elements

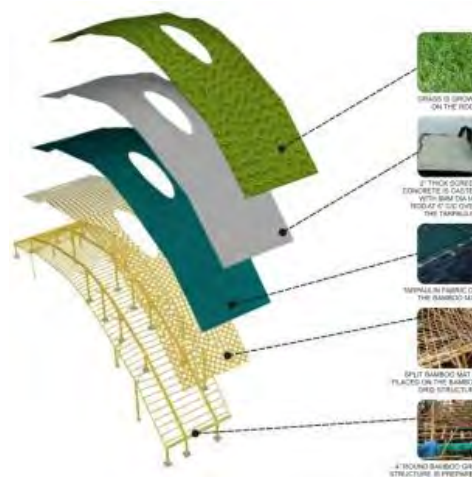


Figure 12: Roof layers



Figure 13: Double-curve roof profile

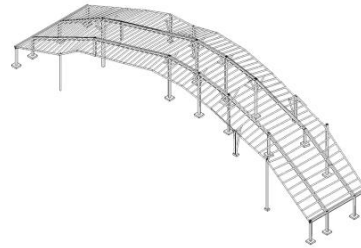


Figure 14: Roof Details



Figure 15: Bamboo Crete wall

This house is an example of bamboo being used with other building materials to produce an extremely aesthetical Architecture.

2. Bamboo Symphony, Bangalore:

This is an office building of 1500 sq ft area, designed as an open plan office with spaces divided by level difference rather than physical walls. The most interesting part of the building is its structure based on the traditional fisherman's platform- a true synergetic structure!

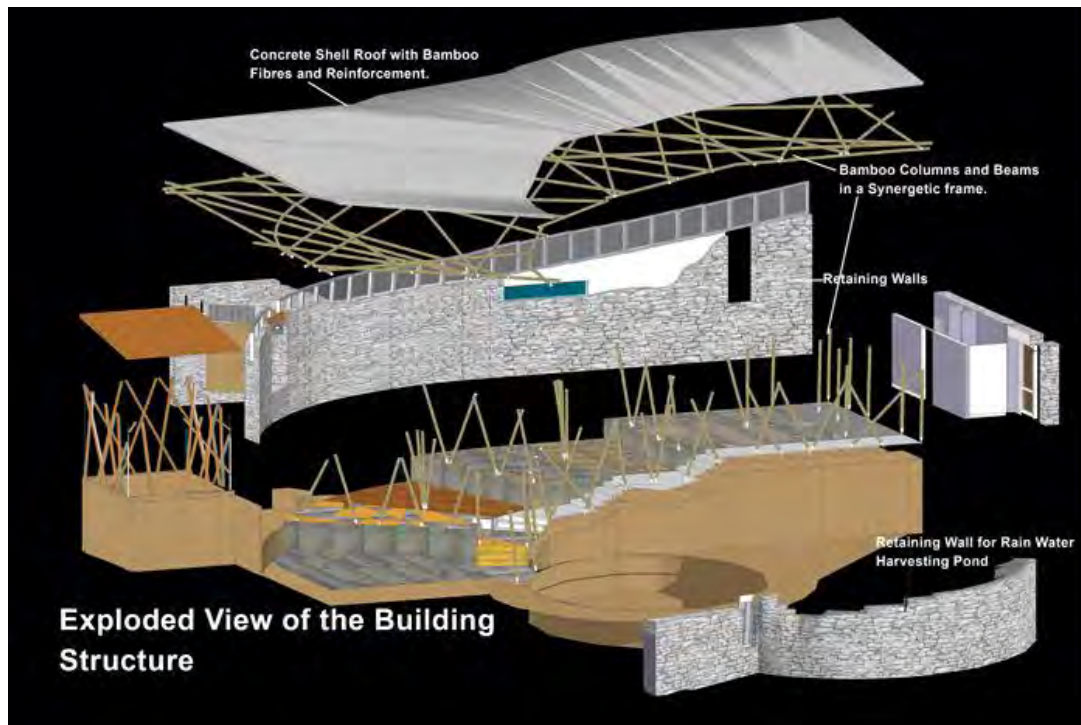


Figure no 16: Evolution of Bamboo Roof in ‘Bamboo Symphony’

This building is designed as a closed loop for the building materials, processes and technologies. The structure of the building is its most unique feature. It is based on the model of synergetic and tensigrity structures. It has been designed as a hybrid of the two systems and was physically tested before concreting the roof. These types of structures are being made across the world with modern materials with high energy balance. Bamboo is the only Natural building material with lowest energy balance that can be used for these structures.

The materials of construction details: bamboo-crete walling system with precast wall panels, usage of stabilized mud blocks from the site, green shell roof over lattice grid made of bamboo culms and supported on bamboo columns & amp, beams, bamboo reinforced concrete with bamboo fibres for reducing the weight of the concrete, bamboo flooring, bamboo column and beams. The columns in Bamboo Symphony, although they look haphazardly placed, have a definite position, size and inclinations, i.e., they are structurally relevant, just like the highly evolved technological logic we find in nature. The roof was allowed to define its own shape as per the flow of forces, naturally, like a fabric assuming its shape. These structures are highly efficient with minimal energy use and amp.



Figure 17: 'Bamboo Symphony' at dusk

Figure 18: Japanese guard

Figure 19: south side view at west-side of 'Bamboo symphony'

Figure 20: Architect's cabin

Figure 21: Reception

3. Police Bhevan, Bangalore:

This project was a competition project by Karnataka State Reserve Police Dept, Bangalore to create a landmark building for their Golden Jubilee celebrations. Total built-up is about 3855.67 Sq.ft. In this project bamboo is used extensively for various elements of the building. All the roofs except for the reception are double curve shells of ferro-crete or bamboo-crete roofs BIPV (Building Integrated Photo-Voltaic cells) for bringing in natural light to the interiors. Other than the roof we have used it for all the structural elements and bamboo railing, furniture's etc. as well.

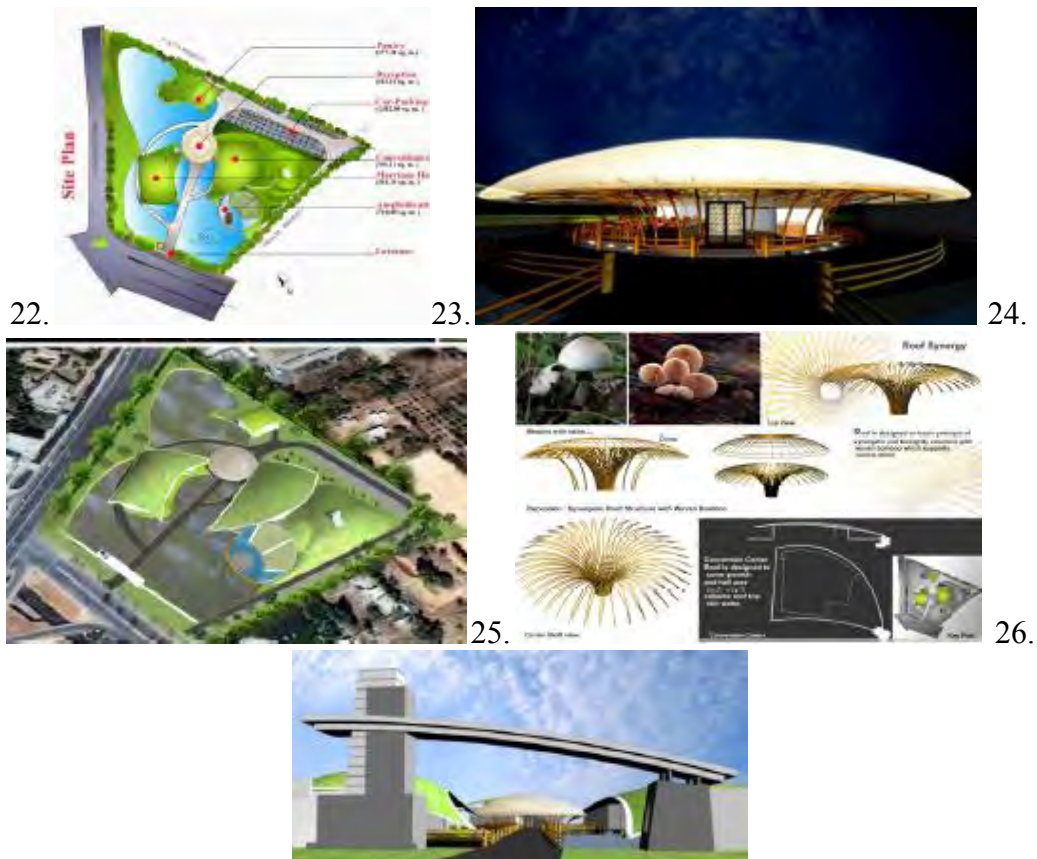


Figure 22: Site plan

Figure 23: Reception

Figure 24: Amphitheater view

Figure 25: Development of roof structure in bamboo

Figure 26: Entrance

The project site is a filled up lakebed. We have designed the whole project as a cluster of Islands connected by bamboo bridges with modernistic buildings made with bamboo shell roofs of about 2500 sft, bamboo dome---sft etc. In the process we proposed the rejuvenation of the lake with wetland development for water filtration. However, we were runner-up in the competition- hence it has not been constructed.

4. EPILOGUE

All of these projects are examples of the improvised traditional building, where local traditional building elements, styles and technologies have been used to revive them and add context to the architecture of the buildings themselves. The projects have been developed as attractive, self sufficient buildings respecting nature in order to meet the environmental standards and run on low energy- Zero Energy buildings. These projects have been aimed at defining a new architectural style and language, and a new definition of the profession of Architecture in terms of Responsible Creativity and Creative Responsibility. Bamboo has brought together the so-called third world countries as equal partners in a fruitful exchange of ideas with architects of the industrialized countries. Only north-south and east-west complementarily can develop a fair and global practice of sustainable development and an

appropriate and reasonable redefinition of our future. The technology of construction with bamboo is the greatest contribution that the South and the Eastern world can give to Sustainable Development.

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SAGA OF THE POOR MAN'S TIMBER.....

CGBMT ,BANGALORE ,INDIA



KALPAVRIKSHA

Once upon a time, millions of years ago, in prehistoric times, man discovered a giant grass in the wild forests---- BAMBOO! It became the KALPAVRIKSHA for him. He built his house with it , protected it with Bamboo forts, used it as firewood, made weapons, cloths, musical instruments etc and after death was carried and buried with it. He developed Bamboo Civilization with indigenous technologies for various uses, like transportation, handmade paper, water distribution pipes, medicines, housing etc.





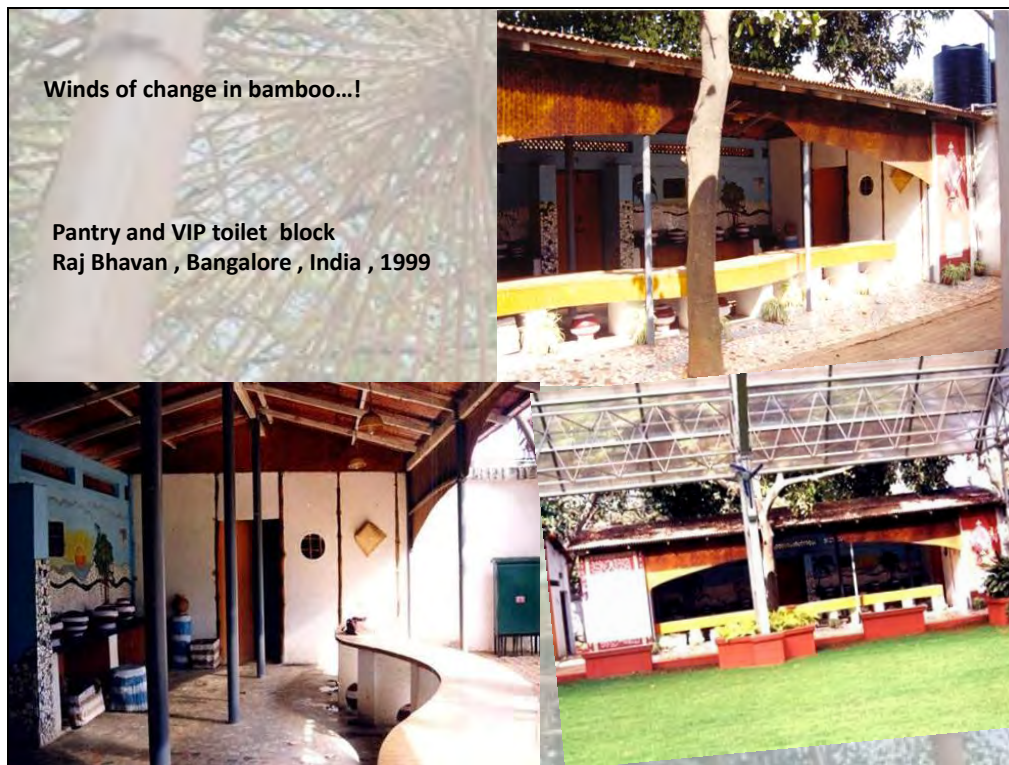
Traditional uses of bamboo....

Bamboo in paper industries









Winds of change in bamboo...!

**Pantry and VIP toilet block
Raj Bhavan , Bangalore , India , 1999**

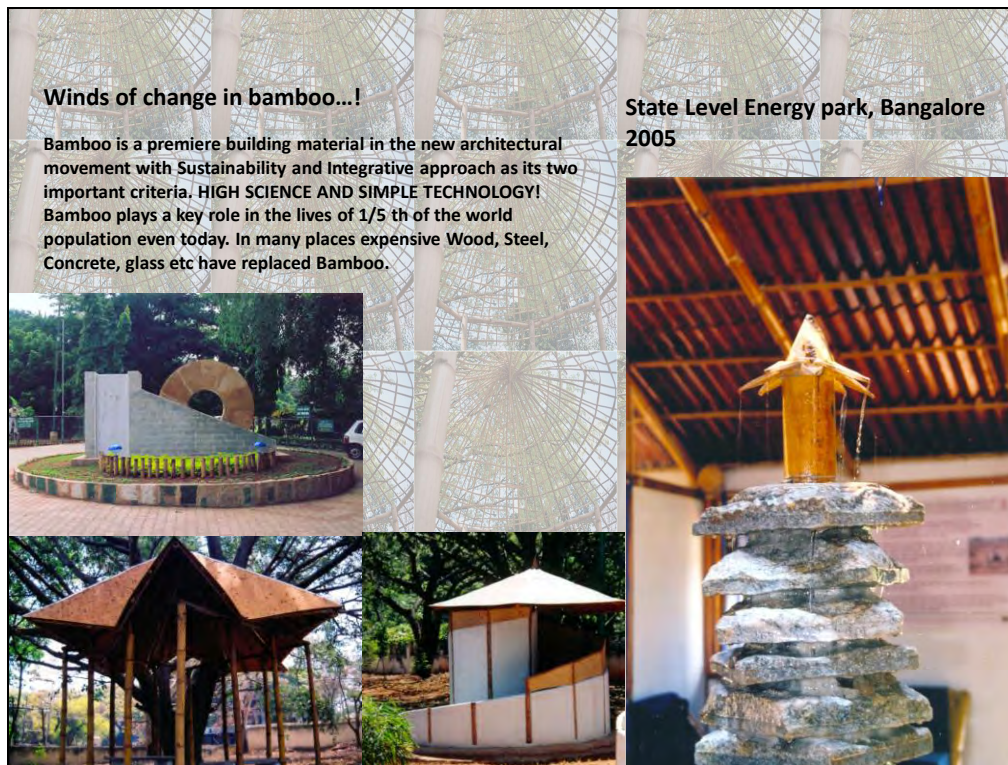


Winds of change in bamboo...!

IPIRTI, Bangalore, 2003

POOR MAN'S TIMBER IS BEING HAILED AS THE WONDER MATERIAL BY THE GLOBAL COMMUNITY, ESPECIALLY FOR THE BUILDING CONSTRUCTION SECTOR - THE LARGEST POLLUTER IN ANY COUNTRY. World is turning towards regional technologies and two definite categories of Development are emerging - one based on the principle of recycling and the other on the use of natural materials capable of being used without requiring industrial processing. Mud and BAMBOO figure prominently in this second category of Development.



















We will be presenting three of our projects which underline the RETURN OF THIS WONDER MATERIAL as the most modern and fashionable material today namely

HOUSE OF FIVE ELEMENTS, Bangalore

POLICE BHAVAN, Bangalore.

BAMBOO SYMPHONY, Bangalore





HOUSE OF FIVE ELEMENTS, Bangalore 2008-2010

This house is a Residence with a built up area of 10,000 sqft. The house has been used for various experiments with natural building materials, low energy materials and Construction technologies etc. The entire construction was done by unskilled workers, with labor trainings given during construction. In this building Bamboo has been used in combination with other building materials like Mud, Stone etc and the new age material WASTE. All the load testing of bamboo roof and other design tests were done by us on site before the final execution. Excavated soil from site has been used for production of Stabilized Mud Blocks for the house. Stones from the excavation have been used extensively for landscaping.



HOUSE OF FIVE ELEMENTS, Bangalore

The main usage of Bamboo in the house is in the following components:

1.1 Bamboo Crete walls in the entire first floor and partition wall in the house A prototype of Bamboo Crete wall from prefabricated panels was made before using it in the First floor.

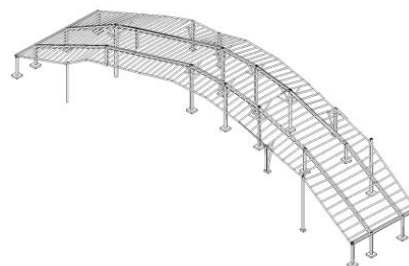
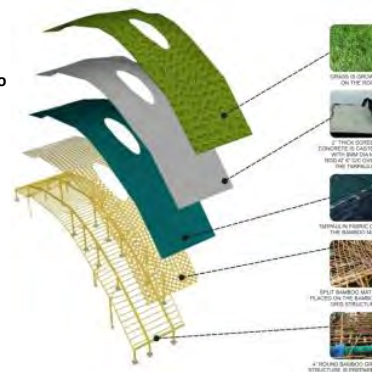
1.2 Bamboo ply for all the doors and 1" Bamboo round poles for ventilators.

1.3 Bamboo mat corrugated sheet roofing with Gypsum board false ceiling.



HOUSE OF FIVE ELEMENTS, Bangalore

A double curve shell roof on Bamboo Structure - The Bamboo Roof is a 3500 sq ft double curve concrete shell roof with a span of 8.5m-10m and length of over 45m, covers the core area of the house from east to west, with verandahs on both sides and a courtyard in between. It has been designed as a lightweight roof (2" RCC slab) with minimal reinforcement supported on two curved triangular Bamboo beams simply supported on bamboo columns of varying heights following the curve of the roof. A grid matrix of 1" bamboo splits at 6" centre to centre hold the screed concrete in place. It is based on the principle that "a material can bear more loads when it is curved". Tarpaulin which is painted on one side is placed before concrete above the split bamboo mat, which acts as water proof member instead of plastic. Thorough documentation of project workshops, tests, training programmers has been done for dissemination of information to propagate the Low energy or Zero energy concept of Sustainable Communities. Cost of construction of the house is extremely low because of the use of local materials and construction technologies; effective usage of 100% construction waste, efficient infrastructure design etc. The project has already been presented in many National and International Forums.

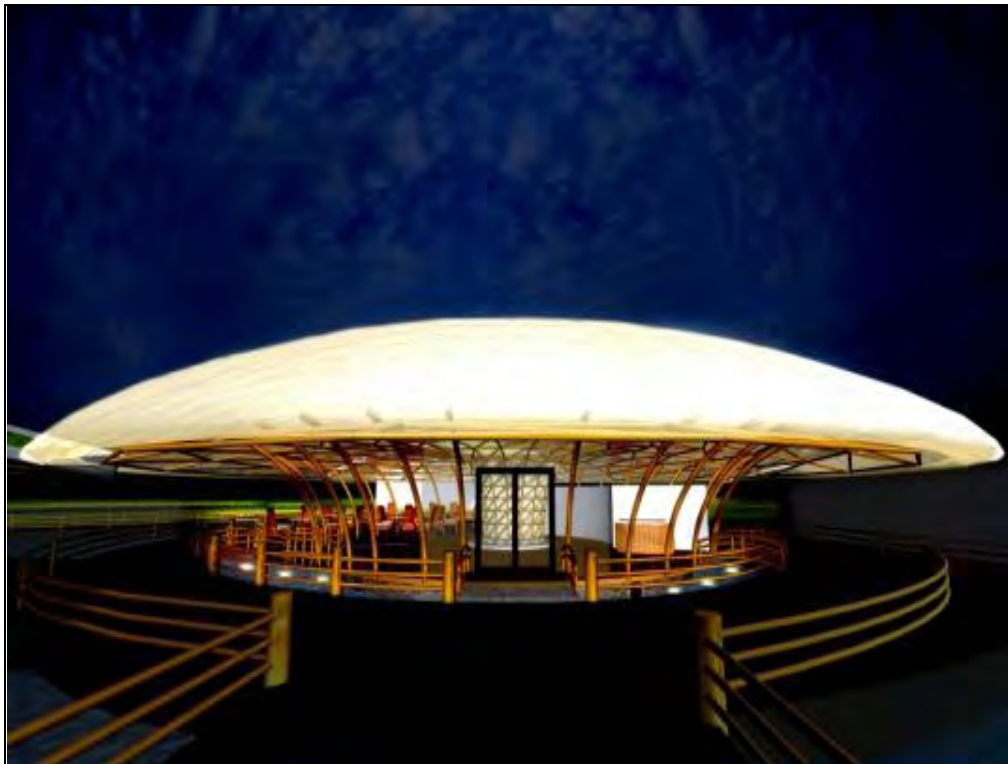








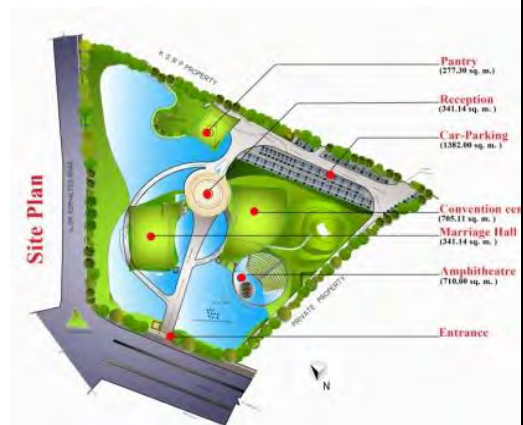


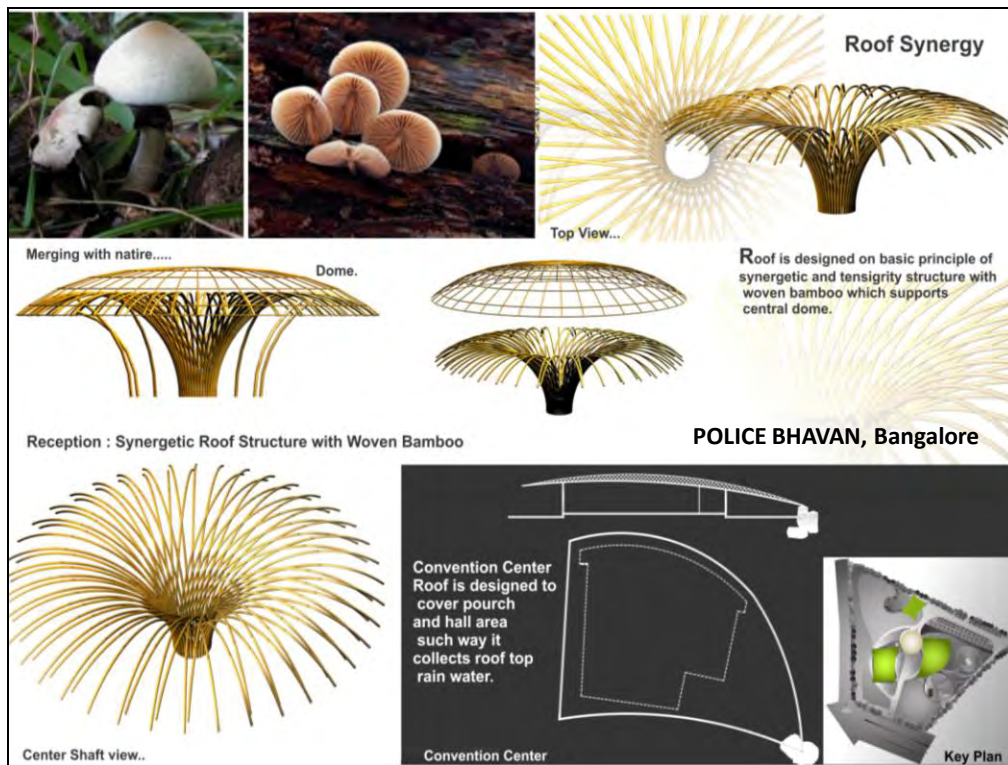


POLICE BHAVAN, Bangalore, 2010

This project was a competition project by Karnataka State Reserve Police Dept, Bangalore to create a landmark building for their Golden Jubilee celebrations. Total built-up is about 3855.67 sqft.

In this project bamboo is used extensively for various elements of building. All the **Roofs except the reception to be double curve shell Ferro Crete or bamboo Crete roofs BIPV (Building integrated Photo voltaic cells) for bringing in natural light to the interiors.** Other than the Roof we have used it for all the structural elements and bamboo railing, furniture's etc. as well.







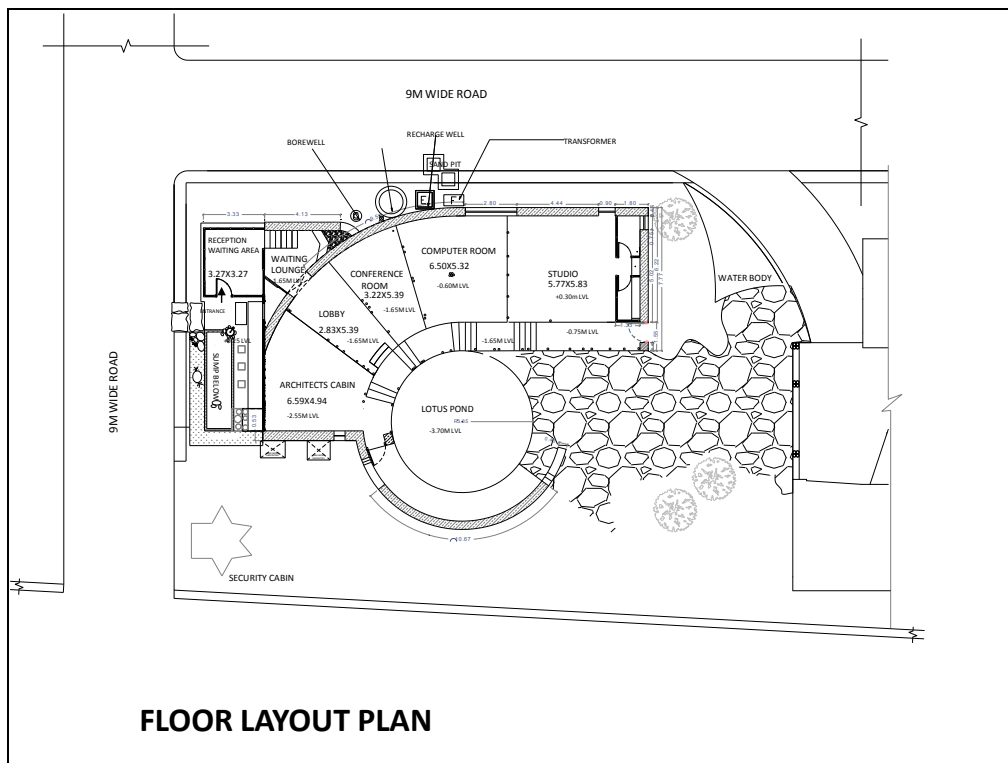




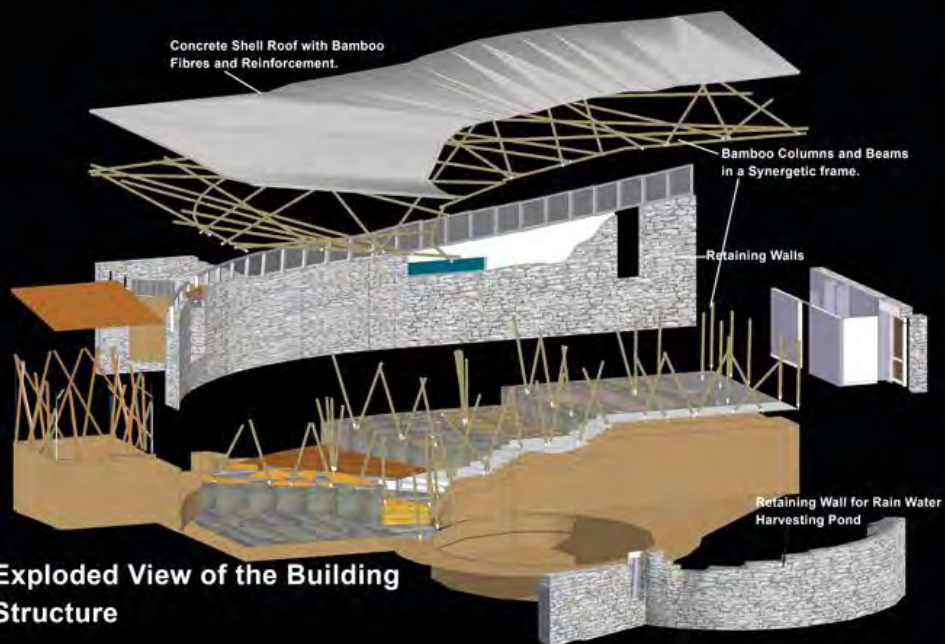
BAMBOO SYMPHONY, Bangalore

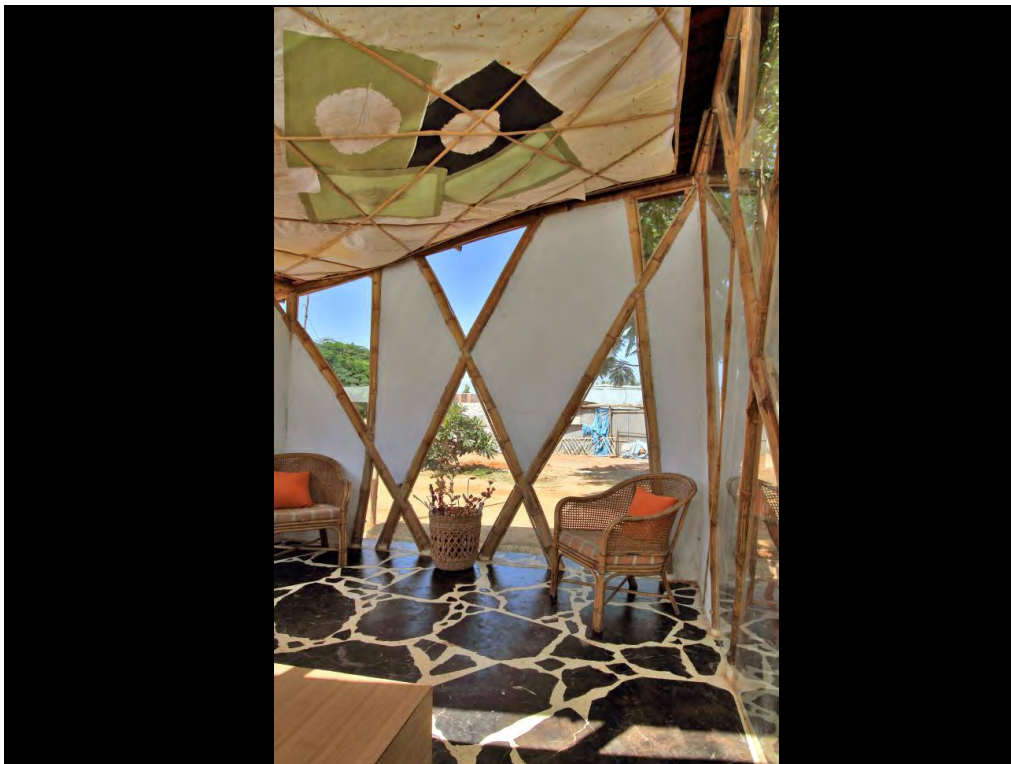
This is an office building of 1500 sq ft area, designed as an open plan office with spaces divided by level difference rather than physical walls. The most interesting part of the building is its structure based on the traditional Fisherman's platform- a true synergetic structure!

This building is designed as a closed loop for the Building Materials, Processes and Technologies. The STRUCTURE of the building is its most unique feature. It is based on the model of SYNERGETIC AND TENSIGRITY structures. It has been designed as a hybrid of the two systems and was physically tested before concreting the roof. These types of structures are being made across the world with modern materials with high energy balance. Bamboo is the only Natural building material with lowest energy balance that can be used for these structures.



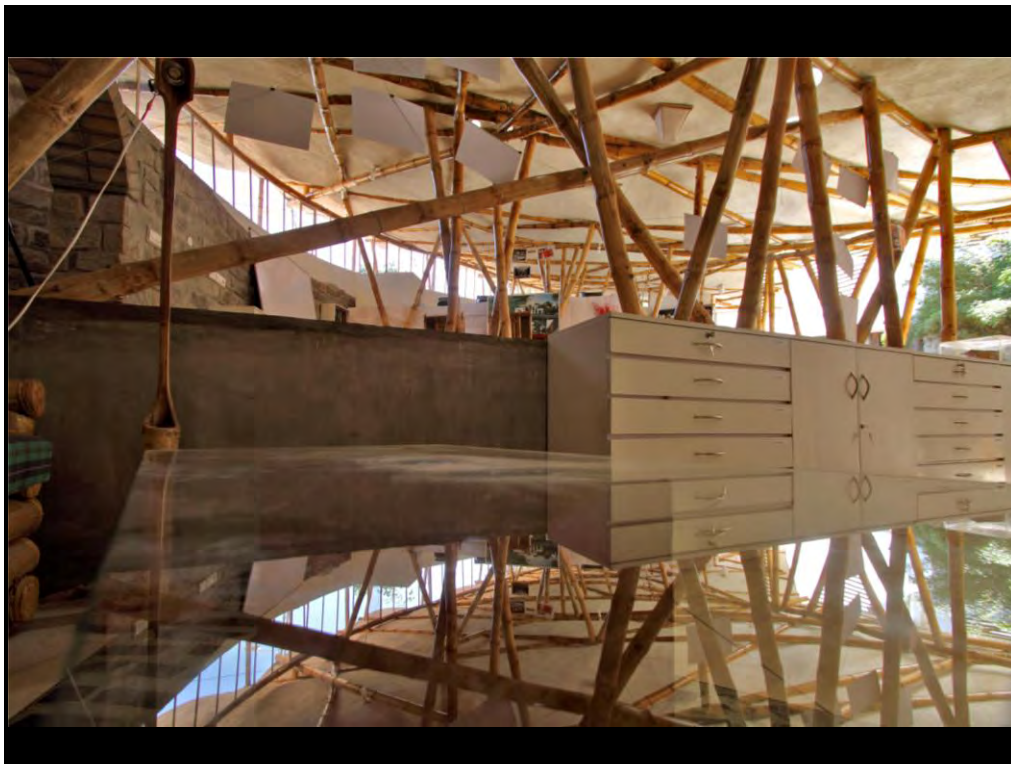
BAMBOO SYMPHONY, Bangalore



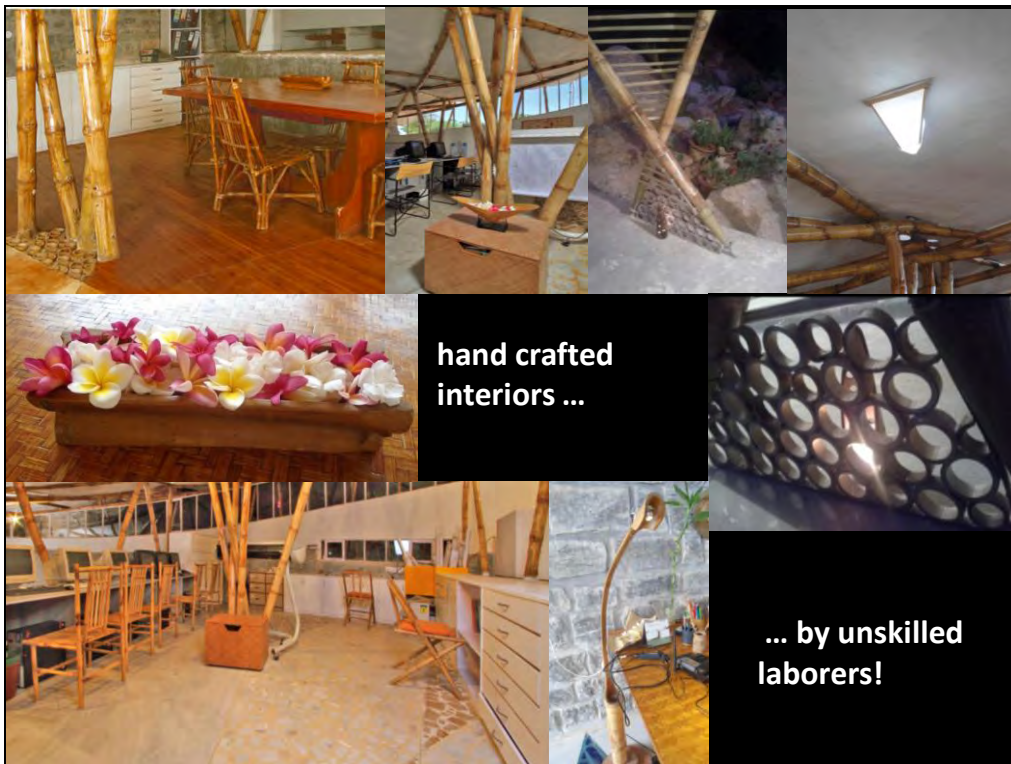






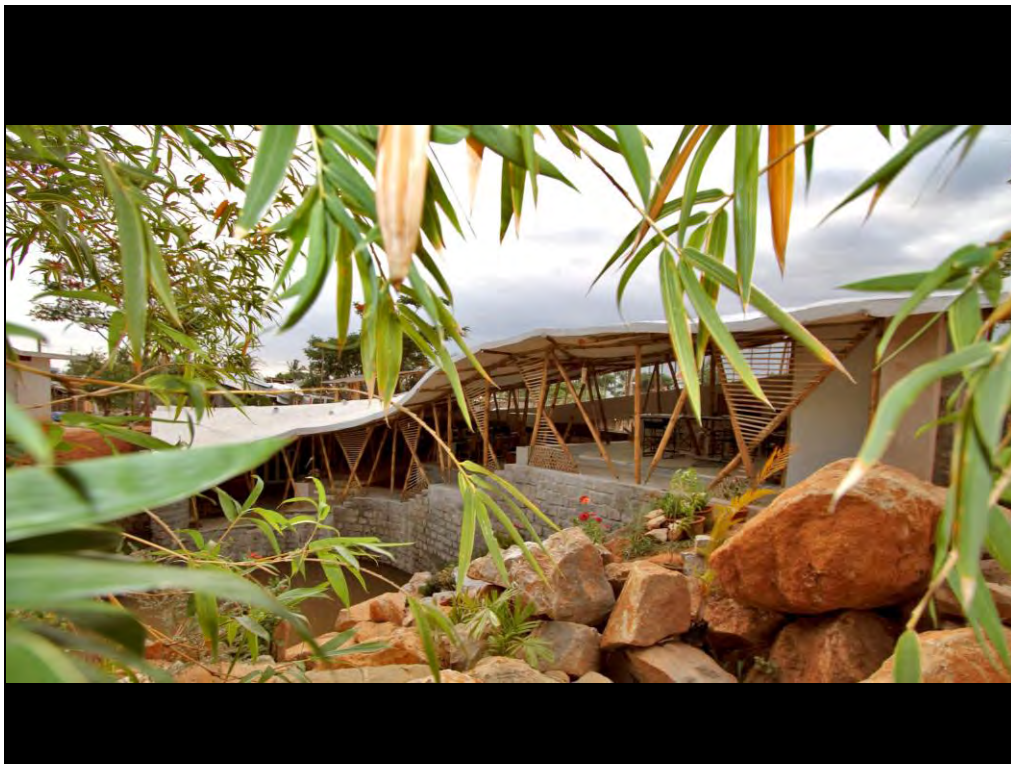
















Session 8

[Thursday 2nd period 1.5 hours - Hall A]

Artistic aspects of wood use and design
(continued)

Speakers



Speaker:
Jianju Luo

Topic:
Introduction of Wood Aesthetics and its Application in Daily Life



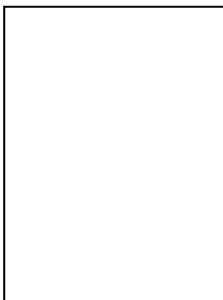
Speaker:
Kitazawa Hideta

Topic:
Enjoyment of Traditional Japanese Wood Carving



Speaker:
Olga G Sevan

Topic:
Traditional and Modern House Paintings and Arts of Wood in Everyday Life



Speaker:
Guixang Wang

Topic:
Impression Comparison and Understanding: Chinese Wood-Framed Architecture in History

Introduction of Wood Aesthetics and its Application in Daily Life

Jianju Luo, Ye Ping and Luo Fan¹

Abstract

After a brief discussion on principle and exploiting technology of wood esthetics, application possibilities of wood esthetics in daily life were demonstrated with concrete examples in this paper. On a macro-level, taking annual rings as an example, the esthetical principle lies in the fact that the patterns of annual rings conform perfectly to “Change and Unity”, a basic rule in esthetics. On a micro-level, taking vessels as an example, the esthetical principle lies in the extremely abundant wood structural patterns formed on the wood surfaces by pores, pits, spiral thickenings, perforations, tyloses and gum blocks contained in vessel cavities. Some of the esthetical elements of macro- or micro-level, can directly form esthetical patterns of high value on wood surfaces, and some of them can be extracted and used as source materials for re-creation of esthetical patterns. No matter whether the wood esthetical patterns come directly from wood surfaces or from re-creation, they are all composed of natural esthetical elements of wood, and go perfectly along with the “Close to Nature” ideal of modern people. Wood esthetical patterns can be widely used in fashion, advertisement, decoration, and even industrial products design. Wood and wood enthusiasts could make new contributions to the development of human civilization through comprehensive study of wood esthetics.

Keywords: Wood, Esthetics, Wood anatomy, Wood esthetical pattern

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From ancient times to today, and even in the future, people have always shown special preference to wood because of its unparalleled beautiful quality and feeling compared to any other material. The beauty of wood quality is reflected in its perfect environment friendliness. Firstly, wood is a renewable material, a kind of natural polymer derived from photosynthesis with solar energy as the driving force and carbon dioxide and rain water as raw materials, and accordingly, the process of wood production is the most energy saving, environment protecting and sustainable. Secondly, wood is very environmentally friendly in its service life because of its characteristics of shock absorption, air conditioning and heat insulation, etc. Thirdly, wood can be decomposed by microorganisms or through pyrolysis, which makes the disposing of waste wood products very easy without any harmful effect to environment. Thus, wood has very high level of environment friendliness during the whole process from its generation to disappearance.

The esthetical feeling of wood is embodied in its texture, grain and extremely abundant patterns, which provide people with wonderful sensations. With interesting patterns and scented smells, it's cool feeling in summer and warm feeling in winter, wood is really a feast for the senses of sight, touch and smell. As wood comes from the trees growing in the green mountain peak and valley, it is different from other kinds of material. It is a kind of a biomass material full of vitality and intelligence of living things, and these are the true essence of the beauty of wood (LUO Jianju *et al.* 2008).

The beauty of wood is natural, but it is deeply buried inside the wood, and needs to be recognized and explored with the theory and technology of wood anatomy and graphic esthetics. It is the duty of our wood scientists to explore the beauty inside the wood and apply wood esthetics to our daily life, and this will let wood and wood scientists have great new contributions to the development of human civilization.

1. EXPLOITATION OF WOOD ESTHETICAL VALUE OF MACRO-LEVEL

Following the conception of traditional wood science, wood esthetics of macro-level refers to the esthetical effect formed by wood esthetical elements that can be seen with naked eyes. On the macro-level, there are many esthetical elements included in wood, such as bark, log surface, knots, burls, roots, tree forks, annual rings, and grain and figure (LUO Jianju 2008). Here one can just take annual rings as an example to illustrate the principle and exploiting technology of wood esthetics on macro-level.

1.1 The esthetical principles of annual rings

Annual rings of trees are the masterpiece of nature. When spring comes, all living things show full vigor, and trees grow as the mother cells in the cambium zone, just beneath the bark, begin to conduct division. In the early period of the growing season, trees grows very fast, and the wood formed during this period is called earlywood, which has large cell lumens and thin walls and so is light-colored; while in the late period of the growing season, trees grow slowly, and the wood formed is called latewood, which has narrow cell lumens and thick walls and so is dark-colored. To the late autumn and winter, trees stop growing until next spring. Again and again, concentric rings with light and dark color form in this way continuously in the trunk, and these rings are called annual rings, as shown in figure 1 (Webset picture).



Figure 1: Annual rings on cross section of Chinese Fir

The annual rings possess a very high esthetical value because they conform perfectly to the rule of “change and unity”, a basic principle of esthetical patterns and a common rule that all formative arts need to follow (WANG Hongfen, 2009). This principle requires that esthetical patterns have both variability and uniformity.

The variability of annual rings is reflected in the width of rings, the diameter of the ring cycle, the differences in color and density of springwood and summerwood, etc. These changes give people a sense of natural beauty of vividness, liveliness and vitality. Uniformity refers to unity and regularity, and is a kind of harmonious relationships, which request the local changes be united as a whole. Pith plays a key role in demonstrating the esthetical uniformity of annual rings. It links each annual ring, and all the annual rings show as concentric rings with pith as the center. In addition, the esthetics of annual rings is also reflected in that each ring is composed of stripes of earlywood and latewood of different color and texture, forming regular changes and rhythmic repetitions, and giving people a sense of music-like rhythm.

1.2 Esthetical effects of annual rings on different sections

Annual rings can exhibit totally different esthetical effects on different sections of wood, which give people a completely different esthetical enjoyment, as shown in figure 2.



a. Cross section; b. Radial section; c. Tangential section

Fig.2 Esthetical effects of annual rings on the three standard sections.

On standard cross section of the wood, annual rings appear as concentric, and these rings alternate in width, color and texture, giving people a sensation of music-like rhythm. On standard radial sections, annual rings appear as parallel stripes of different color and texture, giving people a pleasant sense of both varying contrast and quiet harmony. On standard tangential section, annual rings manifest themselves as coaxial parabolas one mounted after another, leaving people beautiful feeling of vividness, liveliness and uniform.

On non-standard or curved surfaces of wood, the annual ring patterns of trees show much more complexity, and bring people beauty effects much better than those on the three standard sections, as shown in figure 3.

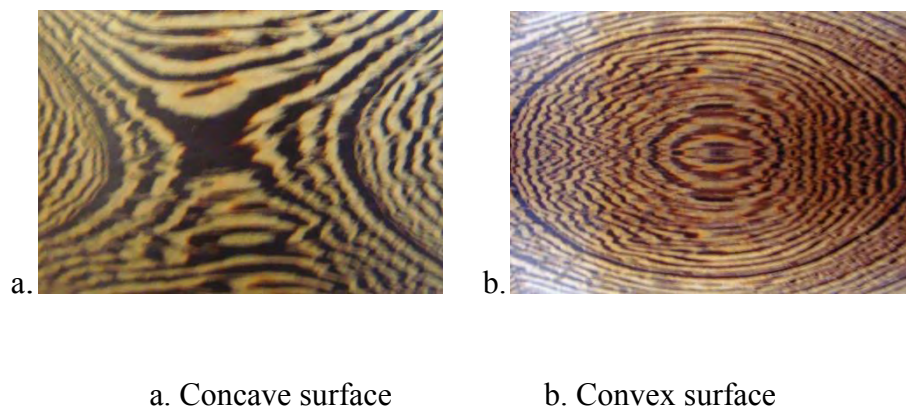


Fig.3 Esthetical effects of annual rings on curved surfaces of Siamese senna

1.3 Re-creation of esthetical patterns of annual rings

Although annual rings themselves possess a high esthetical value, the esthetical patterns obtained directly from the surface of wood are rather limited. In order to further enrich the esthetical patterns of annual rings and explore the esthetical value of annual rings to a greater extent, we can extract esthetical elements from the annual rings, and create a large number of new esthetical patterns with such esthetical elements as source materials. Here take the cross section of Chinese fir (*Cunninghamia lanceolata*) as an example to illustrate the re-creation process of esthetical patterns of macro-level, as shown in figure 4.

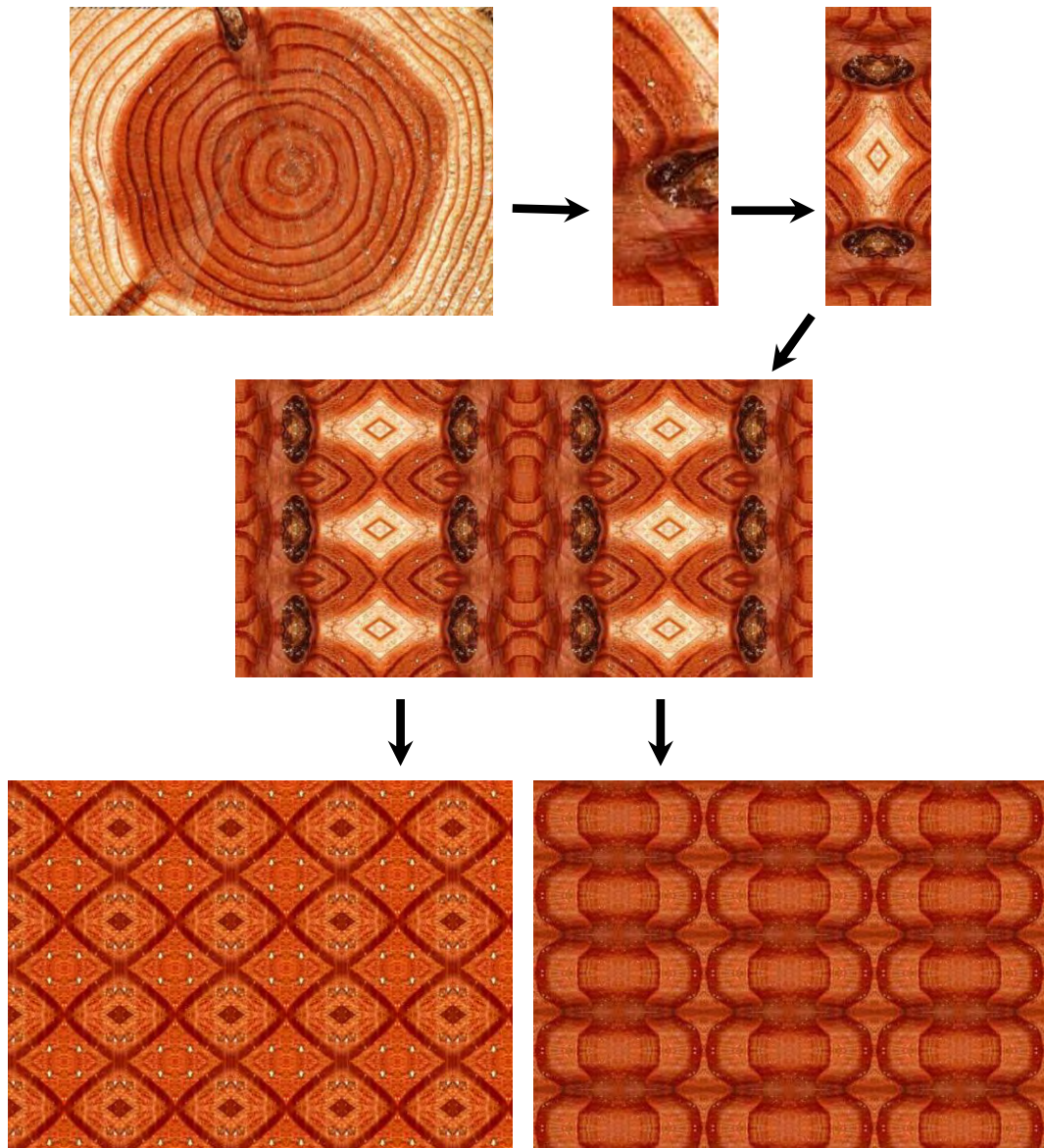


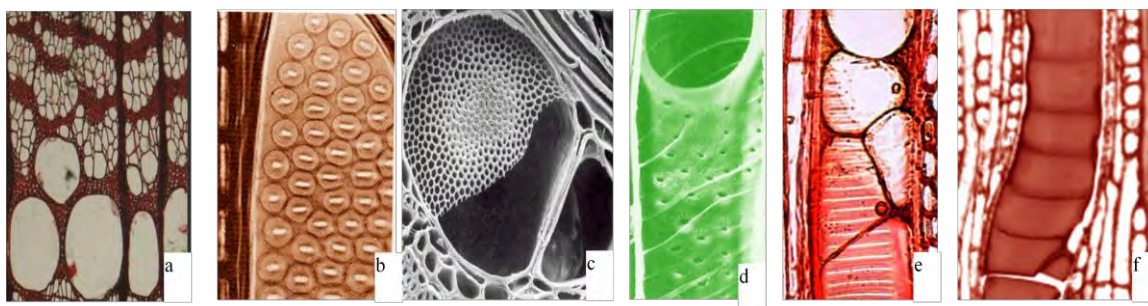
Figure 4: Re-creation process of wood aesthetical patterns of macro-level

2. EXPLOITATION OF WOOD ESTHETICAL VALUE OF MICRO-LEVEL

Following the conception of traditional wood science, micro-level wood esthetics refers to the esthetical effects formed by esthetical elements of wood visible only under microscope. At the micro-level, wood is composed of numerous cells. The same type of cells form a kind of wood tissue. The distribution and arrangement of different tissues inside wood and the features on the cell walls will be displayed on the wood surface, forming plenty of micro-level wood esthetical patterns. The esthetical elements at this micro-level are much more abundant than those of macro-level, including wood rays, wood parenchyma, tracheids, vessels, pits and spiral thickenings on cell walls, etc. Here one can take vessels of wood as example to illustrate the principle and exploiting technology of wood esthetics at micro-level.

2.1 Esthetical principles of wood vessels

A vessel is a conducting tissue in hardwood, which is composed of tube-like cells connected one after another, performing water and nutrients conduction in a tree. The esthetical elements of wood vessels mainly come from the patterns of distribution, arrangement and combination of pores, pits and spiral thickenings on the cell walls, perforations on the vessel perforation plate, and the tyloses and gum in vessel cavities, etc. These features can form lots of patterns and configurations on wood surfaces, which include very rich esthetical elements, as shown in figure 5 (XU Youming et al. 2006; LIANG Min 2008; Webset picture 2007).



a. Distribution, arrangement and combination of pores; b. Pits on vessel wall; c. Perforation and perforation plate; d. Spiral thickenings; e. Tyloses; f. Gum plug.

Figure 5: Esthetical factors of vessels

2.2 Re-creation of esthetical patterns of wood vessels

As illustrated in figure 5, wood vessels possess very rich esthetical elements, but the esthetical patterns composed of wood vessels directly are still limited. In order to further exploit the esthetical value of wood vessel, we can use the esthetical elements of wood vessels as the source material to re-create esthetical patterns, which are composed entirely of natural esthetical elements of wood but bear certain artificial design ideas. Here one can take the sculptured-type perforation plate of *Stipulate Dolichandrone* (*Dolichandrone stipulate*) as an example to illustrate the re-creation process of wood esthetical patterns of micro-level, as shown in figure

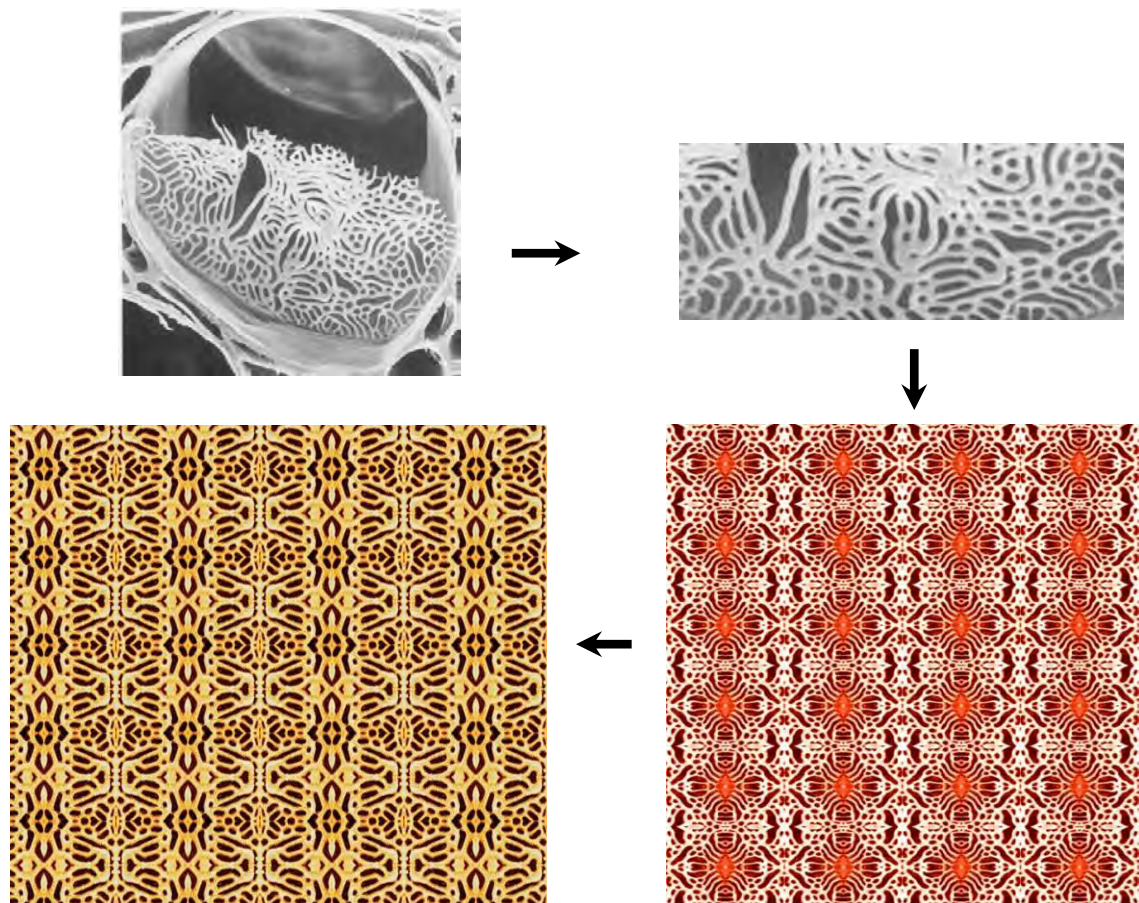


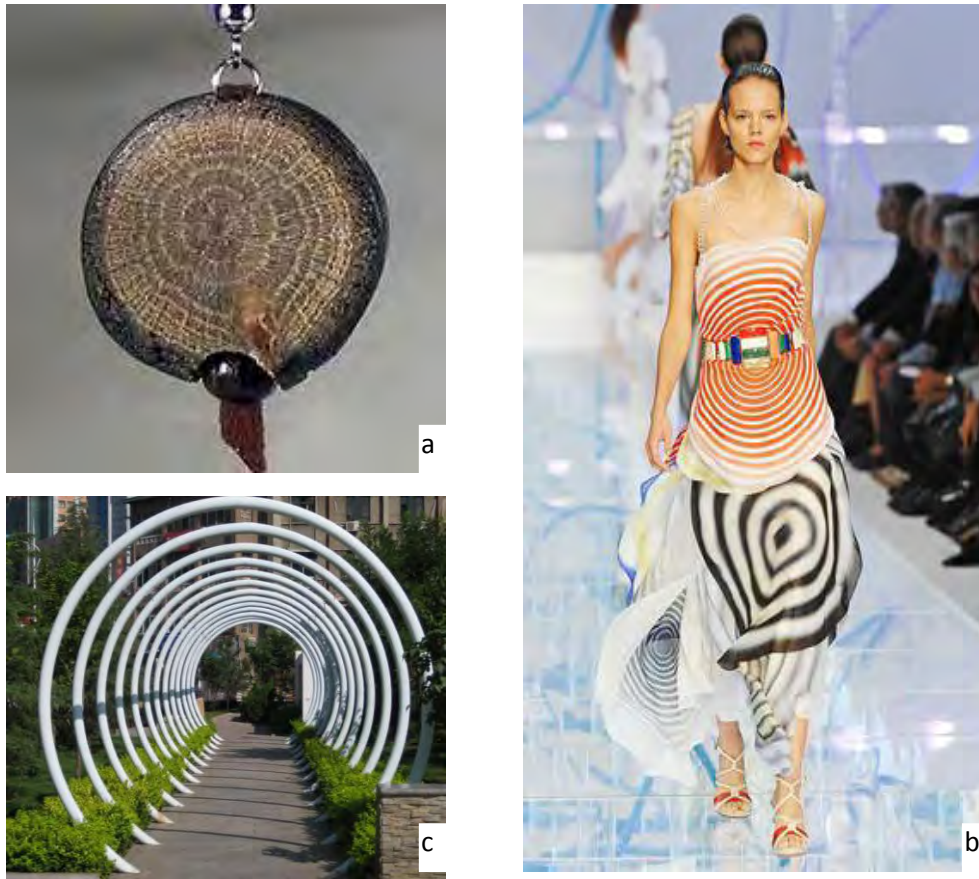
Fig.6 Re-creation process of wood esthetical patterns of micro-level

3. APPLICATION OF WOOD ESTHETICAL VALUE

A large number of new wood esthetical patterns can be developed through wood esthetics research. Such wood esthetical patterns are composed of natural esthetical elements of wood, and accordingly go perfectly along with the 'Close to Nature' ideal of modern people, so they have strong affinity to modern people and will be easy for people to accept. Wood esthetical patterns can be widely used in fashion, clothes, and interior and exterior decoration design. The research on wood esthetical value and its application should have a significant impact in beautifying and enriching people's lives and meeting people's spiritual and cultural needs. The following are some application cases of wood esthetical patterns in daily life.

3.1 Application of wood aesthetics at macro-level

This again takes annual rings as an example to illustrate how the wood esthetics of macro-level to be used perfectly in handicraft article, fashionable dress and landscaping design, as shown in figure 7 (Webset picture).



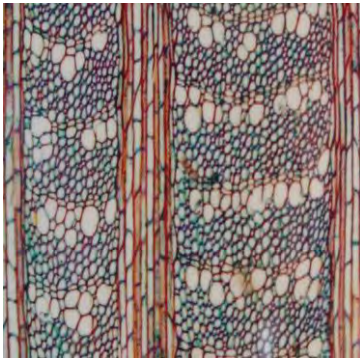
- a. Handicraft article made from wood disc with flower-like annual rings.
- b. Application of esthetical concept of annual rings in fashion design.
- c. Application of esthetical concept of annual rings in garden design.

Fig.7 Application of esthetical value of annual rings

3.2 Application of wood esthetics at micro-level

The following are two application cases of wood esthetical value at micro-level. The first illustrates how the minute structure pattern of cross section of *Helicia wood* (*Helicia formusana*) was directly used in the new-style tie design (LUO Jianju 2009). In the second case, esthetical elements from the sculptured-type perforation plate of *Stipulate Dolichandrone* (*Dolichandrone stipulate*) were used as the source material to re-create wood esthetical patterns of micro-level, and the re-created esthetical patterns were used for interior decoration, as shown in figure 8.

New-style tie design



Classic decoration design

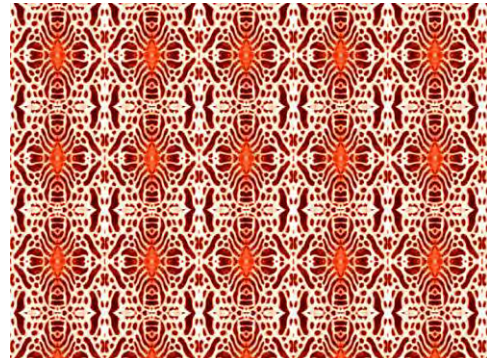


Fig.8 Application of wood esthetical value of micro-level

4. CONCLUSION

There are abundant esthetical elements in wood, and they can be classified as macro-level ones and micro-level ones, which can be exploited by using the theories and techniques of wood anatomy and graphic esthetics, and can be used for re-creation of wood esthetical patterns.

The wood esthetical patterns, whether directly from wood surfaces or from re-creations, are all composed of natural esthetical elements of wood. They just go along with the 'Close to Nature' ideal of modern people, and can be widely used in fashion, advertisement, interior and exterior decoration design, and even in design of industrial products. Wood scientists could make great new contributions to the development of our human civilization through a comprehensive study of wood esthetics.

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- Webset picture, [Http://www.joynlady.net/GB/30/n-12530-19.html](http://www.joynlady.net/GB/30/n-12530-19.html), Annual rings of fashionable color.
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Enjoyment of Japanese Traditional Wood Carving

Kitazawa Hideta²

Abstract

Japan is a forested country and has a 1400 year old woodcarving history which started with Buddha statue carving. Many kinds of woods are used for carving. The presenter is a second generation woodcarver and has been making various kinds of traditional woodcarving for 20 years. An example of this is the decoration of wood carving in Japanese shrines and temples, festival floats, portable shrines and Noh-masks.

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Enjoyment of Japanese traditional wood carving

Kitazawa Hideta











Traditional and Modern House Paintings and Arts of Wood in Everyday Life

Olga G. Sevan³

Abstract

The paper is dedicated to one of the most interesting phenomena of the Russian folk art – house paintings and decorative details of everyday life on wood.

It is for the first time this topic (monograph) gives quite a detailed analysis and description of house paintings and decorative details on wood, and different furniture, wooden objects of everyday life dating back to the middle of the 19th – beginning of the 20th century and located in the regions of the Russian North in connection with the author's work as the chief architect of the project in the museum of wooden architecture (Open Air Museum) in the village of Malye Korely near the city of Archangelsk.

The author illustrates the history of the historic-cultural region, types of settlements, dwelling wood complexes and estates which one meets in the said area. Then she analyzes various types of folk paintings (façade and interior) on wood, their stylistics, symbolism, places of location, identifies craftsmen (local and those who came from other places), reveals the importance of this type of the folk art in the cultural development of certain lands.

The author put the question how the modern artists or users in different regions of these territories could benefit from increased prosperity and the growing demands for more sustainable consumption and lifestyles.

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Painting on wooden surfaces and interiors are one of the most important forms of folk art in Russia. Both in Urals region, in Siberia and in the Russian North paintings on the façades and in the interiors of peasant houses were widespread. The question of when those paintings first appeared on the external walls of the peasant log houses is still open. In the 19th century only battened walls were decorated with paintings, but use of battens in peasant constructions spread in the 19th century at the earliest. This suggests that decorating peasant log houses with drawings is a relatively recent phenomenon. The earliest paintings of peasant wooden houses in Archangel Region date from the 1840s though painted constructions are mentioned in the sources of the 17th century. Both facades and interiors of church buildings were also decorated with drawings.

Colorful paintings decorated façade frontons of the wooden houses, so called battened ‘hemming’ of pendent roofing and balcony base, shutters and outside architraves. Interiors were decorated with drawings partitions especially those partitioning off the stove, movable pieces of furniture, cupboards, or in some cases doors and walls. Peasant artists decorated distaffs, birchbark boxes, shaft-bows, sledges, and even cemetery wooden crosses. Sometimes they both produced utensils and tools and then covered them with paintings. That is why paintings of the northern peasant home in different parts of the regions form interrelated style complexes. The same artists often decorated interior elements of local wooden churches such as beams for ceiling panels or ‘heaven’ and for the iconostasis, lecterns and carved images, doors and portals. Paintings were done by professional or peasant artists. Sometime they organised artels of ‘dyers’, or worked as a family, or practiced seasonal working far from home.

There are apparent parallels between peasant paintings from Russia and those of the Northern Europe - Sweden, Norway, Finland and Denmark. Similar geographical conditions, the history of cultural and trading contacts with the Archangel and Vologda regions produced common traits in that form of peasant art. Those interrelations could be proposed as a subject for international research project, which will result in finding new data and comparisons.

From the artistic point of view, those paintings represent independent and well elaborated part of folk art. One can discover several historical territories in the Archangel and neighboring Vologda regions where different types of painting existed in former times and are still observable. Those territories are namely the Poonezhye and Kargopolye, the area called Povazhye, and basins of North Dvina, Pinega and Mezen’ rivers.

Paintings of Kargopolye and Poonezhye (western parts of Archangel and Vologda Regions)

The names of Poonezhye and Kargopolye are historically applied to the lands on the Onega River and around the Onega Lake. They also border Karelia and in former times were included in the area of economic and cultural influence of the town of Kargopol’. That town was mentioned in the chronicles beginning from the 12th century and for a long period since it was an important economic, political and trading centre of the North West Russia. Many interesting elements of construction techniques applied for wooden religious and dwelling buildings are still applied there together with particular customs and rituals that are practiced. All that witness preservation of distinctive folk culture in the area.



Figure 1: View of the wooden chapel in village Glazovo in the Russian North (*Kenozero national park*), 2005.



Figure 2: Paintings of the wooden dwelling houses of the *Kargopolye* and *Poonezhye*. Color fronton of the house, 2005.

Almost every village had its own chapel. The latter could be located in a place seeming perfectly unusual – in woods, on riverbanks or lakeshores, in fields or at the village outskirts. That abundance of wooden chapels could be explained by predominance of an old believing population from the 17th and till the 19th century. The ‘pogost’ or a big churchyard including summer and winter churches, a bell tower and a graveyard put up in a village or a hamlet or nearby was also typical of the area.



Figure 3: Wooden Pogost in the village Poche in the Russian North (*Kenozero national park*), 2011.

From the architectural point of view, dwelling wooden houses were very diverse in that territory. That could be explained by variety of ethnic groups living there, namely Karels, Vepses, and Russians all having own traditions and culture. Home paintings were very popular here, and a good number of constructions decorated with both frontal and interior paintings are still preserved.

In the North West Russia a certain manner of folk painting emerged in the 18th century. Technically, it was based on a free brush touch and application of white contour lines. That free and easy style of painting, bright colouring together with technical virtuosity is the most distinctive features of that form of folk art. In addition, artistic workshops of the region producing illuminated manuscripts, icons, pictures, painted furniture and utensils influenced that manner a lot.

Some of those items preserved until now prove that folk home paintings of the later period followed in style this artistic school of the 18th and of the first half of the 19th century in many areas of the Russian North. In particular, that influence is apparent in floral patterns with rose motifs widely spread in the North. The bright polychromic palette of the Novgorod artists, adherence to pure local tones, and free manner of paintbrush movement that was developed in herbal patterns also deriving from Novgorod made up the source of that later artistic tradition.

That influence was often an immediate one. E.g. there is evidence that Mikhei Abramov dwelling in Zaonezhye area acquired skill in painting in the monastery and lately taught it to his son Ivan Abramov who began to work with him at the age of 12. The father and his son painted churches, chapels and icons.

Peasant artists also decorated wooden distaffs, birch bark articles, shaft-bows, sledges, etc., and houses too. Almost everywhere, they worked not only at home but wandered away looking for commissions. E.g., the Tarakanov brothers or artists of the Semyin family from Maloye Konevo village painted houses in Kenozero villages and in other places.

The bush shaped bouquet, stretched or curved branch, complex floral composition often in vase were favorite pattern motifs of paintings. Bouquets were composed of lily-tulips, frontally painted rosette-like flowers, apple-balls and roses. In between flowers and long curves leafs white, red, black and blue birds were painted. Rose-apples, rosettes and dog-rose flowers were veiled with pleached thin shoots, tendrils and curves. Frequently that type of composition included a picture of lion. In frontons of several preserved houses one can see the motifs of lion and of grapevine side by side with rich floral pattern decorating a balcony. The vine symbolised prosperity and wealth of the house and a lion had protective functions.

However, it must be underlined that those traditions of different ethnic group's sometime show in peasant paintings. This interaction of culture and artistic tradition could serve as an explanation of nearness in style and even commonness of Russian, Karelian, and Finnish peasant paintings on wood. Beginning from the 11th century popular and folk art developed in similar historic and cultural circumstances and were under influence of the same factors, traditions and phenomena. That picture shows a Karelian peasant wooden house as example.

Many wooden houses (e.g. in Zadnyaya Dubrova village) are four wall izbas and as a rule have four windows on their façades. Decorative paintings of those houses are combined with carved battens. The colour scheme of frontons harmonises with ornamental paintings on outside architraves. The simplest type of decoration was the colouring of battens in stripes. The most widespread composition included triple partitions of pendent roofing with flowers in the centre of each and blue frontons with stars imitating 'starry sky'.

Façade paintings of the house from Iglin Rutchei village show consideration of folk artist for tendencies in a big art nouveau style. The figures of the master and mistress were painted on the sides of central wooden fronton window and pendent roofing was decorated with pictures of 'exotic' fruits – pineapple, peach, pear, and bunches of grapes painted on the white background. The floral pattern consists of roses amidst cornflowers, bluebells and other field flowers. Those paintings highlight decorative character of the fronton of that two-store house.

There were also several pieces of painted wooden furniture in the interior of the houses. Paneled partitions were often ornamented with both paintings and carving, a radiant rosette was the basic motif of the latter. The cupboard and drawer panels were decorated with paintings in dark blue and brown colours with white shades. Stylised flowers were symmetrically arranged and painted rather in a dry manner.

Paintings of North Dvina

In that territory, one can find several types of paintings related to three historic cultural areas. The first and most acknowledged artistic centre bears the name of the town of Verkhnyaya

Tot'ma. Many famous artists worked there but the most renowned and outstanding was Timofei Makarov. He was lame and was given the nickname "Kalets" because of this. His father was also a painter who decorated wooden distaffs, wickerwork boxes, shaft-bows, chests, etc, and filled church commissions. Timofei worked with his father and most of the facades painted by him are still preserved in many villages. One of the most interesting examples is the house in Keras village. Its colouring and picture of the 'paradise garden' perform wonder not only with floral patterns but also with pictures of animals namely of an ox and a horse presented in heraldic manner. (Today this building was removed to a new place by privet person in the Moscow region).

The Chistyakov sisters, whose father also was a painter or 'malyar', worked in that region too. They acquired mastery from him and decorated wooden house interiors, cupboards, doors, partitions and facades. Their bright and colourful painting evenly covers the surface with a vivid and supple ornament. Their herbal and floral patterns are of the ornate style but composed harmonically and symmetrically. In some cases, bushes symbolising 'a tree of life' and crowned with tulips are put into vases while hens walk about. Pictures of tulip one can also discover in ancient Russian books and northern manuscripts, on traditional Russian enamels of the 17th century and on the wall frescoes of Moscow stone churches, etc.

Paradise birds or the Sirin bird are pictured in those paintings in rather an ordinary manner though the latter was a favorite figure always put in the centre of composition. The bird symbolized the joy of life and the idea of growing life force. Sirin was also a symbol of heaven and water and its cult survived Christian epoch when it was linked to earthly happiness.

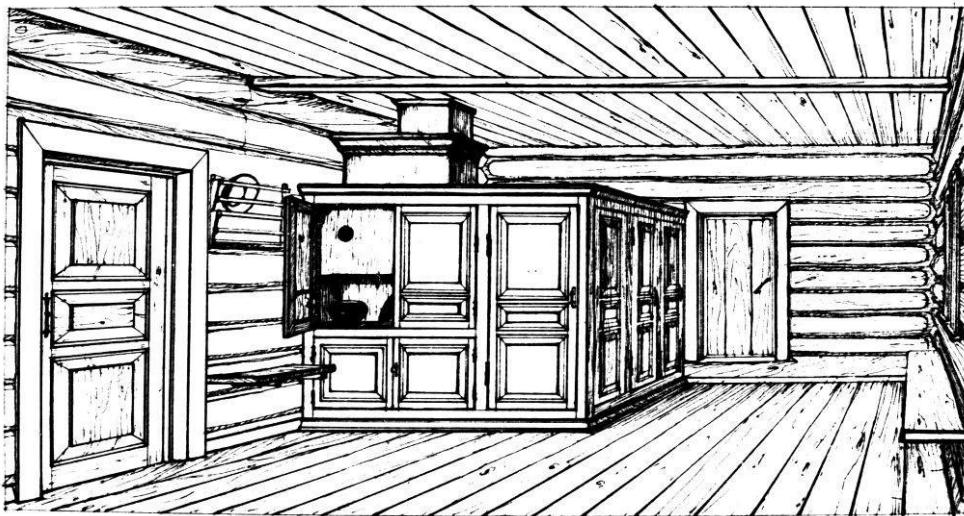


Figure 4: Drawing of the interior of the wooden house in the village of *Upper North Dvina*, 1984.



Figure 5: Paintings of North Dvina. Balcony and fronton of the Bechin's house. Painter Timofei Makarov, 1977

In the Upper North Dvina izbas interiors were decorated with another type of paintings, e.g., the paintings of artists Yurkin, Orlov or the Zakochurin brothers dating from the end of the 19th century covered the fielded wooden panels partitioning off the stove. There exists interesting examples of doors leading to the cellar, of those closing stove stairs and of other ones closing a wash-stand. All these were unique elements of fitted furniture in a peasant house. Paintings were in oils, their bright red, or blue, or rose background was covered with bunches of flowers of most divers and exotic type and shape. The petals were outlined with white in a style which was not as graphic as in the previous area but very picturesque. Paintings were bravely spotted with roses and all the living space of a house formed tout ensemble including both wooden constructive elements and furniture.

Paintings of the Lower North Dvina do not show birds or animals and are rather monotonous. The main ornament consists of floral rhombus pattern painted in bright sunny colours and on the light background.

Unfortunately all the houses mentioned above are not put on the heritage preservation list at the federal or local level. They are not studied yet by specialists from local or state museums including open air museums.

Paintings of Povazhye

Those monuments of folk art in some sense were luckier. Here peasant paintings resemble those of the Verkhnyaya Tot'ma area. The artists used symmetrical composition of three flowers in the centre of a surface with stems and leafs stretching from it and white outlining. Those paintings were made by strange artists coming from the southern Kostroma region.

But that was the area where the most famous in the Archangel and Vologda regions Petrovsky family of artists lived in the middle of the 19th century. Many wooden houses here

were painted by those artists who often showed the lion and unicorn motif, or a lion and a horse on the sides of blossoming tree, or the pair of lion's motif. A picture of a lion was traditional for local monuments as the icon painters also used that exotic image. E.g., on the icon of the 17th century derived from the Vologda region in the composition devoted to the Last Judgment the apocalyptic beast was presented as a lion with a stick out tongue.

That heraldic type of composition was used already in the ancient Russian art and especially beginning from the 16th century. It is probable that an important role in penetration of that motif in folk art belongs to the emblem of the Moscow Printing Yard. Besides a number of European utensils including crockery and dishes with pictures of heraldic character acquired on the fairs were imitated.

The house of Petrovsky family called 'Aleshkin' according to the name of its master and the head of the family provides the most interesting examples of those paintings. The wooden façade decorations were typical of those artists but interior ones were unique. Here the painted door panels showed particular pictures of peasant family life, e.g. a portrait of a master, a hunting scene, a peasant and a cow in the meadow, etc. The wooden panels of stove partitions were also very picturesque and presented portraits of members of the tsar family and its retinue. Those paintings demonstrate an urban impact together with European one. It is known that artists from that family worked in St.-Petersburg and could have hypothetically come into contact with foreigners from the Nordic countries.

Unfortunately that house is already demolished. At the beginning of the 1970s it was discovered by specialists, its paintings were renovated and after that it was put on the list of protected local heritage. Neighboring dwellers of the village Churkovskaya where the house was located gradually left it and the settlement deserted. The threat of house demolition emerged. In that situation workers of the Archangel open air museum "Malye Korely" moved the main painted interior items to the museum. At the moment those paintings are included in the museum collection and presented on travelling exhibitions but they have not succeeded in moving the house.

Another example of façade paintings by Petrovskys one could find in the village of Pakshen'ga. On the wooden house fronton portraits of its master smoking a pipe and his young mistress apparently dressed in urban vogue were painted. Under the balcony on the battened surface one could see protecting pictures of lion and unicorn, flower bunches symbolizing a tree of life and picturesque floral ornaments.

Later on the house was pulled down and paintings passed to the Archangel Museum of Fine Arts and were included in its collections. Peasant portrait paintings by Petrovsky obviously belong to rare phenomena in folk art of the Russian North and need further investigation. But there were other artists from the Volga River and there paintings on the wooden interiors demonstrate mastery and individual artistic manner of the painter who hypothetically was acquainted with European principles of interior decoration.



Figure 6: a, b. Paintings by artists from the Volga River in the village of *Povazhye*. The parts of the wooden door in the house: “Lion”, 1981 and “Man with goblet” found of museum “Malye Korely”.

Paintings of *Mezen’* and *Pinega* rivers

In 1880s, a painter named Ivan Orlov worked in the Mezen’ area. Seemingly, it was him who decorated the wooden house of Vasily Klokotov which was one of the unique monuments of local wooden architecture. The house and farmstead, the social and cultural context of their formation and its history deserve particular investigation (it was undertaken by the author about 20 years ago and was linked to the project of moving the house to the Open Air Museum “Malye Korely”). In practice the house was transferred only some years ago and lately its restoration began. Meanwhile it is still unclear whether original façade paintings will be restored or they will be replaced by a copy of original preserved in the museum depository.



Figure 7: Paintings of *Mezen’* river. The House of Vasily Klokotov 1880s, a painter Ivan Orlov.



Figure 8: Wooden distaffs with the paintings from the Russian North, end of the 19th century

The battened pending roof of the house was covered with a pattern consisting of flowers and grape bunches. The wooden fronton painting showed heraldic figures of lions with ducks and geese over them. In the same part of fronton one could see a picture of man crossing the river from one bank to another in a rope-walker manner (that symbolises transition to the other world). The outside architraves, elements of the porch, the doors and other decorative details were painted red because that colour also performs a protective function.

The interior of the dwelling space was quite traditional for that territory. It included the very interesting wooden paneled partition separating the main room from the female space near the stove. Partition paintings represented flowers in vases which were fulfilled in graphic manner with white outlines together with sketches of diverse fenced foot-bridges.

Color paintings of the dwelling houses in sites of Pinega' river are very simple and look like the drawing of the chess patterns with different colors of black, white and orange or others on the facades of the houses. Sometimes we could see the red color on the decoration of the windows.

On the whole the experience gained is explicit about all the difficulties of preserving peasant paintings and drawings in dwelling houses that are more than 150 years old and survive in living rural environment. The modern construction in the settlements on one hand and there depopulation on the other bring about loses to that very important and fascinating form of folk art. Of course, some of those painting can be preserved and demonstrated in regional museums; often they can be moved to the open air museums. However local museums in situ could be also established on the base of such small architectural complexes in historical villages and hamlets, though that will require special decisions and organizational effort. The latter could be of success only with support from local and regional authorities, private business and population.

The modern artists or users in different regions of these territories could benefit from increased prosperity and the growing demands for wood due to more sustainable consumption and lifestyles. Some workshops and artistic exhibitions could be organized. Mainly there are situated in the big cities, some times in the villages. We can see workshops aimed specifically at children, and special lessons for teaching about these paintings. This would not only be for everyday life, but for tourism as well. Some of these can be found in different markets during the main holidays, with regional specificities from different parts of Russia.

The author prepared a monograph about these unique paintings of wooden dwelling houses in the Russian North and it was published in 2007.



Figure 9: Market in the village during the holiday in the Russian North (*Kenozero national park*)

Impression Comparison and Understanding: Chinese Wood-Framed Architecture in History

Guixiang Wang⁴

Abstract

Main contents: 1. A simple look of Chinese Culture:

2. An outlook of Chinese ancient Architecture

Generally speaking

a. The mainstream of

- Western traditional architecture is stone or brick made building structure system,
- but Chinese traditional architecture is wood-framed building system.

b. And the main form of

Western historic architecture is always a whole form of a monumental building complex;
But Chinese traditional architecture is usually a complicated group of courtyards composed with many simple single buildings.

c. A single courtyard: a cell of Chinese traditional building.

⁴ Tsinghua University, Tsinghua Yuan, Haidian District, Beijing, PR CHINA (wanggx@tsinghua.edu.cn)

Chinese Architecture History

Chinese Wood-framed Architecture in History

By Wang Guixiang



- At the very beginning, I would like to send many of my thanks to :
- European Forest Institute, FLEGT Asia
- And IWCS (the International Wood Culture Society)
- For sponsoring me to be here to have the speech.

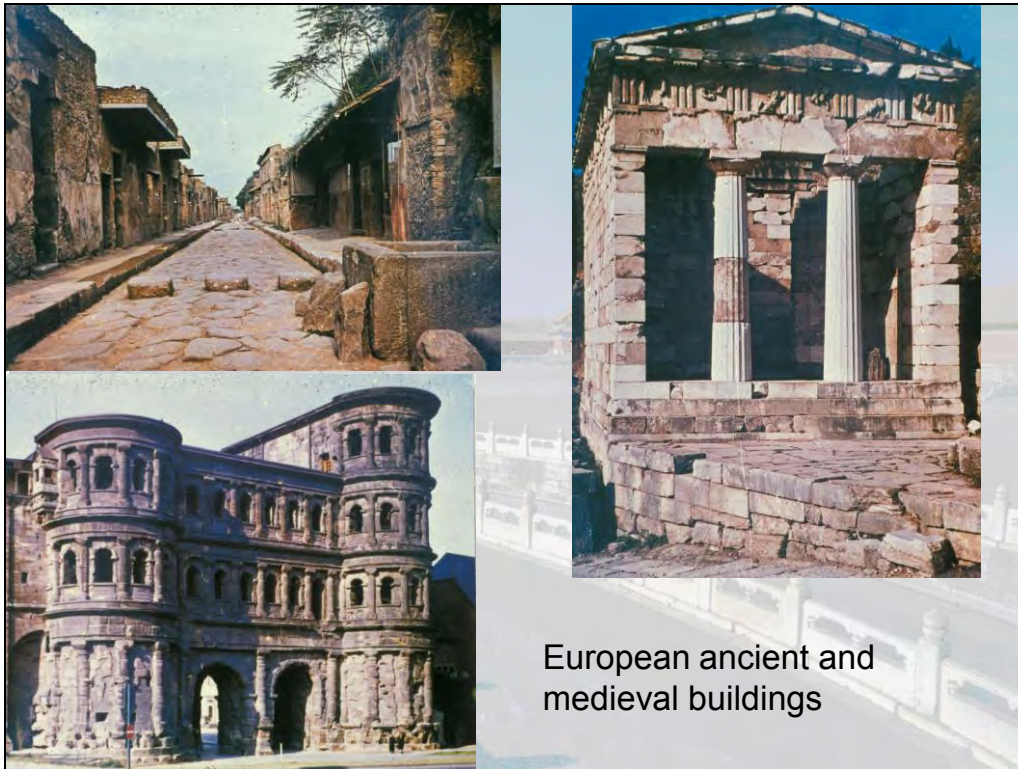
● An outlook on Chinese ancient Architecture

Generally speaking

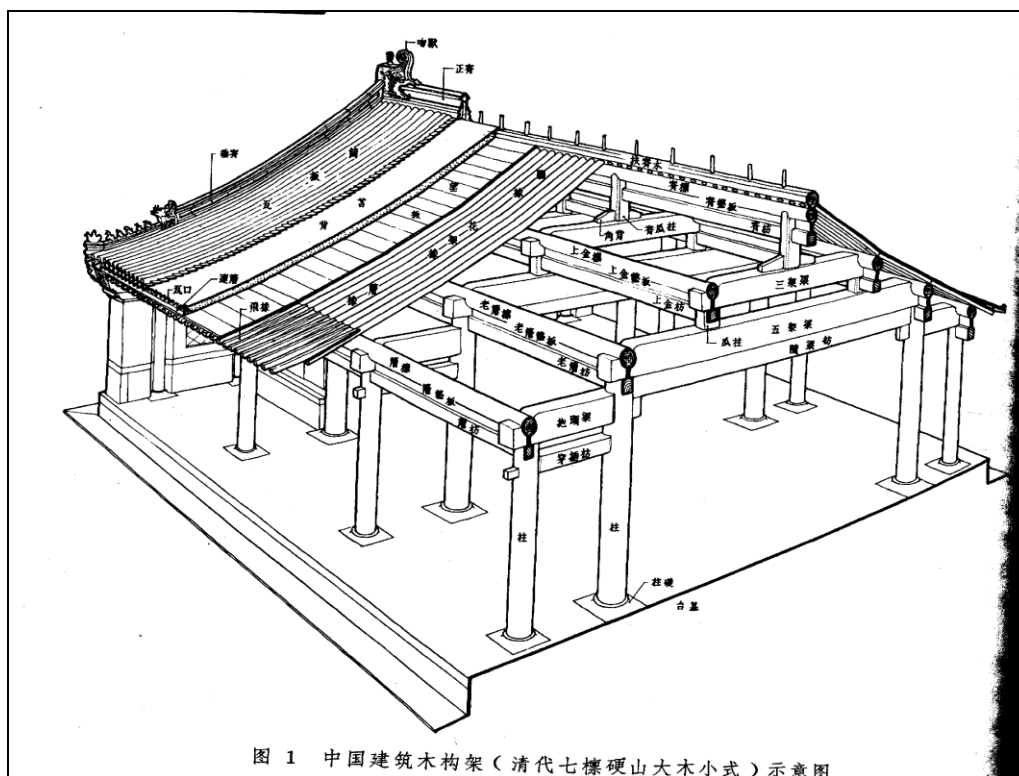
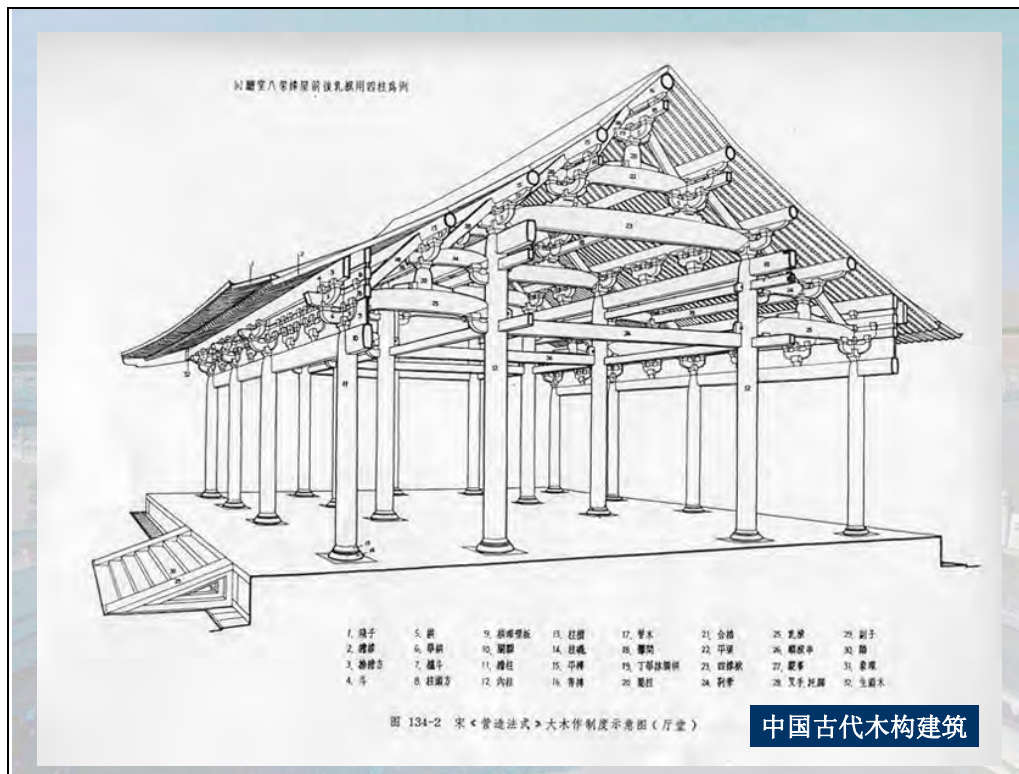
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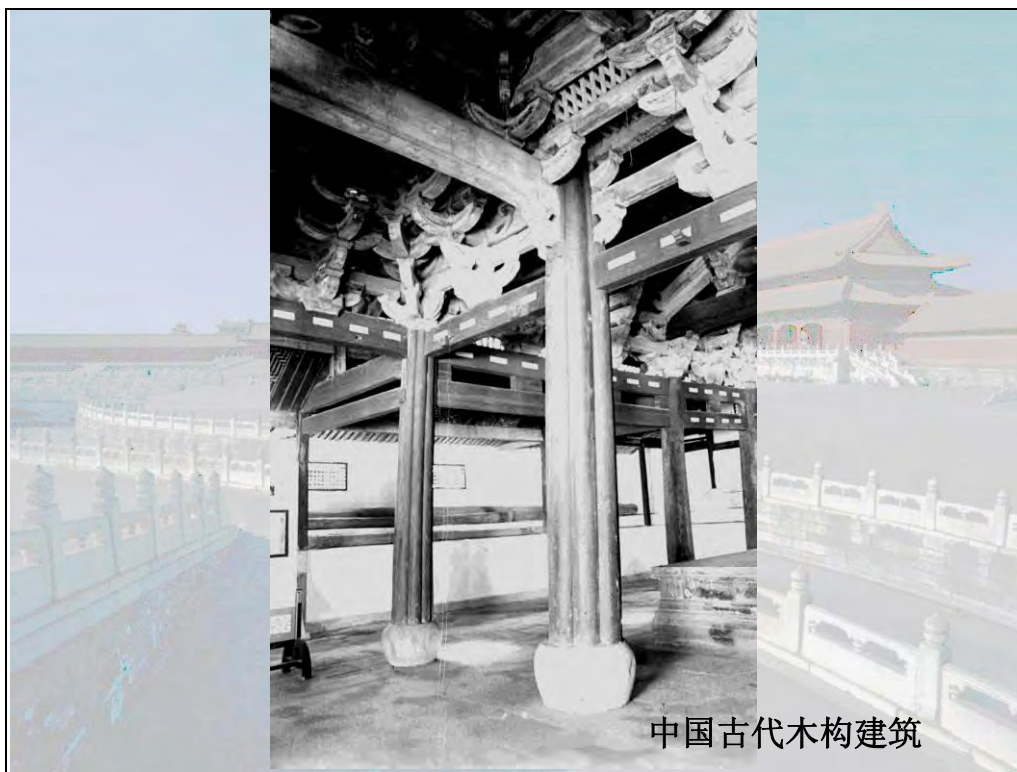
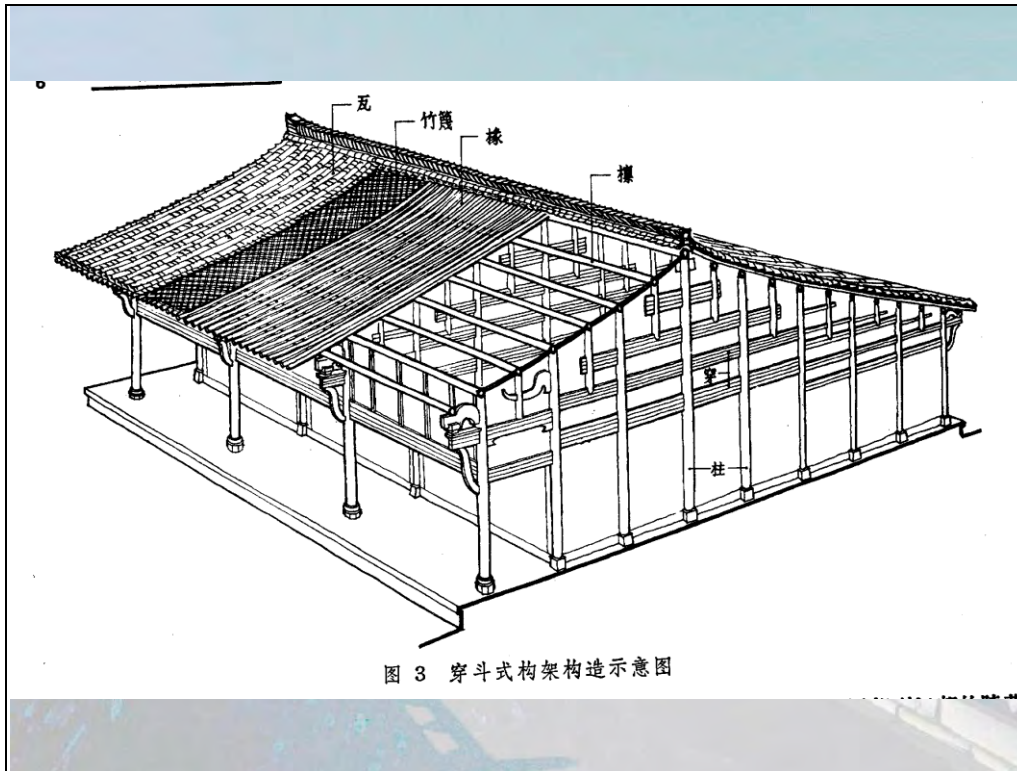
① Western traditional architecture is stone or brick made building structure system,

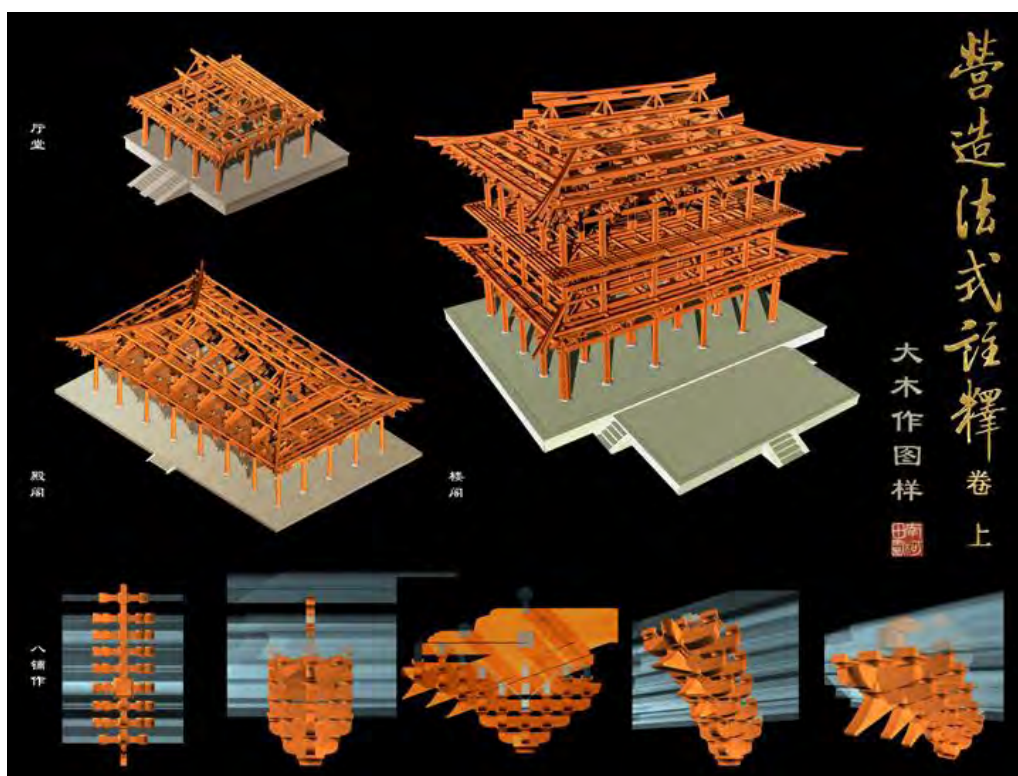
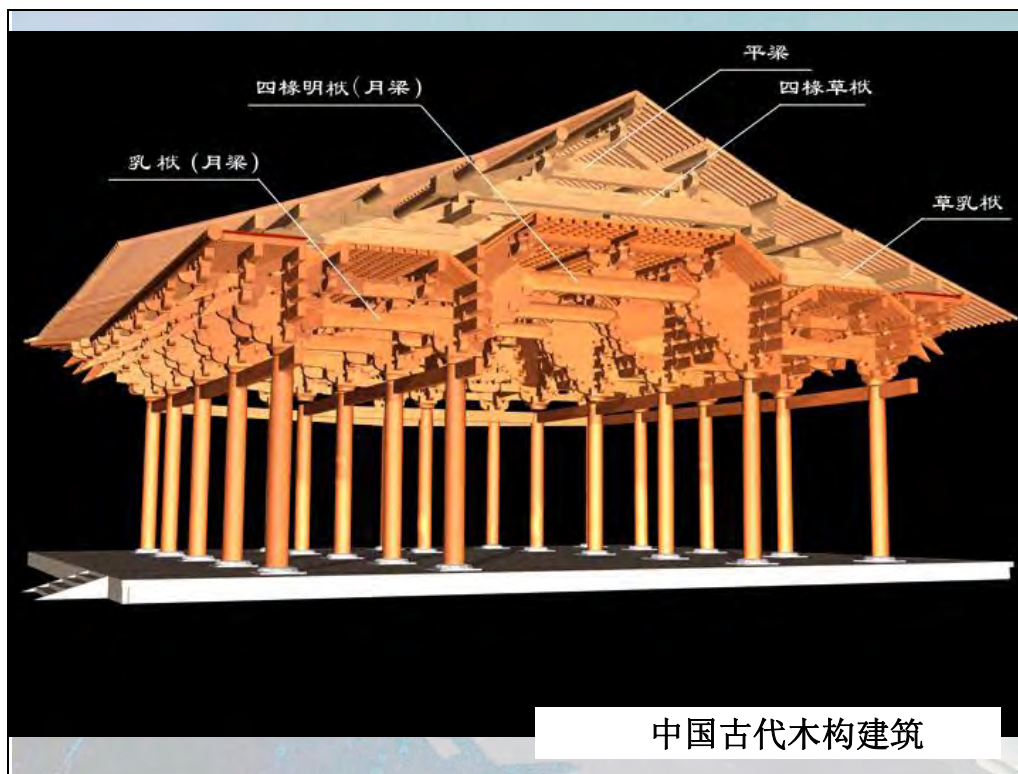
② but Chinese traditional architecture is wood-framed building system.

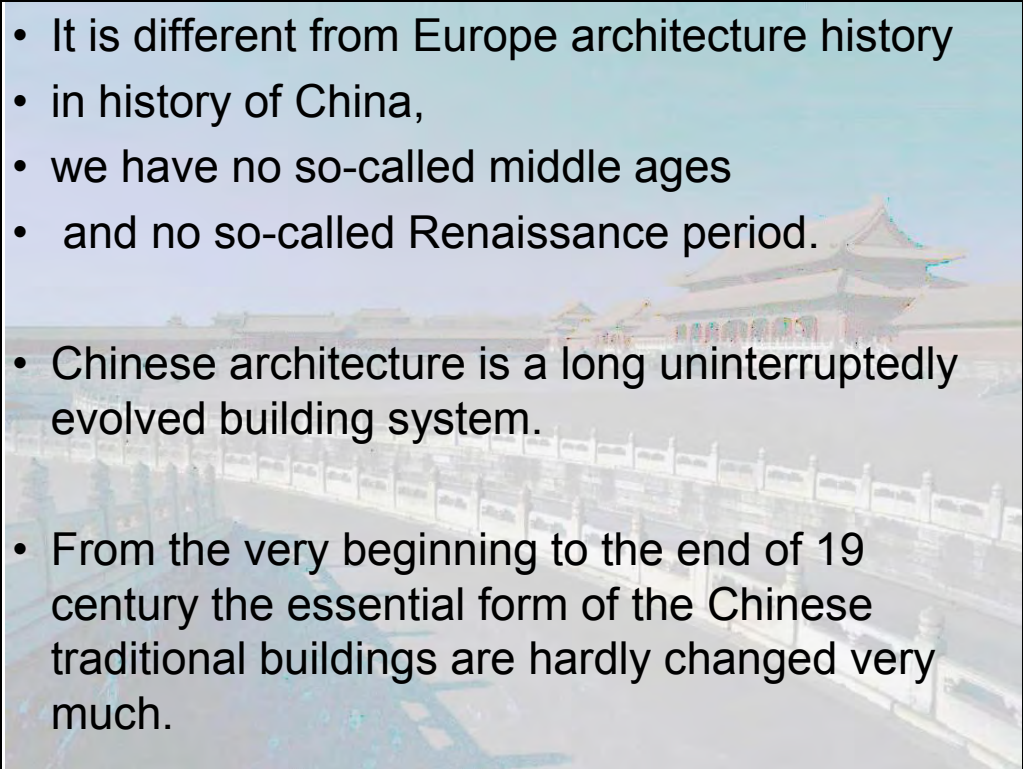


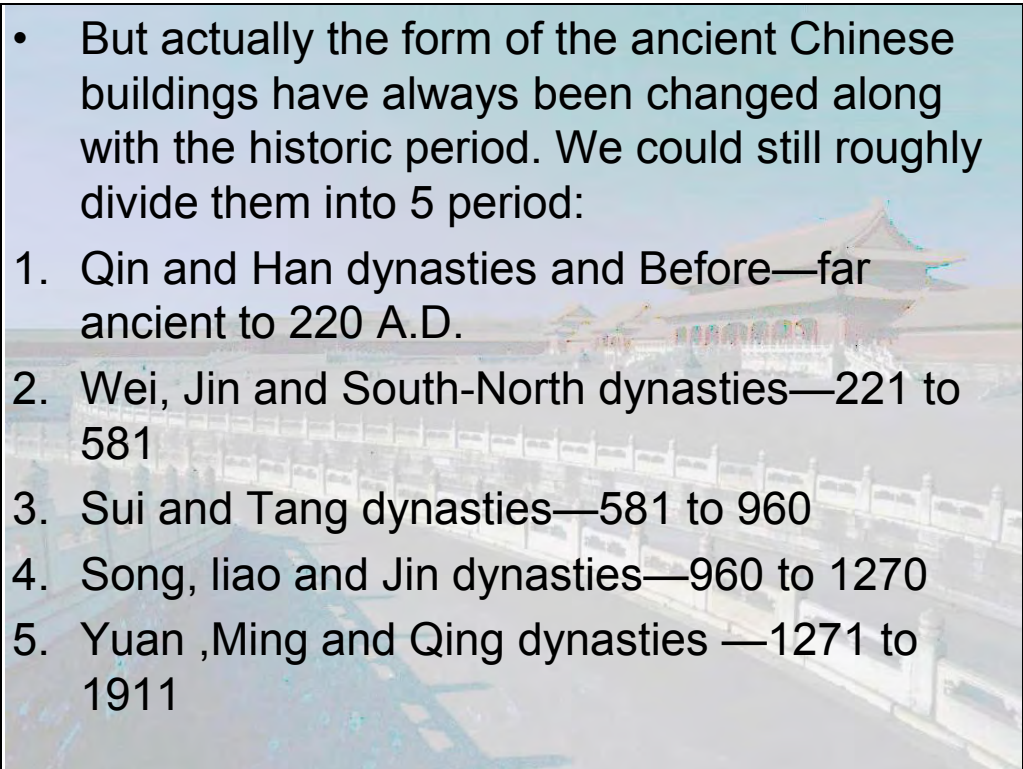
European ancient and medieval buildings





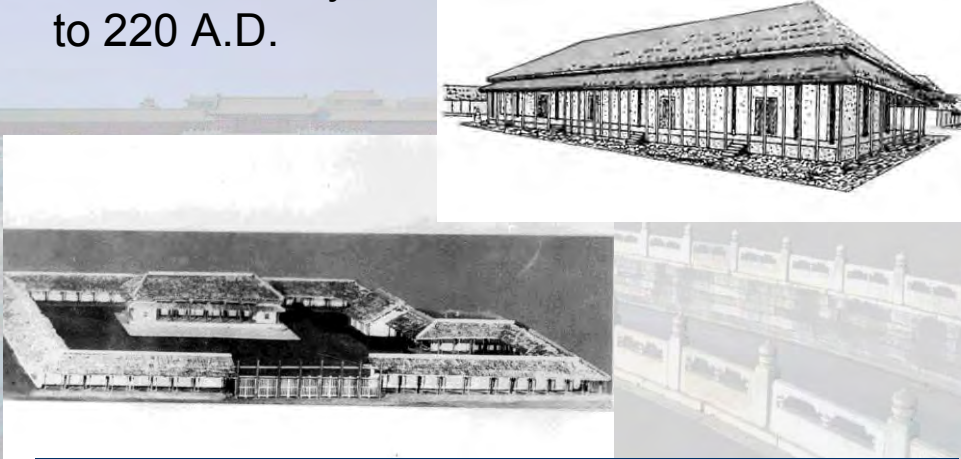


- 
- It is different from Europe architecture history
 - in history of China,
 - we have no so-called middle ages
 - and no so-called Renaissance period.
 - Chinese architecture is a long uninterruptedly evolved building system.
 - From the very beginning to the end of 19 century the essential form of the Chinese traditional buildings are hardly changed very much.

- 
- But actually the form of the ancient Chinese buildings have always been changed along with the historic period. We could still roughly divide them into 5 period:
 1. Qin and Han dynasties and Before—far ancient to 220 A.D.
 2. Wei, Jin and South-North dynasties—221 to 581
 3. Sui and Tang dynasties—581 to 960
 4. Song, liao and Jin dynasties—960 to 1270
 5. Yuan ,Ming and Qing dynasties —1271 to 1911

A simple historic look of Chinese architecture

1. Qin and Han dynasties and Before—far ancient to 220 A.D.

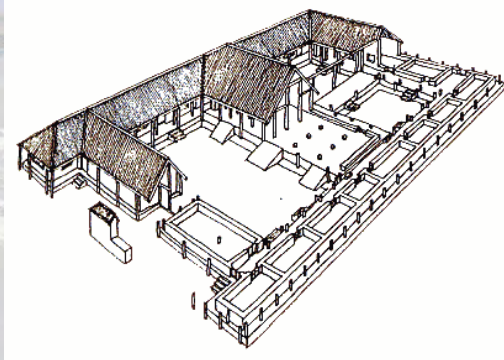
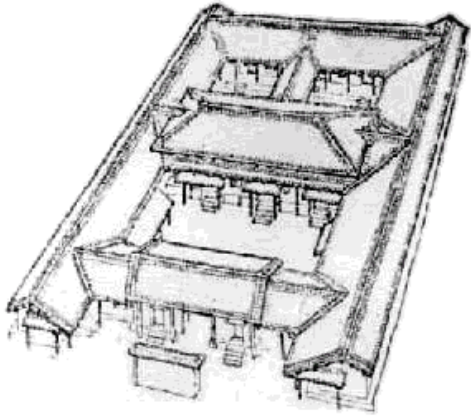
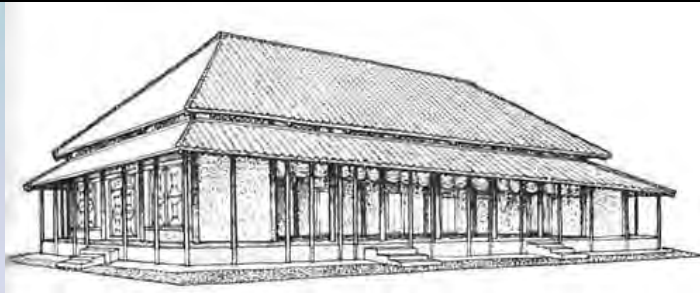


Palace of Shang dynasty: 1500 B.C. - 1800 B.C. (reversion)



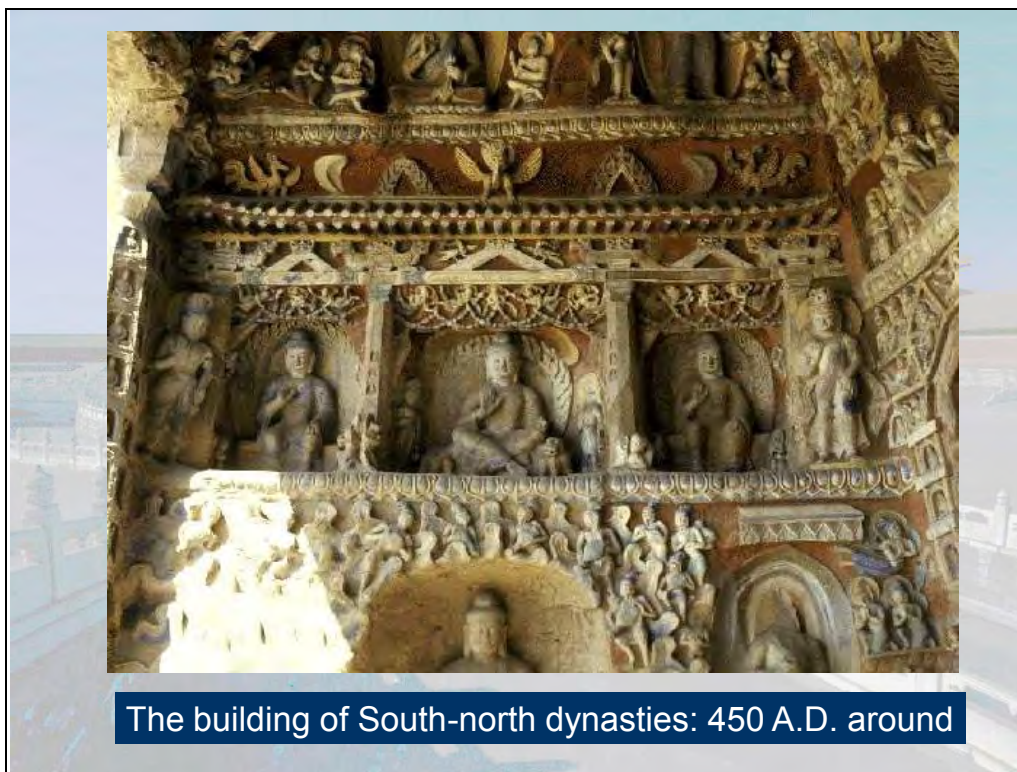
Early building: simple and rusticity

- Early buildings:
- simple and rusticity.



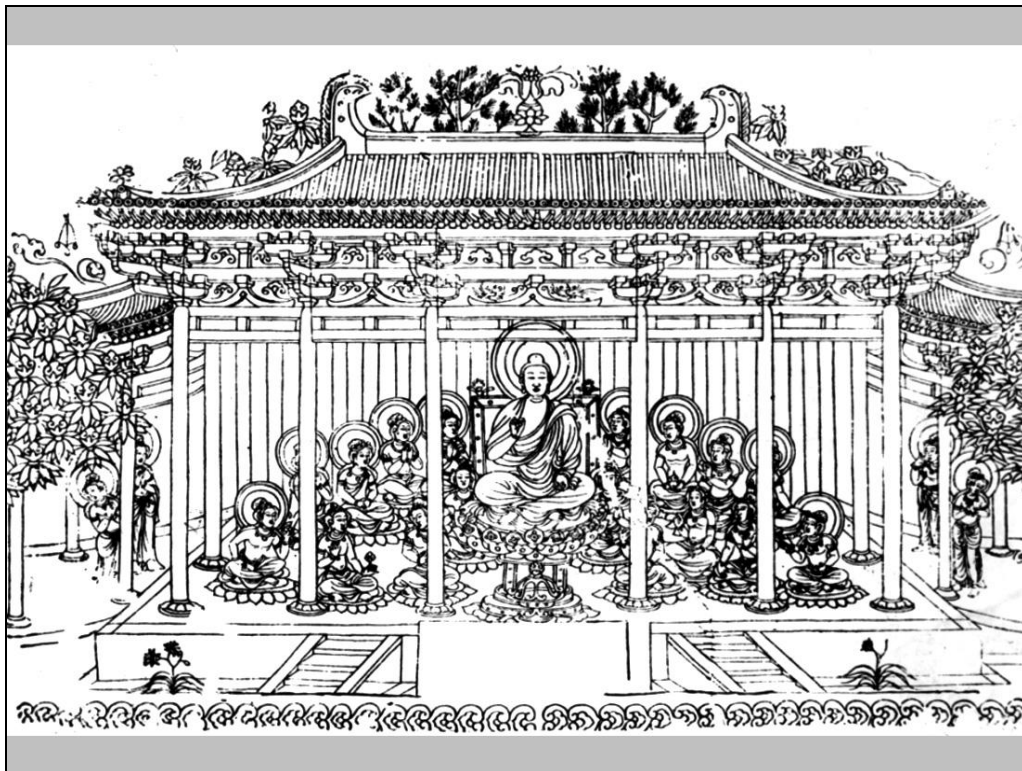
- Early buildings: simple and rusticity—200 B.C.







Buddhist grottos of South-North dynasties





Foguang Temple in Wutai County: 857A.D. Tang dynasty

4. Song, liao and Jin dynasties—960 to 1270



Liao dynasty 开泰九年 (1020)



Liao dynasty 统和二年(984)





5. Yuan ,Ming and Qing dynasties —1271 to 1911



Yong le Gong, Chun Yang Temple, Yuan dynasty 1271 to 1368

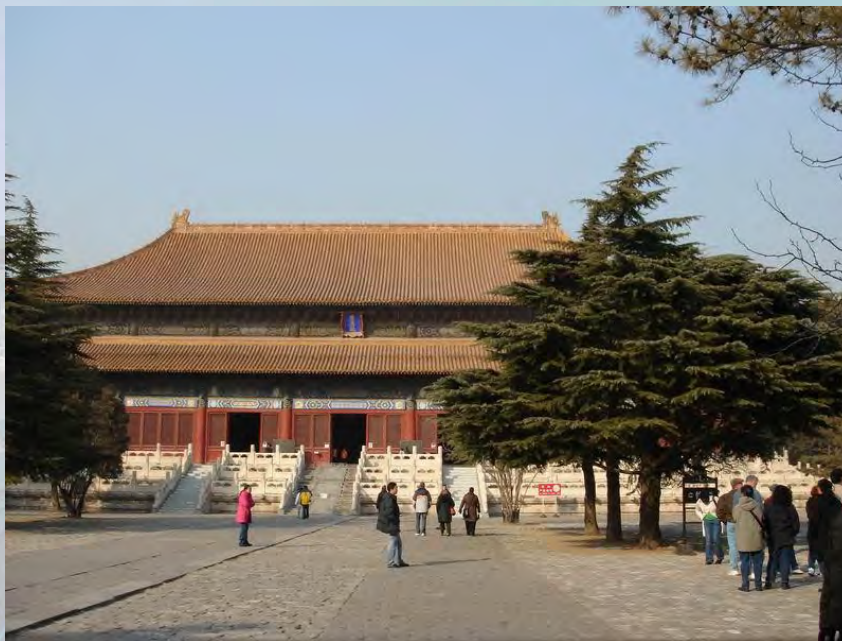


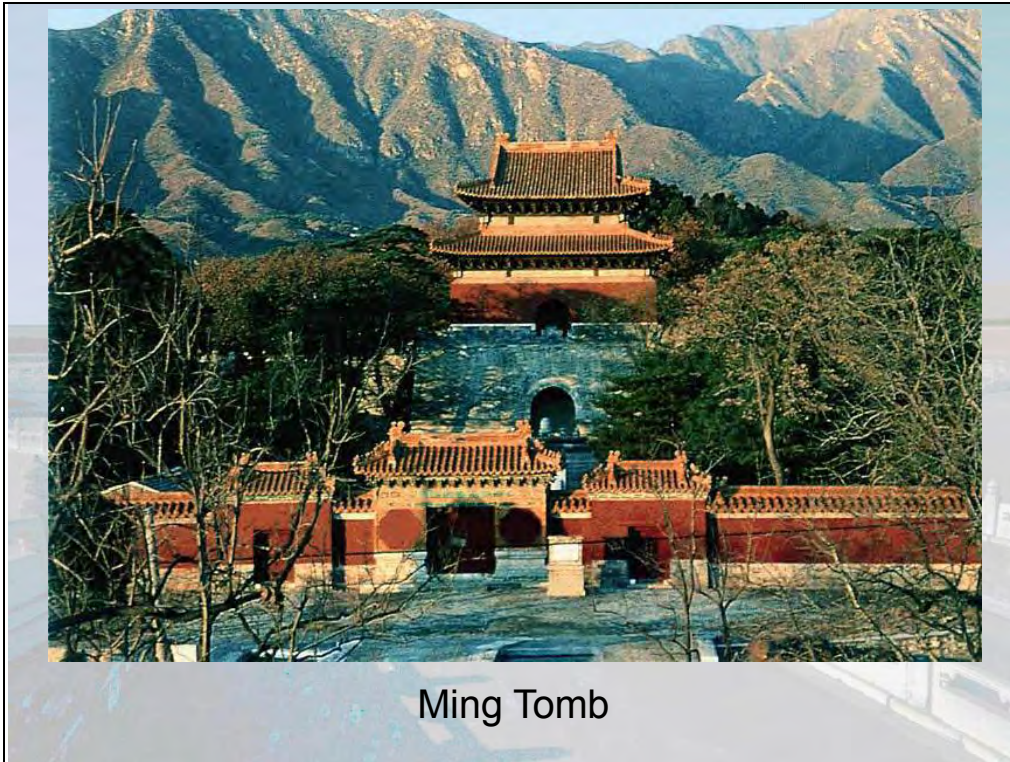
Yong le Gong, Chun Yang Temple, Yuan dynasty 1271 to 1368

- Ming Tomb: Chang Ling Tomb, Ming dynasty

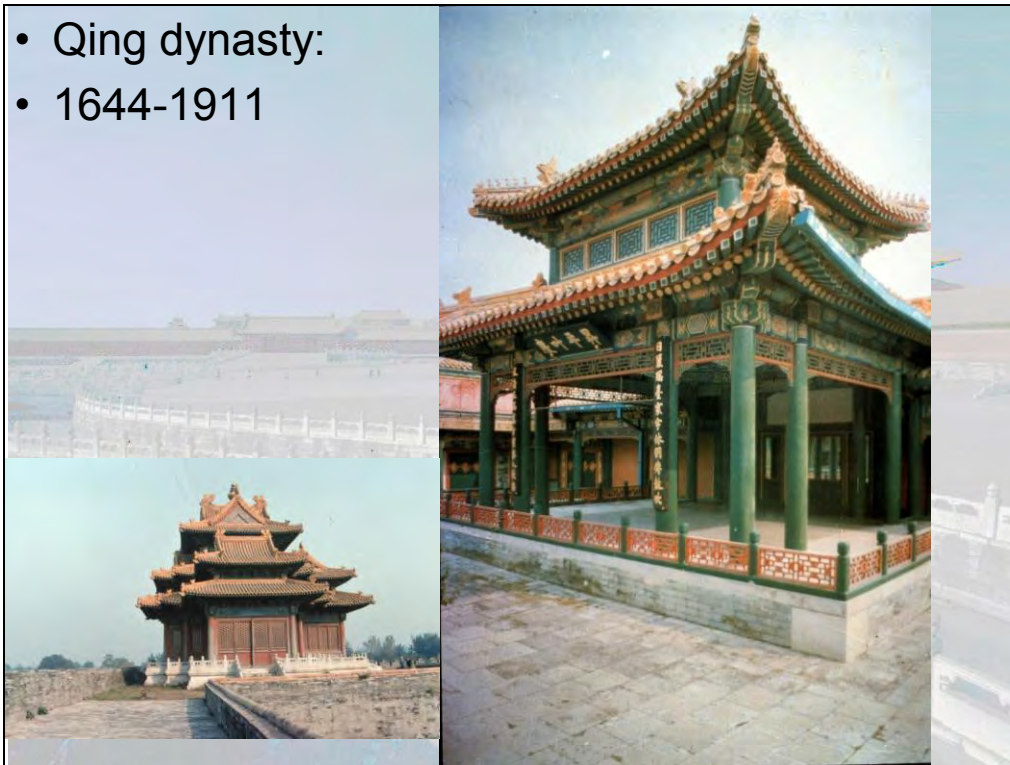


- Cult Temple of Ming Tomb: Ming dynasty

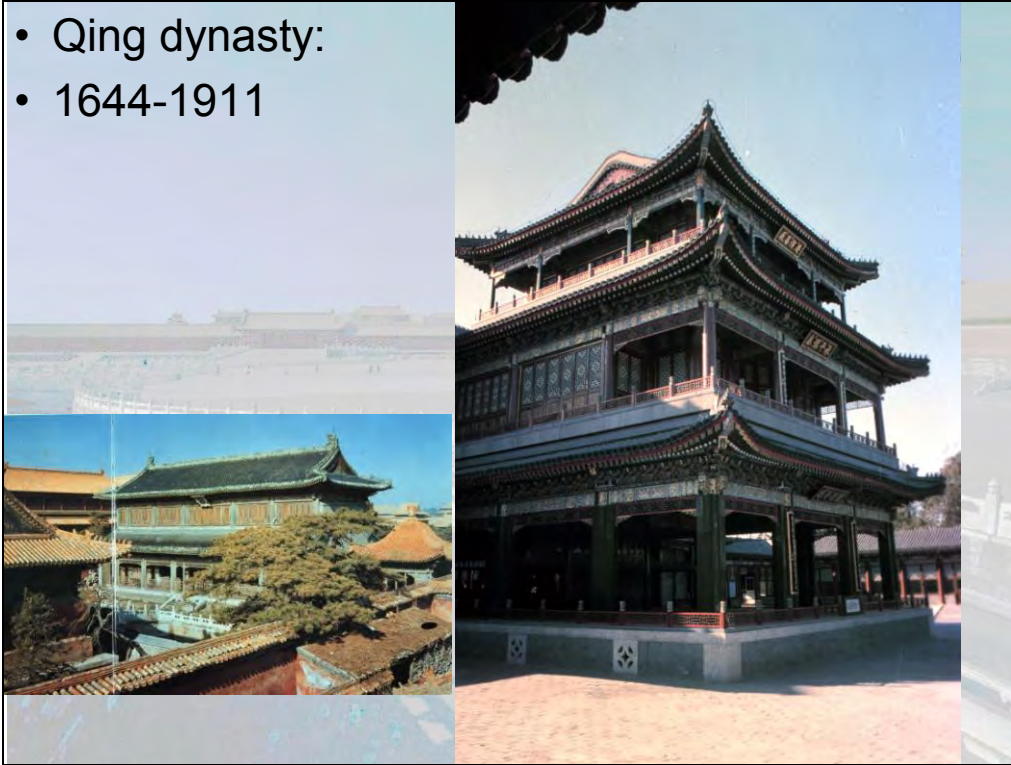




- Qing dynasty:
- 1644-1911



- Qing dynasty:
- 1644-1911



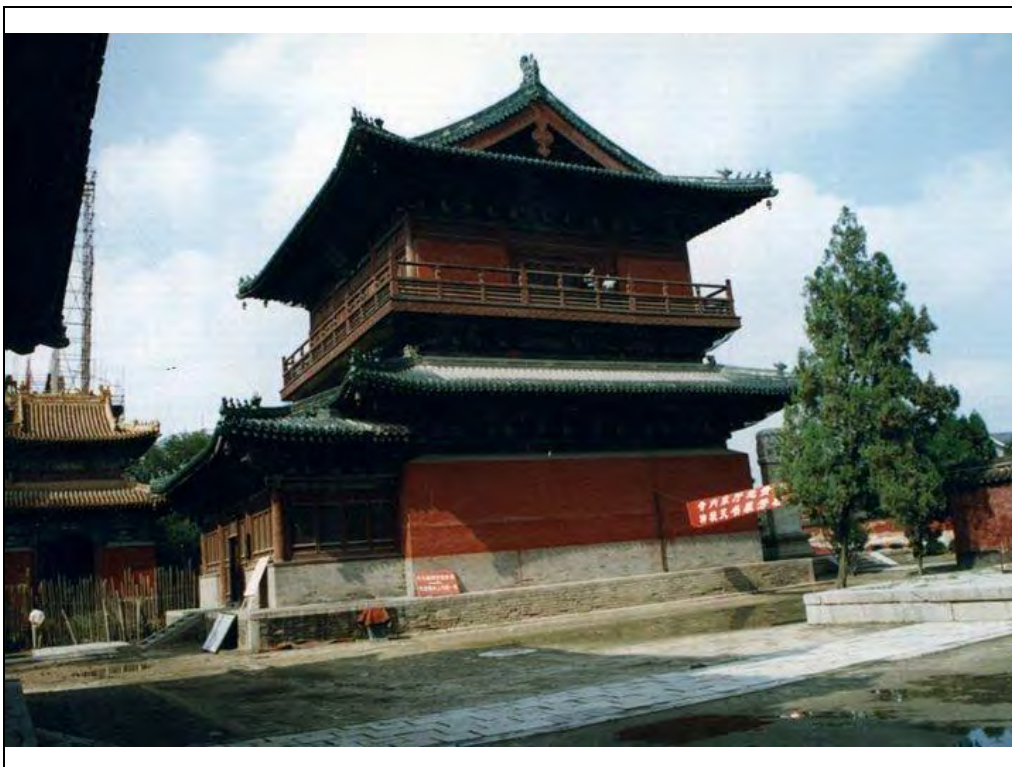
Qing dynasty:1644-1911, Tomb of Qing emperor



- Chinese traditional building always has an appearance of a huge roofed structure on a high terrace.
- The building elevation has always been divided into three parts:
 - 1. roof
 - 2. posts and walls
 - 3. terrace









- The terrace is mainly made with the material of earth, stone or brick.
- At the earlier period buildings, there were a corner animal sculpture in each of the terraces.



14 6:02 PM

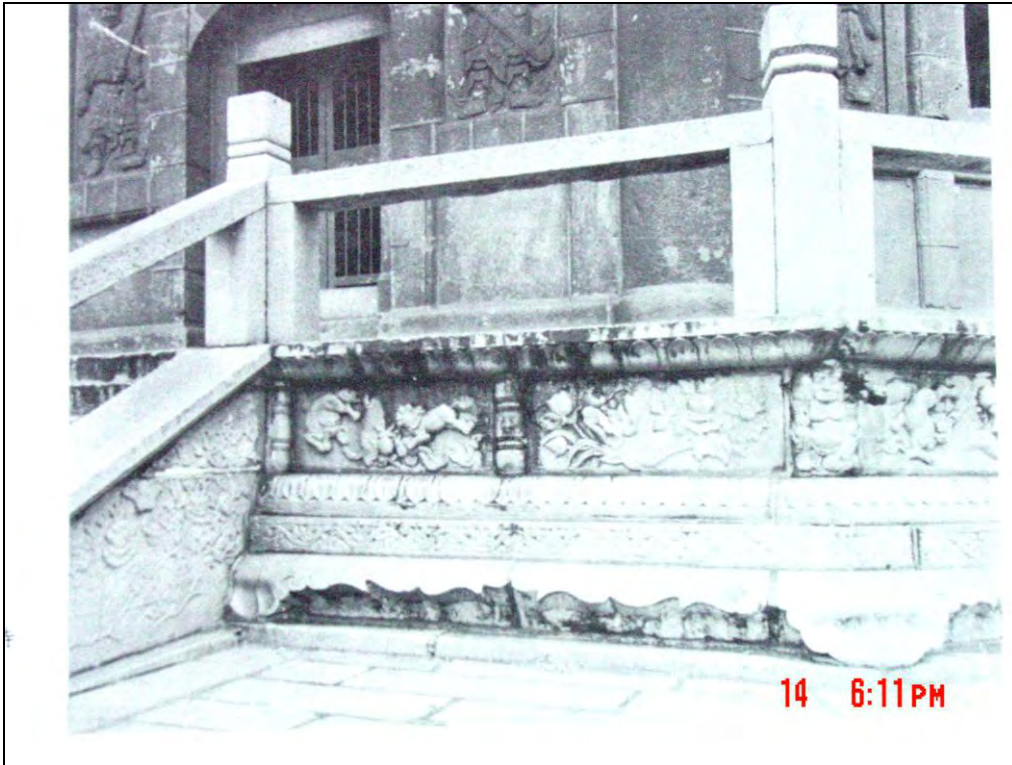
石作圖 1 剔地起突 北京護國寺千佛殿月台角石(元)

The terrace is also an essential part of a Chinese traditional building.

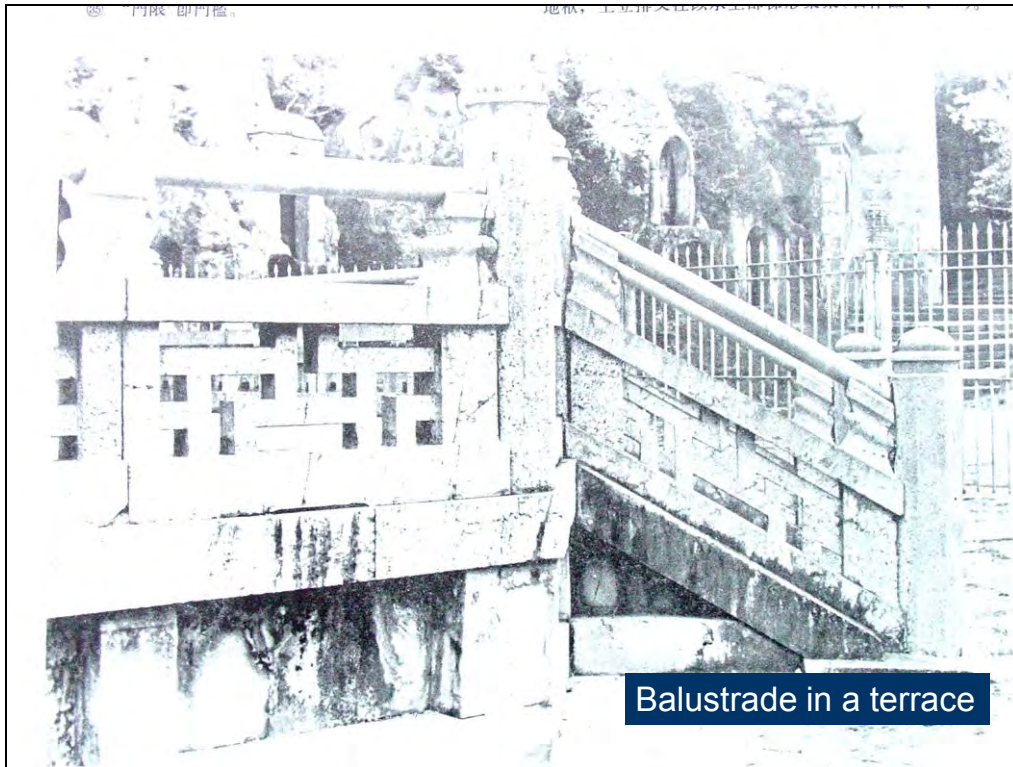


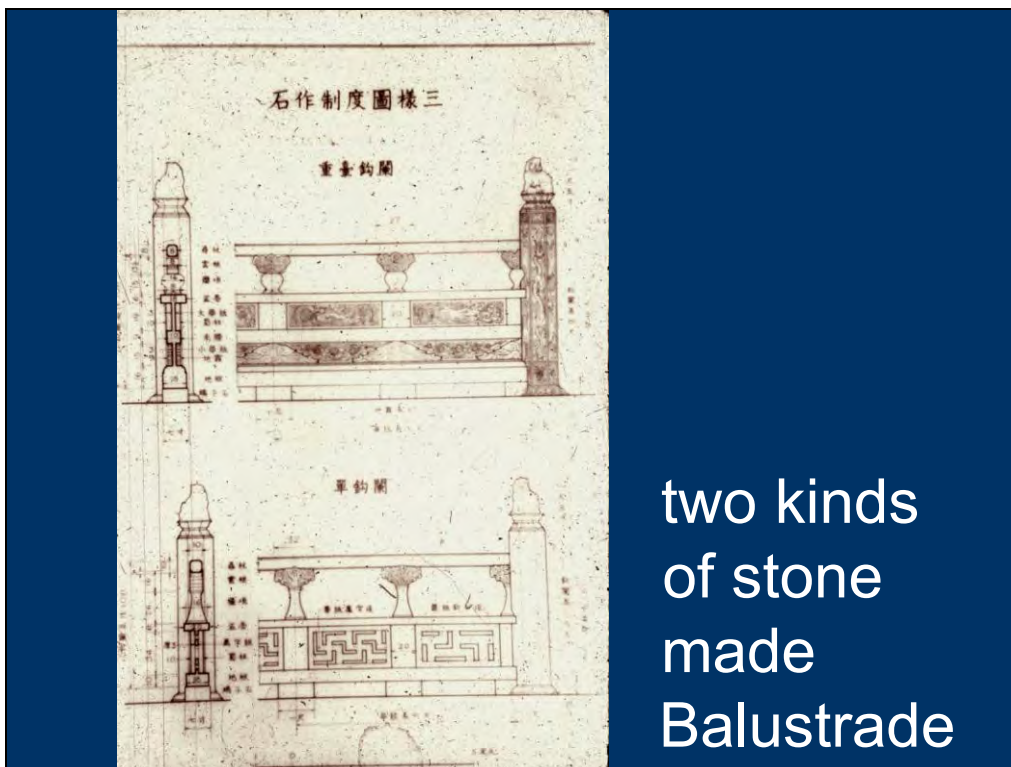
The terrace of an imperial palace:
Stone made terrace

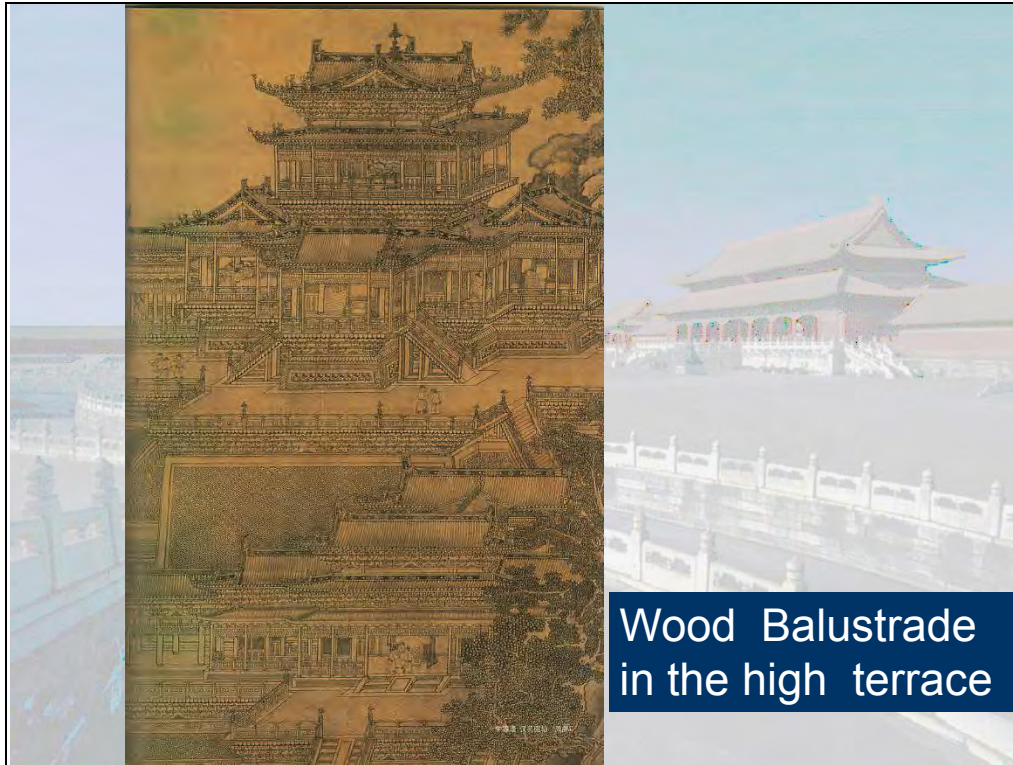




- If the height of a building terrace is high, there were usually some balustrades.
- Sometimes the balustrade was made in woods and some times it was made in stone.

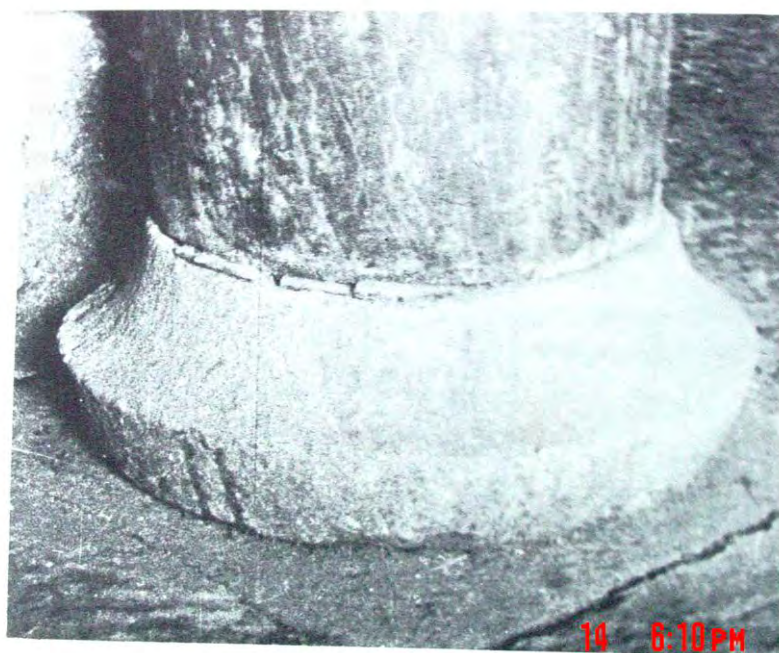






- On the terrace we erected the posts.
- But under each of the posts, there is always a base stone.
- It is always very much decorated on the post-base-stone.

作圖 30 槓形柱礎
浙江武義延福寺
大殿柱礎(元)



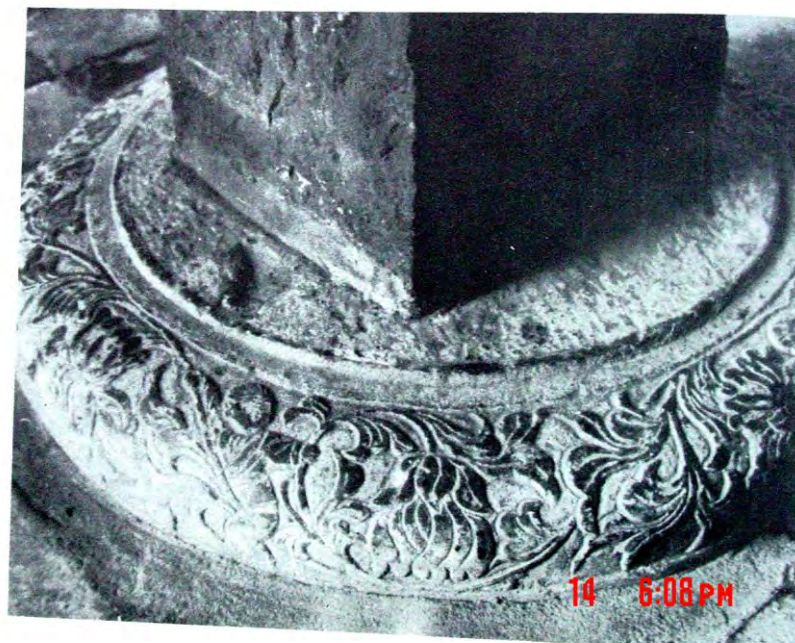
60



石作圖 14 水浪
山東長清靈巖寺
大殿柱礎(宋)

石作圖 23

寫生華 江蘇蘇
州南直保聖寺天
王殿柱礎(宋)



56

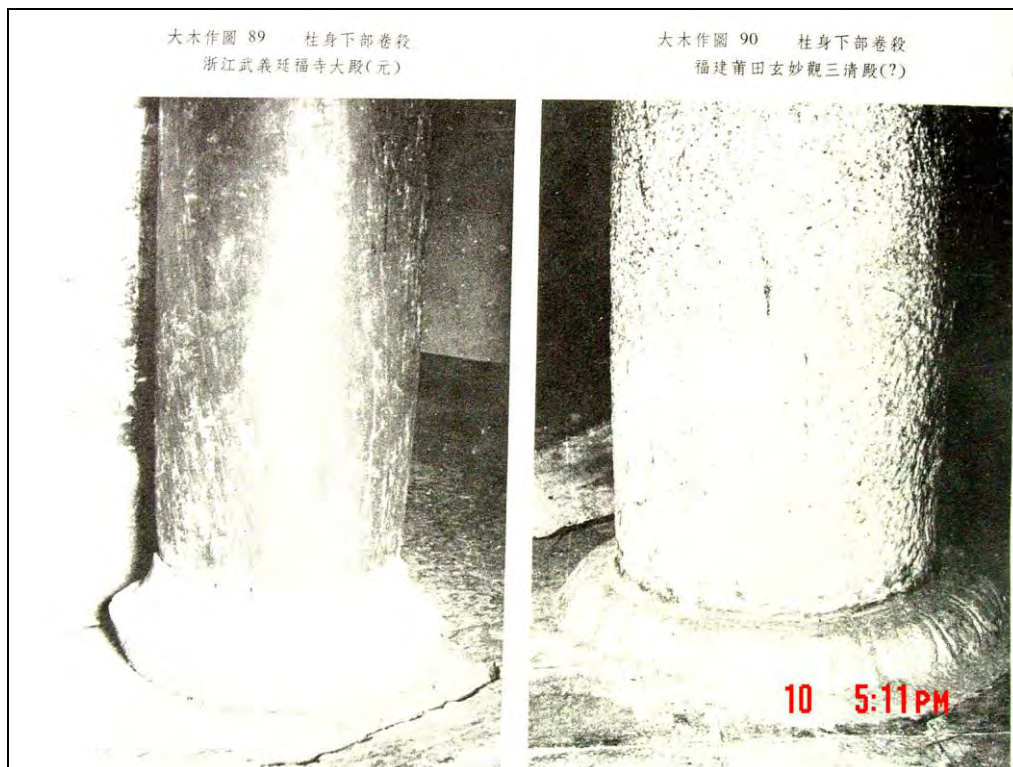
圖 32

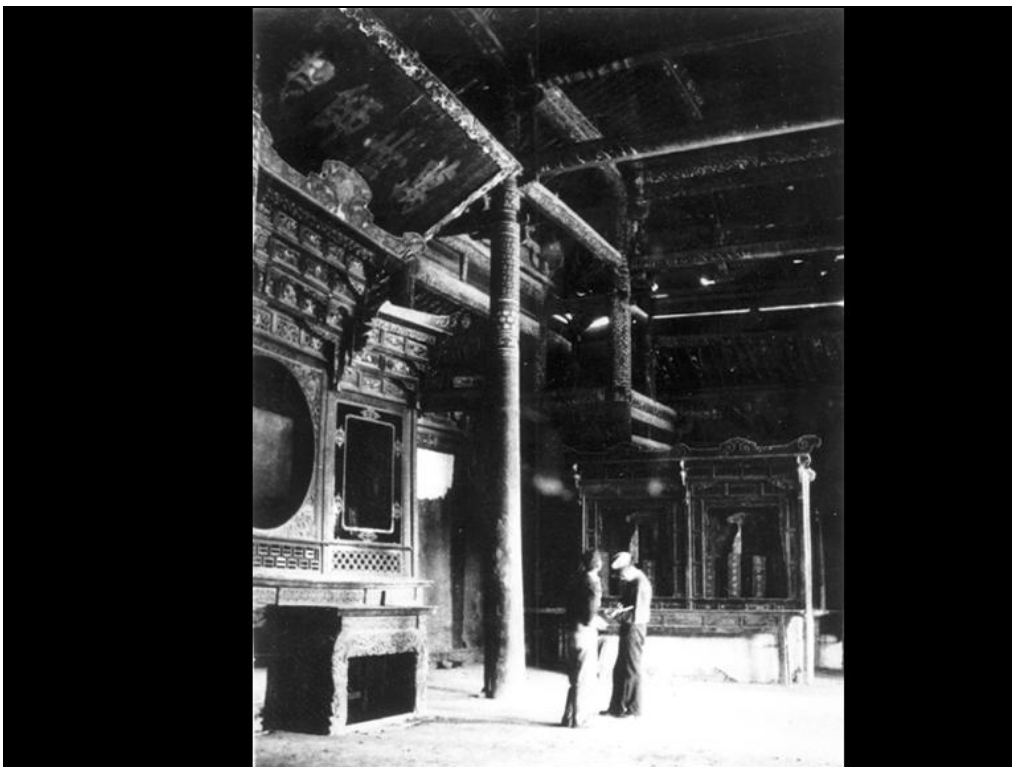
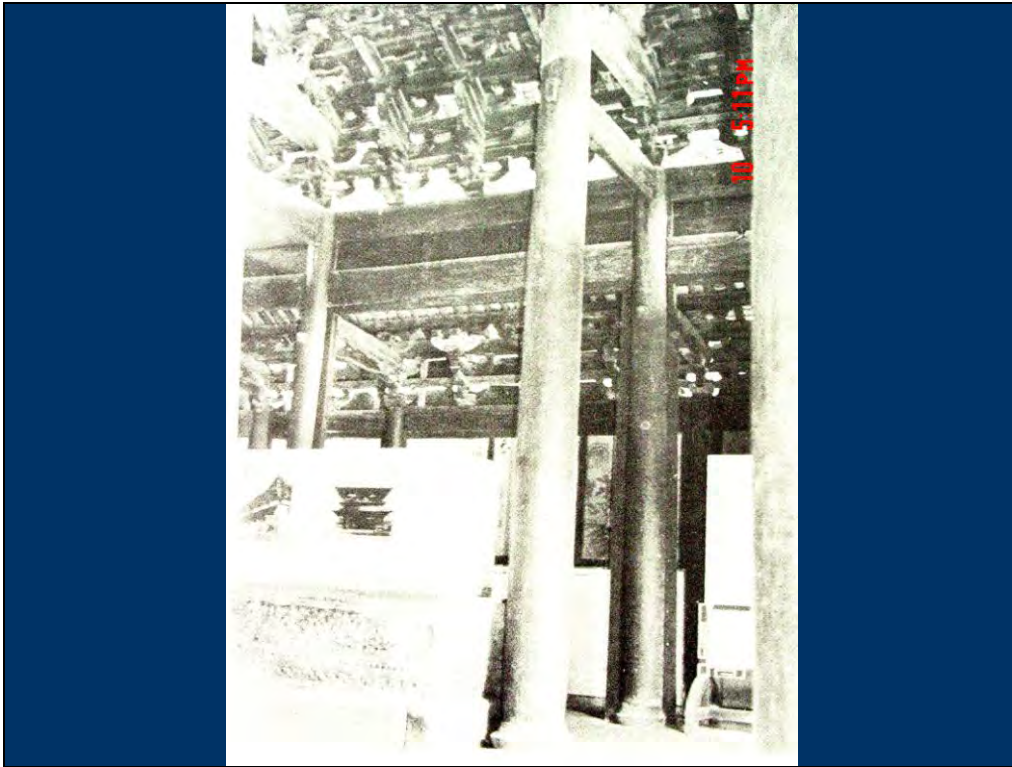
別地起突獸形柱礎
南汜水等慈寺大
殿柱礎(宋?)



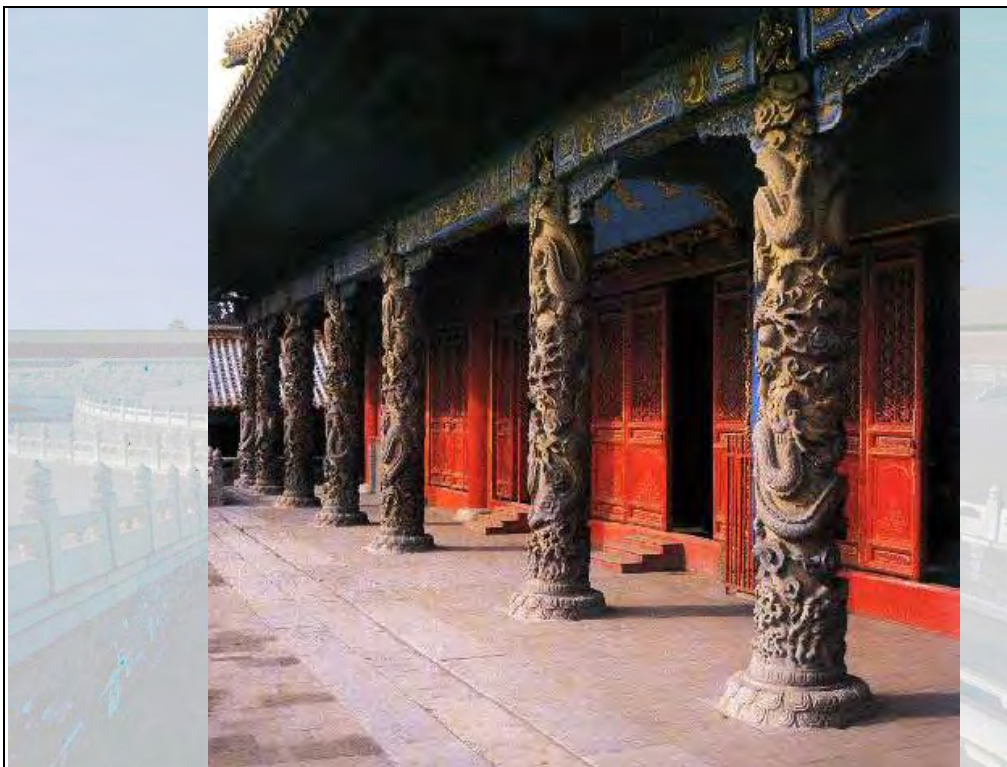
61

- On the terrace is the post (or pillar).
- Most of the posts (pillars) are made of woods but there are also some posts(pillars) made of stone.

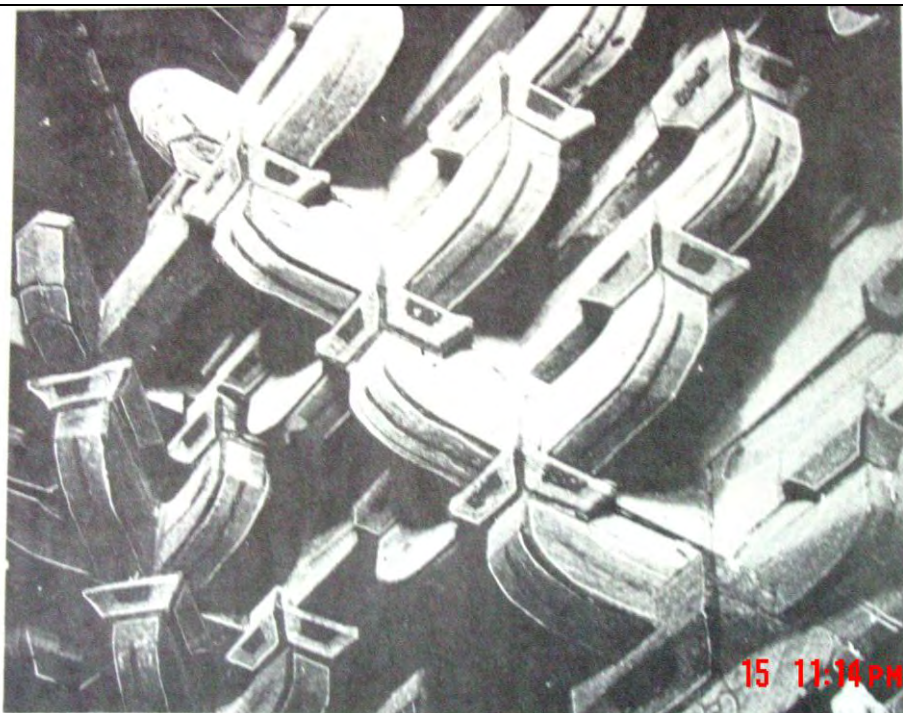


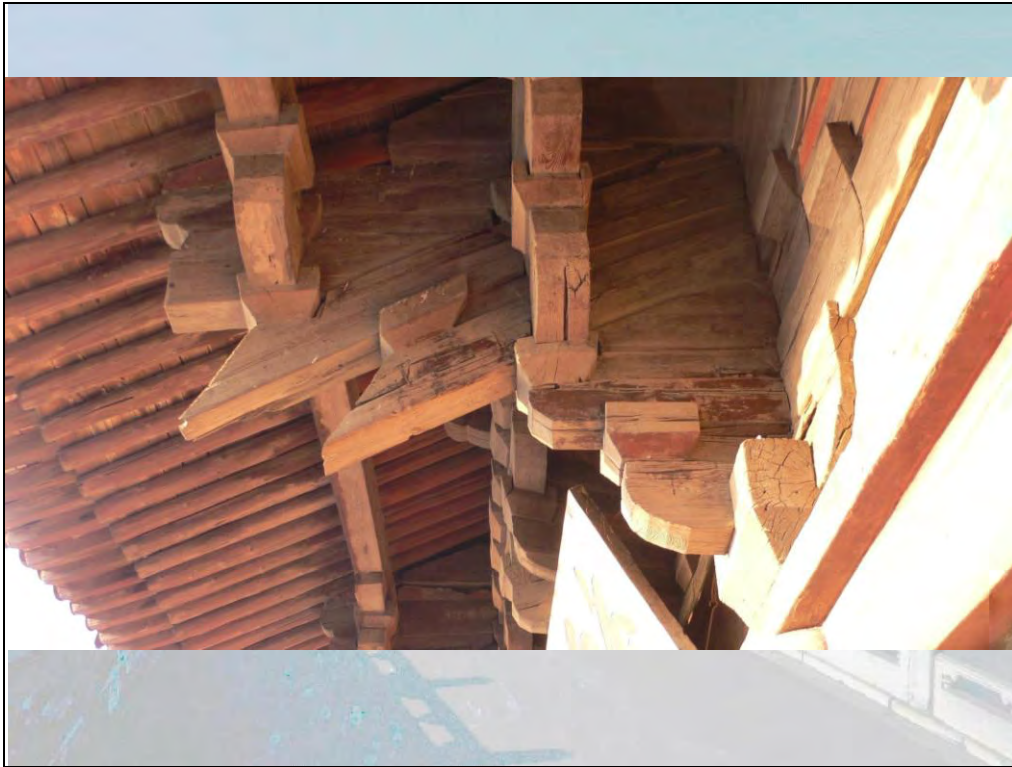


- Interior of the palace:



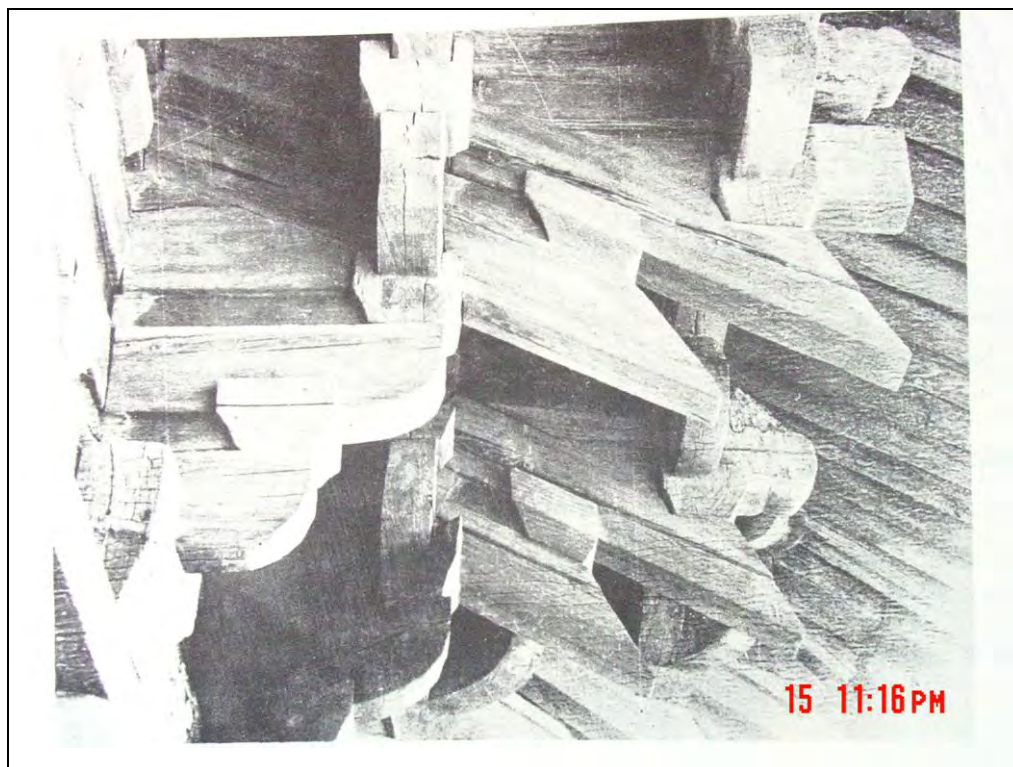
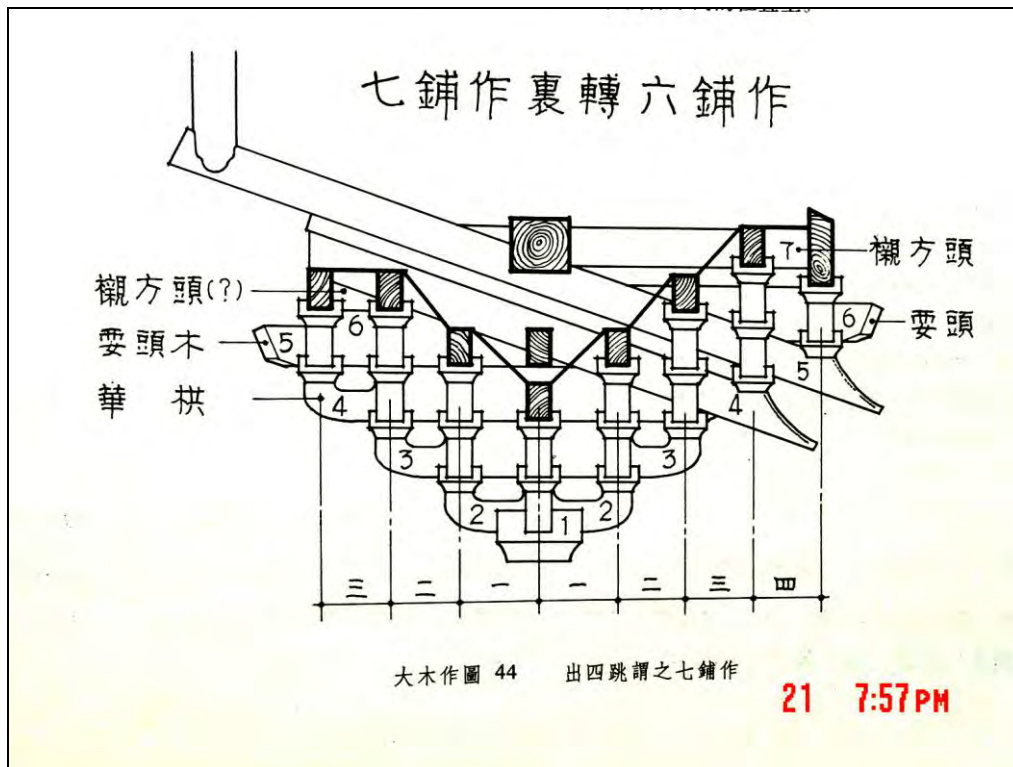
- Between the posts (pillars) and beams there are some bracket-like wood made elements which we called Tou-Kong.
- The Tou-Kong system in earlier time (Tang and Song dynasty) was much different from the later (Ming and Qing dynasty) one.







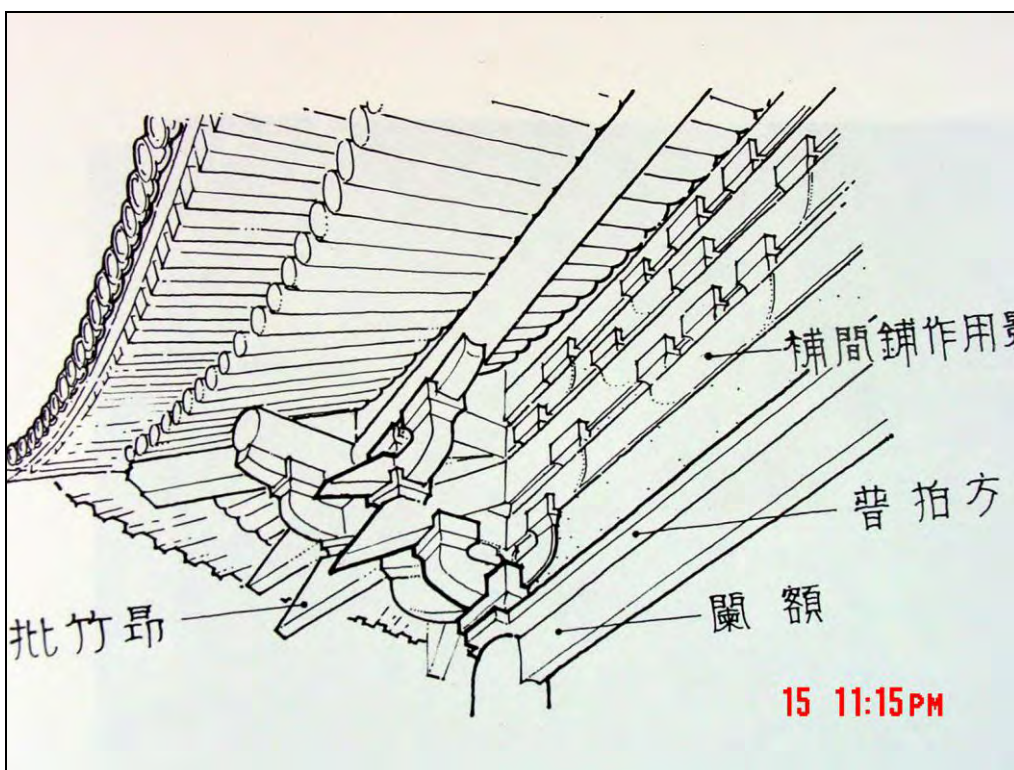




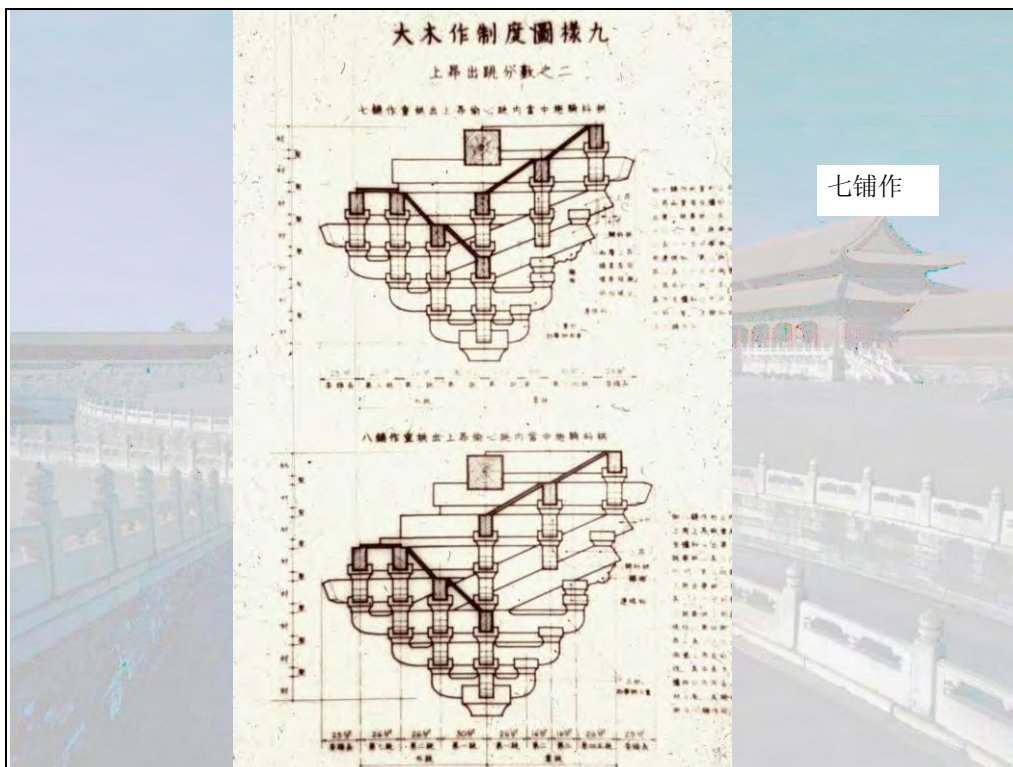
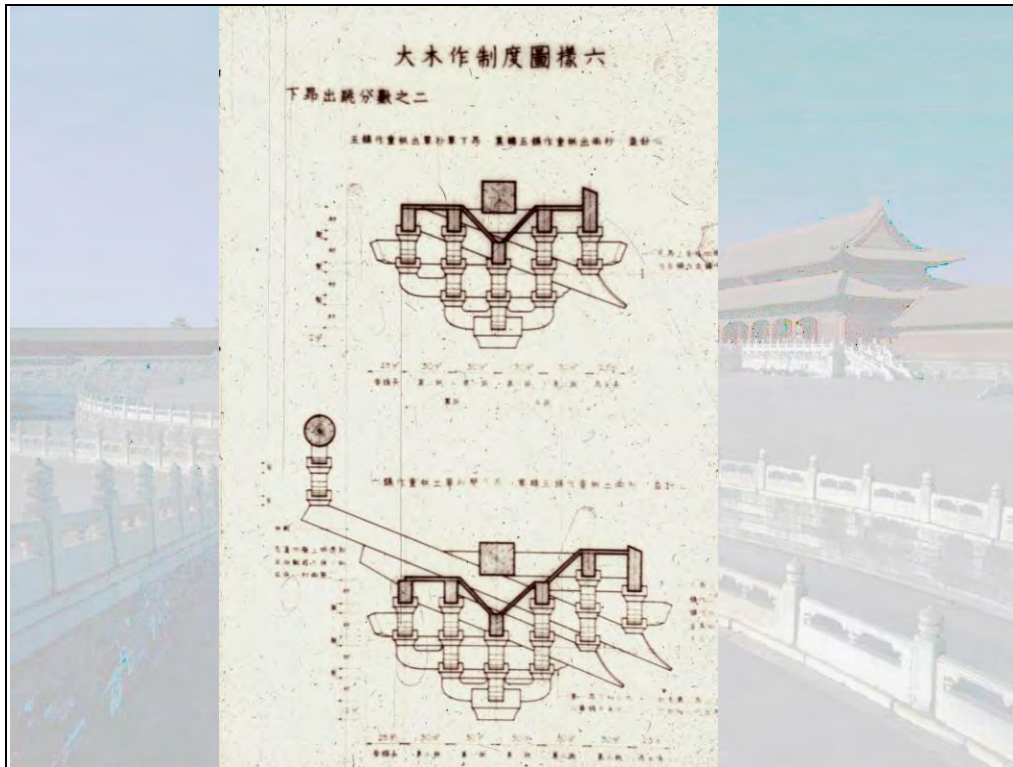


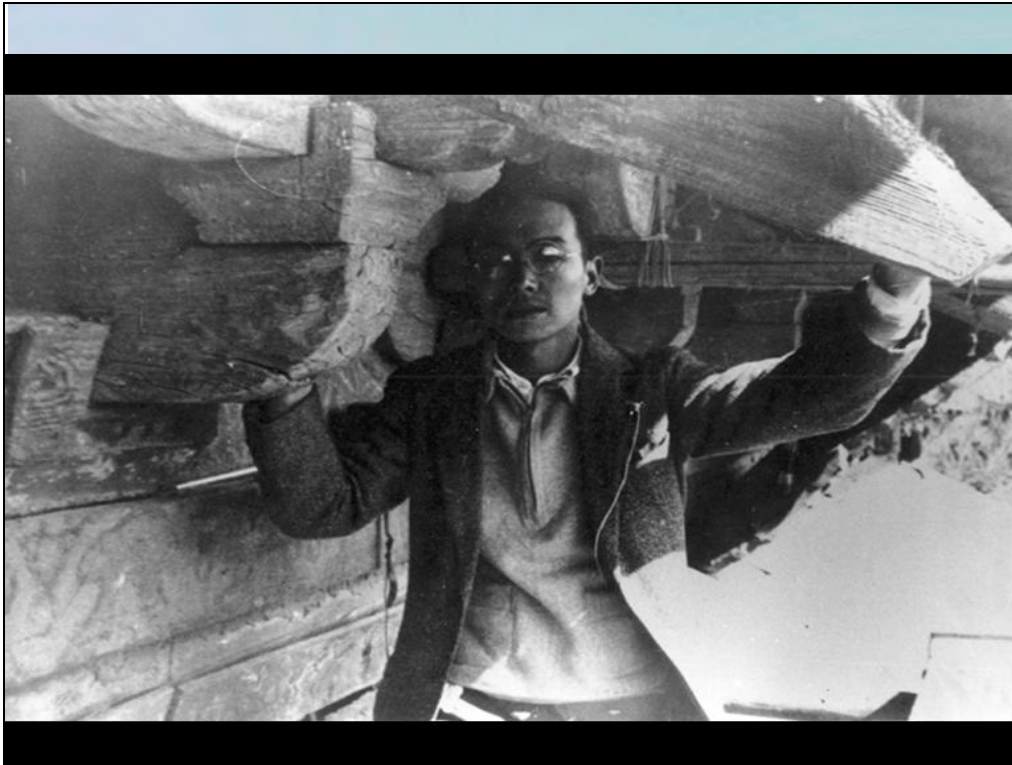
大木作圖 13 紋樑拱 福建
福州華林寺大殿(五代)

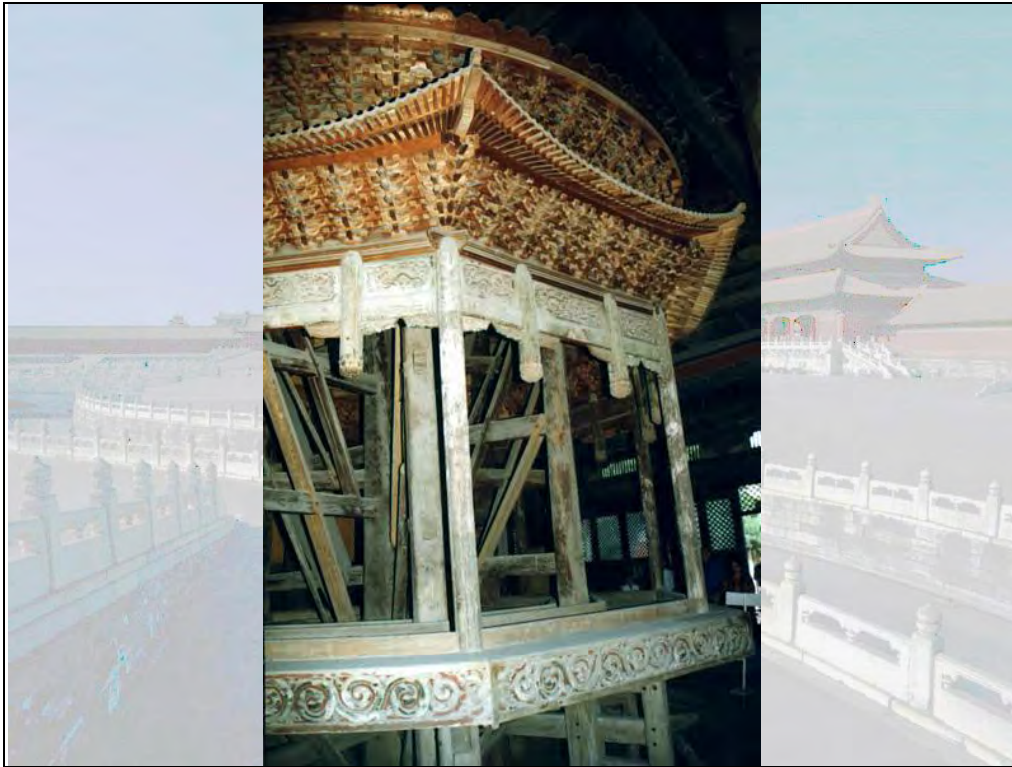
15 11:13PM



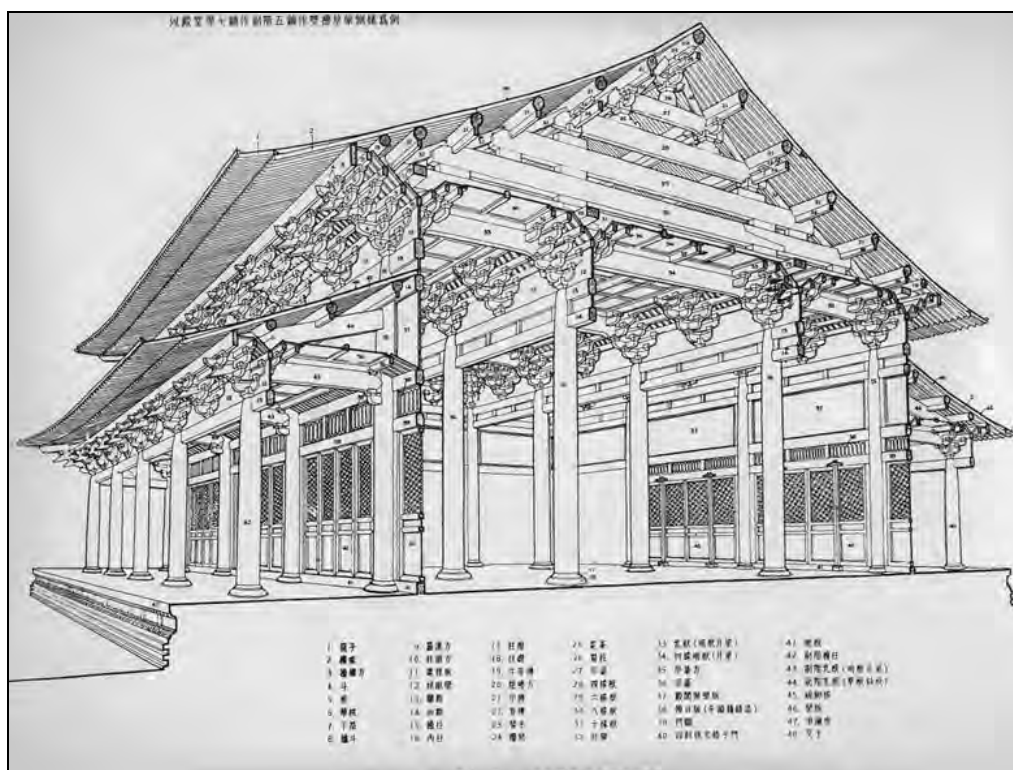
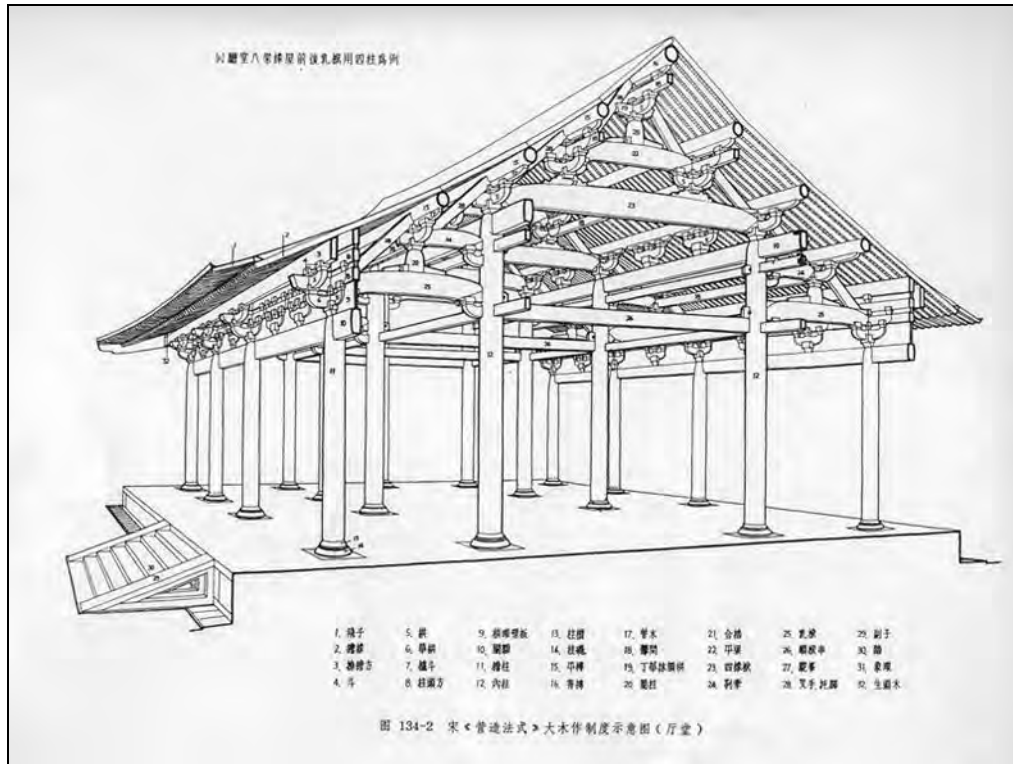
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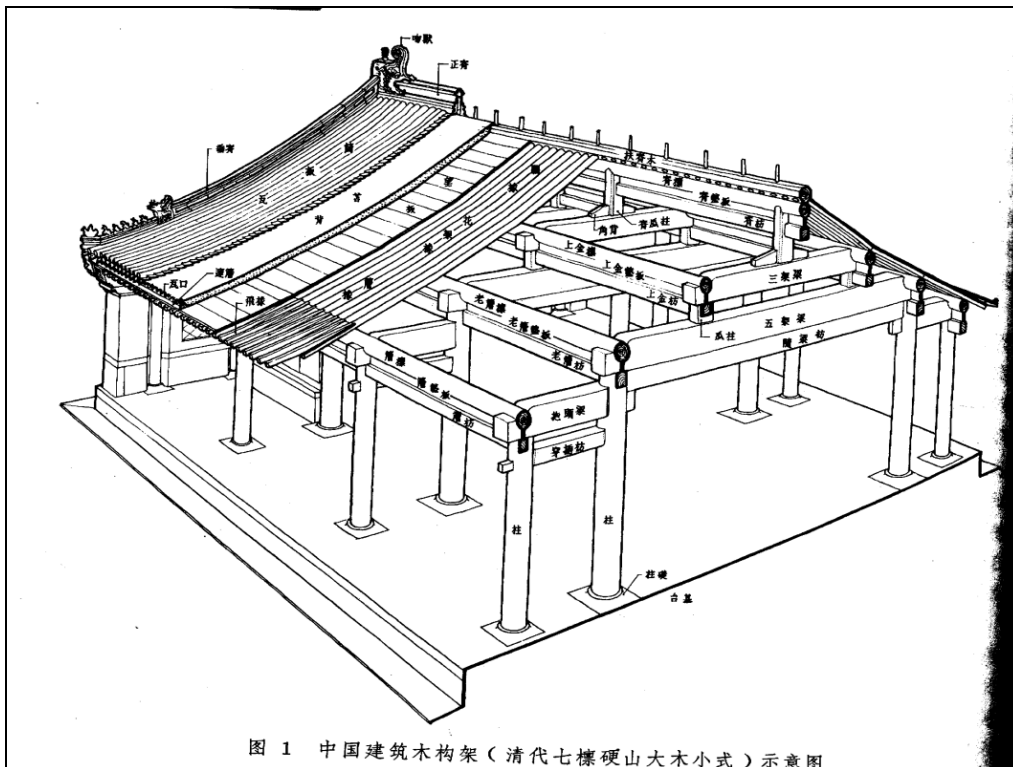




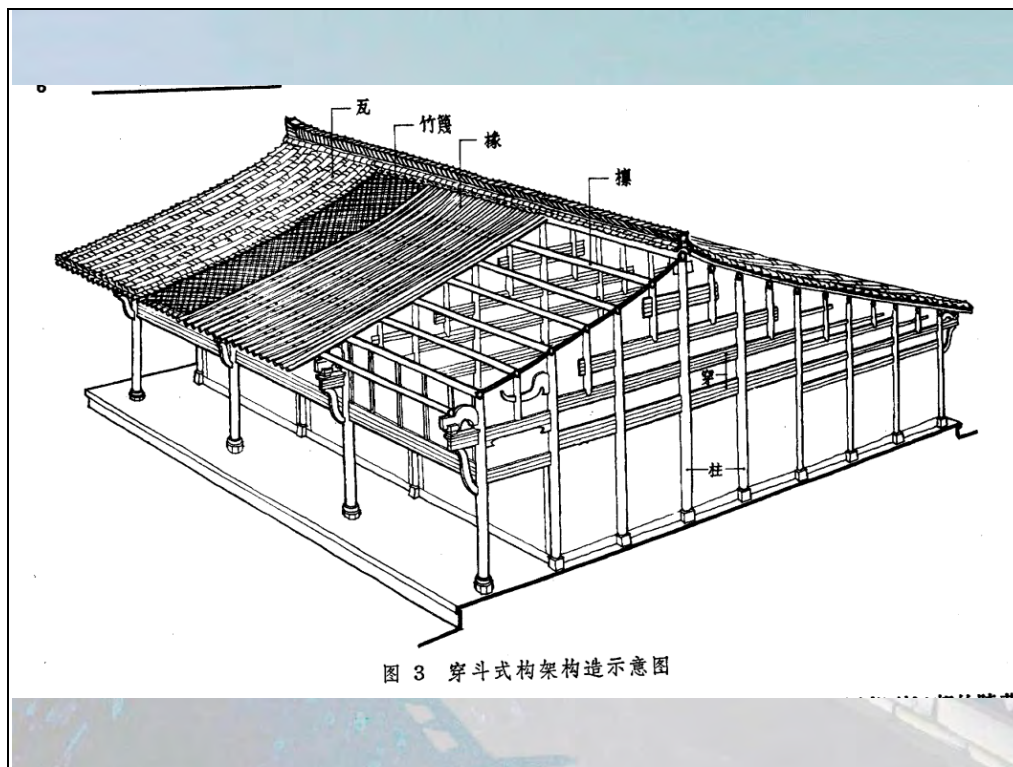
- There are two kinds of building structures with Tou-Kong system.
- One is the so-called Dian-Tang structure with the same height posts (pillars) and a whole layer of Tou-Kong system.
- The other is the so-called Ting-Tang structure with the different height posts (pillars) and some simpler Tou-Kong system.



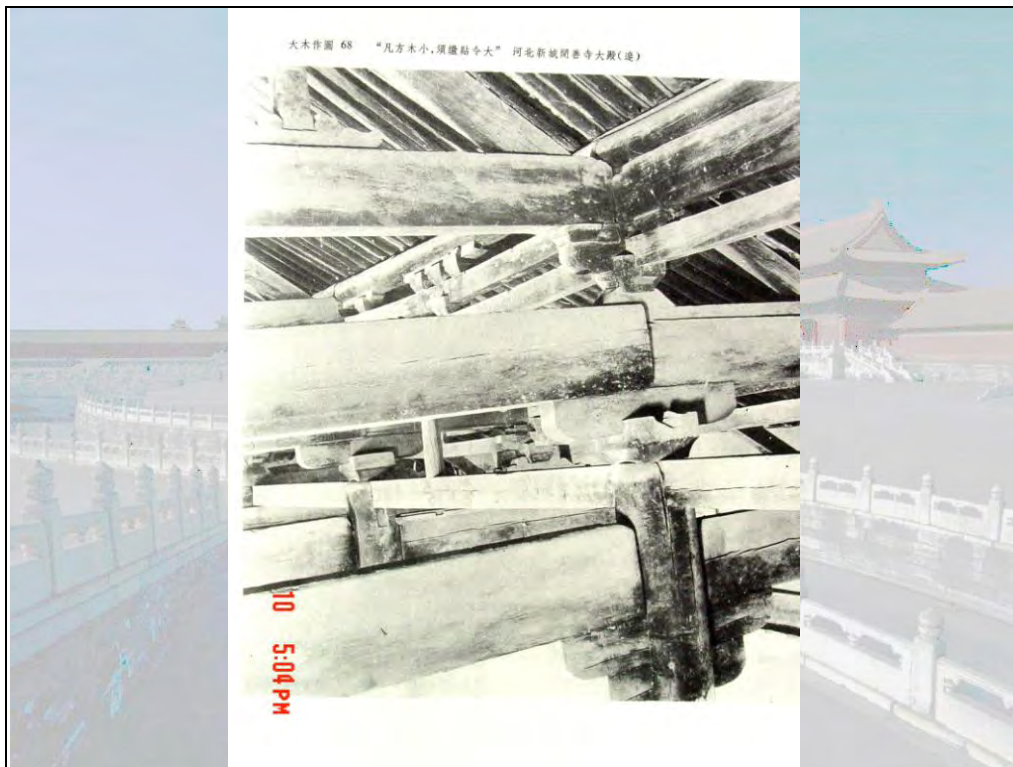
- There are also two kinds of other wood building structure system.
- One is a kind structure without Tou-Kong which is called lower-ranked building system.
- And the kind structure with Tou-Kong which is called Higher-ranked building system.

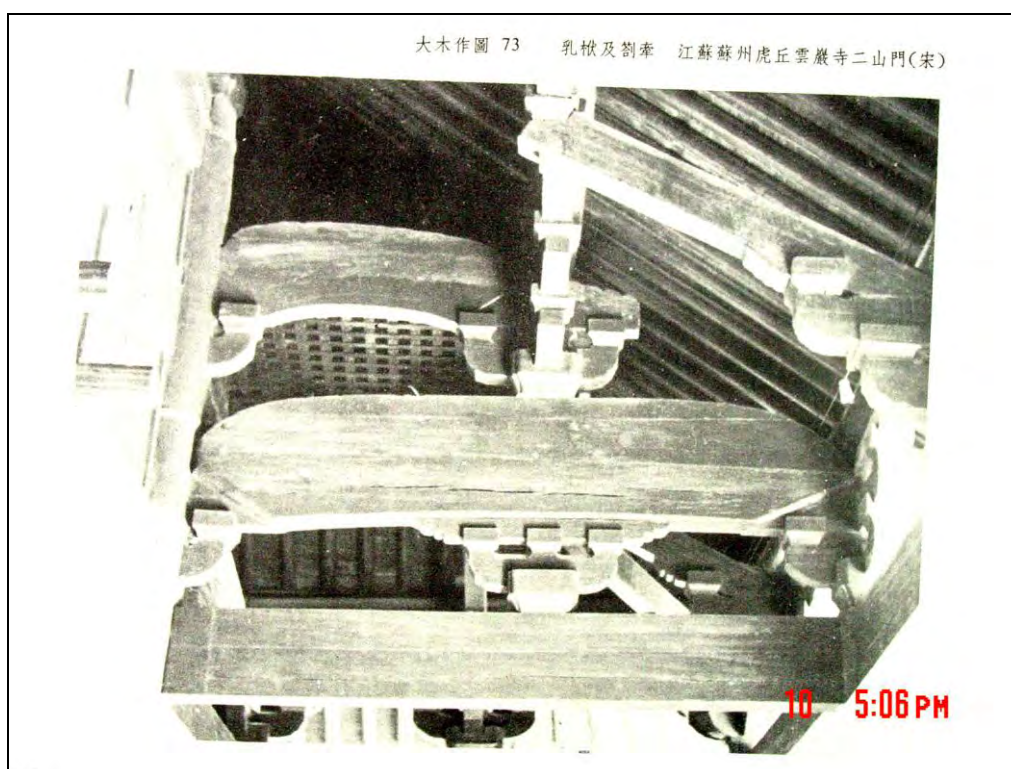


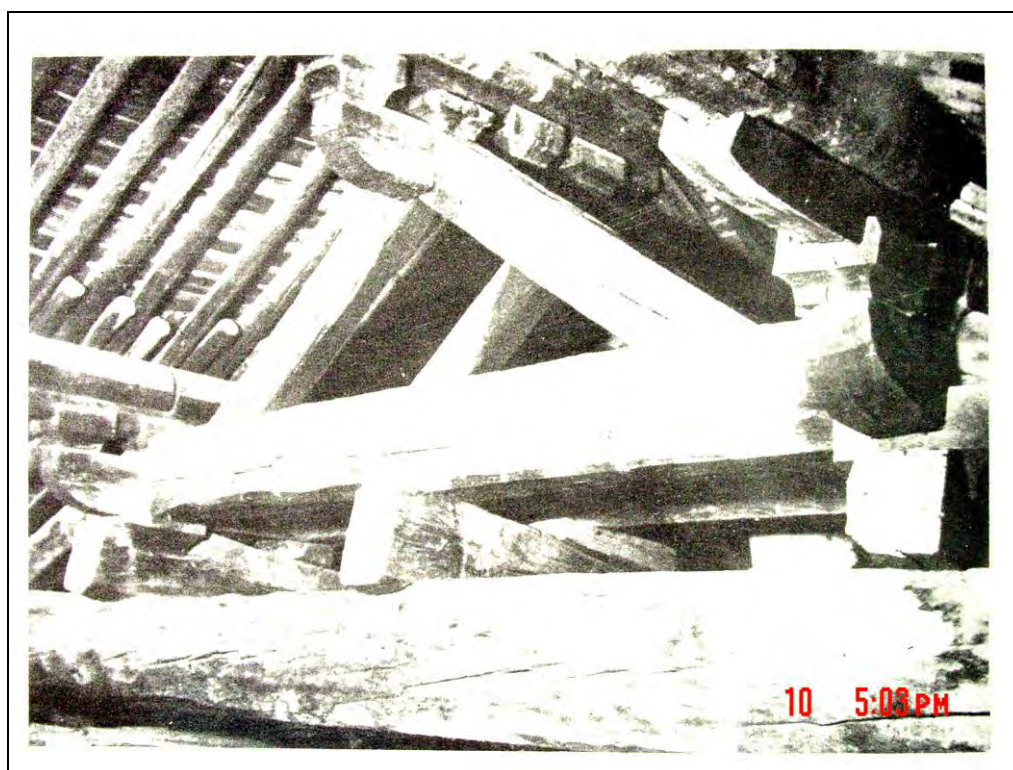
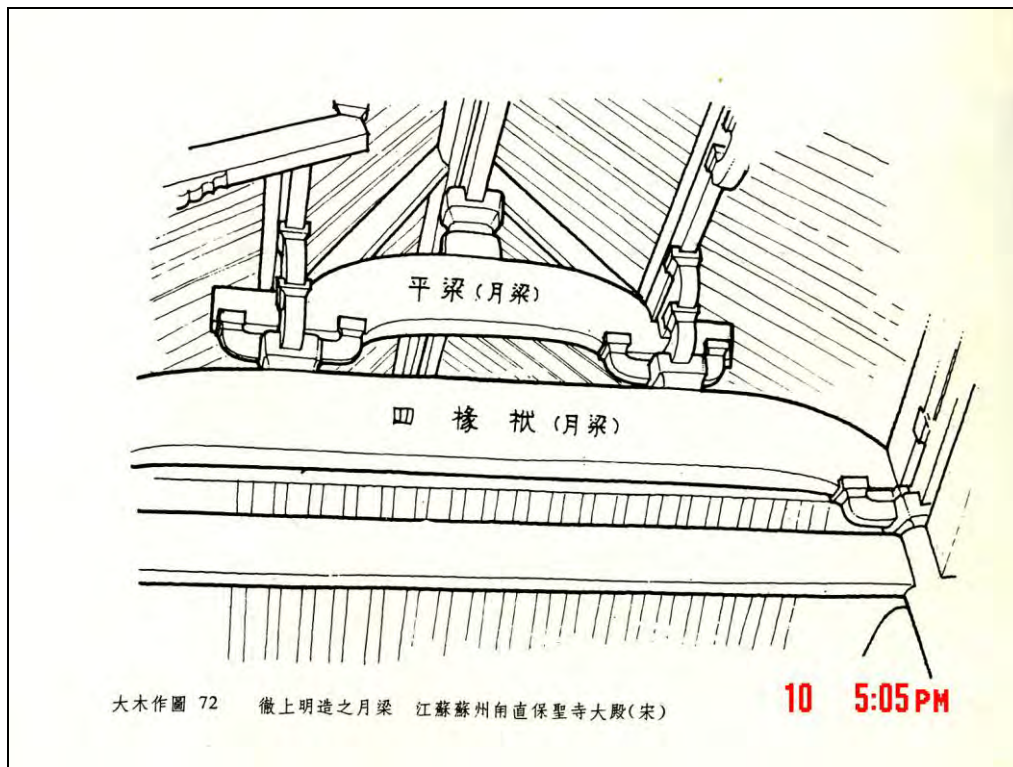
- There also another kind of lower-ranked build structure system we call it Chuan-Tou structure.
- This kind of building structure is usually used in southern China.

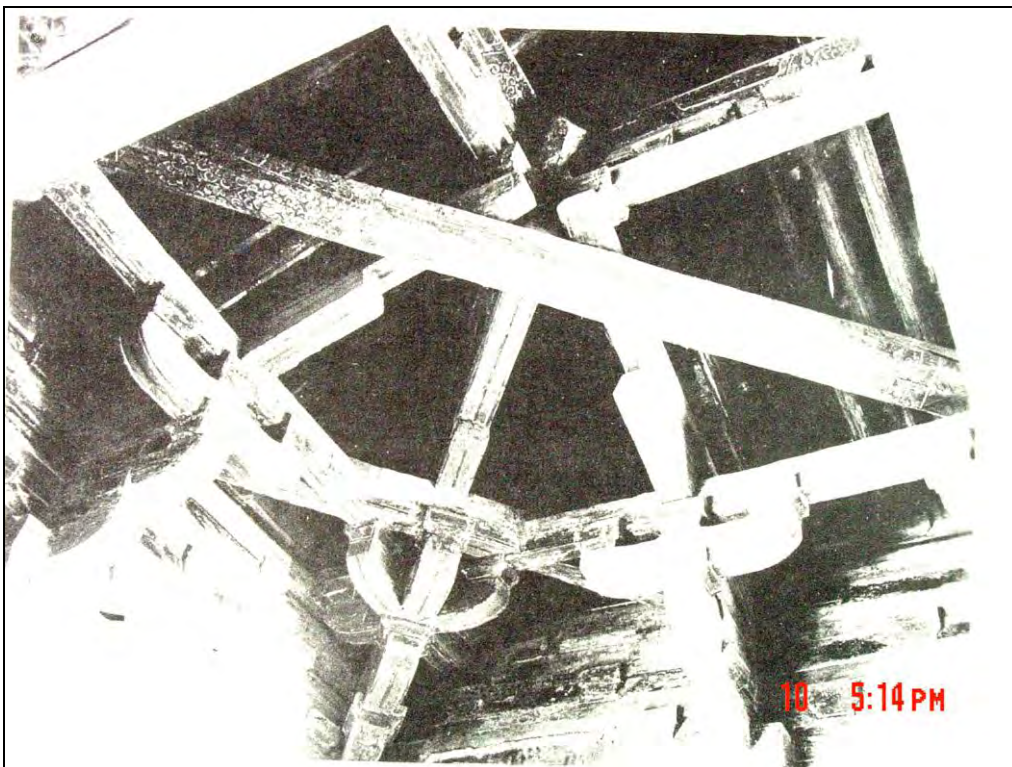
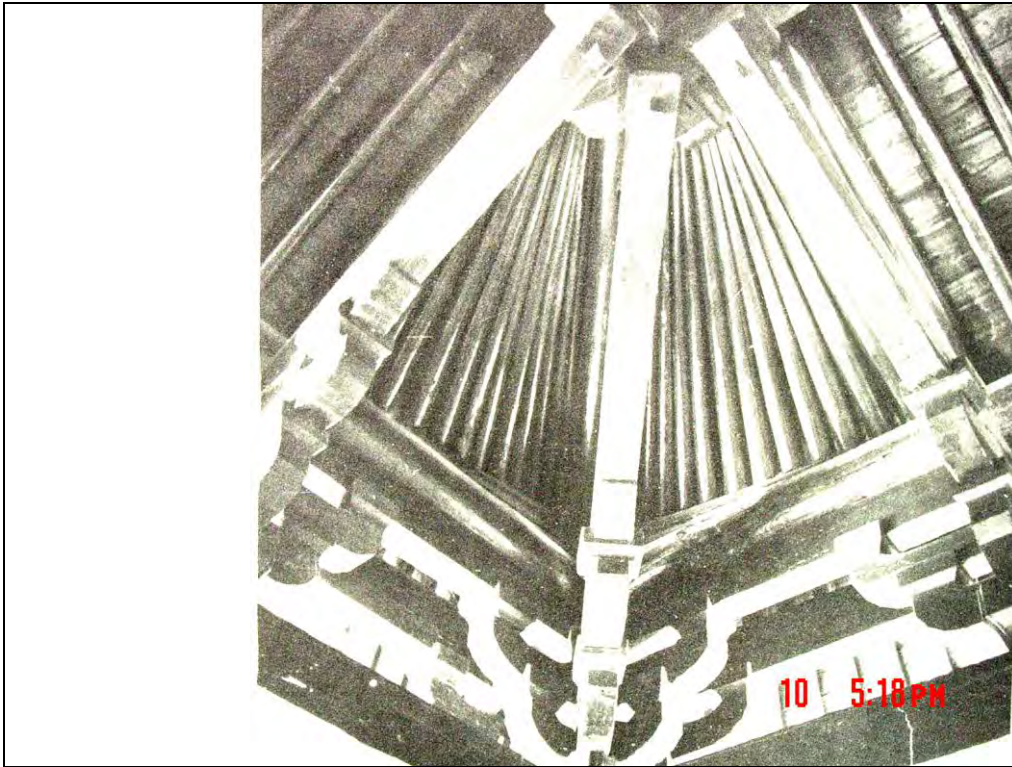


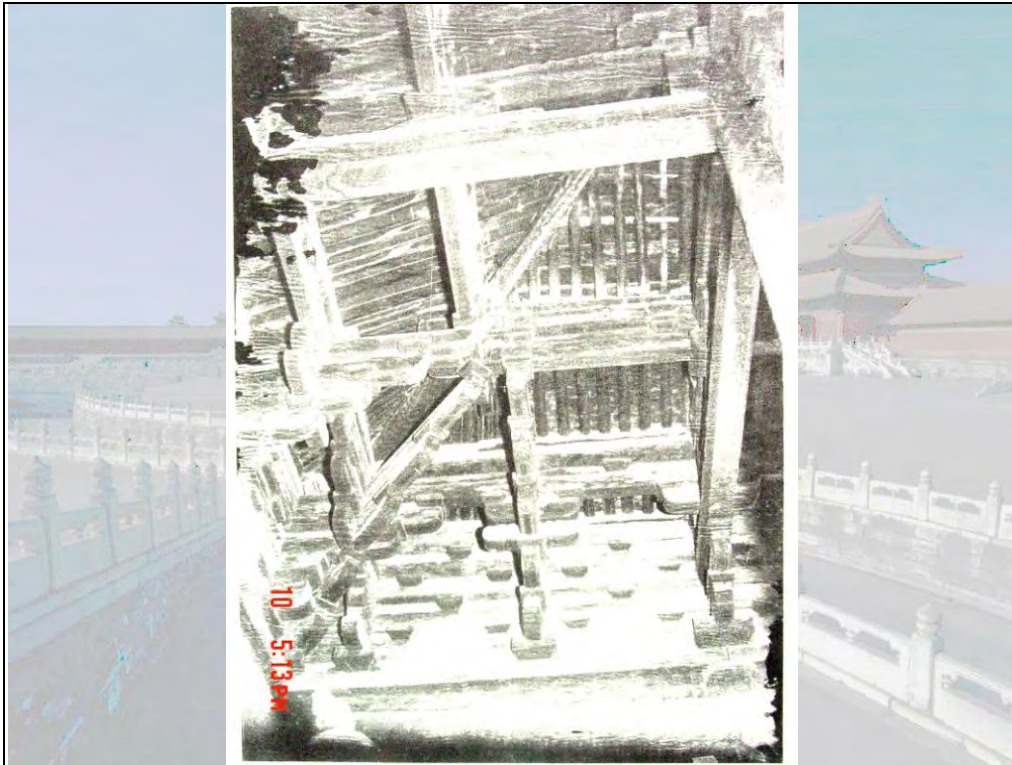
- The beam system
- Up the posts and Tou-Kong system is the beam system which is the main part of the building structure.



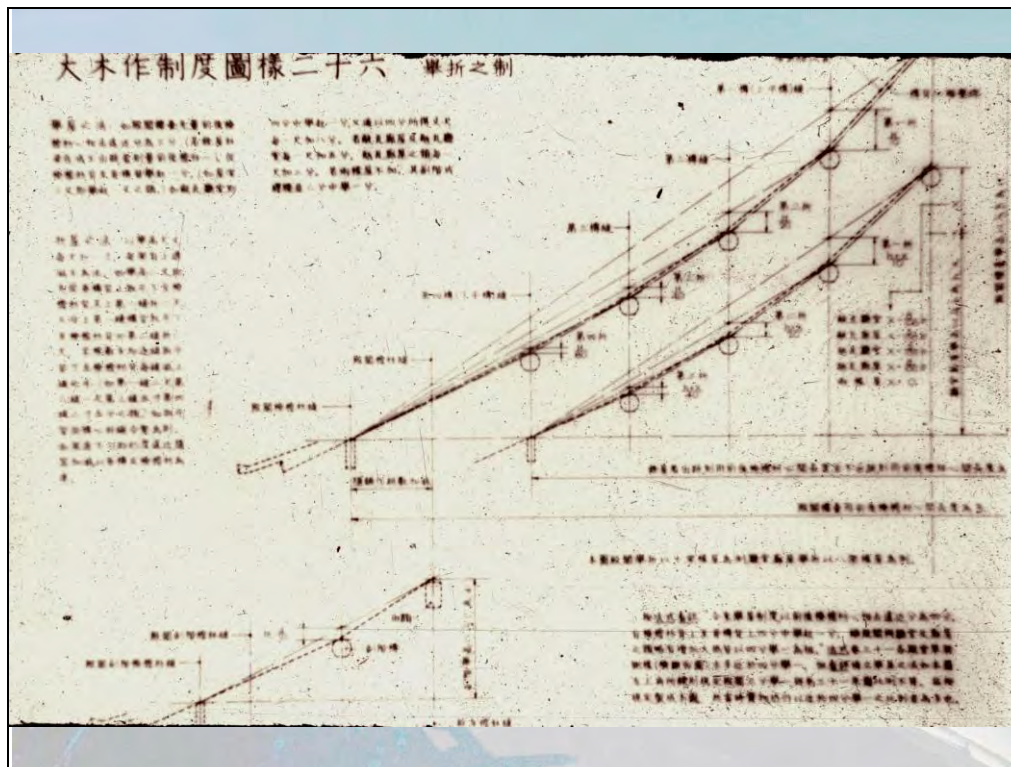








- The roof of Chinese traditional building is some kind of curve which we can make in a regular method.
- In different times the curves of the roof are different.
- Generally to say, the earlier of the building be built in the history the more mild its roof curve is.
- On the contract, the later of the building which is built in the history the more steep its roof curve is.



- Then we could see some wood-framed building examples.
- We will see them according to their built time.
- The existing earliest wood-structure ancient buildings in China were built in Tang dynasty (618-907 A.D.).
- Then the existing earliest multistoried wood-frame building was built in Lian dynasty (916-1125A.D.)

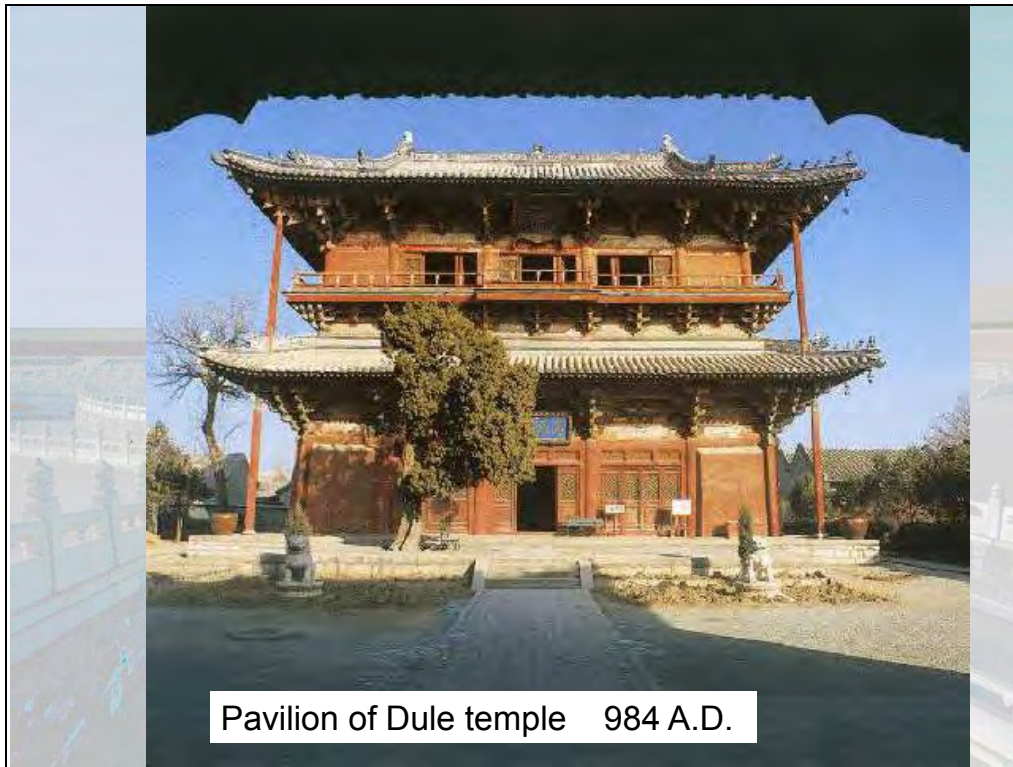


The building of Tang dynasty: 857 A.D. Strong and dignified

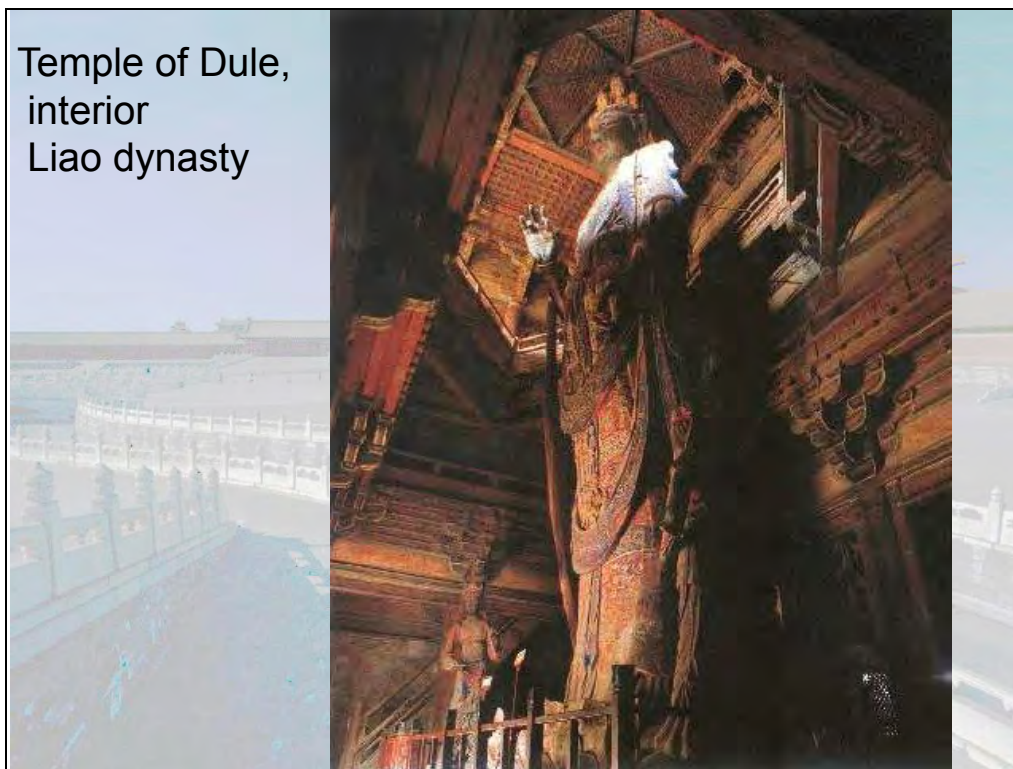
Religion buildings

- Buddhist Temples:





Pavilion of Dule temple 984 A.D.



Temple of Dule,
interior
Liao dynasty



Temple of Shanhua, Liao dynasty, 1050 A.D. around

- And then the existing highest wood-framed ancient Chinese building was built in Liao dynasty (1056 A. D.) which is a wood-structure Buddhist pagoda.
- It is 67.43 meter high.
- And the highest pagoda built in the history is Yong-ning temple pagoda with the height of 140meters around.

Pagoda of Liao:
1056 A.D.

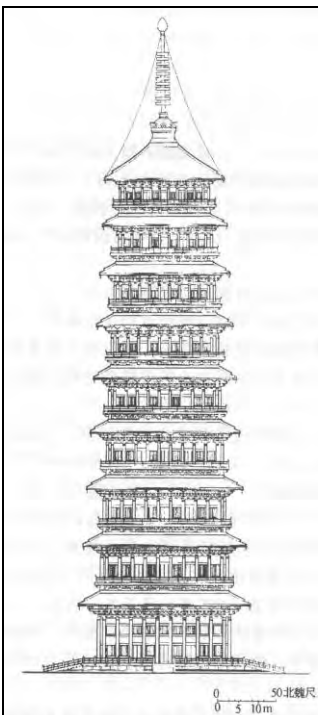
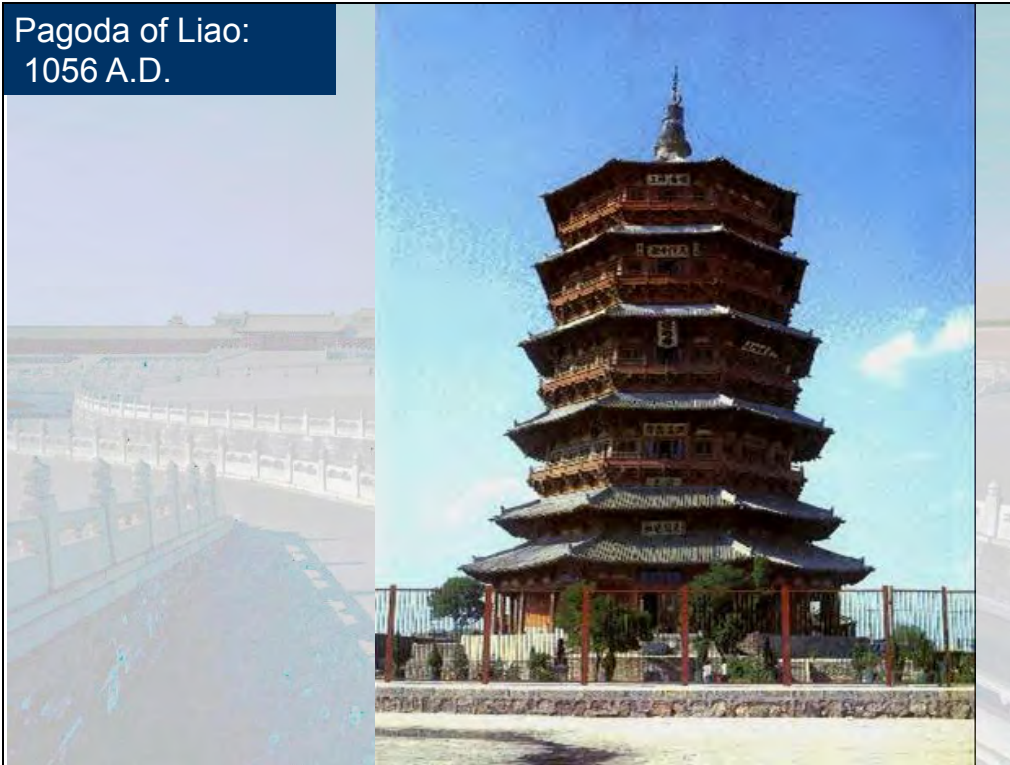


图 2-7-23 北魏洛阳永宁寺塔立面复原图

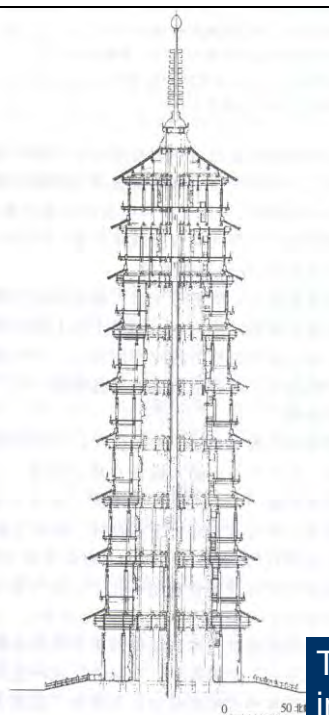
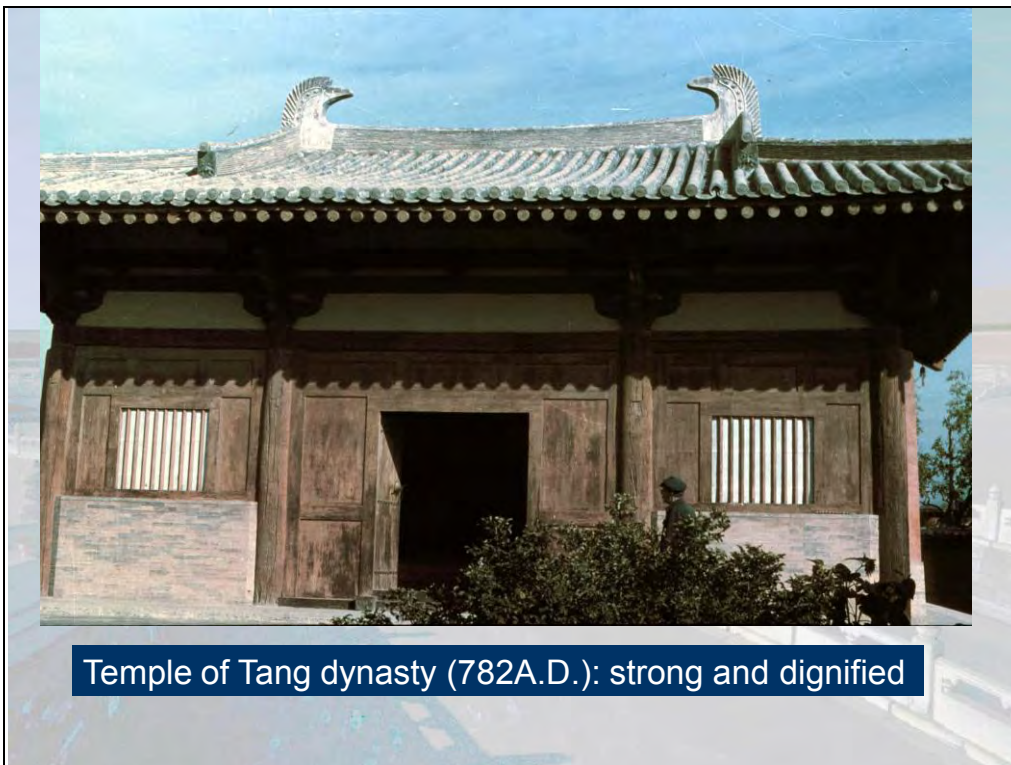


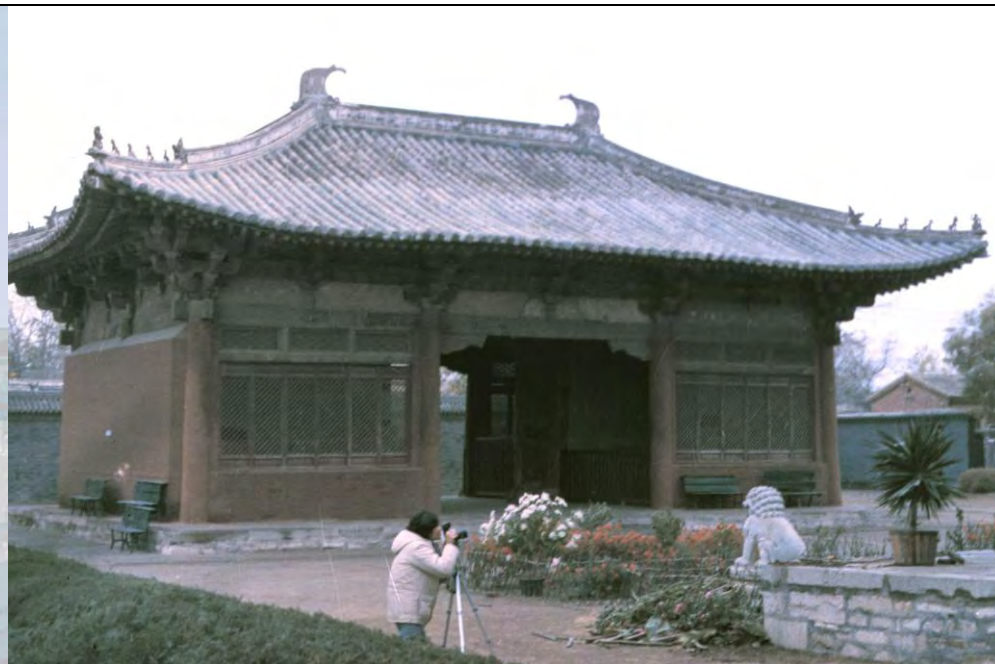
图 2-7-24 北魏洛阳永宁寺塔剖面复原图

The highest Pagoda
in the history:
475 A.D.

- Then we will see several examples of the ancient buildings in the different periods of the history.
- From the examples we could see the difference between the times.



- Temple of Hualin, Song dynasty, 964 A.D.



The building of Liao dynasty (984A.D.)

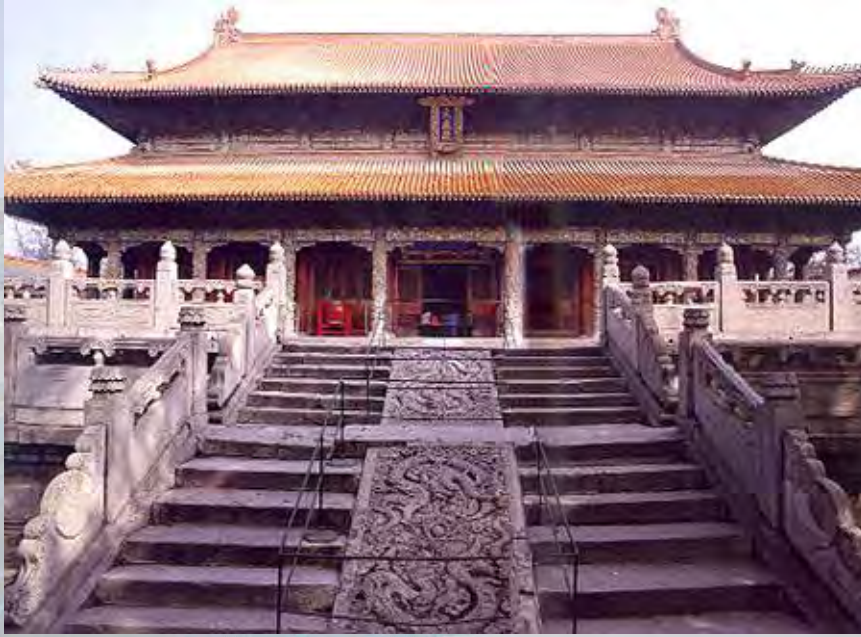


The building of Jin dynasty (1270 A.D. around)

- The main Praying Hall of the Northern Sacred mount of Heng Shan: Yuan Dynasty (1300 A.D.)



Main Hall of the Confucius Temple:



Main Temple in a Taoist palace of Wudang Mountain

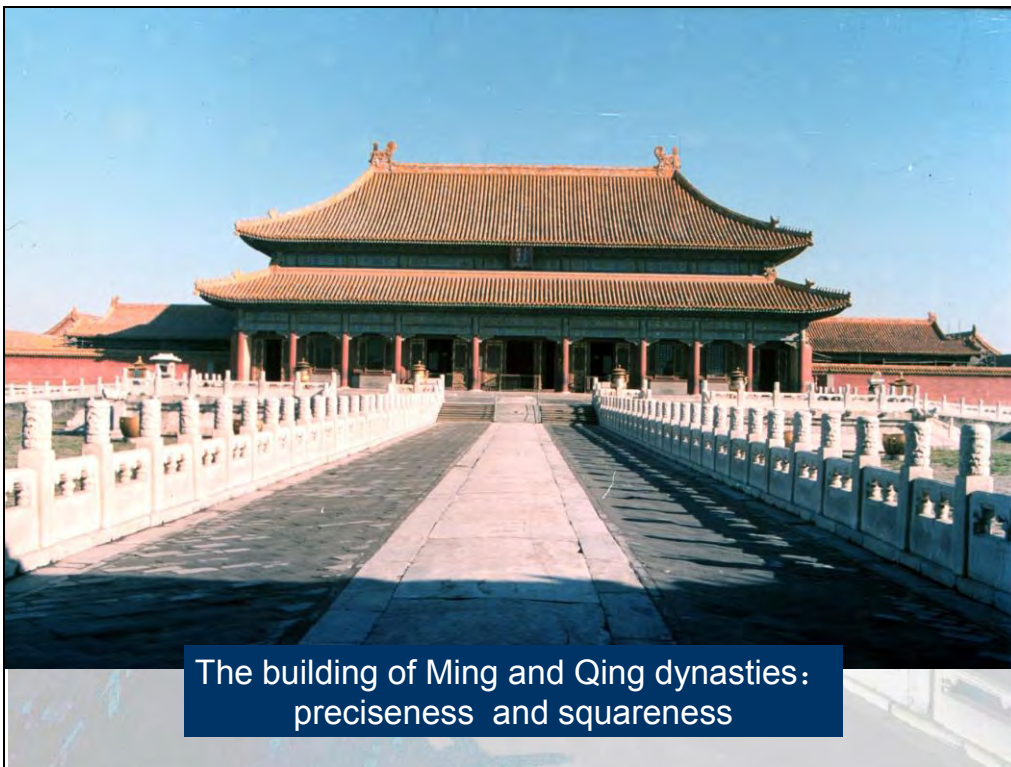
- Temple to pray the Sacred Mount of Tai:



- Yong He Gong Temple:
Qing dynasty:
1644-1911



- Yong He Gong Temple, Qing dynasty, 1644-1911

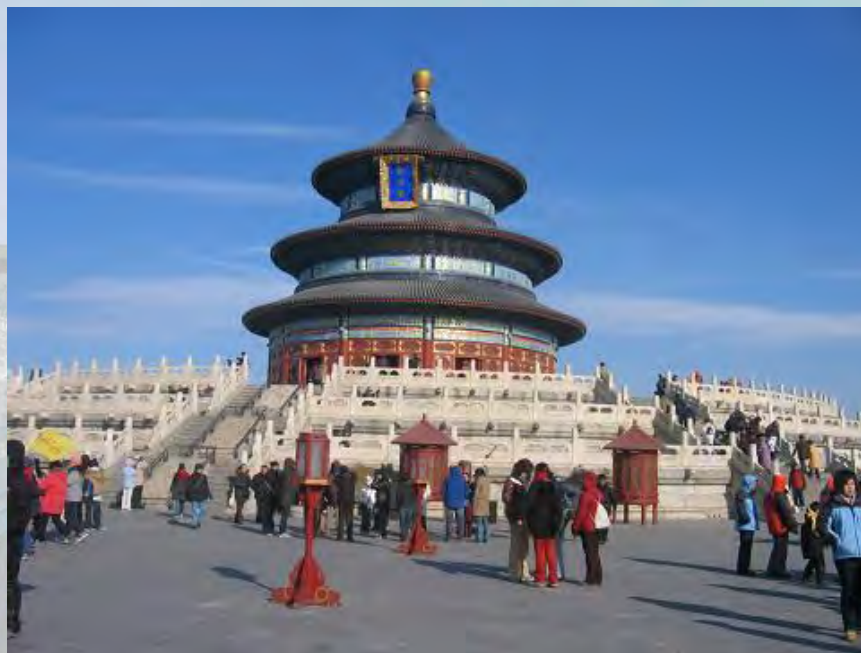


The building of Ming and Qing dynasties:
preciseness and squareness

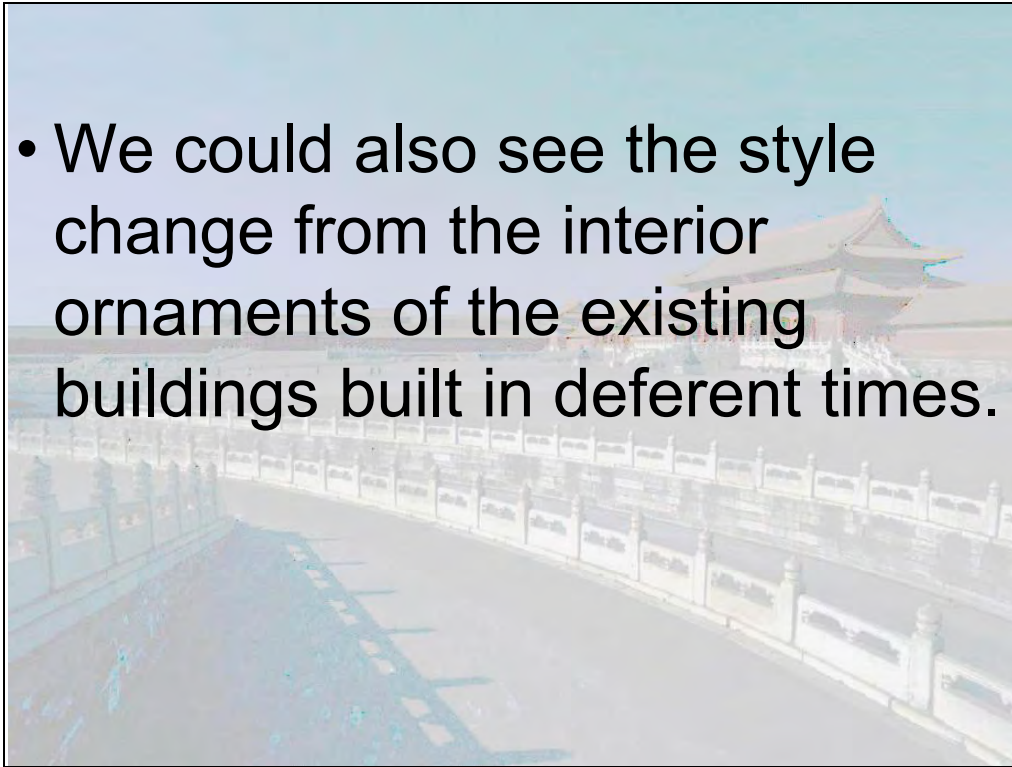


The building of Ming and Qing dynasties:
preciseness and squareness

Temple of Heaven:



- We could also see the style change from the interior ornaments of the existing buildings built in deferent times.

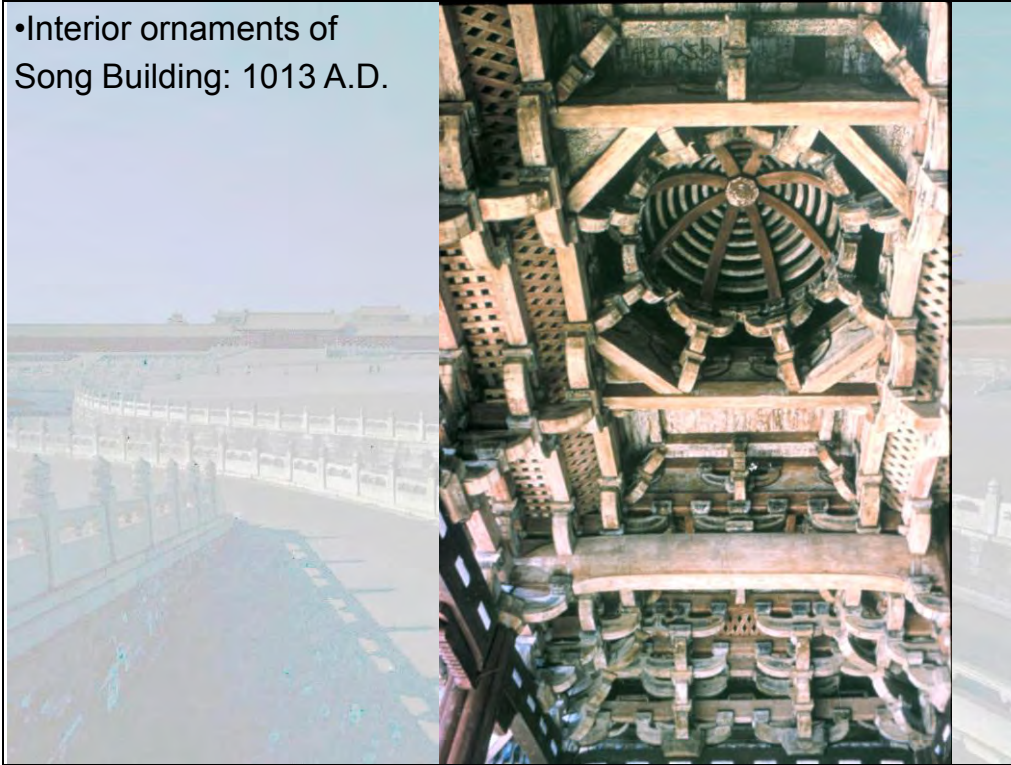


From a
Interior
Point
to see:



•Interior ornaments of Tang Building: 857 A.D.

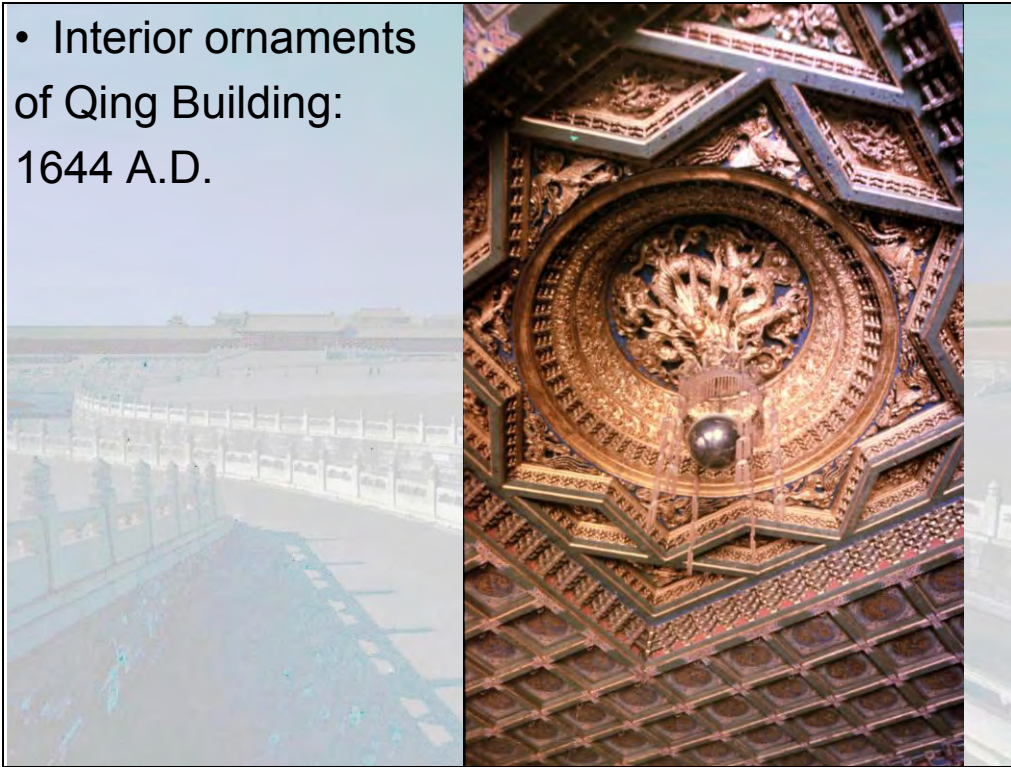
- Interior ornaments of Song Building: 1013 A.D.



- Interior ornaments of Jing Building: 1200A.D.



- Interior ornaments of Qing Building: 1644 A.D.



Session 9

[Thursday 3rd period 1.5 hours - plenary]

Selling the art and joy of wood products to consumers

Speakers



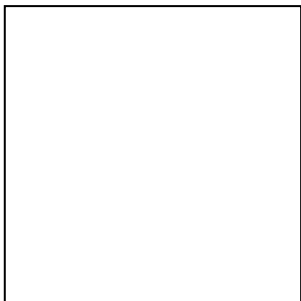
Speaker:
Jim Birkemeier

Topic:
Full Value Forestry: New Jobs from Dead Trees on the Family Farm



Speaker:
Giedrius Leliuga

Topic:
Customer Needs and Control of Supply are the Keys to Success



Speaker:
M V Rao

Topic:
Etikoppaka – An Indian Village Perpetuating the Joy of Wood through the Tradition of Toy Art



Speaker:
Sudipta Dasmohapatra

Topic:
Consumer Purchase Trends and Perceptions in the USA

Full Value Forestry: New Jobs from Dead Trees on the Family Farm

Jim Birkemeier¹

Abstract

Our family forest business sells thousands of high-value wood products direct to customers around the world. The first priority is to sell our solid wood flooring and natural furnishings to homeowners in our local community, we then export our surplus wood to distant customers using the internet. Our 200 acre forest is the most productive, natural, and beautiful woodlot in the region and our annual harvest is just a fraction of the trees that naturally die each year. In the midst of this major economic recession, we are using our dead trees, the natural output of our forest, to put people to work with well-paying and rewarding jobs. Using just 20% of our annual growth, we now support 4 full time jobs. The potential is one full-time job per 10 acres of forest land. I choose to use the smallest machinery possible and hire the most creative people I can. What we do is old-fashioned, just the opposite of Industrial Forestry today. This business model is universal, trees are a plentiful and low value commodity that can be manufactured and marketed on a small scale - to produce high-value products to create new jobs almost anywhere.

¹ Timbergreen Forestry, Timbergreen Farm, S11478 Soeldner Rd, Spring Green WI 53588, USA (Jim@TimbergreenForestry.com, jbirkemeier9@gmail.com)

Full Value Forestry

Our family harvested timber for the first time in 1974. I logged the best trees from 30 acres and the best bid we received for the logs was \$1,400. That total amount was very disappointing and didn't even cover our costs. After earning a forestry degree from the University of Wisconsin and working for several years as a consulting forester helping other landowners sell their timber in the traditional timber industry, I harvested some more of our family timber. The thought was to do it right this time, but we had the same disappointing result. Timber prices are simply too low to pay for good logging and earn a fair price to the grower for their time, effort, and investment. Everyone else (the foresters, loggers, truckers, sawmillers, etc.) in the timber industry earns a good income for their time and investment. If the forest owner is not paid a profitable price for their timber, you better not call anything "Sustainable" when I'm around. Forests and Forest Owners are The Bottom of the Wood Chain – swallowed up and discarded by big industry. I chose to NOT be a sardine any longer. I tried every part of the industrial/government forestry system as a professional forester and as a forest owner for decades - and finally quit in disgust.

I relearned forestry in my own woods with my chain saw following the guiding gut feeling of 'do just the opposite' of what everyone else is doing in the timber industry. It worked! Now I can earn \$1,400 from a single small tree that is considered worthless in the timber market, and I can earn many thousands of dollars per tree for our better timber.

As the landowner, timber grower, forest manager, logger, sawmiller, and woodworker, I learned the same knowledge of the native-American Menominee Tribal Forests in NE Wisconsin and the traditional German Dauerwald. The Menominee forest managers maximize the quality and quantity of timber grown while encouraging greater natural diversity. They grow a healthy tree as long as it is vigorous and the risk of allowing the tree to stand until the next harvest cycle is low. There is no maximum size or age for a tree, and they just harvest part of the natural output of the forest. The German Dauerwald emphasizes natural succession and regeneration, with the understanding to "watch nature". High-grading out the best trees or over-harvesting is Never Allowed. The Best Harvesting techniques and woodworking tools and methods have been gleaned by studying the Scandinavians.

Timbergreen Farm – The best of the best ideas from around the world have been sought out, modified, and personalized for maximum benefit to our family woodworking business. I looked at what resources I had right on the farm and found better ways than industrial logging:

- Let the good trees grow as long as they are healthy and vigorous.
- Harvest the worst trees first – improving the forest each cutting.
- Encourage natural succession and natural regeneration. Watch nature and learn!!
- Take only part of the natural output of the forest, what nature can spare.
- Never let market demand determine what trees are cut for short term profit.
- Perform a small annual harvest for a steady income and minimal impact.
- Pay a professional timber feller a good wage for excellent selective harvesting.
- Use the smallest possible equipment to move the logs, carrying the weight when possible to minimize soil damage.
- Solar heated lumber kilns produce excellent quality lumber. Isolate the solar collector from the insulated wood room.

- Make high value finished wood products from low value logs. Small, crooked, undesirable trees have great potential income.
- Use all wood waste for fuel, bedding, mulch, bonfires.
- Sell what you have, find the best use for every piece of wood harvested.
- Plan ahead to meet needs in the local economy first – then export extra wood.
- Happy customers sell more of your products when they show-off and tell their friends
- Each floor/product is a showpiece to new customers. Happy Customers become volunteer sales staff.
- Eliminate all the brokers, middlemen, shippers, wholesalers – Keep all the money at home in the local economy.
- Selling finished products gives feedback to become a better forester, logger, and woodworker.
- Sell each piece of wood for its highest value use. Make Value not Volume.
- Earn a high annual income to encourage protecting the forest for future production.
- Use the value of natural solid wood products to support well paying jobs and rewarding jobs for local people!
- Use the simplest, smartest method for each step.
- Do just the opposite of what the big timber industry would do.

Create Jobs Connecting the Forest to the Local Community

Last time I talked with Marshall Pecore, forest manager at Menominee Tribal Enterprises, he said they had one full time employee for every 400 acres of forest. Since my harvest cycle can be on an annual basis, instead of every 13 years like at Menominee, our timber management can be much more productive and efficient. Since we manufacture a much higher percentage of our harvested wood to a higher value and practice direct marketing, we can make a lot more money from every cut tree.

Making and installing flooring in the customer's home can support one full time employee for every 20-40 acres of forest at Timbergreen Farm.

Spring Green Timber Growers retail store can support one full time employee for every 10 acres of forest. A wood products business that uses urban trees can support one full time employee for every 50 trees that would otherwise go into the chipper/landfill each year. Forests should directly and primarily benefit the forest owner and the local community, providing regular income, jobs, wood products, fuel, wildlife, water, recreation, etc. Direct marketing of high value wood products in a local economy can make this feasible.

You can choose to work in any part of this process. Spring Green Timber Growers do it every day – these numbers are real and can be duplicated by other small businesses. This chart shows the range in values obtainable for hardwood timber and wood products in the USA, October 2011.

Value Multiplied Wood Processing Value Earned Per Tree in USD

Type of Tree	Scribner Tree Scale	Stumpage Value (USD)	\$ Delivered to Mill	\$ Kiln Dry Lumber	\$Installed Flooring	'Mega Value' Products
Small Diam	10 bf	\$.20	\$2	\$65	\$250	\$500
Crooked	250 bf	0	\$20	\$500	\$2,000	\$4,000
Undesirable	250 bf	\$5	\$20	\$400	\$2,500	\$5,000
Average	300 bf	\$60	\$120	\$1,200	\$3,000	\$6,000
Good Tree	300 bf	\$120	\$240	\$1,200	\$3,000	\$6,000
Super Tree	400 bf	\$2,400	????	\$2,400	\$5,000	\$10,000

We choose to earn Hundreds of dollars per tree for small diameter timber and thousands of dollars per tree for saw-timber sized trees by selling installed flooring and 'Mega Value' products. We choose to sell our wood direct to customers and eliminate all the brokers, wholesalers, shippers etc., and keep all the money right here in the family business. We do this to protect and manage our natural forest.

Timber Growers actually earn just about the same money whether we process a tree with good commercial value or a 'worthless' tree. All species have about the same high value in this system.

Example – Red Oak Floor installed August 2011

I had installed a Red Oak floor in a local family's home in 2002. Nine years later they are remodeling a vacation home on Spencer Lake - 120 miles to the north, and again hired me to add my flooring. The wood was Red Oak – all from trees killed by the Oak Wilt fungus – that I had salvaged recently from my forest. Most of the wood was quartersawn with up to 7 ½" wide planks.

The trees were about 125 years old. I worked about 30 hours to fell and skid the logs, sawmill the lumber, kiln dry the boards, and manufacture the tongue and groove flooring. Great effort, high risks, large expensive machinery and a manufacturing facility were required. The value of the flooring pieces totaled about \$1,800.00

Over the past nine years, this family has bought other lumber and wood products and visited our farm regularly. Knowing your customers and keeping them happy with excellent, personal service, encourages them to keep doing business with your company over and over.

On other jobs, the customers have volunteered to help install the flooring. Picking out the next board to use and working on the huge "wood puzzle" on their floor is very exciting for some homeowners. Nailing the boards to the floor is very simple work that anyone can learn in a few minutes, giving a greater sense of satisfaction and ownership in their new floor.

Often, we make custom air vent covers from matching wood, personalizing these pieces to the family when possible.

At the completion of each floor, we give the family a wood gift from our store – wooden pens, laminated cutting boards, laser cut ornaments, etc. They usually ask for a stack of our business cards to hand out to their friends when they show off their new work of wood art.

Installing the flooring ourselves is the key to success in the local market area!!

With flooring, we can earn about \$10/board foot for a large volume of wood. This is the threshold value where I believe a small woodworking business can operate profitably. “Mega Value” products are higher priced items that take more time and skill to produce. Furniture, cabinets, countertops, stairways, etc. can earn \$20/bf or higher but typically use less volume of better quality wood. Spring Green Timber Grower’s retail store makes a variety of wood art creations using a laser cutter/engraver that can earn up to \$500/bf for jewelry, boxes, ornaments, and other small items that we export around the world.

Global Certification vs Local Service

I was a Tree Farm Inspector long ago, and have known the industry Sustainable Forestry Initiative from the start. I was also the first Forest Stewardship Council Certified Resource Manager, and our family farm was the first FSC Certified small private forest with Chain of Custody to sell our wood - in our Great Lake States region of the USA back in 1998. Global “Certification” was not effective for our local wood sales as it was clear no area consumers knew about FSC or trusted it, while promoting our local reputation came at no cost and quickly became practical and money-making.

Global certification was very expensive with no significant benefit to our business - while providing excellent local service and earning word of mouth sales has been the main growth force of our success. Trust is earned locally, not bought globally.

Earning is limited only by the imagination.

The potential market for wood products is endless and growing. Woodworking is simple and practical on a small scale. Woodworking is nothing new, a traditional way of life that offers hope for the future.

Conclusion:

One very important lesson on processing low value trees into high value products: A landowner or timber grower owned business can actually sustainably harvest and manufacture low value logs, as they also get the high value of improving their forest and land resource. Without gaining the extra benefit of improving your forest, there is no incentive to process small, crooked, defective logs that are very expensive to carefully harvest. A business strictly wanting to make money woodworking can easily get better quality logs at cheaper prices from other landowners who do not value or manage their timber.

Earning high value for traditionally low value logs is essential to actually doing sustainable forest management – from the forest owner’s point of view.

Detailed information on all aspects of this introduction:

www.TimbergreenFarm.com

www.TimberGrowers.Com

www.FullValueForestry.com

www.FullVigor.com

Full Value Forestry



Sustainable Forest Management
From the Forest Owner's
Point of View































“Mega Value” Wood Products earn \$20/board foot and MORE!



Slide 31













Value Multiplied Wood Processing

Value Earned Per Tree in USD

Type of Tree	Scribner Tree Scale	Stumpage Value (USD)	\$ Delivered to Mill	\$ Kiln Dry Lumber	\$ Installed Flooring	'Mega Value' Products
Small D	10 bf	\$.20	\$2	\$65	\$250	\$500
Crooked	250 bf	0	\$20	\$500	\$2,000	\$4,000
Unwanted	250 bf	\$5	\$20	\$400	\$2,500	\$5,000
Average	300 bf	\$60	\$120	\$1,200	\$3,000	\$6,000
Good Tree	300 bf	\$120	\$240	\$1,200	\$3,000	\$6,000
Super Tree	400 bf	\$2,400	????	\$2,400	\$5,000	\$10,000





FullValueForestry.com

TimberGrowers.com

TimbergreenFarm.com

Jim@TimbergreenForestry.com

Customer Needs and Control of Supply are the Keys to Success

Giedrius Leliúga²

² Managing Director, Medžio Stilius (Wood Style), (giedrius@eco-wood.net)

CUSTOMERS NEEDS AND CONTROL OF SUPPLY ARE THE KEYS TO SUCESS

Bangalore, India 2011

Mr.Giedrius LELIUGA

MBA, forest engineer

Director

ECOWOOD, UAB www.ecowood.eu
LITHUANIA

Production of oak semi finished products, engineered flooring, doors and staircases

MEDŽIO STILIUS, UAB (*eng. Style of Wood*) www.parektas.lt
LITHUANIA

Sales and installation of oak flooring, doors and staircases.
5 retail showrooms in Lithuania

DUBAVA LTD,
UKRAINE

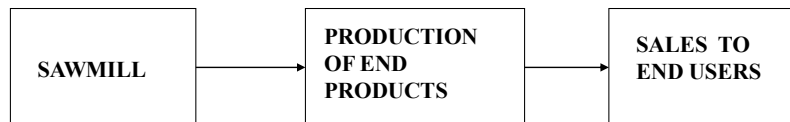
Sawmill in Ukraine. Production of oak sawn wood.

Total production per year : 100 thous.m2 flooring
3500 doors
200 staircases
1000 m3 semi finished products

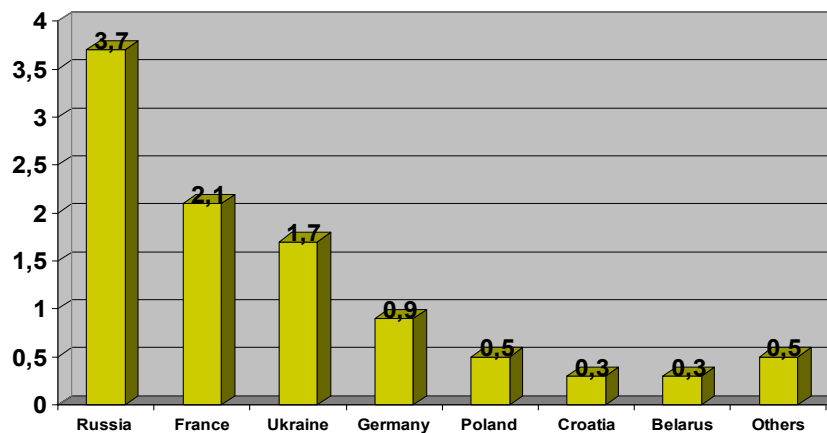
Totally: 150 employees

Distribution channels

FROM FOREST DIRECTLY TO END USER

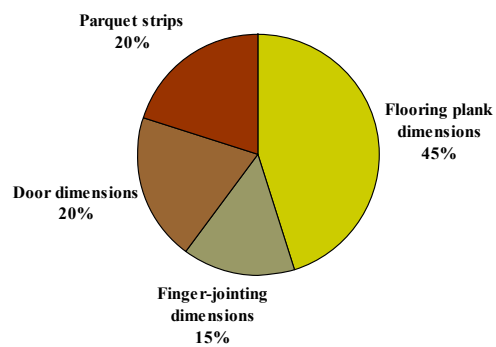


European oak (*Quercus robur*) forest area (million ha), 2007

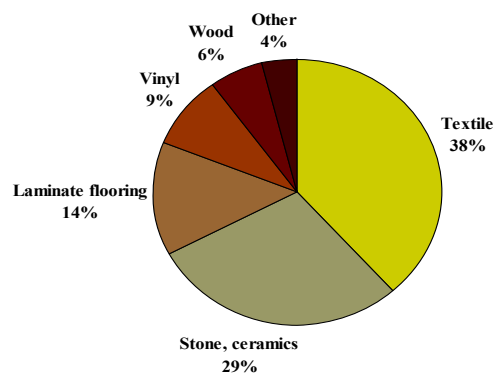


The oak forests in Europe are declining at the same speed as tropical forests

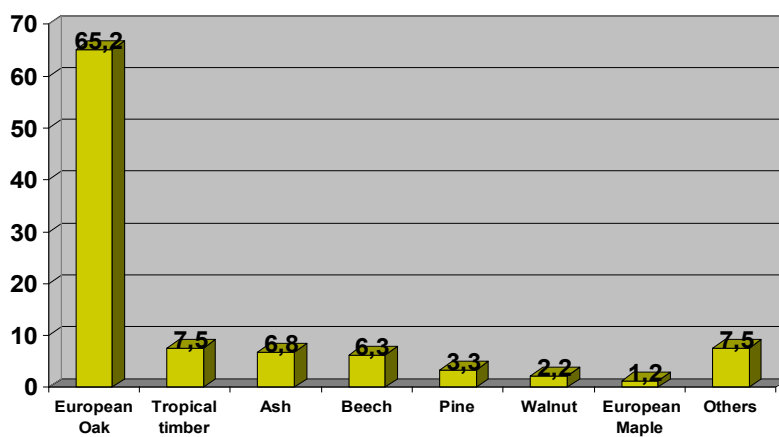
**Sawn wood by assortments in DUBAVA sawmill, Ukraine (2011)
from III quality log , 30 cm diameter**



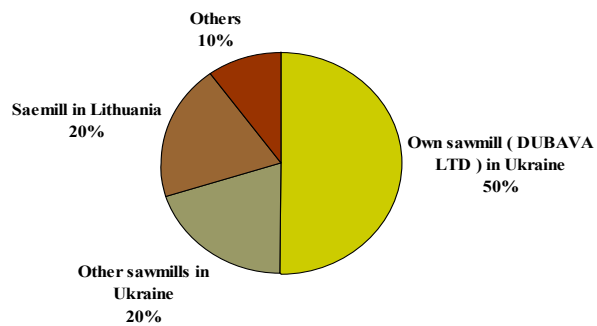
Consumption of floor covering products in EU in milion m2 (2007)



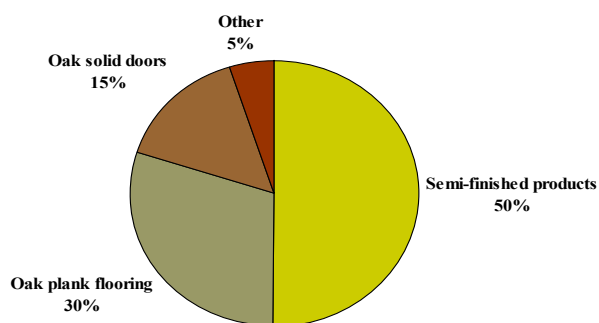
Species - Usage rate in 2010 (%)



Supply of oak sawnwood (%) to ECOWOOD, UAB (2011)



Production by product groups in ECOWOOD, UAB (2011)



Etikoppaka - An Indian Village perpetuating the Joy of Wood through the Tradition of Toy Art

M V Rao³, M Balaji and S C Joshi⁴

Abstract

Etikoppaka, a remote village situated on the banks of river 'Varaha', 120 km south of Visakhapatnam in Andhra Pradesh state, India, is a wonderland of astonishing wooden toys. The entire village continues the tradition of transforming amorphous wood into attractive miniature objects. These admirable artworks include lively, nice and cute dolls, toys, bangles, curios, kickshaws, knick-knacks, items of décor and playing aids through wonderful carving and beautiful polishing. Over the years, the craft has been perfected, reflecting the artisans' care and interest in their surroundings and in nature. These artisans in fact create miniature worlds of life in wood that fascinate onlookers. Every household in the village is involved in toy making irrespective of their caste, creed or religion. The toys are in high demand all over the country, especially "Lepakshi Emporia" and tourist/ pilgrim centres. This article discusses this impressive cottage industry.

Key words: Etikoppaka, wood, toys, carving, polishing, cottage industry

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1. THE PREMISE

1.1 The scenario

Etikoppaka (17°29'03" N, 82°44'35" E), a remote village situated on the banks of river 'Varaha', 120 km south-west of Visakhapatnam in Andhra Pradesh state, India, is a wonderland of astonishing wooden toys. These handcrafted products are rich and varied, and include items as diverse as hair pins, ear tops and bangles to royal figures and their coterie (Fig.1); insects, birds (Fig.2 and 4) and animals (Fig.5) to traditional farmers (Fig.3) to characters from several religious faiths and so on and so forth. Over 200 artisan families form the mainstay of this eco-friendly (green) tradition of toy art in the village⁵.



Fig.1: Royal figures and their coterie

Fig.2: Various kinds of birds

Fig.3: Farming activities

Fig.4: Matryoshka toys

Fig.5: Various kinds of animals

⁵ <http://etikoppaka.com/about-us/about-etikoppaka>

1.2 The legacy

This legacy of toy making is an inheritance early 18th Century Nakkapalli, a village 25 km south-west of Etikoppaka⁶. During the early 20th Century, the artisans migrated to Etikoppaka because of abundant availability of suitable wood yielding trees around the place. It is probable that patronage came from the ruling courts ('rajas') of Vijayanagaram province who immigrated to this area at more or less the same period and settled, and as landlords acted as catalysts.

1.3 The forge

Subsequently, one of the landlords decided to transform this tradition into a business enterprise so that the art and artisans could earn an independent living. During this transition, dyes and processes that enhanced the elegance and quality of the artistic produce were introduced. In due course, all the artisans of the village together formed a co-operative society and adapted to modernization, taking Small Scale Industries registrations, obtaining electricity connections, availing of help from banks and other financial institutions such as Andhra Pradesh State Finance Corporation and replacing the manual turneries with power operated ones. House construction assistance also seems to have been obtained by each of them from the State Government. The artisans even took precautions to install two motors (of 0.5 HP) each to overcome production loss in the event of trouble in one unit. This enabled the traditional industry to achieve great success.

1.4 The retreat

However, the traditional and associated business, despite continued support and encouragement from the landlords; suffered a sharp decline during the mid-1980's due mainly to work opportunities that arose for the second generation of artisans in the country's first co-operative sugar factory set up by the same landlords in early 1930's. Slowly, the society became defunct due to reduced strength, lack of unity, meager contributions and unfulfilling goals.

1.5 The crusade

This departure of a good number of artisans from the artistic tradition together with a discernibly grim future for this ancient art was encouraged one pragmatic young landlord to take instant action.

1.6 The revival

In order to save, revive and perpetuate the tradition of toy art and the joy of wood in turn, rallying call encouraged the launching of a consortium of artisans in the village. By convincing and exposing the remaining craftsmen to the contemporary/ emerging concepts and designs at national craft festivals/ exhibitions; confidence, enthusiasm, pride, competence and competitiveness were gradually restored among the artisans.

⁶<http://ithappensinindia.com/beautiful-toys-etikoppaka-toys-from-ap-india-the-manufacturing-process-of-etikoppaka-toys-without-chemicals>

The far-sighted example led to the involvement of the Fine Arts Department of Andhra University, the National Institute of Design and the National Institute of Fashion Technology in the development of enchanting new designs and aesthetic novel products that attracted innumerable connoisseurs, both national and international. This growing fame also led to the setting up of a well equipped design centre to train others in the craft at the village itself.

By such innovative approaches, indefatigable effort and constant persuasion, this reinvigorated the joy and appreciation of traditional wood art and made “Etikoppaka” the epitome of widely adored handicrafts.

1.7 The epithet

Today, this is the contemporary face of Etikoppaka handicrafts. For all this drive and drudgery, this person together with many artisans bagged several national and international awards and accolades.

2. THE DEXTERITY

2.1 The commitment

Every household in the village, irrespective of its religious, social or other affiliation; is involved in toy making and the entire village thus bears the torch of continuing the tradition of transforming amorphous wood into alluring miniature objects.

2.2 The penchant

Over the years, the craft has been superbly perfected reflecting the artisans’ relationship with their ancestral, cultural, ethnic, historic, mystic and religious subjects as well as contemporary civic and natural surroundings (Fig.6) (Rajani Kanth, 2011).

2.3 The creation

With their innate abilities, the artisans of Etikoppaka create miniature worlds of life in wood that beguile onlookers and stir their emotions. These skilled craftsmen create a vast array of wonderfully carved and beautifully polished items, from breezy, elegant and attractive bangles, curios, decoratives, dolls, kickshaws, knick-knacks to musical models, playing aids, roof hangings and toys (Fig.7 to 12)



Fig.6: Etikoppaka creations at a glance

Fig.7: Key chains, vermillion boxes etc

Fig.8: Tops, pen stands etc

Fig.9: Locomotives, religious items etc

Fig.10: Dolls, showcase items etc

Fig.11: Wall and roof hangings etc

Fig.12: Playing instruments etc

2.4 The pride

Astounded by this vivid creativity, a few more hamlets (e.g. Kailasapatnam) around Etikoppaka have also take up this marvelous art. The appealing handicrafts have achieved widespread renown and a pride of possession particularly among the affluent and semi-affluent all over the country and even in several foreign nations around the globe.

3. THE PRODUCE

3.1 The paraphernalia



Fig.13: Turnery



Fig.14: Working tools

Astonishingly, almost all toys or their component are essentially carved out on a naive turnery (Fig.13) using a few plain tools (Fig.14), viz., hallowing chisel ('Lo uli'), nail-edged shaping chisel ('Goru uli') and sharp-tipped cutting chisel ('Mona uli') from a single variety of wood, with the turnery being operated by two artisans at the most is a small unit, occupying as little space as 1.5 x 0.9 m (1.35 m² of area); generally installed on the floor in the porch (veranda) of each house.

3.2 The nucleus



Fig.15: Wrightia tinctoria wood (lops and tops) and working sizes (insets)

The chief raw material, ivory wood, commercially known as “Dudhi”, scientifically termed as *Wrightia tinctoria* (Roxb.) R. Br. (Family: Apocyanaceae) and locally named as “Ankudu” is obtained from nearby forest tracts (Fig.15). Mostly lops and tops of the trees are used to make the handicrafts since the length of the material is not the main criterion though girths of 2.5 to 15.2 cm are required. Girths above 15cm are a disadvantage too as they result in wastage of a good lot of raw material.

3.3 The processing

Fresh battens procured are kept under truss of the artisans own house and allowed to air-dry for two months. No biological damage of any kind (even that of fungi) is reportedly experienced during such seasoning. Afterwards, the material is made use of to produce various kinds of toys as per orders or requirement.

3.4 The sub-nucleus

The plant dyes, red and orange are prepared from Jafra (*Bixia orellona* L., Bixaceae), yellow from Turmeric (*Curcuma longa* L., Zingiberaceae), black from Karaka (*Terminalia chebula* Retz., Combretaceae) and green from Indigo (*Indigofera tinctoria* L., Fabaceae) in the village while a few more are obtained from Madhya Pradesh state. Concentrated extract of each natural dye is mixed with hot lac and made into ready to use bars (Fig.16) and discs (Fig.17)⁷. Though synthetic dyes were used some time during the 20th Century, the practice was reversed subsequently with growing environmental awareness.

⁷ http://www.india-crafts.com/indian_heritage_products/etikoppaka_toys.html



Fig.16: Lacquer dye bars



Fig.17: Lacquytubuer dye discs

3.5 The finishing

As each toy or component is made, it is lacquer polished on the turnery itself with the dye(s) required. Dry lac is pressed over the object and turnery operated continuously to produce the required heat and uniform coat of lacquer (Fig.18)⁸⁹. Finally, the item is ready for polishing, employing dried leaves of screw pine (*Pandanus fascicularis* Lam., Pandanaceae) particularly growing in coastal areas, to achieve at a bright sheen.



Fig.18: Raw timber to finished toys

⁸ http://www.india-crafts.com/indian_heritage_products/etikoppaka_toys.html

⁹ <http://www.onlytravelguide.com/andhra-pradesh/arts-crafts/etikoppaka-wooden-craft.php>

4. THE TRADE

4.1 The outflow

The final produce flows into the domestic market through wholesale outlets in the village, oft-organized national craft festivals/ exhibitions, Andhra Pradesh State Handicrafts Emporia “Lepakshi” and private outlets in tourist/ pilgrim centres. Direct supply to the companies and agents is also carried out on placement of orders, but never supplied to the consumer directly, except in exhibitions.

4.2 The outspread

Improved packing coupled with a joint initiative with India Post has facilitated the dispatch of the artistic produce to places far and wide. During the recent past (1993 to 2006), the consortium supplied huge consignments of time-piece cases to national watch industries to Canada, USA, Germany, France, Italy and Australia with UNESCO permits, among other items. Annual turnover reached a peak of Rs. 3.2 million in 2007 (Rajani Kanth, 2011).

4.3 The outthrust

Trade with foreign countries slowly ceased due to new statutes such as forest certification, eco-friendly compliance labeling, etc. and the turnover dwindled down to 0.8 million a year by 2010. To comply with the latest export norms, the consortium proposes to seek assistance from the South East European University, Tetovo, Macedonia (Rajani Kanth, 2011).

5. THE CONUNDRUM

Although the untiring efforts of the artisans and their modern mentor led this age-old traditional cottage industry to enormous prominence against the odds and through several ups and downs, the enterprise is still beset with a couple of serious constraints that prove to be ‘Domicile’s swords’ for the perpetuation of the art and unhindered progress of its creators. The first constraint is power supply and a continuous timber source.

5.1 Power supply

The village during most days of the year has a power supply only for a limited period especially during day from 0500 to 0900 hrs. This greatly affects the working schedule. Even at the time of supply, the voltage is usually low because of the operation of four rice mills and several irrigation motors nearby. Working under complete artificial illumination is reportedly not possible, as most of the artisans suffer from impaired vision because of specialized and concentrated work involved.

5.2 Timber source

‘Dhudi’ wood proved to be the material par excellence for ages for toy making as it is soft, easy to work with, withstands working heat, takes polish well, gives a good finish and offers no loss of material right from seasoning to finished product (Nazma et al., 1981).

The artisans report that lot of timber is available in nearby areas such as Kalyanalova, Lothugedda, Madugala and a little farther in Krishnadevaraya peta and Narsipatnam regions. Though not useful for any other end use, at present the timber resources are not accessible to the artisans.

Earlier (possibly till mid-1990s), the Andhra Pradesh Forest Department used to make available the required material under individual permits, but the practice was withdrawn subsequently for reasons not comprehended. As an alternative, the same Department had proposed to start a depot for supplying the material through normal departmental procedures of auctioning. Fearing cost escalation, the artisans did not follow up this proposal.

Therefore, for quite some time now, wood supply is mainly from a secondary source, the middlemen's syndicate, resulting in inconsistent timber supply at premium prices. The secondary sources bring in timber of various lengths and girths in bundles (mainly head loads). Usually each bundle containing 15 battens (each of 150 cm length and 5 to 8 cm diameter) suitable for making toys of different dimensions satisfies the raw material requirement of a unit for two days.

The artisans are not conservative or blind to change. They tried several other timbers [*Diospyros sylvatica* Roxb., Gatha, Ebenaceae; *Eucalyptus tereticornis* Sm., Red gum, Myrtaceae; *Haldina cordifolia* (Roxb.) Ridsd., Haldu, Rubiaceae; *Manilkara hexandra* (Roxb.) Dubard, Ceylon iron wood, Sapotaceae; *Morinda citrifolia* Noni, Indian mulberry, Rubiaceae; *Moringa oleifera* Lam., Drum stick, Moringaceae; *Pterospermum canescens* Bl., Mathi paila, Sterculiaceae; *Syzygium cumini* (L.) Skeels, Jaman, Myrtaceae and *Ximenia Americana* L., False sandal, Olacaceae] available in the vicinity to substitute 'Dudhi', at least to tide over during periods of difficulty. However, most of these timbers were found to be brittle and the rest to be too hard or dark tanned or easily perishable.

Still, the artisans are ready to try more alternatives. The authors also got a few timbers tested for their suitability [*Anacardium occidentale* L., Cashew, Anacardiaceae; *Artocarpus chaplasha* Roxb., Chaplash, Moraceae; *Bombax ceiba* L., Semul, Bombacaceae; *Diospyros ferrea* (Willd.) Bakh, Ebony, Ebenaceae; *D. melanoxylon* Roxb., Ebony, Ebenaceae; *Eucalyptus tereticornis* Sm., Red gum, Myrtaceae; *Hevea brasiliensis* (Willd. ex Juss.) Muell.-Arg, Rubber, Euphorbiaceae; *Leucaena latisiliqua* (L.) Gillis, Subabul, Mimosaceae; and *Pterocarpus marsupium* Roxb., Bijasal, Fabaceae] (Fig.19). Of these, Rubber wood alone was found to meet with all the desired attributes. So the same can be explored to be adapted as an alternative provided the wood is properly seasoned and processed (with eco-benign wood preservatives). However, this timber has to be obtained at present from far off Kerala state as plantations of the species being raised, of late, in East Godavari and Visakhapatnam Districts take some more years to become handy for the purpose.



Fig.19: Trials by IWST with various alternative timbers (1.Cashew, 2.Chaplash, 3.Semul, 4.Ebony, 5.Red gum, 6.Rubber, 7.Subabul and 8Bijasal)

6. THE OPTIMISM

After the advent of Joint Forest Management (JFM) concept, the artisans of Etikoppaka have been involved in raising ‘Dudhi’ plantations from the beginning of the current Century and over 60,000 saplings are being brought up in about 120 ha of forest and non-forest areas with the support of the Forest Department (Rajani Kanth, 2011).

The artisans are eager to realize the advantage of this recent endeavor and are waiting with hope for the quick rejuvenation of their cottage industry.

7. THE SALVAGE

Although ‘Dudhi’ trees possess good coppicing ability, timber extraction from natural forest and wilderness is not permitted by the Forest Department. Similarly, though a large portion of the plantations (initially raised a decade or so ago) also attained exploitable phase, the same are also not allowed to be made use of.

Unless the Forest Department comes to the aid of the artisans with munificence in solving timber inputs and the Eastern Power Distribution Corporation Limited magnanimously ensures continuous power supply throughout the day time, the great tradition of international name and fame of the land is likely to be driven to oblivion before one can say “Jack Robinson” (Rajani Kanth, 2011).

8. THE REVELRY

In the long term interests of the (a) age-old tradition, (b) committed artisans, (c) admiring connoisseurs, (d) employment potential, (e) revenue augmentation and (f) foreign exchange generation, the government and its organs with all sincerity and promptness should recuperate the Etikoppaka handicrafts industry at the earliest possibility and recognize it as a proud tradition of the nation.

9. ACKNOWLEDGEMENTS

The authors express profuse thanks to the artisans of the Etikoppka handicraft industry and their champion for all the information provided and help extended in bringing out this article. Due acknowledgements are extended to the websites referred to in the narrative. Special thanks go to the Director General, Indian Council of Forestry Research and Education, Dehra Dun for the keen interest evinced and support given in materializing this communication.

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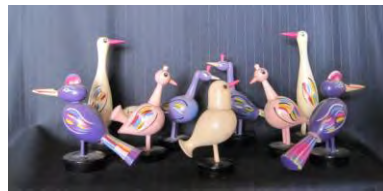
WELCOME TO ALL DIGNITARIES AND DELEGATES

ETIKOPPAKA - AN INDIAN VILLAGE PERPETUATING THE JOY OF WOOD THROUGH THE TRADITION OF TOY ART

M. V. Rao* and S. C. Joshi§

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via Yoga Village, Andhra University Post, Visakhapatnam-530 003

§ Institute of Wood Science and Technology, Malleswaram Post, Bengaluru-560 003



THE PREMISE

- *The scenario*
- *The legacy*
- *The forge*
- *The retreat*
- *The crusade*
- *The revival*
- *The epithet*





THE DEXTERITY

- *The commitment*
- *The penchant*
- *The creation*
- *The pride*



Key chains, vermillion boxes etc



Tops, pen stands etc



Locomotives, religious items etc



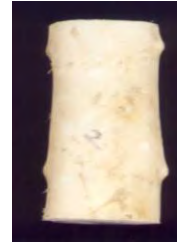
Dolls, showcase items etc



Wall and roof hangings etc



Playing instruments etc



THE PRODUCE

The paraphernalia
The processing

The sub-nucleus

The nucleus
The finishing



THE TRADE

- *The outflow*
- *The outspread*
- *The outthrust*

THE CONUNDRUM

- *Power supply*
- *Timber source*

THE OPTIMISM

THE SALVAGE

THE REVELRY



Trials by IWST with various alternative timbers
(1.Cashew, 2.Chaplash, 3.Semul, 4.Ebony, 5.Red gum, 6.Rubber, 7.Subabul and 8. Bijasal)

Consumer Purchase Trends and Perceptions in the USA

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Consumer Purchase Trends and Value Perceptions in the US

Sudipta Dasmohapatra

*Assistant Professor of Marketing
Environmentally Desirable Products (EDP)*

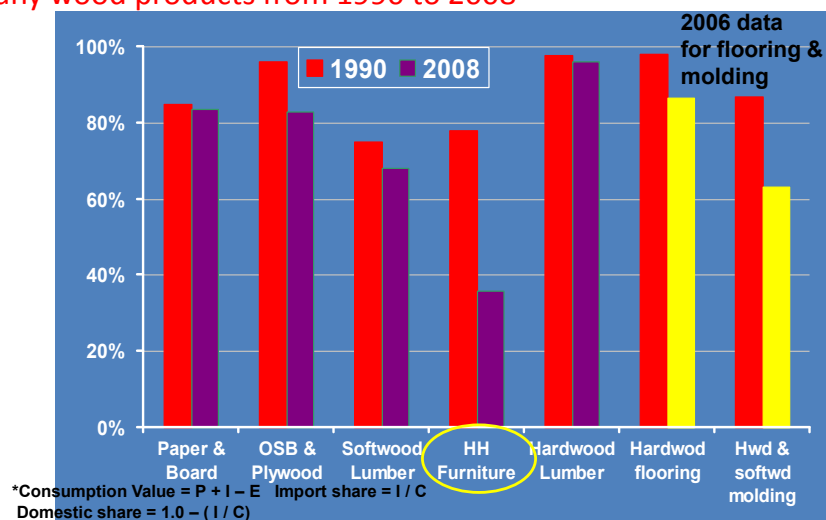


REDISCOVERING WOOD: THE KEY TO A SUSTAINABLE FUTURE
The International Conference and Exhibition on the Art and Joy of Wood
Bangalore, India, 19-22 October 2011

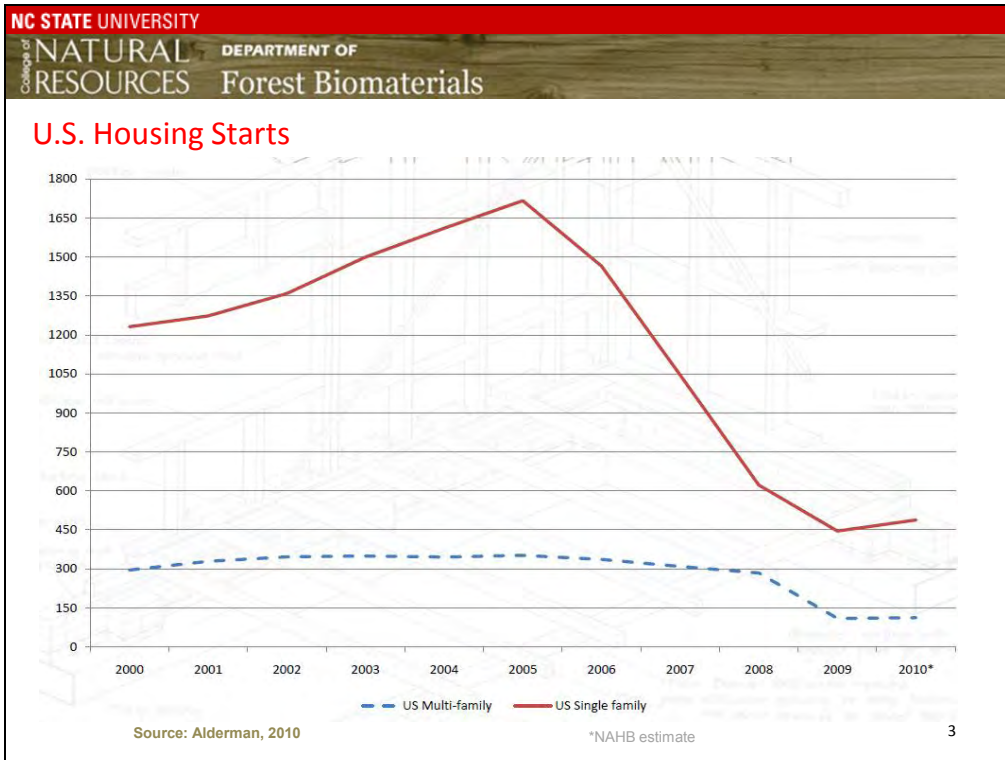


Dr. Phil Mitchell
Nate Irby

Domestically-produced shares* of U.S. consumption declined for many wood products from 1990 to 2008



Sources: Shipments : Dept Commerce, Bureau Census , ASM
Imports & Exports : FAS, B. Luppold for hardwood lumber, P. Ince for paper & board



NC STATE UNIVERSITY
College of NATURAL RESOURCES DEPARTMENT OF Forest Biomaterials

Major Consumer Trends in the US

- Diversity
- Life expectancy: Increasing
- Globalization
- Going green:
 - 30% consumers want products to have green credentials (*American Express* 2011)
 - The value of green building construction in the US is estimated to be \$60 billion by end of 2010
 - Buying local

Source: Trendwatching.com January 2011, Nielson 2011, Mintel 2011, hktcdc.com

4

Major Consumer Trends in the US

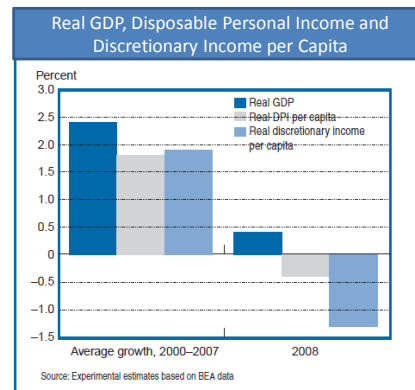
- Customization
- Retail rebirth (creativity to lure consumers into stores)
- Technology revolution: Electronic
- Luxury is mainstream
- On-the move
- Living alone

Source: Trendwatching.com January 2011,
Nielson 2011, Mintel 2011, hktdc.com

5

What Drives Consumer Purchase in Wood Products?

- Discretionary income
 - Home improvement and home planning spending (62% planning at least one major home improvement or remodeling project in the next year)
- Key attributes
(Good, Cheap, Fast):
 - Price is a major driver
 - Product quality
 - On-time delivery



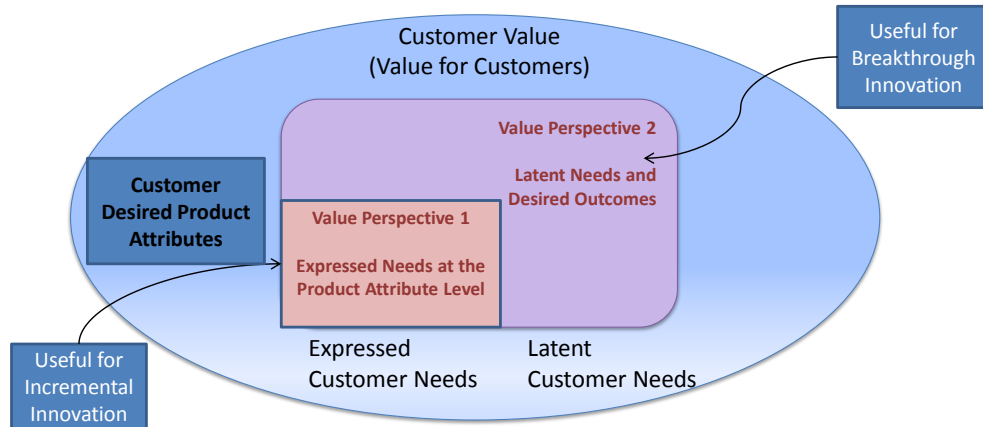
Source: Landefeld et al. 2010. (based on Bureau of Economic Administration data)

Riedel marketing group 13 may, 2011

6

Consumer Perceptions / Value

Customer Value: Product + Service + Price



Source: Naumann, E. (1995) Creating Customer Value: The Path to Sustainable Competitive Advantage. Thomson Executive Press, Cincinnati, OH; Roseno, A. (2005) Customer Value Driven Product Innovation, PhD Dissertation, Copenhagen Business School, UK
Roseno, A. (2008) Developing Radical Innovation Capabilities in Established Firms, Front End of Innovation Europe, Vienna (January 31, 2008)

7

Wood Household Furniture: Customer Perceptions of 4 Concepts



Cost of Manufacturing

Measure Four Concepts

Branding (Origin)

Local Sourcing

Customization

Environmental Friendly
(Green)

Competitive Attributes

Branding at the Source

State Campaign	Symbol
Minnesota Wood Campaign	
California Grown	 Be Californian Buy California Grown™
Vermont Quality Wood Products	
Brand Oregon	

Source: Tokarczyk and Hansen, 2006



Reclaiming Wood From Your Neighborhood

Source: woodfromthehood.com

Buying Locally in Wood Products

- Attitudes for buying local agricultural products will support **WOOD PRODUCTS**
 - Develop the importance of relationship between people and woodlands
 - Show heightened sense of stewardship

Source: Rand, Corroon, C. 2011

Competitive Attributes

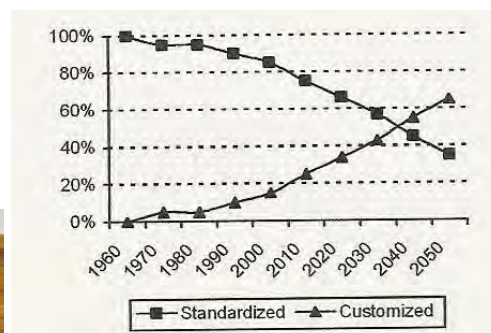
Environmental Attributes of Wood:

- Renewable
- Produced using solar energy
- A carbon storehouse
- Low impact
- Recyclable
- Reusable



Source: Howe, Bowyer and Bratkovich 2010

Market share of mass produced, standardized vs. customized products



Source: Buehlmann and Schuler 2002

10

Methodology

- Data Collection: From Consumers at Home Shows

- Home Shows

- Raleigh, NC (Sept 2009)
 - 126 completes
- Atlanta, GA (March 2010)
 - 125 completes
- Norfolk, VA (April 2010)
 - 155 completes

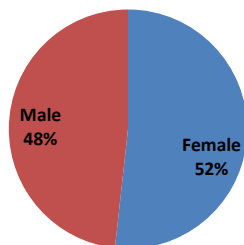


Consumers filling out survey at the Southern Ideal Home Show, Raleigh, NC September 2009 (Nate Irby overseeing)

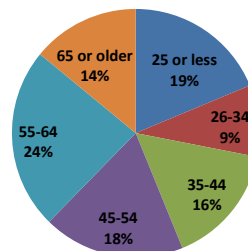
Total Survey Completes: 406

Respondent Type

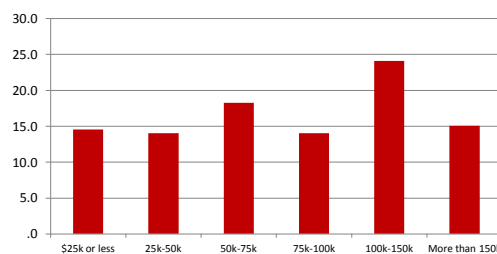
Gender



Age



Income

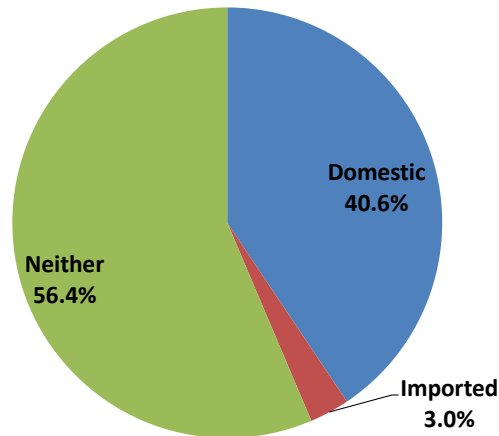


1. 12

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Purchase Attributes of Wood Household Furniture		
Relative Importance Rating (1=least important to 7=most important)		
	Mean	Standard Deviation
Durability	6.45	0.995
Appearance	6.41	0.926
Price	6.00	1.301
Finish	5.92	1.235
Ease of use	5.77	1.225
Color	5.73	1.241
Maintenance	5.60	1.351
Size	5.54	1.326
Service	5.47	1.422
Warranty	5.12	1.697
Already assembled	5.04	1.797
Customized	4.80	1.617
Environmentally-friendly	4.73	1.678
On-time Delivery	4.50	1.769
Local Sourcing	4.41	1.677
Brand	3.88	1.629

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Relative Importance of the 4 Concepts in the Model	
Attribute	% Importance (6-7)*
Customization	34.3%
Environmental Friendliness	36.1%
Local Sourcing	27.6%
Geographic Branding	17.2%
*based on a 7-point relative importance scale (1=least important to 7= most important)	

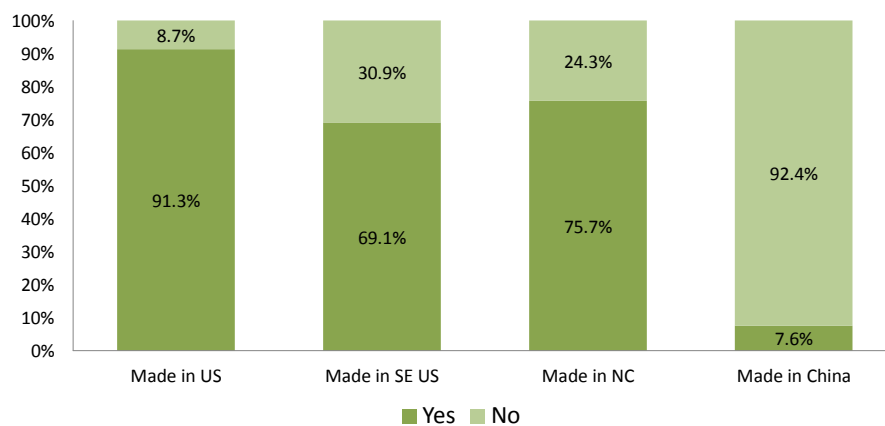
Respondent Preference for Origin of Furniture



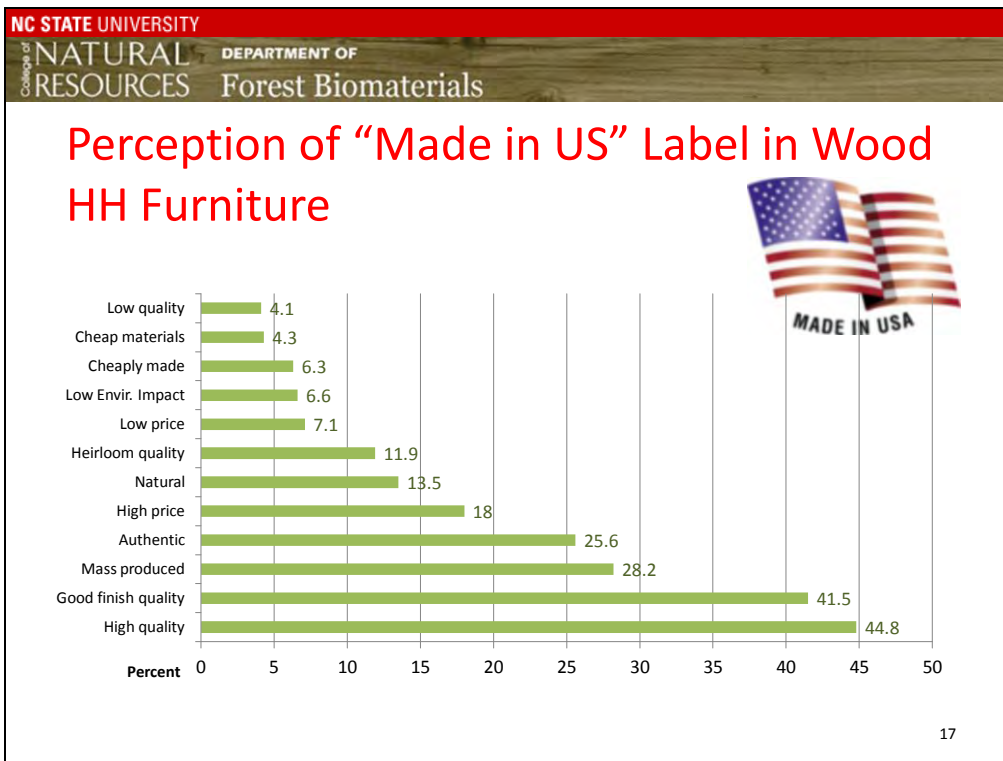
When purchasing your last piece of furniture, did you have a preference for:

15

Would you Prefer HH Furniture labeled as "MADE IN US"?



1. 16



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General Environmental Behavior

Activities	Percent of Respondents
Turned Off Electronic Products When Not in Use	84.4%
Used Recycled Products/ Used Products made of Recycled Packaging	77.3%
Made Homes More Energy Efficient	71.8%
Purchased Local Food Products	71.7%
Donated Money to an Environmental Cause	22.4%
Volunteered Time to an Environmental Cause	14.1%
Driven a Hybrid Vehicle/ Used Biofuels	8.8%

www.icims.com

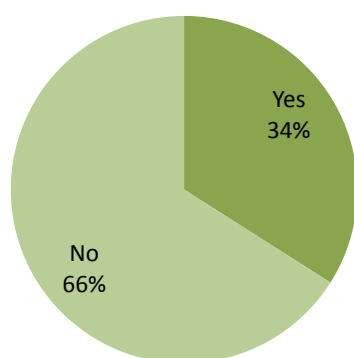
18

Importance of Environmental Attributes in Selecting Wood HH Furniture

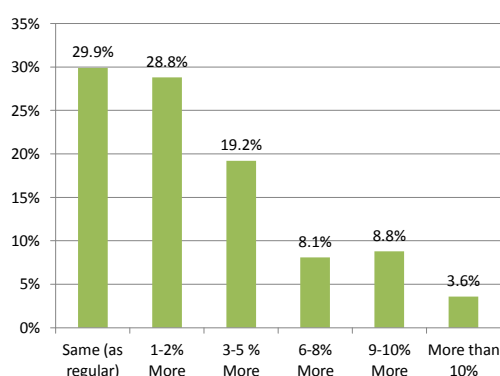
Environmental Attributes	Mean	Std. Deviation
Low Toxic Emissions When Used Inside Home	5.70	1.46
Wood is Not Sourced from Illegally Logged Forests	5.40	1.76
Obtained from Wood that Came from Well Managed Forests	5.02	1.60
Can be Disposed with Low Environmental Impact	4.96	1.57
Has Natural Resins and Binders	4.74	1.58
Originates from a Renewable Resource	4.65	1.55
Packaged using Environmentally Friendly Materials	4.64	1.58
Reduces Transportation Costs in Distribution	4.59	1.61
Low Waste Generation during Manufacture	4.53	1.54
Manufactured Using Local Materials	4.48	1.57
Manufactured Using 100% Recycled Wood	4.26	1.65

19

Willingness to Purchase / Pay More for Environmentally Friendly HH Furniture



Environmental/ Green Labels Important?



How Much More Willing to Pay for Environmental Friendly Furniture Items?

20

Purchase of Local Products

	Percent
Purchased Local Food Products	71.7%
Have Sought Locally-Made HH Furniture	15.3%
Furniture Made Using Local Materials (Respondents Mentioned 7= "Most Important" or 6= "Important" on an Importance Scale of 1-7)	27%



<http://tapamerica.org/american-economy-why-you-should-buy-local/>

21

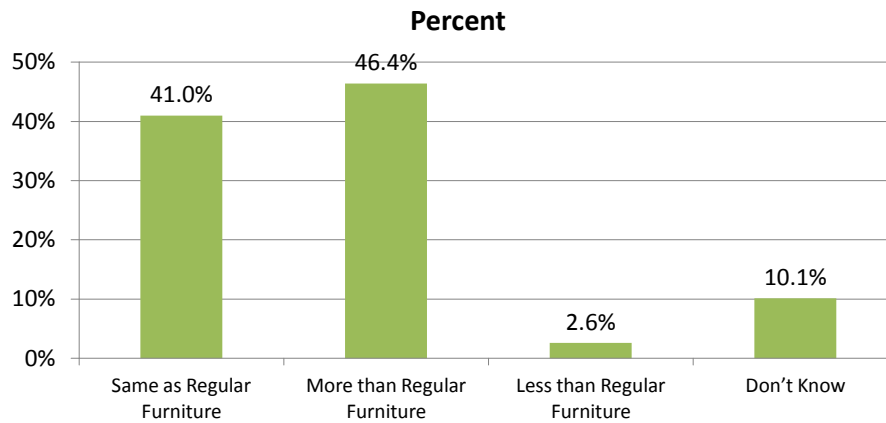
Purchasing Local Products Means:

- Respondents Indicated Purchasing Local equals:
 - Helping Community (76%)
 - Promoting Jobs (76%)
 - Better Service (59%)
 - High Quality (41%)
 - High Cost (8%); Low Cost (8%)
- Females more likely to buy local products than men



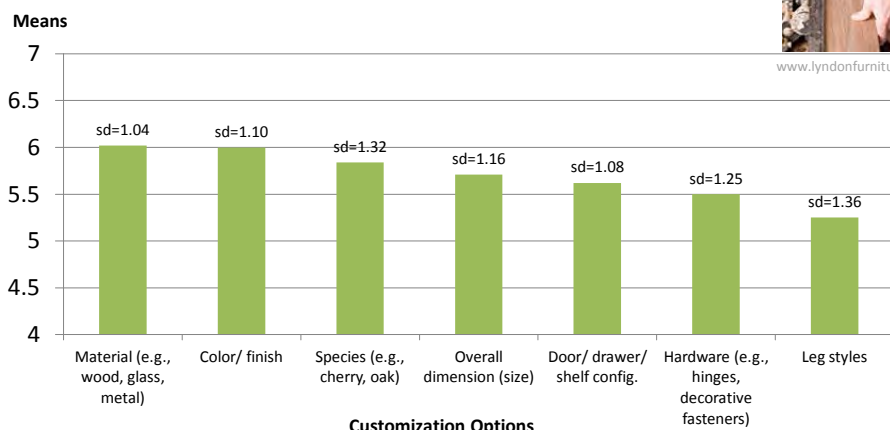
www.capmercer.com

Locally-Made Furniture Purchase Price



23

What Customization Options are Important in Wood HH Furniture Purchase?



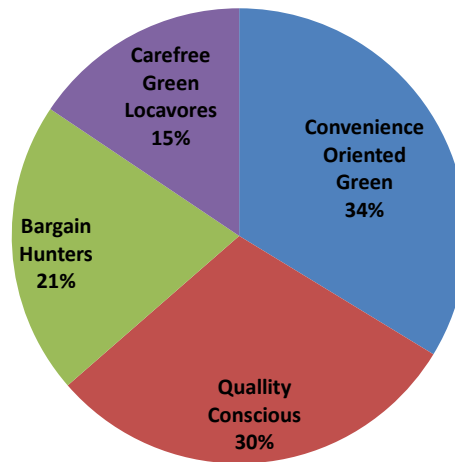
1-7 importance scale, 7= most important, 1= least important

24



www.lyndonfurniture.com

Consumer Segmentation: Segments for Wood Household Furniture Purchase



Cluster analysis was done using SPSS

Consumer Segment 1: Bargain Hunters (21%)

Characteristics of the Segment

- Price is the most important factor in purchase of wood HH furniture
- Also care about ease of use but don't care about quality, service or durability
- Have no preference for origin of furniture or customization options
- Least environmentally conscious segment of consumers
- These consumers are impulsive and risk takers
- Indicate that wood hh furniture made in US is mass produced



Demographics:

- 60% males
- More than 1/3rd buyers less than 35 years old

Consumer Segment 2: The Quality Conscious Buyer (30%)

Characteristics of the Segment

- These consumers care about quality, durability and appearance of products
- They do not care about convenience or service and are price neutral
- Prefer domestic made furniture more than other segments (more than 53%)
- Preference for green/environmental products and local purchasing is neutral
- Frequently purchase hh furniture (60% purchase every 0-5 years)



Demographics:

- 60% males
- More than 40% earn \$100k
- About 40% 55 years and over

Consumer Segment 3: The Convenience Oriented Green Buyers (37%)

Characteristics of the Segment

- Customer service and Ease of Use is very important to this group
- Do not care about low price or custom made products but prefer/show highest environmentally friendly products/ behavior
- 70% indicated they prefer neither domestic nor imported furniture
- Prefer to purchase local products
- Very thoughtful in their purchases and are risk averse



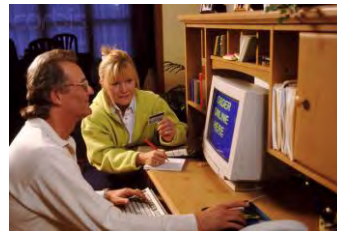
Demographics:

- Split gender
- A quarter each belong to less than 25 years and 55-64 years age group
- 40% earn more than \$100k

Consumer Segment 4: The Carefree Green Locavores (15%)

Characteristics of the Segment

- No other attribute as important as local purchase and customization of products
- Prefer green products (second to segment 3)
- Prefer domestic wood HH furniture over imported (64%)
- Are risk averse group and do not care about cost



Demographics:

- More than 60% females
- Primarily 45-64 years of age (48%)

Conclusions

- Segments of customers with different value perceptions
 - Segment 2 is more environmentally conscious
 - Segment 3 is more locally oriented and customization savvy
- Half of the respondents don't care about the origin of furniture (but are favorable to US-made Label)
- Environmental friendliness: Indoor emission, Legal sourcing
- Local sourcing as important
 - Promotion based on local sourcing should focus on helping communities and jobs
- Almost all customization options perceived important by consumers; most important is the type of material (wood, metal) and color

Updating needs in advertising and promotion

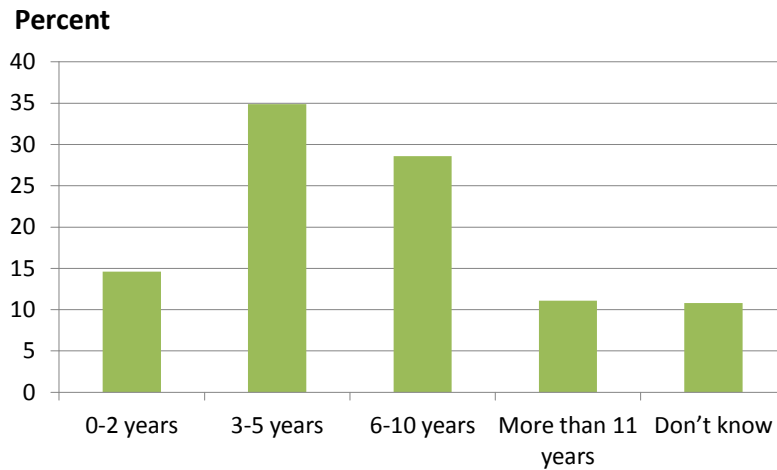
- There is room for anyone to stand out from the crowd with ads that engage consumers
- All or any of the four concepts could be promoted to the appropriate audience (segments)
- Price, appearance and durability is still the most important (and need to be emphasized)

31

Questions

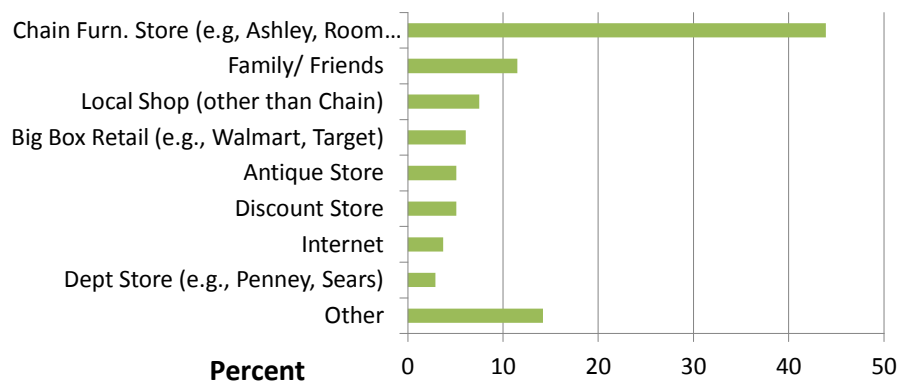
32

How Often Do (Would) You Acquire Furniture?



33

Where Respondents Purchased their Last Piece of Furniture



Other includes: Thrift store, auctions, garage sales, etc.

34

- **Discretionary income drives furniture purchases**
- On average, a person's discretionary income generally peaks around \$35K at age 45-54, and then tapers off sharply after the age of 55, hitting \$18K at age 65-74. Similarly, people's furniture needs start off very high at age 18-34 as living spaces are being created. Those who are still trading up at age 45-54 tend to be the highest-spending group, and then those needs taper off for a number of reasons: kids leave, couples downsize, etc.

35

Factor Analysis of Attributes

Variance explained: 66%

Importance of Purchase Attributes of Wood Household Furniture	Factors				
	Aesthetics	Eco/Local Attributes	Service/Trust Attributes	Ease of Use	Cost to Consumer
Color	.818				
Appearance	.784				
Size	.684				
Finish	.648				
Environmentally-Friendly		.842			
Locally-Sourced		.837			
Customized		.562			
Customer Service			.738		
Geographic Brand			.732		
Already Assembled				.853	
Ease of Use				.636	
Price					.811
Warranty					.571
Maintenance					.476

Geographic Branding

- Recent marketing studies indicate that branding strategies focused on geographic origins of a product can provide opportunities for **differentiating products** (Agarwal and Barone 2005)
- Producers are able to generate **price premiums** especially if actual quality differences exist that are attributable to geographic origin
- Geographic brand identifiers also allow for a product offering to create an **“exotic” image** which enables the producers to gain a price advantage

Branding

1. 37

Two Types of Branding

- **Company Branding (Examples)**

HICKORY CHAIR


 Stanley
FURNITURE

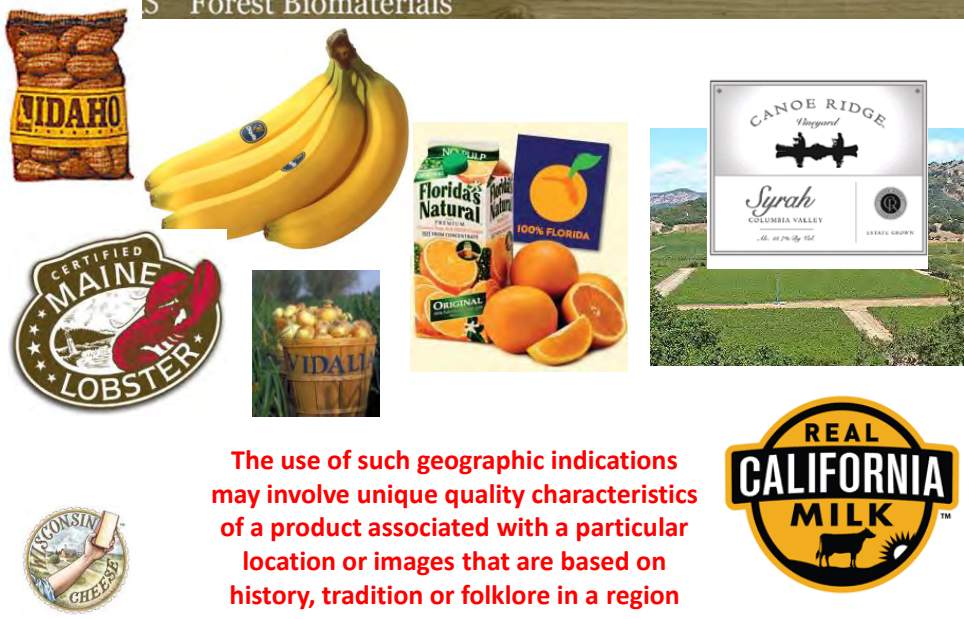

 ASHLEY®
FURNITURE INDUSTRIES, INC.


 Thomasville®

- **Geographic Branding-Regional (Examples)**

- Northern Forest Brand
- Vermont Quality WP
- Maine Made-America's Best
- The New Hampshire's Own
- Appalachian Hardwood
- Minnesota Wood Campaign
- New Zealand Pine

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The use of such geographic indications may involve unique quality characteristics of a product associated with a particular location or images that are based on history, tradition or folklore in a region

Branding 1. 39

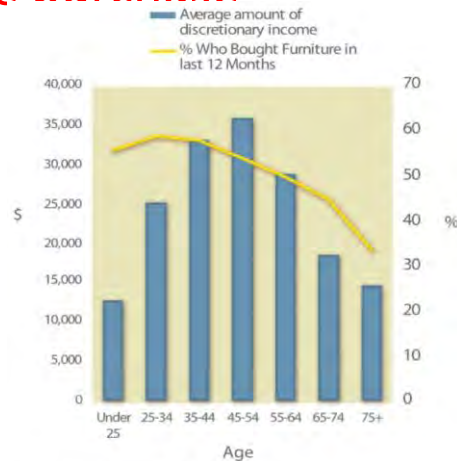
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Key Trends in Furniture Industry

- Major drivers:
 - Discretionary income** It peaks around \$35K for the 45-54s, and then tapers off sharply after the age of 55, hitting \$18K for the 65-74s.
 - New home sales plummeted** 18% in 2006 and another 26% in 2007. If the average new home included \$10,000 in furniture (a very conservative estimate), the amount of "lost" furniture sales would have been \$1.3 billion in 2006 and another \$2.8 billion in 2007. This accounts for much of the deceleration in growth during this period.
 - As consumer research shows, 18-34s are the most likely to buy any furniture, but the 45-54s spend the most. Young adults are willing to spend a larger percentage of their income on furniture as they start homes and build families.

40

Households with discretionary income (2000) compared to incidence of furniture purchase



Source: Simmons NCS/Mintel/American Income, New Strategic Publications

41

Consumers not engaged for such large purchases

- Lifestyle—consumers at various lifestyles have varying furniture needs based on price, style, and type. The aspects of lifestyle that are most important are gender, age, the presence of children, and income.
- Although their discretionary income is still low, young couples and young families are more likely to buy furniture than any other group—they are the highest-volume buyers due to frequent moves and/or starting a new home and family.
- Style—fully 30% of customers say that they don't do research before going furniture shopping, thus suggesting that their in-store experience will drive the sale.
- Of the many methods of research and sources of information that people have at their disposal prior to buying furniture, "family and friends" is by far the most frequently relied upon, at 35%. Accordingly, there is a need for marketing that makes an emotional connection with consumers, rather than simply providing information.
- People buy furniture in a wide variety of different retail channels—in the past two years, 43% bought from stand alone furniture stores, 28% from mass merchants, 22% from value or discount stores, and then ten other channels garnered between 7% and 15% of consumers. The average respondent (who bought any furniture at all) bought from 2.2 different channels.
- Income combines with age to act as the main influencers on where people buy furniture.
- Decision-making—most people take their time when making significant furniture purchasing decisions, but shopping styles vary. Roughly a quarter of respondents chose each of the following lengths of time that it took them to decide what to buy: little or no time; a week or less; two or three weeks; a month or more.
- Decision-makers—young people take less time than older people, men take less time than women, and wealthier people take much more time than those that are less affluent to make a furniture purchasing decisions.
- RTA furniture is popular among consumers, regardless of their income bracket.
- The older the consumer, the less willing they are to embrace RTA furniture.
- Hispanics are most likely to buy RTA furniture, followed by the black and white demographics, respectively.

42

Session 10

[Thursday 4th period 2.0 hours Main Hall]

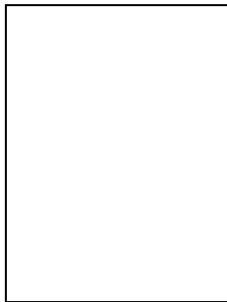
Wood product and industry development in the formal sector

Speakers



Speaker:
Jegatheswaran Ratnasingam

Topic:
Sustainable Wooden Furniture Manufacturing in Malaysia: The Role of Industrial Clusters



Speaker:
K Satyanarayana Rao

Topic:
Promoting Technology Based Processing and Utilization by Small and Medium-Sized Enterprises (SMEs) – The Key to Developing Wood as a Sustainable Material in India



Speaker:
Shengfu Wu

Topic:
The Struggling Chinese Woodworking industry: Challenges and Solutions



Speaker:
Arif Nuryawan

Topic:
The Description of Marketing Mix at Three Level Furniture Industries in Medan area, North Sumatra, Indonesia

Sustainable Wooden Furniture Manufacturing in Malaysia: The Role of Industrial Clusters

Jegatheswaran Ratnasingam¹

Abstract

The Malaysian forest products sector provides employment for about 400,000 people, while contributing almost US\$ 5 billion in foreign exchange earnings over the last several years. Although the production inputs, such as raw materials and labor, have experienced cost increments over the years, the industry has been able to retain its competitive edge, especially in the furniture manufacturing sector. The Malaysian furniture industry has emerged as the fastest growing sub-sector in the forest products sector, and continues to record impressive 20% annual growth over the last decade. With almost 3500 furniture manufacturing enterprises operating in the country in 2010, the furniture sector provides employment to a total of 87,000 workers. The unique industrial structure, organized within industrial clusters, has been able to keep the overhead costs significantly low, while at the same time providing the much needed flexibility in term of product diversity and volume production. This flexibility of the industry is derived from the small and medium enterprises, which make up about 85% of the total manufacturing enterprises, which are focused on specific operations, hence providing much needed economies of scale to ensure cost competitiveness. On the other hand, these small and medium enterprises operate as a single manufacturing unit, supporting a few large enterprises that are engaged in the marketing and product development activities. The large enterprises also serve as creditors to ensure a continuous financial line that will enable the small and medium enterprises to secure the required production inputs at competitive prices. Although successful industrial clusters can be found in many other nations such as Italy and Taiwan, the Malaysian furniture clusters are unique in the sense that the small and medium enterprises are often start-ups of larger manufacturing enterprises, which ensures that the small and medium enterprises are able to cope up with the quality and production requirements of the large enterprises. In essence, the Malaysian furniture clusters have not only been able to develop the booming furniture industry in the country, but it has also contributed significantly to the development of entrepreneurship in the rural economies of the country.

Keywords: Forest Industry Cluster, Furniture Industry, Entrepreneurship, Product Diversity, Development Economics

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1. INDUSTRIAL CLUSTERS IN PERSPECTIVE

Industrial clusters throughout the world have contributed towards industrial development (Scott, 2006), and many studies provide evidences in support of the multiple roles played by such clusters (Iammarino and McCann, 2006). It is a well established fact that industrial clusters have also driven the rapid expansion of industrial outputs in many instances, and this is especially true in labor-intensive and resource-based industries, such as wood products manufacturing. In this context, this paper provides an insight into the development and contribution of industrial clusters in the forest industry in Malaysia, particularly the furniture sector, which has emerged as a strong and resilient industry within a period of just over two decades. The paper also elaborates on the characteristics of the furniture cluster, and also its direct and indirect contributions towards industrial development and overall economic growth.

2. AN OVERVIEW OF THE MALAYSIAN WOOD-BASED SECTOR

The Malaysian wood-based industry has emerged as the second most important commodities sector in the country after the oil palm industry. With export values of US\$ 5.61 billion in 2010, the sector plays a dual role, of a large foreign-exchange earner as well as an important provider of employment. As of 2010, the total number of workers employed in the sector was close of 347,000.

Over the years however, the export constituents of the Malaysian wood-based industry has changed dramatically. From being a large exporter of primary commodities, such as saw logs, sawn timber and plywood, the industry has been transformed to become a large exporter of value-added products, such as furniture, molding, joinery, etc. In this context, it must be emphasized that the Malaysian furniture industry has become the leading sub-sector within the wood-based industry.

Since 1985, the Malaysian furniture industry sector has been growing steadily. Within a period of two decades, the furniture industry has grown to become the star performer of the Malaysian wood-based sector. From its humble cottage-industry background in the early 80's, the furniture industry has grown to become a very important socioeconomic sector. From an export of US\$ 6 million in 1982, furniture exports breached the US\$ 2.5 billion mark in 2008. Against this background, it is no surprise that the Malaysian furniture industry has emerged as one of the top-10 most important furniture exporters in the world (Ratnasingam and Thomas, 2008). Despite the globalization of the furniture industry and the emergence of many other furniture producing nations, Malaysia's resilience in the furniture manufacturing sector is attributed to the strength of its furniture clusters, which account for almost 65% of the total furniture output of the country. In this paper, the success of the Malaysian furniture industry is critically evaluated from the perspectives of the furniture industry clusters, with the aim of highlighting the best practices for possible emulation elsewhere.

3. THE MALAYSIAN FURNITURE INDUSTRY – IT’S DEVELOPMENTAL PHASES

The development of the Malaysian furniture industry could be traced back to three distinct stages (Ratnasingam and Tan, 2002), as elaborated below.

3.1 Pre Industrial Master Plan Stage

In the early 80’s, Malaysia was a large exporter of commodities, primarily sawn timber and plywood. In realizing the potential earnings of the wood-based sector, the government embarked on an industrialization strategy, which focused on the export trade.

3.2 The 1st. Industrial Master Plan Stage (1986 – 1995)

The First Industrial Master Plan (1986 –1995) was aimed at enhancing down-stream wood processing activities. The government provided numerous fiscal incentives and policy instruments aimed at spurring such activities, particularly amongst up-stream activity players. The annual growth rate during this stage was in the range of 40%.

3.3 The 2nd. Industrial Master Plan Stage (1996 – 2005)

The export oriented growth continued into the Second Industrial Master Plan, but the focus had shifted towards the manufacture of export of greater value added furniture. Nevertheless, the annual growth rate during this stage declined to about 15%, as the industry gained greater maturity.

Recently, the Malaysian government had introduced the 3rd Industrial Master Plan (2006 – 2020), which focuses on ensuring global competitiveness of the Malaysian industrial sectors through innovation, and the furniture manufacturing industry has been targeted as one the resource-based industries that would embark on such a growth path.

4. INDUSTRIAL GROWTH DRIVERS

The growth drivers of the Malaysian furniture industry have been well researched (Ratnasingam and Thomas, 2008), and are elaborated below.

4.1 Raw Materials Supply

Factor endowments, particularly the ample availability of raw materials has been hailed as one of the most important success factors. Yet, the competitive edge derived from the raw materials has been steadily diminishing over the years.

Rubberwood

Rubberwood (*Hevea brasiliensis*) is the most important raw material for the furniture industry in the country. A plantation resource, it is environmentally friendly and is therefore an attractive renewable resource for furniture making. There are about 1.3 million hectares of land under Rubber cultivation in the country, and the supply of Rubberwood sawn timber for the furniture industry is in the range of 350,000 m³ per annum. However, the price of the

wood has risen from US 150 per m³ in mid 80's to US 445 per m³ in 2010. Nevertheless, Rubberwood furniture accounts for 80% of the total wooden furniture exports from the country. In order to ensure consistent supply of the material to the furniture industry, an export levy on sawn Rubberwood (US 32 per m³) and an annual export quota of 30,000 m³ has been enforced since early 2000.

Other Materials

The export of furniture made of other materials such as rattan, bamboo, metal, plastic, etc. is small and contributes about 20% of total furniture exports from Malaysia. Although rattan and bamboo grow naturally in Malaysia, its supply and future availability remains a concern.

4.2 Labor

The availability of a cheap workforce has often been cited as another of the success factors of the furniture industry in Malaysia. This was the case previously, but with the rapid industrialization in the country, the cost of labor has risen steadily. In 1986, the labor rate was US 1.50 per day, while in the 2010, it has risen to US 10.30 per day.

Workforce Composition

Due to the rapid expansion of the Malaysian furniture industry, the use of foreign workers (predominantly from Bangladesh and Indonesia) has become inevitable. In the year 2000, 43% of the workforce in the furniture industry consisted of foreign contract workers.

Labor Productivity

The inherently low entry barrier coupled with the extensive use of foreign workers in the industry has made the workforce in the Malaysian furniture industry characteristically mobile. Under such circumstances, labor productivity has stagnated over the years at a level of about US 25,000 per worker per year. It must be emphasized that the Malaysian furniture industry is essentially a low wage economy, which is not attractive to the more stable local workforce (Ratnasingam and Ioras, 2003).

Human Resource Development

Against the need to create a skillful local workforce, the government established the Human Resource Development Fund (HDRF) in 1993 and subsequently the Human Resource Development Council (HDRC). Both these initiatives were aimed at producing skillful local workforce for the furniture industry. Employers were required to make a mandatory contribution of 1% from the payroll to the fund, which is then used, for training the workforce (Ratnasingam, 2003). Nevertheless, the effectiveness of the development program has not been up to mark due to the reluctance of employers to send their workers for training due to limited contractual obligation and the non-relevance of the training programs offered.

4.3 Capital Out-Lay

The rapid growth of the Malaysian furniture industry has been driven by incremental capital inputs, an indisputable fact which is well documented in several studies (Porter, 1998; Scott, 2006; Ratnasingam and Thomas, 2008.; Roveda and Vecchiato, 2008). This is further attested

by the number of furniture manufacturing enterprises, which has increased from 148 in 1982 to almost 3500 in 2010.

Domestic Investment

Domestic investment is high in the furniture industry and stands at about 70% of total investment.

Foreign Direct Investment (FDI)

Foreign investment in the furniture industry was equal to about 30% of the total investment, and investors from Taiwan and Singapore are the biggest players. Liberal government policies together with encouraging investment packages have promoted relocation of manufacturing bases to Malaysia.

4.4 Technology Application

The level of technology employed within the Malaysian furniture industry is on par with other furniture manufacturing countries, with almost USD 35 million in technological investments takes place annually (Ratnasingam and Thomas, 2008).

4.5 Government Policies

The role of the government in the development of the Malaysian furniture industry is very significant and cannot be downplayed. In fact, it is argued that government intervention has been the other main growth factor, apart from factor inputs, driving the furniture manufacturing industry

Political and Macroeconomic Stability

This conducive political climate is a boost for investors and the manufacturing sector as a whole.

Tariff Protection

Imported furniture and furniture parts were subjected to an import duty of 28% in mid 90's but gradually this has been reduced to 0% in line with the Asean Free Trade Area (AFTA) requirement.

Financial Incentives

The financial incentives provided to the furniture industry are very good and have been cited as one of the main reason for the rapid expansion of the furniture industry in the country.

Public Deliverables

The government has also delivered public goods, such as education, health, etc. to ensure the socioeconomic development of the society in the whole.

Infrastructure

Infrastructure such as kiln drying facilities and finishing centers have been established in furniture villages to encourage the growth of the furniture industry in the vicinity.

Gazetted Industrial Estates for Furniture

Industrial estates or furniture villages have been established throughout the country to aggregate the fragmented furniture manufacturers in a specific location, in order to ensure local synergy and networking.

Against this background, it is apparent that the growth of the Malaysian furniture industry has been driven by factor inputs as well as favorable industrial policies, both of which resulted in rapid industrial expansion. Nevertheless, the argument that industrial growth would be unsustainable due to increasing competitive pressure from other cheaper furniture nations in the Asian region has not held true. This is primarily due to the strength within the industrial structure of the furniture industry (Iammarino and McCann, 2006; Callois, 2008; Beerpoot, 2008)

5. INDUSTRIAL STRUCTURE

The Malaysian furniture industry is highly fragmented, and is predominantly composed of small and medium enterprises (SME). In 2010, only 134 mills were classified as large manufacturers, while the remaining was classified as SMEs.

Small and Medium Enterprises (SMEs)

The predominance of SMEs in the Malaysian furniture industry is very significant. Nearly 85% of the furniture manufacturers in Malaysia fall into this category.

Large Manufacturers

About 15% of the furniture manufacturers in the country are large manufacturers, but they contribute 65% of the total industrial output (large manufacturers are those employing more than 100 workers and with an investment of more than US 2.5 million).

6. CLUSTERS IN ACTION

The rapid expansion of the furniture manufacturing base has been attributed to the extensive networking or sub-contracting activities prevailing in the industry. Such a practice enables economies of scale and a spread of overhead, which enables cost competitiveness. Furthermore, it allows a high degree of flexibility, both in product diversity and production volume, in short manufacturing cycle-time. This network forms the furniture clusters, and among the notable furniture clusters in Malaysia are Muar, Klang Valley, Bukit Rambai, Ipoh and Sg. Petani.

Nevertheless, the most successful furniture cluster in Malaysia is located in Muar, in the southern state of Johor (Figure 1). The Muar furniture cluster is composed of predominantly

ethnic Chinese furniture manufacturers. Among the 387 furniture manufacturers, there are 34 large manufacturers located in this furniture village, while the rest are small and medium enterprises (SME) offering sub-contracting services. This furniture cluster contributes 40% of the total furniture export of the country. The reasons for the success of the Muar furniture cluster are:

1. Close proximity to the Rubberwood resource
2. Close proximity to the Johor and Singapore Ports
3. A large pool of experienced carpenters, as most of the factories in this area are family-owned and have been in the business for more than 20 years.
4. Close proximity to Singapore, which is the regional center for machinery and fitting/hardware suppliers
5. Good Infrastructure

The Muar furniture cluster has made tremendous contributions towards industrial development and entrepreneurship (Ratnasingam and Thomas, 2008). Since 2005, the Muar furniture cluster has transformed itself into a model that resembles the highly successful furniture cluster in Kaoshiung in Taiwan. The greater supply flexibility and product diversification adopted has resulted in the strengthening of the supply chain within the Muar furniture cluster. In this respect, it is regarded as a highly successful industrial area, outside the government-gazetted industrial free-trade zones. Therefore, the Muar furniture cluster is unique and warrant an in-depth analysis.

The Muar furniture cluster not only provides for economies of scale, but it also allows product diversification. As a result, the value chain within the cluster is being extended beyond the mere supply of semi-finished parts and components, but it also indulges into design and new product development. The fact that the industrial network is not client-specific, allows the network to carry out a variety of tasks aimed at creating competitive alliances. Furthermore, the cluster is composed of several layers of entrepreneurs, which acts as a 'training platform' for entrepreneurship. The main characteristics of the Muar furniture cluster are shown in Table 1.



Figure 1: Map of Malaysia

Location of Furniture Clusters: Muar ● , Klang Valley ● , Ipoh ● , Sg. Petani ●

Although the industrial integration within the Malaysian wood-based industry has been somewhat limited due to the state intervention practices, the Muar furniture cluster has been able to overcome this shortcoming. The establishment of a sawn timber depot in the nearby town of Batu Pahat ensures continuity in wood supply. Further, the supporting network of accessories and machinery suppliers have also expanded to an extent that the furniture cluster is more or less self-reliant in fulfilling its needs. Moreover, a private training institute established solely by the manufacturers ensures that skilled workers are trained to meet their requirements. In essence, the Muar furniture cluster has emerged as a model of success within the Malaysian wood-based industry, not only as a furniture production hub, but also as a training ground for potential entrepreneurs.

Table 1: Comparative Characteristics of the Muar Furniture Cluster

Feature	1995	2010
No. of Large Enterprises	15	39
No. of SMEs	197	383
No. of Skilled Carpenters	< 50	> 200
No. Tooling & Machinery Suppliers	n.a.	14
No. Fittings/Hardware Suppliers	1	6
No. Packaging Suppliers	2	9
No. of Finishing Centers	n.a.	6
No. of Finish Suppliers	3	11
No. Technical/Training Centre	n.a.	1
No. of Prototyping/Model Making Centre	n.a.	5

7. BENEFITS OF THE FURNITURE CLUSTER

The role of the Muar furniture cluster in the development of the Malaysian furniture industry cannot be downplayed. Many initiatives and programs have been put in place by the furniture cluster to ensure the continued competitiveness of the industry and among the notable programs:

- (1) The organization of the Export Furniture Exhibition (EFE), an annual furniture exhibition organized in simultaneously with the Malaysian International Furniture Fair (MIFF). The EFE charges a lower exhibitor's fee, which essentially caters for the many furniture manufacturers who are unable to bear the high exhibition cost incurred by participation in the MIFF. In recent years, the number of trade visitors to the EFE has increased significantly, and its sales have also doubled. In essence, the Muar furniture cluster has also formed a marketing platform of its own, to cater for the needs of its network members.
- (2) The furniture cluster also sets aside a sum of US\$ 5 million per annum to support collaborative applied research with research organizations in the country, which will offer technical support to the manufacturers.
- (3) The furniture cluster also holds regular dialog sessions among its network members to address issues of common interests as well as serve as a forum for information exchange. In fact, the dialog sessions also cover aspects, such as finance, marketing, inventory, product development, etc., all of which has a strong bearing on the competitiveness of the cluster.
- (4) The Muar furniture cluster serves as a training ground for potential entrepreneurs, and it has been reported that between 2005 and 2010, a total of 53 furniture entrepreneurs were created through the activities of this cluster. In some ways, the cluster not only provides employment to the local people, but also promotes entrepreneurial spirit among the local population, which in turn promotes further empowerment of the available human resource.
- (5) The furniture cluster also enhances the livelihood of the local community, as almost 63% of the local population in the area of Muar is employed directly or indirectly in the furniture manufacturing sector. In fact, the cluster serves as a large potential employer of the local workforce, which in turn improves living standards among the local population.

On account of this, it is apparent that the Muar furniture cluster has contributed significantly towards the development of the Malaysian furniture industry over the years, and its future competitiveness will also pave the way for the sustainable growth of the furniture industry in the country. The presence of industrial clusters within the wood-based industry has not only enhanced the industrial competitiveness, but also the resilience of the industry to face global challenges (Achibugi and Michie, 1997; Dunne, 2000; Ratnasingam and Thomas, 2008).

8. CHALLENGES FACED BY THE FURNITURE CLUSTERS

Among the challenges faced by the furniture clusters in Malaysia are:

1. The strong ex employer-employee loyalty exhibited by most sub-contractors which distorts competitiveness.

2. The focus on economies of scale production, which provides the lowest cost per unit, with little product diversification.
3. The low entry barriers into the industry have resulted in the presence of many sub-contractors who are essentially traders, creating intense domestic rivalry.
4. The value chain which is not extensive due to lack of diversification and innovation.

However, with the rapid globalization of the furniture industry worldwide, it is hoped that market forces will help shape sustainable industrial clusters for the future.

9. CONCLUSIONS

Despite the robust growth of the Malaysian wood-based industry in recent years, the competitive onslaught from other cheaper wood products producing nations in the Asian region may affect the competitiveness of the Malaysian industry in years to come. Nevertheless, the forest industry clusters, particularly the furniture clusters in the country, have created a competitive edge to face these challenges. The furniture cluster in the country has emerged as a self-sufficient industrial structure that not only contributes towards industrial growth and foreign exchange earnings, but also serves as a platform for developing potential entrepreneurs. Such an industrial development program is worth emulating in other countries to ensure a successful wood-based industry, both for the benefit of the people as well as the nation.

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DEVELOPMENT OF FURNITURE CLUSTERS IN MALAYSIA

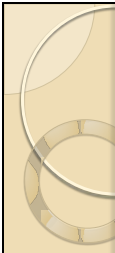
Jegatheswaran Ratnasingam

Faculty of Forestry,
Universiti Putra Malaysia

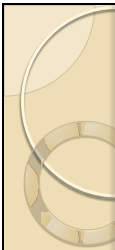
*Presentation at the conference "Rediscovering Wood – The Key to a Sustainable Future"
An International Conference and Exhibition on the Art & Joy of Wood,
Bangalore, India.
19 – 22 October 2011.*



INDUSTRIAL CLUSTERS IN PERSPECTIVE



- Industrial clusters throughout the world plays an important role in industrial development.
- Ample empirical evidence is available in support of this observation.
- In many nations in the developing world, industrial clusters are already at work in-directly.



- Industrial clusters have driven the rapid expansion of industrial outputs in many resource-based and labor intensive sectors in the developing world, such as the wood products sector.
- However, studies on industrial clusters in the wood products sector in this part of the world is lacking.



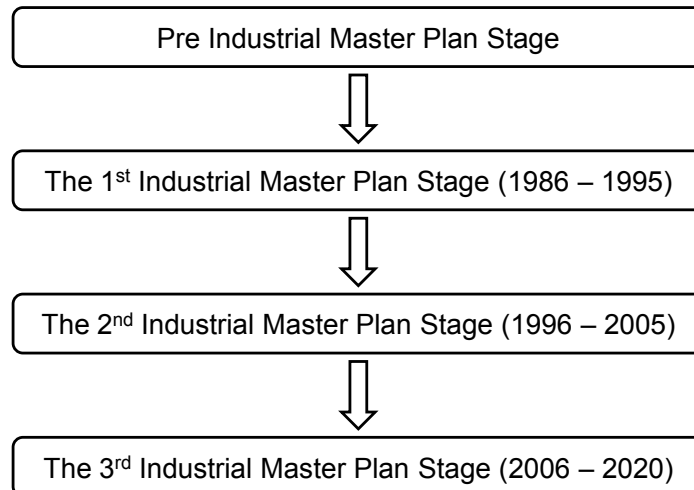
THE MALAYSIAN WOOD INDUSTRY

AN OVERVIEW

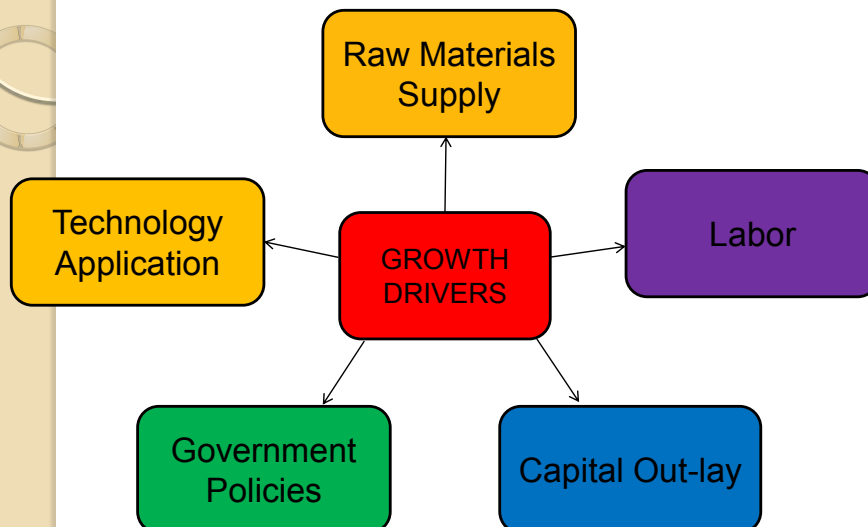
- 
- The Malaysian wood-based industry is one of the most important sub-sectors within the non-petroleum commodity sector.
 - It is second to the palm oil sector, and has replaced the rubber industry which has been a long standing economic powerhouse in the country.
 - It employs almost 347,000 workers and since 1985, the furniture sub-sector has emerged as the rising star.

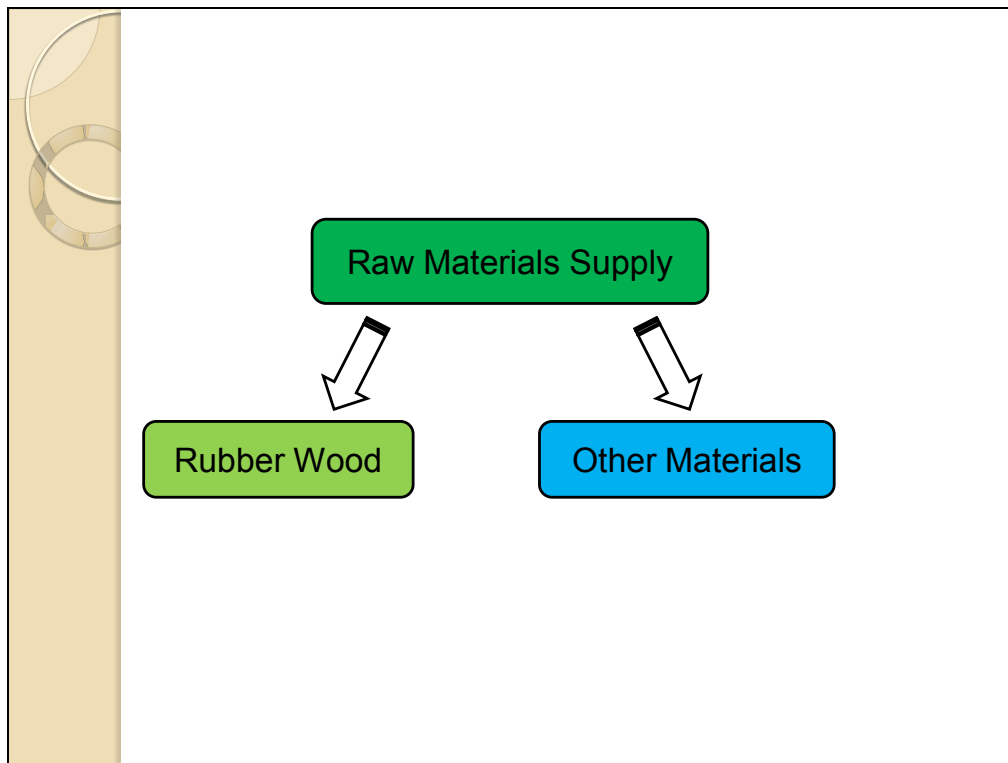
THE MALAYSIAN FURNITURE INDUSTRY

IT'S DEVELOPMENTAL PHASE



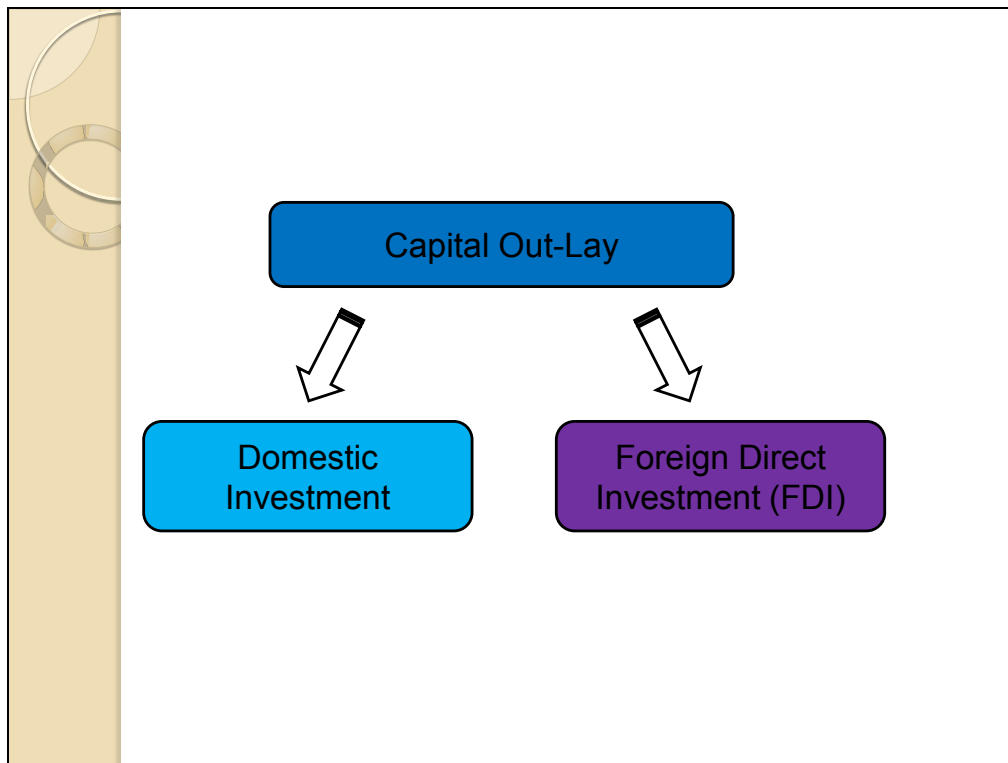
INDUSTRIAL GROWTH DRIVERS





Labor Force

- Workforce competition is increasingly stiff.
- 43% of workers are foreign-contract workers – highly mobile with low skills retention.
- Challenges faced with human resource development in the local scene.
- HRDF scheme aimed at training a pool of workers for the industry.



- Technology application is on the increase.
- Market size for technology absorption circa US\$ 50 million per annum.
- Net consumer of technology, little domestic development.

- 
- Government policies in support of industrial development.

1. Political and macroeconomic stability
2. Tariff protection
3. Financial incentives
4. Public deliverables
5. Infrastructure
6. Industrial estates

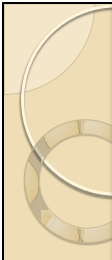


INDUSTRIAL STRUCTURE

- 
- Small and Medium Enterprises – 85% of the establishments.
 - Large Manufacturers – 15% of the establishments.
 - The top 50 manufacturers contribute almost 85% of total exports – skewed industrial structure.

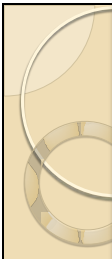


CLUSTERS IN ACTION



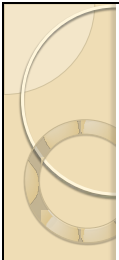
MUAR FURNITURE CLUSTER

1. Close to the wood resource
2. Close proximity to Johor and Singapore ports
3. Large pool of experienced carpenters – family-owned with > 20 years experience
4. Supporting industries and facilities well established
5. Good Infrastructure



Comparative Characteristics of the Muar Furniture Cluster

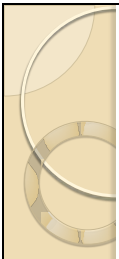
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No. of SMEs	197	383
No. of Skilled Carpenters	< 50	> 200
No. Tooling & Machinery Suppliers	nil	14
No. Fittings/Hardware Suppliers	1	6
No. Packaging Suppliers	2	9
No. of Finishing Centers	nil	6
No. of Finish Suppliers	3	11
No. Technical/Training Centre	nil	1
No. of Prototyping/Model Making Centre	nil	5



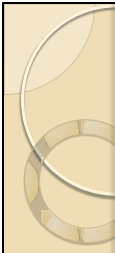
Others Clusters / Furniture Villages

- Sg. Petani
- Ipoh
- Klang-Valley
- Bukit Rambai

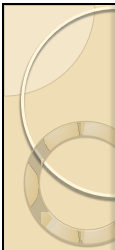
- Ulu Yam
- Taiping
- Setiu



BENEFITS OF THE FURNITURE CLUSTER



- The organization of the annual Export Furniture Exhibition (EFE).
- The furniture cluster also sets aside a sum of US\$ 5 million per annum to support trade and marketing activities.
- Well networked industrial hub.



The furniture cluster also holds regular dialogue sessions among its network members to address common issues:

1. Market potential
2. Raw materials supply
3. Labor issues
4. Training needs
5. Government liaison / industrial relation

- 
- Enhances the livelihood of the local community, where 63% of the available workforce is engaged in the furniture industry, directly or indirectly.
 - It is a training ground for future woodworkers.
 - It is a training ground for potential entrepreneurs.
 - It preserves the generation old tradition of woodworking.



CHALLENGES FACED BY THE FURNITURE CLUSTER

- 
- Strong ex employer-employee loyalty exhibited, which distorts competitiveness.
 - Focuses on economies of scale, with little product diversification.
 - Low entry barrier, creates intense domestic rivalry and supply elasticity for products.
 - Trading rather than manufacturing.
 - Value chain not well developed, lack of innovation and diversification.



THE FUTURE CHALLENGES



Raw Materials

- Very dependent on Rubberwood, almost 80% of all wood material consumption in the country.
- Production from natural forest expected to stagnate at about 8 million m³ per annum.
- Aggressive forest plantation schemes, yet to bear fruit!



Labor

- Interest in woodworking among locals relatively low – 3D syndrome.
- Low wage-economy – relatively 2.3% annual increment in wage – far below inflation rate
- Dependent on contract foreign workers – not sustainable!



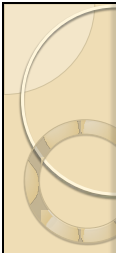
Capacity

- Perhaps a case of too much milling capacity chasing after too little resource!
- Evident supply elasticity – price point downwards spiral.
- Capacity utilization not optimum.
- Reinvestment low.

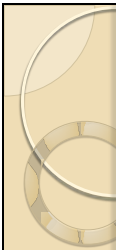


Policy Instruments

- Major force spurring the growth of the industry.
- However, facing limitation as industrial partnership is increasingly warranted but lacking!
- Innovation and creativity stagnating!



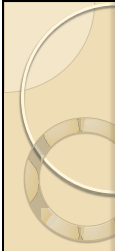
SUCCESS FACTORS IN THE FURNITURE INDUSTRY



Competitive inputs – materials
and workforce

Competitive business
environment

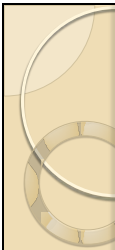
Stimulating and demanding
market forces



Market accessibility

Relevant R & D

**Technology, innovation and
creativity drivers**



**Thank you very much for your
attention!**

Promoting technology based processing and utilization by the small and medium-sized enterprises (SME's) - the key to develop wood as a sustainable material in India

K Satyanarayana Rao²

Abstract

The main thrust of Indian forestry policy thus up until now has been towards increasing forest cover, conservation, protection and management. Technology based plantations have been receiving some attention in recent years, especially in areas outside forests, but very little attention is paid to technology-based utilization.

India is essentially a timber deficit country with huge and ever increasing gaps between supply and demand. It currently imports timber from over 30 countries despite its rich floral wealth that include about 4000 wood-yielding species. Of great concern is the very low level of uptake of scientific processing and utilization, especially in the large number of saw mills, and manufacturing units in the small and medium sized category (SME'S), which form the backbone of the wood industry consuming bulk of the timber. It is in these units that much of the initial mechanical processing, seasoning and preservation are carried out. Improper processing techniques and low degrees of modernization in machinery and equipment have resulted in low quality product output. More importantly, many of the alternate species identified as suitable for different end uses by R&D Institutes in place of the traditionally preferred species whose availability has dwindled, continue to remain un-or under-utilized. Exports have become negligible, despite the country being bestowed with such sought after and valuable timbers as teak, rosewood, mahagony, padauk, sandal redsanders etc.

The situation clearly warrants immediate remedial actions if wood is to be developed and projected as a sustainable material in India and its full value realized in the current global scenario and the emerging opportunities presented by the revival of interest in this most ecological of all the materials we have.

In view of the importance and strategic positions they occupy, it is held in this paper, that SME's in particular merit special and immediate attention and support. These include the much needed and long awaited enabling policy support, backed up by effective regulatory and legal frame works. As technology up-grading requires incremental investments that these units often find hard to meet, financial and material incentives as well as some 'hand-holding' arrangements are needed to be worked out through innovative partnership models.

Also, attention is drawn towards two notable recent developments, one relevant to wood processing and the other concerning upskilling of technical manpower. These are:(1) the supreme court orders (2002) that led to enhanced production of preservative treated wood in Andaman and Nicobar Islands and (2) the establishment of an Advanced Wood Working Training Center(AWTC) at the Institute of Wood Science and Technology(IWST), Bangalore through an innovative Institute-Industry International partnership model. There is a great

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scope and need for replication of such initiatives.

Keywords: plantation timber, technology – based utilization, processing, wood preservation, institute-industry partnerships.

1. INTRODUCTION

The economic, cultural, social, aesthetic and environmental values of wood have always been recognized and acknowledged by Indian society. Its usage has withstood competition from an array of other materials - both traditional as well as modern. As can be seen by mounting demand, wood usage is continually expanding, contrary to incorrect perceptions in some quarters. There have been innumerable studies on the requirements of timber and fuel wood. Reports/Year books periodically brought out by organizations like the Forest Survey of India (FSI, Dehradun), Indian Council of Forestry Research and Education (ICFRE, Dehradun) Food and Agriculture Organization, (FAO, Rome, Italy), International Tropical Timber Organization (ITTO, Yokohoma, Japan) etc. are invaluable sources of information on the demand, supply, trade and related aspects. From time to time, specially commissioned studies have also been undertaken (Bajaj and Bhat, 1996; Anon., 2000; Sushil Saigal et al, 2002; IPIRTI, 2003 etc). Although estimates vary as methodologies differ, all these studies point out that demand far outstripped local supplies long ago and is continually increasing across almost all categories of end-uses. In a study commissioned by the Ministry of Environment and Forest (MOEF), Government of India (GOI), on forest Industries, the consultants involved (ChemProject Consultants Private Limited, New Delhi), reported the requirements of round-wood equivalent (r.w.e) to be around 58 million cu.m (against a production of only 29 million) in 2000, which is expected to raise to about 153 million cu.m by 2020 (Anon., 2000). The figures are much higher if the needs of rural households and fuel wood are also considered (estimated to be around 700 million cu.m that includes 560 million for fuel wood by 2010 itself). The recorded timber removals from natural forest has declined to as low as 1.9 million cu.m (FAO, 2005) which forms a very small percentage of total consumption. At present, the country is meeting 50 percent of requirements from plantations. Import regulations have been liberalized since 1997 and have become an important source of supply.

The forest product scenario has been witnessing marked changes during the last two and half decades. These include changes in the species composition of the raw material, logging bans following Supreme Court orders of 1996 & 1997, liberalization of wood imports in 1997, increasing sustainability concerns, life style changes and new trends in consumption, compliance with the standards and terms of the International Agreements and Treaties. In a recent paper, Satyanarayana Rao (2011) dealt with some of these issues. In an earlier paper, he had also drawn attention on the changing role of Forest Products R&D Institutes in India (Satyanarayana Rao, 2003).

It is in this context that the present paper seeks to examine the main issues involved in promoting wood as a sustainable raw material and retain its prime position as a favoured material in the Indian ethos.

Considering the importance of plantation wood (agri – wood, JFM - wood, Juvenile wood, bamboo wood etc.) in the current and emerging scenario, and the imperatives of value added scientific processing and utilization, special attention has been paid to the factors involved in low levels of technology absorption – a matter of serious concern. Also presented are experiences with two recent initiatives relating to improved wood utilization, acclaimed by the industry and other stakeholders.

2. ISSUES INVOLVED IN PROMOTING WOOD AS A SUSTAINABLE MATERIAL IN INDIA

2.1 Enhancing the domestic resource base through plantations / afforestation

The National Forest Policy 1988, (GOI, 1988) envisages increasing forest / tree cover to 33% of the land area. Plantation activities have been one of the focal areas of Indian Forestry programmes right from the First five year plan (1951-56). These had been undertaken under various afforestation programmes like social forestry, farm-forestry, agro-forestry, energy plantations, national wasteland development and in recent years, participatory management programmes like the Joint Forest management (JFM). A 'Green India Mission' launched in 2011 is currently in operation. In order to realize the objectives of the National Forest Policy 1988, an additional 33.60 million ha. have to be brought under forest / tree cover to green 33% of the land area (estimates in 2008, Behari, 2008). This is truly a challenging task when it is considered that the cumulative area of forest plantations achieved from 1951 to 1999 (covering 9 five year plans) is around 31.20 million ha. Timber supplies to forest based industries have ceased from 1988 following government orders and major companies involved in paper / pulp production, plywood manufacturing and match-splint production have geared up to raise their own supplies through innovative arrangements on private lands. Their contributions to technology-based plantations, (especially clonal technology) have been commendable. Encouraging though these developments are, two aspects of the plantation programme are of concern/relevance to the wood industry. (1) In earlier times, plantations were intended primarily to meet industrial requirements and were largely mono-cultural. Since 1970's, timber production is only one of the multiple objectives of this programme. (2) Given the very nature of end-use requirements, plantations have more crucial contributions to make for the paper and pulp industry and certain types of panel products and match wood manufacturing in the short/mid-terms (10 to 20 years). The benefits can be expected to reach the large mechanical wood industries utilizing sawn-wood only after a much longer time.

2.2 Imports

With a view to reduce pressure on natural forests and to augment immediate supplies, the Government of India, as a major policy initiative, permitted wood imports by placing it under the 'Open General License' (OGL) category (which is called 'Free' now) in 1996. Since then, imports have been steadily increasing from 5.7 million cu.m during 2000-01 to 6.5 million cu.m by 2004-05, and has currently reached the 10 million cu.m mark (source: Director General of Commercial Intelligence & Statistics, Ministry of Commerce & Industry, Government of India). The wood is imported from about 40 countries, main consignments arriving from neighboring South-Asian countries (Myanmar, Malaysia, Indonesia as well as from Africa, New Zealand, Canada etc.). The bulk of imports are in an unprocessed form-mainly as logs, as the tariff structure does not favour the import of processed wood and wood products. While the imports increase, concerns over the National 'forest foot print' (at the exporting countries) are already being raised, which may lead to demands on utilization of 'certified timber' from sustainably managed forests. (Yadav et.al 2008; Manoharan 2007). India is also a signatory to the 'Sanitary and Phyto Sanitary Agreement (SPS Agreement of the World Trade Organization (WTO). Satyanarayana Rao and Rema Devi (2004) conducted a detailed study on the implications of this Agreement on the import of timber into the country and identified steps to be taken to comply with the standards specified in the SPS agreement. Usage of 'certified timber' and compliance with the provisions of SPS agreement might impact the price structure of wood supplies.

2.3 Technology generation (R&D) and Technology Absorption

India has a rich forest product research tradition dating back to 1906, when the Forest Research Institute (FRI) was established at Dehradun and is credited with quality research output on diverse aspects of wood properties, characteristics, processing, utilization etc. Research funding has improved in recent years, but still constitutes a very low percentage of allocations to the forestry sector. Besides the FRI (which has become a constituent Institute of the umbrella organization – the Indian Council of Forestry Research and Education (ICFRE, Dehradun) created on reorganization of the forestry Research in the country in 1988. Wood and forest product research is mainly pursued, apart from FRI, at the Institute of Wood Science and Technology (IWST), another ICFRE institute, the Indian Plywood Industries Research & Training Institute (IPIRTI), both located at Bangalore; the Kerala Forest Research Institute (KFRI) at Peechi, Kerala and the Central Paper and Pulp Research Institute (CPPRI) at Saharanpur, Uttar Pradesh. In addition to these Institutes, forest products and allied research is also being undertaken in a limited way, at the basic Science Universities, Engineering Colleges, Forestry colleges of Agriculture Universities, State Forestry Research Institutes etc., and in recent years, at the newly developed industrial laboratories in the private sector. A perusal of the achievements and progress made by these institutes (available as publications in scientific journals, periodicals, proceedings of seminars and conferences, annual reports, websites of the institutes, doctoral theses etc.), while reflecting the many ‘positives’ of the research part the programme, also indicate that important gaps exist in the ‘development’ part of R&D and more importantly, in the ‘Technology Transfer and Extension’ aspects. Research in marketing, social aspects and policy support have not received the attention they merit (Satyanarayana Rao, 2011). Even though the value of wood products is linked to quality, trendiness and aesthetics, design and finishing also did not receive the due attention as also product diversification. For instance, even though over thirty types of panel products are developed in the world market from bamboo, only a few are currently produced in India. As wood is increasingly being sourced from short - rotation plantations, several technological problems are required to be addressed specially during ‘processing’. Research / technological innovations needed for better utilization of such plantation sourced wood have been addressed in some recent documents like the National Forestry Research Plan developed by ICFRE, (NFRP-, (2000), reports of the National Mission on Bamboo Development (Anon., 2003a), Greening India through agro – forestry and JFM (Anon., 2003b) and in other publications (Bhat et.al 2008; Pandey et.al 2006).

It is a matter of serious concern that in spite of past and on-going efforts, the level of technology absorption has remained very low. Even well tested and easily available technologies are not used efficiently. The status of usage of treated wood and preservatives is an example of the glaring gap that exists in technology generation and utilization. India has developed some world renowned wood preservatives like the ‘Copper – Chrome – Arsenic (CCA)’ patented as ‘Ascu’, ‘Copper – Chrome – Boric (CCB)’, several treatment methods, besides generating impressive data on aspects like treatability (for over 100 species), durability (on land and under marine conditions - for over 300 species), in addition to devising various schedules for treatments etc. The International Research Group on Wood Protection (IRG), Sweden and other scientific bodies recognize preservative treatment as a strategy for ‘tree- diversity conservation’, ‘waste – minimization, and of late, as a mechanism to achieve higher ‘carbon lock-in-periods’. The United States of America (U.S.A) with a population of some 310 million is reported to be using over 50,000 tons of CCA alone, annually. In contrast, the sale figure from India (with a population of about 1.2 billion) of all preservative formulations put together, worked out to be just 2120 tons of CCA equivalent in

2000 indicating how far the absorption of this technology lags behind (Indra Dev and Bhojvaid, 2004). The situation becomes even more discouraging when it is considered that despite indications of internal rate of returns of up to 175 % on cost incurred (Bajaj and Bhat, 1996), simple, on-site, prophylactic treatments are also not undertaken even by high profile companies and departments. It is estimated that above 20-30% of harvested material is lost during transit or storage and it is not uncommon to see timber and bamboo decaying at the felling sites (forest floors) or at the mill sites (Kumar and Indra Dev, 1993).

The gap between generation, availability and absorption of technologies, though not of the same scale as in the case of wood preservation, is nonetheless conspicuous in other areas of wood technologies. All this leads to output of improperly seasoned, inadequately preserved timber, low recovery in sawmills, little value addition, low quality products and more importantly in the Indian context, non-utilization of a number of 'secondary' or 'lesser-known' species which have been found suitable by research for different end-uses, after following the recommendations. At present, even when such hitherto under-utilized species are put to use, recommendations are seldom followed.

While growing concerns over such negative consequences are expressed, effective mechanisms to remove the obstacles in technology transfer have not been evolved. Very few studies, in fact, have focused on understanding the impeding factors and offer solutions. Some of the recommendations aimed at improving the technology transfer scenario include: greater attention to development of product oriented technological packages and adoption of 'cluster approaches' at the Institute level, increasing inter-institutional co-operation to synergize the strengths, and more importantly, conduct research and develop tools to gain a better understanding of the ability of the users to absorb technologies (John Joseph, 2006; Katwal, 2004; Satyanarayana Rao 2003, 2011).

2.4 Wood industry, importance of 'processing' and the need to support Small and Medium sized Enterprises (SMEs)

Domestic trade of timber and other forest products is on a very large scale, but, due to lack of reliable data, is not properly reflected in the contributions of the forestry sector towards the Gross Domestic Product (GDP) (Behari, 2008). Trade is carried out at both the 'formal' (Industry) and 'informal' (Community) levels. The 'formal' industrial sector consists of two broad groups. All industrial units registered under section 2(m), and 85 of the Factories Act are considered as 'organised' sector. The 'unorganised' sector consists of units registered as 'small-scale' enterprises as well as all other unregistered units from the 'informal' category, operated by artisanal craftsmen, carpenters, traditional fishermen involved in manufacture of catamarans and various other types of fishing boats, toy manufactures etc, usually operating at the village level and producing subsistence products.

'Processing' is the dominant segment of the wood Industry, occupying a strategic position in 'promoting efficient utilization, thereby lending support to sustainable management of wood resources'. The benefits of sound practices in processing multiply as the processed wood moves downstream, stimulating a whole range of supporting activities and even other industries. In India, most of the mechanical wood-processing/seasoning, preservation, saw-milling etc is carried out by the large number of smaller units in the SME's category. Apart from the critical role they play in the technical aspects of utilization, they also contribute significantly to the broader social issues of generating employment to a large work force.

Development of the domestic wood processing sector is vital for the growth of the wood industry and its sustainable development. This assumes even greater significance in light of the fact that India is presently perceived to be rather poorly placed in the common 'ease of doing business' indices affecting investments. However, experience from other tropical countries suggest that 'successful processes are not created overnight' and have to be developed in phases. If nurtured properly, the processing industry can be even developed to become the designated managers of the planted wood resources (Tissari 2002; Tissari and Jaaskelainen, 2008).

Successful countries in plantation based industries have developed policies and sets of incentives to promote the growth of the processing and manufacturing industries. The phenomenal expansion of the furniture industry in Malayasia in the recent past has often been attributed to the enabling policies and abundant financial incentives provided to them. The government-led schemes such as offering of 'pioneer status', providing re-investment allowance, infrastructure and training allowance etc., have stimulated the local industry as well as attracting foreign investment. India could perhaps benefit from such examples and adopt appropriate measures to enable the wood processing industries to realise their potential.

Value added processing of the type required to utilize the increasing supplies of short rotation and small dimensioned plantation timber necessitate investments for upgrading of machinery and equipment and scaling up of operations. The units falling under the SME category in particular, already operate under challenging conditions with limited financial resources and require immediate support.

2.5 Markets

Wood is always in great demand in India. The Chemprojects study cited earlier (Anon., 2000) recognized 19 categories of end-uses for which a market already exists and the list is expanding with changing life styles and increasing incomes. The main focus has already shifted to more down-stream, scientifically processed and value-added products. Great scope exists for product diversification that can lead to increased market-created (creation of demand for new products) activity apart from the current market-led activities. This is, however, possible only with greater infusion of technology at various stages of operation, especially processing. The level of technology absorption has to be considerably scaled-up. 'Catching up' technologies may have to be imported where necessary. 'Technology leapfrogging' has been advocated to help the wood forest product sector to realize its potential. 'Certified' and 'eco-labeled' wood, and 'carbon credits' by achieving longer lock-in periods are seen as emerging opportunities in the world market. As of now, India does not have a certification scheme of its own. Only one forest certification (for rubber plantation in Kerala) and 4-chain of custody certifications (two in Jalandhar, Punjab, one each in Delhi and Mysore, Karnataka) have been reported in 2008 (Yadav et al 2008). A few other certifications are currently under way. As the carbon exchanges and certifications agencies are in the rich developed countries, the cost of availing their service is very high and cannot be availed unless operated on a scale to afford the cost (Chundamannil, 2008).

However, immense opportunities exist for developing quality products for high end- niche markets as the country is blessed with a large number of about 1500 tropical timber species in its floral wealth – some of them valued very highly in the international market – like teak, rosewood, mahagony, red sanders, sandal, padauk etc.

2.6 Policy and Institutional Frame Work

The main thrust of the policies of the Indian Forestry since the 1980s had been on increasing tree/ forest cover its conservation, protection and management. The National forest policy, 1988 (GOI 1988) has mentioned ‘development of substitutes to replace wood and wood products’ as one of the priority areas for R & D with a view to ease the pressure on wood resources which has led to some confusion and mis-interpretation as the policy also identified ‘utilization’ as another priority area. Subsequently developed programmes like the NFAP (1999), NFRP (2001), National Mission on Bamboo Applications (NMBA), Green India Mission (2011) etc. contain several projects and initiatives to promote utilization of planted wood, bamboo, canes, wood from non-forest areas as well as other ligno - cellulosic materials (for especially board production). The Bhopal-India (B-I) process a National initiative for developing criteria and indicators (C & I) for sustainable management of forest – initiated by the Indian Institute of Forest Management (IIFM), Bhopal, and revised in 2005 adopted ‘optimal utilization of resources as its 6th criteria (out of 8). While these are welcome developments, a road map is yet to be developed to achieve ‘technology-based utilization’ on the lines of the issue of ‘technology based production’. It is interesting to note in this context, that even during the time when ‘production forestry’ was encouraged, the focus was always on the ‘how much is produced and removed aspects’ rather than ‘how’ it is actually used.

The timber industry in India is mostly in the unorganized sector. For instance it has been reported that 95 percent of the furniture and joinery produced in the country is in the craftsman sector (Gauri Ramakrishnan, 2004). There is no effective regularity framework to monitor/ guide the industry. Incentives of the type provided in countries like Malaysia, are not available to the industry in India. The existing felling and transit rules as well as export / import regulations are seen as ‘disabling’ rather than ‘enabling’, by the Industry. An urgent need therefore exists for evolving a ‘National wood use policy’, with a focus on ‘promotion of technology-based processing and utilization’, which is voiced at several fora.

As can be seen from the forgoing account, a favourable operational regime for wood forest product sector does not currently exist in India. The situation clearly calls for innovative, even out-of-the box approaches and enabling governmental actions. Two developments in the recent past that have been acclaimed by the Industry as well as other stake holders merit special mention in this context. These are: (1) The supreme court orders of 07.05.02, based on the reports of a single member (Shri Shekhar Singh) commission on the “status of forest and other allied matters in Andaman and Nicobar Islands (ANI), “in a case relating to protection of forests of Little Andaman Island, that have led among other things, to increased production and sale of only treated timber in the A&N Islands. The wood preservation industry welcomed this decision and feel that such steps are needed to be taken by other states as well (Agarwal, (2004). (2) The setting up of an Advanced Wood Working Training Centre (AWTC) at IWST, Bangalore through an innovative industry-institute-international partnership model. This centre was developed as a joint project of ACIMALL (the Italian wood-working machinery and tools manufactures association, Milan, Italy), ICE (the Italian trade commission, an organization of the govt. of Italy which promotes Italian technology and products in different countries, and IWST, Bangalore (an R&D institute of ICFRE), in 2003. Details of the aims of the centre, its functioning and progress can be found in the website of the institute. ([http:// iwst.icfre.gov.in](http://iwst.icfre.gov.in)). Satyanarayana Rao (2004, 2011) dealt in detail the benefits of developing such public-private partnerships and innovative approaches to the wood industry in India.

3. CONCLUSION

India is a timber hungry country suffering from a timber deficit. The unmet demands on industrial timber and fuel wood have been well documented and are ever increasing. 'Producing industrial timber at an acceptable cost while promoting the critical environmental values' is a key challenge to Indian Forestry, as mixing of 'market' and 'non-market' objectives creates incompatibilities difficult to solve (Ganguly, 2000). The Government has embarked on a massive / afforestation / plantation programme in both Government and private lands to achieve the national objective of greening 33 percent of land area with tree/ forest cover. However, it is to be realized that this programme has multiple objectives. Given the nature of end-use requirements, benefits from this programme cannot be expected to reach the industry, especially the very large mechanical wood processing sector in the short (10 years) or mid-term (20 years). To meet the immediate demands, India has also liberalized its import regulations on wood since 1997. Although steadily increasing, imports may face problems on account of growing concerns over 'forest foot prints' (which may lead to demands for use of certified wood) and to follow global protocols required by international agreements like the SPS Agreement of the WTO. Both these may impact the pricing of imported timber.

In this scenario it is increasingly becoming clear that the promise, potential and opportunity for the wood product sector cannot be realized unless scientific utilization is promoted through the application of sound technologies, on a priority basis. Unfortunately, absorption of wood technologies is proving very complex, impeded by many factors. Some of the areas for improvement are presented and discussed in the paper. It has been noted that catalyzing and enabling the industry especially the processing segment holds the key to achieving technology-based sustainable utilization, as experiences from other developing countries with successful plantation based industries indicate. Processing is mostly carried out in India by a large number of SME's. In view of the strategic position they occupy, and considering the fact that they often operate under challenging conditions with limited financial resources, these units merit special attention for support.

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PROMOTING TECHNOLOGY BASED PROCESSING & UTILIZATION BY SME'S – THE KEY TO DEVELOP WOOD AS A SUSTAINABLE MATERIAL IN INDIA

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WOOD USE IN INDIA

- Economic, Cultural, Social, Aesthetic & Environmental values of Wood well recognized and imbibed in Indian Ethos
- Usage widespread, extensive and ***continually expanding***
- Demands across all categories of wood use far outstripping local supplies

ISSUES IN DEVELOPMENT OF WOOD AS A SUSTAINABLE MATERIAL

- Enhancing domestic resource base
- Augmenting supplies through imports
- Achieving resource efficiency in manufacture and use

ENHANCING DOMESTIC RESOURCE BASE

- Plantations/ Afforestation programmes
 - Massive target: about 33.60 m. ha. need to be brought under forest/tree cover
Area brought under all forest plantation programmes during 1951-1999: 31 m. ha.
- Benefits to reach only a few segments during short and mid-terms

WOOD IMPORTS

- Liberalized since 1996 (Placed under OGL)
- Steady increase
- Imports from about 40 countries

CONCERNS

- National forest footprints
- Demands for usage of “Certified Wood”
- Compliance with provisions of SPS AGREEMENT of the WTO

What Will Be The Cost ?

RESOURCE EFFICIENCY IN MANUFACTURE AND USE

- Technology generation and utilization
- R & D**
- Many positives
 - Century old forest product research tradition
 - Network of Research Institutes
 - Impressive research output
 - Several world class innovations

Contd ...

RESOURCE EFFICIENCY IN MANUFACTURE AND USE (Contd ..)



- Huge gaps between research output, availability of technology packages and technology absorption

- Are the problems entirely technological ?
- To what extent are we applying/utilizing available technologies ?

Contd ...

RESOURCE EFFICIENCY IN MANUFACTURE AND USE (Contd..)

- Technology transfer – the weakest link

Impeding Factors

- Lack of perception of the ability of target groups to accept technologies (Social technologies, tools to be developed)
- Lack of adequate means

CHANGING ROLE OF R&D INSTITUTES

- Increased attention to development of technology packages— “cluster approaches”
- Development of products relevant to needs of people – changing lifestyles, slick designs
- Keeping pace with shifting focus
 - Economic dimensions → Energy savings → Carbon – emission reducing “green technologies”

Contd ...

CHANGING ROLE OF R&D INSTITUTES(Contd ..)

- Undertaking “Life Cycle Analysis” (LCA) studies of wood products to highlight environmental advantages and capture emerging global opportunities
- Greater emphasis on Market, Policy and Social aspects in research

ENABLING INDIAN WOOD INDUSTRY

- To achieve greater output of well processed timber for downstream uses and quality products by creation of a favorable operational regime
- Processing segment merits special attention and support as Indian industry is increasingly becoming plantation dependent

Contd ...

ENABLING INDIAN WOOD INDUSTRY(Contd..)

- **Strengthening SMEs : a priority area**
- They carry out bulk of mechanical wood processing
- Occupy a strategic position to lend support to sustainable management of wood resources through promoting efficient utilization
- Employ a very large workforce
Nurtured properly, can be developed as “designated managers” of planted wood resources(*Tissari*)

ENABLING INDIAN WOOD INDUSTRY(Contd..)

- Current scenario at the SMEs
 - Low levels of technology application
 - Low recovery in saw mills, wastage
 - Low output of improperly seasoned/preservative treated timber
 - Non-utilization of large number of secondary timbers – Leakage of research effort
 - Low quality products even from high value timbers
 - *Technological upgradation – the urgent need*
- ***Constraint: Inadequate resources***

POLICY, INSTITUTIONAL FRAMEWORK AND SUPPORT

- Increasing “forest/ tree cover” , conservation, protection and management : thrust areas of the policy since 1980s
- Importance of “utilization”, although recognized in the national forest policy as well as in the “Bhopal – India” process, a roadmap to achieve rational utilization yet to be put in place
- Focus so far has been on supply side aspects.

CONCLUSION

- *Achieving "technology – based" utilization: a key challenge in promoting wood as a sustainable material*
- *Innovative approaches needed to foster partnership models, technology leap-frogging where necessary and providing support to all stakeholders*
- *Need to develop a "National Wood Use policy"*

Thank You

The Struggling Chinese Woodworking Industry: Challenges and Solutions

Shengfu Wu³

Abstract

After thirty years of development, the China Woodworking industry now boasts the highest capacity of any country worldwide. The Chinese market has also become the largest in the world and has attracted global suppliers. Due to the world economic crises, both the domestic and international markets have shrunk and the manufacturers are struggling for survival. Local timber as the raw material supply has changed from nature forest into plantation forests. Legally harvested imported timber is a key issue for future development. The quality of Chinese woodworking products is well regarded by the world market. Much focus is now placed on the future of the woodworking industry and the issue of how factories can survive and continue to meet market requirements.

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The Description of Marketing Mix at Three Level Furniture Industries in Medan area, North Sumatera, Indonesia

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Abstract

The research objective was to describe the marketing mix of the furniture industry on three different levels (small, middle, and big), focusing on the 4 Ps of marketing; product, price, place, and promotion. The results showed that:

1) For small enterprises, the products were teak furniture, handicrafts, and guest chairs, with prices ranging from IDR 400.000 – 6 million. The distribution channel involved producers, industrial users, and consumers. Promotion was through exhibition at Pekan Raya Sumatera Utara (North Sumatera Fair)

2) For mid-sized enterprises, the product was grovel furniture and replica furniture (sofa and kitchen set). The price for grovel furniture was between IDR 16-20 million. Because of the expensiveness, grovel furniture did not sell well. The price range for replica furniture was lower, from IDR 10-13 million. Distribution was direct between producers and consumers, without the involvement of agents. Promotion was carried out through commercial advertisements in internet and magazine.

3) For large enterprises, the most expensive product were bedroom sets, costing IDR 50 million. The cheapest product were door frames, at IDR 900.000. The distribution channel included producers, agents and wholesaler (industrial distributor to industrial consumer user). Promotion necessitated looking actively for the clients.

Keywords : furniture industry, marketing mix

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1. INTRODUCTION

Back ground

The development of timber industries in Indonesia began in the 1970s with the export of logs. In the 1980s, after the Indonesian government prohibited the export of logs and sawn timber, there was significant growth in both the primary and secondary wood industries in Indonesia. The primary wood industries include sawmills (Pari, 2002) which convert logs into lumber. The secondary industries are wood enterprises which convert lumber into wood products, both half-finished products (such as beam, board, rafter and lath) and finished products (such as frame, window, sash, door, cupboards, desks and wood chairs) (Simarmata, 2009).

Furniture is a wood product that fulfils household needs and furnishes the home (Hero et al., 2008). In the United States, the furniture industry is the largest user of hardwood lumber, and includes the following subsectors: household furniture, office furniture, public building furniture, partitions & fixtures, and miscellaneous furniture & fixture (Koch, 1977). In 2005 furniture exports reached US\$ 1.78, billion comprising 75% wooden furniture (Kasmaliasari et al., 2009).

Furniture can be produced not only by small-middle enterprises but also by the big industry. In Medan, the largest Indonesian city outside Java, furniture is manufactured by artisans, “panglong” (the term of wood small-middle enterprise), wood industry, and manufacturers of wooden products. Therefore, furniture (moulding and wooden furniture) is classified as a first class commodity (Medan Trading and Industry Service, 2011).

In this research the marketing mix was investigated at three different levels of the furniture industry; small, middle, and big. The marketing mix is a strategy aimed at increasing market share (Kotler, 1998). This research focused in “4P” (products, price, place, and promotion).

Objectives

- To determine the marketing mix at small enterprise (case study at UD.Putra Kalingga)
- To determine the marketing mix at middle enterprise (case study at CV.Karya Kasih)
- To determine the marketing mix at big industry (case study at PT.Elang Tenaga Bersama)

2. METHODS

Data collection on furniture industries was carried out by use of surveys. The first step taken in data collection was conducted using sampling, and was based on both the legal status of the enterprises/ industry and on raw material from solid wood.

- UD: Putra Kalingga represented small enterprise. UD (“Usaha Dagang”) is a trading business in the wood industry, it usually called “panglong” or “artisan”.
- CV: Karya Kasih represented middle enterprise. CV (“Commanditaire Vereniging”) is Dutch terminology for the middle trading of wood and wood products. Both UD and CV have no legal status.
- PT: Elang Tenaga Bersama represented big industry. PT (“Perseroan Terbatas”) is the legal status of the firm.

The second step, interviewing the manager/ owner was conducted using a questionnaire. The main parameters of marketing mix were as follow:

- Products: defining the variety of the products, form, and design making up the three levels of the furniture industry. Some tools are used, such as: questionnaire, camera, and stationery.
- Price: collecting information on decision making for pricing strategies of furniture products. Identifying the total cost to the owner/ manager during interview.
- Place or distribution: identifying the location and distribution channels of the furniture industries.
- Promotion: understanding how the industries communicate the products to public. This includes advertising, personal selling, exhibitions, sales promotions, or marketing.

The third step consists of identifying supporting parameters, furniture production processes and the raw materials. The final step involves analyzing the data using either description analysis or inductive analysis.

3. RESULTS AND DISCUSSION

A previous survey (Sitorus, 2009) stated that 164 “panglong” units (small / mid-sized enterprises in the field of wood) were operating in Medan for 30 years. As Simarmata (2009) states that only 50% of “panglong” have their own machine for manufacturing wood products, the actual number of those owning machines is around 82 units.

Small Enterprise

UD Kalingga used sawn timber from suppliers as a raw material. The species of wood was varied and the machinery used was simple and low-tech. One of the identified species was teak wood (*Tectona grandis*). Teak is known as “the king of wood” and the majority of consumers understand the high quality, performance, and aesthetic value of Teak (Buckley, 2010).

Production process showed at Figure 1.

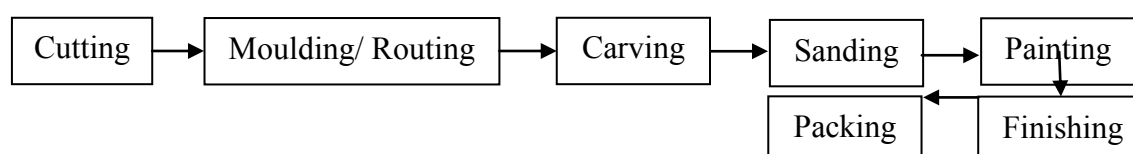


Figure 1. Production process of furniture making at UD.Kalingga

Products and price

Furniture design is one of the important aspect attracting consumers particular products (Kasmaliasari et al., 2009). At UD Kalingga, furniture design can be classified as simple (minimalistic) and classic design. UD Kalingga’s products are shown in Figure 3 and the price list is shown in Table 1.

Table 1. List products and the price list

No	Item	Price (IDR)*
1	Guest chairs	4-6 millions
2	Rectangular table	400.000
3	Oval table	500.000
4	Dining set	750.000
5	Relax chair	1.000.000
6	Cupboard	900.000

Remarks : IDR = Indonesian Rupiah, approximately 1 US\$ = IDR 9000

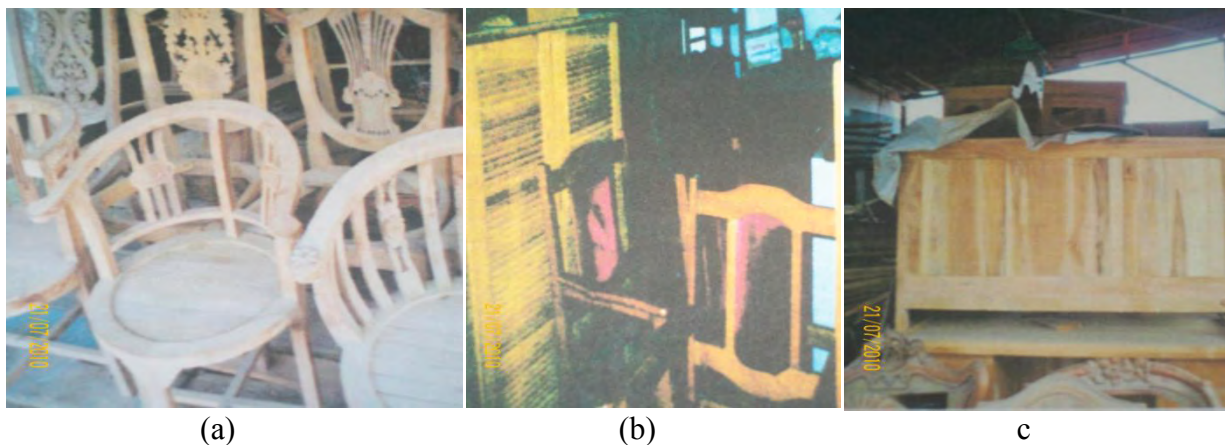


Figure 3. UD Kalingga's products (a) guest chairs (b) dining set (c) cupboard

Place or distribution

The distribution channel involves producers, industrial users and consumers. Promotion was through exhibition at Pekan Raya Sumatera Utara (North Sumatera Fair) (Figure 4)



Figure 4. North Sumatera Fair
(Source : Government of Medan City, www.pemkomedan.go.id)

Middle Enterprise

CV Karya Kasih used commercial timber as raw material. The species identified were meranti, pinus, and teak. The machinery was relatively modern. The production process is illustrated in Figure 5.

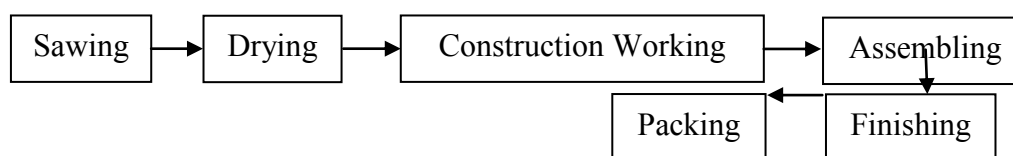


Figure 5. Production process of furniture making at CV. Karya Kasih

Products and price

At CV Karya Kasih, the furniture design can be classified as elegant, simple (minimalistic), futuristic, and classic design. CV Karya Kasih's products and price list are shown in Table 2

Table 2. List products and the price list

No	Item	Price (IDR)*
1	Grovel furniture	16-20 millions
2	Replica furniture	10-13 millions

Remarks : IDR = Indonesian Rupiah, approximately 1 US\$ = IDR 9000

Grovel furniture (Figure 6) is usually made by request/ order. As it has very high levels of durability the price is also usually high. Because of its cost, this furniture does not sell in large quantities. Replica furniture (Figure 7) consists of office school furniture, sofa, and kitchen sets. The price of office school furniture ranges from IDR 10-13 millions while kitchen sets are roughly half the price, with a range of 6-8 million.

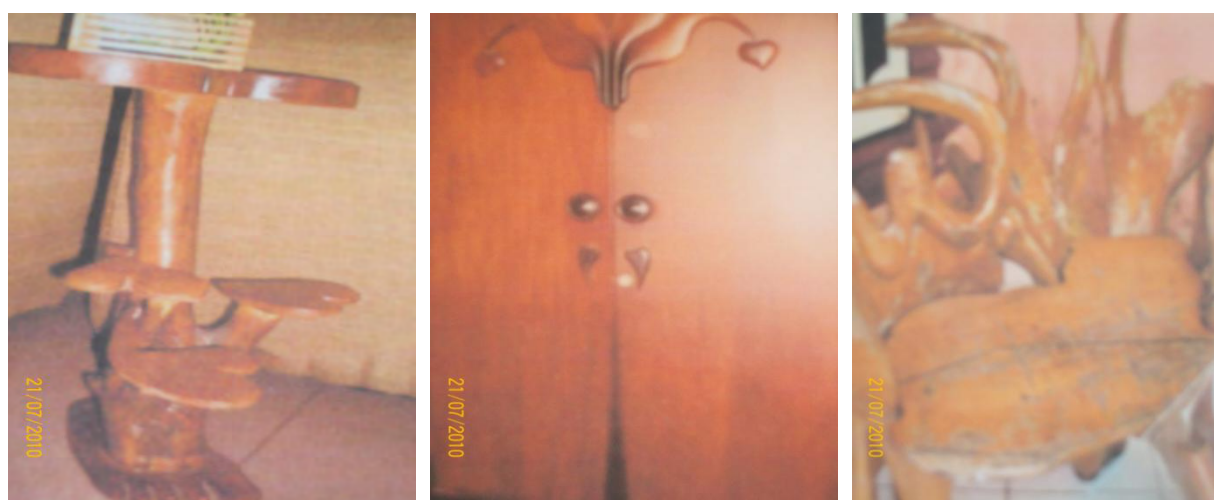


Figure 6. Groval furniture made of CV. Karya Kasih



Figure 7. One of replica furniture called office school furniture made of CV.Karya Kasih

Place or distribution

The distribution channel links producers directly with consumers without the involvement of agents. Promotion is done by commercial advertisements on the internet (Figure 8) and in magazines.

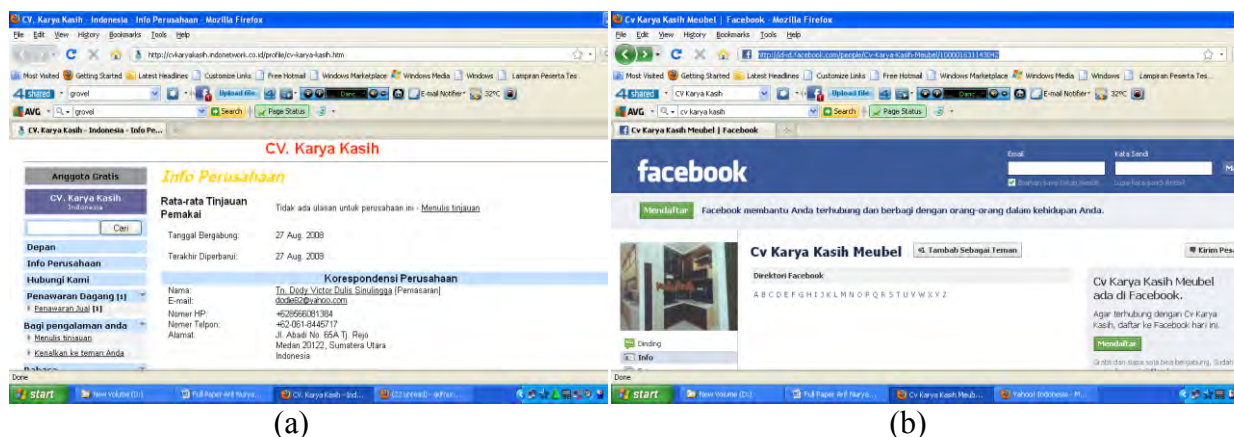


Figure 8. Free advertisements using website of CV.Karya Kasih⁷ and Facebook⁸

Big Industry

PT Elang Tenaga Bersama used sawn timber and logs as the raw material. The species identified were pinus (*Pinus merkusii*) and rubber wood (*Hevea brasiliensis*). Market exports mostly come from East Asia as consumers from this region (eg Japan and Korea) prefer light wood rather than wood. This condition is different from in Jepara. Jepara's furniture industry uses teak and mahogany - both of which are dark – as the raw material (Yovi et al., 2009).

Modern machinery allows large scale production and continuous processing, enabling the products to all have same standard in quality, quantity, and type.

Products and price

⁷ <http://cvkaryakasih.indonetwork.co.id/profile/cv-karya-kasih.htm>.

⁸ <http://id-id.facebook.com/people/Cv-Karya-Kasih-Meubel/100001631143042>

At PT Elang Tenaga Bersama, the furniture design can be classified as elegant, simple (minimalistic), oriental, futuristic, and classic. PT Elang Tenaga Bersama's products (Figure 9) and the price list showed at Table 3

Table 3. List products and the price list

No	Item	Price (IDR)*
1	Bedroom set and sofa	50 millions
2	Door frame	900.000
3	Cupboard	3 millions
4	Dining set	12 millions
5	Guest chair	9 millions

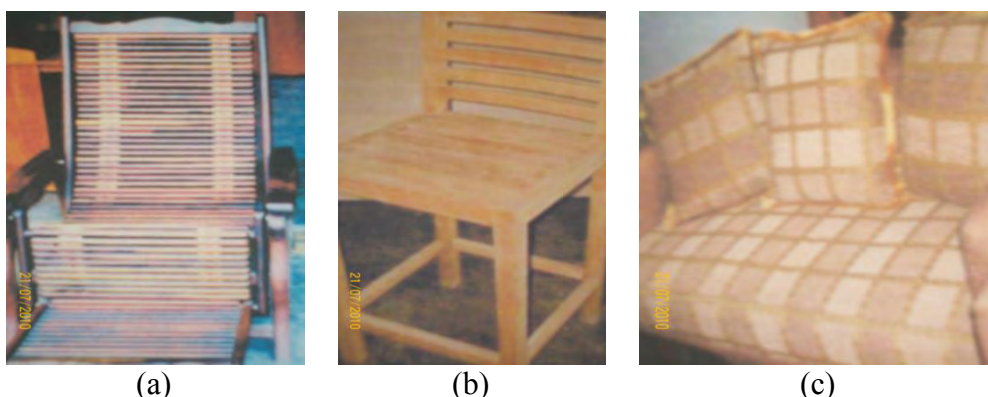
Remarks : IDR = Indonesian Rupiah, approximately 1 US\$ = IDR 9000

The most expensive product was the bedroom set, with a price of IDR 50 million. The cheapest product was the door frame, with a price of IDR 900.000.

The distribution channel includes producer, agents and wholesaler (industrial distributor to industrial consumer user). This is relatively uncomplicated when compared to Jepara as the center for wooden furniture industries in Indonesia. The Jepara wooden furniture marketing channel has five common channels (Kasmaliasari et al., 2009) : 1) artisan – exporter + warehouse – export 2) artisan – showroom + finishing – consumer 3) artisan – collector/broker – showroom + finishing – consumer 4) artisan – collector/broker – showroom outside Jepara – consumer 5) artisan – broker + finishing – showroom outside Jepara – consumer.

The promotion was carried out using both active and passive methods. Looking for the clients and hiring of marketing officers are active, while partaking in an exhibition at PRSU is passive.

Figure 9 below, shows the products made of PT.Elang Tenaga Bersama.



**Figure 9. Chairs Product made of PT.Elang Tenaga Bersama
(a) guest chair (b) dining chair (c) sofa**

4. CONCLUSION

Data taken from this research indicates that UD Putra Kalingga is classified as a small enterprise, the products are very competitive in the market because of their low price. Therefore, price is the most important factor in the marketing mix in this industry.

In a mid-sized enterprise, in this case CV.Karya Kasih, most of the products are manufactured based on orders from consumers. Promotion is done repeatedly, through the internet (both websites and social networking). Therefore, promotion is the most important element in the marketing mix in this industry, as it is essential to receive orders from consumers.

An example of big level furniture industry was PT.Elang Tenaga Bersama. This industry was already stable. All of the components of marketing mix – products, price, place, and promotion- have played the same important rule to this business.

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THE DESCRIPTION OF MARKETING MIX AT THREE LEVEL FURNITURE INDUSTRIES, IN MEDAN AREA, NORTH SUMATERA, INDONESIA

by

Arif Nuryawan, Iskandarini, Vera Sylvia Nainggolan

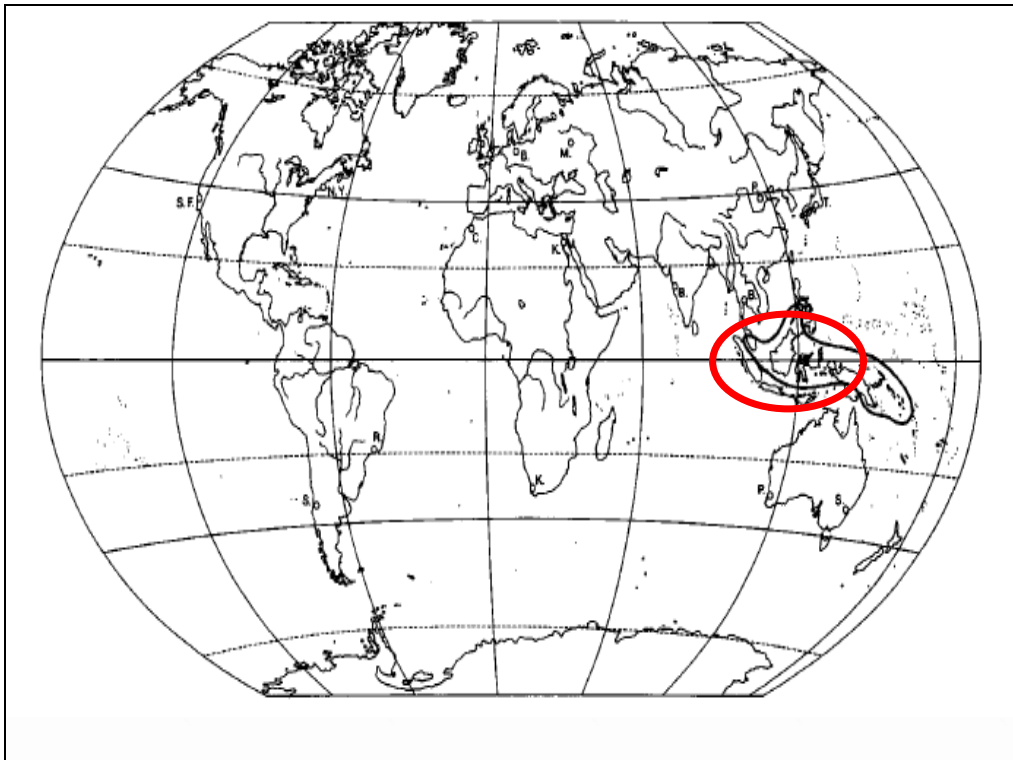
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Presented in



Rediscovering Wood: The Key to a Sustainable Future

An International Conference and Exhibition on the Art and Joy of Wood
19-22 October 2011, Bangalore, India



INDONESIA



Medan, North Sumatera

- Medan is the biggest city outside Java
- Medan is the biggest city after Jakarta and Surabaya
- International airport (Polonia)
- University of Sumatera Utara

INTRODUCTION

• Development timber industries in Indonesia

1970s

- Begun by log export
- Log came from natural forest

1980s

- Government prohibited the export (log & sawn timber)
- Plywood industry became popular
- Secondary wood industries grew (start used mixed raw material)

now

- Changing in wood supply from natural forest to plantation forest
- Panel products became popular (particle board & fiberboard)
- Secondary wood industries relatively stable

Data calculated from Ministry of Forestry Republic of Indonesia (2008).

- Logs production reached 31.4 million m³ in 2007 and during the last 5 years the logs has been supplied about 60 % from plantation forest, it is different from the years before 2000 whereas the logs was mostly supplied from natural forest.
- The changing of logs supply from natural forest to plantation forest brings the changing of wood species, logs diameter, wood maturity, and wood characteristics consequently, and this phenomenon also brings wood industry changing in
 - **kind of products**
 - **handling and processing of raw materials**
 - **machine maintenance**
 - **and equipment improvement**



Furniture

- Produced by secondary wood industries (“panglong”/ small-middle wood enterprises and artisans)

Indonesian Statistic of 2000-2005

- The furniture industries in Indonesia contributed to the country’s income by 17%, and in 2005 the furniture export reached US\$ 1.78 billion comprising 75% wooden furniture



Furniture

- 1st class commodity (Medan Trading & Industry Service, 2011)
- In this research, description of marketing mix at three level furniture industries (small, middle, and big) was investigated.
- Marketing mix is the set of a strategy that includes different elements - the various parts of the marketing mix - to get the target in market share (Kotler, 1998).
- This research focused in “4P” (products, price, place, and promotion) regarding with the term of marketing mix.

Objectives

- To determine the marketing mix at small enterprise
(**case study at UD.Putra Kalingga**)
- To determine the marketing mix at middle enterprise
(**case study at CV.Karya Kasih**)
- To determine the marketing mix at big industry
(**case study at PT.Elang Tenaga Bersama**)

METHODS

- The data collection of furniture industries was carried out by surveys.
- The first step taken in data collecting was conducted using the purposive sampling based on both the law status of the enterprise/industry and the raw material from solid wood.

- UD.Putra Kalingga represented small enterprise. UD (“Usaha Dagang”) is trading business in the field of wood, it usually called “panglong” or artisan.
- CV.Karya Kasih represented middle enterprise. CV (“Commanditaire Vereniging”) is the Dutch terminology which describe the middle trading of wood and wood products. Both UD and CV have no law status.
- PT.Elang Tenaga Bersama represented big industry. PT (“Perseroan Terbatas”) is law status of the firm.

- The 2nd step, interviewing the manager/ owner was conducted using questionnaire. Data taken from this research be described. The main parameters of marketing mix were as follow :

Products : defining the variety of the products, form, and design made of the three level of furniture industries above.

Price: looking for knowhow deciding on a pricing strategy on the furniture products. Identifying the total cost to the manager/ owner by the interview.

Place or distribution : looking at the location of the furniture industries. Identifying the distribution channels.

Promotion : identifying how the industries recognize the products to public. This includes advertising, personal selling, exhibitions, sales promotions, or marketing people.

- The 3rd step, identifying the supporting parameters, consist of furniture production process and the raw material.
- The last step, analyzing the data used either description analysis or inductive analysis.

RESULTS AND DISCUSSION

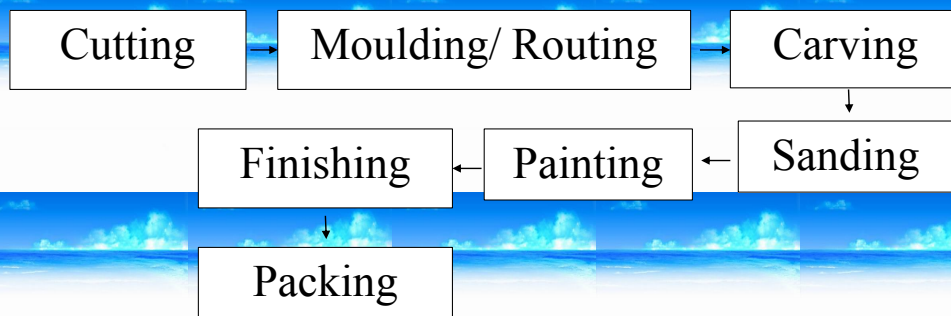
- Previous work by Sitorus (2009) though survey, resulted 164 units “panglong” -small-middle enterprises in the field of wood- were operated in Medan for 30 years.
- Moreover, Simarmata (2009) stated just only 50% “panglong” have own machine to produce the wood products. Therefore just only 82 “panglong” has the own machine to produce/ manufacture the wood products.



Small Enterprise (Case Study at UD Kalingga)

- UD Kalingga used sawn timber from supplier as raw material.
- The species was varies and the machinery was simple and low technology.
- One of identified species was teak wood (*Tectona grandis*). Teak is “the king of wood” and generally, all of the consumers understood that teak is the best in quality, performance, and aesthetic (Buckley, 2010).

Production process



Products and price :

- UD Kalingga's furniture products design is one of the important aspect attracting consumers to buy a particular products (Kasmaliasari *et al.*,2009).
- At UD Kalingga, the furniture design can be classified as **simple (minimalistic)** and **classic design**.

No	Item	Price (IDR)*
1	Guest chairs	4-6 millions
2	Rectangular table	400.000
3	Oval table	500.000
4	Dining set	750.000
5	Relax chair	1.000.000
6	Cupboard	900.000

Remarks : IDR = Indonesian Rupiah, approximately 1 US\$ = IDR 9000



UD Kalingga's products (a) guest chairs (b) dining set (c) cupboard

Place or distribution :

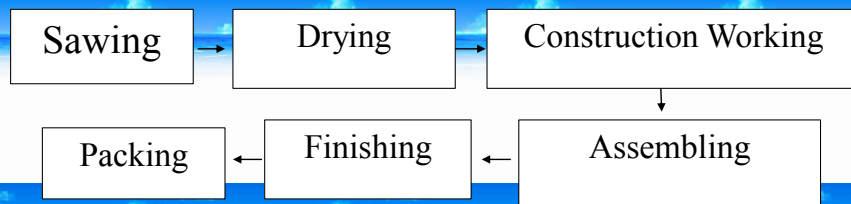
- The distribution channel started from producer, industrial user, and consumer.
- The promotion was through exhibition at Pekan Raya Sumatera Utara (North Sumatera Fair)



Middle Enterprise (Case Study at CV Karya Kasih)

- CV Karya Kasih used the commercial timber as the raw material.
- The species identified was meranti, pinus/pine, and teak.
- The machinery relatively modern

Production process

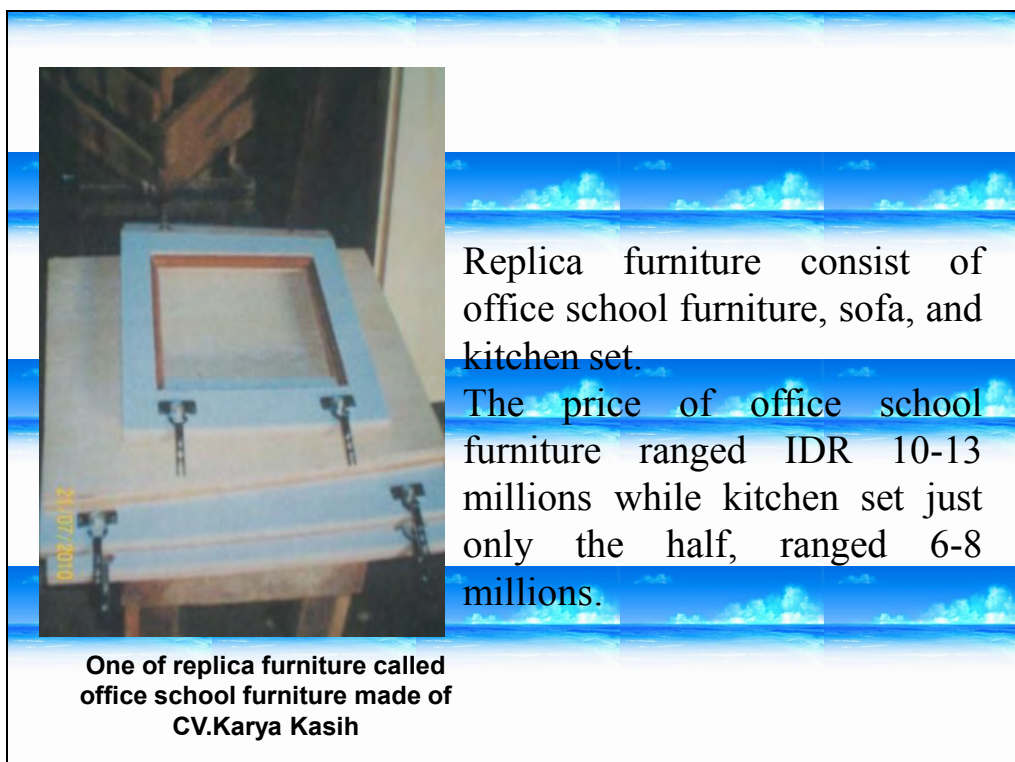
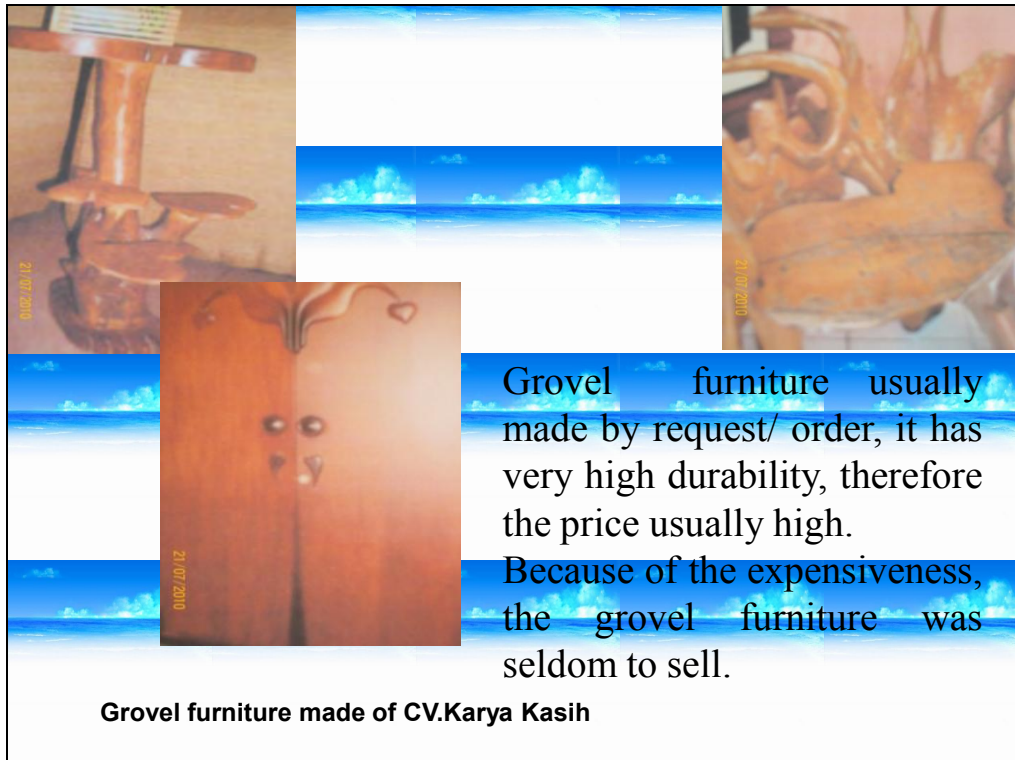


Products and price :

- CV Karya Kasih's furniture products design can be classified as **elegant, simple (minimalistic), futuristic, and classic design.**

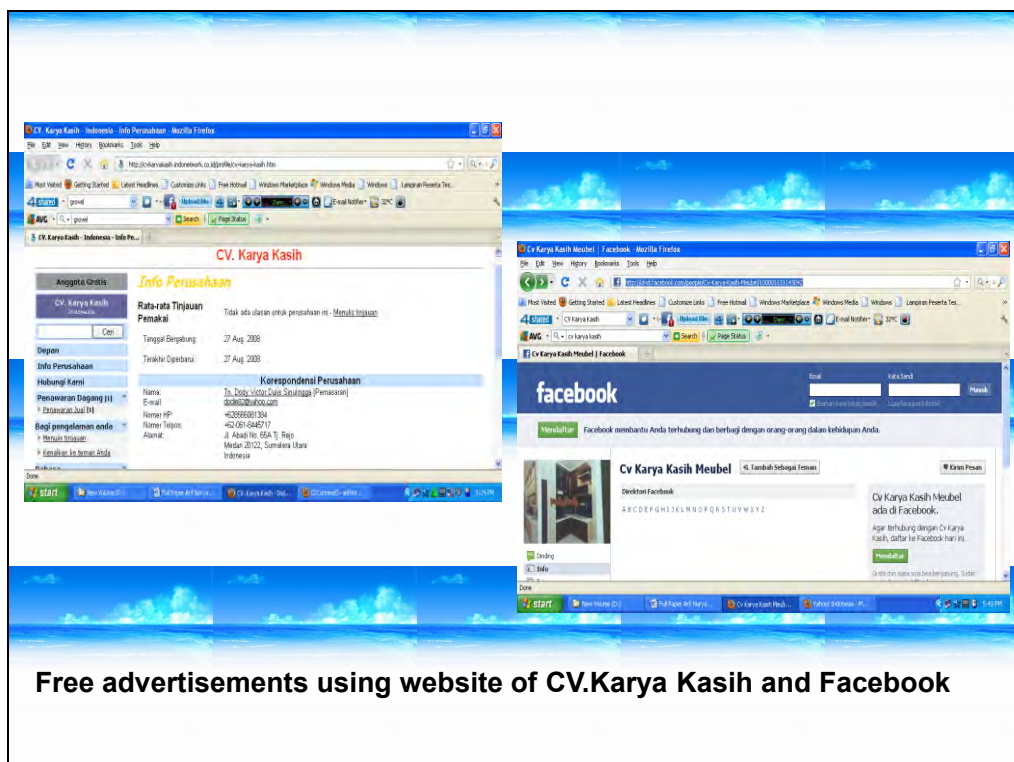
No	Item	Price (IDR)*
1	Grovel furniture	16-20 millions
2	Replica furniture	10-13 millions

Remarks : IDR = Indonesian Rupiah, approximately 1 US\$ = IDR 9000



Place or distribution :

- The distribution channel started by producer and consumer without passing the agents. The promotion used by commercial advertisements in internet and magazine. Advertisement in internet showed with the address <http://cvkaryakasih.indonetwork.co.id/profile/cv-karya-kasih.htm>.
- CV Karya Kasih also used the social network such as Facebook to promote the products with the address <http://id-id.facebook.com/people/Cv-Karya-Kasih-Meubel/100001631143042>



Free advertisements using website of CV.Karya Kasih and Facebook

Big Industry

- PT Elang Tenaga Bersama used sawn timber and logs as the raw material.
- The species identified was pinus/pine (*Pinus merkusii*) and rubber wood (*Hevea brasiliensis*). Both of the wood are apparent, because the market export mostly come from East Asia. Consumer from East Asia (eg Japan and Korea) prefer apparent wood than dark wood. This condition is different from in Jepara. Jepara's furniture industries used teak and mahogany - both of them are dark wood – as the raw material (Yovi *et al.*, 2009).
- The modern machineries are properly to produce in big scale. The production was continuous process, so the products have the same standard in quality, quantity, and type.

Products and price :

- PT Elang Tenaga Bersama's furniture design products can be classified as **elegant, simple (minimalistic), oriental, futuristic, and classic design.**



Chairs Product made of PT.Elang Tenaga Bersama
(a) guest chair (b) dining chair (c) sofa

No	Item	Price (IDR)*
1	Bedroom set and sofa	50 millions
2	Door frame	900.000
3	Cupboard	3 millions
4	Dining set	12 millions
5	Guest chair	9 millions

Remarks : IDR = Indonesian Rupiah, approximately 1 US\$ = IDR 9000

Place & Promotion

- The distribution channel started by producer agents and wholesaler (industrial distributor to industrial consumer user).
- This is not complicated if be compared in Jepara as the center for wooden furniture industries in Indonesia. Jepara wooden furniture marketing channel has five common pattern (Kasmaliasari *et al.*, 2009) :
 - 1) artisan – exporter + warehouse – export
 - 2) artisan – showroom + finishing – consumer
 - 3) artisan – collector/broker – showroom + finishing – consumer
 - 4) artisan-collector/broker-showroom outside Jepara-consumer
 - 5) artisan-broker + finishing-showroom outside Jepara-consumer.
- The promotion was done by active and passive ways. Looking for the clients and hire the marketing officer are active ways while join the exhibition at PRSU is one of the passive ways.

CONCLUSSION

- Data taken from this research indicates that UD Putra Kalingga is classified in **small enterprise**, the products are very competitive in the market because of the **cheapness of the price**. Therefore, price is the most important in marketing mix in this industry.
- **Middle enterprise** in this case was CV.Karya Kasih. Most of the products are manufactured based on order from consumers. The **promotion** is done repeatedly, using internet (both website and social networking). Therefore, promotion is the most important in marketing mix in this industry, to persist the order from consumers.
- The **big furniture industry** was PT.Elang Tenaga Bersama. This industry was already stable. **All of the component of marketing mix – products, price, place, and promotion- have played the same important rule to this business.**

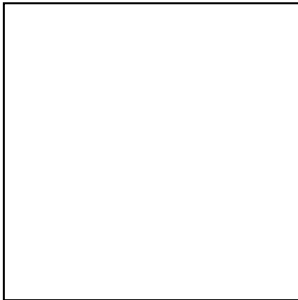


Session 11

[Thursday 4th period 2.0 hours Hall A]

Development of the handicraft sector

Speakers



Speaker:

Rajan Bhowmik

Topic:

The Preservation of Tribal Culture- A Heritage of the Wooden Crafts World: A Case Study of the North East Corner



Speaker:

Pankaj Aggarwal

Topic:

Strategy for Socio-Economic Sustainability of Artists of Channapatna of India



Speaker:

V Ramakantha

Topic:

A Road Map for Strengthening the Solid Wood Based Handicraft Sector of Manipur, India



Speaker:

B Siddapa

Topic:

Efficiency Resources (Forest and Credit) Use by SHG's for Socio-Economic Transformation of the Karnataka Economy



Speaker:

Mangala de Zoysa

Topic:

Rediscovering Traditional Wood Product Industries in Sri Lanka: Promotion of Cultural Heritage, Improvement of Rural Livelihood and Expansion of Export Earnings

Preservation of Tribal culture – A Heritage of the Wooden Crafts World: A Case Study of North-East Corner

Rajesh Bhowmik¹

Abstract

Timber is in abundant in India's North-East region and local inhabitants take advantage of extensive forest areas. There are many differences in the lifestyles and artforms of the peoples of the hills and plains, they all add to the cultural life of the region. The impact of wood working is significant in all societies, including tribal and non tribal. The traditional artisans use different woods according to factors such as longevity and textural quality. Wooden crafts experience wider demand among tribal groups as they are used as daily household objects. In this way, wood is used for a wide range of purposes, from decorative household activities to wooden sculptures or crafts. The tribal communities of Nagaland, Manipur, Arunachal Pradesh etc. are highly skilled in making wooden ornaments.

One of the most important types of wood carving found in North-East India is the traditional mask. The magnificent wooden masks from this area are used in traditional dances by the Khambas and the Membas of North Sian of Arunachal Pradesh.

Other works, such as the “memorable pillar” depicts the community's relationship with the carved images of persons of the past. The Nagas are fond of decorating their houses with carved out images in the pillars and beams of their houses with their ritualistic beliefs. Drums carved out from wooden logs are also used in rituals or festivals. The Monpa tribe of Bomdila district of Arunachal Pradesh makes a variety of bowls of varieties design and shape out of wooden log.

These products which are made of wood have a greater demand not only in the N-E region, but also all over India.

This study examines contemporary modern society and the attempts to promote this traditional product to a more global market. Different Govt. institutions, Ngo's and SHG's have taken different initiatives to develop the existing culture as well as traditional-indigenous practices in order to strengthen the sustainability of tribal wooden crafts.

Key words: cultural influences and crisis, traditional practices, primitivism vs. modernism, dominant culture, loosing traditional behavior, preservation of existing cultural values.

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Strategy for Socio-Economic Sustainability of Artists of Channapatna of India

Pankaj K Aggarwal², P R Triveni and S C Joshi

Abstract

Chennapatna, the toy town of Karnataka in peninsular India is home to more than 5,000 skilled craftsmen called “chitragars” who have long been involved in traditional wooden lacquered toys and ivory craft. As in any other cottage industry, the middlemen in the distribution channel take a disproportionate amount of profit. These middlemen generally make double the amount that they pay to toymakers, who themselves make only a meager profit. This in turn results in lack of interest amongst the artisans.

Wood turning requires extremely close grained and moderately hard wood. Hale wood (Writia tinctoria) is the most suited wood of this region which unfortunately is fast dwindling. Research institute like Institute of Wood Science & Technology, Bangalore has identified alternative species like rubber wood, Acacias etc, to overcome the problem. However, convincing the toymakers about the utilization of these species is the greatest challenge and efforts have been initiated by the institute in this direction. If these alternative species are used by the artisans, it will help to upgrade their socio-economic status due to its greater abundance as well as cost effectiveness.

It is essential to enhance the skills of artisans by identifying trainee-facilitators in the field of design, creating master crafts persons with upgraded skills, awareness in effective technology, communication skills and marketing strategies. There should be regular skill and technology upgradation as the market is driven by new innovations. For this, private and government sectors should come forward in providing training. The other parameter by which artisans can be encouraged is to expose them at national and international trade fairs so that they acquire advanced knowledge at international level. The most important aspect for social upgradation and recognition of the artisan is to give them due respect and prestige. Their work should be recognized and rewarded appropriately. This will motivate other artisans also. Networking of artisans with related departments, research institutions and artisans is also a very important factor in the overall development of this sector.

² Institute of Wood Science and Technology, 18th Cross, Malleswaram, Bangalore-560003, INDIA (pankaj@icfre.org)

A Road Map for Strengthening the Solid Wood-Based Handicraft Sector of Manipur, India

V Ramakantha³, A N Kumar, Mohendra Pratap Singh and N C Talukdar

Abstract

*Manipur, a northeastern state of India, bordering Myanmar is nestled in the folds of Eastern Himalaya and sustains a large proportion of the rich biodiversity of the Indo Burma biodiversity hotspot. Manipur has a rich cultural heritage which includes an ancient and still thriving art and craft industry. The fine craftsmen of Manipur have developed insights into the quality of wood, and as of now, apart from every household having a handloom, the State boasts of more than 400,000 artisans involved in handicrafts, the highest number in North East India. Apart from the cane and bamboo sector, solid wood carving constitutes a major component of handicraft industry in the state. A large number of solid wood species such as *Melanorrhoea usitata*, *Phoebe chinensis*, *Dipterocarpus turbinatus* and *D. tuberculatus* that are preferred by the artisans are restricted in distribution to Indo - Myanmar border area and hence representative in the Indian context. However, in the recent past, supply of such traditional timbers has dwindled to a great extent owing to rampant deforestation happening due to slash and burn type of cultivation and other factors. According a report of the forest department, a total of 173 km² area of forest vanished within a span of two years between 2003 and 2005. This paper looks at the solid wood based handicraft industries both in the valley and hills of Manipur, the species used exclusively, and assessment of the demand-supply situation and its impact on the handicraft sector. Considering the fact that there is a paucity of research data, the paper, apart from documenting the existing information, explores the possibility of strengthening the handicraft sector.*

³ Government of Manipur (v_ramakantha@hotmail.com)

Efficiency Resources (Forest and Credit) Use by SHG's for Socio-Economic Transformation of the Karnataka economy

B Siddapa⁴

Abstract

Credit and forest resources are the major inputs used by productive units (SHG's) irrespective of sectors such as primary, secondary and other services. About 43 percent of the total energy consumed in third world countries (by more than 2 billion people) is met by use of biomass fuel. This is equivalent to 22 million barrels of oil per day, which is saved from consumption. In India about 80 percent of rural people are dependent on wood fuel for cooking their food and 65 percent of the total fuel wood is collected from the local fields free of cost and also from forest and community wood lots.

India is one of the mega- biodiversity regions in the world, with a richness genetic species and eco-system diversity. This heritage system must be conserved for future civilization. It is one of the lowest in the world in possession of per-capita forest land, which is 0.1 ha and has worsened with the increase in population and increase in use of forest land for farming and domicile purposes.

The forest area of Karnataka state, in the south of India, stood at 32467 Sq Km as of December 1999, which is 16.93 percent of the total area.

Poor families including small marginal farmers and rural artisans have extremely limited access to credit in much of the developing world. Nearly 80 percent of women belonging to such societal groups do not possess institutional credit in these countries. Poor families have no capacity to save and deposit in the banks, but the banks should help them with a loan to invest in their well versed occupations, as out of the income generated the banks should recover the loans. This type of scheme of savings mobilization will have positive results for the banks as well as poor families. State and Central Governments have framed various income and employment generation programmes exclusively for the benefit of weaker sections.

The self help groups (SHG's) are voluntarily formed associations of the women members of up to 20 members in order to produce single community and earn income to solve their common problems such as poverty and unemployment in a particular place. In Karnataka 1.3 lakh SHG's have been performing their activities well in different productive fields such as dairy (0.4 lakh SHGS), agarbathi, sandal(0.2 lakh SHGS), wooden handicrafts, dolls, carpentry, statues, furnitures (0.3 lakh SHGS), handmade embroidery, tailoring, basket, mat, maps, panipuri, hotels, petty business, fruit trading (0.2 lakh SHGS), and processing small industries, poultry, piggery, coconut products, manure making , khadi products, pot maker(0.2 lakh SHGS). The women member's strength and their contribution (SHG's) is still improving and contributing much towards the socio – economic transformation of the society.

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Credit and forest products are the major inputs used by the productive units irrespective of the sectors such as primary, secondary and services. Among the various inputs used in the process of production, the co-relation between the credit and forest based inputs occupied a decisive place not only in third world countries but also in advanced countries of the global economy. About 43 percent of the total energy (wood fuel) consumed in the third world countries, by more than 2 billion people, is met from biomass fuel. This is equivalent to 22 million barrels of oil per day. In India about 80 percent of rural people are dependent on wood fuel for cooking their food and 65 percent of the total fuel wood is collected from the total fields on free of costs and also collected from the forest and community wood lots⁵.

Tree crops form a major source of food in many parts of the world. They provide healthier food and boast a high nutritional quality compared to common contemporary foods. The fruits, nuts, berries, edible leaves etc obtained from trees are rich in carbohydrates, fats, proteins, minerals and vitamins. They satisfy the entire food needs of the rural community at times of food shortage. Trees are also more reliable and consistent in food production than seasonal food crops such as cereals. If these trees are grown and managed properly, food production from such a source can be found available throughout the year with little effort and minimum investment⁶. The main tree crops which meet the consumption habits of the community are banana, pineapple, passion fruit, papaya, nuts and seeds, cashew nut, palm oil, coconut products, edible seeds, edible leaves, sap and sugar, tree for spices, medicine tree for firewood, tree for fodder, forest garden, teak, neem, spices, ginger turmeric and so on.

India is one of the mega-biodiversity regions in the world, with a richness of genetic species and eco-system diversity. This heritage system must be conserved for future civilization⁷.

Despite this, India is one of the lowest in the world in terms of possession of per capita forest and which is only 0.1 ha. This situation is worsening with the increase in population on the one hand and the related increase in using of more and more forest land for farming as well as domicile purposes on the other hand⁸.

Karnataka Economy

Karnataka State is one of four making up the the South Indian Economy. The others being Andrapradesh, Kerala and Tamil Nadu. The coverage of forests in these states are given in the following table:

⁵L.K. Jha and Sen Sharma, Forestry for the People, of 908 Jha-Ashish Publishing House, New Delhi, 1994, p 169

⁶P.K. Thampan “ Tree Farming for food and nutrition” Peekay Tree Crops Development Foundation, Cochin, 1994, p.3

⁷ Government of India, My Forest, Quarterly Journal, Special Issue, Vol-35, December 1999, Bangalore p 343

⁸ Ibid, 344

Coverage of forests in 4 south Indian States as per 1991 and 1999 assessments

Sl.No	State	Total Geographical area (sq km)	Total forest covered (sq km)		Dense forest (sq km)		Open Forest (sq km)		Mangrove forest (sq km)		Percent of forest area	
			1991	1999	1991	1999	1991	1999	1991	1999	1991	1999
1	Andra Pradesh	275068 (43)	47220	44229	25017	24190	21874	19642	399	397	17.2	16.4
2	Karnataka	191791(30)	32199	32467	24856	24832	7343	7632	-	3	16.8	16.93
3	Kerala	38863(6)	10292	10323	8421	8429	1871	1894	-	0	26.5	26.56
4	Tamil Nadu	130058(21)	17713	17078	9757	8659	7909	8398	47	21	13.6	13.13
	Total	635780(100)	107494	104097	68051	66110	38997	37566	446	421	18.5	18.20

Source : UAS, National Afforestation and Co-development Board, Banglaore, 2001 p.1

The above table suggests that the four south Indian states total geographical area is 635780 sq km, among which the Andra Pradesh share was 43 percent, Karnataka share was 30 percent, Tamil Nadu share was 21 percent and Kerala share was 6 percent. The percentage of forest area to the total area in the year 1994 was in Andra Pradesh 16.4 percent, Karnataka 16.93 percent, Tamil Nadu 13.13 percent and Kerala 26.56 percent. Including all the four states the coverage of forests area to the total area it was 18.2 percent, which is less than one fourth of the total area.

Credit and forest products used by SHG's of Karnataka Economy

Credit plays an important role in acquiring forest products in particular and natural resources in general. Poor families including small marginal farmers and rural artisans have extremely limited access to credit in much of the developing world. In some of the African countries nearly one percent of total numbers of borrowers use institutional credit, in Latin America and Asia (excluding Taiwan) only 15 percent of poor families could succeed in getting institutional finance. Nearly 80 percent of women in particular and weaker sections in general (such as small-marginal farmers, agricultural labourers, rural artisans, retail traders and people of small means of productive assets) have not possessed institutional credit in these countries⁹.

Rural society in these countries is plagued with mass poverty, illiteracy and a conservative and fatalistic outlook. Only a small percentage of rural and urban population belonging to the weaker sections of society will have surplus liquid funds. They are not in a position to negotiate with banks unless the banks are convinced about the safety and facility of withdrawal as and when they are in need of money. However, the rural and urban population belonging to this group is a potential market for deposits. It is not possible for these groups to save first a certain amount of deposits and then undertake investment in agriculture or allied activities. It would be more realistic to help them with a loan to invest in their occupation and out of the income generated the banks should recover the loans. This type of scheme of savings mobilization would benefit both the banks and the poor families. With increased

⁹ World bank, Agricultural Credit-sector Policy paper 1972, Washington, Dc p.1

income from such investment will augment the savings capacity of the poor and consequently increase bank deposits¹⁰.

Objectives of the study:

1. Most developing countries at global level have been pursuing the policy of inclusiveness in gainful production and employment activities
2. Exclusive groups have been involved in generating income through NGOs or SHGs
3. The state and central governments have been encouraging the exclusive groups to include other groups through interest subsidies, asset subsidies, fixed capital subsidies and so on by implementing various schemes

The state and central Governments have framed various income and employment generation programmes exclusively for the benefit of weaker groups, i.e small marginal farmers, agricultural and non-agricultural laborers, rural artisans, women and the socially marginalized peoples in the Karnataka.

Government Schemes for Self help Groups (SHGs): SHGs are voluntary organizations which have been formed by female members of up to 20 in order to produce a single commodity and higher incomes to solve their common problems such as poverty, and unemployment. These groups have founded their own projects (unit) and the necessary training is given by the Department of women and children development¹¹. The department has provided training to the members of the SHGs concerning the combination of wood forests trees and soil based resources with the capital goods to be used in the process of production.

Other schemes include: (a) a revolving fund of Rs.5000 is to be given to the each of SHG to take up income generation activities (b) kit material cost of Rs.600 is to be given to purchase 9 registers and Zinc trunks to all the groups (c) an incentive of Rs.5000 is to be given to each group at the time of identification of Income Generation Activities (IGA) (d) additional incentives of Rs.15000 and Rs.20000 per group has been given awarded when the group savings reaches up to Rs. 1 lakh and more than Rs.1 lakh respectively (e) the government has given 6 percent interest subsidy to each SHG for bank loans of Rs.25000 to Rs. 1 Lakh (f) the government has held exhibitions and market mela for the products of SHGs for promoting sales (g) the Ministry of Women and Child Development has organised training for skill development, in groups consisting of 25 members, with Rs.12500 provided for conducting this training. Besides this the department has also given training for orientation, communication skill, book keeping, credit management and social issues in 4 phases. Although the gender disparity remains wide with respect to employment, income and other field in rural and urban areas of Karnataka, the government's steps in this direction may be helpful in providing employment and generate income through the SHG's. The total number of groups having bank linkages and open bank accounts only for keeping saved money, total savings accumulated, loan amount disbursed by the SHG's to the members, total loan amount repaid by the members to the SHGs and total repayment amount to bank is illustrated in the following table in each division of Karnataka as on March 2011¹²

¹⁰Masich A.M.A, "A critique of the Methodology adopted by others in evaluating the role of financial institutions in Economic development" Indian Economic Journal, Vol LXI, April 1981, Bombay, PP 56-57

¹¹Government of Karnataka, Various circulars issued by the Ministry of Women and Children Development, Bangalore, Pp 12-13

¹²Ibid

SHG's consolidated statistics on various transactions performed as on March 2011

Sl.No	Name of the Division	No. Of SHGS	Total No. of graphs having bank linkages	No. of Groups opened account only for keep saved amount	Total No. of women of all categories in SHG's
1	Bangalore	49676(38)	44799(40)	5426(32)	711269(38)
2	Belgaum	28783(22)	23927(21)	3219(19)	440536(23)
3	Gulbarga	23509(18)	19401(17)	5697(33)	327602(17)
4	Mysore	28032(22)	24773(22)	2758(16)	417140(22)
	Total	130000(100)	112900(100)	17100(100)	1896547(100)

Source : Government of Karnataka, Ministry of Women and Child Development, Bangalore adopted and modified table,2011 (Figures in the brackets are percentage to the total)

The above table highlights that out of total 140000 SHGs in Karnataka, 130000 have reported to the Government and are involved in various activities such as dairy, readymade garments, blanket marketing, marketing of seeds and manure production and sale of papad, spices and agarbatti, production and sale of soap and detergent, various type of handicrafts etc¹³. The representation of SHGs from the Bangalore division was 38 percent, the Belgaum and Mysore division was 22 percent each and the Gulbarga division was 18 percent. Out of the total number, 112900 groups have a good bank linkage and the representation from the different divisions in the state was almost similar in its percentage. Many groups have opened their bank accounts only to keep a saved amount, as they were unaware of the workings of bank transactions before SHG membership. The total membership of women in all the groups in the state was 189654. The total female population in the state in 2011 census was 25877615, with 1896547 women being members of SHGs as of march 2011, which accounts for 7.32 percent.

A similar number of SHGs, in their respective divisions, kept savings in the savings deposit account, took the total loan amount from the banks and the entire amount was repaid. The loan amount was then disbursed by the SHGs to their members and the members in turn repaid the SHGs.

The SHGs savings, bank transaction and SHGs transactions as on march 2011

Sl.No	Divisions	SHGs	Savings accumulated (in cro)	Loan amount taken from bank (in cro)	Bank Loan repaid(in cro)	Loan from SHGs	Loan repayment to SHGs
1	Bangalore	49676(38)	397.74(42)	541.03(46)	774.46(56)	1328(49)	701116.96
2	Belgaum	28783(22)	189.59(20)	242.97(21)	172.13(13)	398.32(15)	314.62(79)
3	Gulbarga	23509(18)	160.37(17)	139.92(12)	130.68(10)	320.33(12)	220.63(69)
4	Mysore	28032(22)	194.60(21)	257.77(21)	296.54(21)	687.56(24)	603.45(88)
	Total	130000(100)	942.30(100)	1181.69(100)	1373.81(100)	2734.91(100)	2255.66(82)

Source : Government of Karnataka, Ministry of Women and Child Development, Bangalore adopted and modified table 2011 (Figures in brackets are percentage to the total)

¹³ Ibid p 15

The above table demonstrates that the SHGs of the 4 divisions of Karnataka States numbered 130000, which started their production process with zero balance. Similarly SHGs have been involved in using various types of forests resources locally available to initiate production. By selling the products they could earn an income and save surpluses after meeting consumption needs and liabilities. They have been able to keep Rs.942.3 crores in the bank. The saved amount in Bangalore division was Rs.397.74 crores which accounts for 42 percent, in Belgaum division it was 189.59 crores, which accounts for 20 percent in Gulbarga Division, it was Rs.160.37 crores, which accounts for 17 percent and lastly in Mysore division it was Rs.191.6 crores which accounts for 21 percent. Furthermore these groups have taken out loans from various banks to meet their needs to the extent of Rs.1181.69 crores. The four divisions SHG's borrowed amount was Rs.541.03 crores, Rs.242.97 crores, Rs.139.92 crores and Rs. 257.77 crores respectively, which accounts for 46,21, 21 and 21 percent respectively. All the SHGs have repaid the entire bank loan within a specified period so the repaid amount of the SHGs was Rs. 1373.81 crores (including interest part). The repaid share of the 4 divisions was Rs774.46 crores, Rs.172.13 crores, Rs.130.38 crores and Rs.296.54 crores respectively and the same was accounted for 56,13,10 and 21 percent respectively.

Besides the bank loan, the SHGs have borrowed finance from the various public and private sector banks and advanced loans to their women members to the tune of Rs2734.71 crores, with figures of Rs.1328.7 crores, Rs.398.32 crores, Rs.320.33 crores and rs.687.56 crores respectively for the Bangalore, Belgaum, Gulbarga and Mysore divisions and which account for 49,15,12 and 24 percent respectively.

The members of the SHGs have also repaid their group loan to the extent Rs.2255.66 crores as on March 2011. The repaid performance was 82 percent in general. The repaid amount of the respective 4 divisions was Rs.116.26 crores, Rs.314.62 crores, Rs.220.63 crores and Rs.603.45 crores, which accounts for 84,79,69 and 88 percent respectively. The repayment performance of the Gulbarga (69 percent) and Belgaum was (79 percent) very low compared to the counterpart divisions.

Forests and Socio-economic Transformation

Social transformation means change in the social status of the households in the society while economic transformation means a change in the consumption habits and which leads to better standard of living of households in the Karnataka State¹⁴. Due to the fact that the governments have been encouraging to the Non-government organizations, self help groups and the service institutions for a decade¹⁵, the forests played a vital role in building the production structure of the SHGs by contributing various forest resources to them. In Karnataka State leading 1.3 laks SHGs are functioning and mainly stands the various forest based resources¹⁶. Many SHGs (0.4 lakhs) depend upon dairy, and the required cattle fodder is provided by the forests. Other SHGs (0.2 lakhs) depend upon Agarbatti, the sandal and other required wood for sticks is provided by the forests. Other SHGs (0.3 lakhs) depend upon the wooden handicrafts such as dolls, carpentry, statues, furniture's, interior decorators and so on. Some of the SHGs (0.2 lakhs) engaged in various type of hand-made embroidery, tailoring, basket, mat making, panipuri, self help serviced hotels, petty business, plantation of

¹⁴Nanjundappa D.M, Area Planning and Rural Development, Associate Publishing House, New Deli, 1981, P.3 and series of lectures delivered by the Author in 1990-1991.

¹⁵ Government of Karnataka, Annual Report, Bangalore 2009-10. P 173

¹⁶ Government of Karnataka op. Cit, various circulars, pp.12-13

anthorium, flower trading, fruit trading etc and for all these activities forests is the main source of production. SHGs (0.2 lakhs) have also been involved in small processing industries, poultry farming, piggery, sericulture, coconut product, yarehulu manure making, khadi products, weaving spinning activities, soil based pots and household cooking products produced by the SHGs of Karnataka.

The female members of the (20 lakhs) SHGs have been living at below subsistence level before the membership of the SHGs, because of their contribution to their households was almost nil. That means zero savings¹⁷. Whereas after becoming SHG members, each female member's average savings per annum was Rs.6800. This is one of the outstanding achievement of the women involved. Their strength and their household contribution is still improving and contributing much towards the socio-economic transformation of the households of either in rural or in urban areas of the state.

¹⁷ Ibid

EFFICIENCY RESOURCES (FOREST AND CREDIT) USED BY SHG'S FOR SOCIO-ECONOMIC TRANSFORMATION OF KARNATAKA ECONOMY

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1. Co-relation of credit and forest inputs

- Credit and forest products are the strong inputs used by the productive units irrespective of the sectors such as primary, secondary and services. Among the various inputs used in the process of production the co-relation between the credit and forest based inputs occupied a decisive place not only in third world countries but also in advanced countries of the global economy

2. Wood fuel save the oil consumption by 22 mm barrel per day.

- About 43% of the total energy(wood) consumed in third world countries by more than 2 billion people is met from wood fuel
- In India about 80 percent of the rural people is dependent on wood fuel for cooking their food and 65 percent of the total fuel wood is collected from the total fields on free of costs and also collected from the forest and community wood lots.

3. Importance of tree crops

- The tree crops form a major source of food in many parts of the world. They provide healthier food and improve the nutritional quality of the present days usual food.
- If the trees are grown and managed properly food production from such a source can be found available throughout the year with little effort and minimum investment

4. Diversification of forest land into farm and domicile purpose in India

- India is though rich in genetic species and eco-system diversity but which is one of the lowest in the world in possession of per capita forest and which is being 0.1 hecter and this is worsen with the increase in population on the one hand and increase in using of more and more forest land for farming as well as domicile purposes on the other hand.

5. Coverage of forest area in South Indian 4 states.

- 4 south Indian states total geographical area was 635780 sq km, among which the Andra Pradesh share was 43 percent, Karnataka share was 30 percent, Tamil Nadu share was 21 percent and Kerala share was 6 percent, the percentage of forest area to the total area during the year 1994, in Andra Pradesh 16.4 percent, Karnataka 16.93 percent, Tamil Nadu 13.13 percent and Kerala 26.56 percent. Including all the four states the coverage of forests area to the total area it was 18.2 percent.

6. Most of the people belongs to weaker sections remained outside the institutional credit in developing world.

- The credit occupied and played a big roll in acquiring the forest products in particular and natural resources in general. The percentage of poor families including small marginal farmers, rural artisans receiving a very small percentage of credit in different parts of the developing world. In some of the African countries nearly one percent of total numbers of borrowers use institutional credit, in Latin America and Asia (excluding Taiwan) 15 percent of poor families only could succeed in getting institutional finance. Nearly 80 percent of the people belongs to the women in particular and weaker sections in general have not possessed institutional credit in these countries

7. Bankers should first help the poor with a bank loan and than expect deposit

- Bankers in these areas can spread the banking habit and encourage thirsty habits to these poor. It is not possible to these groups to save first a certain amount of deposits and then undertake investment in agriculture or allied activities. It would be more realistic to help them with a loan to invest in their well versed occupation and out of the generated income the banks should recover the loans.

8. Objectives of the study

1. Most of the developing countries at global level have been pursuing the policy of inclusion of the exclusives in gainful production and employment activities
2. The exclusive groups have been allowed particularly and involving them in generating the income through the NGOs or SHG's
3. The state and central governments have been encouraging the exclusive groups to bring them in inclusive groups through the interest subsidy, asset subsidy, fixed capital subsidy and so on by implementing various schemes

9. Meaning of women SHGs and its objectives

- The SHGs are the voluntary organizations which have formed by the women members of upto 20 in order to produce single commodity and earn income to solve their common problems such as poverty, unemployment in a particular place.

10. Government of Karnataka's programmes for SHGs

- The women and children development department has been given training to the members of the SHGs about the combination of wood forests trees, soil based resources with the capital goods to be used in the process of production in Karnataka.

11. Production activities of SHGs in Karnataka

- Out of total 140000 SHGs in Karnataka 130000 SHGs have reported to the Government and involving in various activities such as dairy, readymade garments, blanket marketing, marketing of seeds and manure production and sale of papad, spices and agarbatti, production and sale of soap and detergent, various type of handicrafts etc.

12. Bank transaction account of women members in SHGs

- Out of total groups 112900 groups have a good bank linkage and the representation from the different divisions in the state was almost similar. Among the total groups have opened their bank accounts only keeping saved amount, as they have not known anything about bank transaction before the SHGs membership. The total women membership of all the groups in the state was 6.5 Lakhs. The total women population in the state in 2011 census was 2.58 Crores and the population 6.5 Lakhs women became the members of the total SHGs as on march 2011 which accounts for 2.51 percent.

13. Saving performance of the SHGs in 4 divisions of Karnataka state

- By selling the products they could have earned some income, out of which saved some income after meeting the consumption needs and all their liability and they have been keeping money in savings account of the bank to the tune of Rs.942.3 crores, it is one of the achievement of SHG's. The saved amount in Bangalore division was Rs.397.74 crores which accounts for 42 percent, in Belgaum divisions it was 189.59 crores, which accounts for 20 percent in Gulbarga Division, it was Rs.160.37 crores, which accounts for 17 percent, lastly in Mysore division it was Rs.191.6 crores which accounts for 21 percent.

14. Socio-economic transformation means

- Social transformation means change in the social status of the households in the society, economic transformation means a change in the consumption habits and which leads to better standard of living of households in the Karnataka State

15. Most of the SHGs products are Forest based one.

- many of the SHGs (0.4 lakhs) depends upon dairy, the cattle required fodder is provided by the forests, the some of the SHGs (0.2 lakhs) depends upon Agarbatti, the sandal and other required wood for sticks provided by the forests, some of the SHGs (0.3 lakhs) depends upon the wooden handicrafts such as dolls, carpentry, statues, furniture's, interior decorators and so on.

16. Forest is the main source of hand made products in Karnataka

- The some of the SHGs (0.2 lakhs) engaged in various type of hand made embroidery, tailoring, basket, mat making, panipuri, self help serviced hotels, petty business, plantation of anthurium, flower trading, fruit trading etc and for all these activities forests is the main source of production. The some of the SHGs (0.2 lakhs) have been involving in processing small industries, poultry farming, piggery, sericulture, coconut product, yarehulu manure making, khadi products, weaving spinning activities, soil based pots and household cooking products have produced by the SHGs of Karnataka.

17. SHGs have been helping much for socio-economic transformation of Karnataka state.

- After becoming the membership of the SHGs each women member average savings per annum was Rs.6800. It is one of the outstanding achievement of the women member. Their strength and their household contribution is still improving and contributing much towards the socio-economic transformation of the households in rural or in urban areas of the state.

Rediscovering Traditional Wood Product Industries in Sri Lanka: Promotion of Cultural Heritage, Improvement of Rural Livelihood and Expansion of Export Earnings

Mangala De Zoysa¹⁸

Abstract

The handicraft sector has become a major contributor to sustainable economic development and the eradication of poverty in local economies. The global handicrafts industry accounts for a market share of more than US\$100 billion. Wood-based handicraft industry is one of the oldest wood product industries in Sri Lanka. With the development of the export industry, the demand for wood-based handicraft products has been increasing rapidly during last few years. One of the main objectives of the establishment of Ministry of Traditional Industries and Small Enterprises Development was the development, marketing and export promotion of handicrafts. Hence the paper review the relevant literature and attempts to discuss the rediscovering traditional wood-based handicraft industries in Sri Lanka in terms of promotion of cultural heritage; improvement of rural livelihood; and expansion of exports.

Sri Lanka's cultural heritage and skilled craftsmanship have had a great influence on the production of handicrafts using natural raw materials, which is essentially a cottage industry. Wooden masks are used for curative rituals and for demon propitiation. Wooden crafts are linked with ancient Ayurvedic concepts of disease causation. A wide variety of traditional drums and musical items are among the other interesting wood-based handicrafts. Ebony carvings of Lord Buddha and elephants are popular in Sri Lanka. All these industries are highly diverse and depend almost entirely on the local wood supply for raw materials, and employ a large number of rural people. Manufacturers adapt to the varying requirements of buyers. These handicrafts are best purchased from the villages themselves or from government run "Laksala" outlets. The wood-based handicraft industry is presently catering to the domestic and overseas markets with the involvement and investment of the private sector. Sri Lankan exporters have adopted testing of handicraft products prior to cross-boundary transportation. Sri Lanka has adopted flexible policies in order to encourage more foreign investment and exports and regularly participates in leading international trade fairs. It could be concluded that the wood-based handicraft industries in Sri Lanka not only make some contribution but also have high potential to promote the cultural heritage, improve the rural livelihood and expansion of exports.

Key words: *Wood-based handicraft, cultural heritage, rural livelihood, exports*

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1. BACKGROUND

Handicraft goods are generally considered traditional creative works made with natural materials and traditional techniques (Wikipedia, 2011). Handicrafts found in Moen jo Daro, Sindh Indus Valley Civilization (3000 BC-1700 BC) are the first known items of this kind on Indian subcontinent (Wikipedia, 2011). Handicrafts are a unique expression of art which represents a culture, tradition and the heritage of a specific country. Every country has its own unique handicraft style continuing diverse historical aspects in beautiful forms of handicrafts. The array of handicraft items is very wide and made up of many different materials. However, wood-based handicraft items are very popular and are in huge demand worldwide due to their excellent craftsmanship. High standards of quality, social and environmentally responsible production as well as cultural authenticity of handicraft play an important role in promoting handicrafts and gaining consumer confidence which will strengthen presence in new markets (UNESCO, 2011). In the wood –based handicraft products sector, items include wooden toys, sport goods, educational items for children, household items, furniture, sculpture and toys, ceilings etc. The handicraft sector is one of the major contributors to sustainable economic development and the eradication of poverty in local economies. Apart from earning revenue, wood-based handicraft industries provide additional employment to the people living in rural areas. The global handicrafts industry accounts for a market share of more than US\$100 billion (Craft Central, 2011)

Wood-based handicrafts have a long tradition in Sri Lanka which has a vast forest resource and a variety of timbers. Sri Lanka has a large variety of traditional handicrafts and tradition of making handicraft is as old as the nation. The wood-based handicraft industry is one of the oldest wood product industries in Sri Lanka (Sri Lanka Export Development Board, 2011). Today the wood-based handicrafts of Sri Lanka include the adaptations of the traditional and contemporary handicrafts during the long and eventful history since 800 BC and under numerous foreign invasions, especially by South India; and by three European nations, the Portuguese, the Dutch and the British (Wijeratne, 2011). The industry depends entirely on the local wood supply. Most wood-based handicraft manufacturing companies are small-scale enterprises with low volumes of production that cater the domestic markets, foreign tourists as well as target export markets (Perera and Vlosky, 2009). A wide range of exclusive wood-based handicraft items combine utility and beauty adding elegance to the lifestyle. Gift boxes, toys, educational items for Montessori school children, household items, wall hangings, fancy jewellery, figurines, sculpture, lacquer products, ornamental products and seasonal decorations are some of the woodcraft items produced in Sri Lanka (Sri Lanka Export Development Board, 2007). With the development of the export industry in Sri Lanka, the demand for wood-based handicraft products has been increasing rapidly during last few years. The wood-based handicraft sector in Sri Lanka has a customer base in many countries such as Australia, UK, Germany, France, Japan, Middle East, New Zealand and USA.

For this reason, efforts to rediscover traditional wood-based handicraft industries in Sri Lanka has become a practical importance with the view of social and economic development of the country while preserving cultural heritage and the natural environment. This paper reviews the relevant literature through a search methodology and attempts to discuss the rediscovery of traditional wood-based handicraft industries in Sri Lanka in terms of promotion of cultural heritage; improvement of rural livelihood; and expansion of exports.

2. PROMOTION OF CULTURAL HERITAGE

2.1 Recognize Important Traditional Wood-based Handicrafts

The history of Sri Lankan wood-based handicrafts dates back several millennia. Sri Lanka has ancient ties with India and has a close relationship with its cultural styles of handicrafts. Sri Lanka's cultural heritage and skilled craftsmanship have been passed down through the ages and have had a great influence on current wood-based handicrafts (Sri Lanka Export Development Board, 2007). A wide range of handicraft items made of wood combine utility and beauty and elegance. Wall hangings, fancy jewelry, figurines, sculpture, lacquer products, gift boxes, toys, educational items for pre-school children, household items are some of the woodcraft items produced in Sri Lanka

Carvings of Lord Buddha: The three dimensional carvings of ebony Lord Buddha are popular in Sri Lanka. Sri Lanka's arts and crafts including the traditional wooden handicrafts are largely influenced by the beliefs and customs of Buddhist culture. Most Sri Lankan arts originate Buddhist religious beliefs, represented in many artistic forms including wood-based statues of Lord *Buddha*

Elephant Carvings: Wood-based elephant carvings are the most popular handicraft item in Sri Lanka as elephants play a key role in Sri Lankan culture, religion and history. The expert craftsmen can turn a log of wood to a figure of an elephant almost looking alive with only the help of a chisel and mallet. They are made of Mahogany, Ebony, Teak, Nadun, and Coconut. They can turn a hard kernel of the log of Ebony wood to a figure of a black elephant almost looking alive with the help of a chisel and mallet.
(<http://www.mysrilanka.com/travel/lanka/art/handy.htm>)

Traditional Drums: Wide variety of traditional drums and musical items are among the other interesting wood-based handicrafts. Sri Lankan Drum Tradition is believed to go as far back as 2500 years. Although in ancient times there were some 33 different types of Sri Lankan drums, today one will find only about ten and the rest are known in name only. The Drums in use today are: Geta Bera (Bera Drum), Yak Bera, Davula, Thammattama, Udakkiya, Dakkiya, Bummadiya, Hand Rabana, Bench Rabana, Dandu Beraya. The drum is turned out of wood taken from the Kohomba, Ehela, Kitul, Jack or Milla trees. The drum is painted with lacquer. Openings on the sides of the drum are covered with skin of a monkey, cattle, buffalo, goat or the stomach lining of a cow. The strings that are used tighten the sides are from a deerskin or cattle skin. The drum is fixed to the waist or hung on the shoulder of the player and the sound is controlled by applying pressure on the strings. The drums are played on both sides with hands; one side is played with the hand while the other side is played with a stick; or played with two sticks. (Asian Recipe.com, 2011).

Traditional Masks: Wooden masks are made out from the timber of the 'kaduru' (Nux vomica or Blazar) tree and the carving of the mask is a tradition that passes from generation to generation. Kaduru trees grow in the marshy lands bordering paddy fields. There are three main types. The wood used for these masks is called "Diya Kanduru" (nux vomica or Blazar). The reason for using Diya Kanduru is for its lightness, durability, non-cracking, resistance to insects and easiness of carving. The masks are colorful creations with faces of gods, humans, demons and beasts and are used mostly in religious processions and offerings. The masks have colorful hues and details painted in bright colors. Different traditional masks including the devil masks will even last for 150 years which indicates the quality of the

wood-based handicrafts (Paranamanna, 2011). Historically, wooden masks each have their own distinct characteristic style and shape (Naga, Gurulu, Mayura, Gini, Raaksha, Dahaata sanniya, Kolam, Nadagam). These masks make colorful and dramatic interior décor of truly authentic value. Three different types of masks are used for different purposes such as: 1. Sanni mask: Sanni means sickness and there are 18 sicknesses hence there are 18 sannu masks; 2. Kolam mask: Kolam mask used more in dramas and commonly seen in the Southern part of Sri Lanka. "Aatha Kolama, Arachchi Kolama, Police Kolama, Jasaya and Lenchina are some of them; 3. Raksha mask: Used in many functions and features comes as Gurula Mask (Gurula is a mythical bird), Cobra mask, Peacock mask...etc. (<http://www.mysrilanka.com/travel/lanka/art/handy.htm>)

Puppets: The history of puppetry in Sri Lanka can be traced from the 19th Century. Wooden make-shift dolls an ancient form of art carving out intricate details on the faces of the dolls and dressing them to look like actual humans. A puppet interprets the Sinhala term 'rukada' the human figures made out of wood, as image and dancing doll. 'Rukada' and means 'miniature figure' or 'replica' or 'doll'. The puppets are carved in a variety of wood particularly 'kaduru' (Nux vomica or Blazar) that happens to be light in weight and easy to carve on. The people have great interest in puppetry and pay gratitude to the traditional artists who preserved this form of ancient traditional art (Cader, 2011).

Cane and Other Products: Cane products like tiny baskets and jewellery boxes are neat and strong. Wood-carved decorative panels are used widely in Sri Lanka in the trade of interior decoration too. Traditional craftsmanship of all types of Sri Lankan traditional handicraft and related products made from well seasoned indigenous wood which are pest and insect free and the products are everlasting. Wooden handicraft industry usually uses timber species such as Jack, teak, mahogany etc., which are mostly obtained from home gardens and well managed forests (Sri Lanka Export Development Board, 2011)

2.2 Facilitating Curative Rituals and for Demon Propitiation

Wooden traditional masks are very much a part of Sri Lanka's culture and folklore. The masks are originally used for curative rituals and for demon propitiation. There is a strong and undying connection between religions with tradition masks that afford curative power for physiological problems and they were used in rituals, dramas, and curing sickness, and other fine creations mastered by the articulately skilled artisans (Senevirathne, et al., 2010). Wooden mask making is a specialized craft of the southern province. These masks were originally used for curative rituals and for demon propitiation. Popular wooden handicraft masks of the "Yakun Natima" and other dance rituals of Sri Lanka are carefully crafted ritual with a history reaching far back into Sri Lanka's pre-Buddhist past. Carved from wood and pigmented with natural hues and resins, the wooden masks are infused with a spirit and animation which command attention. Ritual performances use each mask for a specific purpose and it is believed that masks provide curative benefits for physiological problems. Sanni mask represent 18 sickness, Kolam mask used more in dramas such as Aatha kolama, Arachchi kolama, Police kolama, Jasaya and lenchina. Raksha mask used in many functions and features comes as gurula mask (gurula is a mythical bird), Cobra mask, Peacock mask etc. (Senevirathne, et al., 2010)

2.3 Popularizing Carved of wood Combined Ancient Ayurvedic Concepts

The yakun natima, or devil dance ritual of Sri Lanka is a carefully crafted ritual combining ancient Ayurvedic concepts of disease causation with deft psychological manipulation. “Ayurveda” is not only a form of medication but also a total way of life which is a gentle method of treating the root causes of illness in both mind and body. Medicated steam bath is specially recommended for certain skin diseases, to eliminate impurities from the body and to reduce fat. Herbal roots heat the body thoroughly in a traditional Margosa (Azadirachta Indica) wooden box. The head stays outside the box and thus remains cool. The curative effects of the herb vapours penetrate the skin, while waste products are excreted with the sweat. (<http://www.lanka.com/sri-lanka/ayurveda-sri-lanka-101.html>)

2.4 Performing Traditional Dancing and Procession

Mask Dancing: The traditional mask is an ornamental facial decorative wear used in entertainment and dancing in rituals, dramas, and curing of sickness and disease (<http://www.mysrilanka.com/travel/lanka/art/handy.htm>). Traditionally wooden masks were used for curative rituals and exorcism. Today, masks are more commonly seen in religious processions, theatrical and cultural concerts. Drums normally accompany the dances, especially the mask dancing connected with rituals and the folk play Kolam. During the ancient times drums were used for pleasure and rituals, as well as used in the Buddhist Temples for the many ceremonies. Some of the functions are: Ana Bera - to inform the people about orders from the King; Vada Bera - drums played when a criminal is taken for beheading; Mala Bera - drums used in a funeral procession; and Rana Bera - drums used by the army when going out to meet the enemy (Asian Recipe.com, 2011). Bench Rabana is the biggest of the drums used in Sri Lanka. The special feature of this drum is that it is played at a time by two or more people. They use both hands. This drum is commonly used presently for New Year festivals and there are many special rhythms played on them. It is mostly played by women. Even the present society both in villages and cities commonly use drums on special occasions during the life span of people, from their birth to the death. Drums are often used in the Buddhist Temples as well as in government and private places for the many ceremonies. Mala Bera drums are still used in almost all funeral processions (Asian Recipe.com, 2011),

Puppets Dancing: The Sinhala terms ‘rukada keliya’ and ‘rukada natima’ mean a puppet show. There is ample evidence in literature to prove that puppet shows had been a form of entertainment which was popular by the year 1832. The master puppeteers and vocalists make these wooden dolls walk, talk and behave like humans. The public who come to view the puppet shows are entertained with re-enactments of incidents that occurred in the village or in many instances characters found in Buddhist literature and chronicles are added. Puppetry is said to have begun in the Southern part of Sri Lanka where the village people preserved puppetry with sheer dedication, passion and love (Cader, 2011). There is a great deal of talent in the artistes that keep puppetry still alive. The efforts made to combine dedication of the puppeteer families that live in all corners of this island who have come forward to support and keep the tradition alive (Cader, 2011). The Traditional Puppet Art Museum was inaugurated in 2007 in the hopes of keeping the tradition alive and reviving the old form of art. The Museum hopes of keeping the tradition alive facilitated by the Department of Cultural Affairs as well as the Arts Council of Sri Lanka. Many school and university students visit the puppet museum and never get tired of watching the plays and entertainment.

3. IMPROVEMENT OF RURAL LIVELIHOOD

3.1 Preservation of Traditional Technology and Cottage Industry

The production of wood-based handicrafts is essentially a cottage industry. The Sri Lankan Handicraft industry reflects traditional craft skills, cultural and religious values of local people. Many kinds of wood-based handicrafts are produced in Sri Lanka with technologies gifted from generations. Traditional wood-based handicrafts are produced in different parts of the country as home based cottage industries where intricate skills are passed down in generations. Products are turned out making use of natural raw materials by means of time tested age-old techniques. The traditional skills have been preserved with its purity, resulting in the continuance of characteristic identity of Sri Lanka wood-based handicrafts. The National Chamber of Handicrafts of Sri Lanka founded in 2004 is a private sector association of craftsmen and women who have come together to uplift their business, while maintaining the traditions of Sri Lanka's handicraft industry island-wide which are engaged in the production of handicraft items. "LAKSALA" under the Ministry of Rural Industries and Self Employment Promotion was set up to preserve and develop traditional skill of the craftsmen. "LAKSALA" serves nearly 3500 leading master craftsmen/entrepreneurs producing handicrafts item at Rural/Cottage industry level.

3.2 Supply of Natural Wooden Raw Materials

All the wood products industries are highly diverse in Sri Lanka and depend almost entirely on local wood supply for raw materials (Perera and Vlosky, 2009). One of the major problems encountered by the producers of wooden handicrafts today is dwindling supplies of timbers such as ebony and quality soft and hard woods. With the high cost of wood raw materials and the increasing price of logs, the profit margin of handicraft industry is reduced. The entrepreneurs try to trim production costs by lowering workers' wages, bringing them to the verge of poverty. The government has to intervene to rectify this shortfall by creating special plantations for sourcing raw material for the wood craft, especially to protect natural forest resources of the country.

3.3 Creation of Employment Opportunities

At present a large number of craftsmen engaged in the production of traditional wood-based handicrafts. The wood-based handicraft industry in Sri Lanka employs a large number of people in both urban and rural areas. There are over 9000 wood-based handicraft industrial plants employing around 28,000 people (Sri Lanka Export Development Board, 2011). The Kandyan Arts and Crafts Industrial Centre manufactures, deals and exports traditional Sri Lankan handicraft items including wood-based handicrafts. The center directly employs 30 highly trained personnel and over 6000 traditional handicraftsmen (http://www.kandyanarts.com/about_us.php, 2011)

3.4 Market Promotions and Increase Income

The growth potential of the wood-based handicraft industry is very high in view of increasing per capita income in the domestic market and high demand in foreign markets. Miniature replicas of the low-relief wood carving and other handicrafts done by the traditional woodcarvers can be bought at fair prices. The industry is dominated by private sector enterprises accounting for about 95 percent of the total market share (Chandrasiri, 2009).

These crafts are best purchased from the villages where they are produced as well as from the government run “LAKSALA” outlets. LAKSALA is the only state owned organization in Sri Lanka providing marketing and export promotion of handicrafts through 14 provincial purchasing points and 23 sales outlets. Visitors can buy traditional handicrafts being displayed at these craft villages in Battaramulla and Sigiriya. Talented craftsmen produce these items while using the common facilities available at these centers and market their products at these villages (Sri Lanka Export Development Board, 2007). Many wood-based handicrafts have a good demand from the many tourists and the producers earned a good profit from the crafts. A traditional mask manufacturer earns about Rs. 40,000 a month by selling masks to ‘Laksala’. There is an increase in monthly income during the festive season between November and February with the arrival of tourists to Sri Lanka.

4. EXPANSION OF EXPORTS

4.1 Worldwide Publicity

Sri Lanka has gained a worldwide reputation for its ancient tradition of wood-based handicrafts (Senevirathne, et al., 2010). Sri Lanka regularly participates in leading international trade fairs such as the Frankfurt International Trade Fair ‘Ambiente’ and ‘Nuremberg International Toy Fair’ in Germany. Many buyers visit the Sri Lanka pavilion at these fairs and are impressed with the product quality and price (Sri Lanka Export Development Board, 2007). The Sri Lanka Export Development Board recently launched the official website of Sri Lanka Expo 2012, www.srilankaexpo.com, which gives a high level of publicity to wood-based handicrafts. Private sector industries also give publicity for their wood-based handicrafts through their professionally designed websites. The Traditional Puppet Art Museum in Sri Lanka has achieved international standards in the art scene and opened many doors for Sri Lankan puppetry in many foreign venues. Many local and foreign school and university students visit the Traditional Puppet Art Museum and spend hours listening to the stories and explanations.

4.2 Product Development

Due to evolving consumer tastes and trends in the changing world scenario, the wood-based handicraft industry requires changing designs, patterns, product development, and production techniques in the face of fast growing global competitiveness. Manufacturers also have the flexibility to adapt to the varying requirements of buyers and product to suit their requirements. However, Sri Lankan handicraft manufacturers have the advantage of servicing a thriving and emerging tourist market and are therefore exposed to the different requirements and tastes of a large cross section of buyers from overseas markets (Sri Lanka Export Development Board, (2007). The Wooden toy industry in Sri Lanka is an established industry with over 50 exporters and over US\$ 70 million annual exports. Most of the products are value-added products with value addition depending on the design, method of production, and quality of the final product (Chandrasiri, 2009).

4.3 Market Expansion

The wooden handicrafts industry presently caters not only to the domestic market but also to overseas markets. Tourists can find excellent collections of Sri Lankan handicrafts in shops and stores throughout the country. Foreign tourists can gain a valuable insight into the manufacturing process of the handicrafts at the “Craft Villages” in Battaramulla and Sigiriya

and also have opportunity to purchase items in one place (Sri Lanka Export Development Board, 2007). Sri Lankan exporters in the past served niche markets with limited production capacity. Although they have potential to penetrate into new foreign markets, they do not properly invest in marketing or advertising their products. The main reasons for less of export capacity are the difficulties in meeting buyer-required product volumes and maintaining timely delivery of orders (Perera and Vlosky, 2009). Recently, wood-based handicraft exporting has become an emerging sector in Sri Lanka with the involvement and investment of the private sector (Weerawardena, 2003). Sri Lankan exports handicraft mainly to the U.K., USA, India, Maldives, Saudi Arabia, France and Germany (Sri Lanka Export Development Board, 2011).

4.4 Maintain Standards and Quality Assurance

Quality-oriented woodcarving manufacturers pay exquisite attention to the detailed needs of both local and foreign buyers. There are many leading exporters of wooden-based handicrafts in Sri Lanka. Their products are manufactured by highly skilled and experienced craftsmen and they supply high quality products to foreign customers. They are capable of manufacturing quality products to customer specifications. Furthermore the products are biodegradable and thus environmentally friendly in both sourcing and disposal. Wood-based handicrafts made using FSC certified treated wood at the international quality standards have also become very popular and created a heavy demand from international markets (Sri Lanka Export Development Board, 2011). Sri Lankan exporters have adopted phytosanitary testing handicraft prior to cross-boundary transportation to control for dispersion of pests and destructive organisms which can be transmitted with wood products and packaging materials (Perera and Vlosky, 2009).

4.5 Government Commitments

The Sri Lanka Handicrafts Board better known as “LAKSALA” was established on 17th January 1983, under the National Crafts Council & allied Institutions Act No. 35 of 1982. One of the main objectives of the Ministry of Traditional Industries and small enterprises development, which was established on 30th April 2010, is the development, marketing and export promotion of handicrafts. Sri Lanka has adopted flexible taxes and policies, and export of wood-based handicraft products are exempted from duties or subjected to concessionary duty rates in order to encourage foreign investment and exports (Perera and Vlosky, 2009). The export Development Board (EDB) worked out several measures to provide policy support on export development, quality standards, and import policies to promote wood-based handicraft industry. Similarly, the Ministry of Industrial Development and Ministry of Rural Industries offered policy support on import of machinery, production technology and supply of raw material. Ministry of Technical and Vocational Training offered skill development programs (Chandrasiri, 2009).

5. CONCLUSIONS AND POLICY IMPLICATIONS

Sri Lanka promotes its cultural heritage through traditional wood-based handicrafts; facilitating curative rituals and for demon propitiation; popularizing wood carving combined with ancient ayurvedic concepts; and performing traditional dancing and procession. Wood-based handicrafts have improved rural livelihoods to some extent by preserving traditional technology and cottage industry; creating employment opportunities; market promotions and

increasing income. Worldwide publicity; product development; market expansion; maintenance of standards and quality assurance; and government commitments have made some contribution to the expansion of the exports of Sri Lankan wood-based handicrafts. Expansion of local wood supplies for raw materials; maintaining products with high quality standards; investing in marketing and promotional activities to promote products at competitive market prices are required to rediscover the wood-based handicraft industry in order to make contribution to socio-economic development of the country.

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Session 12

[Friday 1st period 1.0 hours - plenary]

Promoting wood culture in the future

Speakers



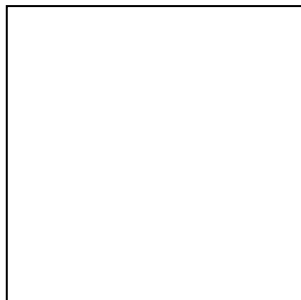
Speaker:
Gabriel Hemery

Topic:
Reviving Britain's lost wood culture



Speaker:
Yang Ping

Topic:
The promotion of wood culture in Japan



Speaker:
S C Joshi

Topic:
Forestry sector at crossroads in India

Reviving Britain's Lost Wood Culture

Gabriel Hemery¹

Abstract

Britain is the second least-wooded country in Europe, having lost its woods after centuries of clearance for agriculture and economic development. Its people are disconnected from the concept of growing trees for wood, even though timber is Britain's sixth largest import. It is argued that there is a lost wood culture in Britain. A number of initiatives have been developed by the Sylva Foundation that together aim to recover Britain's wood culture by helping people to: understand more about sustainable woodland management; allow experts to have a say in policy development; develop a closer relationship for members of the public with trees; and, support and encourage woodland owners to undertake sustainable forest management.

Keywords: wood culture, Britain, education, society, sustainable forest management

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1. INTRODUCTION

1.1 Forest resources in Britain

Forest resource assessments for the UK indicate that the nation is the second-least wooded country in Europe, alongside the Republic of Moldova, with just 12% forest cover (UNECE 2011). Ireland and the Netherlands are equally the least-wooded countries in Europe, each with 11% forest cover, while there are four territories with less cover: Isle of Man (6%), Jersey (5%), Guernsey (3%) and Malta (1%). Some territories have 0% forest cover: Gibraltar, Holy See, Monaco, San Marino and Svalbard & Jan Mayen Islands. At the other extreme Finland is the most-wooded with 73% forest cover, while Sweden, Slovenia, Latvia and Estonia all exceed 50% forest cover (UNECE, 2011).

Within Britain, Scotland and Wales account for much woodland cover; England alone has proportionately the smallest forest area and the least state forest resource in Europe and yet is one of the most intensively used. Compared to the EU average there are over 66 times more people per hectare (ha) of state forest in England. (Forestry Commission, 2011).

An Enquiry on Private Forest Ownership in Europe revealed that on average, across 23 countries in Europe, 50.1% of forests were in public ownership compared to 49.6% in private ownership (UNECE/FAO/CEPF, 2007). Timber utilisation rates were higher in public forests than private forests in all nations except Bulgaria, France and Finland. Britain, in comparison to the rest of Europe, has a very low amount of publicly-owned forests at just 18%.

1.2 A lost wood culture

Despite having a low woodland cover, trees and woodlands nevertheless surround people in Britain, and wood remains important to everyone even though there are many substitute materials available.

In Britain today, people that access or view woodlands do so through a society that cherishes the beauty of the trees in the landscape and the wildlife it supports. Exercise and recreation is encouraged from picnic areas near roadsides, along signposted walks or mountain bike trails. Environmental membership-based NGOs boast of the wildlife value in our woods and celebrate their heritage, sometimes calling for more protection of forests or for more tree planting through magazines and websites. There is little mention of the production of wood in these communications.

It is well known in Britain that woodland owners and foresters can experience considerable negativity from members of the public in response to woodland management or tree felling. Such reactions raise two important questions: (1) the level of understanding among the public about forestry; and suggest (2) a more fundamental question surrounding the culture of growing trees for wood.

In terms of public attitudes to forestry (Q1), the forestry profession has not been always the best advocate. Wood was once the principle material for society but with the reduction of Britain's forest cover to an all time low (5%) at the end of the 19th Century, which coincided with the relentless substitution of wood by manmade materials, we lost our connection with growing trees for wood. The response of the forestry sector was the bold afforestation of the uplands of Britain. With hindsight it is easy to criticise the planting of mono-cultured rows of

alien conifers that took place in the early and mid 20th Century, scarring some of Britain's most valued landscapes, burying precious archaeological heritage, and damaging precious habitats. These activities resulted in a doubling of woodland cover in Britain but this came at a cost to the goodwill of the public. It is my view that forestry is still tarred with this brush today, some 40 years since large scale coniferous afforestation virtually ceased in the UK.

In relation to the culture of growing trees for wood (2), comparisons can be made with rearing livestock in modern farming, although an important difference is that the unsightly aspects of production, particularly slaughter, are hidden from view. The strongest example would be the production of lamb: the joyous antics of the lamb at Springtime attract thousands of members of the public to 'lambing days' on farms and where fields of new born lambs in the countryside attract admiring comments from the public. These same lambs will be culled for the table within a year but this is never mentioned, never witnessed; perhaps out of sight - out of mind. Contrast this with the public nature of woodland management, where the sound of chainsaw and sight of vehicles among the trees may instantly raise the fears and anger of local people.

Yet wood is as popular as ever in modern society as sales boom for 'real wood' flooring and kitchen cabinets, and supply of wood burning stoves has failed to meet demand in recent winters as more and more people aim to cut their energy bills. How can this demand be reconciled with the public's at best, antipathy, and at worst negativity to woodland management? Perhaps a main factor is the certainty that many people will never have considered where the wood they are using may have come from; there is no connection between the wood and a forest of trees in the mind.

A new purpose for forestry is emerging, centred on a role for trees in soaking up carbon dioxide, and in protecting society from environmental damage such as flooding (so called 'ecosystem services'). Increasing concerns about the importation of timbers from endangered forests, especially in the tropics, has led to certification schemes providing certainty that the wood is sustainably sourced. The concepts of 'wood miles' and 'wood security' are as yet muted but it is likely that in the near future the benefits of home-grown wood may become more apparent. Recent evidence has shown that lack of management may adversely affect woodland biodiversity. To meet all these challenges and opportunities, some form of management of our tree resources will be required. Perhaps the greatest challenge is communicating these to both the public and professionals.

2. EXAMPLES OF WOOD CULTURE INITIATIVES

A number of initiatives aimed at tackling these issues have been developed by the Sylva Foundation (www.SYLVA.org.uk); a tree and forestry charity based in the UK. These provide some case studies highlighting the challenges and difficulties in connection with:

1. the perceived public disconnection with growing trees for wood;
2. giving professionals and the public a voice in developing forestry policy; and,
3. the practical difficulties of reconnecting the woodchain in Britain, with its fragmented woodland ownership structures and disconnected wood-based sector.

2.1 Public perceptions on growing trees for wood

In addition to the issues highlighted in the overview above it is clear that a key difficulty in communicating the benefits of sustainable forest management is the complexity of forestry, both in practice and theory. How can the felling of a tree that took three human generations to mature (e.g. 120-150 years for oak) be sustainable? Why do all the trees in an area have to be felled together? Why not fell a tree that had died naturally or was dangerous?

These are most the common questions by members of the public in response to an education initiative run by Sylva, the OneOak project (www.OneOak.info). A mature oak tree, which turned out to be 222 years old, was felled in a plantation grown on the famous Blenheim Estate in Oxfordshire, England. Its felling was witnessed by 450 people who were invited to the woodland, including 250 children, and recorded in detail on film and camera. These activities and all those that have followed to date, such as the milling at a sawmill, replanting at the woodland a year later, and work by wood workers, are being used in a series of exhibitions travelling Britain and broadcast in the media and on the dedicated project website. Sylva have set out to marry science and art in telling the story of sustainable forest management by focussing on the life of a single tree. The science activities have provided detailed information about the tree's age and growth through dendrochronology, a laser scan before felling provided a 3D model of the tree and its precise volume, while a massive effort to weigh every stem, branch and twig after felling provided information on the weight of the tree and ultimately its carbon content (Hemery and Morison, 2010). Dozens of artists have depicted the tree in various art forms, while many more woodworkers have started using the tree's timber to make a wide variety of objects. While the main timbers are still awaiting drying to make them usable for furniture and joinery, already the green (wet) wood has been used in sculpture, in turning and carving, for outdoor furniture and house construction, and even the sawdust has been used in the kitchen of a Michelin-rated restaurant to smoke salmon.

The public exhibitions held to date have provided a platform for Sylva's staff to talk with the public about the concept of growing trees for wood. It is their experience that many people admit, when challenged, that they have a lot of wood in their lives; in their offices and homes. However, many will also admit to never having considered the origins of this timber, either geographically (i.e. homegrown or imported) although reasonable knowledge exists of certification schemes (particularly FSC), and few may have connected their use of wood with the felling of trees in woodland. The graphically potent film and images of the OneOak tree's felling provokes strong emotions and stimulates much debate at the exhibitions. Although data is only anecdotal, it has been clearly evident that for many people they have not been stimulated to think about growing trees for wood in any detail before. It has also been evident that for some, admittedly very few, the very notion of felling a tree with a productive intent, is simply very wrong. When challenged to think about how important wood is to modern society, including in their lives, some people have steadfastly objected to the very notion of felling a tree. Among this minority, there has been a view that only trees that have died naturally should be used by man. The OneOak project has been a small initiative with limited geographic impact. It is obvious that there remains a major communication task to help members of the public understand the sustainable nature of forest management. The diversity of its gifts to society and the environment, are at the same time the complexity causing the lack of understanding by members of the public.

2.2 Giving stakeholders a voice in developing policy

Evidence-based policy-making came to the fore in medicine and has made slow progress into other disciplines. There are many barriers to policy makers being well-briefed, including the difficulties of accessing relevant material, while the distance at which experts can advise and comment can further hinder good decision making. The concept of allowing experts and interest groups to inform policy can be challenging and difficult to achieve practically.

A novel research project by a Graduate student at the University of Oxford, supported by Sylva, set out to identify the top-ranking research priorities relating to forestry in Britain according to experts and stakeholders (the Top Ten Questions for Forestry project or T10Q). An online survey was promoted across a very wide membership, not only commercial foresters but among scientists, conservationists and woodland owners (Petrokofsky et al., 2008). A second phase brought a group of experts together in a workshop to review, rank and condense the questions.

A total of 481 people responded to the first phase survey, submitting 1594 questions, while the workshop was attended by 51 people (Petrokofsky et al., 2010). The first ranked question was “What are the most technically and financially effective ways of identifying, monitoring and controlling invasive species, pests and disease?”. The second ranked question “How can we achieve better understanding between foresters and other parts of society?”. The high rank of this issue was a surprise to many of those attending the workshop.

The resulting top ten questions have raised considerable interest among the sector in Britain, and while the notion of a participatory process in setting research or policy agendas was initially quite challenging for policy makers, the concept is now viewed positively.

2.3 Engaging the public in citizen science

Volunteers have been encouraged to join a new initiative called TreeWatch with the aim of keeping a watchful eye on the health and vitality of trees across Europe (www.TreeWatch.com). TreeWatch is a citizen science project run by the Sylva Foundation with partners, including Earth Watch, Forest Research, Royal Horticultural Society, and the Tree Council. It aims to monitor the health of trees, while also engaging people with trees and the environment.

Our trees and woodlands are increasingly under threat from pests & diseases. Climate change is helping new tree pests & diseases to survive and thrive, while the global trade in plants is spreading new pests & diseases. Keeping track of existing and new threats to trees is expensive; and scientists are increasingly stretched and underfunded.

Volunteers are encouraged to 'adopt a tree' of any species, anywhere. It can be in a volunteer's garden, in their local street or park, or in the countryside. Volunteers can plot their tree on an online map and provide basic information about it, such as its size and history if known. They are then invited to take part in an annual survey of all adopted trees, whilst specific surveys are run from time to time. For example the 2011 surveys were studying horse chestnut leaf miner and European pear rust.

TreeWatch is not a project that focuses solely on trees with a view to the production of wood. It has been developed specifically with a view to broadening the subject of trees and

environmental change to a wider audience than Sylva's other initiatives. It is hoped that it will encourage people to explore their local environment, whether urban forest or wild wood, and thereby start to build a closer relationship with trees and forests.

2.4 Encouraging sustainable forest management

Woodland owners find that management of their trees is sometimes prohibitively expensive. An increase in hobby or leisure ownership means that woodlands are less often considered to be a wood resource, and more often a place for recreation or long term investment in land value. There are an estimated 100,000+ woodland owners in Britain, and some 649,000 hectares of woodlands in England alone without a management plan². The absence of a Government-supported management plan does not of course necessarily mean that a woodland is not being managed, however it is a strong indicator of the likelihood of a lack of management; and the area is staggering.

In an interesting move, in 2009 13 of the UK's eminent environmental NGOs, representing 8.3 million members and 690,000 ha of land, issued a joint statement calling for more woodlands to be brought into sustainable forest management with the aim of halting declining woodland biodiversity³. This is a powerful argument for woodland management for informing members of the public about the benefits of sustainable management, as it dispels the common myth that woodlands are natural and wild in England.

In 2010 the Sylva Foundation launched “myForest” as a web-based service to support woodland owners and wood using businesses across Britain, with the aim of reconnecting the wood chain www.myForest.org.uk. It has the ambitious aim of identifying woodland owners and encouraging woodland management across Britain, by providing online woodland mapping tools for owners, and a management planning template that is closely aligned with Government grants, should the owner wish to link to the regulatory framework. It also provides a wood marketing platform and a directory of businesses. Woodland owners are provided with a library of information about woodland management and linked to local woodland initiatives that can provide practical support, where available.

Eighteen months following the launch of myForest it has gathered 388 woodland owners of 528 woodlands, totalling 8544 ha in area. This is an encouraging start especially when the effectiveness of the service is reliant on uptake by neighbouring owners and wood-related businesses, and therefore its effectiveness before wider uptake is limited. Sylva have found that a number of regional and local initiatives have been keen to adopt myForest as a specific tool for an area (e.g. Chilterns Woodland Project⁴, Ward Forester in Devon⁵).

A wide variety and scale of woodlands have been signed up to the myForest service, from a 3000 ha country estate, to small hobby woodlands of 1 ha or less; the average being 16 ha. A real measure of success will be not only the mapping and mensuration of the woodlands, but the number of management plans produced (and therefore woodlands brought into good condition), and volume of home-grown wood products mobilised.

² Pers. Comm. Head of Woodland Surveys, Forestry Commission. National Inventory of Woodlands and Trees – England.

³ http://www.wcl.org.uk/docs/2009/Link_position_statement_Woodfuel_Strategy_03Jul09.pdf

⁴ http://www.chilternsaonb.org/caring/woodlands_project.html

⁵ <http://wardforester.co.uk>

3. DISCUSSION AND CONCLUSIONS

Four separate initiatives led by the Sylva Foundation have been described that together aim to help people to: understand more about sustainable woodland management; allow experts to have a say in policy development; develop a closer relationship for members of the public with trees; and, support and encourage woodland owners to undertake sustainable forest management. These are relatively small in scale and yet the task of recovering a wood culture in Britain is immensely challenging.

Larger scale projects would be beneficial to achieve greater impact given that the public is increasingly suffering from 'nature deficit disorder' (Louv, 2010). To achieve this scale of impact it is likely that collaboration between the numerous actors in the wood-related sector will need to occur. If this were between those traditionally seen as having contrasting standpoints then this could be particularly effective.

Changes at the strategic level to forestry practise may be beneficial. For instance, the practise of clear felling is often central to any difficulties of public perception towards forestry. At the same time the perceived threat from climate change suggests that our forests would benefit from being more diverse in structure and species diversity. Adopting close to nature forestry practice (for example continuous cover or group selection systems) would minimise landscape and environmental impact, thereby minimising public ill-feeling towards forestry, while leading to more robust forests.

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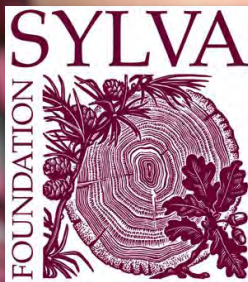
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Recovering Britain's wood culture

Dr Gabriel Hemery FICFor

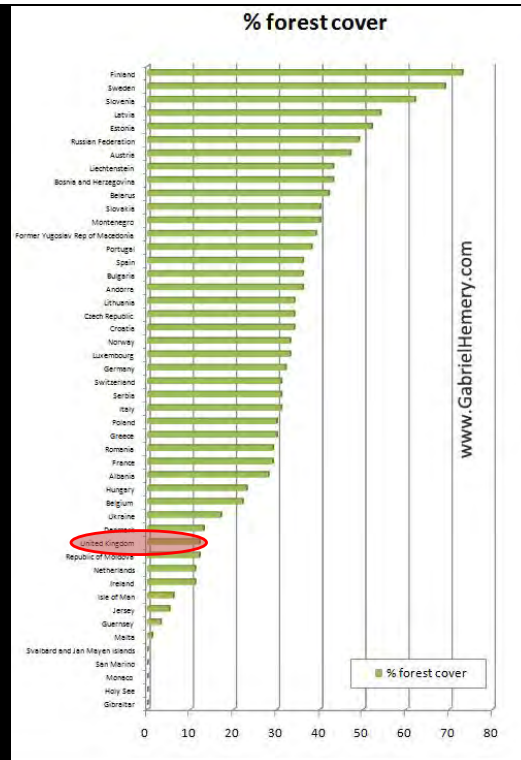


Overview

1. Britain's tree resources
2. Wood culture issues
3. Wood culture initiatives
4. Final thoughts

Britain's tree resources

2nd
least-
wooded



Wood culture issues

Woodlands and ownership ...

$\frac{2}{3}$ neglected

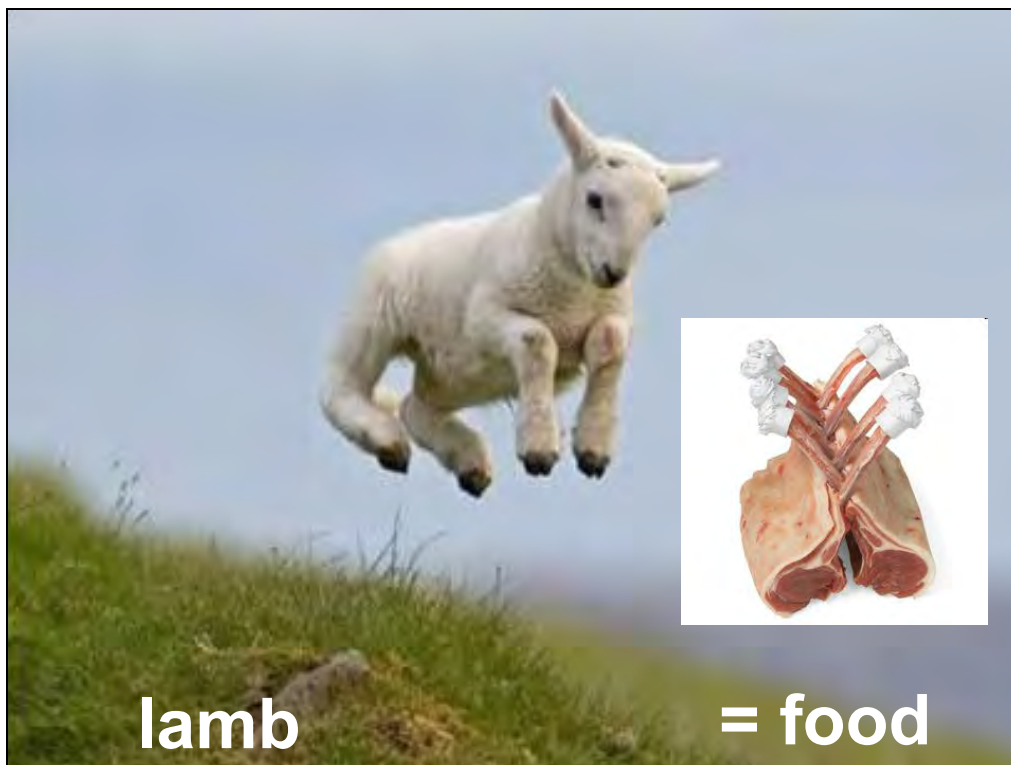
82% private ownership

63,000 owners

General public ...

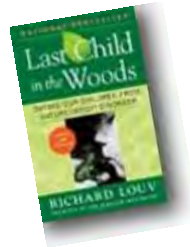
“Forestry”

- Environmental damage from plantation forestry
- Exploitation of ‘natural’ woodlands
- Tropical deforestation





“Nature Deficit Disorder”

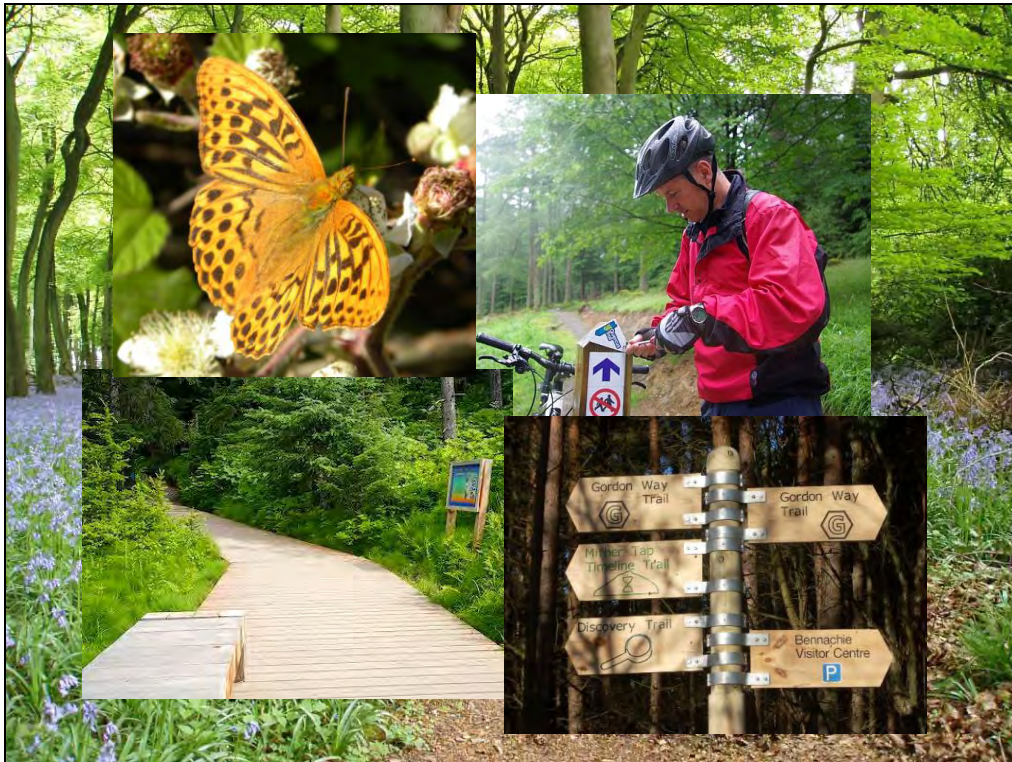


Sustainable Forestry

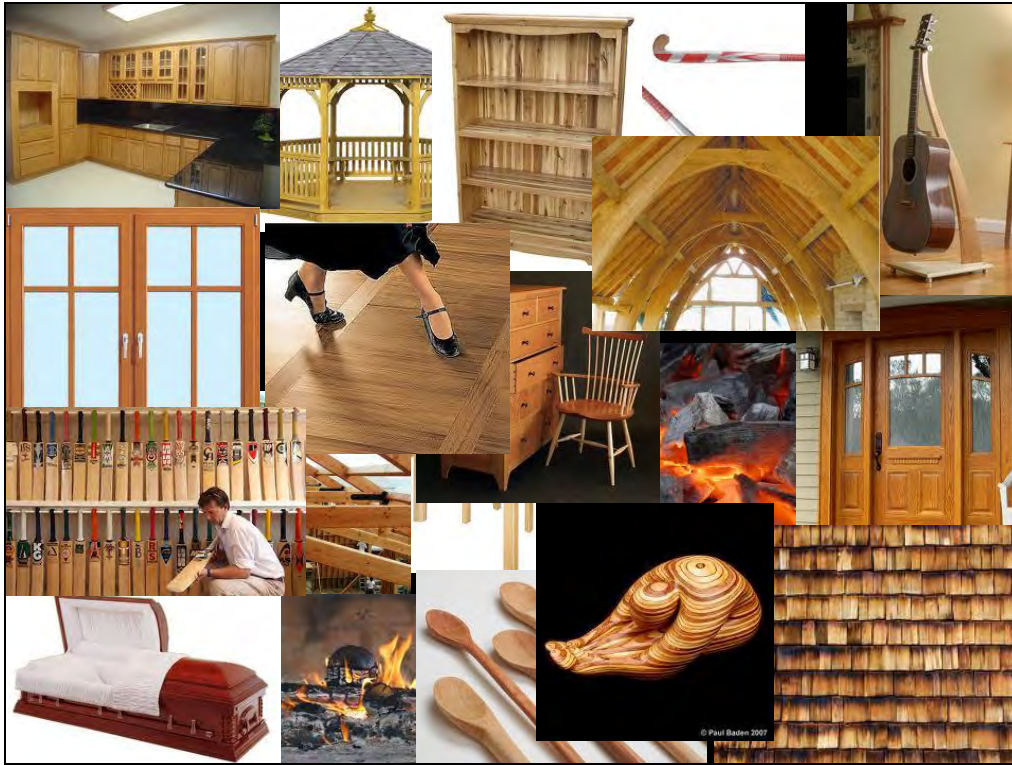
“ ... the stewardship and use of forests and forest lands in a way, and at a rate, that maintains their biodiversity, productivity, regeneration capacity, vitality and their potential to fulfil, now and in the future, relevant ecological, economic and social functions, at local, national, and global levels, and that does not cause damage to other ecosystems”

The BIG *Question ...*

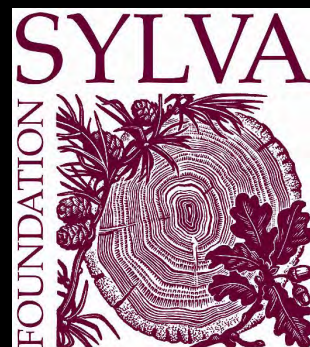
How can cutting down a 100+ year
old tree be ...
sustainable?







Wood culture initiatives



Giving stakeholders a voice in policy

- 1594 questions from 400 respondents
- Top ten questions for forestry research (T10Q)
- Peer review papers

Engaging the public in citizen science

- “Adopt a tree”
- Google map-based: www.TreeWatch.com
- Education + Science

Encouraging sustainable forest management

The screenshot displays the myForest website, which aims to link the woodchain. The header features the SYLVA FOUNDATION logo and the myForest logo with the tagline "linking the woodchain". Navigation links include home, myForest map, blog, forum, about, help, and my account. A user greeting for Alistair Yeomans is visible.

The main content area is titled "Search or browse the map to find wood products and email the advertiser." It includes a "Search Wood Products" section with filters for address/postcode (oxford), search radius (20 miles), species (any), width/dbh (7 cm to 50 cm), and length (1 m to 6 m). A "search" button is provided.

Search results are displayed under the heading "Search results" with "Found 2 results". The results are sorted by distance and date.

Species	Distance	Contact	Width / dbh	Length
Larch, Hybrid - Larix X eurolepis	8.54 miles from you	Richard Pigott 01865 408 018	between 4cm and 8cm	between 0.5m and 0.6m
broadleaf	8.8 miles from you	Alistair Yeomans	between 40cm and 80cm	between 8m and 14m



www.
myForest
.org.uk



- **Woodland mapping and inventories**
 - 9000 hectares / 400 woodland owners

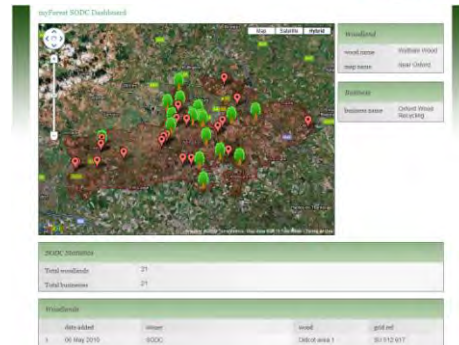


www.
myForest
.org.uk

- Woodland mapping and inventory
- **Woodland management plans**
 - EU Common Agricultural Policy reform



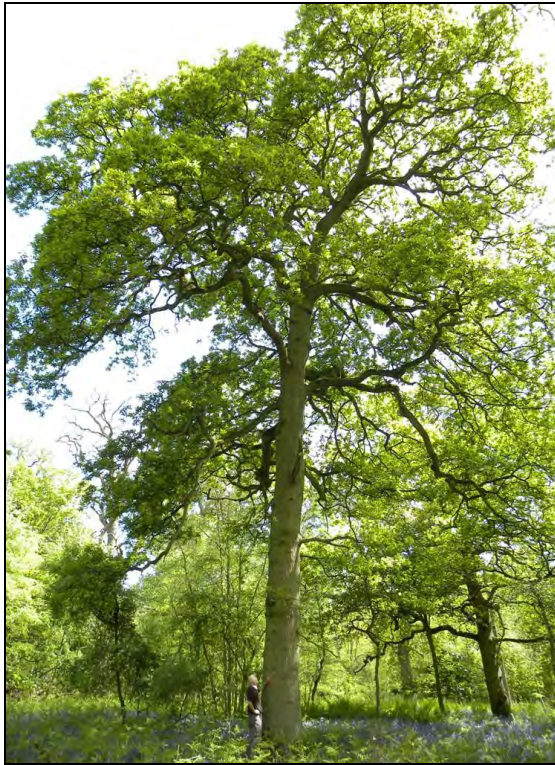
www.
myForest
.org.uk



- Woodland mapping and inventory
- Woodland management plans
- **Wood marketing**
- ***Featured in State of World's Forests 2011***

Public perceptions on growing trees for wood





Following the full life story of one oak tree



www.OneOak.info

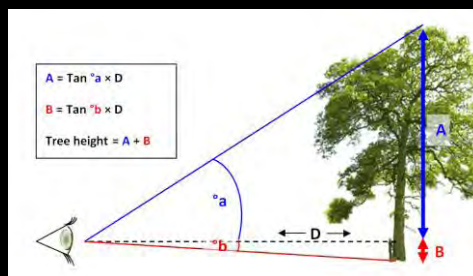
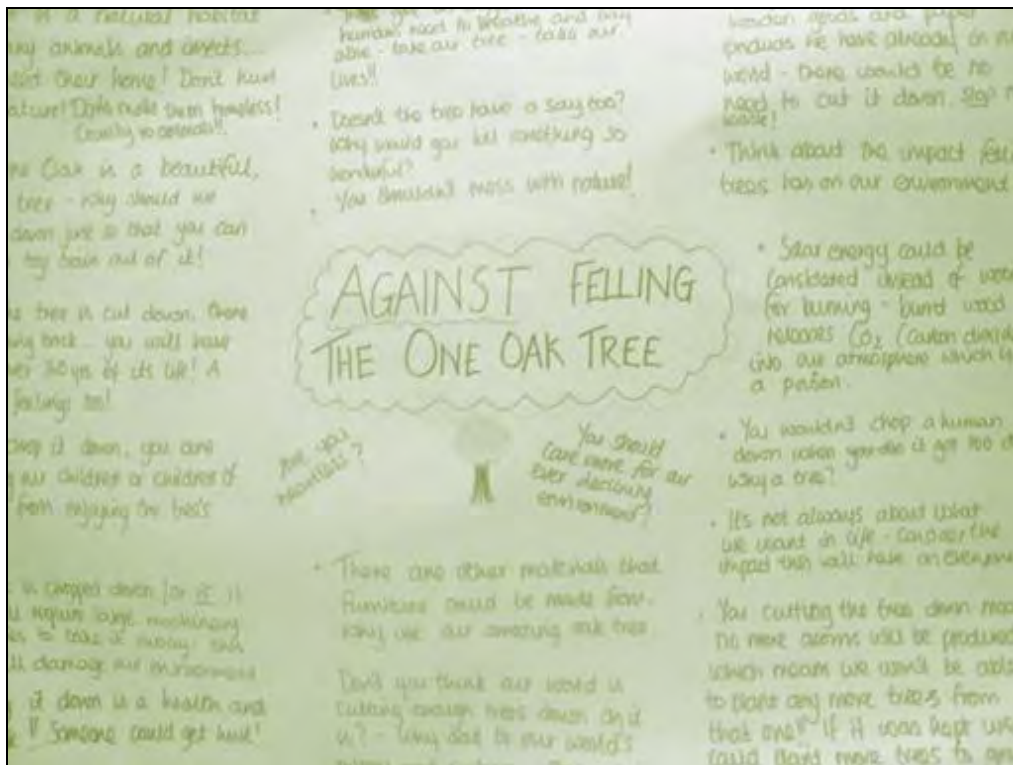


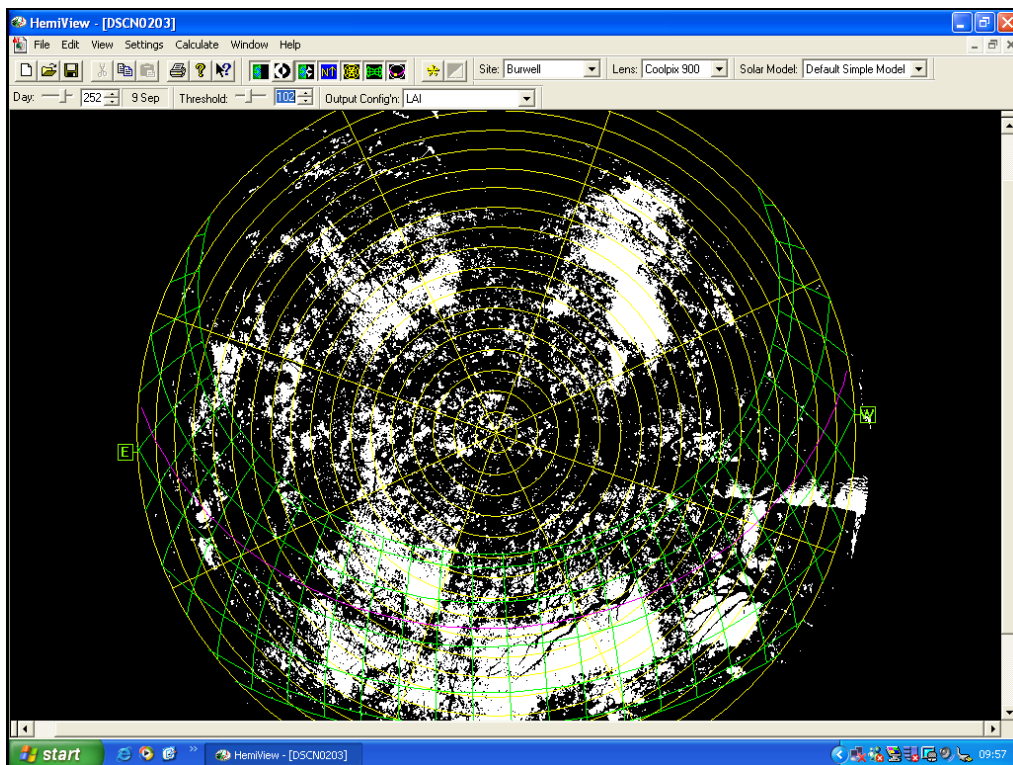
BLENHEIM PALACE

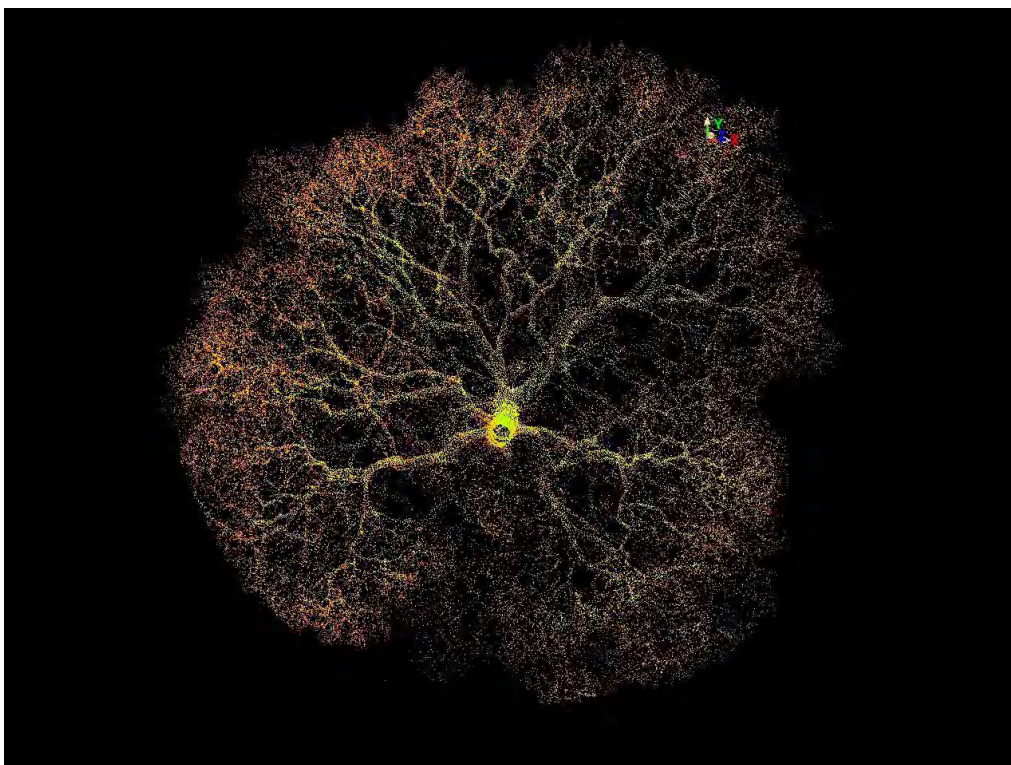
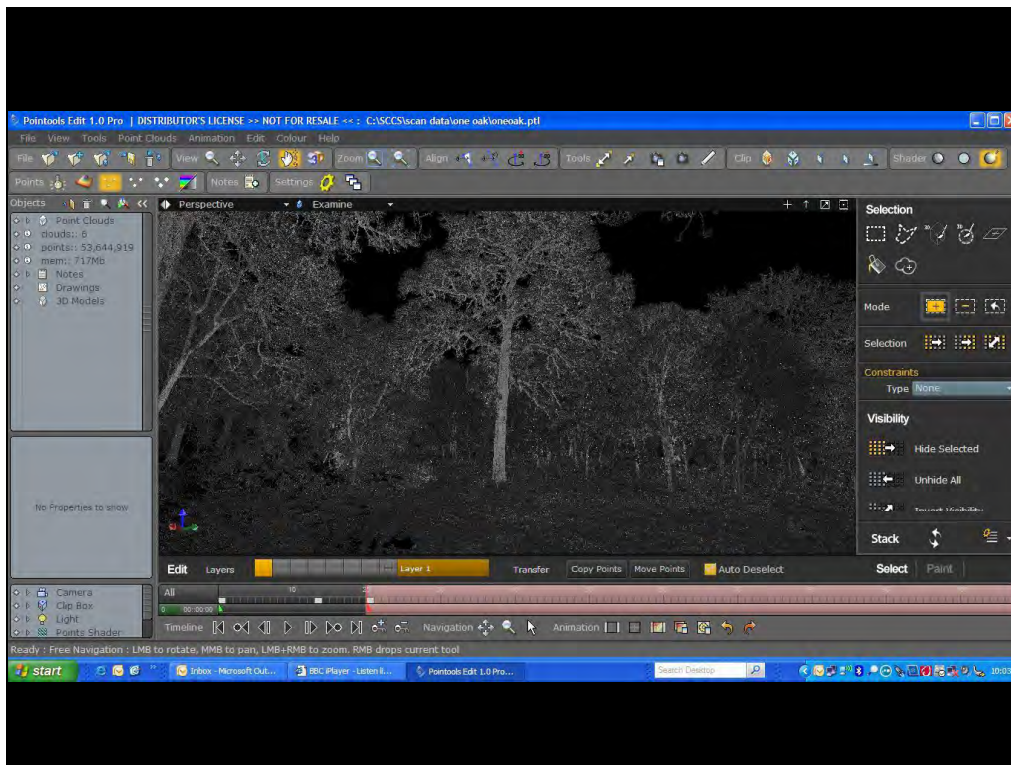


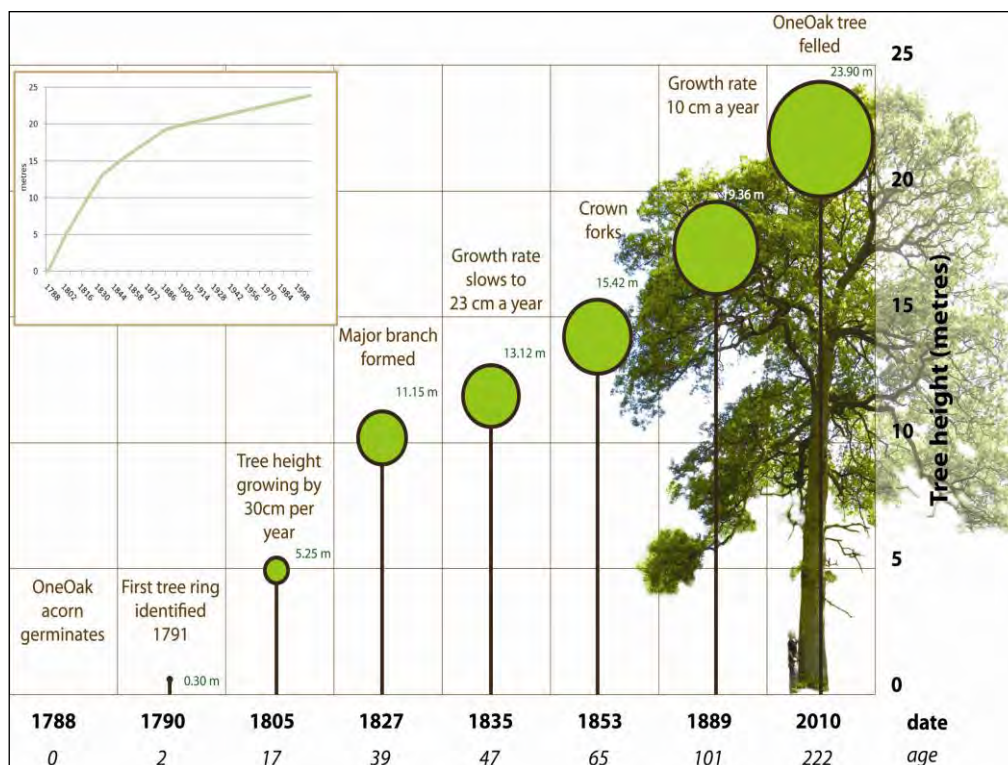
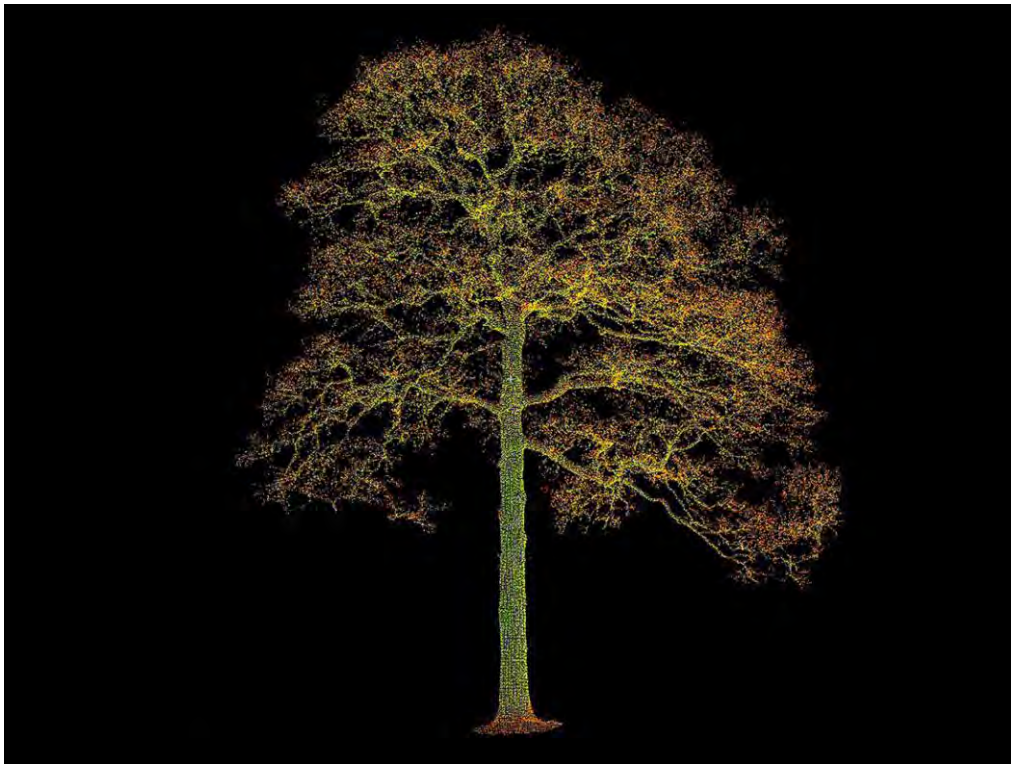










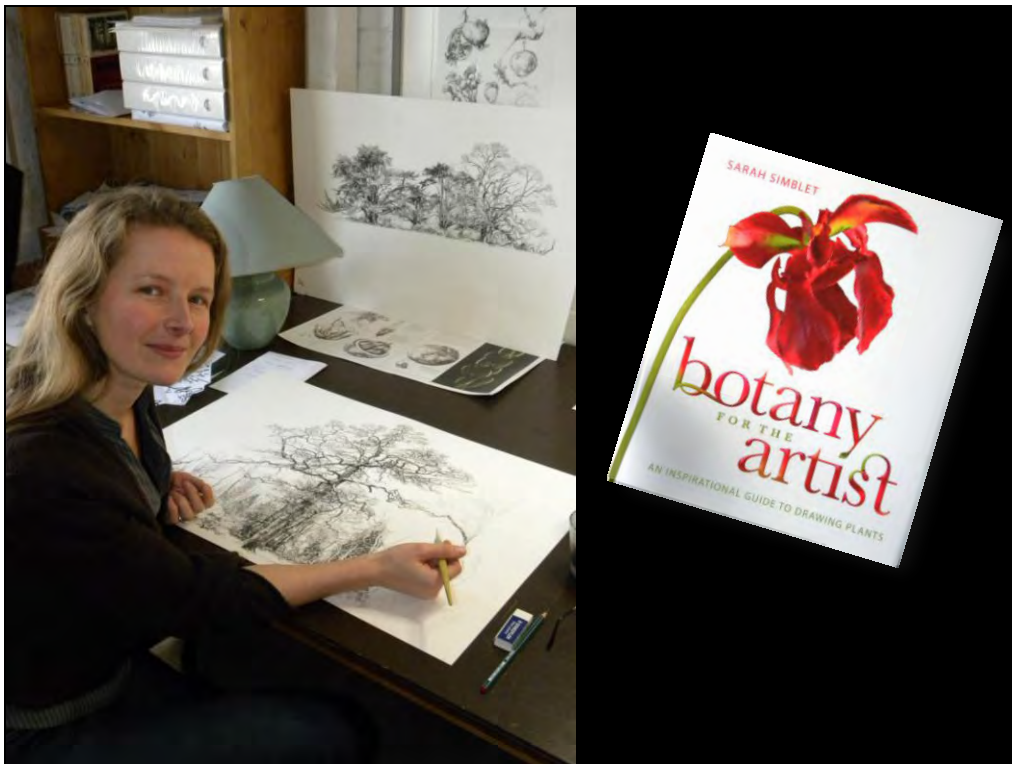




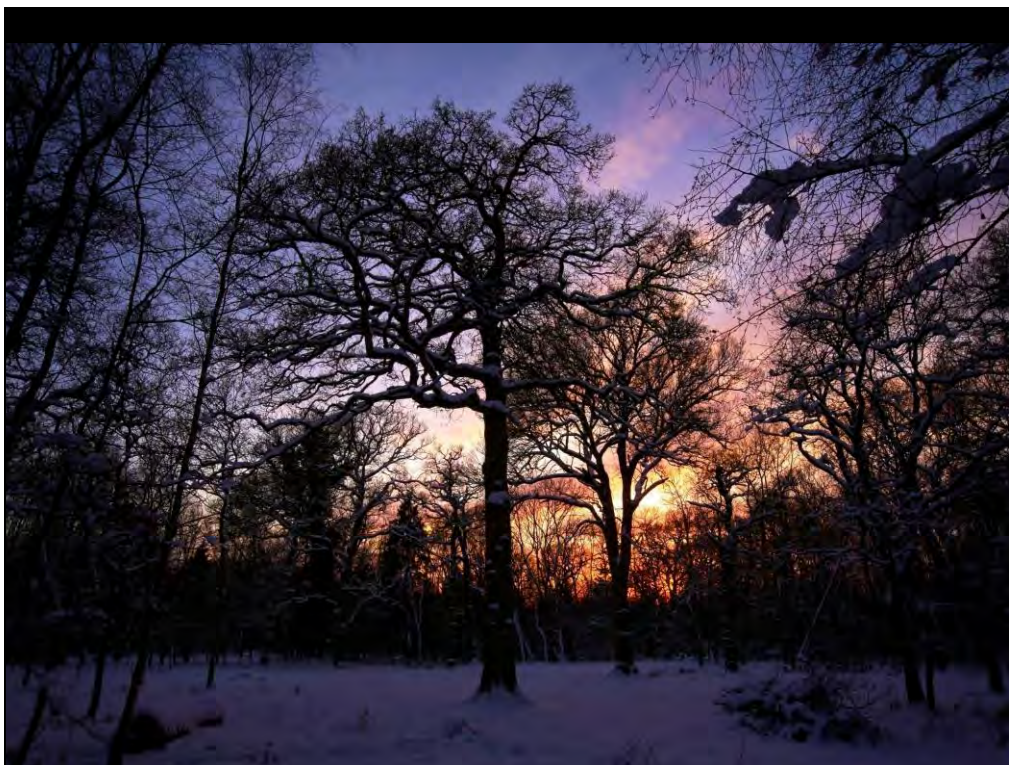
14,385 kg

3.93 tonnes C























le manoir
AUX QUAT'SAISONS









Website

Film
Music
Photos
Blog

Exhibitions

Media

Book

Talks

Final thoughts ...

- **Trees and forests will only increase in importance (e.g. Bioeconomy, climate change, ecosystem services)**
 - **“Nature deficit disorder” an increasing problem if it stifles innovation and activity**
 - **Trees precede civilisation, deserts follow ...**
 - **... But not with *Sustainable Forest Management***
 - **Recovering a Wood culture**
- = rebuilding understanding and trust**

The promotion of Wood Culture in Japan

Yang Ping¹

Abstract

This report describes the promotion of wood culture and educational movements in Japan, which was advocated by the Japanese cabinet as a national strategy intended to inspire all citizens to appreciate wood culture and wood products. Wood educational programs emphasize the multi-step approaches from enjoying woodworking experience to deepening understanding of the benefits of using wood and expanding the creativity in effective use of wood. The establishment of learning programs is targeted towards schools and communities for lifelong education. Such wood culture and educational activities are expected to have a great impact in Japan.

Keywords: wood culture, wood education.

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1. INTRODUCTION

In 2006, a Japanese cabinet decision set forth the national strategy of wood education in the Basic Plan of Forest and Forestry (Japanese Agriculture Ministry, 2006). In order to organize the large scale campaign of wood education systematically, the national institution, Japan Wood-Products Information & Research Center, has taken the lead in collaborating with various social groups. With the aim of encouraging all citizens to appreciate wood culture through lifelong learning so as to deepen the understanding of wood properties, especially realizing the meaning of wood utilization, this nationwide educational movement has been extended to local communities. Its main emphasis is focused on the three multi-step approaches described as touching with sensitivity, making with understanding, and learning through application, respectively. The detailed efforts in promoting wood education in Japan are dealt with in this report, such as the development of wood educational programs and teaching materials, implementation of forums, workshops, wood education instructor trainings, regional wood educational activities, and an All-Japan Championship of Woodworking Skills for Junior High School Students.



Figure 1 Image of wood education flowering in three stepwise approaches

2. EFFORTS IN PROMOTING WOOD EDUCATION

2.1 Development of wood educational programs and teaching material

To improve citizens' wood cultural awareness from the early age, a series of wood educational programs and teaching materials have been developed for children in accordance with the three multi-step approaches of wood education and their specific goals. Sensual activities like feeling wood benefits, enjoying wood amenities, and taking part in wood culture excursions are designed for the first step. Producing activities such as making annual ring puzzle, tissue box and bookshelf are developed for the second step. Learning activities for better understanding the properties of wood such as lessons on carbon storage and experiments of thermal conductivity are planned for the third step. Figures 2 to 4 are some concrete plans in three different phases of wood educational activities, the tips of each plan include time required, target learners, key words, summary and features, examples and goals, relationships with other steps, effective implementation cases, matters to be attended to,

preparation of materials and tools required. Various study units such as wood structure (Figure 5), wooden temple (Figure 6), energy comparison, prevention of global warming, and renewable resource etc, are also included in wood education service package (Japan Wood-Products Information & Research Center, 2009). Additionally, the user manual of woodworking tools including saw, planer, gimlet, hammer, etc. (Figure 7) is also contained in the teaching materials. These are edited with a variety of pictures and illustration for children to easily imagine and understand the proper and safe ways in using tools. All teaching materials can be downloaded from the website of Japan Wood Products Information & Research Center.

Figure 2 Wood culture excursion activity



Figure 3 Activities of making wooden objects



Figure 4 Teaching materials of wood orthotropic properties



Figure 5 Teaching materials of wood structure



Figure 6 Japanese traditional wooden temples

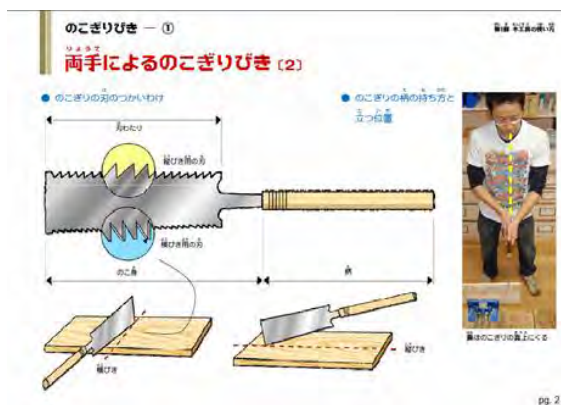




Figure 7 User manual of various woodworking tools

2.2 Wood education forums, workshops and wood education instructors training

In order to achieve the goals of wood education nationwide, efforts have been made to establish a powerful platform for people to exchange information on wood education. Under the leadership of the Japan Wood-Products Information & Research Center, regional wood education forums and workshops have been held nationwide. Additionally, these events were followed with instructors training including lectures on wood education, practice of woodworking, individual final action plan presentation, and training certificate delivery ceremony.

To promote instructors' ability in wood education planning, preparation and implementation, a two day training program covers the following curriculum:

- Lecture on the social mission of the wood education instructor
- Lecture on planning of wood educational activities
- Lecture on implementation of wood educational activities in details
- Lecture on essential knowledge and skills of wood education instructor
- Guidance of safe operation
- Experiments on wood science and its environmental characteristics
- Practical guidance of wood education
- Practical planning of wood education activities
- Woodworking skills training

A variety of trainees have participated the training course, including university students, in-service teachers, employees in public or private sectors and some housewives. The final task for trainees is the presentation of a detailed wood education plan for a group of twenty elementary school fifth graders in a local community hall furnished with tables. The duration is set as two hours and takes place for three consecutive Saturdays. However, the available costs for materials should be less than 1,000 Japanese yen. Up until the present time, over one hundred participants throughout the country have received certification as qualified wood education instructors. This plays an important role creating an appeal to a large public so as to gain a social consensus of wood education nationwide. The Japan Wood-Products Information & Research Center has supported these regional wood education plan financially.

2.3 Regional wood educational activities

To encourage children's interest towards wood, a fascinating opportunity for them to enjoy wood hands-on activities (Ping, Y, and Hirotsugu, T, 2009) has been provided every year since 2005. The application of shape memory characteristics of wood is the key of the workshop. The porous structure of wood enables a large compressed deformation perpendicular to the grain without the occurrence of failure in wood cell wall when it is loaded after softening enough in hydrothermal state with high moisture and temperature. Such compressed deformation can be fixed temporarily under loading and drying (drying set) (Masafumi, I, et al., 1993). However, deformation would disappear completely when it is placed in hydrothermal state again. This feature of so-called shape memory characteristics of wood under hydrothermal action is illustrated in Figure 8.

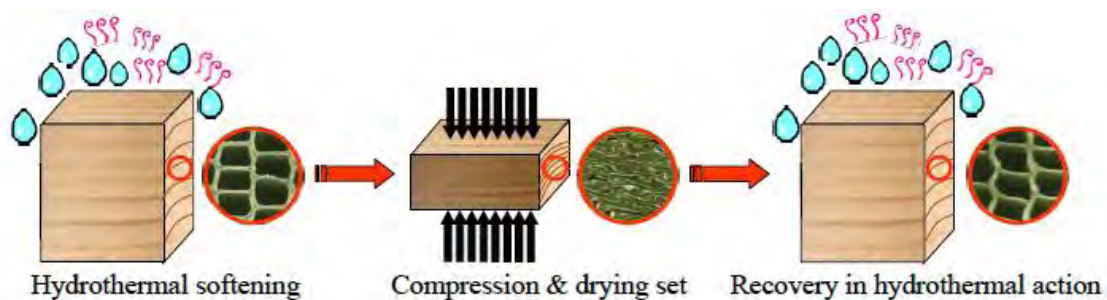
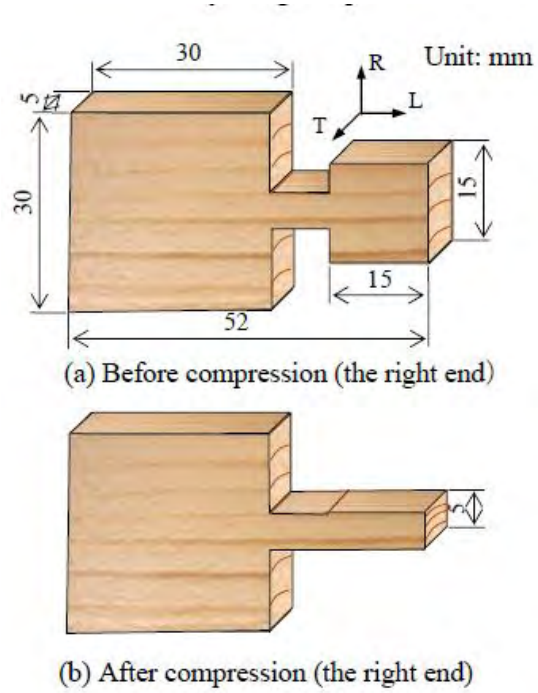


Figure 8 Schema of shape memory characteristics of wood

Activities for kindergartener or lower grades of elementary school accessory involve harnessing such unique hydrothermal features of wood. The compressed wood piece (Figure 9) was prepared at a size designed for making a strap in 5 mm thick along tangential direction (T), 30 mm wide along radial direction (R), and 52 mm long along longitudinal direction (L). Its left end, at 30 mm by 30 mm square area, was designed for children to draw what they like, which would be shaped out later to their favourite figure. In advance, after boiling in water for twenty minutes when moisture content rose to around 40%, the right end was compressed along the radial direction from 15 mm to 5 mm by using a vise, i.e., the compression ratio (C) was taken to be two-thirds (66.7 %) as set before. Then keeping it in air-drying naturally for one week until it reached the equilibrium moisture content around 15%, the compression end was ground into a round bar in diameter of 5mm. This compressed end could be put into the hole of a five Japanese Yen coin or a wooden ring, then immersing it into the hot water to recover it to the original dimension. Finally, the recovered end would not be able to be extracted from the coin or wooden ring any more. Figure 10 shows the variety of accessories made by using compressed wood.



(left) Figure 9 Compressed wood piece for making accessory

(right) Figure 10 Compressed wood accessories



Figure 11 Timetable board samples and works of elementary higher graders

On the other hand, the object for upper graders in elementary school was to make a timetable board as shown in Figure 11. The rotating weekday pointer is designed to apply the shape memory characteristics of wood. We can imagine the fulfilment and enjoyment from children smiling (Figure 12). Such kinds of amazing experiences at an early age are necessary to inspire children to become wood enthusiasts.



Figure 12 Enjoyment of Children in making activities

2.4 All-Japan championship of woodworking skills for junior high students

Furthermore, remarkable achievements of wood education in Japan have also been reflected in annual nationwide woodworking championship for junior high school students (Division of Materials and Processing, the Japan Society of Technology Education, 2009). This event has been held for eleven years. About twenty players take part in final event each year, having been winners from eight regional tournaments (Figure 12). They are challenged

with given materials and tools for a four hour period. This “idea-to-product” competition evolves students fully engaged in wood education.



Figure 13 Scene in All-Japan championship of woodworking skills for junior high students

The judge’s evaluation was focused on skills, attitude, precision, creativity, and presentation impact. Ten high-ranking challengers were awarded by the Minister of Education, Welfare, Forestry, and some presidents of educational associations. Figure 13 shows the award ceremony and reports from mass media. We can expect the ripple effect of wood education on the society nationwide.



Figure 13 Reports on All-Japan championship of woodworking skills for junior high students

3. CONCLUSIONS

Recently much promotion of wood education with diversified collaboration has been carried out in Japan. This national strategic enlightening movement was systematically designed in multi-step approaches and with goals devised accordantly. The wood educational environment has been established by developing of a series wood education teaching materials for social sharing, the implementation of wood education forums, workshops, and instructor trainings. These provide citizens, especially children, with various opportunities to take part in activities with wood and to enjoy wood culture, thus deepening their understanding of the wood properties and advantages, the environmental significance of using wood. Encouragingly, the annual All-Japan championship of woodworking skills for

junior high students demonstrates successful wood education results, which plays a great role in cultivating wood enthusiasts for a mass of green consumers to secure global sustainable development in the future.

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The Promotion of Wood Culture in Japan



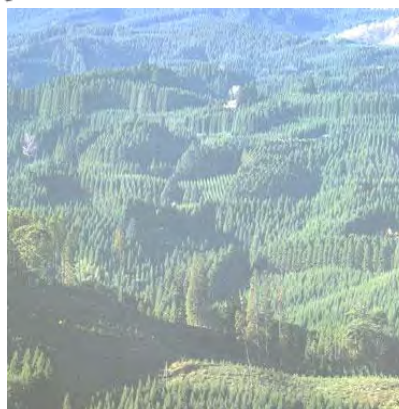
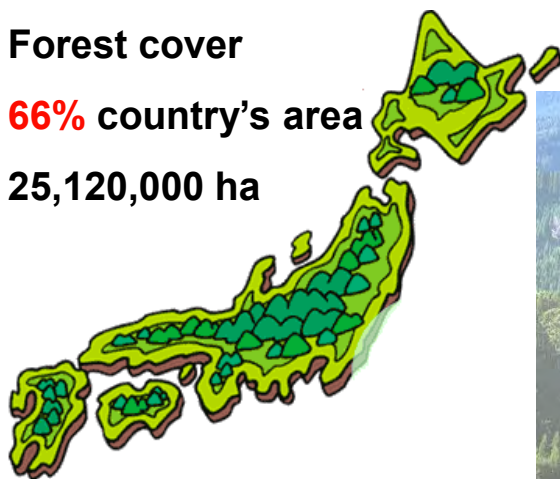
Yang Ping
Kumamoto University
Japan

Abundant in forest resource

Forest cover

66% country's area

25,120,000 ha



Supporting rich and unique Japanese wood cultural heritage

Japanese wood cultural heritage



Wooden relics



Traditional temples, shrines



Religious statues

Movement of wood education in Japan



■ To appreciate wood benefits

- ecological material
- renewable resource
- green amenities for human being



■ Promotion of wood culture and wood education in Japan



WOOD is GOOD

Features of wood education in Japan



National strategy: **Basic Plan of Forest & Forestry**
Japanese cabinet decision in 2006 



Leadership organization: Japan Wood-Products
Information and Research Center



Diversified collaboration: to call for a wide
participation extending to communities

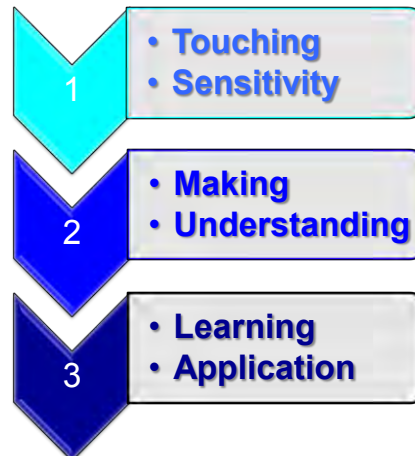


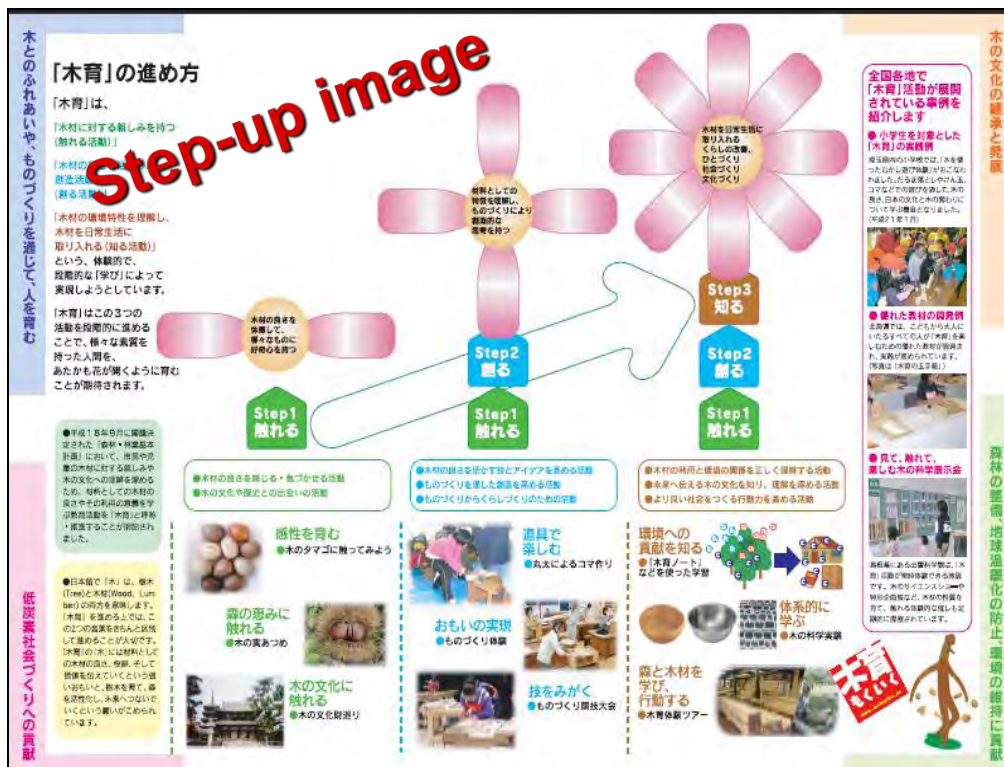
Encourage all citizen and children to appreciate
wood culture through **lifelong learning**



Deepen understanding of wood culture and
features, especially the **meaning** of wood
utilization

Stepwise approaches





Teaching materials

Tips of activities in wood education service package

- Time required
- Target learners
- Key words, summary and features
- Examples and goals
- Relationship with other steps
- Effective implementation cases
- Matters to be attended to
- Preparation of materials and tools required



のこぎりびき ① 第1部 木工具の使い方

Hand saw

● 木材の固定 (横びき用)

● 木材の固定 (縦びき用)

● 両手によるのこぎりびき (2)

万力で固定

クランプで固定

万力で固定

pg. 1

Hand plane

●こぐち

「こぐち」とは、この面のことです!

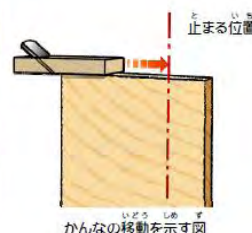
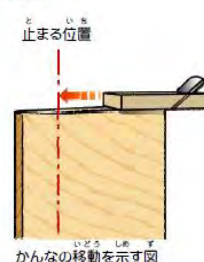


●木材の固定



けずりやすい板の低い位置を万力で固定

●こぐちけずりの始めから終わりまで



かんなの移動を示す図

きりもみ

Gimlet

●つきさし動作



最初にきりの刃先の位置を決め、安定した状態で回転するきりもみ動作を開始できるように、つきさし動作を行う。



きりを回すだけではダメ!!
全身の力を加えて
腰の力で押し込む
力をだすのだゾ!!

●左右の手のひらの動かし方と立つ位置



おしこむ力を加える。



全身の力です。
右手左手を前後に動かす。



Hammer

● げんのうの柄の持ち方とくぎの打ち方



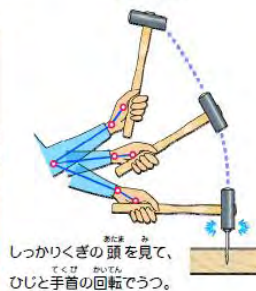
A: わしづかみ



B: 人差し指をそえる



うまくなったら、柄のはしを持つ

しっかりくぎの頭を見て、
ひじと手首の回転でうつ。

● くぎうちの始めから終りまで



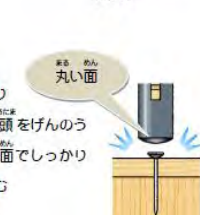
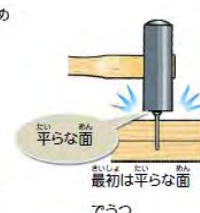
① うち始め



② うち中



③ うち終り

くぎの頭をげんのう
の丸い面でしっかり
うちこむ最後の1ミリぐらい
から丸い面です。

Structure of wood

木材の構造

木材を電子顕微鏡で見ると、ストローのような細胞が無数に集まっています。このことが、自然素材の木のやさしさを私たちに与えてくれます。

木材のストローのような細胞の中には、空気が入っています。このことは、熱をつたえにくくしており、触れると冷たくなって、気持ちいいのです。

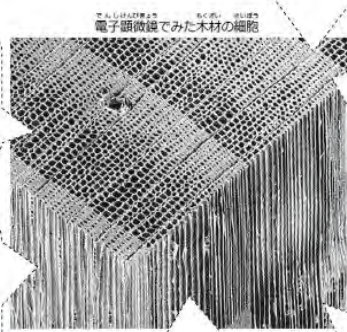
木は木目が不規則にならんでいるので、目への刺激が少なく、心地よいゆらぎが感じられます。



杉の木目

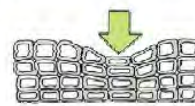


規則的な直線



木の表面はでこぼこしているの
で、光を散らばってはねかえすの
で、まぶしくありません。

ストローのような細胞が
衝撃力を吸収し、
衝撃をやわらげます。



ストローのような細胞は音の振動
をほどよく吸収し、音をまろや
かにします。

木は古くから劇場やホールに使わ
れています。

ストローのような細胞の中には、香りの成分
がたくさんつまっています。ダニや細菌はこ
の香りが嫌いなので、寄ってきません。

Wooden temple

木材は、軽くて強く、加工しやすく身近にあったので、昔から住まいをはじめ、お寺や神社、暮らしの道具、工芸品など、さまざまなものに使われてきました。

〔日本には世界最古も世界最大もある〕

日本には世界最古の木造建造物である「法隆寺」、世界最大の木造建造物である「東大寺」があり、世界文化遺産にも登録されています。

木は重さのわりに、とても丈夫な材料なんだ。同じ重さの材料と比べてみると、スギを引っ張ったときの強さは鉄の4倍、押しつぶしたときの強さはコンクリートの6倍です。



世界最古
法隆寺



法隆寺は、ヒノキで建てられており、1300年経った今も維持されています。鉄やコンクリートにはこれほどの耐久性はなく、せいぜい100年程度と言われています。

世界最大
東大寺



東大寺の大仏殿は、世界最大の木造建築物です。直径約1m、長さ約30mの丸太を84本も使っています。現代の木造住宅の約860戸分に相当します。

次のページに移動

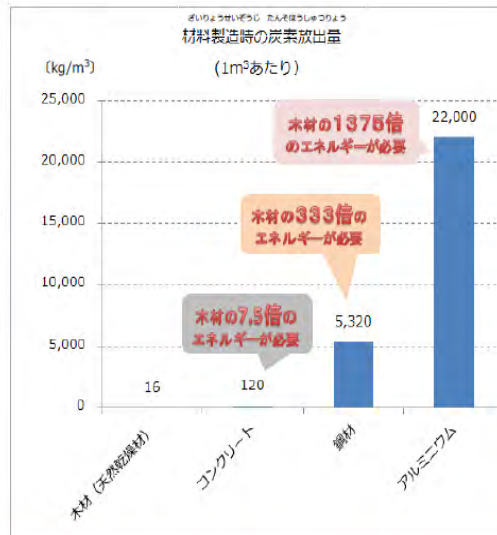
Energy comparison

〔木材の製造にはあまりエネルギーを使わない〕

木を加工して、柱や板などの木材を製造するときには、他の材料とくらべて、エネルギーをあまり使いません。エネルギーが使われないということは、「地球にやさしい」ということです。

どれだけエネルギーを使ったかは、炭素の放出量で知ることができます。

地球の環境にとって、大気中に出る炭素の量が少ない方がいいので、木材は地球環境にやさしい建築材料といえるんだ。



Prevention of global warming

がくしゅう
の学習

木材は炭素の「かんづめ」、住宅は第二の森林

人工林で育てられる若い木はどんどん成長するので、二酸化炭素(CO₂)をたくさん吸収してくれます。二酸化炭素(CO₂)をあまり吸収しなくなった年取った木(収穫期の木)は切って若い木を植え、得られた木を木材として大切に使うことが環境にいいのです。

樹木にたくわえられた炭素は木造住宅になっても、森林の木々と同じようにたくわえられています。住宅は「第二の森林」です。

大気中の二酸化炭素(CO₂)は樹木の光合成とよばれるはたらきにより吸収され、炭素(C)の形で、幹や枝、根など樹木をつくりまします。



京都議定書で国際的に約束したCO₂の排出量の削減の6割以上は森林によるCO₂吸収で達成する計画になっているんだ。

Renewable resource

木材は、一度使ったら捨てるだけではありません。たとえば、家をこわしたときにできる解体材で、使える柱は別の家で使ったり、柱として使えない木材は細かく削って木質ボードなどにして家具をつくることができます。木材は形をかえながら長いあいだ使える材料なのです。木質ボードも古くなって使えなくなったら、燃料として使えます。また燃料として使っても、森林に木を植え、育てることで、再び木材として使える資源を生み出すことができます。同時に燃やすことによって、貯えられていた炭素を二酸化炭素(CO₂)として大気中に出しても、再び木を植えることで吸収することができます。

エネルギーになる石油や石炭は、使えば使うほど、減り続け、増えることはないんだ。でも、木は、伐ったら植えれば、くりかえし生まれ使える資源なんだ。



「地球にとってもやさしい木の家」 社団法人日本木造住宅産業協会より

Education resources



Website of Japan Wood-Products Information and Research Center
<http://www.mokuiku.jp/>

Diversified collaboration



Mokuiku Forum in Shimane **木育フォーラム in 島根**



Mokuiku Forum in Hokkaido **赤レンガ 木育フォーラム in 北海道**





Course, What's Mokuiku

木育講習会 ～木育って何だろう～



Instructors training

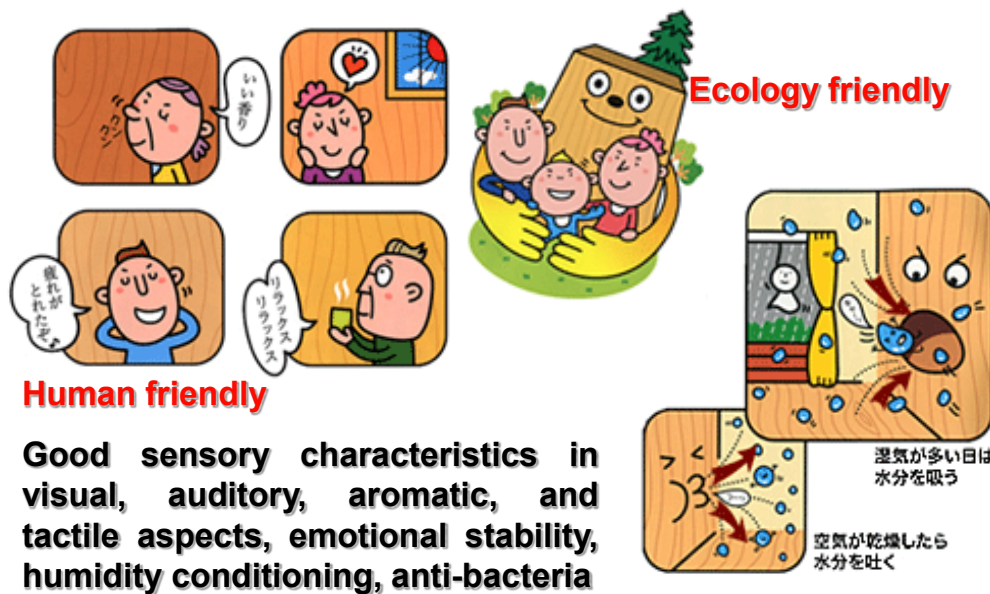
- Two days program
- Lectures on wood education, practice of woodworking
- Final presentation of action plan individually
- Delivery ceremony of training certificate
- Trainees were from a wide range of university students, in-service teachers, employees in public and private sectors, and some housewives



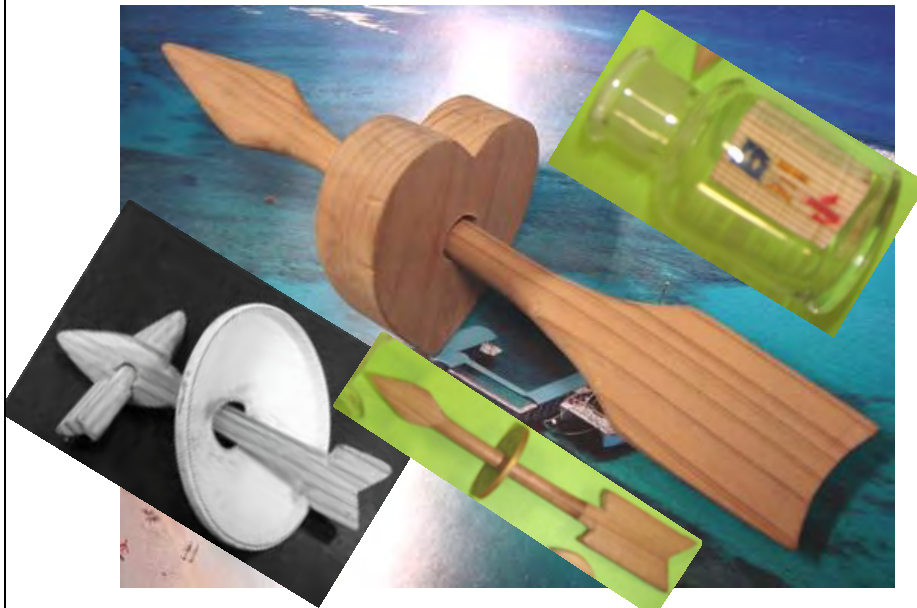
Off-school wood workshop



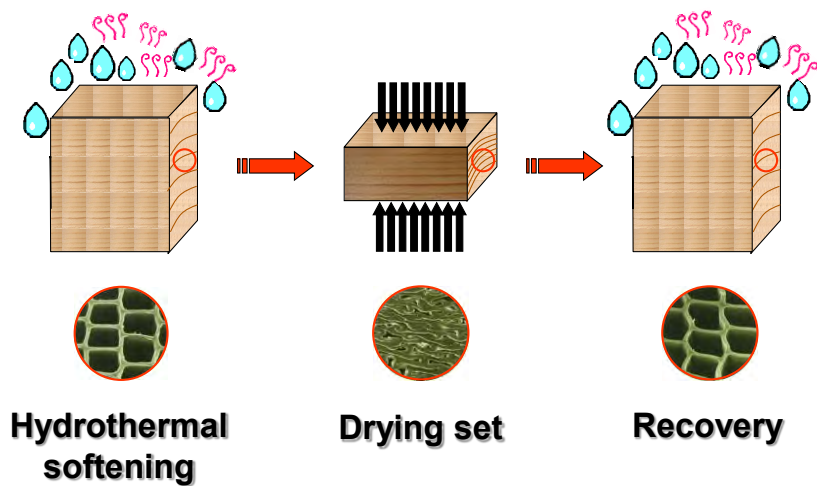
Wood advantages



Fantastic wooden toys



Shape memory characteristics of wood

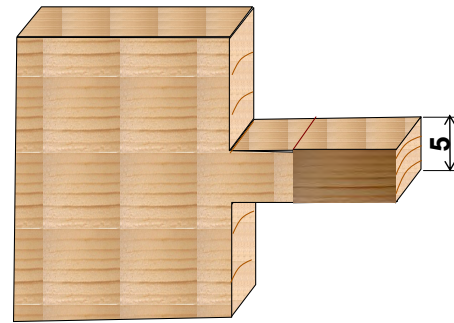
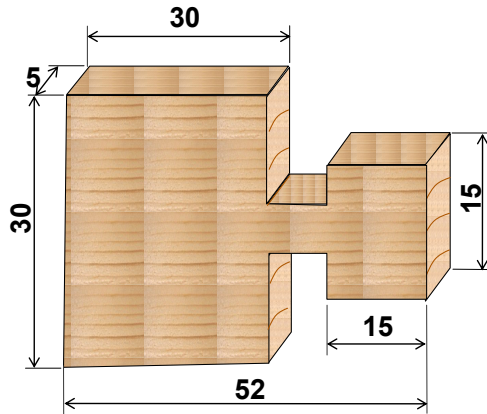


Making strip activities

(For kindergarteners and lower graders of elementary school)



単位: mm



(a) Before compression

(b) After compression

Sugi (*Cryptomeria japonica* D. Don) sapwood

What kind of strip do you want?



Figure drawing



Shaping with a jigsaw



Recovery of compressed deformation



Boring holes with gimlets



Various strips



Favorite shapes

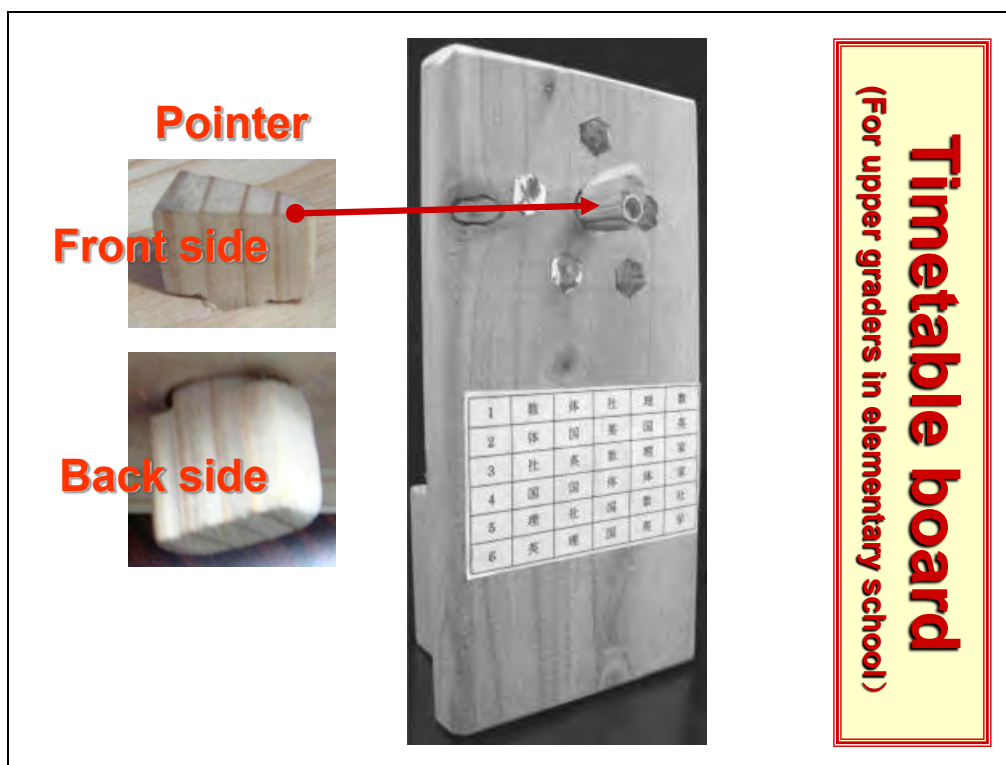


Waiting for making



Wood education instructors





Fulfillment and enjoyment



Amazing experience at the early age is necessary to inspire children to become wood enthusiasts

All-Japan championship of woodworking skills (For junior high school students)



About twenty players take part in the final competition each year who are winners from eight regional tournaments

Scene of Championship in 2011

Award ceremony



Judge's evaluation

**Work's precision, attitude, skills,
creativity, presentation impact**

Awards

**Top awards from Ministers of
Education, Welfare, Forestry, etc.**

Awarded works



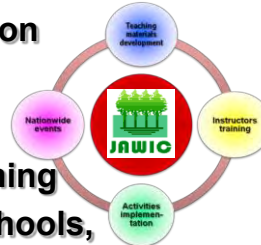
Reports from mass media (Ripple effect of wood education on society)





Conclusions

- Deliberate implementation of wood education
 - leadership & diversified collaboration
 - systematic stepwise approaches
 - development of teaching materials
 - forums, workshops, instructor training
 - lifelong learning environment in schools, communities, nationwide
- Praiseworthy impact on advertising wood benefits
- Cultivation of wood enthusiasts for a mass of green consumers is absolutely vital for the sustainable development globally



Sponsored by
International Wood Culture Society

The Need to Rethink the Forestry Sector Perspective in India

S.C.Joshi²

INTRODUCTION³

For the last few decades the forestry sector has been at cross roads in India. On the one hand, since almost all the natural forests and government plantations are under the control of state forest departments (SFDs), these SFDs face several criticisms *inter alia* that they are not able to protect natural forests properly and conserve their available biodiversity. SFDs are also usually blamed by other sector's official and many un-official bodies such as environmentalists, non-governmental organizations (NGOs), nature lovers etc., for not supporting the demand to provide forest lands for development purposes as well as for not fulfilling the demand of a large number of forest dependent communities, forest neighbours and rural poor.

At the same time, a large number of forest officials belonging to different SFDs, believe that they are committed and sincerely carrying out an onerous task of balancing two almost opposite responsibilities. This firstly concerns the protection and conservation of large and extensive extent of forest areas, which are almost like open treasuries, prone to misuse, if the small numbers of forest staff are evaded, particularly protecting valuable trees from illegal felling, diseases, fire etc., and preserving biodiversity and ecosystem services. The second concern is to ensure the availability of raw materials to priority sectors of the state (based on policy thrust). Foresters, therefore, believe that it is due to carrying out these commitments sincerely that their actions are interpreted in multiple ways, based on the interest of the concerned group or people and thus, usually they are blamed wrongfully. Whereas the environmentalists and NGOs are becoming ever bolder in strongly airing their views that it is the forest officials who have mismanaged the forests and are, therefore, not able to meet the aspirations of the society.

Thus it can be appreciated from the present scenario as described above that at the moment there exist two broad groups having markedly different views regarding the nature of forest management and its implications for different sectors of the society, one whose proponents are largely the officials of SFDs and the other whose proponents are mainly environmentalists who in turn, wrongly or rightly, have the silent support from a large group of less educated and "impressionable" sections of society, particularly those who feel aggrieved that SFDs are not looking after their genuine needs. The former believes that since the beginning of first forest policy of 1894 till the latest policy of 1988, forest policies of India have been quite exhaustive in terms of both content and reach. In fact, according to this view (in a sense from the limited official perspective), due to the existence of comprehensive policies and their sincere implementation, foresters could bring almost all the existing natural forests under one or other type of control and management and were able to meet the priorities of the state over the years. The latter criticizes the SFDs for adopting wrong practices and therefore being unable to meet either stakeholder demands or provide environmental and ecological security to society.

² Director, Institute of Wood Science and Technology, Malleswaram, Bangalore, India

³ The content of this paper is largely conceptual and qualitative in nature based on existing literature and studies related to forest management, forest laws and their impact on various stake holders as well as on author's personal experience of working in the state of Kerala and various other forestry organizations of Ministry of Environment and Forests, Govt. of India, as professional forester for the last 3 decades.



From the former point of view having exhaustive forest policies since 1890s have led to the emergence of many scientific forestry practices and valuable information concerning different types of trees from the point of view of their silviculture, mensuration, entomology, pathology, genetics, nursery and plantations raising techniques etc., and for the management of various types of forests in India. These in turn led to development of some of the earliest highly valuable scientific documents, procedures and records, such as the development of working plans, forest codes and forest laws. Consequently, almost all the valuable forests have been declared government property with differential accessibility with regard to obtaining tangible and intangible benefits from them by declaring them either reserve or protected forests.

However, from the latter's point of view the main purpose of various forestry practices based on different forest policies has always been to meet the revenue or wood demands needs of the state, initially of the colonial state and subsequently of the native government. According to this view, the forestry practices developed were on the lines of European practices made for largely single species European forests and thus not ideally suited to manage Indian forests having many species. Furthermore, due to an emphasis on meeting the demands of valuable timber yielding species of the state, forestry management practices were standardized only for ten selected species such as Teak, Sal, Deodar etc., at the cost of neglecting a large number of other species which were useful to forest dwellers, forest neighbours and a large number of assorted group of wood users. Moreover, for ensuring protection of forest for these valuable species, forest laws and acts have over the years mostly denied the access to various other goods and services earlier enjoyed by forest dwellers/ neighbours and communities. Additionally, a large number of multi species original forests were converted into mono species plantations of species valuable largely for the state such as Teak, Sal etc.,

The latter viewpoint, besides being the major plank of criticism often resorted to by the environmentalists, has of late started gaining greater currency among the large number of wood users as well as some of the environmentally conscious politicians in charge of Forest and Environment Ministry. This is largely due to two reasons, first, that forest officials, adhering to the former viewpoint, have been content with arguing their point of view through official documents or official channels, as they are not usually free to air their views either on their achievements or on the multiple constraints through any popular medium of publicity and awareness such as news papers and other electronics media. Also, due to the fact that the nature of their training and forestry practices, developed historically since the colonial period and continued until the present time, necessitated them to primarily concentrate upon the function related to forest protection and meeting the state priorities, at the cost of subjugating

the demands of other users and this often led to their failure to satisfy the critics holding latter view.

Secondly, the fact that the bearers of the latter view were, by training and profession, either highly educated and elite members of society or other professionals such as writers, academicians, or sundry group of educated people, who due to their education, social background and profession were free to write and propagate their ideas utilizing all possible mode of publicity such as popular articles, books, electronic media etc. Obviously, therefore, the view of the latter group have occupied much more public literary space and consequently achieved greater visibility and importance.

A deeper analysis and understanding of the existence of the two afore-mentioned type of views, would reveal that both the views are limited and narrow due to the great differences in professional background and world view and therefore in the nature of their learning/training, position, experiences and expected role in the society between the members of proponent groups of these two views. Notwithstanding the merits and demerits of the two views, it is however not difficult to appreciate that certain shortcomings do exist in the forestry practices used by SFDs in the management of society's natural resource like forests, as evidenced by the fact of inability of SFDs to meet the genuine demands of all the stake holders of forest resources. This is evident from the fact that despite more than hundred year old forest policies and practices and the existence of a very old and established forest administration throughout the country, which controls and manage almost all the forest areas of the country (all legal forests which include all natural forest areas and plantations in the forest area), foresters have not been able to meet the demands of all the traditional sector wood users and such other stake holders who depend directly or indirectly upon forests for their livelihood.

In fact, over the years, besides the above weaknesses, limited and inadequate focus of forestry practices have also resulted in many other lacunae in planning and functioning of SFDs. Some of the major lacunae in planning include non-availability of reliable data related to the extent of different type of forests including plantations and the condition of degradation in various layers of trees and other vegetation of natural forests, particularly in the predominant and co-dominant layers and in the overall biodiversity. Although data at national level is available through Forest Survey of India (FSI) reports, this data is too general and provides information on areas of forests under different levels of canopy closures, in other words it provides information on only the predominant tree layers of different forests, therefore it does not give any information on the condition of other tree and vegetation layers as well as on species composition and extent of biodiversity, moreover this data is often contended by various SFDs. Whereas, at state level, SFDs do collect and record data on the extent of various types of forests, different tree and plant species and the extent of biodiversity for preparing working plans, but of late even the working plan data is also contested by various independent academic and other organizations that have carried out studies to collect similar data.

So far as figures of demand and supply of timber as log or as industrial wood, pulp wood, fire wood etc., are concerned, the situation is much worse. Most of the SFDs do not have fool proof mechanisms of collecting such data and often independent studies undertaken by centres or the state under specific projects and schemes bring out the inaccuracy and inadequacy of the available data. Unfortunately even the various central government organizations of MOEF, such as FSI, ICFRE etc., do not have any fool proof method of collecting such data. Broadly, the problem with data collection is two fold, i) the data

collected by SFDs are not filtered through statistically acceptable methods using appropriate questionnaires and, ii) the complete exercise of collection and preparation of reports on these data is not considered an important function of the SFDs and is done in a casual and routine manner at lower levels by usually inadequately qualified staff from unimportant and relegated statistical branches of SFDs. Therefore, data collected is generally not supervised, monitored and verified. Resultantly, often different figures are noted for various components of wood and wood products belonging to the same year in the reports of above mentioned different sources.

Implications of the hitherto followed forest policies and practices,

Apparently, this situation whereby the forest administration has not been able to meet the wood and wood products requirements of various stakeholders is difficult to understand on a cursory examination, as after independence, presumably to meet the requirements of stakeholders, the first forest policy of 1894 made during the colonial period was changed twice, in 1952 and in 1988. However, on deeper examination, the reasons for such a situation could be found to lie in the historical dynamics of forest policies and forestry practices itself since their inception, more importantly in the policies and practices of Independent India. Due to the fact that during colonial times, priorities of colonial rulers were different, therefore neglect of the genuine demands of traditional wood users, especially of the unorganized workers such as handicrafts, and other artisans, is understandable. Since, during those days, demand from these communities were low and there existed community forests and desired specific trees in the natural forests which could be utilized, there was no apparent movement, or pressure to draw attention to the wood requirement of these communities.

However, over the years at the time of independence, the continued neglect of wood requirement of these communities along with continuous reduction in the availability of desired trees in the natural forest and therefore increased efforts to control their felling coupled with substantial reduction in community forests, has had multiple impact on these communities. Among many impacts, two important negative impacts were significant. First, due to non-availability of required trees and alternative resources needed by these craftsmen, artisans and other traditional wood users there has been a gradual decline in extent, diversification and standard of wood based traditional products, which were once a rich and prospering tradition. Secondly, due to almost negligible or no support and encouragement, over the years from the state, to meet the demands of these sectors, the communities involved in these activities has been greatly discouraged, their livelihood security increasingly came under threat resulting in forcing many members of these communities left their traditional profession. In other words, once an all pervasive and thriving culture of art and craft made out of woods and thereby the charm and joy inherent in the profession of wood use involving many such activities which were usually considered and described by wood workers and craftsmen emotionally satisfying and personally fulfilling got greatly suppressed and declined till the independence.



Fig. Vibrant wood Use culture and handicrafts

According to available information is mainly oral, provided by various craftsmen during various formal and informal discussions. This latter aspect is related to a certain type of special bond craftsmen feel while working with different types of wood. According to them, working with wood provides them with a unique experience owing to umpteen colours, patterns, texture of various woods, their distinctive smell, besides providing them a certain kind of joy while handling specific woods for carrying out planing, carving, chiseling, modeling etc. to give them different shapes and forms to convert them into different wood products. After several decades of neglect of management of such woods and continuous loss of relevant trees from the natural and community forests, by the time of independence, the once vibrant culture of art, craft and joy of wood use had not only declined but was also discouraged due to post industrial opinions that wood as a material was inferior to many other industrially produced materials like steel, aluminum, glass etc., and thus using wood a material was considered as a sign of backwardness or under development, consequently the profession of all type of wood workers such as craftsmen became less preferred and unappealing to members, especially the young, of the communities traditionally related with such professions.

Under such a situation it was expected that after independence, modified policies and various practices develop to implement them ought to have been holistic, in order to set right the historical incongruities of forest policies and practices and should have rectified the lacunae and omissions of the past and provide equal opportunities of access to forests and it's produce to all stake holders, particularly to those hitherto neglected communities such as traditional wood workers. However, in hind sight, it is evident that though theoretically forest policies after independence did mention meeting the needs of traditional users of wood, rural poor and tribals, the expected efforts to make available wood required by these communities remain neglected. This was largely because forestry practices, since independence, have not been holistic and integrated and have taken place in intermittent waves of limited focused thrust areas.

Further, these waves of thrust areas were neither organically linked nor comprehensive, particularly from the point of view of meeting the needs of large sections of wood using traditional sectors and populace, as they were either oriented towards meeting the demands of organized wood based industry or are focused upon meeting some specific consumption needs of the rural poor and forest dependent communities at the cost of neglecting demands of traditional wood using craftsmen and artisans.

Initially i.e. soon after independence, the forest practices were intended to increase the productivity from the forest and therefore, multispecies forests were replaced with plantations of economically important species. Subsequently, the thrust of forest practices shifted to meet the demands of wood based industries and a large extent of natural forests were converted into plantations of industrially important species. Thereafter, a wave of conserving the natural forests and raising fast growing species outside the forest areas, under the social forestry schemes emerged. This thrust which emerged during early 1970s, along with emphasis on augmenting the degraded natural forests through schemes like joint and participatory forest management (JFM\PFM) assisted natural regeneration (ANR) has been the main focus of forestry practices since then. In between, some limited specific

purpose schemes based on interest of the then existing governments, particularly ministers of forests and environment keep on emerging and implemented by SFDs such as raising and supplying medicinal plants to the communities etc.

Development of environmentalists limited point of view

After independence, parallel to the above developments, awareness of conservation of nature and environment started emerging among the NGOs\ environmentalists. The process started during the 1960s, with the awareness, influence and adoption by the Indian NGOs\environmentalists and of a particular type of ideology of conservation propagated by many international organizations' programmes and movements, such as, Man and Biosphere programme (MAB), World Conservation Strategy, United Nations Conference on Human Environment (UNCHE), 1972 etc. Since the referred philosophy of conservation originated in the rich and developed countries it largely concentrated upon preserving the quantity and quality of existing natural wild life and natural forest areas for conservation of specific wild life species or for the sake of eco-tourism or ecological values of such conserved natural areas. In other words, since in these developed countries there was hardly any human population which was dependant on the produce of these natural forests and wild life areas, not only for day to day survival needs but even for any type of tangible forest produce, it was understandable that these conservation strategies initially evolved in developed countries but were subsequently adopted and strengthened on similar lines by Indian environmentalists in essence recommending a complete ban on any type of management strategies related with providing wood products to any sections of the society.



Fig. Thrust in forest practices

Such a conservation strategy actually strongly discourages any felling of trees for wood from forests to meet even genuine demands of people as is actually met from the various forest resources available in India, legally or illegally and insist on leaving forests as such for bio diversity conservation and for providing environmental and ecological services to the society and the nation. However, it can be appreciated that such a strategy is not suitable for India where historically there exists genuine unfulfilled demands of wood and NWFPs both for day to day survival and professional needs of various wood workers. But unfortunately in general most of the environmentalists in India without holistically considering the reasons or constraints under which various type of forestry practices were historically developed and followed by SFDs, which have been the cause for historically existing unfulfilled demands of certain sections of the society, and therefore instead of suggesting appropriate strategies, have been recommending leaving the forest areas as such mainly for biodiversity conservation and for ecological values.

In fact, often some of the NGOs and environmental groups, which are under stronger influence of western conservation discourse, do not recommend use of such fast growing exotic trees which are almost naturalized and have comparatively greater potential to meet the genuine needs of hitherto neglected stake holders, as compared to several native species, by espousing an extreme and narrow

ideological view that is evidenced from among other of their oft propagated ideas. Firstly, that for providing raw materials to traditional wood workers and meeting the needs of rural poor only native trees should be propagated and harvested. Secondly, that as such wood use should be minimized and in its place other materials should be used, in order to avoid tree felling and loss and degradation of forests. Such has been the impact of repeated propagation of this type of arguments coupled with their influence on large number of forest dependant communities and some of the environmentally conscious politicians, that in recent decades an overarching general idea has been in vogue that since wood use, necessitates tree fellings, it would ultimately lead to environmental and ecological ill consequences.

This view had such a tremendously powerful psychological influence on officials of SFDs, that nowadays they not only maintain an indifferent or unconcerned response even to the genuine needs of stakeholders including wood workers and wood based industries but often put forth untenable and at times illogical arguments to defend their behavior or actions. However, this much propagated idea that wood use is bad for ecology and health of forests is the consequence of insufficient knowledge and inadequate appreciation of various types of forests as well as on all possible combinations of their management options, which may allow achievement of goals of conservation along with meeting tangible needs of stake holders. For example, the above view lacks appreciation of the fact that given availability of both biodiversity rich natural forests and mono species or few species based plantation forests, through holistic planning a sustainable management model could allow conservation of ecologically sensitive and environmentally important natural forests without felling any trees, and at the same time meet the wood requirements of the society sustainably without causing any carbon footprint from existing and new appropriate plantations managed on sustained yield principle.

The situation has come to such an impasse that at present a situation exists wherein due to less public acceptability of the views of foresters along with over arching influence and acceptance of the limited and non-holistic much propagated view of the environmentalists to reduce wood use, the foresters who should actually advocate greater production and use of wood prefer to remain silent on this issue during various official meetings and other programmes. At the same time the influence on the policy makers of limited and narrow conservation discourse propagated by the environmentalists are getting evident in the latest policies and programmes proposed by Ministry of Environment and Forests (MOEF) of Government of India (GOI). A glaring example of this influence is discernible in a highly ambitious latest programme of MOEF called “Greening India” in which several thousand crores of rupees are earmarked for raising plantations for rural poor and tribals but hardly any allocation is considered for meeting the genuine needs of wood using organized and unorganized sectors.

Therefore, the situation at present is paradoxical, wherein in order to address present day environmental challenges along with meeting genuine demands of various stakeholders including wood using organized and unorganized sectors there is a need to sustainably produce more of the relevant trees and harvest them from government plantations and other private areas, besides conserving the natural forest areas. But the environmentalists and therefore the general public, due to ignorance and influence of the dominant view created by these environmentalists, believe wood use is harmful for environment. In fact, at present, the foresters are considered anti-development by the other sectors of economy, mainly industrial and infrastructure, and against the poorer sections of the society by the environmentalists, as referred earlier. The foresters themselves due to historical weaknesses in the forestry practices have become mute spectators and feel constrained to come out with appropriate

solutions and strategies to answer either the arguments of environmentalists or to fulfill the demands of stakeholders, particularly traditional wood users and craftsmen.

Opportunity provided by the climate change

However, it appears that the whole awareness and acceptance of the truth that over the years due to unsustainable production and use of various resources, the climate has definitely been effected and global warming needs serious consideration in future development discourse and strategies. This has created a very potent opportunity to propagate the use of wood as well as to refute scientifically the argument made by environmentalists that in general wood use is harmful to the environment. As, during the last few decades the debate on global warming has clearly demonstrated that the main reason for global warming was the development path taken in the past, of ever increasing consumption of mass produced goods, mainly after industrial revolution, especially using non-renewable resources. And that such a path is not only unsustainable but needs to be changed, if climate change is to be managed. It is now increasingly accepted that such technologies and products which increase emission of Green House Gases (GHGs) and have high carbon foot prints both in production and use, cause climate change along with irreversible depletion of raw materials and ultimately may lead to natural and man made disasters of such proportions that the survival of human race itself would be in danger.

It is in this scenario that wood use as a raw material and product is the most relevant strategy, not only from a scientific point of view but also from the socio-economic, cultural and aesthetic point of view. Scientifically speaking wood is a renewable and natural product and therefore not only does not need any energy or lead to any carbon foot print in its production, as it is produce through photosynthetic activities of trees, using sun's energy but at the same time can be produced and used sustainably if appropriate policies and management practices and adopted. This can be achieved by adopting the strategy of removing from the total available wood stock only that much quantity of wood each year, which is equivalent to the quantity of wood added during that year, if the material is removed from the natural forests through selective felling or by planting new areas equivalent to the extent of area felled in the case of plantations. Besides, once a wood product is made it locks carbon for several years. And finally due to availability of modern technology and machines, even the waste wood can be converted into different lignocellulosic products and thereby minimize carbon emission to almost negligible levels, compared with other raw materials, like iron, steel, concrete, glass ,aluminum etc..

Compared to wood these latter much heralded and greatly used modern raw materials in both developed and developing economies not only require a lot of energy for production inside the factories and cause emissions of GHGs but often requires cutting of forests to create the necessary production units (Factories/plants) and thereby cause long term harm to the eco system by removing valuable carbon sinks (i.e. forests).

Thus, in these times of climate change encouraging and actually using and sustainably producing the wood is the most appropriate development strategy. Once this fact is appreciated and internalized, the next important issue and perhaps more challenging one would be to actually achieve this objective. Because to achieve such a goal not only hitherto adopted forest management policy and practices need to be changed but also a great deal of appropriate research, technology development and extension activities need to be done by the

SFDs to make all the stake holders agree to this strategy and willingly cooperate in this endeavour.

Such being the need of the present times so far as strategic perspective on forestry sector is concerned, the situation demands firstly a clear appreciation of the fact that simply having well intended and written forest policies is not sufficient to meet the genuine demands of all the stake holders. To achieve this objective sustainably, the forestry sector plans both at the GOI (MOEF) level and subsequently at SFDs level must be based on correct data on type of demands of all stake holders' vis-à-vis all available forest and wood resources to meet them. These facts should then be used to set long and short term priorities with regard to type of schemes and programmes GOI and SFDs must prepare. These priorities should in turn be based on certain preferential weightage given to the demands of weaker and hitherto unrepresented sections of the society. Additionally any particular scheme or programme's project must clearly indicate the methods of regular monitoring and evaluation as well as mechanism for course correction. Finally inter alia, these projects must include clearly specified unambiguous and easily monitorable physical indicators for each and every objective of the project.

Secondly, and most importantly, to achieve the above goal there is a need to reverse the existing paradigm with regard to wood use, instead of hitherto widely propagated thinking that wood use must be reduced and substituted with other materials, the present thinking should be that wood as a material is good and must be encouraged. The motto "Wood is Good" must be firmly accepted and adopted by not only all the stake holders of forest and forest products but all the sectors of the economy. Once the importance and necessity of such a paradigm is truly appreciated and therefore imbibed by relevant players- such as MOEF, SFDs, environmentalists, sectors related with infrastructure industry, planners, economists etc. - then the synergy needed to sustainably produce and supply the genuine demands of wood of the growing economy can be met from within the Country, after regulating import at appropriate levels, by fixing realistic appropriate priorities and targets, as referred above.

Since one of the most important aspect for succeeding in the latter endeavour would be the change of existing mind set about wood use among environmentalists, and the acceptance of this changed paradigm by society, the role of environmentalists – NGOs, voluntary organizations, nature lovers, academicians etc. - along with efforts to revive and invigorate the lost culture of "art and joy" of wood use, is very crucial. Broadly stating this may require, first, concerted efforts to propagate awareness and knowledge with the help of environmentalists, who are more articulate and whose views are more accepted in the society, on advantages of wood as a raw material, particularly in these times of climate change, compared to other hitherto much used materials like iron, steel etc. Secondly, all out efforts must be made to showcase successful examples of old and existing traditions of solid wood use, which is aesthetically and culturally rich and lock carbon for many decades along with encouraging causing use of several modern wood products made of fast growing small girth timber largely produced outside forests such as plywood, and several other panel and engineered wood products, through continuous and repeated publicity and extension methods, with the help of expert extensionists and environmentalists.

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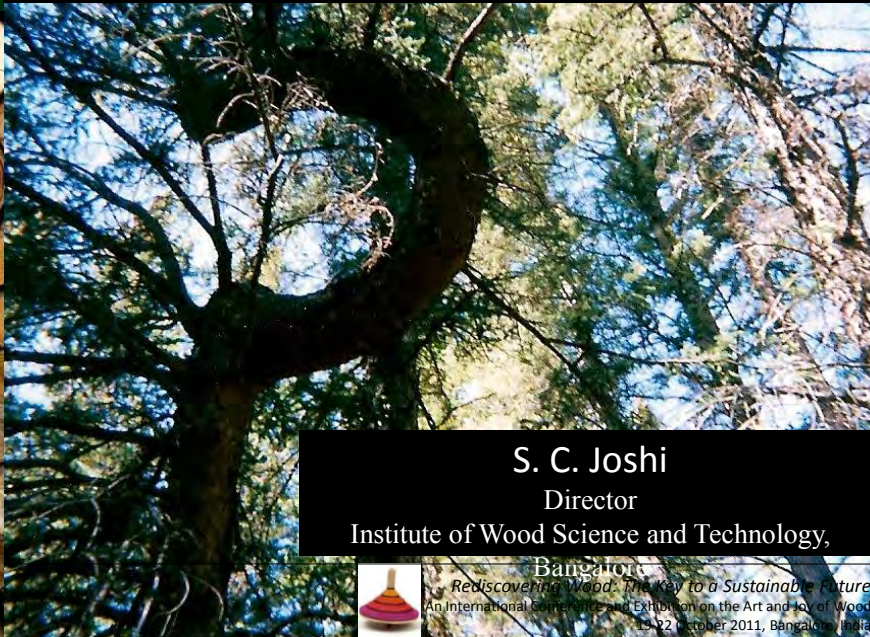
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THE NEED TO RETHINK THE FORESTRY SECTOR PERSPECTIVE IN INDIA



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How do we dovetail
(reconcile) the idea of
ART and JOY of wood
in the serious
business of forest
management and
wood use in a
particular economy
or region?



Because, on the face of it, one refers
to a higher level of thinking and
creative urges usually without any
need to consider political economy of
resource. Whereas, the other refers
to the whole gamut of politico-
economics and administrative issues
related with resource management.



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However on a deeper examination it appears that perhaps this apparently unrelated idea of ART and JOY of wood could become the foundation of finding solution to several weaknesses of present day forest policies and management issues, particularly in the scenario of climate change and ever increasing need to look for sustainable development.



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To appreciate how this is possible, there is a need to view the two concepts holistically from the historical perspective



Therefore, an attempt is made here to conceptualize this seemingly difficult proposition by historically analyzing the present day situation of ART and JOY of wood use and issues related to forest management



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Material and Culture

Art and Joy of use of any material largely relates to the culture of the society.

The philosophy of life, religious and spiritual beliefs, developed historically over the years, reflected in the meta-physical thinking, creative ideas and values of the society, which gets echoed in the art, craft and other joys associated with use of the material

Availability and affordability of sufficient quantities of desired qualities of material resources is one of the conditions for the art and joy of use of any material besides existence of factors conducive to development of creative ideas and long periods of creative activities.



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THE STORY IS SIMILAR FOR WOOD



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Before Industrial Revolution, wood use was not very different across different societies



Resource was in plenty and requirements were limited in most parts of the world; technology was simple



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Wood use covered all aspects of human needs. Even magnificent wooden structures came up during the period



An old wooden monastery in Europe



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Wood use in Asia was not far behind Europe...



The oldest fully wooden pagoda in China - The Fugong Temple of Liao dynasty (1056AD). It reaches a total height of 67.31 m (220.83 ft).



The Sanctuary of Truth in Thailand is a gigantic wooden construction. The top point of the building is about 105 meters high



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India...

Historically, India is a nation that has walked hand-in-hand with nature. Trees and wood featured in all facets of traditional India.

Even today, they form a part of many customs, traditions and religious practices.

In short, it can be said of India that trees and wood are ingrained in the psychology of people.

NATIONAL GEOGRAPHIC

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India is a Nation that worships Nature. Many trees, like *palash*, *peepal*, *neem* and *rudraksh*, are deities to them. Nakshatravanams (forests associated with astrology) have been created at many places




Peepal




Rudraksh



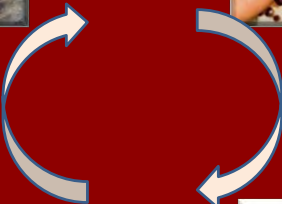

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Wood use in India permeates through human life. It is intimately related with day to day activities, particularly concerning religion and ceremony.








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Ayurveda (Indian form of medicine), in particular *Vrikshayurveda*, uses many parts of trees including wood

www.myhcredibleindia.org

Sandalwood helps in vitiating burning sensation, headache, hyper perspiration, skin disease, psychotic ailments, memory loss, cardiomyopathy, ulcer, jaundice, cough and inflammations

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As is everywhere else in the world, India has its own share of indigenous musical instruments made of wood

Veena

VANIGAM.COM

Mridanga

Santoor

Ektara

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India has a rich culture of wooden toys and handicrafts. The country is famous for intricate wooden carvings



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Wood is also extensively used in leisure and play



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A HISTORICAL PERSPECTIVE FOR DECLINE IN THE ART AND JOY OF WOOD-USE IN INDIA



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After the Industrial Revolution there has been a perceptible change in wood use across different societies of the world

Changes in
wood-use
after the
industrial
revolution



In fact, wood was, in one way, instrumental for the Industrial Revolution. Energy was primarily obtained from burning wood. It was the principle material for railways, ships, bridges and other constructions.



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Nations that were rapidly industrializing took advantage of their colonies for wood resource. Wood was needed not only for supporting their industries, but also for their developmental needs

Wood from colonies was exploited to support industrial nations



Whereas, the non industrialized, or colonized countries, largely had policies and practices suited for colonial needs.

This led to two consequences:

1. important forests were reserved for the state purposes, and
2. traditional demands got neglected.



This has, perhaps, led to a great difference in viewing ART and JOY of using wood in different societies – industrialized and emerging economies



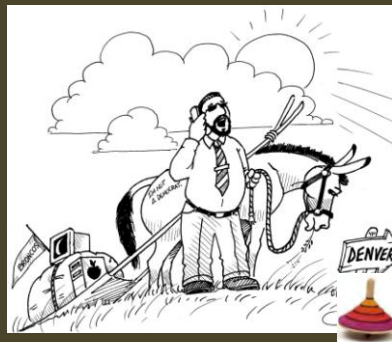
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Initially most of the industrialized nations became prosperous and developed material comforts at the cost of losing greater part of their forests. However, during 20th century they realized importance of conservation



Silvicultural systems were based on European systems. Plantations of selected species only were encouraged. Large number of native species neglected. Consequences were multidimensional.



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A strong technological base was developed in industrialized countries.

Conservation consciousness gained momentum particularly after 1960s.

Art and joy of wood of niche kind was developed.



Policies and practices in India did not change even after independence. However, two different independent forces further aggravated the existing ills.

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In advanced countries technology for large scale exploitation got developed. Rebuilding forests was taken up seriously, and sufficient wealth and time allowed following conservation and environmental movements.

Environmental awareness leading to critical view of forest management started emerging. Practices became large scale and followed waves.




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Technologies using modern tools kept on improving . Advances towards improvement of productivity and value addition pursued. Environmental consciousness became dominant discourse.

There were waves of practices in India

Waves of practices include productivity increase, industrial linkage, social forestry, JFM, PFM. Due to neglect of traditional wood users and rural and tribal populations their alienation increased




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Today, the more developed industrialized nations can afford conservation and keep their traditions alive. They have a culture of both conservation and commercial exploitation. They also have the scope for developing niche areas of wood use – for ART and for JOY

Scope for Commercial exploitation, Conservation and Art & Joy was possible in advanced countries



In many emerging nations like India, the gamut of activities concerning ART and JOY of using wood appears to be on a decline. In fact, there is a downbeat with ART and JOY of using wood



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There is a peculiar situation in India, where resource use is very skewed and with the liberalization of import and economic growth, newer demands from the neo-rich has been met by imports and a vast section remains out of the focus of forest managers, particularly traditional users and traditional industries.

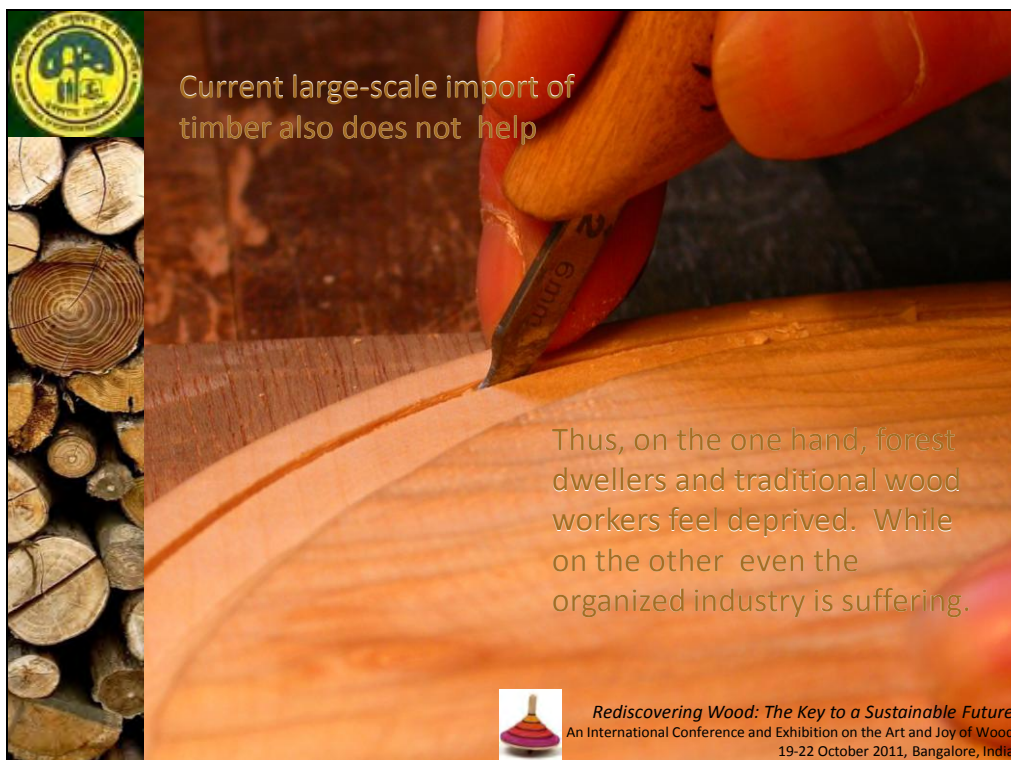


Demands of the neo-rich are met by exports and traditional users are not in the main focus

Without proper policies and practices in the department, rural poor, wood users are increasingly getting alienated. Changing policies have not helped the cause.



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Current large-scale import of timber also does not help

Thus, on the one hand, forest dwellers and traditional wood workers feel deprived. While on the other even the organized industry is suffering.



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Knowledge about availability and demand of wood is not accurate. Research and technology development is very poor. Policy appears to lack holistic and integrated approach.

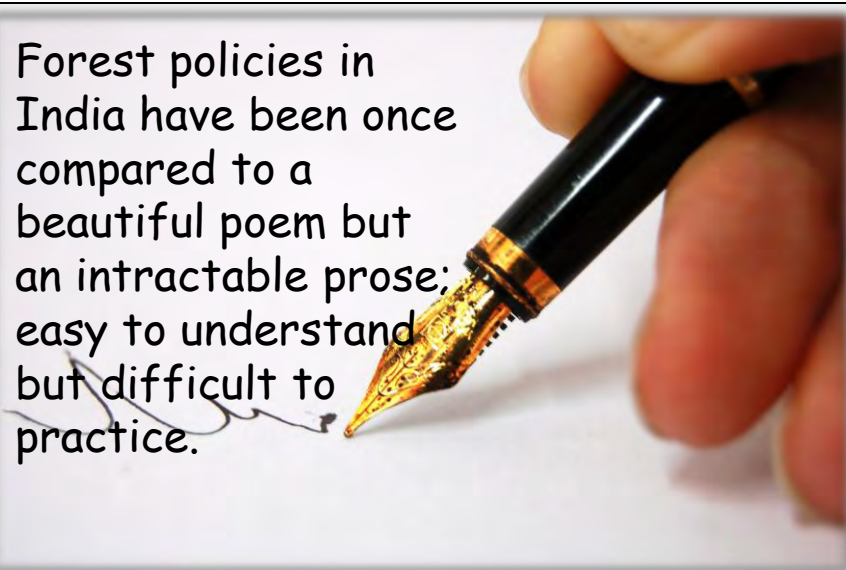
A very dominant and strong force of a wide array of assorted groups and individuals critical of forest management make the matter worse.



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Forest policies in India have been once compared to a beautiful poem but an intractable prose; easy to understand but difficult to practice.



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Indian forestry today is at crossroads



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CONSERVATION WAVE IN THE BACKGROUND OF LACK OF HOLISTIC APPROACH



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Conservation and environmental concepts without considering ground realities taken up by many assorted groups in India, have in a way, propagated the idea of wood use as anti-ecological which is largely acceptable to politicians

Forest managers have become mute spectators in the light of their inherent weakness to meet the challenges both from environmentalists and genuine wood users.

Forest managers therefore do not dare to take a stand for advocating meeting the genuine demands of not only industry but also the traditional users.



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The growth in economy is causing ever more demand of wood materials, which is met largely from import, forest department playing hardly any role.

The departments are still continuing their old practices of planting few selected species therefore unable to meet the demand of traditional uses, industry as well as from neo rich.

All the above factors led to ongoing debate in the country on "Conservation versus Development", in which foresters have become silent and ineffective players and are often labeled as villains

Coupled with all these, the forest department does not have a holistic policy, practices, skill and technology to deal with the present crisis.

This is the paradox faced by the country



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In fact the overarching social thinking of reducing wood consumption may actually be a bane to the society and environment



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WHAT ARE THE SOLUTIONS... ?



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One of the key areas for improvement is in sound policy, planning, implementation and monitoring. Conservation needs to be kept in focus and impetus should be laid on developing technologies based on actual requirement.

Changes are needed in policies

Synergy in various sciences in the need of the hour

This can be achieved by synergy in various sciences like physical, chemical and biological to meet the demands of industrial and other wood users. It requires actual knowledge of the true requirement and balancing the ecological and developmental consideration using appropriate technologies



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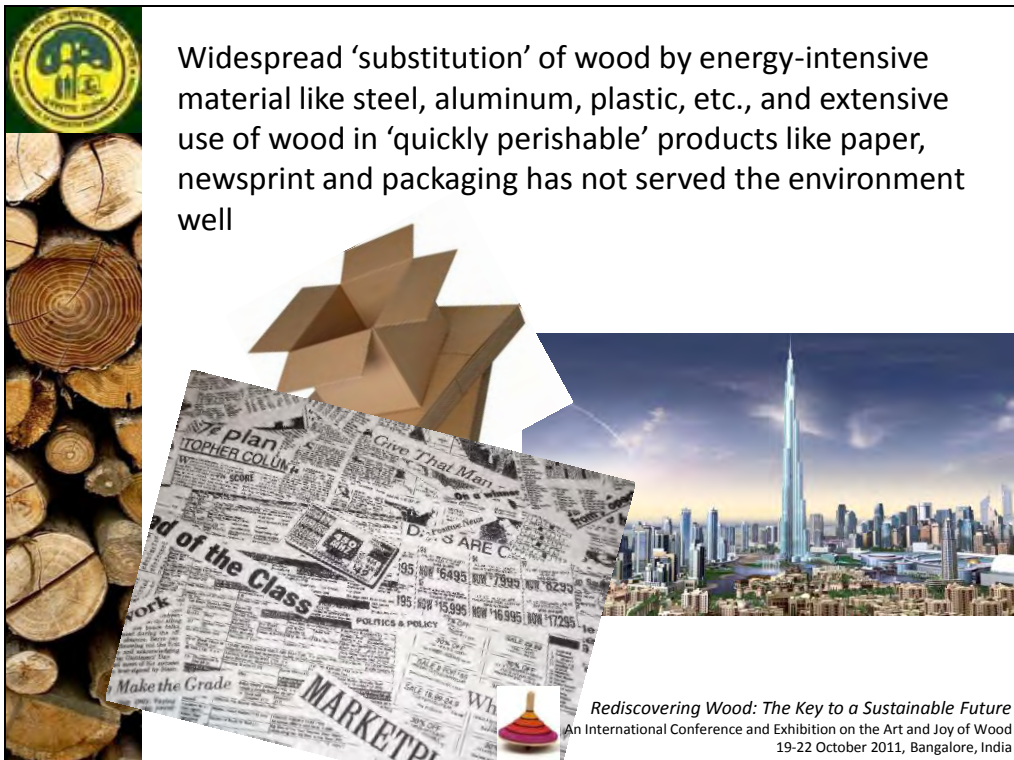
The forest departments need to seriously consider efforts to provide major impetus for promoting wood use –
- The 'Climate Change' scenario



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- Efforts are needed:
 - Holistic policies and practices
 - Policies which ensures proper implementation
 - Practices based on ground realities and therefore
 - Must include genuine requirements of all sectors keeping in view the development requirements, state of existing natural forests and biodiversity as well as plantations, therefore need
 - Correct data, appropriate technology and a concerted effort to change the mindset of all concerned.

- In terms of policy and planning :
 - Conservation strategies –natural forest
 - Production strategies – plantation, private and public
 - Substitution of carbon intensive materials
 - Appropriate research
 - Appropriate extension



Widespread 'substitution' of wood by energy-intensive material like steel, aluminum, plastic, etc., and extensive use of wood in 'quickly perishable' products like paper, newsprint and packaging has not served the environment well

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Wood being an extremely diverse, carbon neutral, renewable resource that needs low energy for production is perhaps the best choice as a material in the changing world. It would not be difficult for human society's transition back to using wood



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If art and joy has to come back in India, we should be meeting the demands of people and developing appropriate technology by balancing various demands in a green manner.

One should remember that increasing the use of wood can be a major force in increasing tree planting, therefore increasing greening of the country

However, policies have to designed carefully. Areas for conservation and production have to be clearly set aside after considering the actual availability and demands in the country. Sector-wise industrial requirements need to be met within the country.



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Policies should encourage wood industries, specially the traditional sector. Research and development in these fields should get priority. Technologies already available in the advanced nations need to be adopted.

There is a need for a synergy between the environmentalists and the forest department to develop a holistic approach for conservation and sustained development



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Sound technologies in several areas of wood science are required in this country...

To overcome problems like degradation, dimensional instability, processing defects

To develop new wood-based materials, composites...

Enhance efficiency in harnessing energy from wood



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Some of the developments in this regard at
IWSST, Bangalore are...

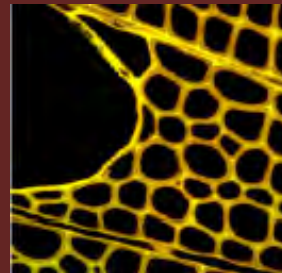


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WOOD WEATHERING

The focus is on characterizing surface degradation due to biotic and abiotic factors, and developing coatings or chemically modifying surfaces for minimizing weathering



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GROWTH STRESSES IN WOOD

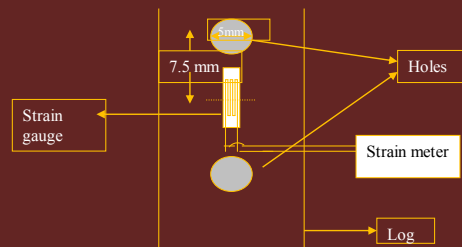
Pioneered this work in India for measuring stresses in standing trees

Developed and standardized strain measuring tools and methods for alleviating stressing before processing

It is a major problem in species like *Eucalyptus* when used as timber. The research provides opportunities for putting eucalypts to many alternate uses.



Eucalyptus log showing effects of release of stresses



Configuration of holes and strain gauges to measure longitudinal growth strains in trees



WOOD-POLYMER COMPOSITES

Pioneer of this work in India

Wood chips, bamboo fibres and nano cellulose have been blended into thermo-plastic composites

The results have been highly encouraging and 2 patents have been filed

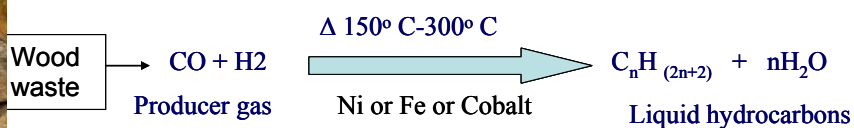




Biodiesel from wood wastes



The Institute has taken a new direction in the country in production of synthetic biodiesel from producer gas using wood wastes. This technology will overcome the problem of compressing producer gas for transportation and efficient utilization.



Change in perception of people is crucial to the development of forests and meeting industrial needs

In certain situations, wood is considered as primitive, as a stone-age material...

...in certain others, wood is considered as a rich man's material. Cheap substitutes have pushed wood to an elite category

Both versions have not been good for wood and for the environment



Rediscovering Wood: The Key to a Sustainable Future
An International Conference and Exhibition on the Art and Joy of Wood
19-22 October 2011, Bangalore, India



For all this to happen...

India needs to get back its past glory –
when there was a true appreciation of

ART and JOY of using WOOD



Rediscovering Wood: The Key to a Sustainable Future
An International Conference and Exhibition on the Art and Joy of Wood
19-22 October 2011, Bangalore, India



GROW WOOD, USE WOOD...

...TO SAVE THE ENVIRONMENT

...TO GREEN THE LANDSCAPE

...TO TAKE THE NATION FORWARD



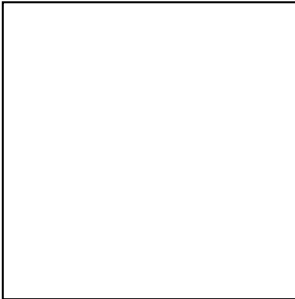
Rediscovering Wood: The Key to a Sustainable Future
An International Conference and Exhibition on the Art and Joy of Wood
19-22 October 2011, Bangalore, India

Session 13

[Friday 2nd period 1.5 hours - Main Hall]

Promoting wood culture in the future (continued)

Speakers



Speaker:
Ying Ling Hung

Topic:
Wooden Paths to a Sustainable Future



Speaker:
Criswell Davis

Topic:
Designing with Sustainable US Hardwoods the Future?



Speaker:
Nobuaki Hattori

Topic:
The Present State of Lifecycle and Carbon Footprint Assessment in Japan to Visualize the Eco-friendliness of Products Including Wood



Speaker:
Maria Riala

Topic:
Mapping Customers' Minds with a New Technique: The Case of Housing Needs and Preferences in Finland



Speaker:
T R Manoharan

Topic:
Forest Certification and Wood Based Industries in India

Wooden Paths to a Sustainable Future

Ying Ling Hung¹

¹ Researcher, IWCS, Taiwan

Wooden Paths to a Sustainable Future

- A Cultural Approach towards 'Wood is Good'



International Wood
Culture Society

A Taste on Cultural Perspective

- In terms of Chinese word '[wood](#)' itself:

木

林

森

A Chinese Idiom 木本水源

木 (wood) + 一 (ground) = 本 (root or foundation)
水 (water) 源 (source)

International Conference and Exhibition on
the Art and Joy of Wood



BACK

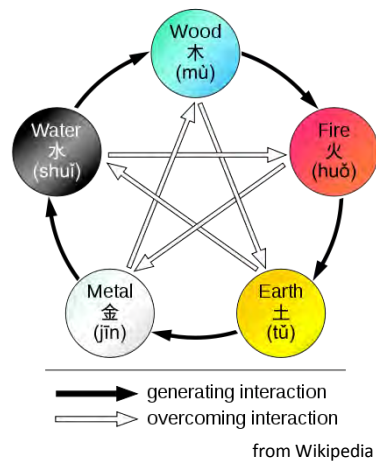
International Conference and Exhibition on
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Cultural Perspective (cont.)

- In terms of cosmology

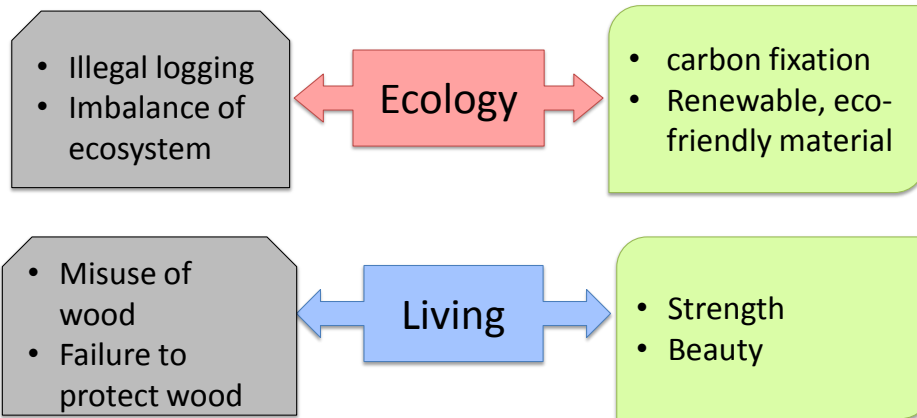
Five phases:

Wood feeds Fire,
Fire creates Earth,
Earth bears Metal,
Metal carries Water,
Water nourishes Wood



International Conference and Exhibition on
the Art and Joy of Wood

Wood is Good?!



Wood is Good!!

International Conference and Exhibition on
the Art and Joy of Wood

Cultural Approach

- **Culture**
 - Humanity and Civilisation
 - Life style – an integrated pattern of human knowledge, belief and behaviour
 - Set of attitudes and values
- **Wood Culture**
 - Three aspects above regarding wood
- **Cultural approach**

International Conference and Exhibition on
the Art and Joy of Wood



International Wood Culture Society

INFORMATION

- IWCS journal
- IWCS books
- IWCS video

EXPERIENCE

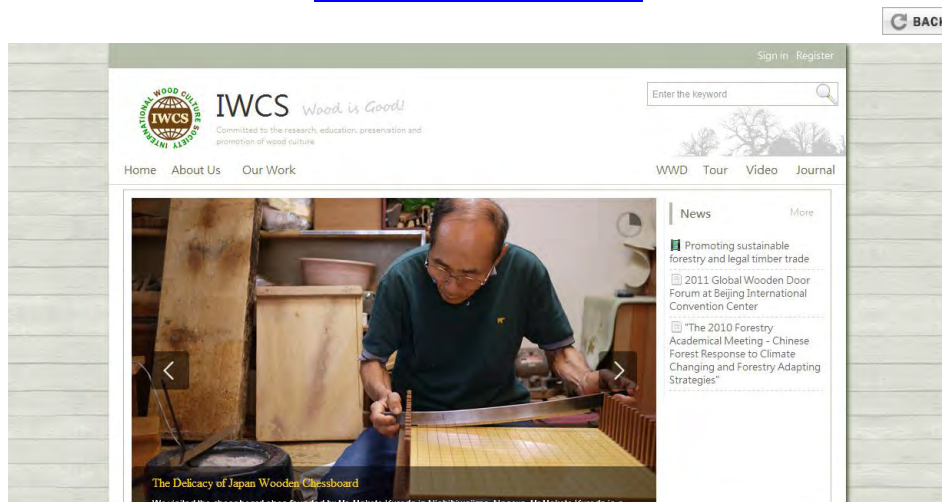
- Wood Culture Tour

<http://www.wood.info/100002/>

International Conference and Exhibition on
the Art and Joy of Wood

Main page of IWCS

<http://www.wood.info/100002/>



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Webpage of IWCS knowledge

<http://www.wood.info/customPage/100002/tab/16/index.html>

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■ Wood Culture

■ JOURNAL

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About the Journal

WELCOME!

Wood Culture Journal is published by International Wood Culture Society (IWCS), an international academic non-profit organization.

Wood Culture Journal is an open access journal, free to public. Quotes may be used provided that citation is done properly. Submission of papers will also be free of charge.

Wood Culture Journal is published semiannually, with additional publications of specific subjects and topics of wood culture.

WOOD IS GOOD

Wood Culture Journal welcomes any researcher to contribute their work by submitting their papers for publication. Wood Culture Journal strives to be an up-to-date learning platform to share the research and studies of wood culture.

Wood comes from nature as a beautiful eco-friendly material. Its physical and ecological characteristics makes for great usability. As a green renewable resource, its environmental protection performance allows it to be a fine ecological material.

The word 'culture' is rich in its semantics. It covers a wide range of meaning and differs through time and place. IWCS has drawn its own conclusions through cultural discussions and defines culture as a civilized procession, sharing of customs, values and lifestyles. When applied

International Conference and Exhibition on
the Art and Joy of Wood

Webpage of IWCS tour

<http://www.wood.info/customPage/100002/tab/10/index.html>

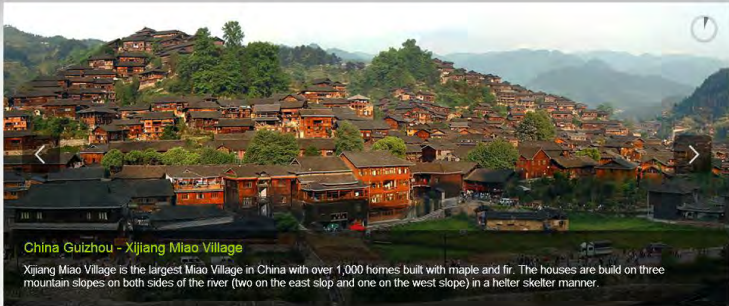
BACK

O IWCS

Wood Culture Tour

HOME DESTINATION LIVE ABOUT US

Select Language ▼



China Guizhou - Xijiang Miao Village

Xijiang Miao Village is the largest Miao Village in China with over 1,000 homes built with maple and fir. The houses are built on three mountain slopes on both sides of the river (two on the east slope and one on the west slope) in a helter skelter manner.

International Conference and Exhibition on
the Art and Joy of Wood

Sedan Chair



Chan-Hua, Taiwan

Historically, sedan was one of the means of transport. Even though it is out of date, the concept of gods being seated in the sedan has been deeply printed in people's mind.

International Conference and Exhibition on
the Art and Joy of Wood

Young Shing Craft School



Tainan, Taiwan



Young Shing Craft School provides regular courses for those who want to learn proper wood crafts.

In a exhibition, they also offered a 'hands-on' session for people to experience the joy of wood-crafting (chopsticks).

International Conference and Exhibition on
the Art and Joy of Wood

Master of Chessboard



Master of wooden chessboard, Mr. Makoto Kuroda is the thirteen generation of a wood-crafts family, and dedicates his whole life to preserving traditional craftsmanship.



Nagoya, Japan

International Conference and Exhibition on
the Art and Joy of Wood

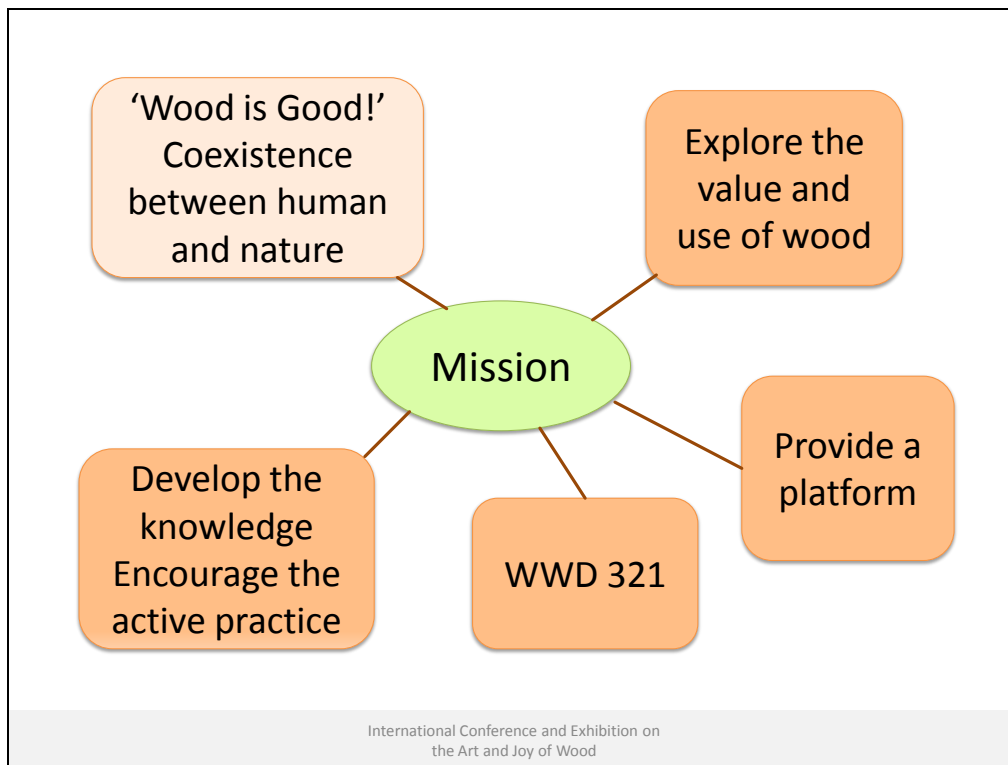
Wood Carving Contest

Exhibition Baham, Wood: Joy, Art and Culture took place in Cameroon in August this year. 36 wood carvers participated.



Baham, Cameroon

International Conference and Exhibition on
the Art and Joy of Wood



World Wood Day 321

<http://www.worldwoodday.org/>

The logo features a stylized brown tree trunk with two branches reaching upwards, set against a circular background of a blue and green globe. Below the tree, the text '321 WWD' is written in a bold, green, sans-serif font.

Spring equinox
Flourishing season

International Conference and Exhibition on
the Art and Joy of Wood

Webpage of WWD

<http://www.worldwoodday.org/>



International Conference and Exhibition on
the Art and Joy of Wood

World Wood Day 321 (cont.)



**Your sharing will be
shown here on the Map!**



**Leave a message/story/
photo/video for us**

International Conference and Exhibition on
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Example 1 – Thai Design

The Way of Wood: Finding Green Pieces in Thailand

by Jirawat Tangkijngamwong



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Example 2 – Elegant Living

By Mr. Morris Lin

from ELEGANT LIVING OF SAMLING GROUP



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Designing with Sustainable US Hardwoods

Criswell Davis²

² Mighty Oaks Consulting (criswell.davis1@gmail.com)

The Role of US Hardwood in
Sustainable Design
A View from The Source
presented by Criswell Davis
AHEC

**"With his materials the architect can do whatever the masters have
done with pigments or with sound – in shadings as subtle, with
combinations as expressive – perhaps outlasting himself. Wood is
universally beautiful to man.**

It is the most humanly intimate of all materials."

Frank Lloyd Wright

Humans are like US
Hardwood trees in three
significant and profound ways

They are mostly water

They have a peak life span of
about 80 years

THEY ARE ALL UNIQUE

Hardwoods

- Hardwoods are woods produced by broadleaf trees known as angiosperms. They lose their leaves in winter. This is a White Oak, *quercus alba*.



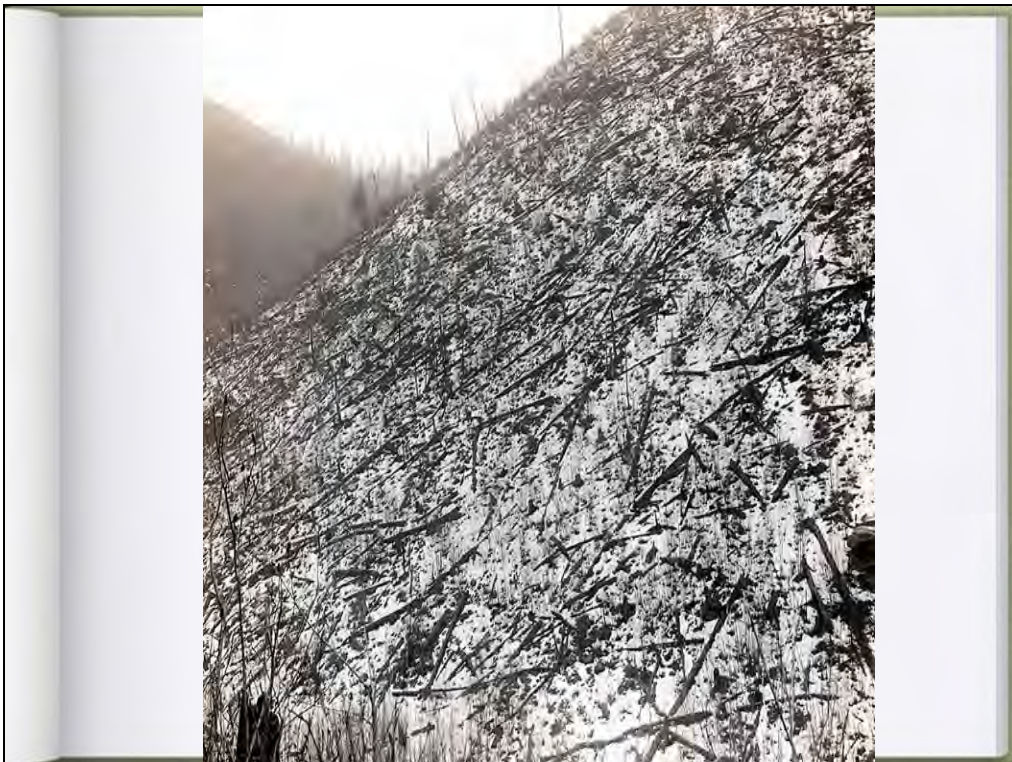
Softwoods

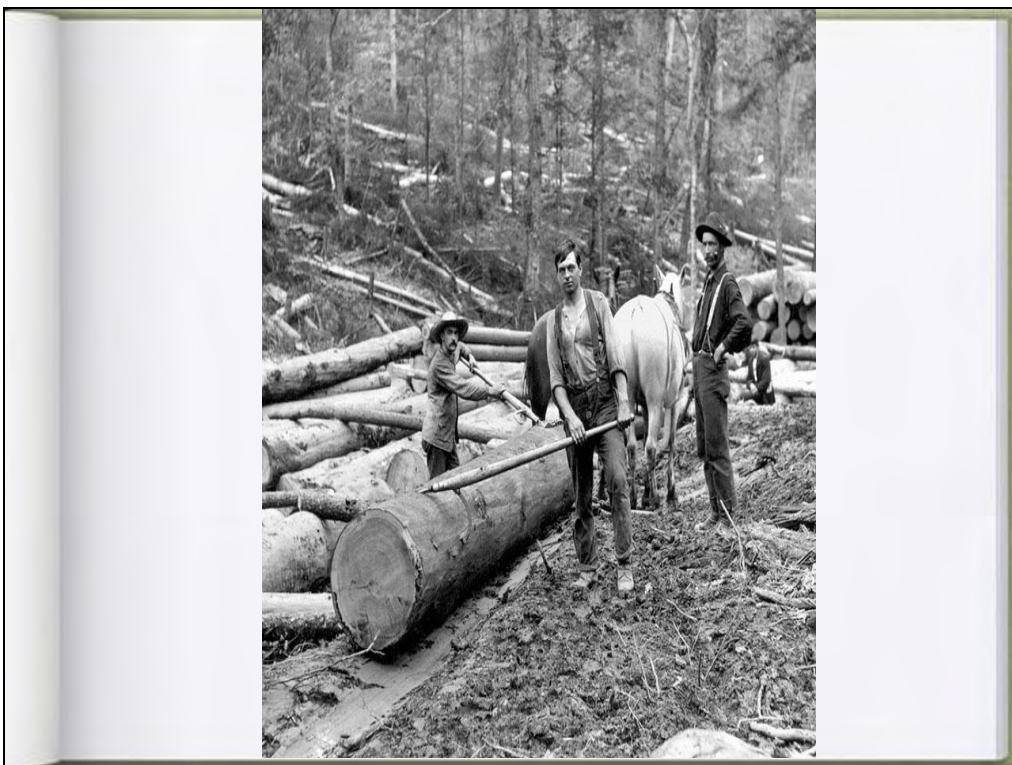
- Softwood is wood produced by coniferous trees (cone bearing), referred to as gymnosperms. Softwood does not necessarily refer to the hardness of the lumber. These trees are known as "evergreens"

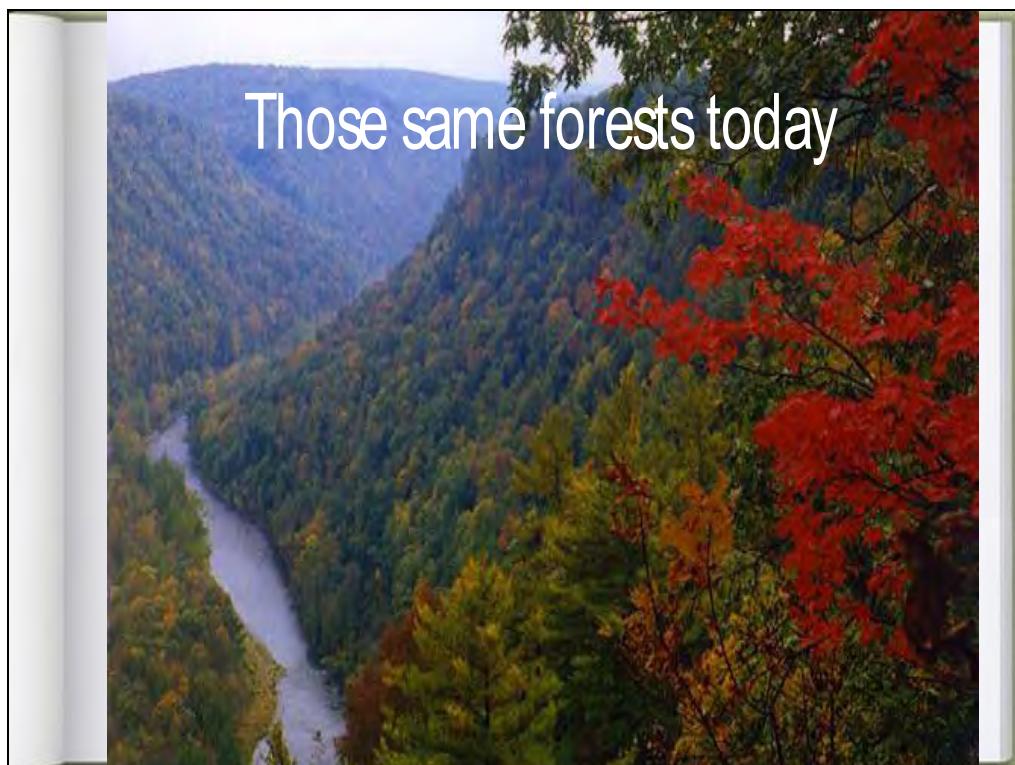
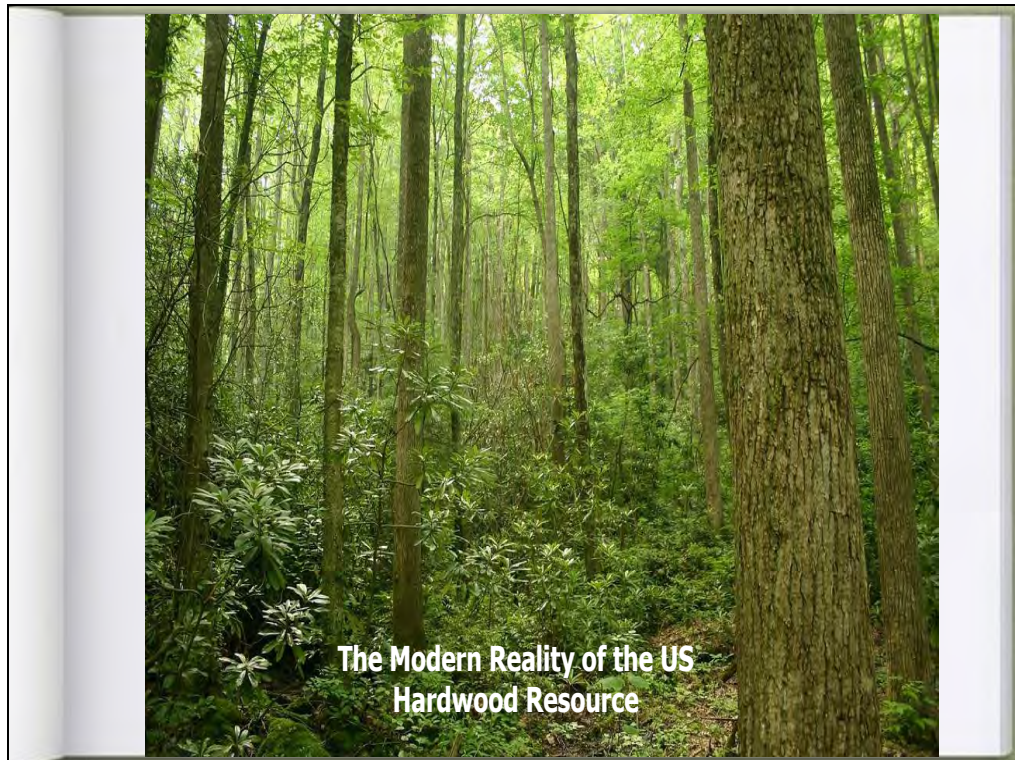


How we once managed our forests









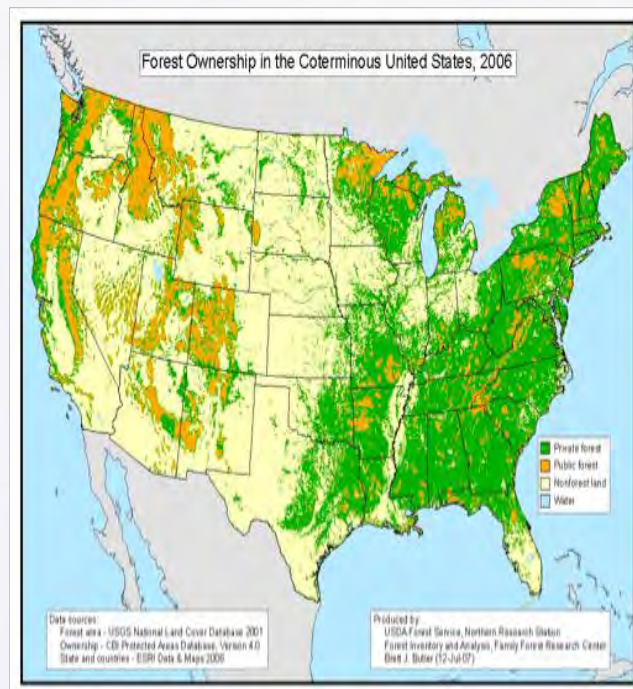
US Hardwoods – a genuinely sustainable resource

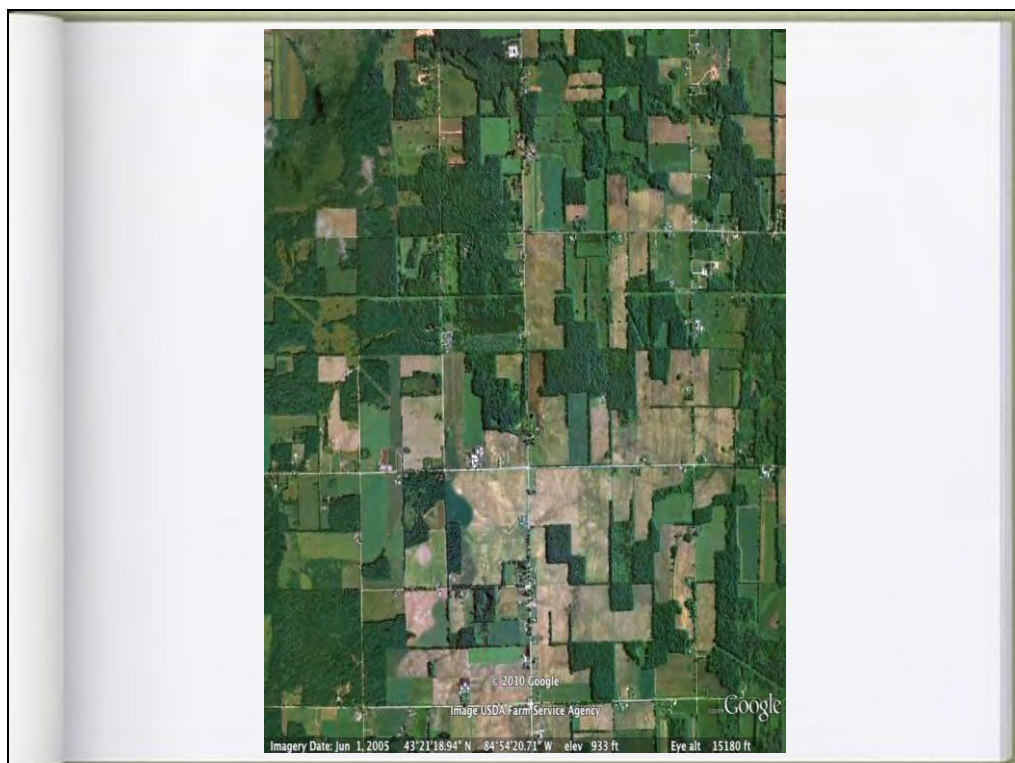
The volume of US hardwoods over the past 50 years has *more than doubled* and the area of forest has increased by 18%. This is due to the diligent practice of sustainable forestry and selection harvesting.

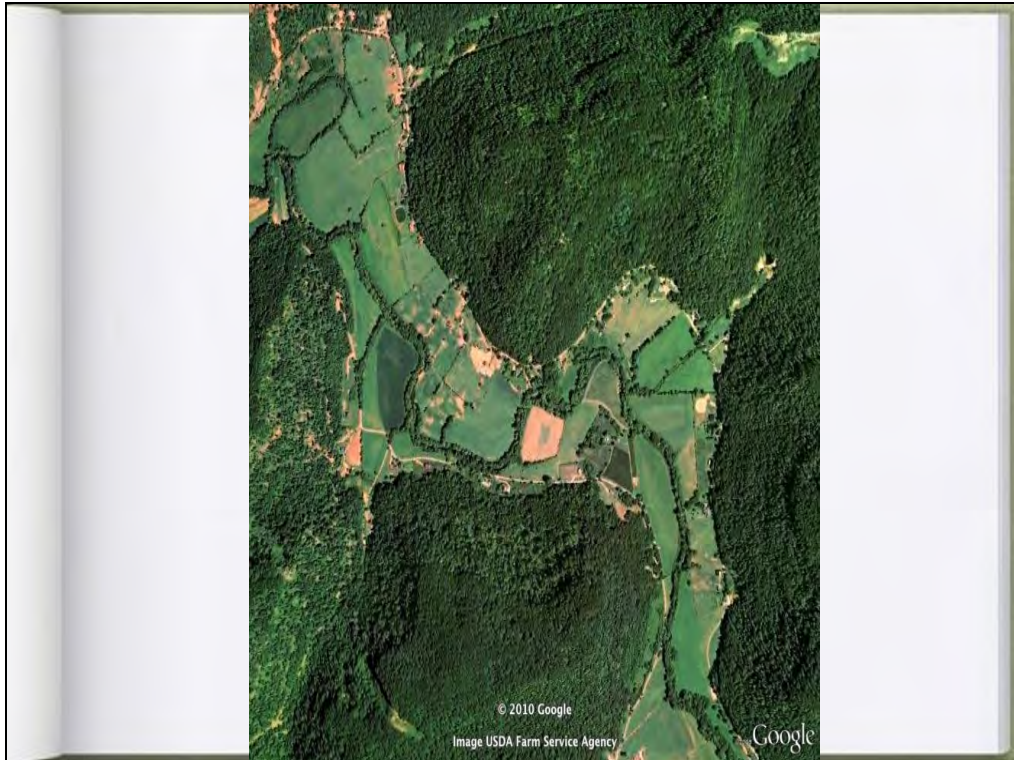
Approximately 90% of the hardwood producing land in the US is owned by over 4 million private land owners. It is usual for a sale of hardwood logs to occur only once or twice in an owners' lifetime.

If US Hardwoods are sustainably managed, why aren't all of the US Hardwood Certified?

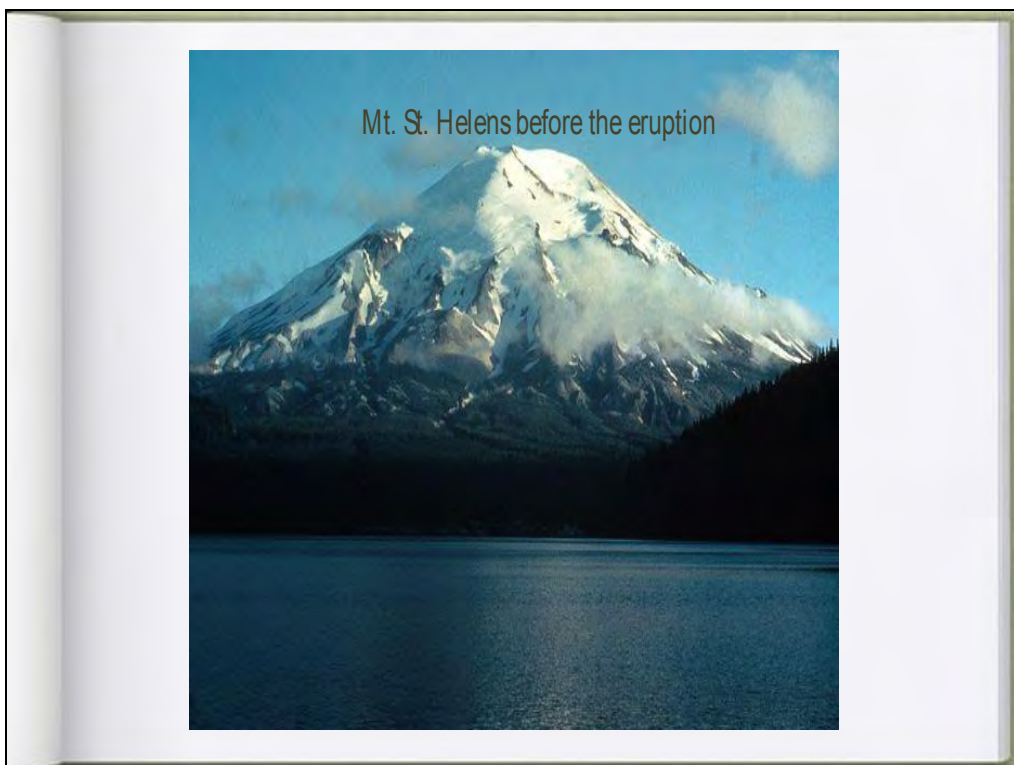
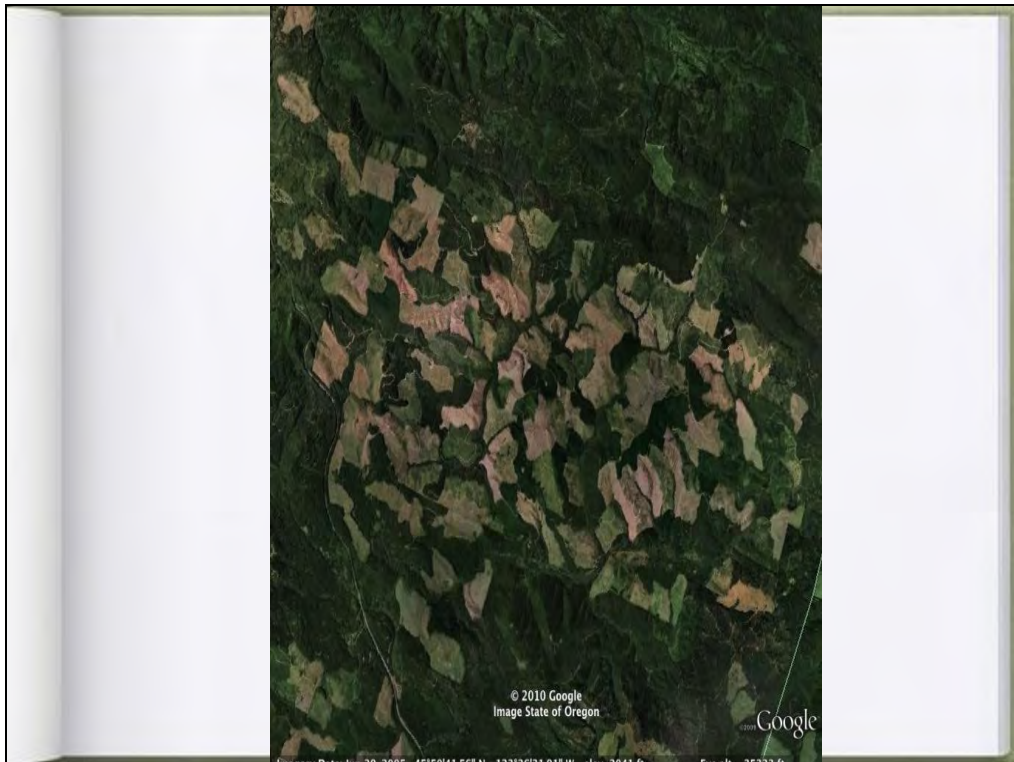
1. Many of the more than 4 million private landowners who control most of the resource are unaware of certification.
2. Those who are aware of certification perceive it to be expensive, complicated and not necessarily of benefit.
3. There is relatively low demand for certified wood in the US and approximately 75% of all US hardwood lumber produced is for US domestic consumption.

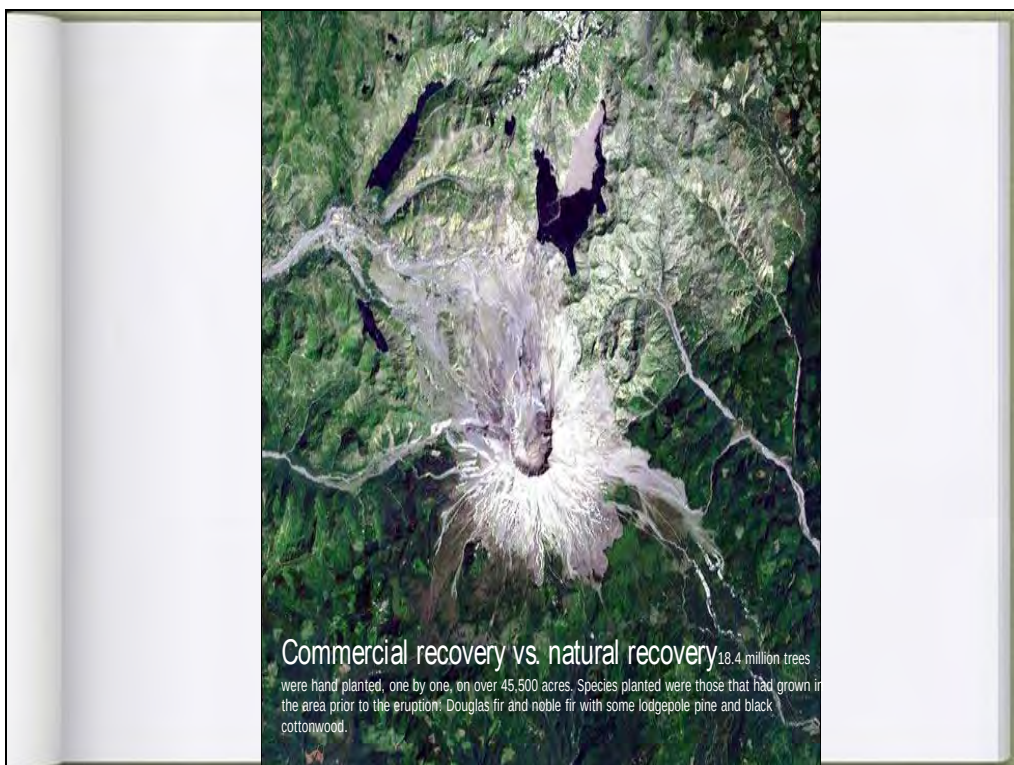
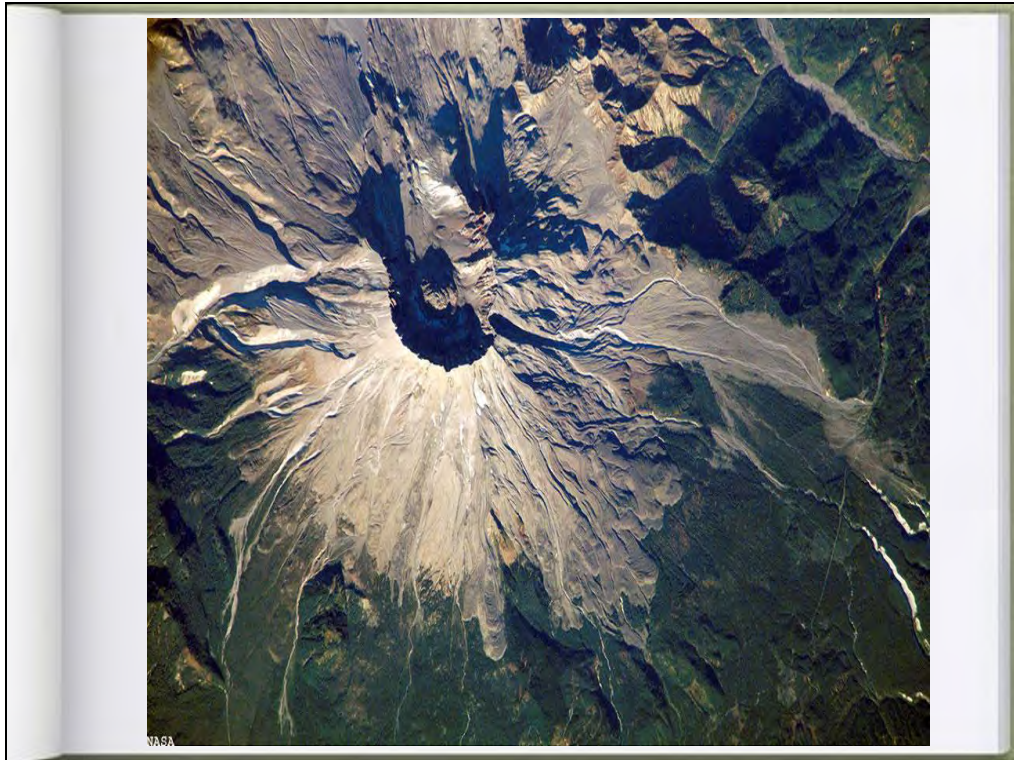






Softwood management is
different





Selection Harvesting and Natural Regeneration



Horses are still used in logging



An independent Risk Assessment carried out by Seneca Creek in 2008 concluded that less than 1% of the US Hardwood entering the American hardwood pipeline could be classified as illegally harvested.

Life Cycle Assessment is the best framework currently available to assess and compare the environmental impacts of products.

AHEC is investing in the largest Life Cycle Assessment ever undertaken in the international hardwood sector.

The assessment will be completed by PE International, a leader in the field of LCA

The LCA will provide comprehensive information about the environmental impacts of the processes used to extract, process, fabricate, transport, install, maintain, replace and dispose of American Hardwoods and their competitors.

The study will include an assessment of the "Carbon Footprint" of American Hardwoods

**The US only has approximately 8% of the world's
hardwood forests, but is the largest hardwood
lumber producer in the world
@ nearly 24%**

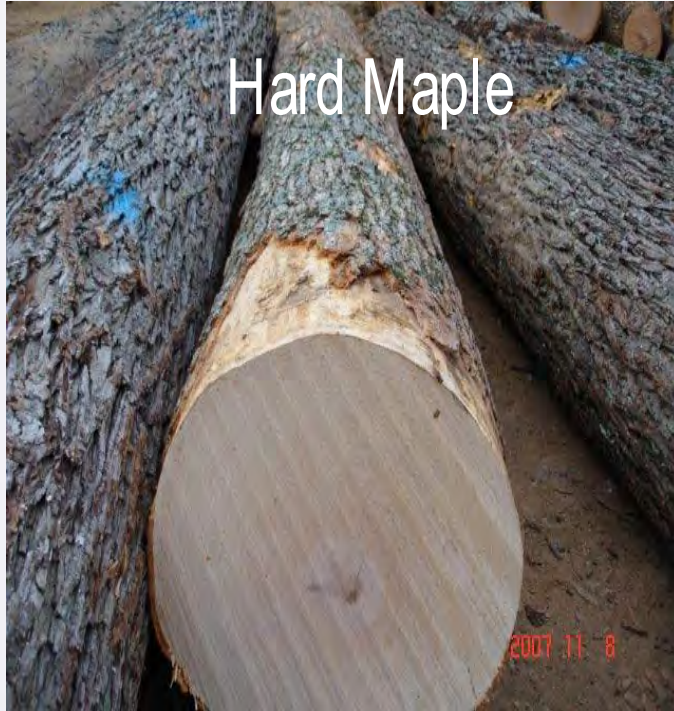
Veneer logs
leveraging the beauty of perfect logs



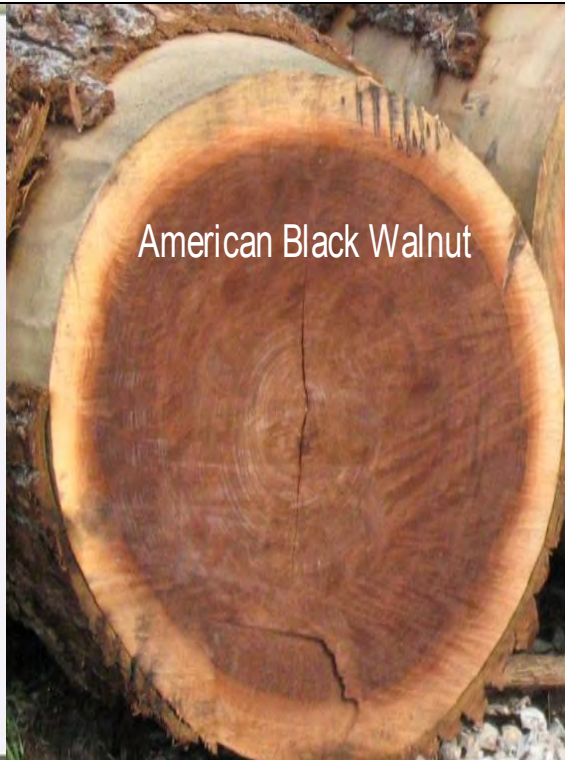
Red Oak

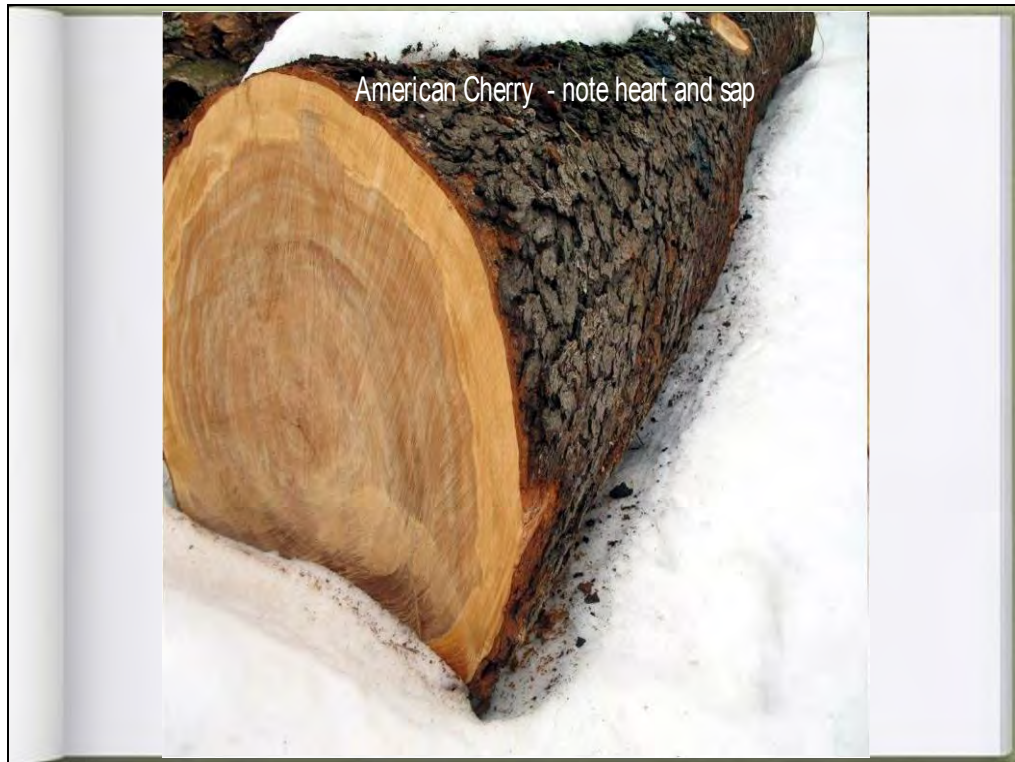


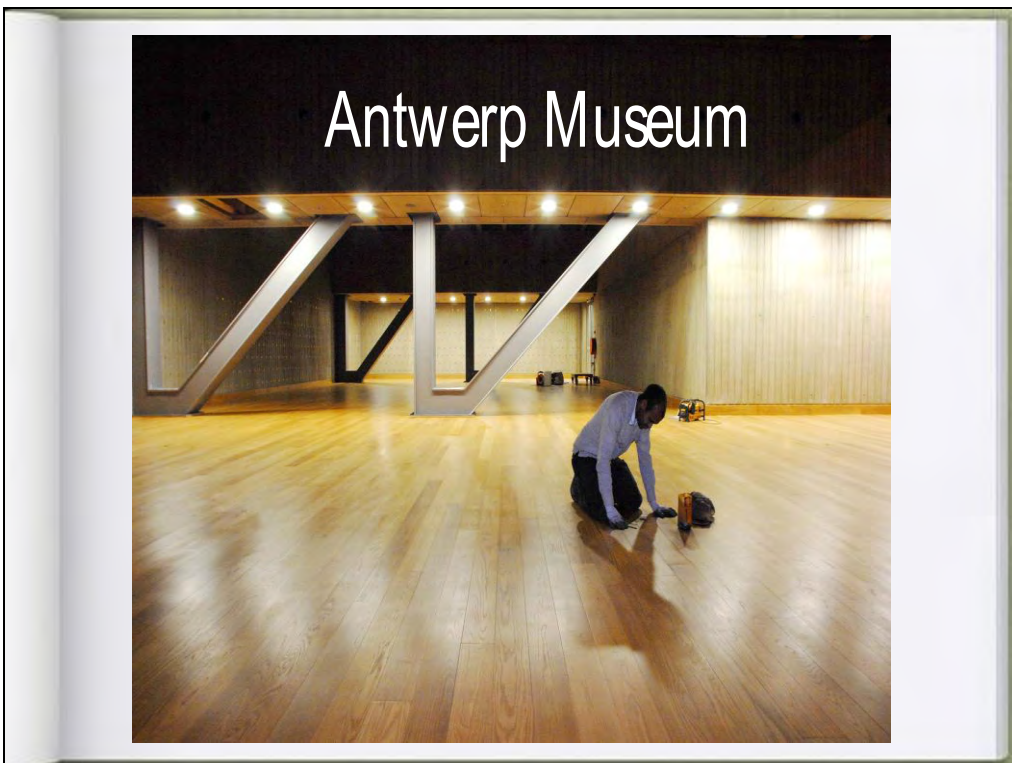
Hard Maple

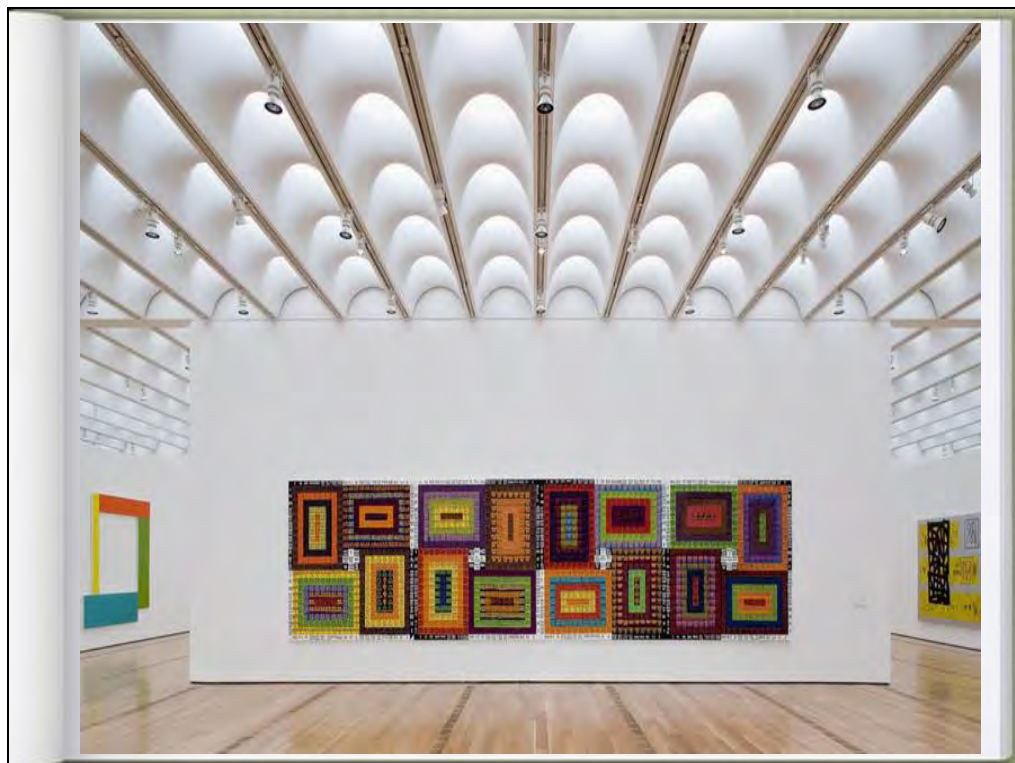


American Black Walnut







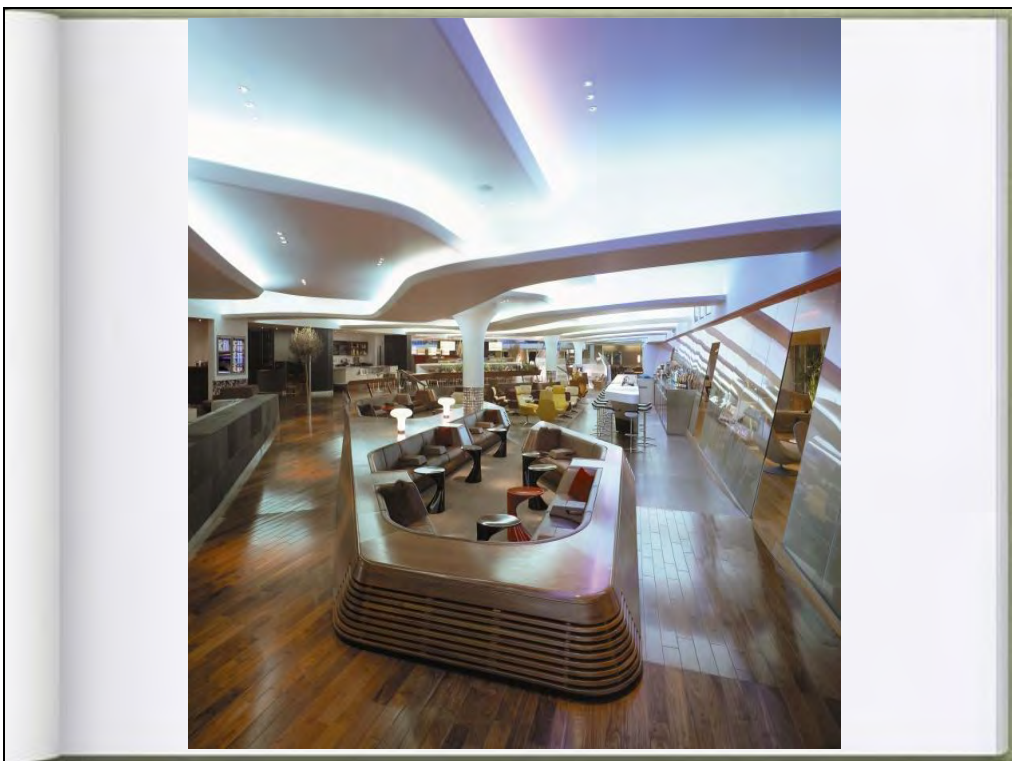
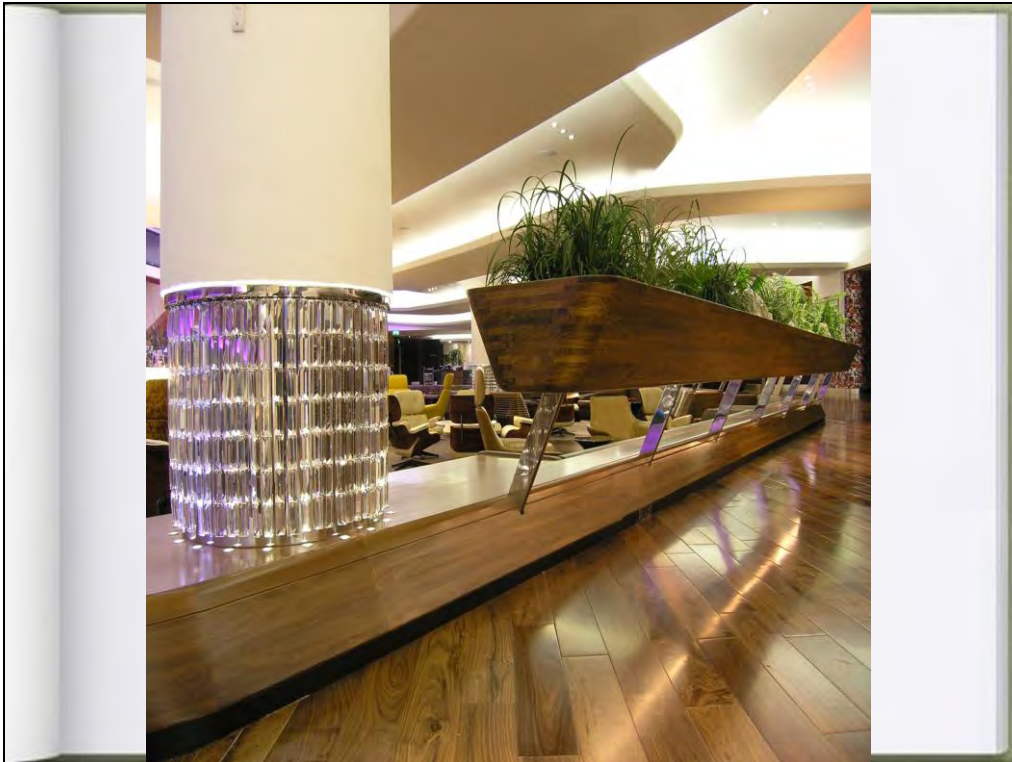


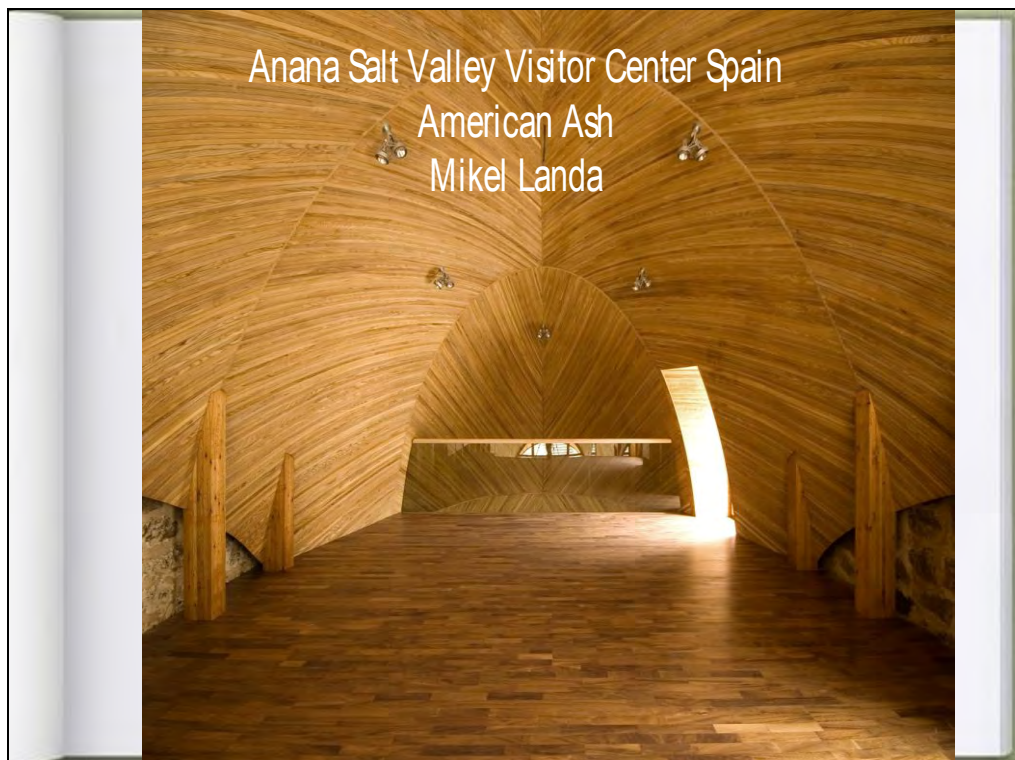
Interiors

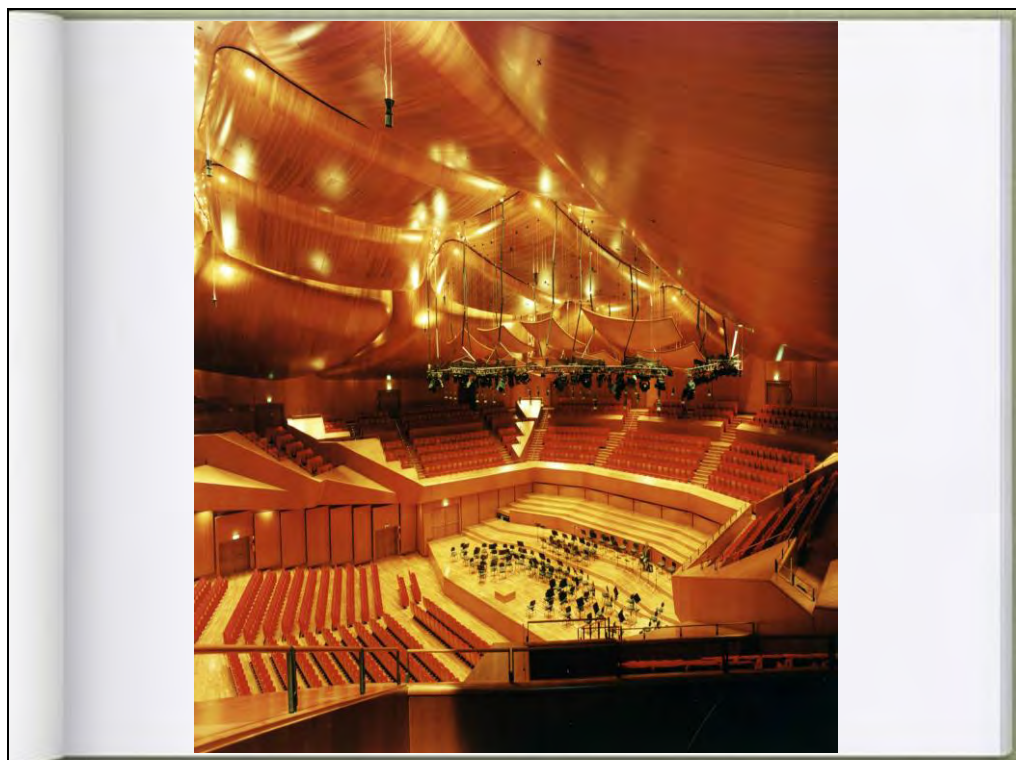
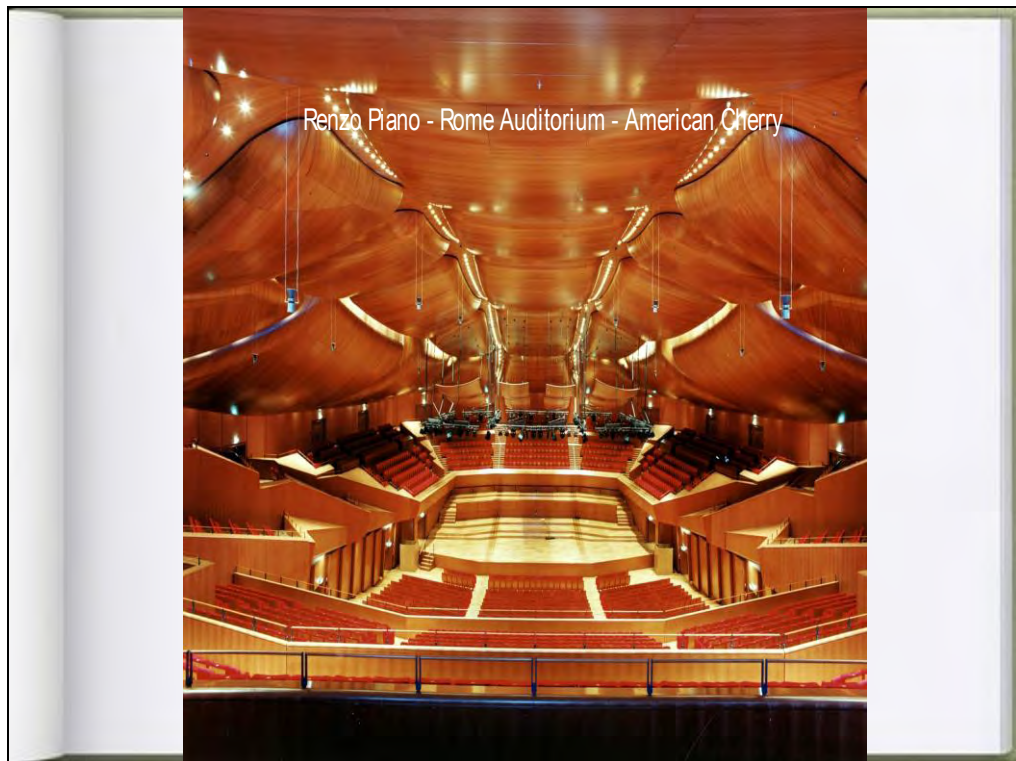
Oslo Opera House American White Oak

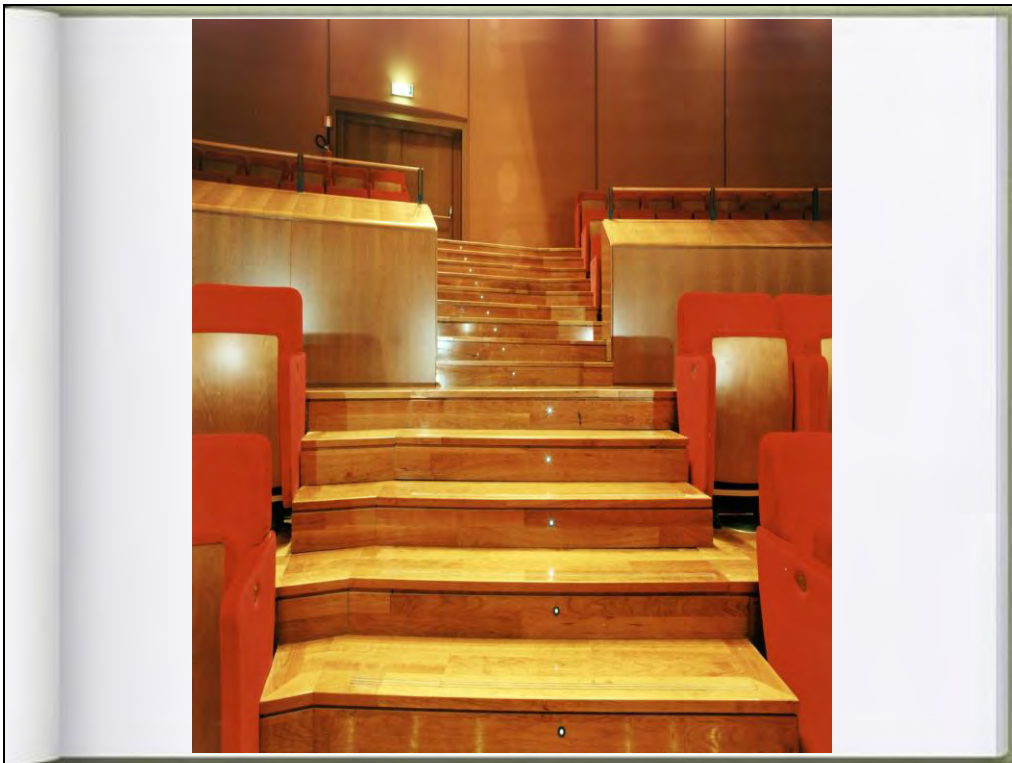
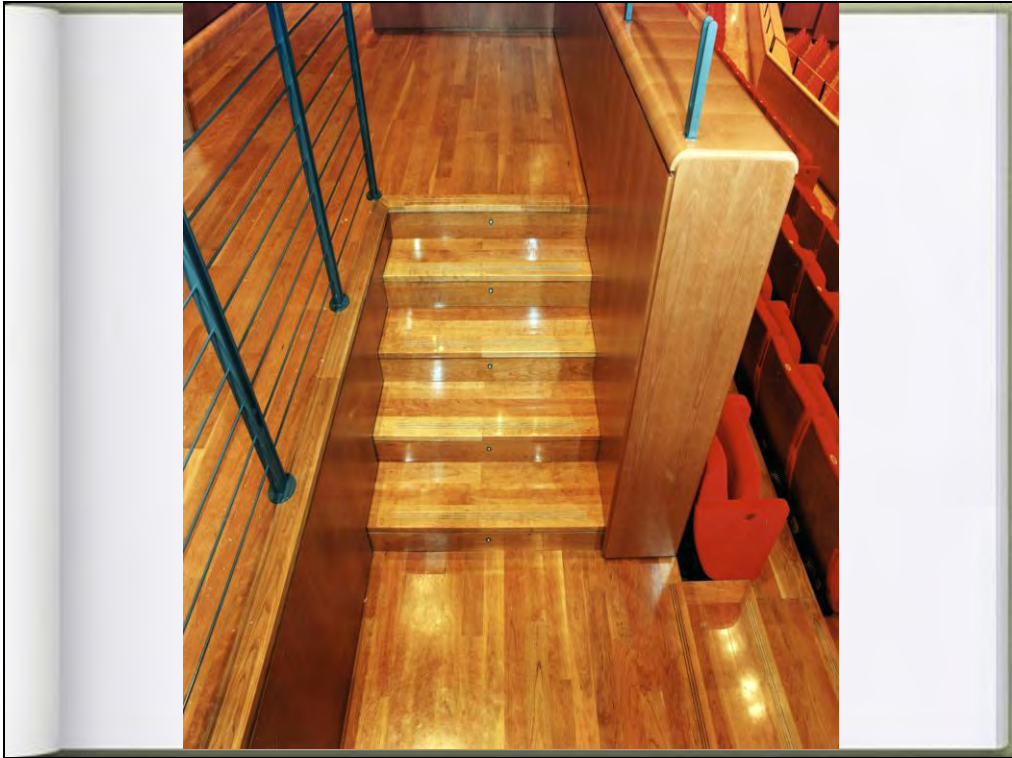




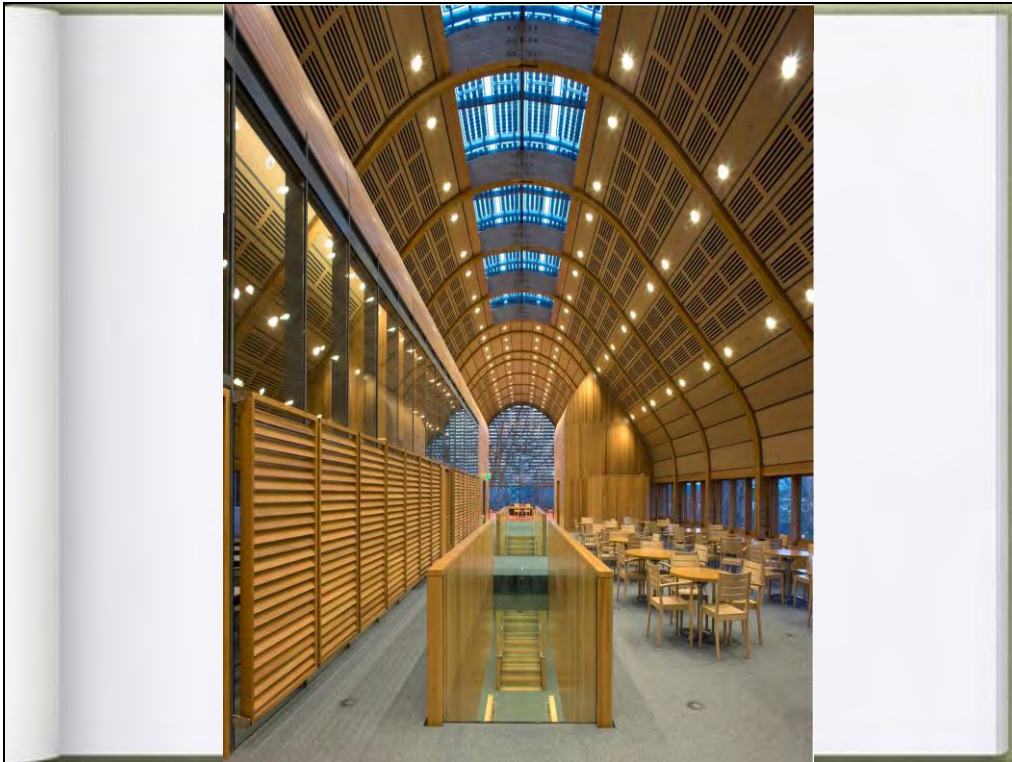


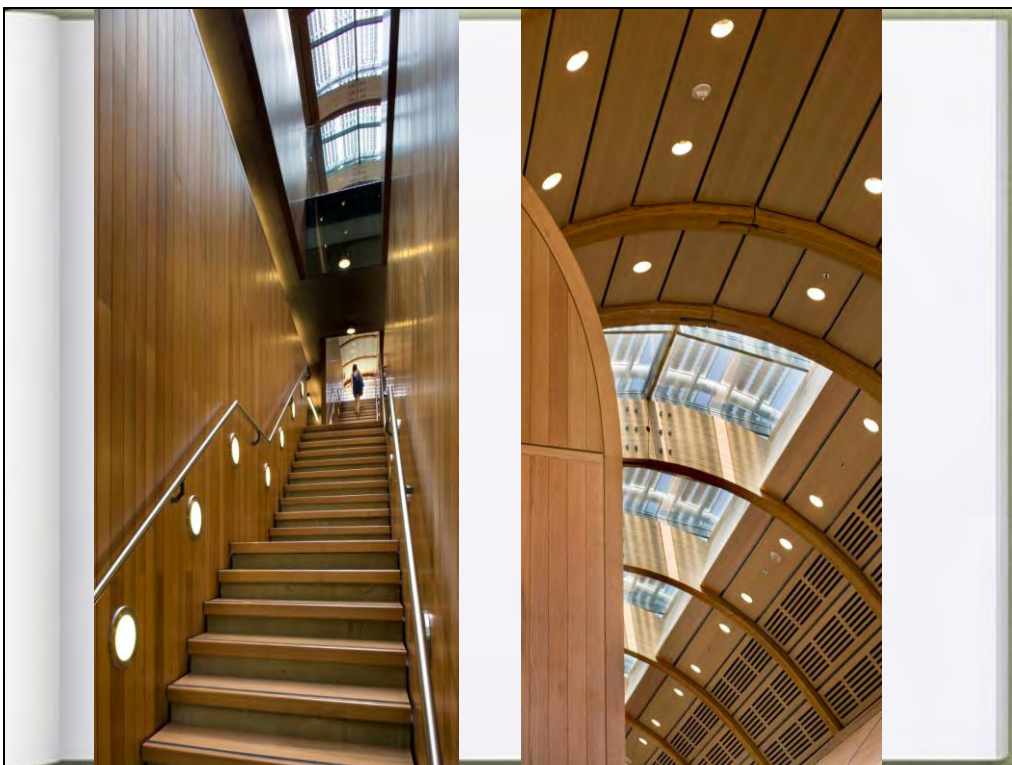
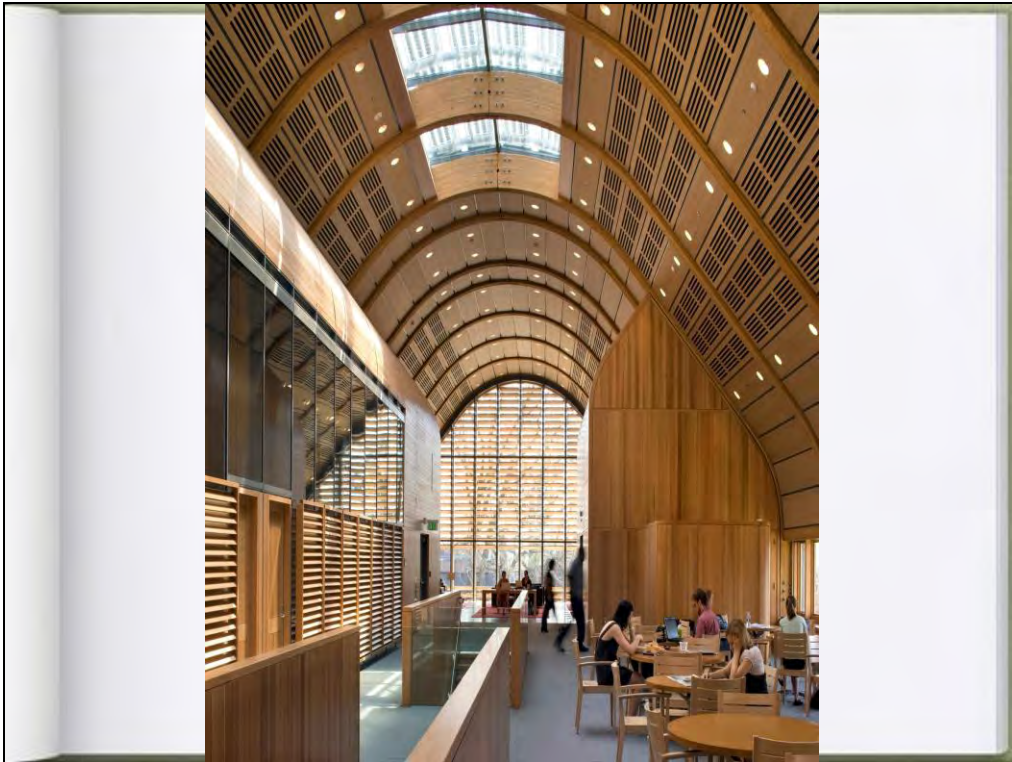






Yale School of Forestry
Michael Hopkins Partners





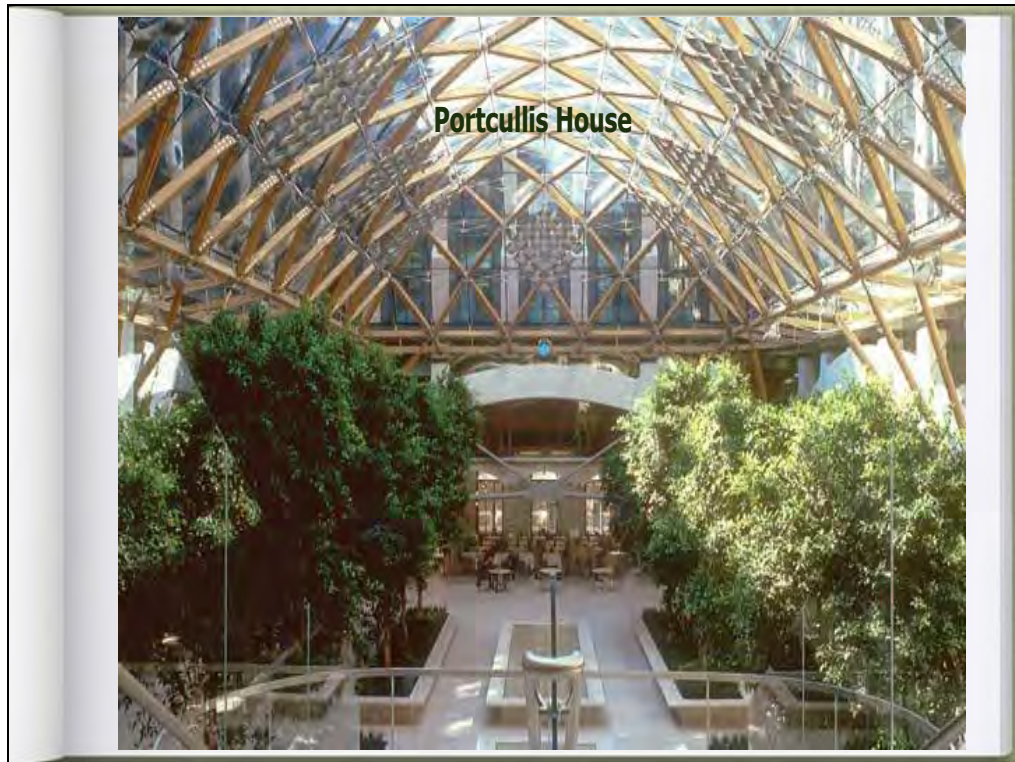
Historical Perspective - McKim, Meade and White 1862

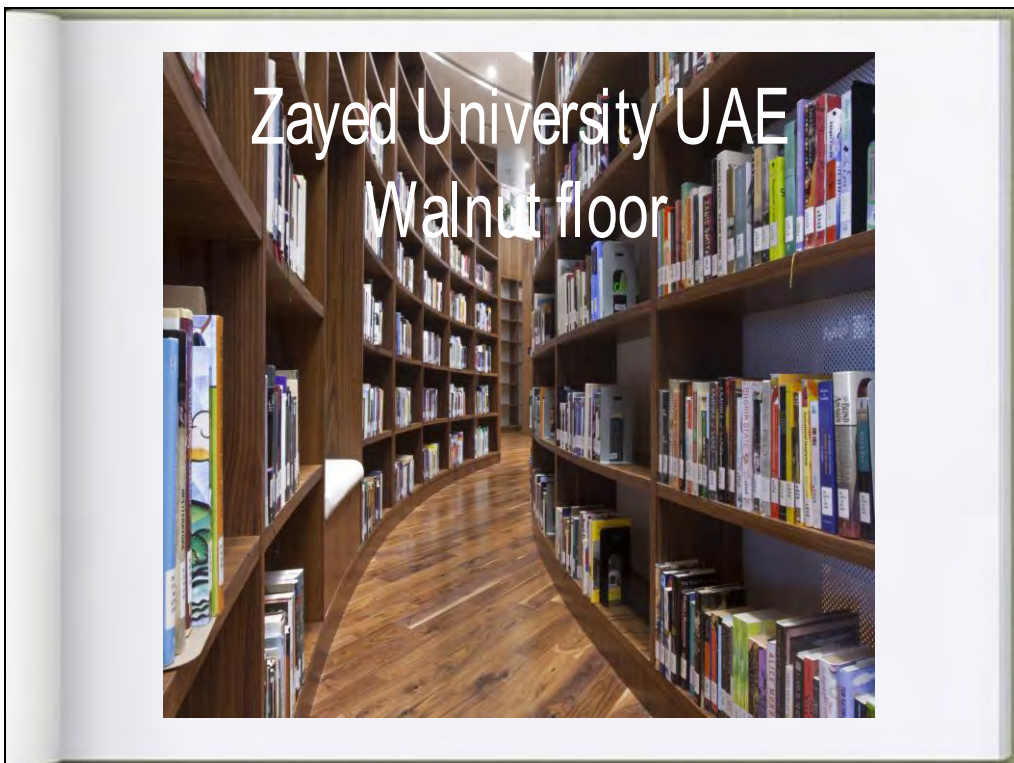
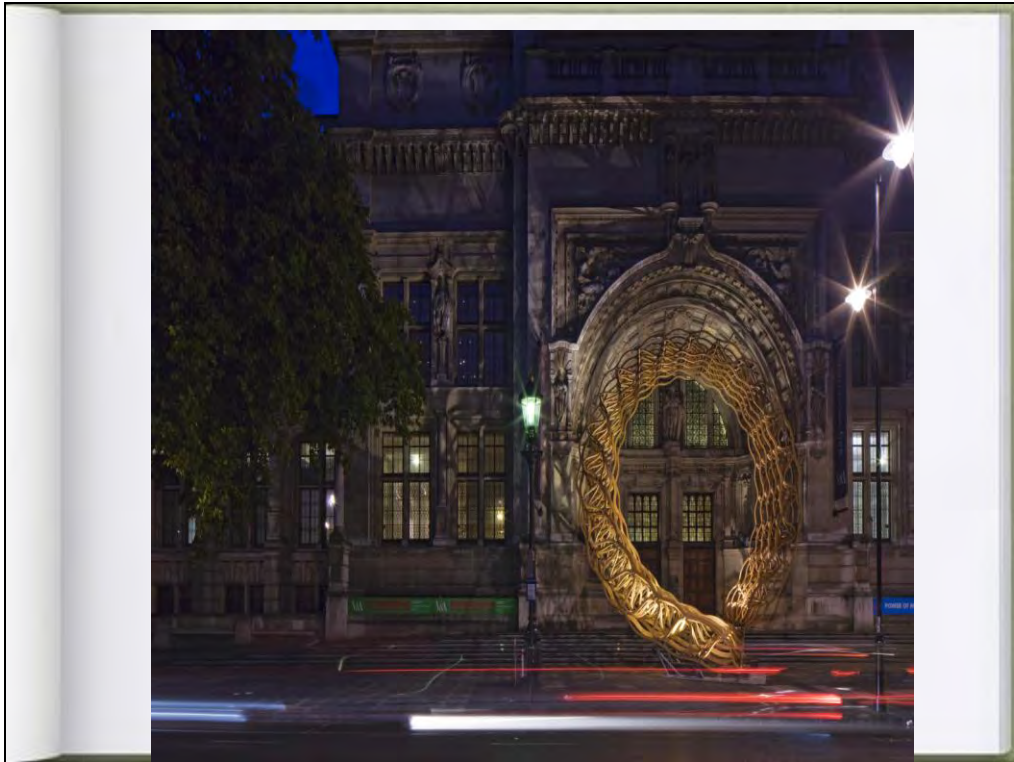


White - Garrett Jacobs House
Frederick, Maryland 1862





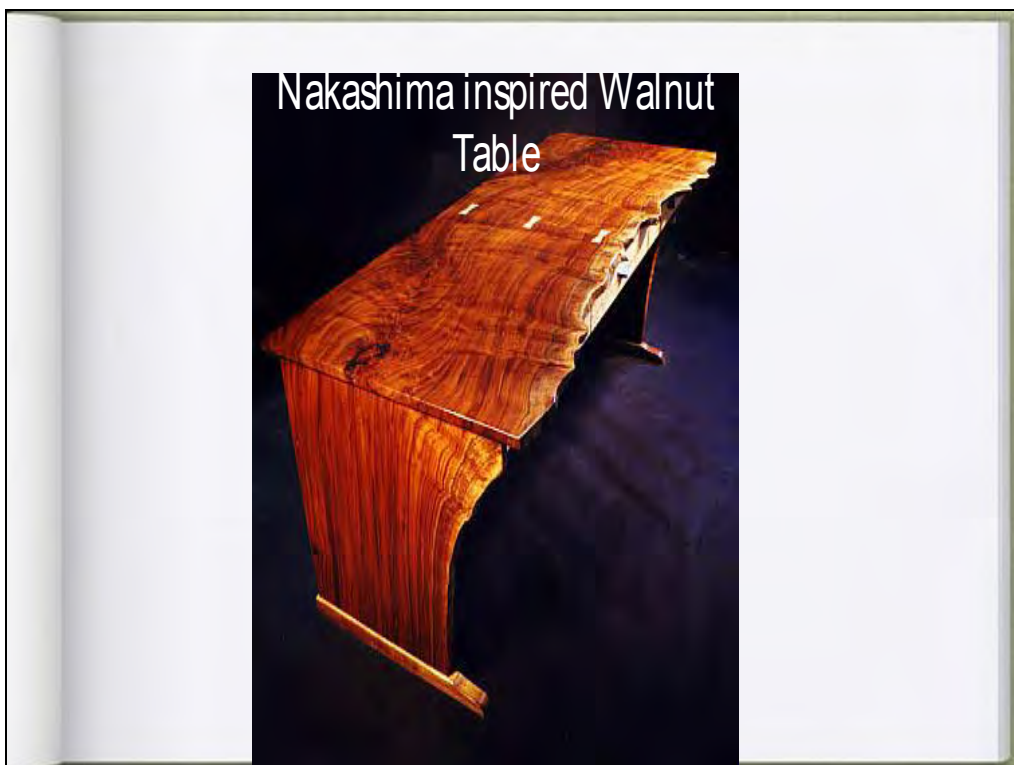




Zayed University UAE Walnut floor



Furniture



David Trubridge Bench – American Walnut



Thomas Moser American Cherry

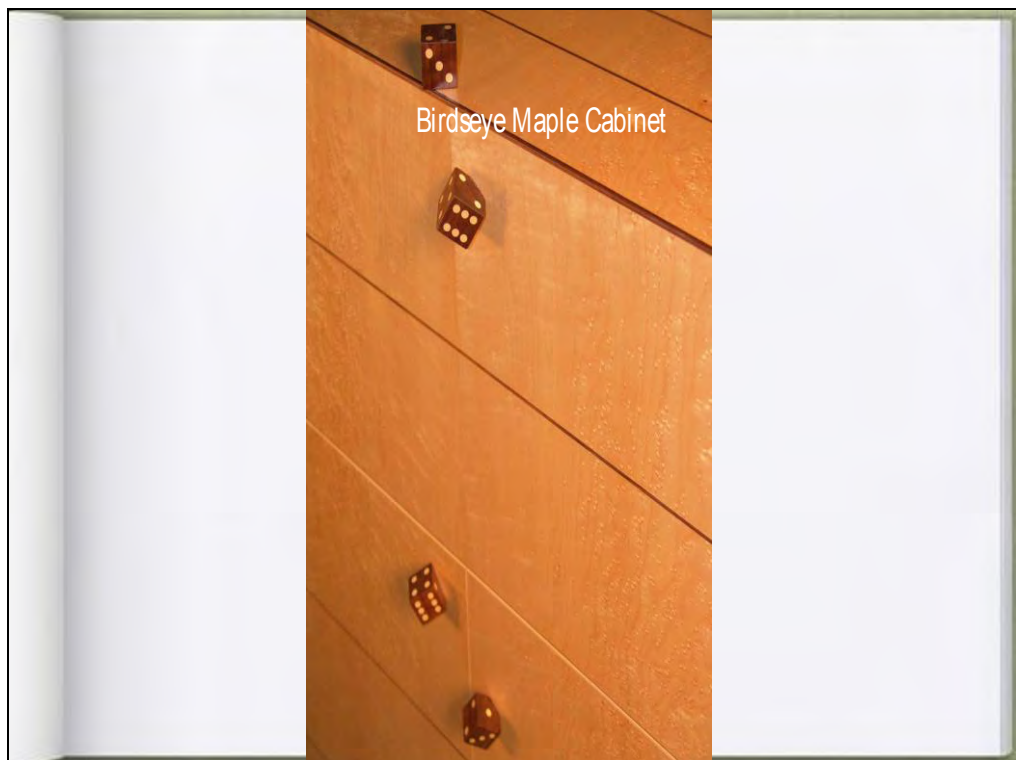


John Galvin Lounge Chair American Walnut



Red Oak and Walnut Table







Remember that wood is a natural product, subject to variations in color within each species

For More Information:



www.americanhardwood.org



The Present State of Lifecycle and Carbon Footprint Assessment in Japan to Visualize the Eco-friendliness of Products Including Wood

Nobuaki Hattori³

Abstract

To reduce environmental loads of products or services for an environment-friendly society, it is necessary to know them quantitatively. At present, life cycle assessment (abb. to LCA) is the only tool to assess the environmental loads quantitatively. In order to reduce greenhouse gases emitted from a product over its life cycle, carbon footprint (abb. to CFP) is the only tool to assess the total emissions of greenhouse gases quantitatively. CFP is defined as the total amount of greenhouse gases emitted from a product throughout its life and expressed in functional equivalent amounts of carbon dioxide. Therefore, CFP can be obtained by inventory analysis of LCA and the global warming potential among many potentials used in LCA.

The activities of CFP have become known in Japan from the year of 2009 thanks to a subsidized three year CFP pilot project funded by the Ministry of Economy, Trade and Industry. In this paper, the concept and procedure of LCA and the present state of products category rule (abb. to PCR) and the CFP system in Japan were introduced, though PCR for wood materials was just applied to the carbon footprint office.

A few case studies of LCA and CFP about wood materials were also introduced for particleboard, hardboard and insulation fiberboard.

Key words: Inventory analysis, Impact assessment, LCA, Greenhouse gas, carbon footprint

³ Tokyo University of Agriculture and Technology, Faculty of Agriculture, 3-5-8 Saiwai-cho, Fuchu-shi, Tokyo 183-850, JAPAN (hattori@cc.tuat.ac.jp)

1. INTRODUCTION

In Japan, the emission of greenhouse gases (GHG), such as CO₂, due to energy consumption increases year by year for all sectors except industries. To halt global warming, the first step is to identify how a sector or a product emits GHG. A visual demonstration of GHG emissions would be very useful. Recently, the carbon footprint (CFP) system has been introduced to do this. CFP is usually calculated based on the methodology of life cycle assessment (LCA). Therefore, we first have to understand LCA. If we could implement the recommendations by LCA in the development of a new product or reflect it in government policy, the secondary effect will be expected for life prolongation of depleted resources.

2. WHAT IS LIFE-CYCLE ASSESSMENT?

2.1 Concept and procedure of LCA

LCA is the abbreviation of Life Cycle Assessment and it is used as a tool to evaluate the environmental burdens of a product or service by identifying and quantifying energy and materials used and wastes released to the environment, and to assess the impact of the product or service to the environment across its life cycle from extraction and processing of raw materials, manufacturing, transportation, distribution, use, recycling and to final disposal (from cradle to grave) as shown in Fig. 1. LCA is also a tool to used visualize mass balance between natural area and artificial one.

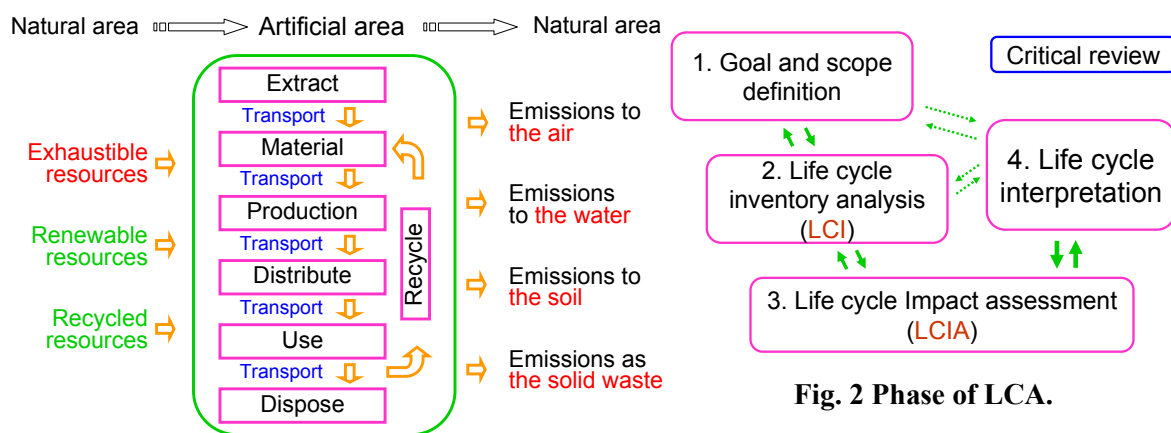


Fig. 1 Outline of LCI.

LCA consists of 1. Goal and Scope definition, 2. Life Cycle Inventory (LCI), 3. Life Cycle Impact Assessment (LCIA) and 4. Interpretation as specified by ISO (ISO 14040), as in Fig.2. The LCI phase is designed to capture all processes across the life cycle of a product assessed (Preparing for data collection), capture the amount of input and output materials in each process (Collection of foreground data), calculate environmental loads by multiplying background data and foreground data for each material (Data aggregation). The LCIA phase assigns the inventory results of CO₂, NO_x · · · to impact categories such as global warming, ozone depletion and so on (Classification), calculates a category indicator within each impact category by multiplying environmental load by characterization indicator (Characterization), calculates modified category indicator according to an indicator list (Weighting) and

integrates modified category indicators according to an indicator list to a single indicator like Japanese Yen when LIME was used (Integration).

When LCA is carried out, you have to pay attention to use high quality background data, collect foreground data as much as possible to get reliable average environmental impact and to check miscalculation by a peer reviewer.

Therefore, JEMAI-LCA Pro Ver. 2.1.2 and LIME (Life cycle Impact assessment Method based on Endpoint modeling) developed by LCA Center of AIST has been used as a reliable background database and an integration one in Japan. Furthermore, recently MiLCA (JEMAI, 2010) and LIME2 (Itsubo, 2010) have started to come into use.

2.2 Present state of LCA in Japan

The activities of LCA were initiated by the Life Cycle Assessment Society of Japan (JLCA) in 1995. The ILCAJ was established in 2004 as an academic society. Membership and numbers present at annual meeting have increased in Fig. 3.

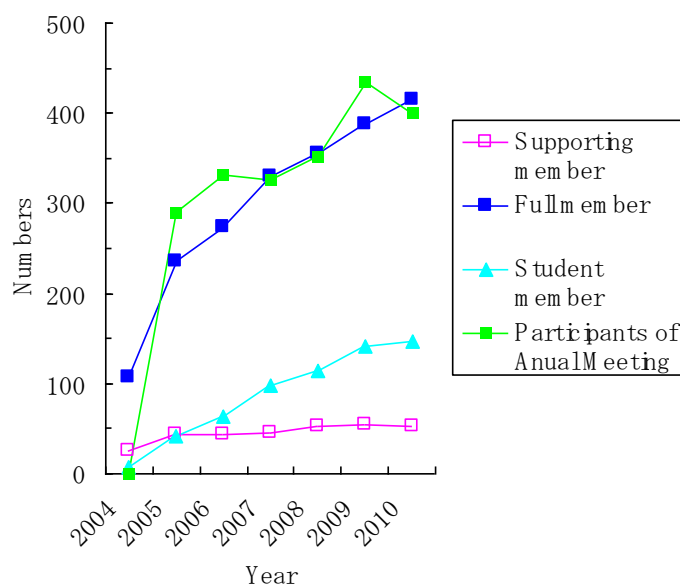


Fig. 3 Trends about ILCAJ.

Some of leading research groups are as follows: Genchi Lab. and Tahara Lab., The Research Institute of Science for Safety and Sustainability (RISS) at the National Institute of Advanced Industrial Science and Technology (AIST) have worked on LCAs and methodology. Harada Lab., Innovative Materials Engineering Laboratory at National Institute for Materials Science has worked on LCA of metals. Matsuno Lab., Faculty of Engineering, The University of Tokyo has studied LCA of steel. Inaba Lab., Faculty of Engineering, Kogakuin University has studied various types of LCA. Itsubo Lab., Faculty of Environmental and Information Studies, Tokyo City University has developed LIME and studied various types of LCA. Ikaga Lab., Faculty of Science and Technology, Keio University has studied LCA of architecture. Hondo Lab., Graduate School of Environment and Information Sciences, Yokohama National University has studied LCA of energy and methodology.

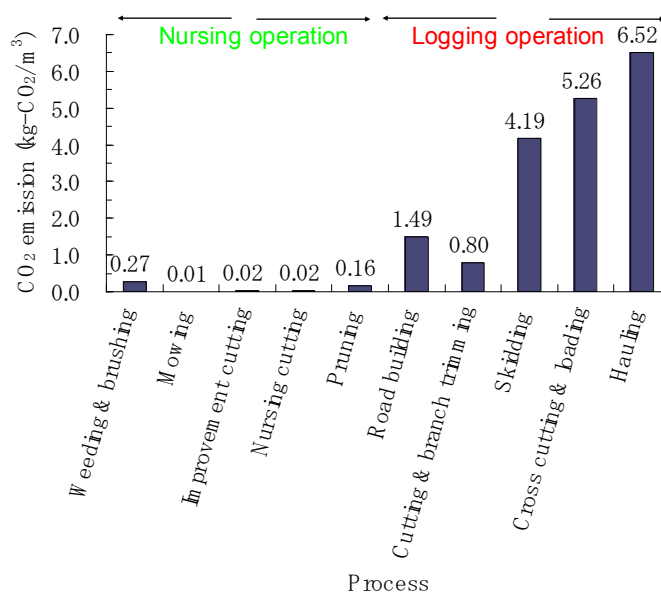


Fig. 4 CO₂ emissions of log production

2.3 Case study of LCA

Many LCA surveys about wood or wood materials have been conducted by my laboratory in which the results of logs are indicated here.

CO₂ emission from 1 m³ of log production was shown in Fig. 4 for major processes (Tahara, 2004). The total CO₂ emission for production of 1 m³ log was 18.7 kg-CO₂/m³ in which major emission processes were hauling, cross cutting & loading and skidding in this case.

Other major published case studies about wood products concern domestic larch logs in Hokkaido (Komata, 2006), five types of adhesives for wooden panels (Sawada, 2006) and allocation concept of domestic lumber (Hitoe, 2009).

Popular types of detached houses are made of concrete, steel and lumber in Japan. As it is very difficult to compare the results of their LCA because of a lack of back ground data, I calculated single indexes whose environmental loads were in the database (Ikaga, 2003) using LIME2 and showed in Fig. 5.

It is clear that the most eco-friendly detached houses are made of wood, with steel built houses representing the lowest level of eco-friendliness. Potential damage cost due to urban air pollution was nearly the same as the one by global warming.

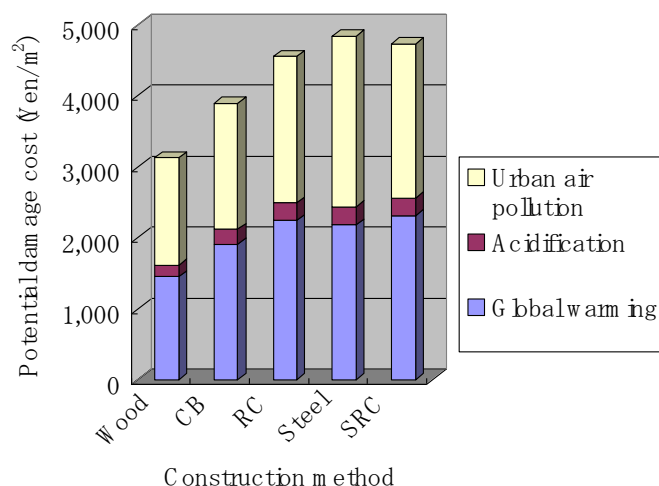


Fig. 5 Comparison of potential damage cost for types of detached house.

3. WHAT IS CARBON FOOTPRINT?

3.1 Concept of CFP

Carbon Footprint, abbreviated to CFP or CF, is a term used to describe the total amount of greenhouse gas (GHG) emissions caused by a particular activity or entity, and is thus a way for organizations and individuals to assess their contribution to the prevention of global warming. CFP refers only to GHG emissions of a product or service provision across its life cycle among all environmental categories assessed by LCA.

CFP is expressed in equivalent weights of carbon dioxide equivalent (CO₂e) in which carbon dioxide (CO₂), methane (CH₄), nitrous oxide (N₂O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulfur hexafluoride (SF₆) are included. CFP includes not only GHG from artificial sources but also natural sources, such as rice paddies, livestock and so on. CFP is calculated with global warming potential for 100-year time horizon brought up by IPCC.

CFP can be used for Business-to-Consumer (B2C) goods, where the customer is the end user; and for Business-to-Business (B2B) goods, where the customer is another business using the product as an input to its own activities.

CFP system has been developed as part of the pilot project for three years from 2009 supported by the Ministry of Economy, Trade and Industry. The secretariat division is in JEMAI who has managed dedicated web site about CFP (Web site of CFP).

3.2 How to calculate and indicate CFP in Japan?

The equation is the sum of all activities in a product's life cycle multiplied by their emission factors as follows.

CFP of a given activity = $\sum (\text{Activity data } i \times \text{CO}_2 \text{ equivalent emission of factor } i)$
 where i means a process

Steps to calculate CFP are, 1. Build process map of product's life cycle, from raw materials to disposal, including all material, energy and waste flows. 2. Confirm boundaries and perform high-level footprint calculation to help priorities efforts. 3. Collect data on material amounts, activities and emission factors across all life cycle stages. 4. Calculate the product carbon footprint. 5. Assess precision of the footprint analysis.

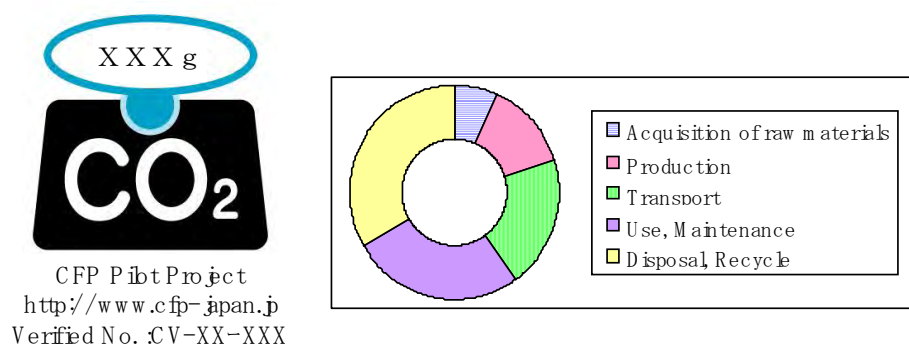


Fig. 6 Image of a recommended CFP label with the official mark.
Basic indication area (Left) and additional indication area (Right)

The indication of a CFP consists of basic indication and additional indication on a label as shown in Fig. 6. The basic indication is required to state the absolute total CO₂ equivalent value of the product or service across its life cycle on the authorized label. CFP values should be states in grams, kilograms or tons, although the correct expression is CO₂ equivalent. The label must be on the body of the package itself. Detailed CFP information should be disclosed on the website of the CFP office.

Additional information such percentage of total GHG, cut down percentage against the current model or default value in the industry sector and amount of carbon stock in biomass are permitted to indicate on the additional area of the label. Differences in regions, seasonal changes of climate and suppliers should be indicated if significant. Verification of CFP by a third-party is recommended.

The advantages of CFP include: reduction of GHG emissions, identification of cost savings opportunities, incorporating emissions impact into decision making on suppliers, materials, product design, manufacturing processes, etc., demonstrating environmental/corporate responsibility leadership, meeting customer demands for information on product carbon footprints and meeting demands from 'green' consumers, for companies.

Customers are expected to use products in a low-carbon manner and choose recycled products with less environmental impact and take voluntary actions to reduce GHG emissions, such as selecting products with fewer GHG emissions when shopping.

3.3 What is PCR?

When a manufacturer calculates a CFP of his own product, there is always a possibility of willfully underestimating the value. If a customer realizes this fact, the CFP system may immediately lose the trust of its users. This is why the PCR (Products Category Rule) system was introduced to CFP system.

PCR is a rule to calculate CFP of a product and approved by PCR committee after strict review. As there is only one usable PCR for a product, all manufacturer have to use the same PCR if they produce the same products. CFP of a product is reviewed and verified by the CFP panel whether it was calculated in accordance with the PCR or not in this pilot project.

As the possession and licensing of PCR belongs to the Japanese government, persons in charge of PCR and CFP always watch and offer comments to promote this system for prevention of global warming.

3.4 Case studies of CFP

The well-known brand IEON produces a rice product “Akitakomachi” weighing 5 kg with CFP on market this January at their ten stores as shown in Fig. 7. The CFP of this package shows that the total CFP is 7,730 g and the largest step is cultivation in which natural emission from paddy was 3,119 g. Can you imagine that 7.7 kg of CO₂ emitted from 5 kg rice during the life cycle and 40 % of CFP came from paddy?



Fig. 7 Test marketing of rice with CFP.

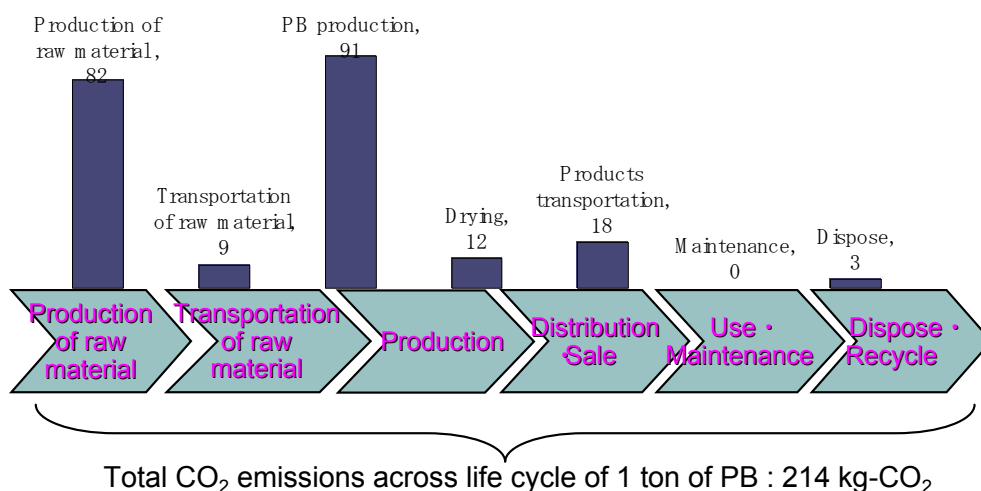


Fig. 8 Case study of CFP of particle board for sub-floor.

A CFP of 1 ton of particle board was estimated by Hattori Lab. in cooperation with a manufacturer in Tokyo and resulted in Fig. 8, which illustrates GHG emitted mainly from the stages of the production of chips and board among its life cycle stages. The CFP of a board for sub-floor whose size and density are 20 by 600 by 1800 mm and 0.75 g/cm³ respectively was 3.47 kg referring to the main result. This estimation carried out in 2008 and not verified.

3.5 The present state of PCR and CFP in Japan

PCR planning has been adjusted at first to avoid definition of a product in more than one PCR before PCR review. This adjustment is sometimes done in ministerial talks.

Products with verified CFP label are displayed at the Eco-Products Exposition from 2008 as shown in Fig. 9.



Fig. 9 Test marketing of products with CFP from 2008.

You can see products with CFP label include not only daily necessities but also foods and beverages.

Statistics of PCR and CFP from 2008 are indicated in Fig. 10.

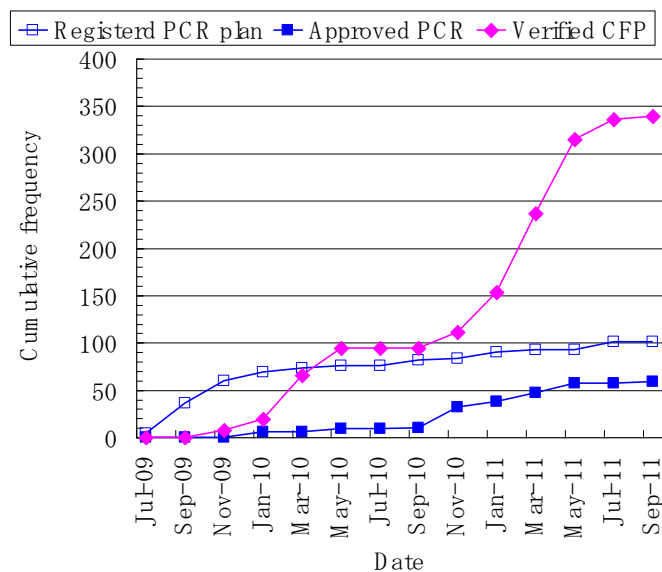


Fig. 10 Statistics of registered PCR plan, approved PCR and verified CFP.

About 60 % of planned PCR have been approved in which some of them were already revised for completion. Numbers of verified CFP in this year, through the PCR plan, increased in the first year of this project.

ACKNOWLEDGMENTS

I wish to express many thanks to IWCS for the invitation and provision of accommodation.

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Web site of CFP by JEMAI, <http://www.cfp-japan.jp/english/>



To visualize eco-friendliness of a product – The present state of life cycle assessment and carbon footprint in Japan –

11:36 – 11:54, October 21, 2011

Room: Main auditorium

by

Nobuaki HATTORI, Dr. of Agr.
Professor, Graduate School of Agriculture,
Tokyo University of Agriculture and Technology
E-mail: hattori@cc.tuat.ac.jp



Wood is good?

- Visualization of environmental loads and GHG emissions.
- The emission of GHG by energy consumption increases year by year for all sectors except industries in Japan.
- To stop global warming, we have to know how a sector or a product exhausts GHG.
- Carbon footprint (CFP) system has been used to visualize GHG emissions for this purpose.
- CFP must be calculated by life cycle assessment (LCA).
- Expected secondary effect is to prolong the life of depleted resources.

2

Contents



- Part 1 : What is Life Cycle Assessment (**LCA**)? and present state of LCA in Japan
- Part 2 : What is carbon footprint (**CFP**)? and present state of CFP in Japan

3

What is LCA?



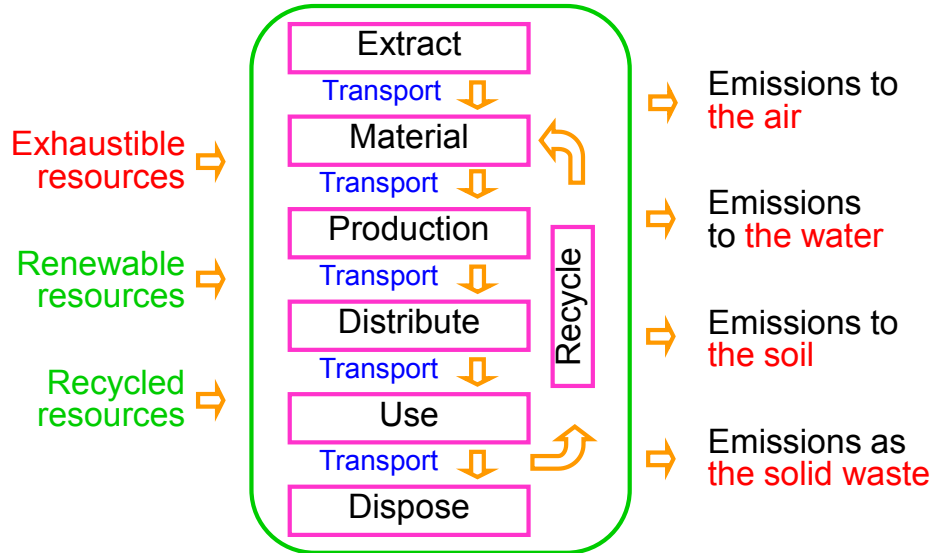
- Abbr. of **L**ife **C**ycle **A**ssessment.
- Tool to assess environmental impacts associated with all stages of a product or service by identifying and quantifying energy, materials used and wastes released to the environment.
- Stages are from raw material extraction through materials processing, manufacture, distribution, use, repair and maintenance, and disposal or recycling (**from cradle to grave**).
- LCA can cover many environmental categories.
- Impacts can be integrated to one value such as Japanese Yen, if you use **LIME**.

4

Concept of LCA

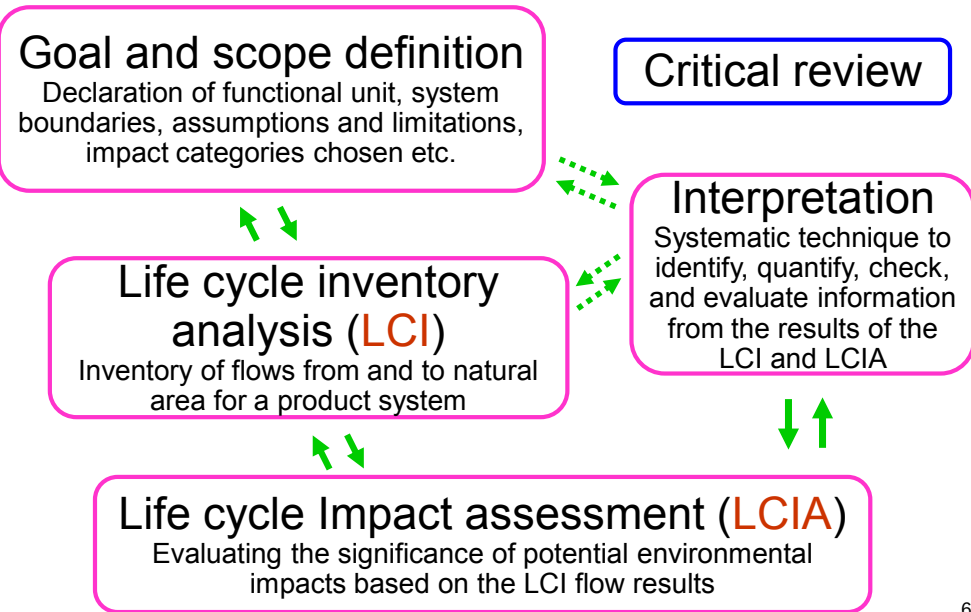


Natural area → Artificial area → Natural area



5

Procedure of LCA



6

Reliable tools have to be used to do LCA



- Software
JEMAI-LCA Pro Ver. 2.1.2 developed by LCA Center of AIST and sold by JEMAI (Japan Environmental Management Association for Industry, 105,000 yen), MiLCA by JEMAI (usable under license key), Simple LCA (free from Web site)
- Background data
JLCA, NIRE in LCA-Pro, MiLCA, Simple LCA
- Integration tool
LIME (Life cycle Impact assessment Method based on Endpoint modeling) applicable in Tokyo and LIME2 applicable in Japan by LCA Center, and LIME3 applicable in Asia comes up soon.

7

LIME can be used for



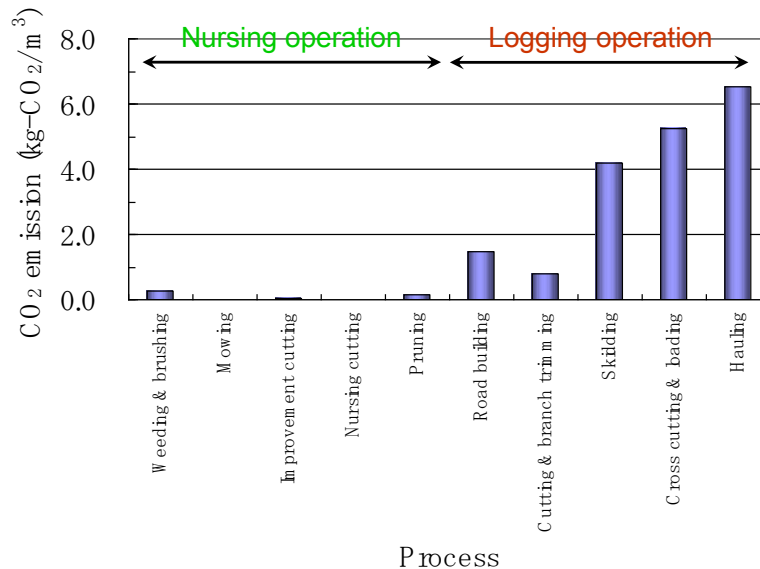
- calculation of a potential damage cost for all environmental loads assessed by LCA.
- getting the damage cost in Japanese Yen.
- full cost assessment consists of internal cost (direct cost) and external cost (potential damage cost) in which the assessment of direct costs is well known as life cycle costing.
- eco-efficiency of various levels.

8

Case 1: Inventory of logs



- CO₂ emissions of log production assessed by LCA.

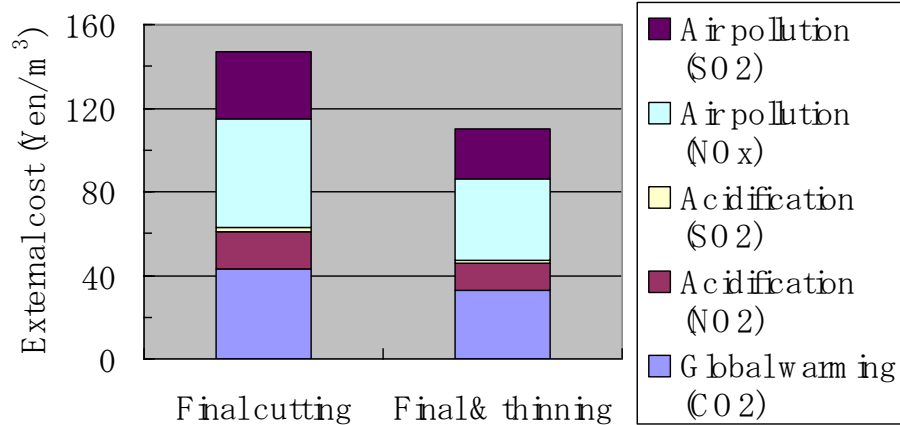


9

Case 1: Impact of log



- Potential damage cost of log production

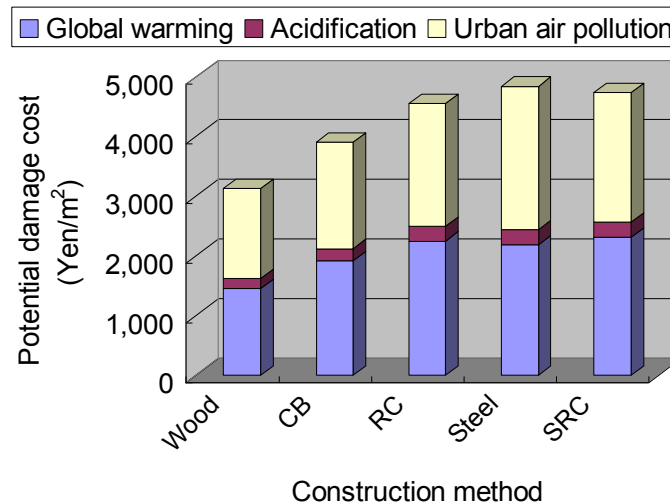


10

Case 2: Impact of house



- Potential damage costs for types of house assessed by economic input-output LCA.



11

Contents



- Part 1 : What is Life Cycle Assessment (LCA)? and present state of LCA in Japan
- Part 2 : What is carbon footprint (CFP)? and present state of CFP in Japan

12

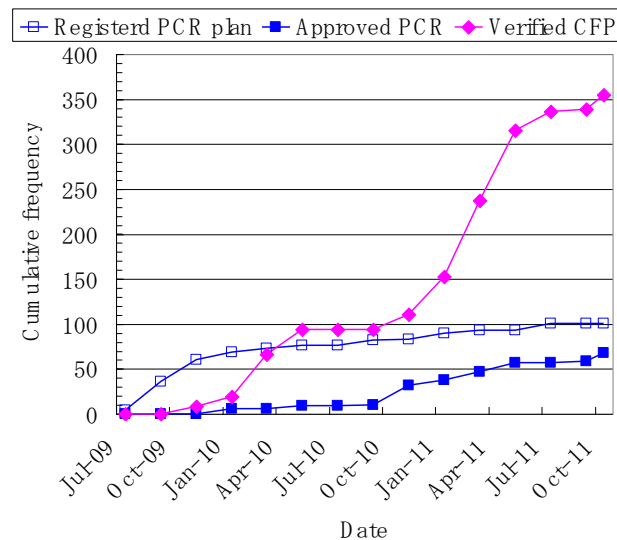
How to calculate CFP?



- The same as **process based LCA**.
- Greenhouse gas (**GHG**) emissions can be only assessed.
- **PCR** (Products Category Rule) must be planned and made at first.
- **CFP** must be verified by the authorized committee in Japan.
- This system has been developed in three years from 2009 on the CFP **Pilot Project** by the Ministry of Economy, Trade and Industry.
- The system is managed by **JEMAI** whose web site is <http://www.cfp-japan.jp/english/> .

13

Outline of PCRs and CFP in the project



14

Eco-Products Exhibition



- Eco-Products Exhibition is held every year at Tokyo Big Sight to let people know the CFP system.



15

Test marketing about rice



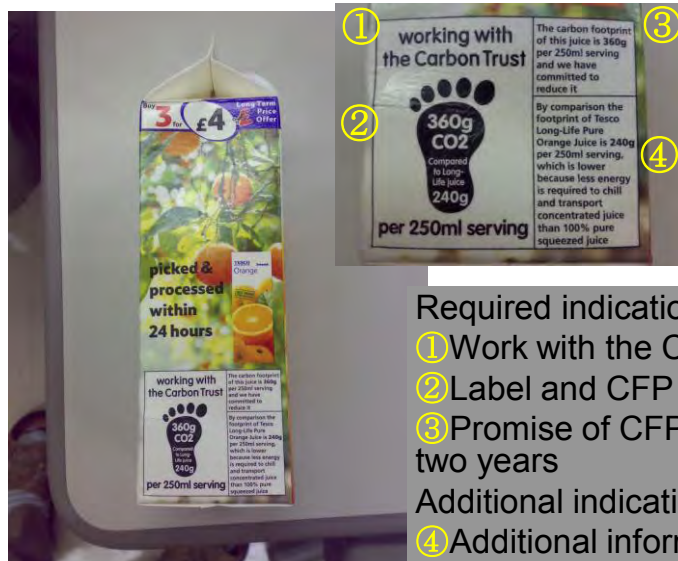
- Famous supply chain IEON put a brand rice "Akitakomachi" of 5 kg with CFP on market from January, 2009 at their ten stores.



- The CFP of this package shows that the total CFP is 7,730 g and the largest step is cultivation in which gas emission from paddy field was 3,119 g.

16

Test marketing of goods with CFP in England ?



Tesco, Coca-Cola, and some others have started to show CFP in a label.

Required indication :

- ① Work with the Carbon Trust
- ② Label and CFP
- ③ Promise of CFP reduction within two years

Additional indication :

- ④ Additional information etc.

17

Test marketing in France ?



- LECLERC in France started to print CFP on a tag of 20,000 items.
- You can recognize CFP when you get the receipt.



A receipt with CFP issued at cash register by LECLERC (URL :



18

The present state of PCRs for wooden products in Japan



- PA-CC-02 “Wood and wood materials” for lumber, glulam, plywood, PB, FB and preservative impregnated lumber made by NPO Sainoki and me.
- PA-CD-01 “Wooden products” for flooring and small wooden products by Flooring Industries Association and me.
- PA-CB-01 “Wood plastic combination” by WPC group and me.
- PA-BB-02 “Paper containers, packaging and wrapping” by Japan Printed Papers Association.
- PA-CJ-01 “Publication” by Japan Publishing Association.
- PA-AK-03 “Office furniture” by Japan Office Furnitures Association.

19



*Thank you for your
attention!*

20

Mapping Customers' Minds with a New Technique: The Case of Housing Needs and Preferences in Finland

Maria Riala⁴ and Tuomas Nummelin⁵

Abstract

This study tests a novel method for studying customer preferences in housing and explores Finnish customers' housing needs and wants. The approach is based on the means-end theory of consumer research. Traditionally studies grounded in this theory have used laddering interviews to uncover chains linking product attributes to their psychological consequences, and to a person's values. The method used in this study, by contrast, utilises the concept of a mind map. As a visual representation of a complex reality, it offers the respondents a more natural way to think about their preferences than the laddering interviews.

The mind map tool needs to be developed further, but we still received interesting mind maps from respondents. The resulting networks were analysed with quantitative tools, as well as interpreted qualitatively. The data was also compared with results of previous studies on housing in Finland. The respondents looked for functional apartments in good locations, which is mostly in line with previous research. There were also some interesting differences, e.g. the emphasis on families and children. It seems that building materials are not on top of the list when people look for apartments, and thus timber construction promotion activities should focus on the quality of construction.

Keywords mind map, housing, consumer research, means-end chain theory, Finland

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1. INTRODUCTION

Housing is an interesting and complex area of consumer research. In Finland, most of the previous studies have focused on the living environment, and thus we wanted to shift the focus to apartments. Knowing what people look for in apartments and why those aspects matter to them might offer pathways to promoting timber construction, and thus lead to more environmentally sustainable housing stock.

The study is based on the means-end chain theory of consumer research. We wanted to develop a new, easier method of uncovering means-ends networks, which would give respondents opportunities for expressing themselves freely, while reducing the reliance on interpretations by researchers. This article first outlines the means-end chain theory, and then explains how our new method applies the theory. Our results are presented and compared with those of previous housing research, with a particular focus on timber construction. Due to the small number of valid responses, the conclusions offered are tentative, but suggest that the mind map tool is useful and can help people consider their preferences related to complex products.

2. MEANS-END CHAIN THEORY

The core assumption of means-end chain theory is that consumers do not choose products only because of product attributes e.g. surface colour. Instead, consumers have certain values, which consciously or subconsciously influence their decision-making. However, the values are not directly observable on a product. The observable attributes of a product and the underlying values of the consumer are linked by 'consequences', i.e., what the consumer hopes to achieve with a specific mix of attributes. Consequences are a tool to fulfil the values. An example of an attribute-consequence-value chain for salty snacks is 'flavoured chip' (attribute) – 'strong taste' (attribute) – 'eat less' (consequence) – 'don't get fat' (consequence) – 'better figure' (consequence) – 'self-esteem' (value) (Reynolds and Gutman, 1988).

The most common method to uncover means-end chains has been laddering. Laddering is a structured form of interviewing for gathering data about consumer preferences and values. The various laddering techniques differ in terms of how structured they are. The first stage is finding out which attributes are relevant to the respondent, and this can be achieved in a structured manner (e.g. giving the respondent a list of attributes, or a couple of alternatives), or by allowing the respondent to introduce the relevant attributes themselves in an interview. In the stage of constructing the means-end chains there are two main techniques, hard and soft laddering. In hard laddering the respondent is asked a series of questions, which guides them to generate value chains. In soft laddering, the respondents discuss the issue at hand in a less structured manner, and the researcher then forms the chains based on the data and their interpretations (Miles and Rowe, 2004).

2.1 Previous applications of means-end chain theory in housing research

The applications of means-end chain theory have generally been in consumer products, e.g. exploring cross-cultural differences in relation to particular products (Miles and Rowe, 2004). However, means-end chain theory has also been applied to housing (Arvola et al, 2010) studied consumer perceptions of residential environments in Finland. Their respondents walked independently in a residential neighbourhood along a guided route, and stopped at set

points to evaluate the surroundings, and rank attributes. Afterwards, relatively structured laddering interviews were conducted by phone. The researchers then coded and categorized the data into hierarchical value maps, i.e. groups of means-end chains.

Schauerte (2009) studied consumer perceptions of wooden multi-storey houses in Sweden and Germany. He started by conducting laddering interviews in person in both Germany and Sweden. He focused on positive value chains, and kept the data for the two countries separate throughout the process. The results of the laddering interviews were used to create structured matrix questionnaires. Matrices represented linkages between attributes and consequences, consequences and consequences, and consequences and values. The questionnaires were delivered to residents of multi-storey houses in the two countries and returned by post.

2.2 Methodological difficulties

The main observed difficulty with studies based on means-ends chain theory is to orientate consumers to discuss their preferences in a clear, linear manner. Preferences about products are not always that obvious, and it is even more difficult to connect product preferences to underlying consequences or values. Both hard and soft laddering attempt to deal with this issue, but have their own problems. If the interview is too structured, it may force the interviewee into a mould they feel uncomfortable in. In soft laddering, by contrast, the role of interpretation by the researcher might be too great (Grunert and Grunert, 1995).

One challenge in interpreting laddering data is determining the difference between attributes, consequences and values. This problem has been highlighted e.g. by Grunert and Grunert (1995), who point out that these terms have not really been defined in laddering literature. There are many borderline cases, where a concept could fall into more than one of the categories. They also state that the interpretation of data is prone to inaccuracies. This derives from the different understanding of attributes, consequences, and values by the respondents and the researcher, which is a result of different backgrounds.

Another challenge is finding the 'right' level of abstraction. If you combine two terms under the same heading, the level of abstraction rises. This process is common in laddering because respondents tend to use different terms even if they mean the same thing. The problem is deciding when several terms can rightfully be combined under the same heading. For example, Arvola et al. (2010) have an attribute 'surroundings', which includes statements such as 'pleasant surroundings', 'no restaurants very close by', 'urban view', and 'nature close-by'. Thus, an attribute in a hierarchical value map can contain a large variety of attributes within it. Similar groupings are found in Schauerte (2009). While grouping variables might be necessary in analysing means-end chains, it is nevertheless challenging to come up with the 'right' groups.

In addition to these general problems with laddering, the studies on housing that used laddering have their own issues. In Schauerte (2009), the questionnaire was far too difficult for the respondents, which is reflected in the extremely low response rates. This was probably mainly due to unclear and ambiguous instructions. The matrixes also contained a very restricted set of alternatives. In Arvola et al. (2010), the main problem seems to be in coding the results of the interviews. Their decision to use six categories (two each for attributes, consequences and values) resulted high levels of overlap between the categories. Thus, there is a lot of dependency on coding by the research team, which might be too subjective.

3. MAP OF CUSTOMERS' MIND

In the light of difficulties faced by previous applications of means-end chain theory in consumer research, we decided to try a different, visual approach to the complex issue of housing preferences. We decided to use the mind map as a graphic tool to help understand housing preferences. The mind map approach also makes it possible for the respondent to create networks of variables affecting housing.

3.1 The principle

Our goal was to find a less structured and easy to use tool to model complex issues in a visual manner. In essence, the goal was to combine the best features of hard and soft laddering techniques and to remove the challenges encountered in them. The attempt was to find a balance between avoiding excessive structuring to guide the respondent, and reducing the need for interpretations by the researchers. It was also important for us to allow free associations by the respondents.

The previous studies have shown problems in formulating questionnaires for laddering. We thought the visual tool would make it easier for the respondents to make connections between different levels of abstraction. There might still be a need for some interpretation of the replies (e.g. if the respondent had used a slightly different expression for the same feature), but hopefully less than in laddering interviews. It would also be possible to analyse the networks using quantitative methods.

In order to create some structure for the tool and to give the respondents a starting point we decided to give each respondent a few variables at the start. This would help getting them in the right frame of mind. All starting 'maps' included an apartment, and between four and ten other variables. These were drawn randomly with an equal probability of being selected from a list of 34 variables, which were mainly derived from previous housing research in Finland. We hoped that this would enable comparisons with results of previous studies.

The respondents were then asked to think about what they find important when looking for an apartment. They could remove the default variables, add new ones, connect variables to each other, and determine whether they were attributes, consequences or values. The completed maps were collected online, and we also collected background data from the respondents.

3.2 Practical application

We decided to implement the mind map tool as a web-based application on our institute's website. The application was designed to be easy to use and a web-based tool was a practical way to collect data. The application was produced with Java⁶. We received user feedback during the data collection process and made some improvements to the application. The first bigger change to the application was to show the help text at the start-up. This improved the quality of the replies, and resulted in networks that are more complex. The second larger change was to alter the application so that all tasks were possible simply by clicking the mouse, without first choosing the right mode. We are working on further improving the application, and intend to use it in the future.

⁶ <http://java.com/en/> (Accessed 7.9.2010)

The respondents were directed to the questionnaire through a variety of channels. The main channel was an advertising campaign on one of the main Finnish housing websites. The advert was displayed as a banner, and by clicking it, the respondents were directed to the survey website. Later on, we expanded the sourcing of data with announcements on the Finnish Forest Research Institute's website and its Twitter feed, newsletters, and intranet. We also sent out the link through Facebook to our contact network.

4. RESULTS AND DISCUSSION

4.1 Data

The results of this research project reflect the fact that the data collecting method was experimental. We got a total of 50 replies. The number of valid responses, where the respondent has made some changes to the default settings is 31, i.e. 62 percent of all responses. The small number of responses means that the results are only indicative and would need further study in order to be generalisable.

The proportion of valid responses varied to an extent between respondents according to gender, age, and educational level. Women had a little higher rate of valid responses, but the difference is insignificant. Age has a weak negative correlation with valid response rate, younger respondents being more likely to return valid maps. Educational level correlates slightly more strongly with rate of valid responses, as those with a Master's degree or even higher education level have a noticeably higher rate of valid maps than those with lower educational level.

Figure 1 displays the key characteristics of the respondents. The respondents are somewhat skewed towards the younger, more educated section of Finnish people, and there is a much larger proportion of females among the respondents than in the general population.

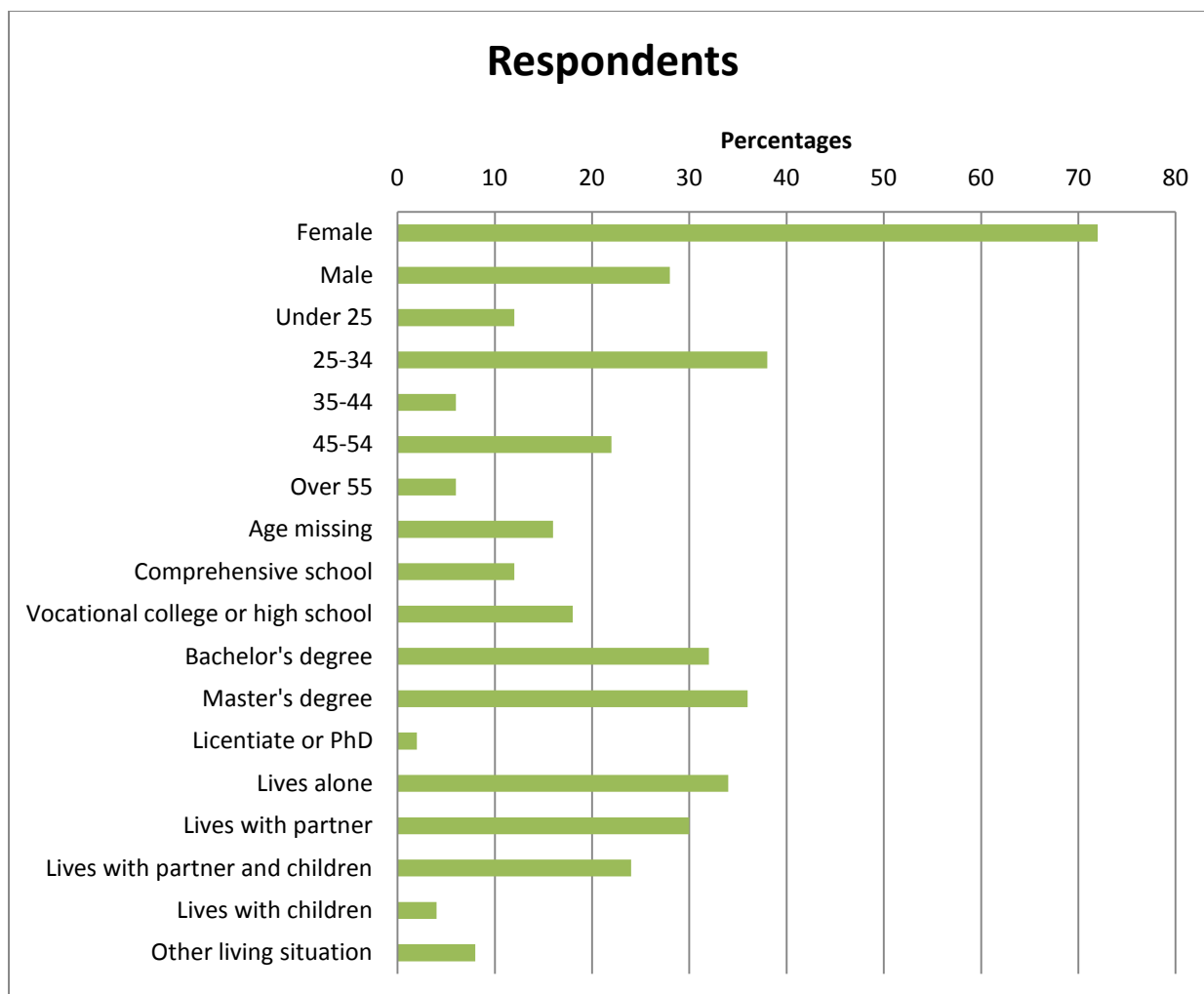


Figure 1: Background information of respondents.

4.2 Analysis of results

The resulting mind maps were of reasonably good quality. There was quite a lot of variety in terms of complexity of the maps, and in most of the valid responses there were some interesting linkages. The responses contained 119 variables in total. The variables listed include the 34 default attributes incorporated in the application, which means that the respondents added 85 variables to different categories. Some variables appeared on many different levels, for example, 'security' was labelled most often an attribute, but it was also deemed a consequence, and a value in different maps. Almost 60 percent of all variables were attributes, and there were more values than consequences on the maps.

The full list of variables has some overlaps with previous studies (see section 4.3.), but there are also interesting new issues. Most of the requirements for apartments are quite practical, e.g. good functionality of the layout, but there seems to be also quite a lot of emphasis on the needs of children and family. Figure 2 lists those variables, which appeared on the maps at least twice. Attributes are marked in red, consequences in green, and values in blue. It is easy to see that attributes appear most often on the maps, which indicates that people look for these when searching for an apartment. The smaller numbers for consequences and values might be explained either by it being more difficult to think about those, or by the greater variance between people in this respect.

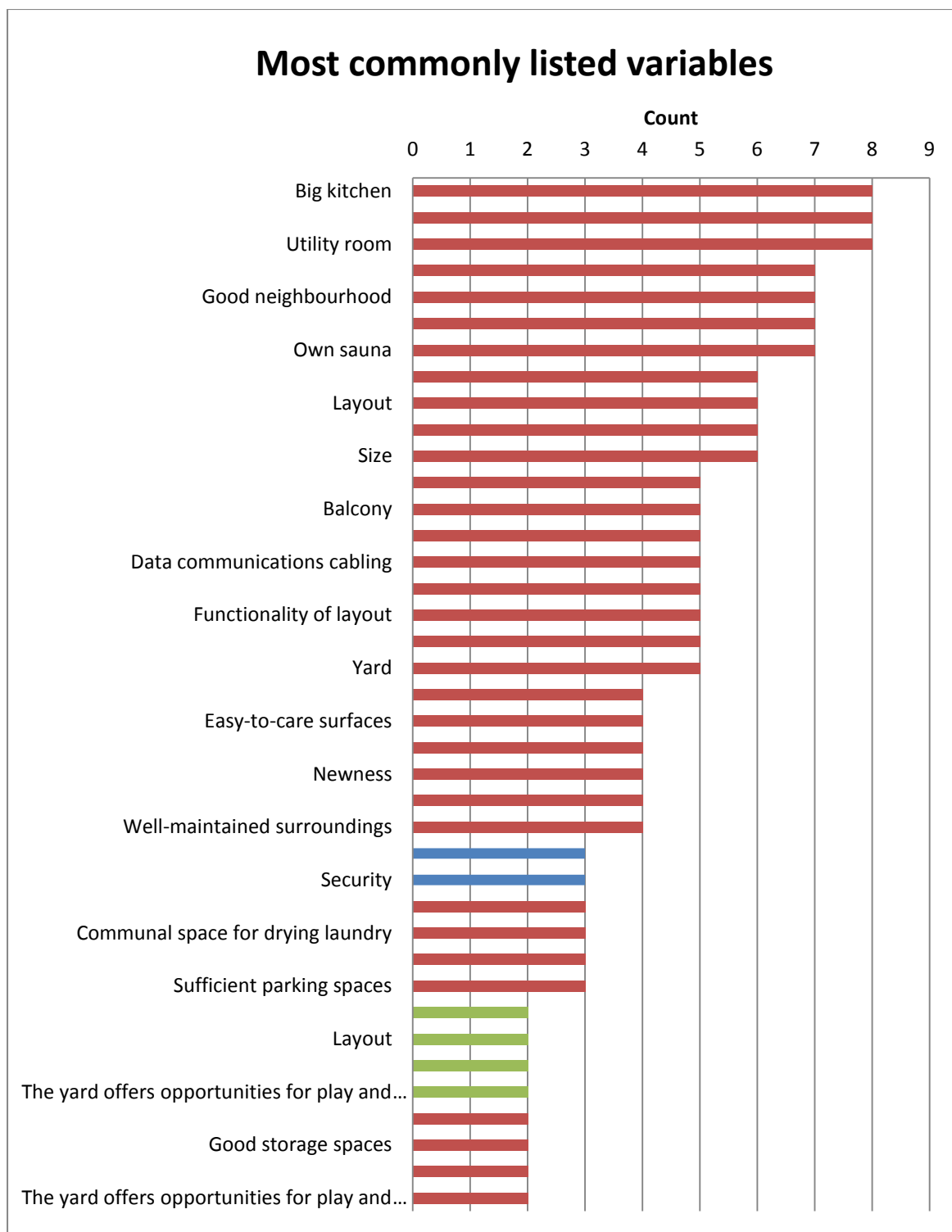


Figure 2: Most commonly listed variables.

The next step was to analyse the quality of the mind maps, which forms a key part of our study and of the new method. The assessment of mind maps has been studied before (e.g. Evrekli et al. 2010) but these approaches have tended to focus on mind maps as a tool for learning. In Evrekli et al. (2010), mind maps were scored by several evaluators, awarded points according to their complexity and the number of linkages, and the scores given by different evaluators were then compared. Cline et al. (2010) used an even more structured

marking system, where students constructed concept maps online, and these were graded by comparing them to a concept map created by the course instructor. In our study, there were no correct answers, so we could not adapt these approaches directly.

Figures 3 and 4 show some examples of mind maps we received from the respondents. Figure 3 shows a simple map, where variables are only connected to the apartment, and only one ('healthy apartment') is at the level of value. There are also some unnecessary arrows, which only connect an attribute to itself. Figure 4 shows a more complex map. There are more interconnections, a greater variety of issues presented, and more levels of variables. Thus, it would be reasonable to argue that the latter map provides a more comprehensive picture of what this particular respondent finds important in apartments and why.

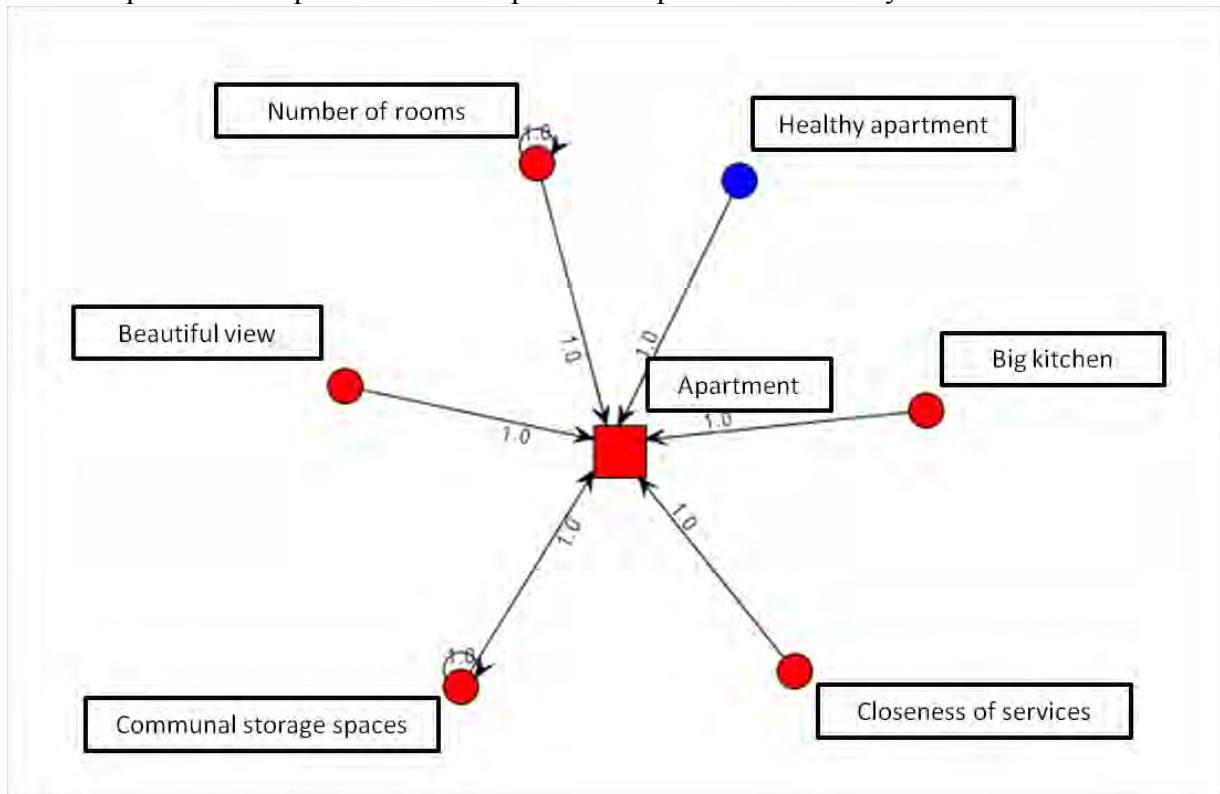


Figure 3: Mind map 1, respondent female, 28 years, Bachelor's degree, lives alone.

Complexity of a mind map seems to make it more representative, and thus in the analysis of data we chose to focus on the combination of all 31 mind maps, look at the complexity, and try to find patterns in it. The first analysis focused on the number of linkages coming into and going out of each node. The combination of these two formed the degree to which a particular node is connected to others. Degree is a commonly used indicator of properties of networks, and can also be used as a proxy for the importance of a particular node in a network. (Albert and Barabási 2002). The focal point 'apartment' was left out of this analysis, based on the assumption that most attributes would be connected to it. Figure 5 shows those nodes, which had a degree count of over four, the top eight percent of the connections.

The variables, which have the greatest number of connections to others, include those, which are generally recognised to be important in housing. Location, comfortable home, good neighbourhood, and layout of the apartment are obviously important features of housing. These are also included in the most commonly listed variables in figure 2 above. In fact, none

of these variables, with the possible exception of public transport, are very surprising at the top of the list. However, it is also interesting that there are large numbers of variables, which are connected to very few others. 13 variables are connected to 3 others, 28 to two, 45 to one, and 20 to no variables at all. This may reflect the complexity of housing as an issue, or just indicate that people find it difficult to make connections between variables.

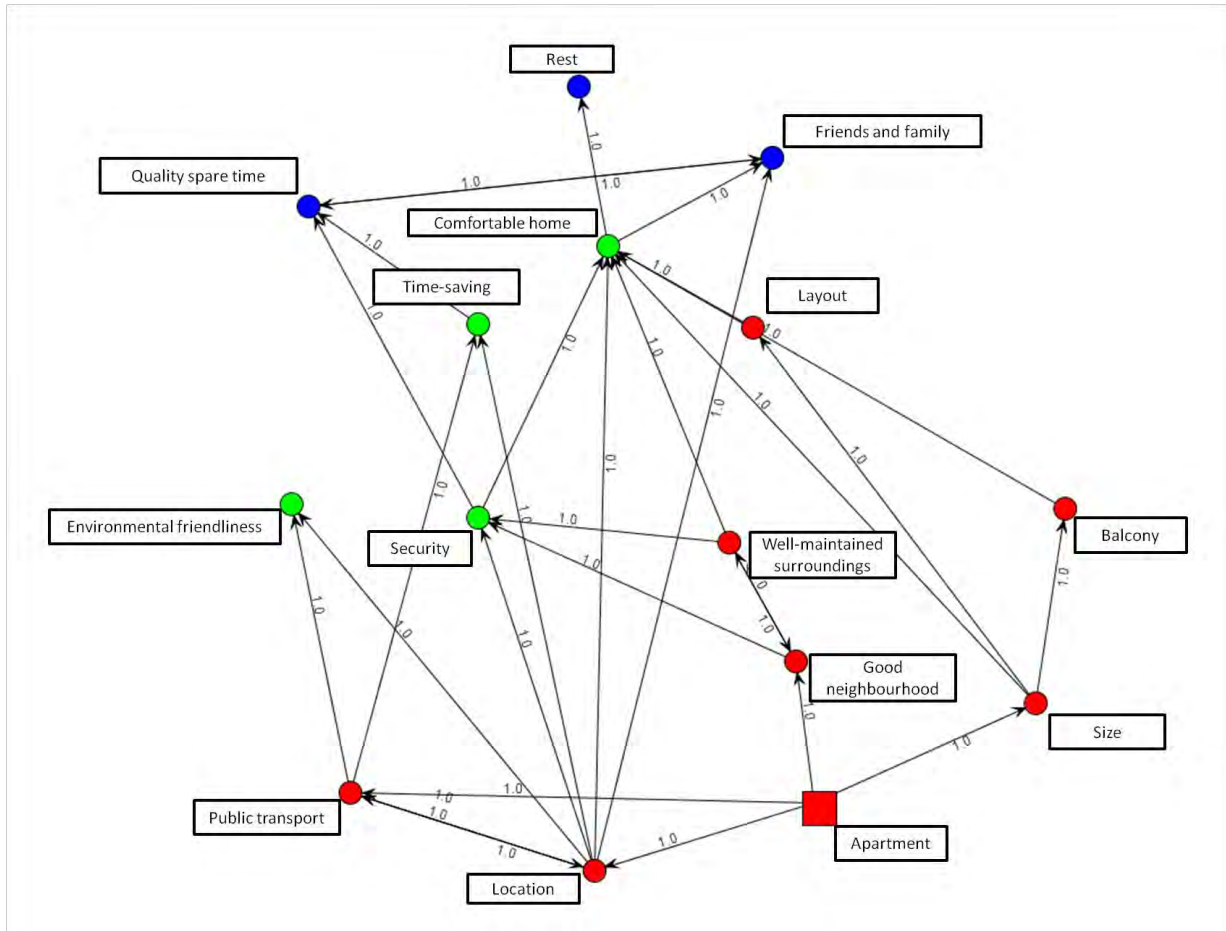


Figure 4: Mind map 2, respondent female, 26, Master's degree, lives alone.

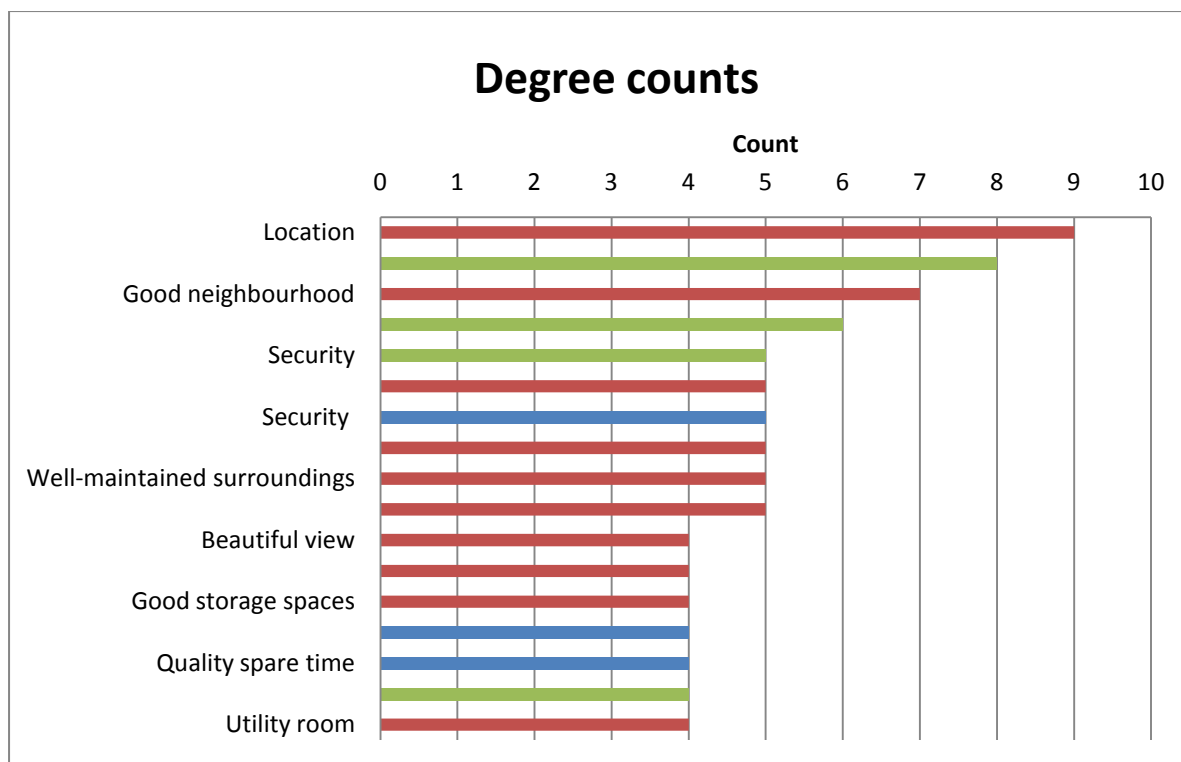


Figure 5: Highest degree counts of variables. Attributes in red, consequences in green, values in blue.

Another interesting finding is that almost all linkages between the variables were unique. Links which appeared more than once linked ‘apartment’ to ‘healthy apartment’, ‘good neighbourhood’, ‘big kitchen’, and ‘beautiful view’, and quite interestingly ‘location’ to ‘public transport’. The very small number of shared linkages indicates that housing is a complex issue, and there are few shared ideas about why certain aspects are important.

4.3 Comparisons with previous studies

Although the results of our study are rather tentative, it is interesting to compare them with other studies on housing preferences in Finland. These give more perspective, and may help in interpreting the maps.

Helminen-Halkola et al. (2001) studied the housing preferences of people living in Espoo, capital region of Finland. While the main focus was on the living environment, they also asked about the desired properties of apartments. ATT (2005) in contrast focused on the properties of apartments, and their survey acted as a basis for the development of their construction activities. Arvola et al. (2010) concentrated on the general surroundings of two neighbourhoods (one purely residential, one a mix of residential and commercial) in Helsinki capital region in Finland.

Helminen-Halkola et al. (2001) asked their respondents to rate a list of 22 variables according to how important those were in their dream apartment. Most of the variables related to the apartment itself, but some referred to the housing company or nearby surroundings. Those ranked the most important among all respondents were functionality of layout, soundproofness, an own sauna, a terrace, good storage spaces, healthy apartment, well-

maintained surroundings, and good neighbourhood. Many of these, e.g. good neighbourhood and functionality of layout also feature prominently on our maps.

Some interesting similarities emerge between ATT (2005) and Helminen-Halkola et al. (2001). A healthy, well-soundproofed apartment is very desirable, as are good storage spaces. The most interesting difference between these two studies seems to be the difference assigned to communal aspects of housing. In ATT (2005) communal aspects, including laundry and storage facilities were deemed considerably more desirable than was the case in Helminen-Halkola et al. (2001). The mode for these was 'the most suitable', and the difference was at its clearest in the case of lifts, which were not very important at all in Helminen-Halkola et al. (2001), while almost all respondents in ATT (2005) thought a lift would be very suitable for them. These differences are interesting, and not explained by respondents' age or type of housing they live in.

The hierarchical value maps represented in Arvola et al. (2010) are only in some ways comparable with our results, as that study did not focus on attributes of apartments. Their hierarchical value maps include more shared connections than our mind maps do, because of combining variables mentioned by interviewees to make up larger entities. The main similarity to our study appears to be the importance assigned to good location and the tendency to highlight attributes which are good for children.

Thus, it appears that the findings of our study are reasonably in line with the previous housing research in Finland. People tend to value good location, and practical attributes of housing. However, ecological values, evidenced e.g. by the rank of public transport (figure 5), seem to have gained in importance to an extent.

4.4 Application to timber construction

The applicability of the data to timber construction is an interesting issue. The variables which might be useful in terms of timber construction are 'wood as building material', 'facade material', 'frame material', and 'good soundproofing', because multi-storey timber buildings sometimes have problems with soundproofing (e.g. Karjalainen 2002). Most of these variables did not feature very often on the mind maps. 'Facade material' appeared five times as an attribute and once as a value, and was not linked to any other variables. 'Frame material' appeared once as an unconnected attribute, and 'good soundproofing' featured as an attribute on one map, where it was rather oddly connected to 'sufficient parking spaces'. In comparison, 'wood as building material' featured on the maps quite often, five times as an attribute, once as an unconnected consequence, and once as a value. All of these variables were also quite likely to be removed from the default maps, which indicates that they might not be that important to people.

The one mind map where 'wood as building material' featured as a value is quite interesting and is represented in figure 6. In this map, wood is directly connected to 'closeness of nature' and through it to other variables related to quality of life. This seems to indicate that at least for some people wood as a building material has positive associations with environmental values, and might form a target market.

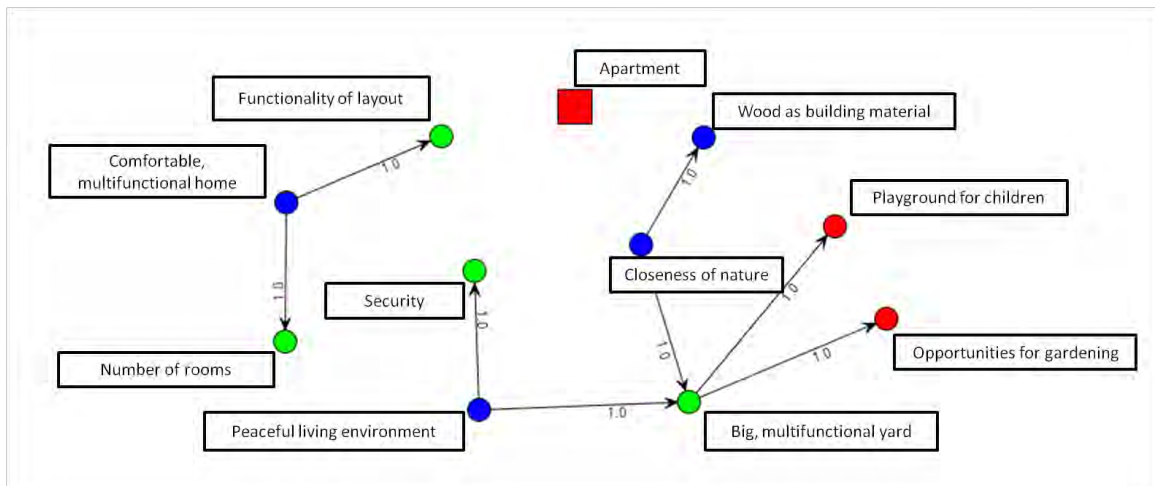


Figure 6: Mind map 3, respondent female, 36, Master's degree, lives with spouse and children.

What these results suggest to timber construction industries is that facade material is more important than frame material, and that wood might have a positive image, which could be utilised in e.g. marketing. Our data also indicates that good soundproofing might not be quite as important to consumers as the other Finnish studies claim. Thus, the challenges of good soundproofing in timber frame buildings might not be such a hindrance, as long as the buildings meet the norms set in regulations. In general, timber construction industries should focus on producing houses that are practical, attractive, and of high quality. As for example Karjalainen (2002) suggests, the Finnish construction industry in general struggles with quality issues, and high quality timber buildings might be able to gain larger share of market.

4.5 Suggested improvements to the application

Our experimental application had some problems, which caused the rather low 'response rate'. The site on which the instructions were was opened 872 times during the data collection process, and out of these, 314 people clicked to open the questionnaire, although due to the security message some may not have launched it. Even though some of these visits were from members of the research team, the fact that we only got 50 responses indicates that the application was not yet sufficiently easy to use.

The concept of mind maps was not familiar to all the respondents, which caused some confusion. It seems some respondents were unable to structure their thoughts in a visual manner, despite the instructions given in the application. Secondly, the distinction between attributes, consequences and values appeared difficult to understand, which is a general problem with means-ends chain theory (see e.g. Grunert and Grunert 1995). It appears to be hard for people to think about their preferences in hierarchical terms. We thought the visual approach would make seeing interconnections easier, but the respondents still struggled with this.

The respondents also had some difficulties with the graphical user interface of the application. We received some feedback on these issues, e.g. that the separate windows in the original application were confusing, it was difficult to execute all the different commands, and that it was problematic to connect the attributes. Some respondents were also wondering if the location of the nodes had some significance, or if the axes should have labels.

Some of the difficulties originated from the instructions, which were deemed confusing. Suggested improvements for this were a simple demo map, or constructing the map in a controlled setting, e.g. during a fair. Giving the respondents too much freedom in this type of setting might make it more difficult for them to provide responses, because an interviewer does not guide them. Still, in order to get an accurate picture of the thought patterns of people, it would seem preferable to give them more leeway and freedom, even if this leads to some responses getting lost along the way.

On a positive note, a majority of the respondents were able to make changes to the default maps. They removed variables they did not find important, added new ones, connected variables to each other, and changed attributes into consequences or values. Some connections seem a little strange, as does the labelling of some consequences or values. Nevertheless, the respondents attempted to draw complex mind maps. We also received positive feedback about the visual nature of the tool, which made it easier to think about complex relationships. Thus, it seems that the tool does have potential, but needs further development.

5. CONCLUSIONS

The mind map as a tool to uncover means-ends networks is an interesting application, even if it still requires technical development to improve its usability. For many respondents it was easier to think about a complex issue such as housing with the help of a visual tool. For others usability might improve with clearer instructions.

Our tentative findings seem to be mostly in line with the previous housing research conducted in Finland. Our respondents appreciated a comfortable, well-located home with a good layout in a good neighbourhood, which is hardly surprising. It was also interesting that for example child-friendliness of apartments and surroundings, and environmental values seemed to feature more strongly in our data than in the earlier studies.

Timber construction sector could benefit by focusing on good architecture and building high quality multi-storey buildings. Our respondents did not seem to find the frame material or soundproofing, which have sometimes been seen as hindrances to larger-scale timber construction, very important. In our data, wood as a building material had some positive associations, but was mostly not linked with other variables, so more work needs to be done on assessing consumer perceptions of wood in buildings. However, it seems likely that consumers are more concerned about other attributes of housing than building materials.

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Mapping customers' minds with a new technique – case 'Housing needs and preferences in Finland'

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Contents

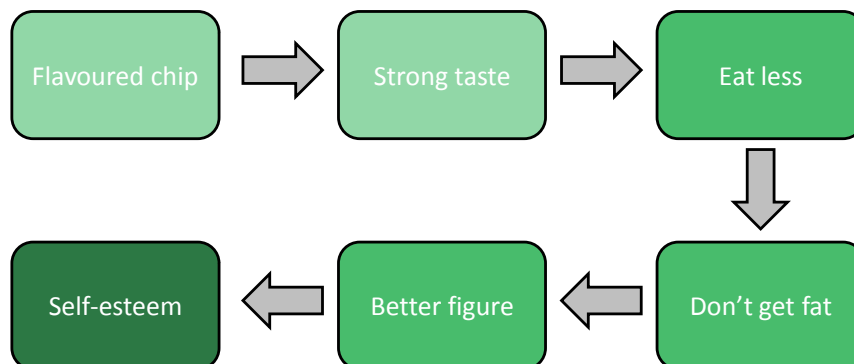
- Introduction
- Means-end chain theory in marketing research
- Mind map as a tool to mapping customers' mind
- Tentative results
- Conclusions

Introduction

- On-going research project into what **customers** of woodworking companies need and want from wood products
 - Includes **housing**, a complex area of consumer research
 - From the point of view of **timber construction**, knowing what aspects of housing matter to consumers might offer business opportunities
 - Funding for travel costs from Finnish Forest Foundation
- We approached housing with means-end chain theory, and developed a new method to uncover **means-end networks** related to housing

METLA

Means-end chain theory



METLA

Uncovering means-end chains

- **Laddering** interviews
 - Ways of making it easier for consumers to think about why they prefer certain aspects of products
 - Hard vs. soft laddering
- Applications generally in consumer products, e.g. exploring cross-cultural differences

METLA

Previous applications of means-end chain theory in housing

- Consumer perceptions of **residential environments** in Finland
 - Walking tour of two residential neighbourhoods
 - Assessing positive and negative aspects
 - Laddering interviews conducted by phone
- Consumer perceptions of **wooden multi-storey houses** in Sweden and Germany
 - Laddering interviews in person
 - Structured matrix postal surveys

METLA

Difficulties faced by previous applications

- Orientating consumers to discuss preferences in a **linear manner**
- **Interpreting** data – differences between attributes, consequences, and values
- Grouping variables
- Specific challenges in the **housing** studies
 - Extremely complex survey
 - Coding of the results

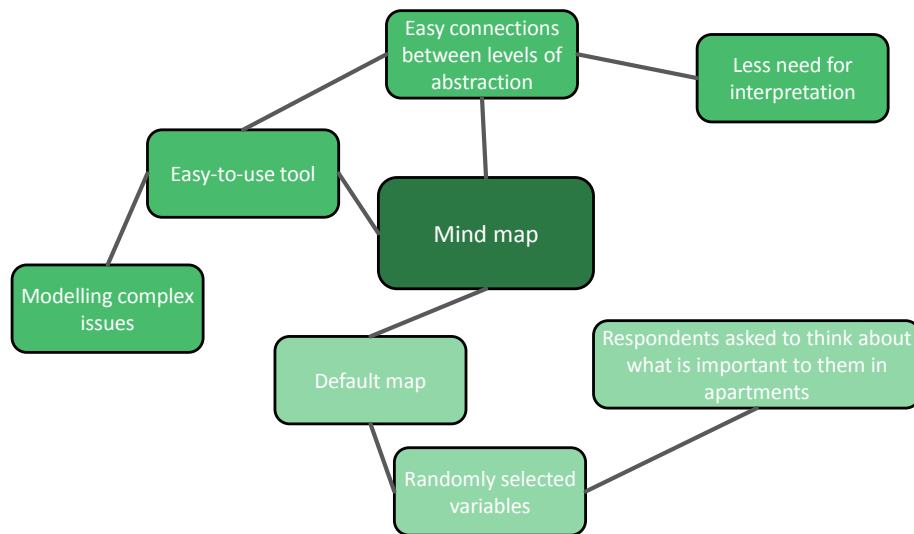
METLA

Mind map application – concept

- **Easy-to-use** tool to model complex issues in a visual manner
- Easier to make **connections** between levels of abstraction and less need for interpretations by researchers
- Starting with a default map, with a **randomly** selected group of variables
- Respondents asked to think about what is important to them in apartments

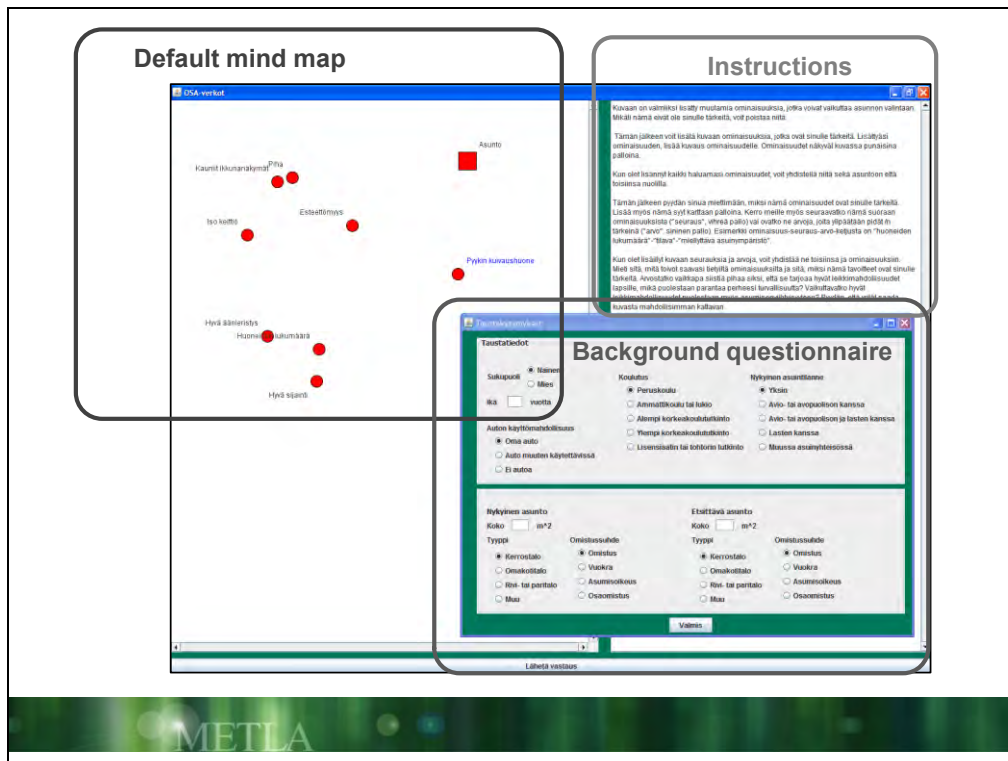
METLA

Mind map application – concept



Mind map application – in practice

- **Web-based** application on our institute's website
 - Produced with Java
 - Improvements based on user feedback throughout the data collection process
- Respondents directed there through a variety of channels
 - Mainly through an advertising campaign on a Finnish website with rentals and apartments for sale
 - Also used links on our institute's website, Twitter feed, newsletter, and Facebook

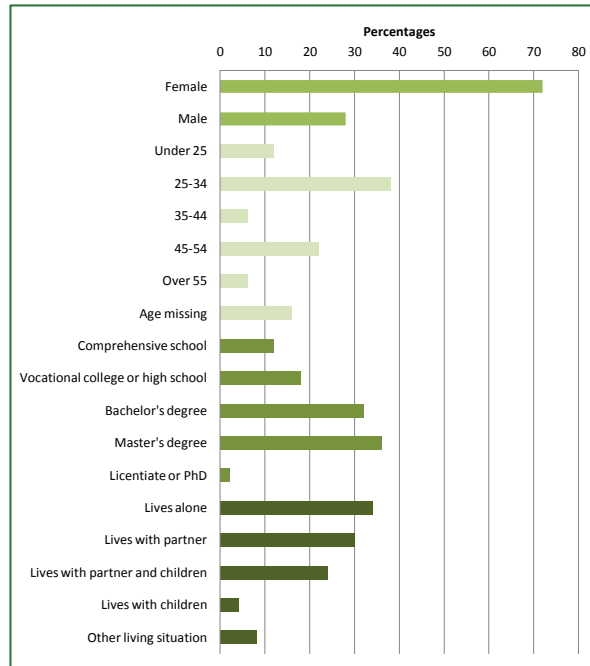


Results – data

- 50 responses, out of which 31 valid
- Small variance in the proportion of valid responses according to age and educational level

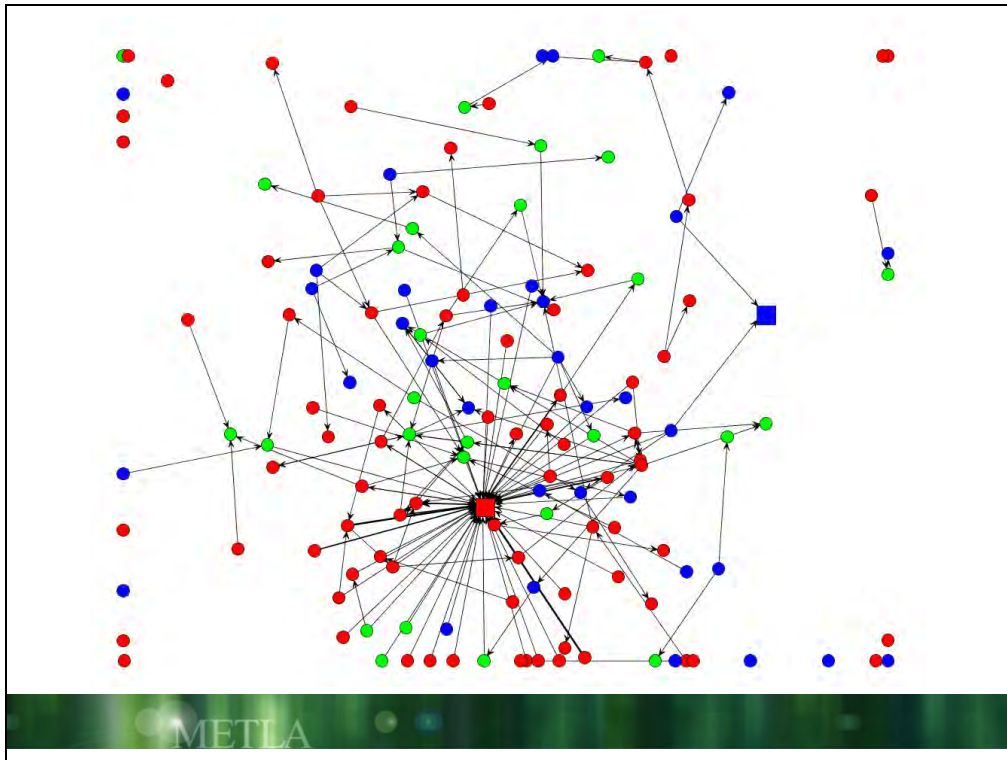
Results – respondent characteristics

- Women considerably overrepresented
- Somewhat skewed towards the younger, more educated section of Finnish population

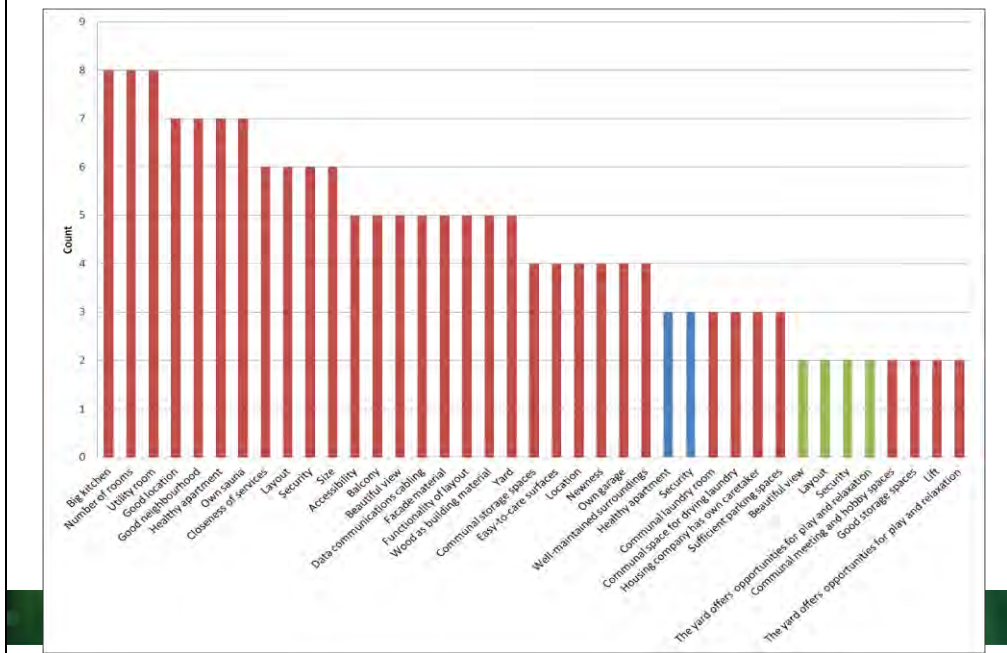


Results – variables

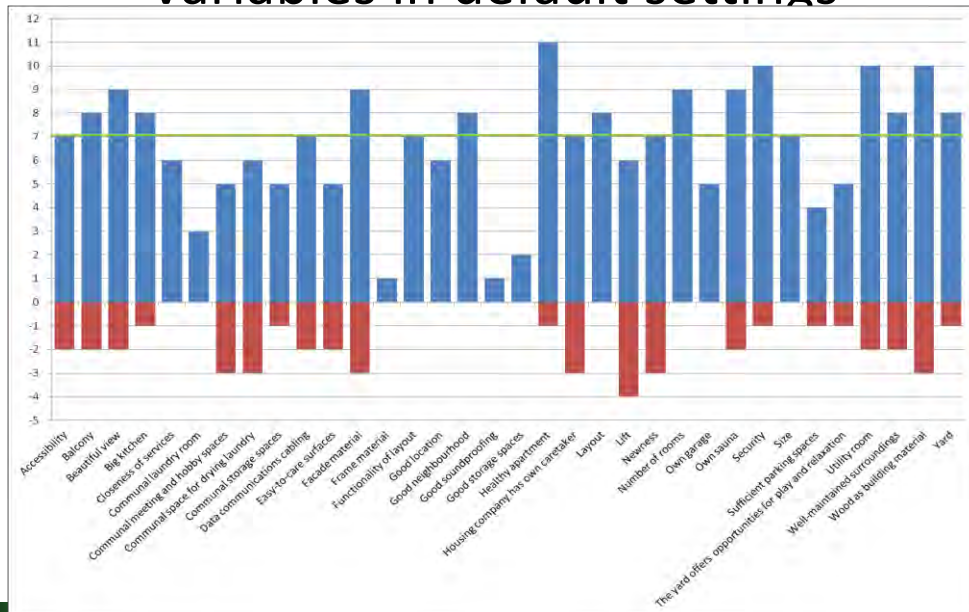
- The mind maps were of good quality
- Contained **119** variables
- Many **requirements** quite practical, and possible to detect slight emphasis on needs of children and family



Results - variables



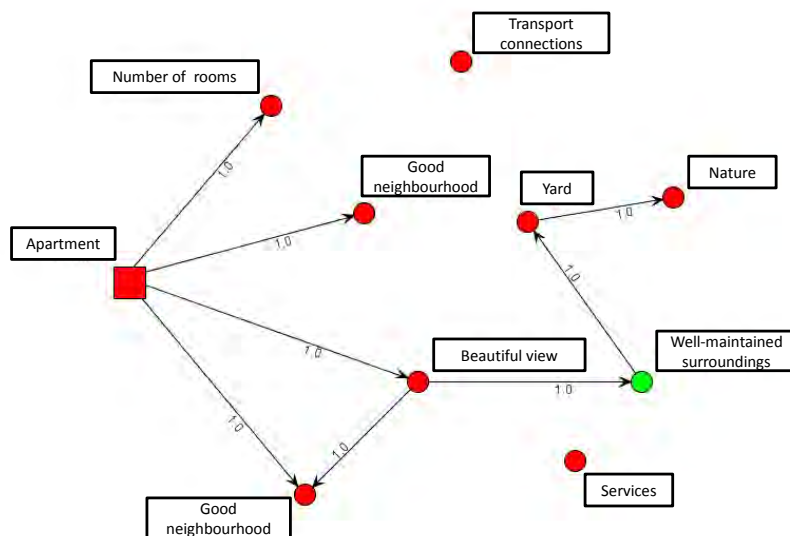
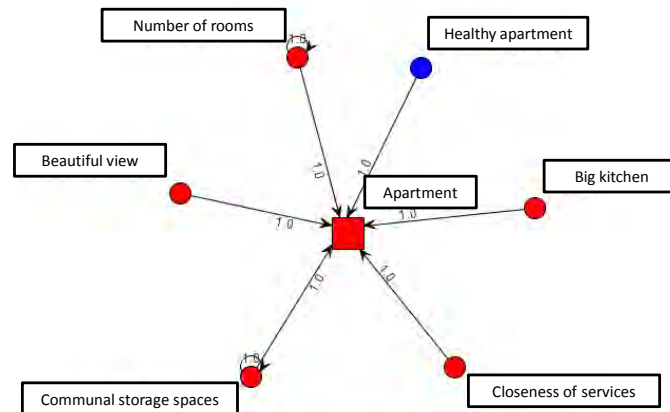
Variables in default settings

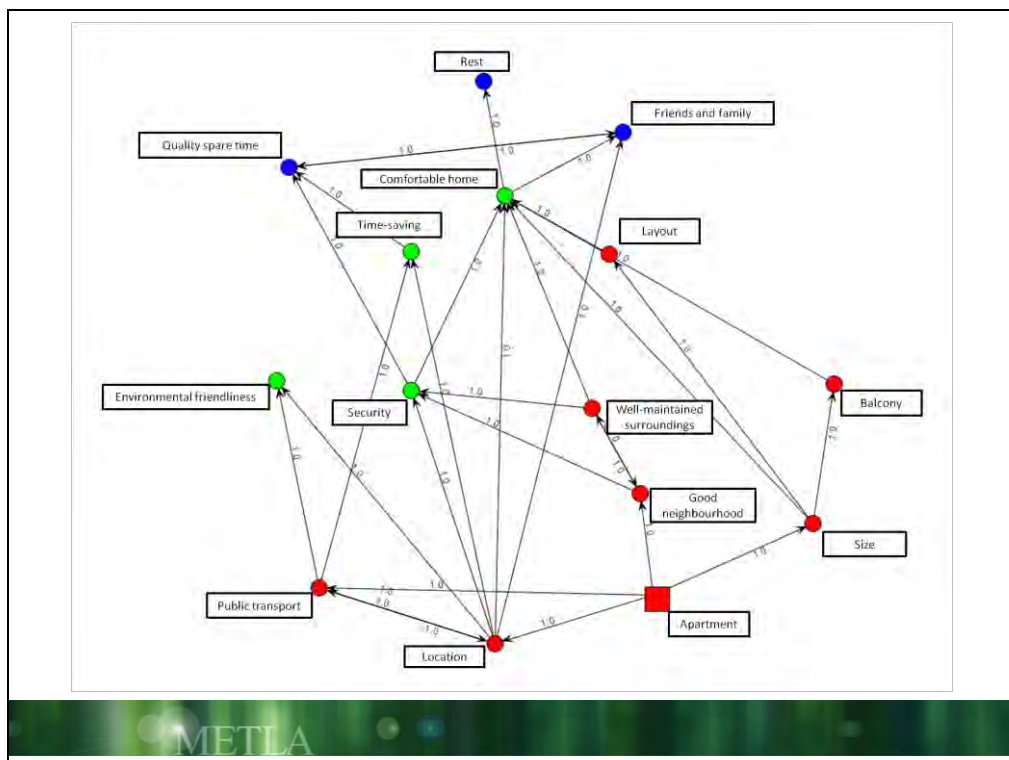
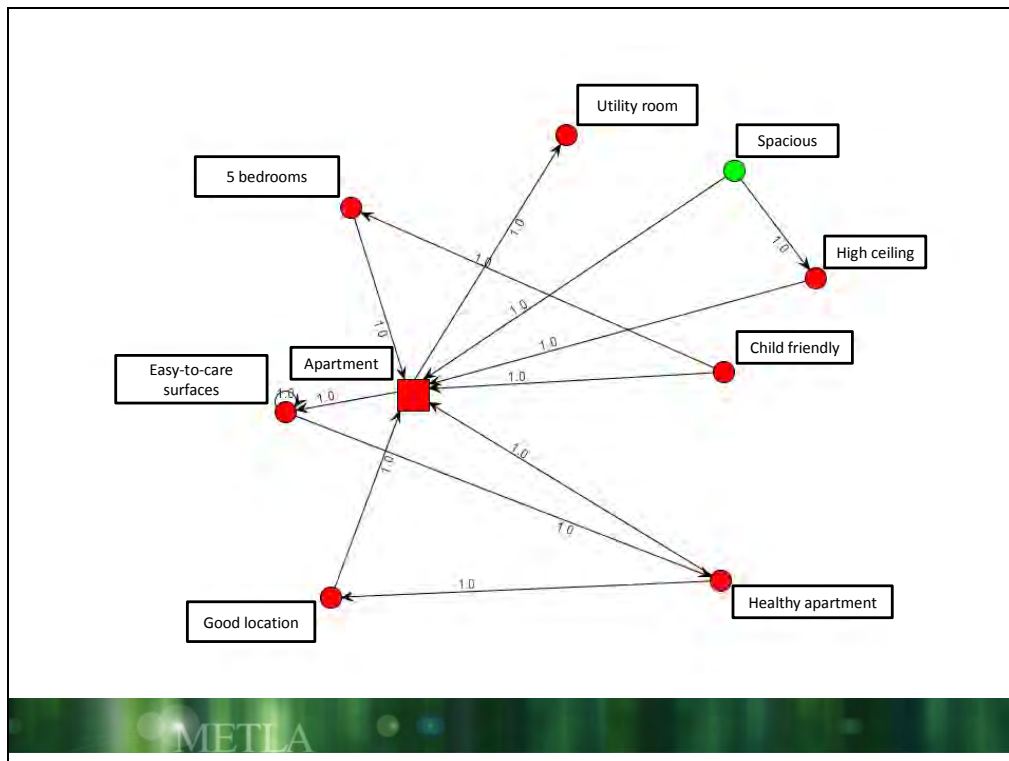


Results – complexity of maps

- Analysing the complexity of maps
 - Previous approaches to analysing quality of mind maps done in educational settings
 - We had no correct answers to compare the maps to
- Assumption that a more **complex** map is more **representative** of the mind of the respondent

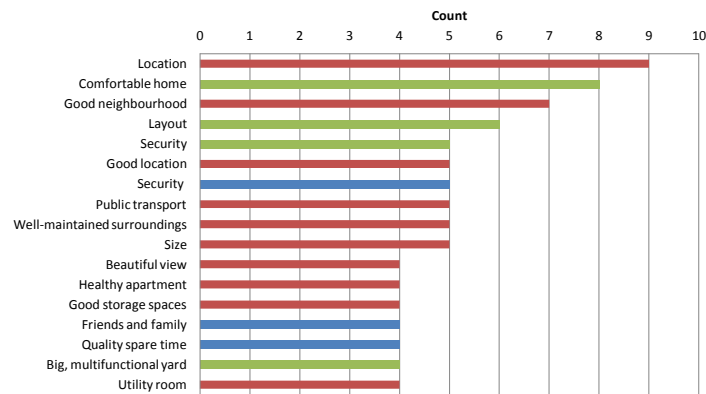
Results – examples of maps





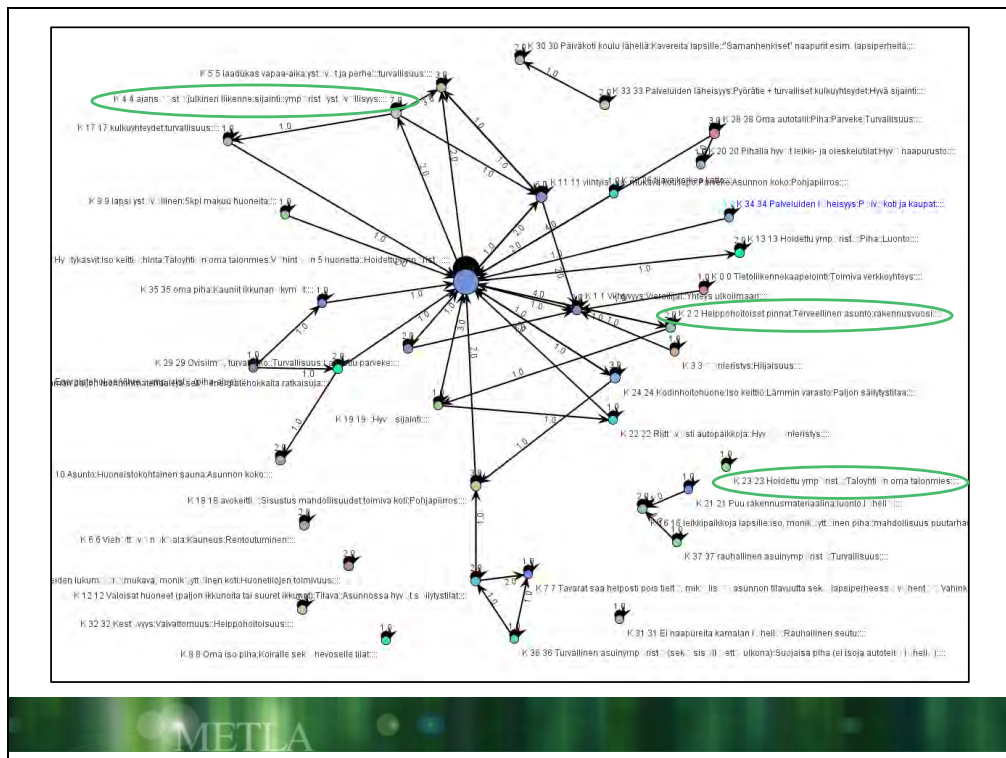
Analysis of complexity

- **Degree** counts, generally used indicator of network properties



Analysis of clusters

- The search for clusters is based on algorithm of Blondel et al. (Heuristic **modularity** maximisation).
- **Clustering** on the basis of those variables the respondents had in common
- The clusters did not differ on the grounds of background variables



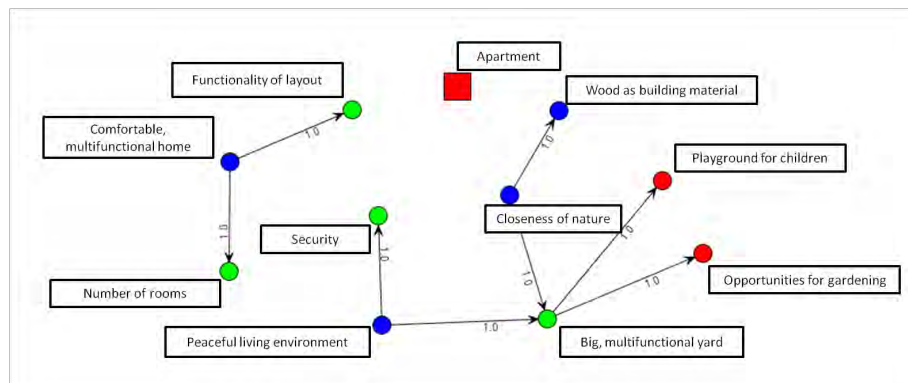
Comparisons with previous studies on housing in Finland

- Important aspects found in **previous studies** e.g. good neighbourhood, functionality of layout, and a healthy, well-soundproofed apartment
- Differences between previous studies e.g. importance assigned to communal aspects of housing
- Findings of our study reasonably in line with previous studies -> **good location and practical attributes**
- **Ecological** values appear to have gained in importance to an extent

Implications for timber construction

- Relevant variables did not appear on the maps very often
 - 'Wood as a building material' appeared quite frequently in comparison to others
- Our findings suggest
 - **Facade material** more important than frame material
 - Wood might have a positive **image**
 - Good **soundproofing** might not be that important

Mind map with wood as building material



Suggested improvements to the application

- General problem of means-end chains is **hierarchical thinking**
 - Attribute-consequence-value distinction also challenging
- Concept of mind map **unfamiliar**
- Problems with usability -> low 'response rate'
- Problems with the graphical user interface
- Confusing instructions
- However, **majority** of respondents were able to do what was asked of them

METLA

Conclusions

- Mind map an **interesting** method
 - Needs further development
- Finnish consumers seem to **value** a comfortable, well-located home with a good layout
 - Ecological values and child-friendliness also emerging issues
- **Timber construction** should probably focus on good architecture and high quality buildings
 - Frame material and soundproofing do not appear to be barriers

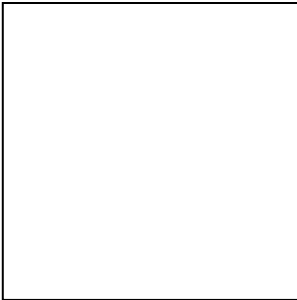
METLA

Session 14

[Friday 3rd period 1.5 hours - Main Hall]

Sustainable wood supply: the key to success

Speakers



Speaker:
T S Rathore

Topic:
Status of Wood Consumption in the Handicraft Industries of Jodhpur



Speaker:
Aimi Lee Abdullah

Topic:
Changes in EU Timber Consumption



Speaker:
E V Anoop

Topic:
Kerala's Withering Wood Security – The Way Forward



Speaker:
K S Shashidhar

Topic:
Changing Trends in Timber Usage in Nagaland, India

Status of Wood Consumption in the Handicraft Industries of Jodhpur

T S Rathore¹, Ranjana Arya, Hemant Kumar and Nirmal Bhandari

Abstract

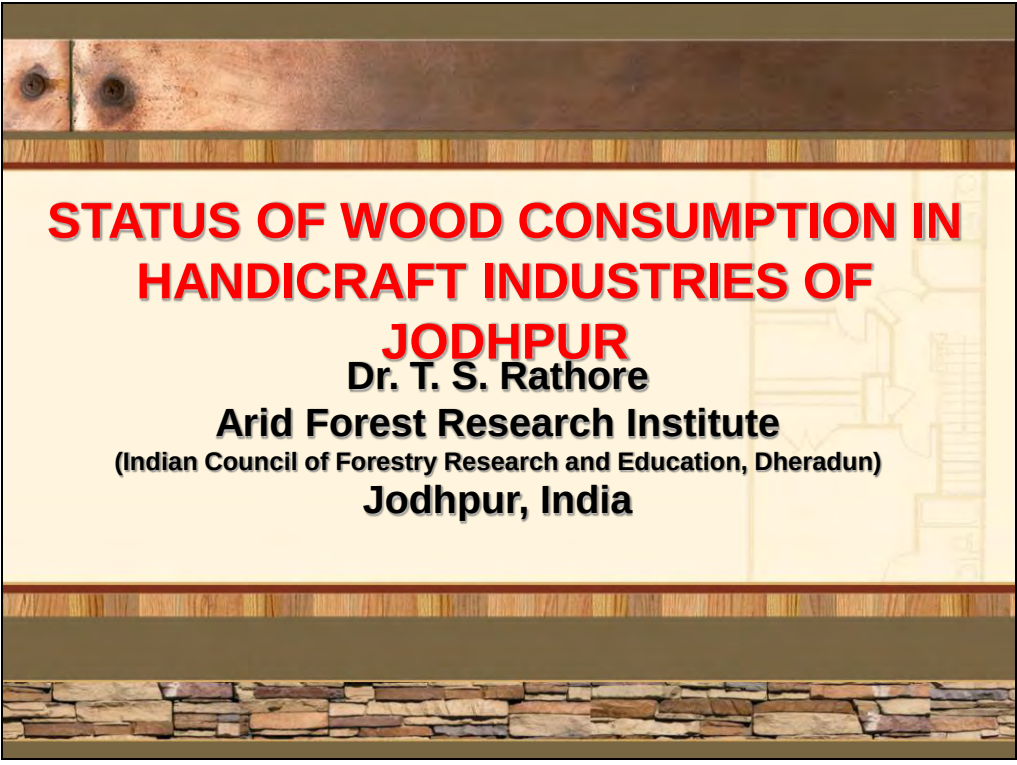
The desert state of Rajasthan is well known for its woodwork. Furniture making is an integral part of wood work, and reached a creative peak in the havelis and palaces of the medieval period. Rajasthan is the only state where the lattice-work on wood is to be found. Jodhpur and Kishangarh are known for their painted furniture that consists of screens, doors, caskets and chairs. Jodhpur's handicraft industry has eclipsed the others in recent years. Wooden furniture made in Jodhpur has always been in great demand not only throughout India, but also abroad. Furniture export alone accounts for more than Rs 1000 crore (2009-10) in Jodhpur's economy. The Jodhpur Handicraft Exporter's Association (JHEA) was founded in 1998 to strengthen the network of exporters in order to achieve a sustained higher growth in exports in handicrafts to various global destinations. Exports experienced a sharp climb from zero to Rs. 1500 crore in two and a half decades, employing 3 lakhs persons comprising artisans, craftspeople, skilled/ semi-skilled workers or unskilled labour, most of them belonging to weaker sections of the society. JHEA provided list of 226 members, 95 of whom are regular members, with the remaining 131 being associate members. A representative survey was conducted through questionnaires in which 15% of industries were visited randomly.

The data analysis revealed that the wood types commonly used by the industry were Mango (*Mangifera indica*) 94%, Shisham (*Dalbergia sissoo*) 67.6%, Babool (*Acacia nilotica*) 62%, Teak (*Tectona grandis*) 15.0%, and Jamun, Neem and Eucalyptus with 3% each. Only 21% of members have their own seasoning, preservation and treatment plants while others are dependent on others. However, 100% new wood is used after seasoning and treatment. Wood is mostly obtained from Gujarat, UP, MP, Punjab, Haryana and Ganganagar in Rajasthan. The end products are exported to Europe (100%), USA (~60%), Australia & New Zealand (~10%), South America, Japan & S. Africa (~8.5%) and Gulf countries. Growing demand for manufactured products and preference for all types of handicrafts has resulted in consumption of more wood by the industry and 76.5% are also using recycled wood such as beams, unused household items, windows and doors from old havelies and old railway sleepers, broken ships and rafters. The old wood does not require seasoning or preservative treatments, which makes it environmentally safe. The annual wood consumption of wood industries range is >5000 cft (16%), 5000-1,00,000 cft (74%), < 1,00,000 cft(10%).

Most of the Industry complains about non- availability of quality wood material and trained labor. They also complain about not-availability of any state of the art wood testing laboratory, where identification and certification of wood can be carried out. There is a need for quality planting materials, improvements in plantation forests and searches for alternative wood species. There is a widespread willingness to raise plantations with support from Research Institute and State Forest Department. The Arid Forest Research Institute has done seasoning and treatment work on *Prosopis juliflora*, *P. cineraria* and *Acacia tortilis*, lesser

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known timber species, with encouraging results. The combination of preservative chemicals, Copper Chrome Arsenic (CCA) and chloropyriphos were found effective against insect pest attack on furniture and other prepared articles which showed resistance after six years and have potential for utilization in the handicraft industry.



STATUS OF WOOD CONSUMPTION IN HANDICRAFT INDUSTRIES OF JODHPUR

Dr. T. S. Rathore

Arid Forest Research Institute

(Indian Council of Forestry Research and Education, Dheradun)

Jodhpur, India

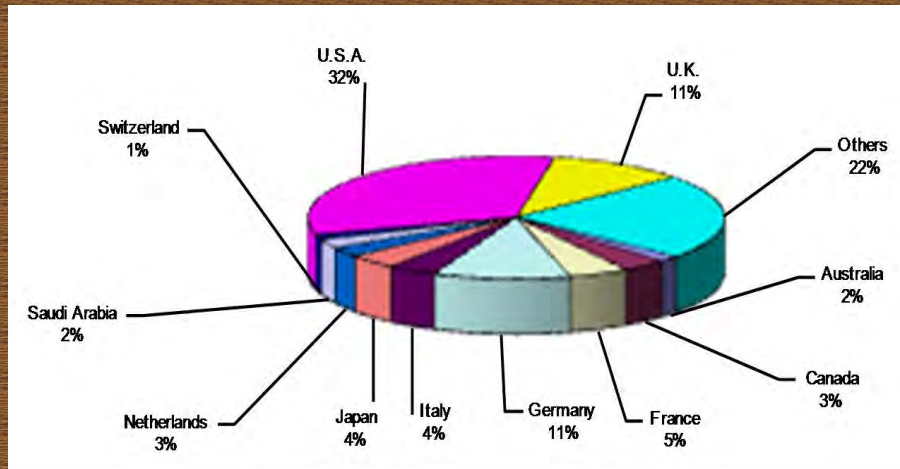
Indian Wood Handicraft Industry

- ❖ India is one of the important suppliers of wood handicrafts to the world market.
- ❖ The Indian handicrafts industry is highly labour intensive cottage industry and decentralized, being spread all over the country in rural and urban areas.
- ❖ The industry provides employment to over six million artisans, which include a large number of people belonging to the weaker sections of the society.

Wood-based Industry

Wooden articles in India range from the ornately carved to the simple. This include toys, furniture, decorative articles, etc. bearing the art and individuality of the craftsman.

Major Destinations of Indian Handicraft



Jodhpur Handicraft Industry

- The desert state of Rajasthan is well known for its woodwork.
- Furniture making is an integral part of wood work, and found its pride in the havelis and palaces of the medieval period.
- Rajasthan is the state, where the lattice work on wood is carried out.
- Jodhpur and Kishangarh are known for the painted furniture that consists of screens, doors, caskets and chairs.
- The Handicrafts industry has in recent years eclipsed all other industries in the city
- Wooden furniture made in Jodhpur has always been in great demand not only in India, but abroad, too.

Jodhpur Handicraft Industry

- The Jodhpur Handicraft Exporter's Association (JHEA) was registered in 1998 to strengthen the network of exporter's to achieve a sustained higher growth in export in handicraft to various global destinations.
- The export witness a sharp climb from zero to Rs. 1500 crore in two and a half decades employing 3 lakhs persons comprising artisans, craftspeople, skilled/ semi-skilled workers or unskilled labour, most of them belonging to weaker section of the society (**JHEA, 2010**).
- JHEA has 226 members of which regular member are 95 and associate member are 131.
- **Jodhpur handicraft industry has exported wooden handicraft worth Rs.1000 crores in 2010, even during recession period (JHEA, 2010)**

Small Scale Handicraft Manufacturing Unit





PRODUCTS (Furniture)



Dressers & Cupboards



Almirah



Designer Shelves



Chairs

PRODUCTS (Decoration Items)



Decorative Utility Items



Decorative Hanging Items



Suitcases and Briefcases



Wooden Photo frames

Fine Traditional Artistry



A master craftsman at work

PRODUCTS (Traditional Art)



An antique-looking wardrobe



An antique-looking dresser

Fine Traditional Artistry



Finishing a ethnic photo frame

PRODUCTS (Toys and Gift Items)



FINISHING & PACKAGING



Preference of tree species in handicraft industries



Dalbergia sissoo



Mangifera indica



Acacia nilotica



Tecomella undulata



Use of re-cycled wood

- Beams
- House holds items
- Windows and door frames of old Havellis
- Railway Sleeper
- Broken ships and raft

The re-cycled wood needs no seasoning and preservative treatments (Environmentally safe)

Reduce pressure on Forest / plantations



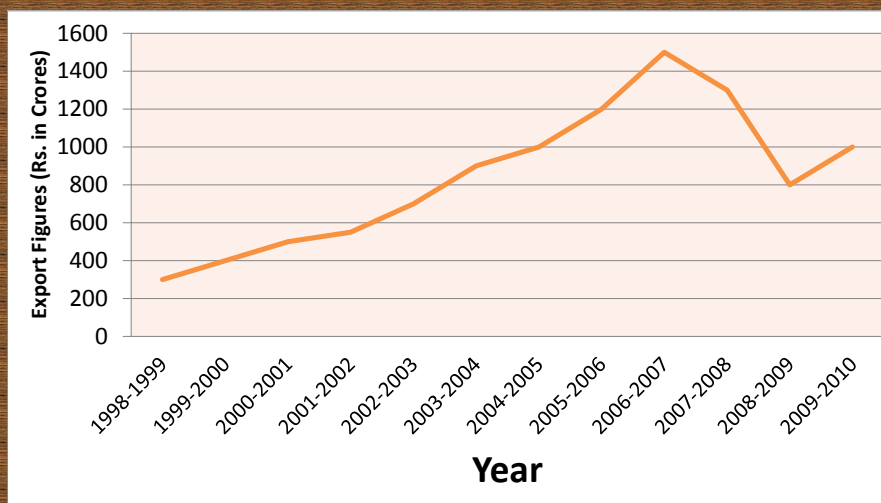
Annual wood consumption of handicraft industries

- < 5000 cft by 16% industries
- 5000-1,00,000 cft by 74% industries
- > 1,00,000 cft by 10% industries

Export of handicraft items

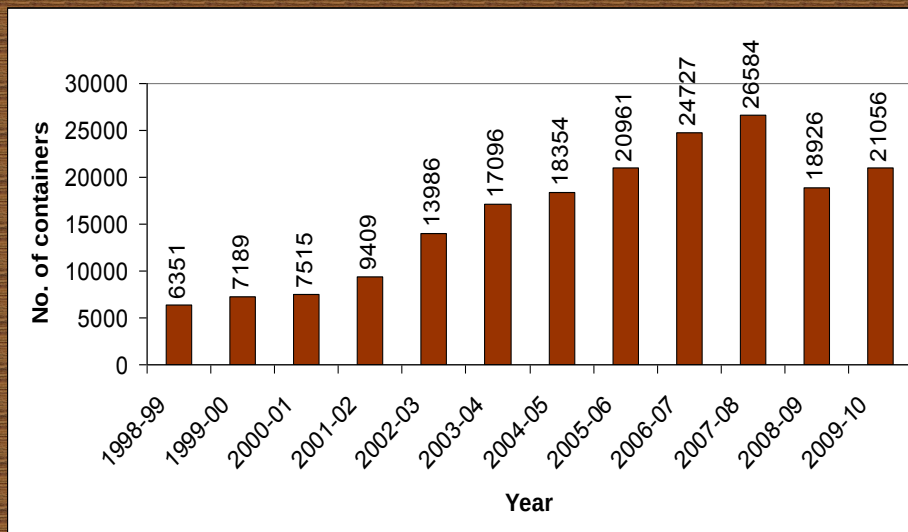
- Europe
- Australia
- New Zealand
- South America
- Japan
- South Africa
- Gulf countires

Year wise export of handicraft from Jodhpur



Source: JHEA

Year-wise export of handicrafts from Jodhpur in terms of containers



Wood seasoning and preservative treatment

- Wood is mostly obtained from Gujarat, UP, MP, Punjab, Haryana and Rajasthan.
- 100% new wood is used after seasoning and preservative treatments.
- Only 21% of industries have their own seasoning, and preservation treatment plants.
- Remaining 79% industries depends on other industries for seasoning and preservation treatments.

Potential alternative timber species of handicraft Industries



Prosopis cineraria



Prosopis juliflora



Acacia tortilis



Ailanthus excelsa



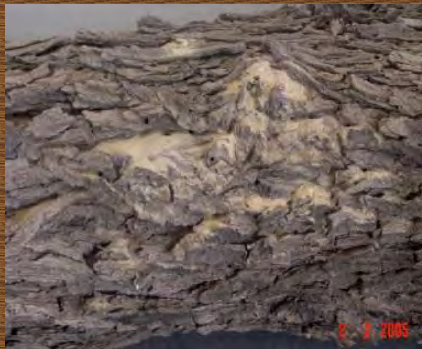
Azadirachta indica

Wood seasoning and preservation of alternative timber species

- Arid Forest Research Institute with handicraft industries have done seasoning and preservatives treatment on *Prosopis juliflora*, *P. cineraria*, and *Acacia tortilis*, the lesser known timber species.
- A study was conducted to enhance shelf life of wood of *Prosopis juliflora* and *P. cineraria* and *Acaia tortatils* by treatment with CCA, CCB and Chloropyriphos for resistance to insect, pests, termites and fungi.

- Sawn wood of these species have been treated with 2% solution of Copper, Chrome, Arsenic (CCA) and 2% Chloropyriphos in pressure treatment plant at 80 psi and moisture brought down to 10-12% in steam generated seasoning kiln, further seasoned under natural condition for 2 months.
- The combination of preservative chemicals, Copper Chrome Arsenic (CCA) and chloropyriphos were found effective against insect pest attack on furniture and other articles prepared which showed resistance after six years and have potential for utilization in handicraft industry.

Deterioration of wood logs due to infection of pests/insects and wood rotting fungi



P. cineraria



P. juliflora



Untreated sawn wood

- Untreated sawn wood of *P. cineraria* is found to be attacked by insect/pests and wood rotting fungi within 2 months.
- *P. juliflora* wood is resistant to insect/fungus

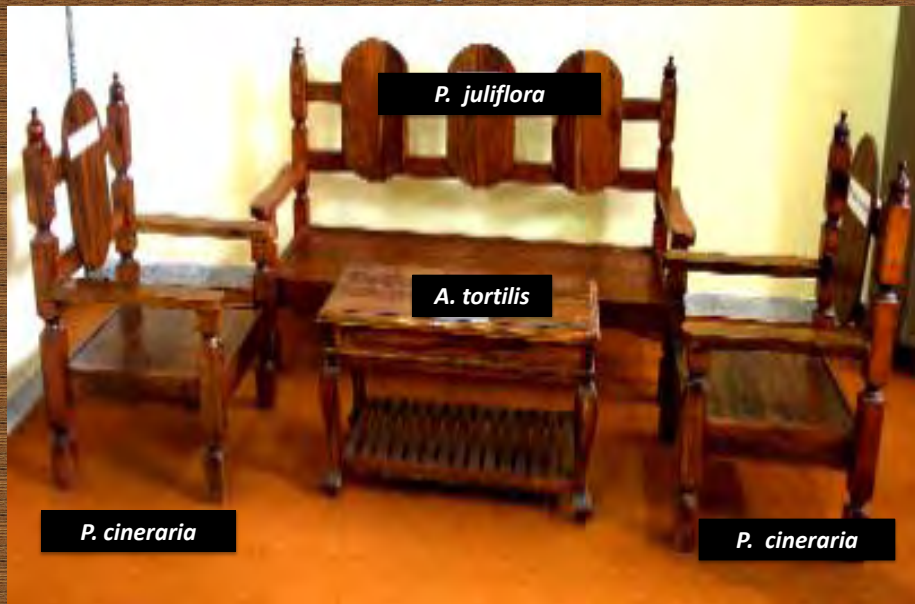
Seasoning and preservative treatments has made the wood to resist the attack by insects and wood rotting fungi and improved the shelf life.



Seasoned and treated wood samples

- ❖ Value added products like sofaset and utility box have been made from treated wood.
- ❖ Wood of *P. juliflora* exhibited very good turning, carving, finishing and polishing properties. Moderate appearance exhibited in *P.cineraria* wood.

Furniture made from plantation grown timber species



Furniture made from plantation grown timber species



P. juliflora



P. cineraria

Utility Box



Prosopis juliflora

Wood products from
P. juliflora and *P. cineraria*



•Preliminary work on preservation with combination of CCA and Chloropyriphos on *P. cineraria* and *P. juliflora* have shown promising results.

•Further observations in this study and different combination of eco- friendly preservatives can be tried to consolidate the schedule of treatment and longevity of shelf life of these woods.



- The deterioration of wood commenced within 2 months of felling and deteriorated to the extent of 50% within a year.
- Untreated wood of *P. juliflora* was not influenced with any decaying agent for four years after which decaying was observed in the sap wood while, damage was extensive in *P. cineraria*.
- Treated wood is showing resistance till six years of observations, indicating their potential to use in handicraft industry.



- Treatment and seasoning costs Rs. 40/- per cft. on commercial scale.
- Value addition by preservative treatment to make them suitable for use in wood industry will reduce pressure on consumption of traditional wood.
- Also fulfill the needs like furniture and building material of rural sector.



Strengths, Weaknesses and Threats of the Handicraft Industries

Strengths

- Aesthetic and functional qualities
- Wrapped in mist of antiquity
- Cheap labour hence can compete on price
- Low capital investment and high ratio of value addition.
- Hand made and hence has few competitors
- Variety of products which are unique
- Exporters willing to hand small orders
- Increasing emphasis on product development and design up gradation

Weaknesses

- Inconsistent quality
- Inadequate market study and marketing strategy
- Lack of adequate infrastructure and communication facilities
- Capacity to handle limited orders
- Untimely delivery schedule
- Unawareness of international standards by many players in the market

Threats

- Better quality products produced by competitors from Europe, South Africa, South Asia etc.
- Better terms of trade by competing countries
- Consistent quality and increasing focus on R&D by competing countries
- Better packaging
- Stricter international standards

Constraints Faced by Jodhpur Handicraft Industry

- Most of the Industry complains about non- availability of quality wood material and trained labor.
- Lack of state of art wood testing facilities, identification and certification of wood.
- Lack of quality planting material and alternative wood species.
- Lack of government land for plantation of trees by the wood based industries.

Changes in EU Timber Consumption

Aimi Lee Abdullah²

Abstract

Since the major event of the June 1992 United Nations Conference on Environment & Development (UNCED), or Earth Summit (Rio Summit), discussions and debates on legal international regimes that have impacts on forests have continued at various multilateral fora.

The EU's Forest Law Enforcement, Governance & Trade (FLEGT) Action Plan was launched in 2003. The centerpiece of the Plan is a Voluntary Partnership Agreement (VPA) to be agreed bilaterally between the EU and a timber exporting partner country. Once signed, the VPA is legally-binding.

It was in October 2010 that the EU Timber Regulation to ban illegal timber and to require EU importers to exercise "due diligence" in determining and assuring legality of timber imports was politically agreed and adopted by the European Council, i.e. by the Governments of the 27 EU member States. The requirement to meet this Regulation will be EU-wide, affecting all companies importing timber and timber products into EU Member States. After going through all the formalities of the European and national institutions, the legislation would come into force, after adoption by EU member state governments, by March 2013. This Regulation is a very strong market instrument to improve forest governance and the legal and regulatory framework in timber exporting countries.

India has a strong economic outlook and with the predicted continued rise in per capita income and the growth of the middle class, India will see significant increases in consumption, including that of timber. There is a global shift towards sustainable consumption and production. As home to some of the most rapidly expanding wood processing sector industries, will India be ready to go for responsible and sustainable timber consumption?

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Meeting market requirements for legal timber

by Aimi Lee Abdullah

European Forest Institute – FLEGT Asia

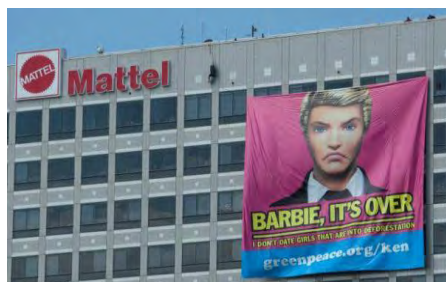
14 October 2011

Mumbai, India

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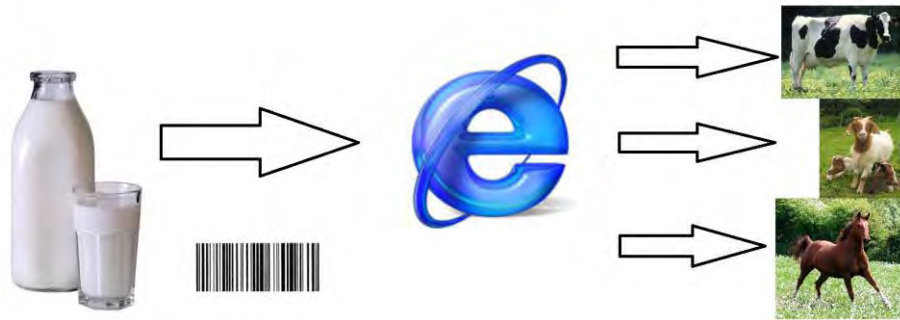
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2003 EU FLEGT Action Plan

Towards Sustainable Forest Management, good governance & transparency

Mix of supply and demand sides activities:

- New Legislation
- Bilateral Trade Agreements
- Encouragement of public and private procurement policies

**Aim to eliminate trade in illegal timber in the
EU**

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4

EU Timber Regulation – Main obligations

- 1 It prohibits the placing on the EU market of illegally harvested timber and products derived from such timber
- 2 It requires EU traders who place timber products on the EU market for the first time to exercise 'due diligence'
- 3 Other traders further down the supply chain must keep records of their suppliers and customers.

EU Timber Regulation - What is Due Diligence?-

1. INFORMATION

Operator must have information describing the timber and timber products, country of harvest, quantity, details of the supplier and information on compliance with national legislation.

2. RISK ASSESSMENT

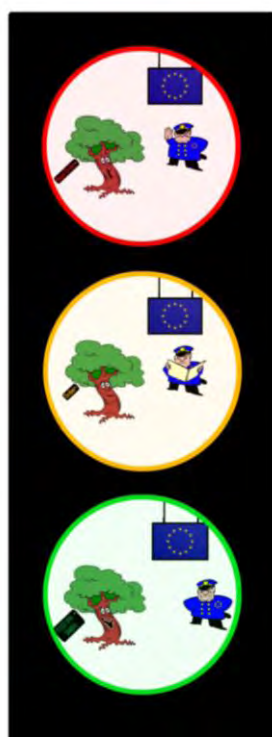
Operator to assess the risk of illegal timber in his supply chain, based on the information identified above and taking into account criteria set out in the regulation.

3. RISK MITIGATION

When there is a risk of illegal timber in the supply chain, mitigate that risk by requiring additional information and verification from the supplier.

EU timber operators will be looking for assurance that the timber is legally harvested:

1. **Negotiation** of FLEGT Voluntary Partnership Agreements between the EU and timber-exporting countries
2. **Private sector initiatives** (e.g. legality verification and forest certification)
3. Use other means of providing information on **legality**



Illegal Timber

With the EU Timber Regulation in place, the placing of illegal timber and timber products on the EU market will be prohibited.

This does not only apply to imported timber, but includes timber produced in the European Union itself as well.

Good evidence of legality, documents to show risk mitigation/forest certification & chain-of-custody

Timber imported from countries that have not signed Voluntary Partnership Agreements can still enter the EU market, provided the operator can prove that the risk of illegal timber entering the EU market is minimal.

FLEGT Licensed Timber

Once a VPA has been signed and implemented the timber exporting country can produce FLEGT Licensed Timber.

This timber is considered to be automatically compliant with the new Regulation: it will have a "green lane" entering the EU market.

EU Timber Regulation – which products

- Almost all timber products covered, including solid wood products, flooring, plywood, pulp and paper.
- Not included: recycled products, printed papers such as books, magazines and newspapers.
- The product scope can be amended.
- The Regulation applies to both imported and domestically produced timber and timber products.

EU Due diligence regulation

Products for regulation
4401*—Fuel wood
4403—Wood in the rough
4406—Railway or tramway sleepers
4407—Wood sawn or chipped lengthwise
4408—Sheets for veneering
4409—Wood continuously shaped
4410—Particle board
4411—Fibreboard
4412—Plywood, veneered panels
4413—Densified wood
4414—Wooden frames
4415—Packing cases, boxes, crates, drums
4416—Casks, barrels, vats, tubs
4418—Builders' joinery and carpentry of wood
47 & 48 chapters—Pulp and paper
9403—Wooden furniture (940330,40,50,60 & 90)
94060020—Prefabricated buildings

*Customs harmonised tariff codes

US Lacey Act (amendments)

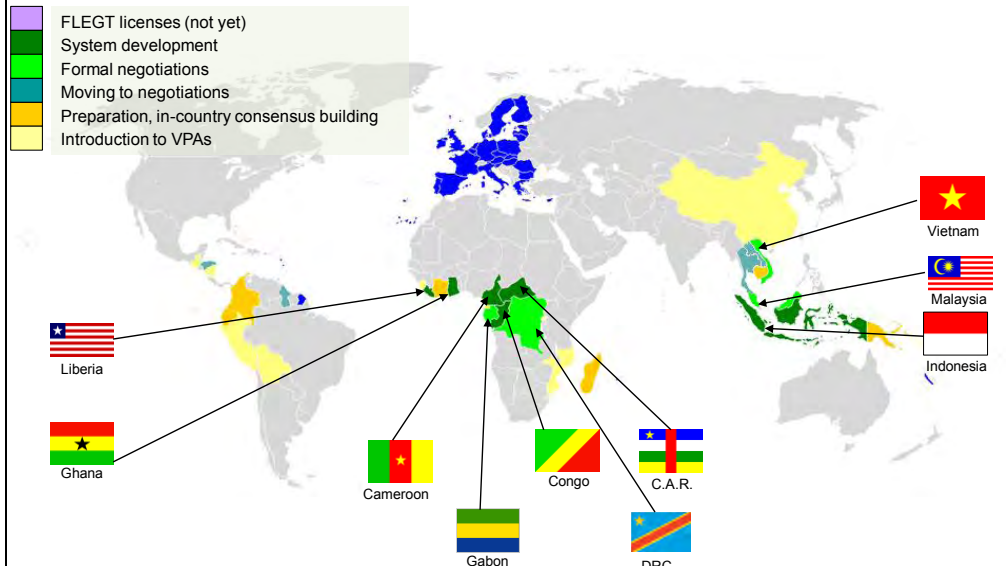
Product requiring an import declaration
4401—Fuel wood
4402—Wood charcoal
4403—Wood in the rough
4404—Hoopwood; poles, piles, stakes
4406—Railway or tramway sleepers
4407—Wood sawn or chipped lengthwise
4408—Sheets for veneering
4409—Wood continuously shaped
4412—Plywood, veneered panels
4414—Wooden frames
4417—Tools, tool handles, broom handles
4418—Builders' joinery and carpentry of wood
4419—Tableware & kitchenware of wood
4420—Wood marquetry, caskets, statuettes
4421—Other articles of wood
6602—Walking sticks, whips, crops
8201—Hand tools
9201—Pianos
9202—Other stringed instruments
9302—Revolvers and pistols
93051020—Parts & accessories for revolvers & pistols
940169—Seats with wood frames
950420—Articles and accessories for billiards
9703—Sculptures

Do not yet require an import declaration

4405—Wood wool (excelsior)
4410—Particle board
4411—Fibreboard of wood
4413—Densified wood
4415—Packing cases, boxes, crates, drums
4416—Casks, barrels, vats, tubs
47 & 48 chapters—Pulp and paper

FLEGT VPA partner countries

June 2011



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EU Timber Regulation - Implementation

December 2010

Regulation entered
into force

By June 2012

EU Implementing
Regulation: more detailed
rules on the "due diligence
system" rules for
recognition of monitoring
organisations

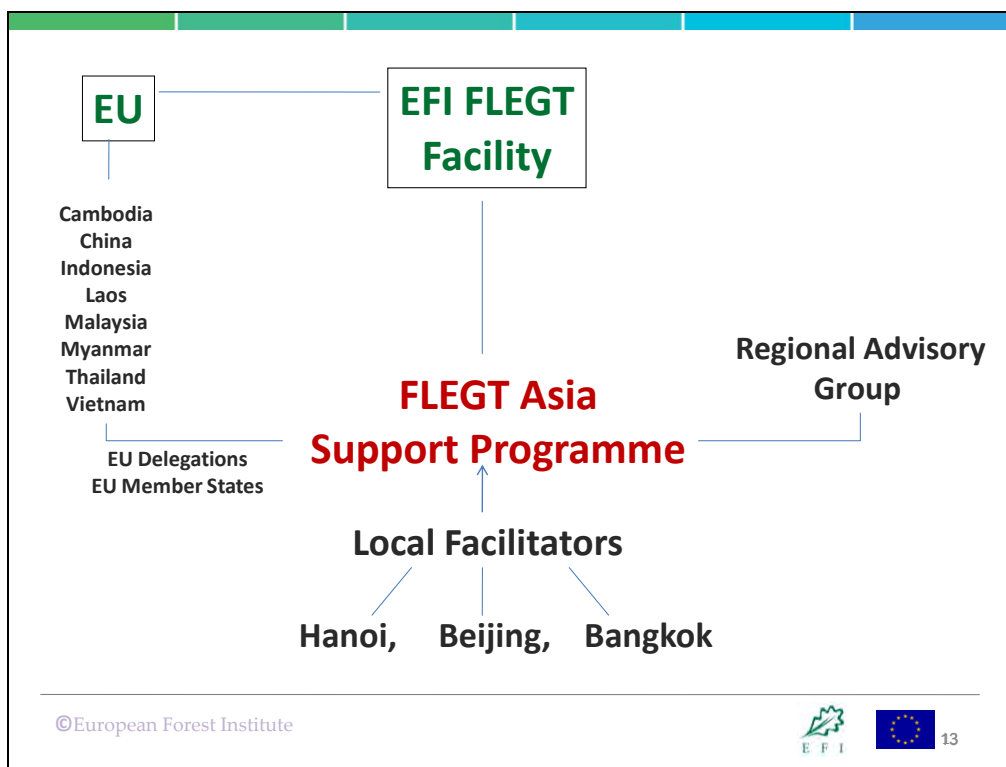
3 March 2013

EU Timber Regulation
applicable / operational

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12



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<http://ec.europa.eu/environment/forests/flegt.htm>
http://ec.europa.eu/environment/cites/home_en.htm
http://ec.europa.eu/environment/forests/illegal_logging.htm

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Kerala's withering wood security - the way forward

E V Anoop³, V Ajayghosh, T K Kunhamu and P Aruna

Abstract

Even though Kerala is one of the greenest states in India with roughly 44.58 per cent of the land area under forest cover (FSI, 2009), the state's forests, including plantations, account for only 9 per cent of industrial round wood supply, in contrast to 76 per cent from households and estates, with the rest coming from imports (Krishnankutty 1990, 1998, 2005). The state is heavily dependent on timber imports, particularly from Southeast Asia and Africa, and this trend is likely to rise many fold in the coming years. Many lesser known timbers are becoming increasingly present in the market supply, causing difficulties in identification, quality assessment and price fixation. While increased timber imports will be an opportunity for our forest products industries and trade allies, the sourcing of wood in either legal/illegal forms will put tremendous pressure on high value, ecologically important forests across the world. While encouraging sustainable consumption of tropical timbers, Forest Certification initiatives across the world will certainly put a stranglehold on imports from abroad in the years to come.

The timber market in Kerala is a sellers' market where wood is scarce and demand is high. Therefore, there is a pertinent need to strive hard and look for supplies elsewhere. Trees outside forests (TOF), particularly from homesteads, agroforestry and plantation resources hold tremendous promise to satisfy the state's ever increasing demand. Lesser Used Species (LUS) also needs to be explored as they are welcome substitutes to the higher priced but popular species for solid wood uses. However, there are several challenges in effectively utilizing these by assessing the quality and price fixation owing to the presence of small girth logs and significant proportion of juvenile wood in short rotation plantation grown timbers. Homestead/private estates grown timbers such as rubber wood, silver oak and even coconut wood are potential resources of the future. A relook at the planting programmes by the forest department by including trees that provide timber in addition to the other benefits is needed to save the state from an impending crisis affecting its 'Wood Security'.

Key words: Trees outside forests, Wood security, Forest Certification, Lesser Used Species

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INTRODUCTION

Kerala state in southern India, located between 8°18' to 12° 48' N and 74°52' to 77°22' is a small but highly populated state located in peninsular India. It has a long history of agroforestry, especially homegardening (Randhawa, 1980). Contemporary studies also highlight the importance of agroforestry in Kerala (Guillerme, 1999). Out of the total geographic area of Kerala, about 58% is used for agriculture (MoA, 2000). Trees and shrubs are present on most agricultural lands, except in the paddy (*Oryza sativa*) fields. Dominant agroforestry types of Kerala include shaded commercial crop production systems involving cacao (*Theobroma cacao*), coffee (*Coffea* spp.), tea (*Camellia sinensis*), spices etc., silvopastoral systems with fodder grasses in association with commercial trees, and homegardens. Such tree based systems generally encompass many disparate and intricate species-mixes, often specific to topographic, geomorphological, and edaphic niches (Kumar, 2007). The dominant agroforestry practice of Kerala, however, is the tropical homegarden, which represents an intimate, multistory combination of various trees and crops, sometimes in association with domestic animals, around the homestead (Kumar and Nair, 2004).

Table 1. Composition of forests of Kerala based on ownership and legal status.

Reserve Forest	Proposed Reserve	Vested forest	Total
9107.2066	364.4731	1837.7957	11309.4754
80.53%	3.22%	16.25%	100%

There are about 6.3 million predominantly small operational holdings in Kerala (average size 0.24 ha in 2000–01) covering a total area of 1.2 million ha (MoA, 2001). About 80% of these holdings are homegardens (Kumar, 2006), where both naturally occurring wild plants and deliberately introduced plants abound (Kumar et al, 1994). Despite their ecological and socioeconomic importance, traditional agroforestry systems including homegardens have been subject to conversion linked to socioeconomic changes (Guillerme, 1999; Peyre and others, 2006). The rapid increase in the state's population between 1941 and 1971 resulted in high pressure on land. Due to an acute scarcity of food grains during the 1950s, the state policy was oriented towards growing more food crops. With increasing emphasis on industrial models of agricultural development, fragmentation of land holdings due to demographic pressures driving land use intensification and systems declined (Jose and Shanmugaratnam, 1993; Kumar and Nair, 2004) and monocultures of commercial crops became dominant in Kerala.

Government policies play a vital role in providing incentives and disincentives to farmers to invest in tree farming and other agroforestry practices including homegardening. Case studies from Kerala regarding the impact of public policies on tree farming and agroforestry dynamics are, however, rare. Nevertheless, a plea was made in a 2001 Workshop on Cultivation of Bamboos, Rattans, and Timber Trees in Private and Community Lands to review and amend outdated or conflicting laws and harmonize them in view of the new

challenges of rising wood requirements of society and increasing pressures on remaining natural forests.

At present, 75 per cent of the state's demand for wood is satisfied by supplies from trees outside forests, the majority being from the homesteads. With the low availability of forest based raw materials, the potential of homesteads and private plantations to meet the short supply needs should be assessed and explored further. The Kerala Agricultural University and other leading departments need to step in and play a crucial role at this juncture to try and resolve the crisis by providing agro forestry and wood technological support services through research and extension to sustain wood based industries such as the match splints and veneer manufacturing which are mostly in the small scale sector and are facing an imminent threat of survival.

Forest tree species of Kerala produce timbers which are light to very light (<550 kg/m³), moderately heavy (550-750kg/m³) and very heavy (>750kg/m³). With the wide range of wood density values, these species have the potential to meet the wood requirements of major wood using industries, viz., saw milling, plywood, match wood, packing case, paper and other reconstituted products. However, most of these industries are in the small scale sector. With roughly 30 per cent of the land area under 'forest cover' (11,034 sq km), Kerala may be one of the greenest states in India. However, ironically the state forests, including plantations, account for only 9% of industrial round wood supply, in contrast to 76% by households and estates, with the rest coming from imports. The timber market is a sellers' market. Wood is scarce and demand is high.

Table 2. Annual outturn of major forest products of Kerala during 2006-2007 and 2007-2008.

Sl.No	Name of Products	Units	2006-2007	2007-2008
1	Timber in round logs	Cum	26774.360	48627.829
2	Sawn and Squared Timber	Cum	17.287	23.354
3	Poles (Teak)	Nos	296013	352896
4	Fire Wood	MT	12748.397	12676.413
5	Charcoal	MT	239.99	0
6	Bamboo	Nos	1237030	1551168
7	Reeds	Nos	21403530	15246981

8	Sandal Wood	Kg	3159.35	17537.1
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The state is heavily dependent on timber imports, particularly from Southeast Asia and Africa. Imported timber was popularly called Malaysian wood. With the construction business booming, wood is scarce in the state although demand is getting higher and higher each year (no recent estimates are currently available). Many lesser known timbers are becoming increasingly significant in market supply such as violet (*Peltogyne* Sp.), iroko (*Chlorophora excelsa*), green heart (*Ocotea rodiaei*), Kusia (*Nauclea diderrichii*) etc. causing difficulties in identification, quality assessment and price fixation.

India which is one of the burgeoning economies of the world and predicted to be a major economic power next only to the USA and China in coming decades, will very soon become the second largest importer of tropical timber in the world, next only to Japan. The country is already a net importer of timber. Coupled with this fact is the emergence of the green building movement, that advocates usage of higher quantity of wood in buildings as a means of capturing carbon for long periods of time (more than a lifetime) which otherwise would have been emitted to atmosphere had it been burnt or allowed to decompose in a natural forest situation. Alternatively, this 'locking' of carbon in buildings helps lower carbon emissions as equivalent substitute materials like steel and concrete are more energy intensive in production. Representatives of the Indian Green Building Society claim that the carbon foot print left by the various industries had led to the idea of a re-evaluation of the building industry. This has ultimately led to the mission to create buildings which are environment-friendly and use significant quantities of wood. In the United States, an official body that can issue a certification of buildings claimed using the concept. This institution, namely: U.S. Green Building Council has a certification system known as LEED (Leadership in Energy and Environmental Design) Certification.

In India, rating systems for green buildings were also developed by The Energy and Resources Institute (TERI), including the Indian codes, standards and best practices. The Indian Green Building Council (IGBC) is also very active in this sphere. Taking the green line vis-à-vis reducing carbon emissions will definitely increase the demand for timber supplies which under the present scenario can be met from imports. While increased timber imports will be an opportunity for our forest products industries and trade allies, the sourcing of wood either legally/illegally will put tremendous pressure on high value, ecologically important forests across the world. This will also increase the nation's forest footprint, particularly in South East Asia and Africa. In order to minimize the forest footprint, we need to encourage sustainable consumption of timber by promoting forest certification.

FOREST CERTIFICATION

Another interesting global development related to timber trade in recent years is the requirement, particularly by the richer Western nations, for certified wood either in round form or wood products. Forest Certification, particularly the COC (Chain of Custody) component, although essentially a voluntary, market driven system is becoming mandatory for Indian export houses trading in wood to the European and US market, not only for large enterprises but even for small and medium ones, who will be hit the most, thanks to the Lacey Act in the US and the FLEGT in Europe.

Forest management certification is a process which verifies that an area of forest /plantations from where the wood, fiber and other non-timber forest products is extracted is managed to a defined standard. Forest certification refers to two separate processes viz., forest management unit certification (FMU) and chain of custody certification (COC). COC certification is a process of tracking forest products from the certified forest to the point of sale to ensure that product originated from a certified forest.

For buyers of forest products, the responsible sourcing is their adoption of policies and practices that reward suppliers using wood, fiber and other non wood forest products from well managed forests or from recycled products and discouraging suppliers using it from unknown, illegal or otherwise controversial sources. Forest certification is a mechanism for forest monitoring, tracing and labeling timber, wood and pulp products and non-timber forest products where the quality of management from environmental, social and economic perspectives is judged against a series of agreed standards. It is a process that leads to the issuing of a certificate by an independent party, which verifies that an area of forest is managed to a defined standard.

There is a pertinent need to prevent illegal felling in valuable forests and also to use the global market commitment to conserve it. While creating an environment conducive for strong B2B relationship of business houses supporting responsible sourcing of wood, it should also lead to reasonable economic and social benefits for businesses as well as to the people dependent on wood.

There are several certification schemes in operation of which Forest Stewardship Council (FSC) certification is one of the most popular and credible certification schemes globally. Other Certification Systems include Programme for Endorsement of Forest Certification Schemes (PEFC), American Tree Farm System (ATFS), Canadian Standards Association (CSA) Standard, Australian Forestry Standard (AFS), Certification Forestal en Chile (Certfor), Malaysian Timber Certification Council (MTCC), Sistema Brasileiro de Certificacao Florestal (CERFLOR).

The Forest Stewardship Council (FSC), resulting from an intergovernmental convention of nations to enforce the commitment of the signatories to adhere to a system of certification whereby the forest and the resulting products should be sustainably managed ensures that ecologically fragile and vulnerably forests are not exploited recklessly to satisfy the timber needs of countries elsewhere.

FOREST CERTIFICATION- THE INDIAN SCENARIO

India is located at the center point of global trade of forest produce. Furthermore, this nation can exert considerable influence on countries that produce and trade extensively in tropical timbers. As with Carbon trading, our country was also late to wake up to the Forest Certification movement happening elsewhere in the world. Dependence on imports for meeting the demand of wood for varied uses will be on the rise and more common in years to come. To conserve forests and at the same time provide adequate encouragement and support for wood based industries, forest dependent communities and artisans, it is necessary to have adequate areas under reliable and under forest certification.

In order to meet the growing demand for forest certification in the global market, the Indian industry has to look for certified forests/plantations to source their raw materials. The increased demand for forest certification is likely to affect the economic prospects of many farm forestry/agro-forestry areas in India unless these areas are certified. The MOEF recently established a committee to develop a National Forest Certification System. Forest certification in India is still in its infancy and therefore the nation has not been able to make use of the benefits of forest certification. So far, India has secured one FSC Forest management Unit Certificate (644 ha of rubber plantations in Tamil Nadu State) and a many COCs mainly by small and medium companies to meet export demand. While the number of COCs in the country is expanding, FMU certification has not largely taken off. The situation is likely to change due to the increased demand for forest certification in the global market and the high growth of the Indian economy.

The impact of such demand on forest based industries and growers, particularly those of small and medium scale in India will be severe unless they secure forest certification. To address this situation, there is a need to ensure adequate FMU certifications in the country. The export promotion council of handicrafts (EPCH) set up by the Ministry of Textiles is concerned about the adverse effects of increased demand for forest certification on export prospects of Indian wooden handicrafts industry and initiated several approaches to promote forest certification.

Very recently, in November 2010, the Forest Stewardship Council, in association with the Worldwide Fund For Nature - India (WWF) in New Delhi has set up a trust called the Forest Certification Council (FCCI) to give impetus to FSC certification programme in India. While COC Certification might increase and SME enterprises will definitely increase several folds in the coming years due to this welcome development, the more important and difficult FMU certification might not improve since a vast majority of our forests are government owned. While all government owned forests with definite working plan prescriptions are managed on a sustained yield principle which is cardinal to the process, thereby conforming to the strict regimens of the Criteria and Indicators (C&I) laid down by the FSC might still elude certification since national policy decisions might be hard to come by, more so because local level indicators are yet to be developed and partly due to the overall bureaucratic apathy towards certification. However, Certification of our forests holds manifold advantages while offering numerous challenges for its implementation.

MEETING THE TIMBER DEMAND OF KERALA- FUTURE RESOURCES

The state's forests including plantations account for only 9% of industrial round wood supply, in contrast to 76% by households and estates the rest is being satisfied by imports. Imports will rise significantly in the coming years. However, the increasing need and awareness for Forest Certification will certainly put a restriction on the supply of tropical timbers in the years to come. The State Forest Department mostly supplies teakwood which is sold through auctions. The cost of teakwood timber is on an average above Rs.2,500 per cubic foot and can go upto Rs.4,000 and even more. It has been 20 years since 'Malaysian wood' started reaching the Kerala coast, Mangalore and Tuticorin ports being the chief entry points for the wood to south India. Wood is arriving from all parts of the world, even from South America. However, the majority of the imported wood is sourced from the Indo-Malaysian region including Myanmar, Indonesia, Papua New Guinea (PNG) and more recently from the African countries, particularly the Congo basin countries, most of which are

poor and have democratic governments to regulate exploitation. Pyinkodo (*Xylia dolabriformis*) wood constitutes the majority of the imports. The timber market is a sellers' market. Wood is scarce and demand is high.

Therefore there is a pertinent need to strive hard and look for supplies elsewhere. Trees outside forests (TOF), particularly from homesteads, agroforestry and plantation resources hold tremendous promise to satisfy our ever increasing demand for supplies. Lesser Used Species (LUS) also needs to be explored as they are welcome substitutes to the higher priced but popular species for solid wood uses. However, there are several challenges in effectively utilizing these by assessing the quality and price fixation owing to the presence of small girth logs and significant proportion of juvenile wood in short rotation plantation grown timbers. Homestead/private estates grown timbers such as rubber wood, silver oak and even coconut wood are potential resources of the future.

While the state forest department has implemented highly successful and large scale afforestation initiatives outside natural forest particularly in public lands, schools, colleges and homesteads through a plethora of programmes involving the masses such as 'Ente maram', 'Nammude maram', 'Haritha Keralam' and the like, little or no attention was paid in selecting species providing timber on a short rotation for the large scale planting activities. It is time the forest department takes another look at the planting programmes by including trees that provide timber in addition to the other benefits to satisfy the rising demand for industrial wood in the state.

POTENTIAL FOR CERTIFYING FORESTS, FOREST PRODUCTS AND TIMBER RESOURCES OUTSIDE FORESTS OF KERALA

While the government owned reserve forests (RF) of the state which are managed by definite working plan prescriptions on a sustained yield principle will be no doubt conforming to the Criteria and Indicators (C&I) laid down by the FSC, after suitable country specific modifications to it is made by the recently constituted Standards Development Group (SDG) for India by the FSC, homesteads and the timber supply there from has vast potential to be certified since, by their very nature, these are sustainably managed. Rubber plantations that supply rubber wood satisfy roughly 41 % of the current timber demand (Krishnankutty, 2005) has huge potential to get certified as the state currently enjoys a monopoly by holding 85% of the area occupied by the rubber plantation in the country. Once certified under FMU, even the rubber latex originating from it can carry the FSC logo on it, thereby enhancing the market value, particularly in the export and premium market segment. Since majority of the growers are small, barring a few coming under the corporate sector, there might be a need for formation of co-operative societies to secure FMU for the latter.

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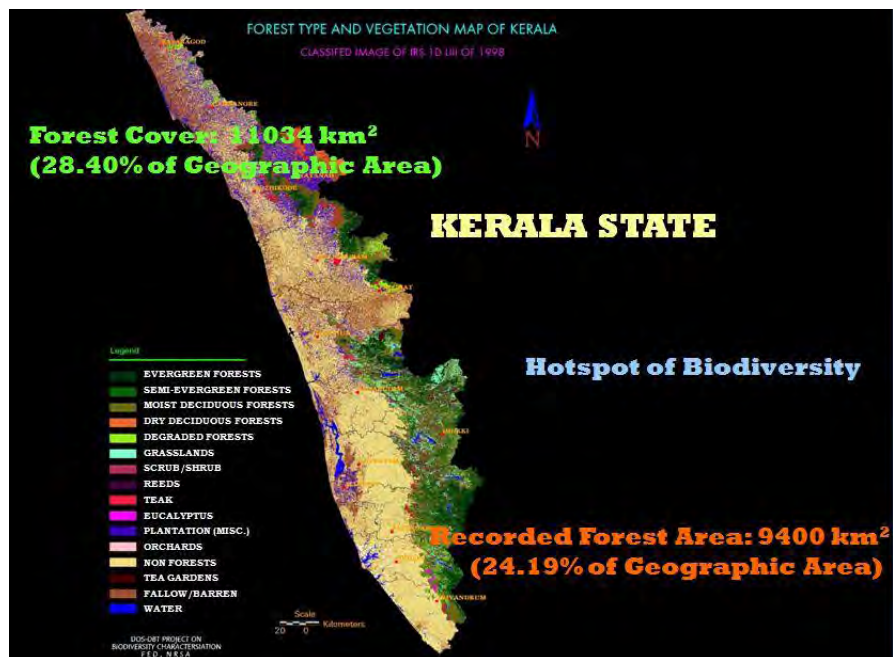


Plate 1. Forest cover map (True Colour Composite) of Kerala showing the diversity of forest types.

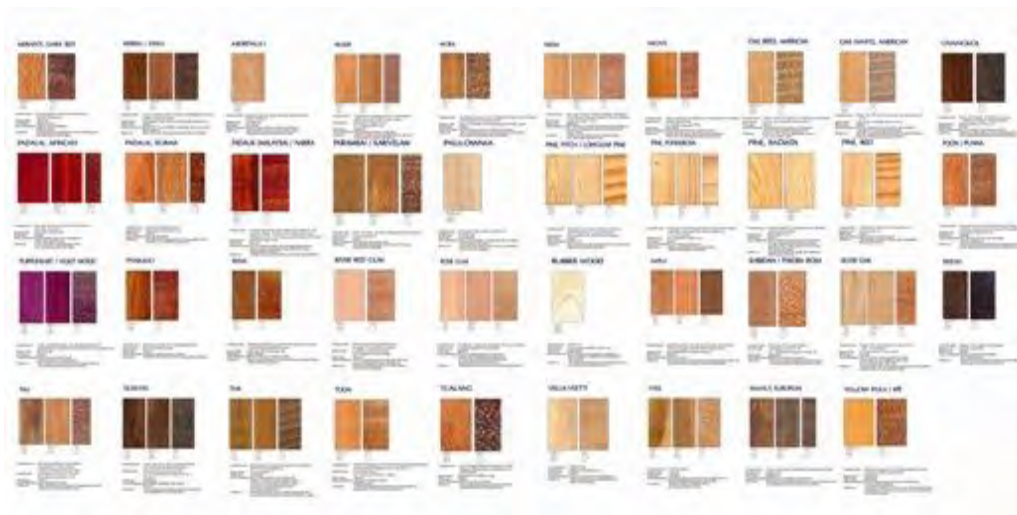


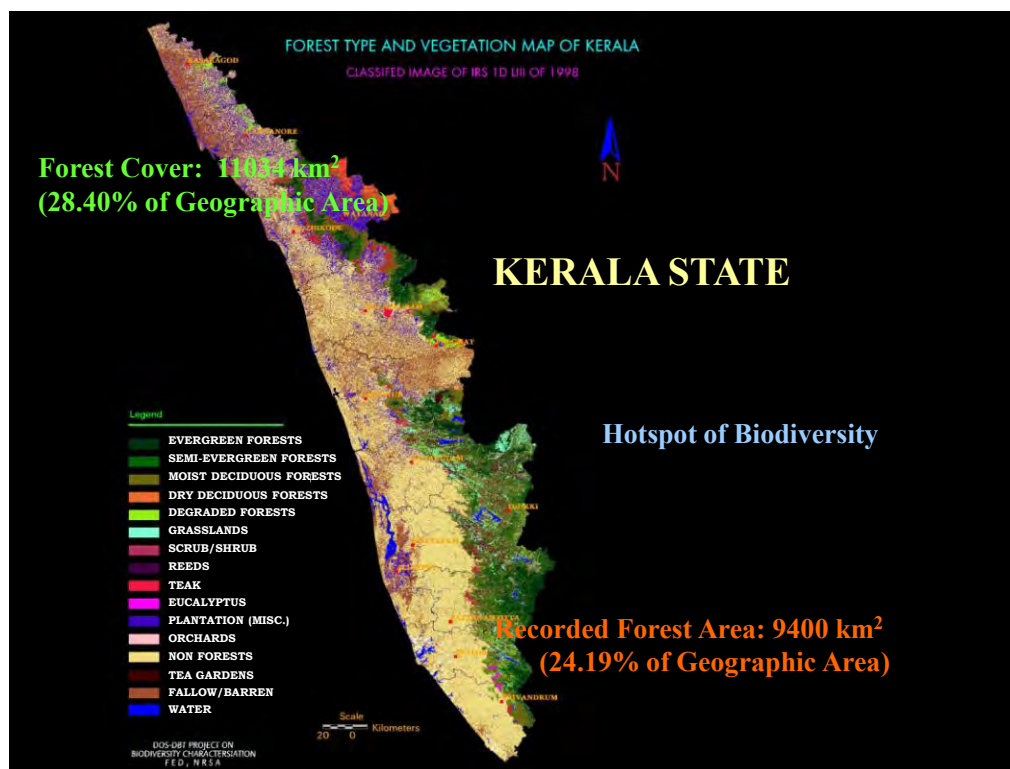
Plate 2. Many lesser known species are becoming increasingly significant in the market supply, causing difficulties in identification, assessing the quality and price fixation.

KERALA'S WITHERING WOOD SECURITY - THE WAY FORWARD



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**CLASSIFICATION OF FOREST AREA OF KERALA 2008
BY TYPE AND LEGAL STATUS**

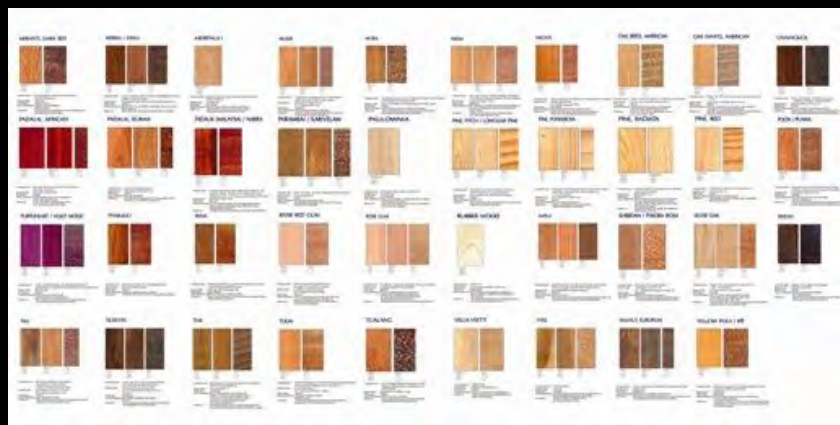
I	Forest Type Wise	(Sq.Km.)
	(Effective Forest Area)	
1	Tropical Wet Evergreen and Semi Evergreen	3299.000
2	Tropical Moist deciduous	4100.000
3	Tropical Dry deciduous	100.000
4	Montane Sub-tropical Temperate sholas	70.000
5	Plantations	1809.424
6	Grass Lands	21.576
	TOTAL	9400.000
II	By Legal Status (Area as per Records)	(Sq.Km.)
1	Reserved Forests	9078.1595
2	Vested Forests	1838.5454
3	Land proposed for Reserve Forest	116.6827
	TOTAL	11033.3876

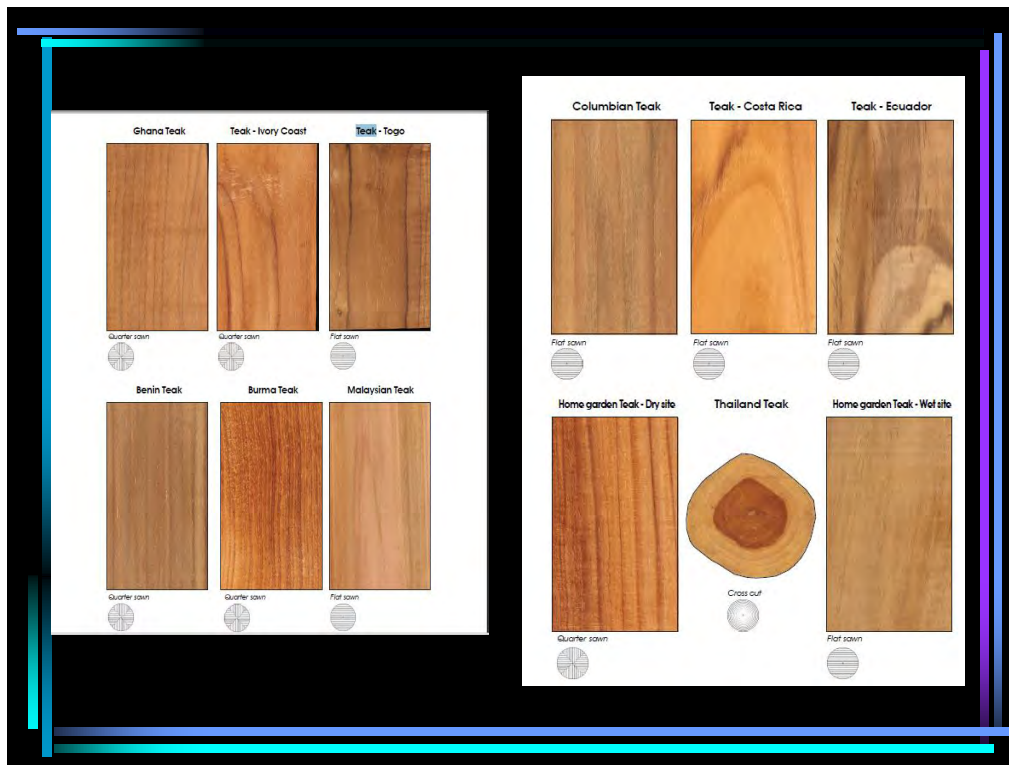
Kerala may be one of the greenest states in India with about 28 percent (11,034 sq km) of its total area (38,863 sq km) covered by forests . However, the State forests including plantations account for only 9% of industrial round wood supply, in contrast to 76% by households and estates while the rest being from imports (Krishnankutty 1990, 1998, 2005).

The state is heavily dependent on imports, particularly from Southeast Asia and Africa for timber. Imported timber is popularly called Malaysian or African wood. With the construction business booming, wood is scarce in the state although demand is getting higher and higher each year (no recent estimates yet !)

- The State Forest Department mostly supplies teakwood which is bought through auctions. The cost of teakwood timber is on an average above Rs.2,500 per cubic foot and can go upto Rs.4,000
- It has been 20 years since 'Malaysian wood' started reaching the Kerala coast, "Mangalore, Tuticorin and Chennai ports" being the chief entry points for the wood to south India
- Wood is arriving from all parts of the world, even from South America. However, majority of the imported wood is sourced from Myanmar. Pyinkado wood constitutes most of the import
- The timber market is a sellers' market. Wood is scarce and demand is high.

- Therefore, many lesser known timbers are increasingly become significant in the market supply, causing difficulties in identification, assessing the quality and price fixation.





Timber Qualities and Suitability for specific purposes

- Forest tree species of Kerala produce timbers which are light to very light ($<550 \text{ kg/m}^3$), moderately heavy ($550\text{-}750\text{kg/m}^3$) and very heavy ($>750\text{kg/m}^3$) (*Timbers of Kerala CD ROM*)
- With the wide range of wood density values, these species have the potential to meet the wood requirements of major wood using industries, viz., saw milling, plywood, match wood, packing case, paper and other reconstituted products
- However, most of these industries are in the small scale sector

ANNUAL OUT TURN OF MAJOR FOREST PRODUCTS
2006-2007 & 2007-2008

Sl.No	Name of Products	Units	2006-2007	2007-2008
1	Timber in round logs	Cum	26774.360	48627.829
2	Sawn and Squared Timber	Cum	17.287	23.354
3	Poles (Teak)	Nos	296013	352896
4	Fire Wood	MT	12748.397	12676.413
5	Charcoal	MT	239.99	0
6	Bamboo	Nos	1237030	1551168
7	Reeds	Nos	21403530	15246981
8	Sandal Wood	Kg	3159.35	17537.1

Source: <http://www.keralaforest.org>

SPECIES WISE OUT-TURN OF TIMBER BY GOVERNMENT AGENCY 2007-08		
SLNo.	Name of Species	Quantity in CuM
I INDUSTRIAL WOOD SPECIES		
1	Tek	21547.196
2	Rosewood	479.068
3	Mahogany	769.735
4	Ajilly	37.602
5	Thambaru	158.503
6	Vengai	11.218
7	Ventek	202.66
8	Jack Plavu	6.571
9	Maminanilla	13.466
10	Marutha	2007.74
11	Iru	1548.971
12	Muluvangai	294.118
13	Unam/Chadichu	877.618
14	Thenu	89.749
15	Karimthakara	2.464
16	Padiri	9.187
17	Poom	63.22
18	Kumarvaka	15.144
	TOTAL	28184.26
II FLYWOOD SPECIES		
1	Vellapine	2.94
2	Kulamavu Coravu	42.955
3	Maru	10816.161
4	Poon Puma Pumarvu	19.453
5	Cheeni	4.619
6	Nedunur	8.258

SLNo.	Name of Species	Quantity in CuM
7	Kumbil	3.792
8	Njeral	3.732
9	Chorupine	5.208
	TOTAL	10907.118
III MATCHWOOD SPECIES		
1	Elavu Poola	11.946
2	Pala/Makkampala	51.619
3	Vaka	250.41
	TOTAL	313.975
IV BOBBINWOOD SPECIES		
1	Akai/Vellakal	7.172
2	Manjakadamu	6.452
	TOTAL	13.624
V PENCIL WOOD SPECIES		
1	Vinkota	29.577
2	Poochakadamu	0.23
	TOTAL	29.807
VI PACKING CASE WOOD SPECIES		
1	Malavappu	28.995
2	Vata	184.006
3	Utha	3.754
	TOTAL	216.755
VII PULPWOOD SPECIES		
1	Eucalyptus (MT)	17006.013
2	Bamboo (Numbers)	1551168
3	Reeds (Numbers)	14552181
VIII MISCELENEOUS SPECIES		
1	Fire wood (MT)	12676.413
2	Tek pole (Nos)	352896

Species wise outturn of timber by the Kerala State Forest Department
(<http://www.keralaforest.org>)

Why responsible sourcing ?

- While increased imports will be an opportunity for our forest products industries and trade allies, the sourcing of wood either legally/illegally will put tremendous pressure on high value, ecologically important forests across the world.
- This will also increase the nation's forest footprint, particularly in South East Asia and Africa. In order to minimize the forest footprint, we need to encourage sustainable consumption of timber by promoting forest certification.

Forest Certification

- Forest certification refers to two separate processes viz., forest management unit certification (FMU) and chain of custody certification (COC).
- Forest management unit certification (FMU) is a process which verifies that an area of forest /plantations from where the wood, fiber and other non-timber forest products is extracted is managed to a defined standard.
- COC certification is a process of tracking forest products from the certified forest to the point of sale to ensure that product originated from a certified forest.

Responsible sourcing !

- For buyers of forest products, the responsible sourcing is their *adoption of policies and practices that reward suppliers using wood, fiber and other non wood forest products from well managed forests or from recycled products and discouraging suppliers using it from unknown, illegal or otherwise controversial sources.*
- There are several certification schemes in operation of which Forest Stewardship Council (FSC) certification is one of the most popular and credible certification schemes globally.

FC – the Indian scenario

- In order to meet the growing demand for forest certification in the global market, the Indian industry has to look for certified forests/plantations to source their raw materials.
- The increased demand for forest certification is likely to affect the economic prospects of many farm forestry/agro-forestry areas in India unless these areas are certified.

Need for forest certification

- There is a pertinent need to prevent illegal felling in valuable forests and also to use the global market, commit to conserve it.
- While creating environment conducive for strong B2B relationship of business houses supporting responsible sourcing of wood, it should also lead to reasonable economic and social benefits for the them as well as to the people dependent on wood.

Solomon Islands (FSC certified) teak in India ?



Mberande (SI) teak plantation on alluvial soils - 35.5 cm in 4 years



At 9 years



9-11 year old teak freshly cut and ready for loading

Visiting indian buyers and discussing the measurement system



Tracing timber from forest to consumer with DNA markers

Extracting DNA from timber samples for genotyping purposes difficult - most valuable part, the heartwood - consists of dead cells with DNA that is partly degraded and occurs in low concentrations - wood contains compounds that inhibit the necessary PCR reactions.

Success rate higher for chloroplast and mitochondrial DNA where the genes are found in many copies, in contrast to the nucleus.



Conclusion

- Homegardens are fundamental features of the rural landscape of the Indian state of Kerala. Yet these mixed species systems are increasingly being replaced by monocultures.
- Public policies on land tenure, agriculture, forestry and tree growing on private lands have interacted with farmer preferences in shaping land use dynamics and agroforestry practices.
- Not only is there no specific policy for agroforestry in Kerala, but also that the existing sectoral policies of land tenure, agriculture, and forestry contributed to promoting plantation crops, even among marginal farmers.
- Forest policies, which impose restrictions on timber extraction from farmers' fields under the garb of protecting natural forests, have often acted as a disincentive to maintaining tree-based mixed production systems on farmlands.

Changing Trends in Timber Usage in Nagaland, India

K S Shashidhar⁴, A N Kumar⁵ and Sidramappa Chalkapure⁶

Abstract

The State of Nagaland in North East India is endowed with rich forest resources. With about 52.04 per cent of its geographical area under forests of which 88.30 per cent are owned by communities and individuals, the state is sustained mainly by a rural economy. Forests along with agriculture and animal husbandry are the main source of livelihood, impacting the economic and socio-cultural aspects of the people. The timber resources have three major end users, domestic consumers, wood based industries and market outside the state. Initially, the hardwood species like Phoebe goalparensis, Michelia champaca, Morus laevigata and later Terminalia myriocarpa, were preferred for durability and suitable sizes for construction. No gap existed between demand and supply with availability of timber in plenty. With the setting up of wood based industries and export outside the state, the demand far exceeded the supply resulting in escalation of prices. Species costing Rs. 50-100 per cubic feet during 1985-90s are now priced at Rs. 350-500. With gradual shrinkage of natural forests, scarcity of the preferred timber species resulted in shifts towards lesser known hardwood species such as Chukrasia tabularis, Artocarpus chaplasha, Albizzia lebbeck and Duabanga sonneratioides. The Jhuming cycle has been reduced to 4-5 years from 15 to 20 years. All these factors necessitated augmentation of the resource base through a people's initiative in the form of plantations of Terminalia myriocarpa, Gmelina arborea and Duabanga sonneratioides. Subsequently, plantations of Tectona grandis and Gmelina arborea were taken up on a large scale. In this scenario one can foresee a future for fast growing species like Teak and Gmelina. Emphasis on plantations of short rotation timber species with technological interventions to explore the potentials of engineered woods would augur well for the sustainable management of forest resources in the state.

Key words: Nagaland, timber, Jhuming, price, economy, industry,

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1. INTRODUCTION

Nagaland, a state with rich biodiversity, is located in the North Eastern part of India. To its East is Myanmar and Assam to the West. The states of Arunachal Pradesh and Manipur are located to the North and South of the Nagaland respectively. Nagaland, a part of the eastern Himalayas, is endowed with luxuriant vegetation. The rolling mountains, enchanting valleys and the perennial rivers present a magnificent picture. About 82 per cent of the state's population lives in villages, and more than 70 percent of the population depends on agriculture and forestry as their main occupation. Agricultural practice is mainly by shifting cultivation (*jhuming*) and in some places by terrace cultivation.

Physiographically Nagaland comes under the Eastern Himalayas and North East hills of Patkai – Naga Hills forming part of Indo – Burma (Eastern Himalayas) Biodiversity hotspot. The area is the confluence of Indo-Malayan, Indo – China and India Bio geographical realms with high level of endemism. Out of the State's geographical area of 16,579 sq.km, recorded forest area is 8629.38 sq.km (about 52.04 percent of the geographical area). As much as 88.3 per cent of the forests in the state are owned by private individuals or communities and the remaining 11.7 per cent is with the Government. The State with its bio-geographical identity supports a unique assemblage of communities of flora and fauna including threatened and endangered species. The region also has high level of endemism. The Forest types in the state ranges from, Northern Tropical Wet Evergreen Forests, Northern subtropical Pine Forests, Montane wet temperate forests and the alpine forests are some of the major types. The forests are rich with economically important tree species such as *Terminalia myriocarpa*, *Phoebe goalparensis*, *Dipterocarpus macrocarpus* and *Shorea assamica*, *Tetrameles nudiflora*, and *Pinus kesiya* along with host of secondary species and other Non Timber Forest Products.

Shifting cultivation or *Jhuming* has been the mainstay for people of Nagaland. The practice integrates their socio - cultural and economic activities. Increase in area under jhum along with intensity and reduction in jhum cycle have all resulted in degradation of quality and quantity of forest cover in the state. Consequently the availability of timber, its demand and prices are affected.

Natural resources, primarily the forests have been playing very important role in the sustenance and livelihood of the people of Nagaland. These resources have to be managed sustainably to support the livelihood of people emphasising the importance of economic dimension. Over a period of time several key factors have influenced the availability of forest produce including timber and resulted in steady increase of their prices. A thorough analysis of these factors highlights the need for a sustainable management of the diminishing forest resources from economic as well as environmental perspective. Further, an attempt has been made to suggest measures to achieve this objective with technological intervention and planned resource augmentation through plantation programmes with the people's involvement.

This paper discusses the role played by various important factors which have influenced the availability of timber and its price over a period of time in the state of Nagaland.

Timber dependent economy

With abundant forest resources, particularly timber, Nagas (people of Nagaland) dependency on timber and other forest products is well established. The utilisation of timber for

construction of houses, community halls and for other purposes has been a common practice and continues even now. The scenario in the earlier times did not show any gap between the demand and the supply of timber resources. This was because of availability of sufficient material and the usage was mainly for their own purposes with hardly any commercial dimension. One of the major factors which changed the scenario is increasing dependency of the people on timber as an economic source

Perusal of trends in timber utility since 1950s brings out two specific facts. First, the economically important species and secondly, the price. Species such as *Terminalia myriocarpa*, *Phoebe goalparensis*, *Gmelina arborea*, *Mesua ferrea*, *Morus laevigata* and *Mansonia dipikae* were available in plenty in Nagaland. They were used extensively for construction purposes. The preference for these species was because of their easy availability and durability. Subsequently, these were replaced by lesser known and sparingly used hardwoods such as *Amoora wallichii*, *Chukrasia tabularis*, *Albizia procera*, and *Terminalia chebula*, *Cinnamomum cecidodaphne*, and *Adina cordifolia*. This shift in pattern was due to lesser availability of these preferred species and the need for quality hardwood species in terms of durability. This high demand for economically important hardwoods and its declining availability resulted in their replacement by lesser known species.

Several of the hardwood species of *Terminalias*, *Phoebe* spp, *Michelia chmpaca*, *Tetrameles nudiflora*, *Mansonia dipikae*, *Morus laevigata*, widely used in 1970s, are less available today indicating a change in the composition of the species in the timber resource pool of the natural forests (Table 1). Ever since, there has been an increased awareness to augment the timber resources, plantation drive was initiated in the state. The delay in taking up plantations of timber species has further put pressure on the natural forests of the state. The requirements for domestic use as well as for commercial purposes were on the increasing trend and it further prompted people to take up plantations of commercially important timber species such as Teak and *Gmelina*. Though the climate in Nagaland is ideally suited for cultivation of many timber species, Teak, a non-native species has occupied considerable space and attention owing to its commercial significance and relatively fast growing nature. There have been plantations of *Terminalia myriocarpa* and *Duabanga sonneratioides* (mainly for cultivating the betel vine) in some parts of the state. Plantations of *Pinus kesiya* was taken up in the districts of Zunhebhto, Kiphire and Phek and these areas have naturally occurring *Pinus kesiya* along with *Quercus* spp.

Table 1. Change in the composition of top five tree species on the basis of estimated number of stems during 1985 and 2010

1985	2010
<i>Schima wallichii</i>	<i>Schima wallichii</i>
<i>Quercus</i> Spp	<i>Gmelina arborea</i>
<i>Alnus nepalensis</i>	<i>Tectona grandis</i>
<i>Callicarpa arborea</i>	<i>Albizia procera</i>
<i>Castanopsis indica</i>	<i>Pinus kesiya</i>

(Source: Forest Survey of India, 1988)

From Table 1, it can be observed that the composition of species in the natural forests around 1985 was predominantly of *Schima wallichii* and *Quercus* spp, This composition has changed due to the impact of *jhuming* and unsustainable harvesting of the preferred species for both domestic and commercial use. *Quercus* spp. which is an associate of *Pinus kesiya* in many

areas, is on the decline. Native hardwood species such as *Callicarpa arborea* and *Castanopsis indica* had previously dominated the composition of species. However by 2010; these two species did not figure in the composition of the top five and have been replaced by Teak, *Albizia procera* and *Pinus kesiya*. The occurrence of Teak is mainly due to the large scale plantations established in many parts of the state. Plantations of *Pinus kesiya* as well as its regeneration resulted in *Pinus* becoming established as one of the major species. This clearly indicates the shift in the population of species between 1985 and 2010. Factors such as unsustainable removal of preferred species for commercial purposes as well as *jhuming* practices are the main reasons. This has resulted in a rise in prices of all the timber species and especially the preferred species. These changes in the pattern of composition of species in forests have been occurring throughout the state and more so in areas where the forests are accessible and removal and transportation is made easier.

Table 2 List of top five tree species on the basis of estimated volume (in '000 cu. m.) during 1985 and 2010

1985	2010
<i>Schima wallichii</i>	<i>Schima wallichii</i>
<i>Quercus</i> Spp	<i>Castanopsis indica</i>
<i>Castanopsis indica</i>	<i>Gmelina arborea</i>
<i>Stereospermum personatum</i>	<i>Stereospermum personatum</i>
<i>Duabanga grandiflora</i>	<i>Albizia procera</i>

(Source: Forest Survey of India draft report 2010)

Table 2 shows that the population of the top five species based on the total standing volume indicates that *Quercus* spp which had second largest volume in 1985 did not occur in the top five by 2010 indicating probable excess removal of the species. Similar observations are made in the case of *Duabanga grandiflora*. Unsustained removal of a particular species which has high standing volume has probably resulted in rise in prices due to scarce availability of the species. Similarly, from Table 1 and 2 can be seen the appearance of some of the plantation species such as *Tectona grandis*, *Gmelina arborea* and *Albizia procera*, indicating the shift in the preference of the tree species. Some of the traditionally important species such as *Dipterocarpus*, *Terminalia* and *Duabanga* are found to be replaced by alternate species.

Dependence of land owners on timber resources as a source of economic gain has also influenced the price changes. Land ownership is predominantly private or community owned and the timber resources are treated as an economic entity. In the initial period the population was at low levels and the major portion of timber utilisation was for construction purposes, carving and other local uses. The pricing was also low. The mode of sale was mostly at the site either as a standing tree or felled. Important hardwood species such as *Terminalias*, *Duabanga*, *Phoebe*, *Michelia* etc were abundant. The availability of species used for peeling of veneers such as *Dipterocarpus macrocarpus* and *Shorea assamica* were plenty in districts of Mon, This indicates that the demand within the state was amply met by these resources and there was no gap between the demand and the supply. Currently, the hardwoods fetch as much as Rs.700 per cubic foot and Teak fetches Rs.1200 per cubic foot compared to price of standing trees for as low as Rs.20 per tree.

With the passage of time, the demand for the hardwood species increased due to preference for durable construction timber. This demand was mainly from outside the state, however,

even within the state the demand has always been for solid wood. Many of the hardwood species were preferred for their durability and quality without much need for seasoning or treatment. These timbers found their way to the markets of metropolitan cities of New Delhi, Chennai, Kolkata and even far off places in North India. In addition to these superior qualities, the low prices resulted in high demand for timber. Different places in India preferred particular species either for their colour, decorative properties or for their durability in addition to the price factor. For instance, markets in Gujarat preferred *Amoora wallichii* and *Adina cordifolia*, Kolkata preferred *Gmelina arborea*, *Albizia* spp, and *Phoebe goalparensis*. In North India preference was for *Phoebe*, *Terminalia* and *Michelia*. Parts of the South demonstrated a preference for *Adina cordifolia* and *Duabanga*. Some states had banned the extraction of Pine resulting in demand for *Pinus kesiya* from the state. Several forest based industries were established depending on timber from the forests. Initially the demand was specific for few species and eventually with the removal of these species a change in the species composition as well as price increase is observed. This also led to lesser availability of preferred species and the scene shifted to utilisation of hitherto lesser known species.

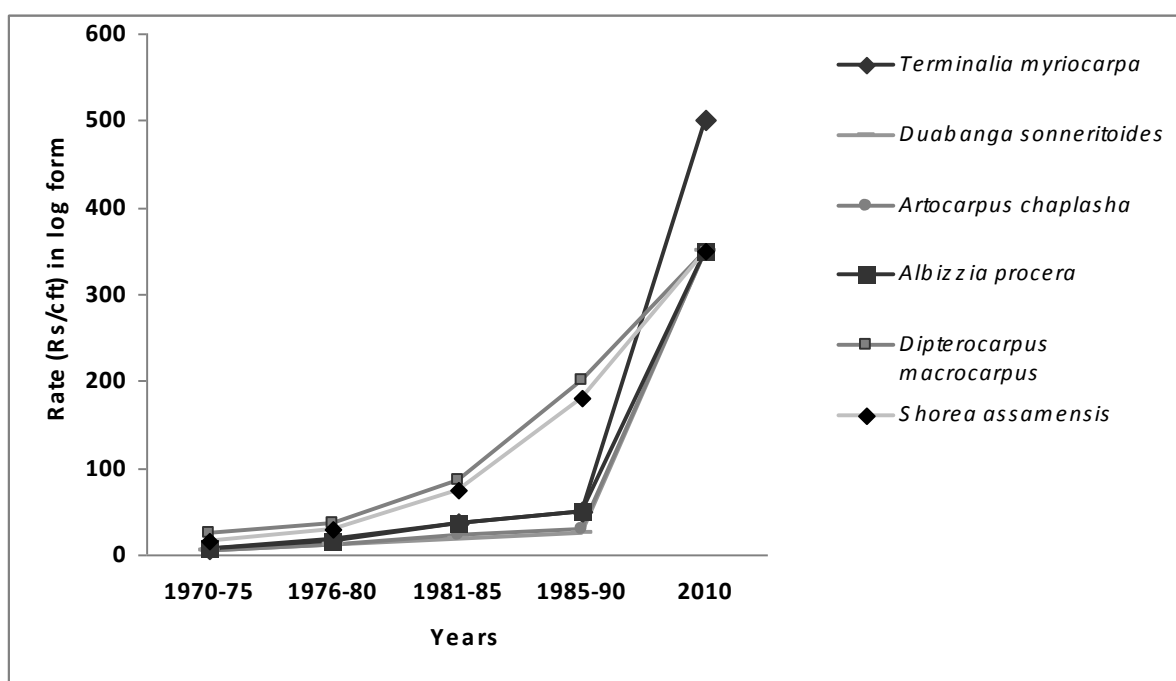


Figure1. Change in the prices of the timber yielding trees over the years

It is evident from Figure 1 that the price of some of the traditionally important species has increased over a period of time. In the case of *Dipterocarpus macrocarpus* which was as low as 25 rupees per cubic feet during 1990 has increased to Rs. 500 in a span of 20 years. This is partially due to the decline in the population evident from the species composition. Similarly, *Terminalia myriocarpa* has increased from Rs. 50 per cubic feet to Rs. 500. One of the main reasons for such a steep increase can also be attributed to the fact that the demand for such wood is far higher than the supply and at the same time its declining availability. The overall price factor almost remained flat between 1970-75 till 1985-1990, once the demand for timber started increasing and exported outside the state, prices showed steep increase. Although almost all the species showed an increase in price and some species such as

Dipterocarpus and *Shorea* showed a steep increase. Among the hardwoods, *Terminalia myriocarpa* is the most preferred wood and its price showed a steep increase.

***Jhuming* and its Impact on Trends in Timber Usage**

Jhuming or shifting cultivation is an accepted agricultural practice and is the mainstay of Nagas. It is being practiced in areas where the land is sloping and difficult for any other type of cultivation. The Socio – Cultural and economic activities are centred around this practice. With many festivals, cultural and social occasions coinciding with various stages of *jhuming*, the main economic dependency is on the land based activities of Agriculture and Forestry. Almost all the tribal groups in the districts follow this practice and in some districts they also practice terrace farming.

The practice of *jhuming* involves several steps. It starts with the selection of an area for *jhuming*, which could be a new area with forest or tree cover or an area which has already been subjected to *jhum*. This selected area is cleared of any tree growth or vegetation (sometimes they retain stumps of grown up trees to allow them to regenerate) and the area is burnt and prepared for sowing of crops. The village community or the individual owner decides that the area is to be *jhumed* in advance in that particular year. After *jhuming* this particular area, in the next year, another patch of land is selected for *jhuming* and this goes on for subsequent years and finally returns to the area taken up in the first year. The time taken for returning to the first plot is known as the *Jhum* cycle. This *Jhum* cycle was initially about 20 years and above and currently has come down to 4-5 years. As long as this period was 20 years and above it ensured sufficient tree re-growth and also maintained fertility status to some extent and reasonable crop yields are produced. But with the passage of time, and increase in population, the *jhum* cycle is reduced to 4-5 years resulting in low crop yields in the subsequent years due to loss of top fertile soil. Repeated *jhuming* has rendered many hills barren except few grasses colonising over a period of time.

Although it is difficult to make an exact assessment of the extent of area under *jhuming*, it is estimated to be around 900,000 ha in the state with an annual area of about 1, 31,000 ha (Anonymous, 2001). The area which is currently under *jhum* cultivation is known as current *jhum*.

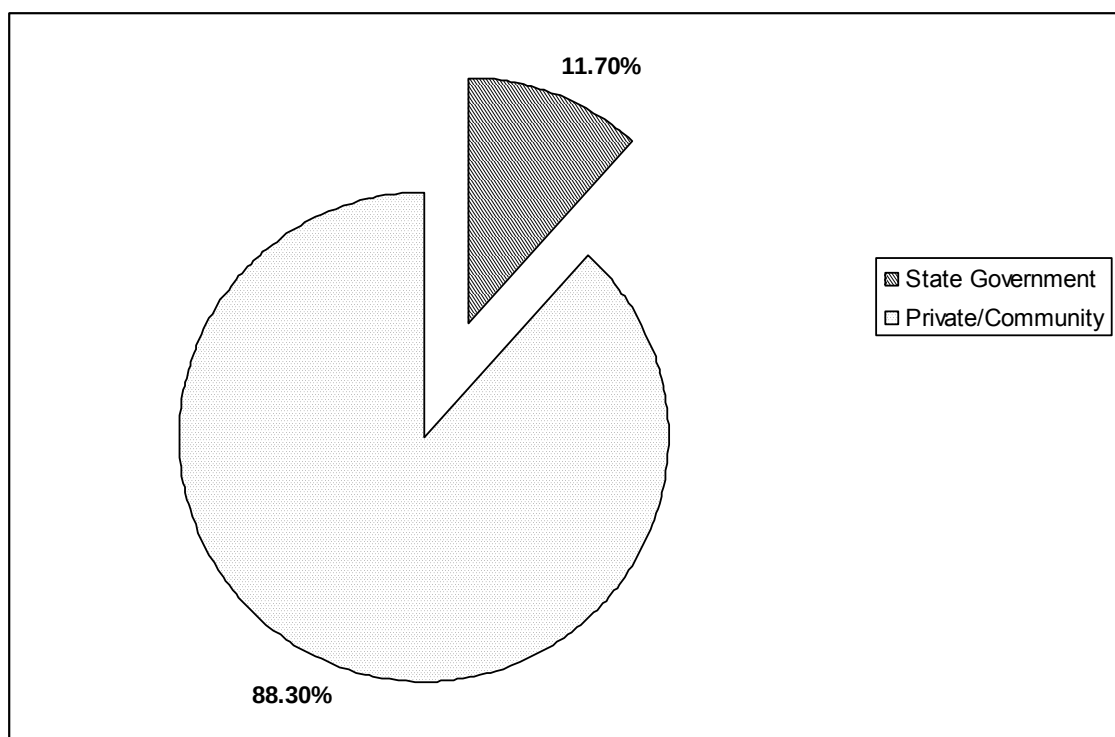


Figure 2. Forest ownership status (%) in Nagaland

With 88.3 percent of the forests are privately or community owned (Fig 2), the area selected for *jhuming* depends on the need and the decision of the community or the land owner as the case may be. *Jhuming* has been one of the important factors to affect the forest cover in the state. In the event that an area rich in timber resources is earmarked for *jhuming*, removal of forest produce including timber has a bearing on the forest cover. The impact of *jhuming* in forest areas has not only reduced the extent of forest and tree cover but also the quality as observed from the changes in the species composition. The decline in the availability of important species such as *Phoebe goalparensis*, *Terminalia myriocarpa*, *Morus laevis*, *Artocarpus chaplasha* and *Michelia champaca*, has eventually given way for lesser known species such as *Chukrasia tabularis*, *Amoora wallichii*, *Terminalia chebula* and *Duabanga sonneratioides*, among others.

There have been several efforts to mitigate the adverse effects of *jhuming* by devising several methods of practising agriculture in combination with tree farming and stabilising the *jhum* cultivation with due attention to the socio – cultural dimension of the community.

Impact of wood usage by industries and other sectors

In the earlier period logs were allowed to be transported outside the state to the industrial units located in Assam. Subsequently the state had few wood based industries in the form of saw mills which mainly catered to the requirement of domestic market. Many of the sawn timbers used were hand sawn at the site of felling mainly for own use. With the passage of time, after the 1980s several saw mills and veneer units were established in the state. These units utilised the timber from private and community forests and eventually started exporting sawn timber and veneers outside the state. During 1980s about 35 saw mills were functioning in Mon district alone, indicating a spurt in timber utilisation on commercial scale.

Apart from these Saw and veneer mills, other units dealing with molding beats, furniture units also started subsequently. Although furniture units catered to the local demand to some extent, the main demand was from outside the state. Furniture demand within the state was on the rise from 1985 onwards coinciding with the migration of people from villages to urban areas. Of the different species, *Artocarpus chaplasha* and *Gmelina arborea* (mainly for cots and chairs) were initially used for furniture. Subsequently *Cinnamomum cecidodaphne*, *Morus laevigata*, *Michelia* and *Tetrameles* were also used. At present *Melia* spp is also being used. Teak furniture attained popularity in the market only from 1990 onwards. These changes in the species usage indicate that the preferred species is on the decline and a wider range of species is being used for furniture.

Few plywood and veneer units started utilising the species such as *Dipterocarpus macrocarpus* and *Shorea assamica* for peeling and as the utilisation and demand exceeded the availability. Decline in population and scarce availability of these species resulted in usage of other alternative species such as *Mangifera indica*, *Schima wallichii*, *Ailanthus grandis*, *Artocarpus chaplasha*, *Canarium* spp, *Anthocephalus cadamba*. Furthermore, there was preference for red colour veneers, and *Bombax malabaricum* was used.

During the late 70s and early 80s the state supplied huge quantities of railway sleepers to the Department of Railways. Two categories of sleepers were supplied, one from *Mesua ferrea* which is one of the hardest timbers available and the other category consisting of general hardwoods from different species such as *Artocarpus*, *Albizzia*, and *Altingia excelsa* etc. This major supply put tremendous pressure on the timber resources in the state resulting in unsustainable harvesting of these species. Eventually their availability declined and the prices increased very steeply. This has also resulted in less availability of many hardwoods for construction and other purposes. The preferred available species were at a premium price and the users were forced to shift their preference to alternate species instead of the main ones.

The art of wood carving is closely associated with the culture of Nagas. Carving in different forms and in various places such as community halls, houses and other places in the villages is a common feature exhibiting their talent and penchant for carving. These carvings depicted various cultural and traditional practices. Konyaks from Mon district are well known for their artisan skills. Some of the carvings done in front of the community halls and the front doors are beautiful and are in high demand. To encourage these skills, crafts villages are established. One such village is Diezephie in Dimapur district. A working shed financed by the government is used by the skilled workers from the villages and they practice craftsmanship. Species such as *Gmelina arborea*, *Artocarpus* spp. *Wrightia tinctoria* and bamboo are used. Some of the artefacts prepared by them are, Naga Thali (traditional dish for taking food), kitchen items, tea tray, key holders and chain, cloth hangers, walking sticks, mementos, decorative items, wall hangars, flower vases and traditional Naga bangles. The craftsmen get orders from individuals, shop owners, and firms/organizations from within the state as well as from outside. The craftsmen are comfortable working with Teak and *Gmelina* as it is easy to carve different shapes with it and the wood of these species is abundantly available locally at lower rates.

At present teak as well as several hardwood species continues to be transported outside the state which includes species such as *Phoebe goalparensis*, *Michelia champaca*, *Terminalia myriocarpa*, *Chukrasia tabularis*, *Amoora wallichii* and *Pinus kesiya*. It clearly indicates that there is a growing demand for timber outside the state. To augment the resources especially timber and to supplement the livelihood of people, plantations of economically important

species on one hand and sustainable management of natural forest on the other hand should be given due attention. Plantations of Teak, *Gmelina arborea* and to a limited extent that of *Terminalia myriocarpa* and *Duabanga sonneratioides* and *Pinus kesiya* are being established. Selection of species for plantations is an important parameter as the selected species have to be fast growing and of short rotation periods so that *jhuming* can be integrated with plantation programmes. With the intervention of technology, these short rotation timbers can be efficiently utilised.

Scarcity of preferred timber species due to population decline, increasing demand both from the domestic sector as well as outside the state and *jhuming* practices have all resulted in increases in the price of timber in the state. There appears to be tremendous potential for composite wood industry and it can cater to the demand from outside the state as well as for domestic usage. The combined approach of augmenting the resources on one hand and efficient utilisation of timber through intervention of technology will enable sustainable management of forest resources in Nagaland.

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Changing trends in timber usage in Nagaland, India

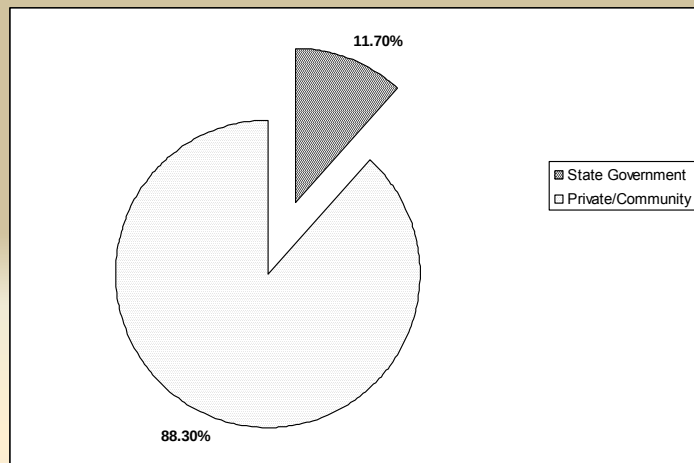
K. S. Shashidhar, A. N. Arunkumar & Sidramappa

Introduction

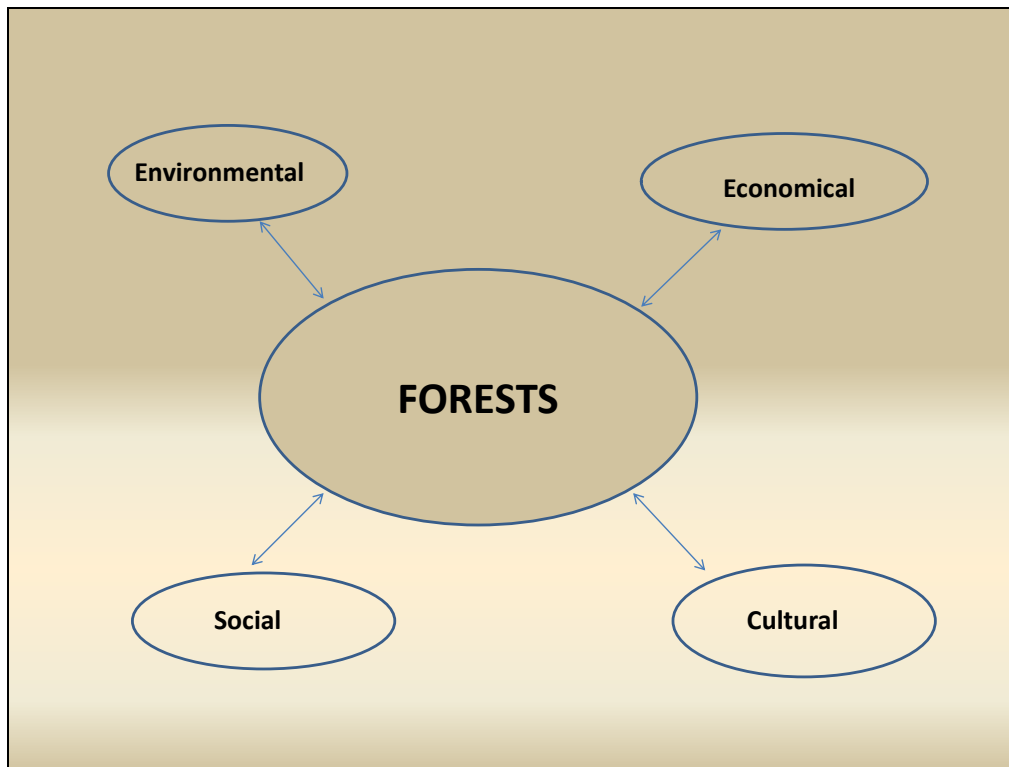
- ❖ Nagaland, a Bio diversity rich state located in North Eastern part of India
- ❖ It forms part of Indo-Burma (Eastern Himalayas) Biodiversity Hotspot with high level of endemism
- ❖ About 80 % of population lives in Villages and 70 % depends on agriculture animal husbandry and Forestry for livelihood
- ❖ Agriculture is mainly by shifting cultivation (*Jhuming*)
- ❖ 52.04 % of the geographical area is under forests
- ❖ **88.3 % of the Forests are owned by communities and individuals and the remaining 11.7 % is with Government**

Forests.....

- ❖ Forest types ranges from Tropical Wet evergreen forests , Sub tropical Pine forests to Montane wet temperate forests
- ❖ Economically important tree species include
 - Terminalia myriocarpa*
 - Phoebe goalparensis*
 - Dipterocarpus macrocarpus*
 - Shorea assamica*
 - Tetrameles nudiflora*
 - Morus laevigata*
 - Michelia champaca*
 - Pinus kesiya*
- ❖ Other important Non Timber Forest Products include host of aromatic and medicinal plants including Ginseng

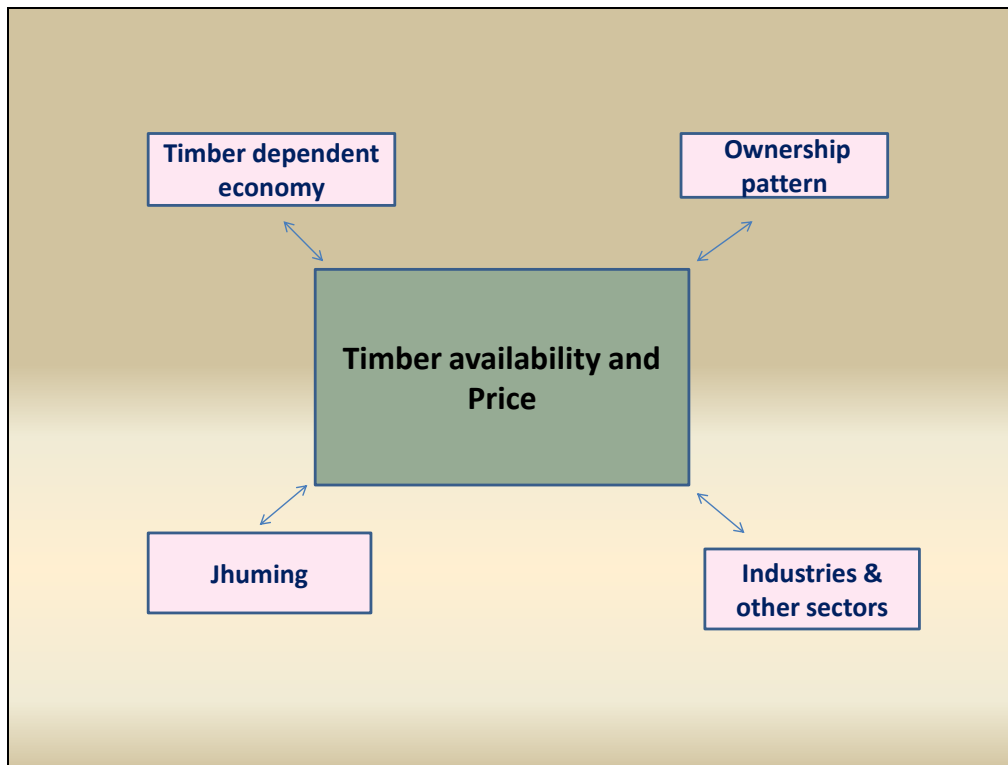


Forest ownership status (%) in Nagaland



Several factors influenced

- Availability of Timber
- Demand for preferred species
- Price variations



Timber dependent economy

Earlier (between 1950's and 1970's)

- Timber is mainly used for construction purposes, carving and handicrafts and mainly for bonafide use
- Little or no gap between demand and supply
- Timber species such as *Terminalia*, *Phoebe*, *Gmelina*, *Mesua*, *Morus* & *Mansonia* were available in plenty in the forests
- Preference for these species due to durability and availability
- Little commercial dimension

Later (1970's onwards)

- Commercial outlook and demand for durable hardwood increased
- Lesser availability of preferred species
- Shift to lesser known species such as *Amoora*, *Chukrassia*, *Albizzia*, *Cinnamomum* and *Adina* as these were still quality hardwoods

Change in the composition of five tree species on the basis of estimated number Of stems between 1985 and 2010

(Source: Forest Survey of India, 1988)

1985	2010
<i>Schima wallichii</i>	<i>Schima wallichii</i>
<i>Quercus spp</i>	<i>Gmelina arborea</i>
<i>Alnus nepalensis</i>	<i>Tectona grandis</i>
<i>CalliCARPA arborea</i>	<i>Albizzia procera</i>
<i>Castanopsis indica</i>	<i>Pinus kesiya</i>

- Composition changed due to jhuming and excess removal of preferred species
- Plantations of Teak, *Gmelina*, *Terminalia*, *Pinus* and *Duabanga*
- Demand for commercially important species also resulted in price changes

Top five timber species on the basis of estimated volume (in '000 cu.m) between 1985 and 2010

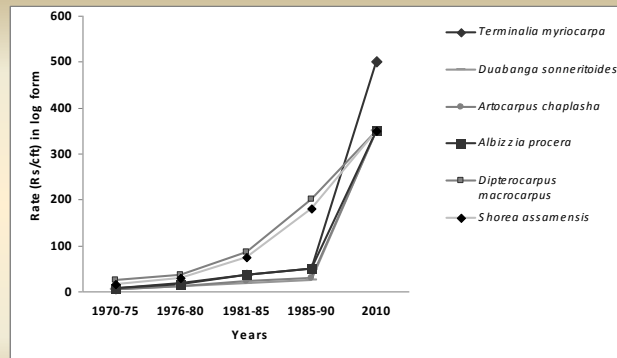
(Source: Forest Survey of India, 2010)

1985	2010
<i>Schima wallichii</i>	<i>Schima wallichii</i>
<i>Quercus spp</i>	<i>Castanopsis indica</i>
<i>Castanopsis indica</i>	<i>Gmelina arborea</i>
<i>Stereospermum personatum</i>	<i>Stereospermum personatum</i>
<i>Duabanga grandiflora</i>	<i>Albizzia procera</i>

- Unsustained removal of preferred species has resulted in lesser availability as well as increase in prices
- Traditional species such as *Duabanga*, *Terminalia* have been replaced by alternate species
- Increasing view of timber resources as an economic entity

Increase in price of timber is the result of

- Demand for durable construction timber increased and gap in supply position
- As the prices of timber were reasonable compared to other places
- This increased demand was mainly from outside the state from major cities
- Establishment of forest based industries inside the state as well as in the adjoining states



Change in prices of timber yielding trees over the years

Effect of Jhuming on Price structure

- Estimated area of about 900,000 ha subjected to jhuming
- Annually about 1,31,000 ha area is jhumed
- Due to ownership pattern jhuming area is decided by community/individuals
- Reduction in jhum cycle from 20 years to 4-5 years

Consequences....

- Reduction in forest cover in the state
- Quality of forests is also affected as observed by the change in the composition
- Decline in the availability of preferred species such as *Phoebe*, *Terminalia* and *Morus*
- Scenario giving way for lesser known species such as *Chukrassia* and *Amoora*,



An overall view of current *jhum* area



Another view of current *jhum* area surrounded by forests



Closer view of current *jhum* area

Impact of Industries and Other sectors on Price rise

- Initially not many wood based industries were operating in the state
 - By 1980's and onwards many saw mills and veneer units were established
- Dipterocarpus and Shorea were used for peeling veneers, later it was alternative species such as Mangifera, Ailanthus, Anthocephalus
- Large scale supply of Railway sleepers had put pressure on resources and influenced the price
 - Furniture industry by 1985 started picking up
 - Species such as Artocarpus and Gmelina were popular for furniture making and later shifted to Cinnamomum, Michelia were used.
 - 1990 onwards saw Teak in the market on a large scale
 - Wood carving is associated with culture of the people of the state
 - Carving in community halls, houses, front doors is very common
 - Species such as Gmelina and Artocarpus were widely used for carving



Pochury tribe



SANGTAM TRIBE



CHAKESANG TRIBE



ANGAMI TRIBE



Decorative carving in front door for a community hall in the village



Handicrafts made at Deziphe crafts village



Another set of Handicrafts at Craft's village



Different types of wooden utensils, fruit bowls made at Crafts village



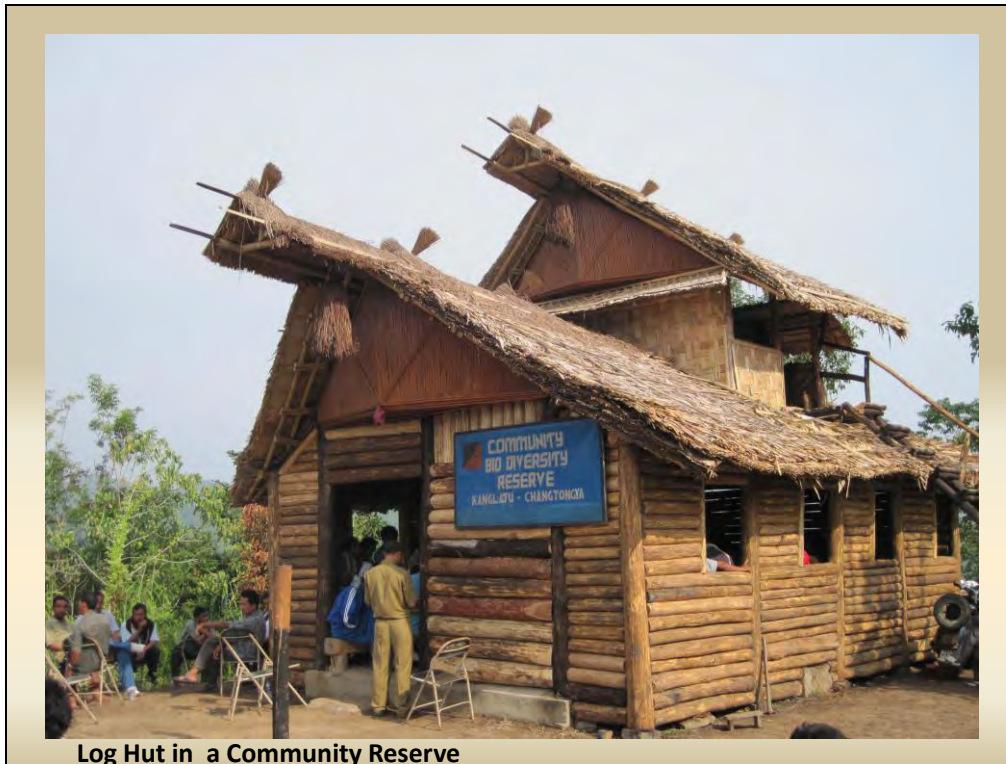
Bamboo and wooden handicrafts for sale



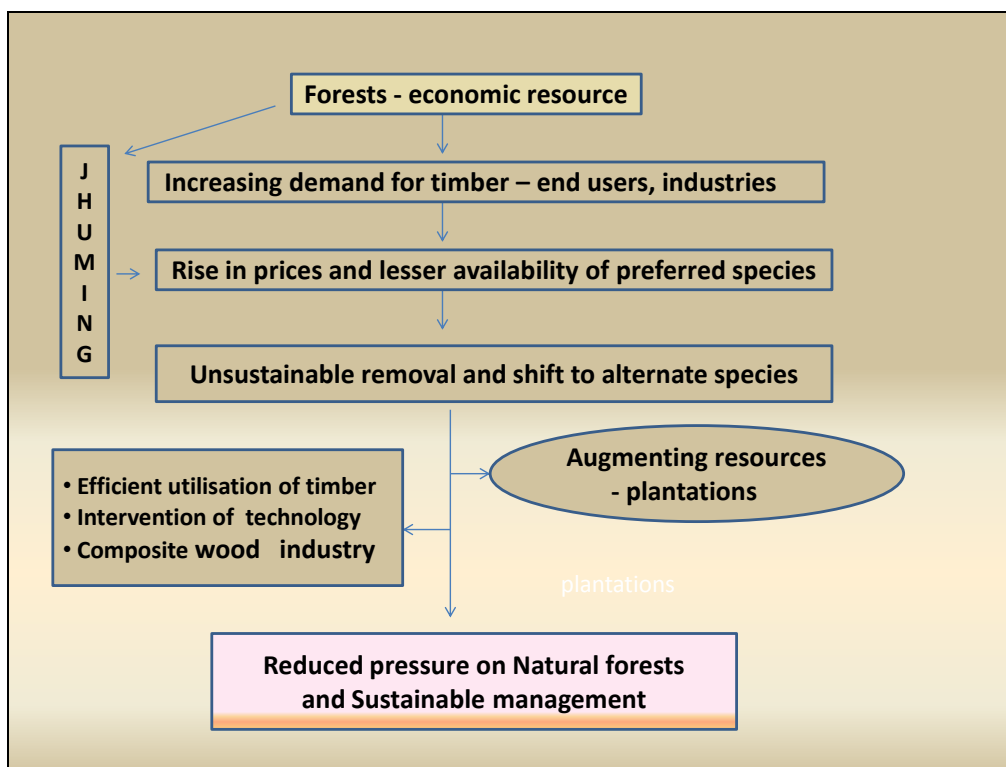
Huge *Phoebe* plank



A hut in a tourist village



Log Hut in a Community Reserve

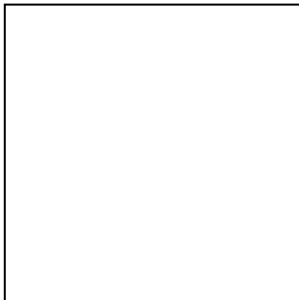


Session 15

[Friday 2nd period 1.5 hours - Hall A]

Focus on sandalwood and teak

Speakers

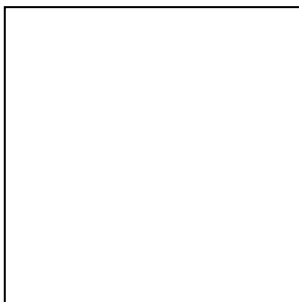


Speaker:

V S Venkatesha Gowda

Topic:

Global Emerging Trends on Sustainable Production of Natural Sandalwood in Ghana

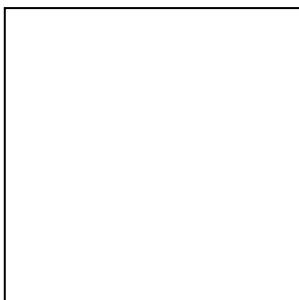


Speaker:

H S Ananthapadmanabha

Topic:

Sustainable Supply of Sandalwood for Industry



Speaker:

Ramesh Chandra Mishra

Topic:

Sandalwood: The Saviour of Ecological Balance and Super Wealth Creator



Speaker:

K Jayaraman

Topic:

TEAKNET – The International R&D Network on Teak

Global Emerging Trends on Sustainable Production of Natural Sandalwood

V S Venkatesha Gowda¹

Abstract

There are sixteen recognized species of sandalwood spread over in the world; broadly they can be grouped as East Indian sandalwood, Australian sandalwood, Hawaiian sandalwood and sandalwood of the Pacific Islands. Many of these are under the threat of extinction due to over exploitation. Some countries are taking steps towards commercial cultivation using modern techniques to save these species. East Indian sandalwood, Santalum album L., is the queen among sandalwood species, yielding superior quality essential oil very much required by perfumery and related industries. Over the past decades, India was producing the largest quantity of sandalwood oil, meeting over 80 percent of world demand. However, due to over exploitation and various other reasons, the quantity of production has declined drastically during recent years.

Many sandalwood based industries have sprung up recently in India as well as abroad due to a worldwide shift in customer preference towards natural products and a demand for legal, ethical sustainable supplies of Natural Sandalwood and essential oil. Sandalwood oil is used for perfumes, fragrances, flavours, cosmetics, panparag and gutka, among other applications. Many countries, such as Australia, Sri Lanka, Thailand, Cambodia, Costa Rica, etc., are involved in the commercial cultivation of East Indian sandalwood to meet global demand.

In the meanwhile, India remains competitive in its attempt to grow more sandalwood both in-situ & ex-situ by inter plantation methods to bring back its lost glory as a emerging economy in the world with vast human resources potential. It is hoped that this initiative will meet both domestic and international market demands. Furthermore, this will increase green cover, reduce global warming, economic empowerment of the grower, alleviate poverty, generate massive rural employment and conserve the ecology and bio-diversity of the country.

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1. INTRODUCTION

Sandalwood is the fragrant heartwood coming from the species of genus *Santalum*, of family Santalaceae. The most notable members of this group are *Santalum album* (Indian Sandalwood) & *Santalum spicatum* (Australian Sandalwood).

Sandalwood has been valued for centuries for its fragrance, wood working potential and various purported medicinal qualities. In India the genus is represented by *Santalum album* and the wood is commercially known as East Indian Sandalwood and the essential oil from it is East Indian Sandalwood oil. East Indian Sandalwood & Sandalwood Oil are amongst the oldest perfumery materials used.

Role of KS&DL on sustainable production of Sandalwood

KS&DL, a State owned Company in India with a nearly 100 year legacy in the production of natural sandalwood oil and sandalwood oil based products working towards promoting the sustainable development of sandalwood for meeting the needs of society, present and future. Accordingly, the company integrated the practice of Sandalwood Tree based farming by joint cultivation on a Share & Prosper basis for reaping the rich benefits, both individually and for the community, by making efforts in converting unproductive waste lands into productive lands. In this endeavor the company is trying to interconnect the needs of the nature, traditional culture of the brand of Mysore Sandal product and contemporary science.

Agro-technology of cultivation of Sandalwood

It is a mistaken belief that sandalwood grown in natural forest conditions alone produce scented heartwood and sandalwood grown in northern region does not. Sandalwood can be grown in a variety of soil with pH ranging from 7 to 8.5, with area temperature ranging from 5° to 50°C. It is not region specific and can adapt to different environmental conditions. The plantation-grown trees with irrigation and fertilization perform exceedingly well compared to natural forest conditions. In natural conditions sandalwood trees takes more than 7 years to produce scented heartwood and its growth is restricted due to climatic factors, soil, vegetation, fire, grazing and human interventions. Under these stress conditions, fully developed tree requires about 30 to 35 years for harvesting. Whereas the plantation grown trees produce heartwood formations in about 3 to 4 years and develop good heartwood ranging in diameter from 15 cm to 25 cm in about 12 to 15 years. Harvesting at this age is much more economical and commercially viable.

The sandalwood oil obtained at this age may range from 3.5 to 4 percent with good percentage of total santalol content. These results are based on the existing plantations of Indian Sandalwood in Australia. Timely Irrigation, fertilization, soil working, pruning or training and inducing stress, providing good host plants are the important criteria for the healthy growth of sandalwood. The sandalwood tree is a partial root parasite, requiring another host tree by its side, through which it draws nutrient for its good growth.

Cultivation Practices

Seeds are available in two seasons, April to May and September to October; both the seeds perform alike with respect to germination. Some seed producing areas have been identified for collection. Fresh fruits collected are depulped and dried seeds are kept for two months due to dormancy before sowing. If the seeds are soaked in 0.05% gibberellic acid for 16 hours prior to sowing, good and uniform germination could be achieved.

Well-developed healthy seedlings of 6 to 8 months old are ideal for planting in the field. Different configuration models can be adapted in the field depends on the sustenance of the grower. If one needs regular income returns from the plantation, interplanting with fruit crops of small canopy can be made. Some of the trees identified for intercrops are, grafted Amla or gooseberry (*Phyllanthus emblika* or *Emblika officinalis*), or grafted Tamarind (*Tamarindus indica*), or grafted Pomegranate (*Punica granatum*).

Planting sandalwood trees is much more economical and the expenditure required for planting and maintenance up to a period of 12 to 15 years for a hectare would be about Rs.10 lakhs, with impressive economic returns. On average about 500 trees can be planted on one hectare and the average yield per tree is about 15 to 20 kg of scented heartwood after 13 years.

Discounting 20 percent towards the causality of trees, the total production of scented heartwood would be approximately 6.75 Metric tonnes. Lucrative returns can be calculated from sandalwood, apart from other benefits from host and other intermediate plants.

Cultivation of Sandalwood - Economic feasibility in Indian Context

I. No.	Particulars	Per Hectare (2.5 Acre)	Quantity / Price
01	Requirement of Sandal Seedlings / Hosts		
	No of Sandal plants required per hectare		500 Nos.
	No of pot hosts required per hectare		500 Nos.
	No of Intermediate hosts plant required		500 Nos
	No of long term hosts plant required		500 Nos
02	Cost of Sandalwood Seedlings / Hosts		
	Cost of production of sandalwood seedling	Rs.12 x 500	Rs. 6,000-00
	Cost of production of seedling primary host	Rs.2 x 500	Rs. 1,000-00
	Cost of production of Intermediate host	Rs.10 x 500	Rs. 5,000-00
	Cost of production of long term host	Rs.10 x 500	Rs. 5,000-00
	Cost of planting, transportation, soil work, pit formation, watering etc.,	Rs.10 x 500	Rs. 5,000-00
	Cost for pit formation, soil work, watering etc.,		Rs. 20,000-00
	Cost of Drip Irrigation		Rs.1,00,000-00
03	Recurring Expenditure till Harvesting		
	Security &Vigilance for 15 years	Rs.36,000/- pa	Rs.5,40,000-00

	Annual Weeding & Soil working for 8 years	Rs. 2,000/- pa	Rs. 16,000-00
	Irrigation for 8 years	Rs. 2,000/-pa	Rs. 16,000-00
	Fertilizer/Manure for 8 years	Rs. 5,000/-pa	Rs. 40,000-00
	Miscs., expenses (Management of Pests & Diseases, Supervision etc.) for 15 years	Rs.25,000/-pa	Rs.3,75,000-00
	Expenditure on Land & other Infrastructure		Rs.10,00,000-00
	Total approximate expenditure (After reckoning the Investment, Inflation @ 5% & Interest @ 12% on Investment)		Rs.48,00,000-00
04	Expected Heartwood yield at the age of 15 yr. after taking 10% as mortalities, thefts etc., at the prevailing rates of Sandalwood of various class in Karnataka	Per Hectare	
	No. of Sandalwood Trees eligible for extraction	450 Nos.	
	Approx. quantity of Heartwood expected per tree	20 kgs. x 450	9000 Kgs.
	Approx. quantity of Sapwood expected per tree	30 kgs x 450	13500 Kgs.
	Average Price of Sandalwood Heartwood class	Rs.3,500 per kg x 9000 Kgs	Rs.3,15,00,000-00
	Cost of Sapwood	Rs.65 per kg x 13500 Kgs	Rs.8,77,500-00
	Estimated profit from Inter crops for 10 years	Rs.12,000/- pa x 10 years	Rs,1,20,000-00
	TOTAL		Rs,3,24,97,500-00
05	NET ESTIMATED PROFIT AFTER RECONING EXPENDITURE OF Rs.48,00,000/-	Per Hectare	Rs.2,76,97,500-00

Distillation and Extraction

Karnataka Soaps and Detergents Ltd are the pioneers in distilling quality sandalwood oil. Distillers follow different methods for obtaining oil from wood. However, steam distillation is a simple and efficient method and the oil extracted from steam distillation is widely accepted in the perfume & medicinal industries. The crude oil floating on the surface of distillate is skimmed off and filtered. Moisture present in the oil is removed by vacuum process. On average, good quality sandalwood yields about 5 to 6 percent of oil upon distillation.

Quality of Sandalwood oil

The quality of Sandalwood oil is assessed on the basis of the total Santalol content by GLC method along with the other physico chemical characteristic viz., optical rotation, refractive index, specific gravity etc., detailed evaluation report of different Sandalwood oil including GCMS are enumerated as per the Annexures for information of the participants the physico

chemical analysis of Indian Sandalwood oil, vis-à-vis other different origin Sandalwood oils is enumerated as follows:-

Sl No	Characteristics	Results			Specifications		
		Sri Lankan	Austro Caledonicum	Australian Spicatum	East African	Australian Spicatum	Indian
1	Specific gravity (270C)	0.9709	0.9730	0.90643	0.9613	0.9400 to 0.9720	0.9635 to 0.9775
2	Refractive Index (200C)	1.5024	1.5052	1.5052	1.5079	1.5003 to 1.5095	1.5000 to 1.5070 (270C)
3	Optical rotation	-160	-40	-40	-450	-10 to -40	-150 to -200
4	Esters	6.66	5.87	2.72	7.61	Max. 5.0%	Max. 7.0%
5	Total alcohols	90.89	87.44	85.08	80.44	Min. 70%	Min. 90%
6	Santalols by GLC	89.39	85.10	69.90	25.48	Min. 53%	--
7	Solubility	Soluble	Soluble	Soluble	Soluble in 4 vols 70% alcohol	Soluble in 5 vols 70% alcohol	Soluble in 5 vols 70% alcohol
8	Colour	Pale yellow viscous liquid.	Yellowish red viscous oily liquid.	Golden yellow oily liquid	Yellow coloured viscous liquid.	Golden yellow oily liquid	Nearly colourless to golden yellow some what viscous oily liquid.
9	Odour		Not comparable to Indian sandalwood oil.	Sandalwood odour with terpinic some what green floral top note.	Very faint, pleasant woody somewhat sweet odour.	Sandalwood odour with terpinic some what green floral top note	Pleasant, sweet, woody & persistent.

The detailed GCMS analysis also enumerated is as follows:-

Sl No	Constituents	Santalum Album-India	Santalum Album-Indonesia	Santalum Spicatum-West Australian	Santalum Yasi - Fiji	Santalum Osyris-East African
1	Furfural	-	-	-	0.01	-
2	Santene	-	0.87	-	0.02	-
	Alpha-Santalene	0.68	1.37	0.88	0.85	0.50
3	Trans-Alpha-Bergamotene	0.12	0.25	0.35	0.35	0.65
4	Epi-Beta Santalene –	0.88	1.80	0.63	0.62	0.80
5	Beta – Santalene	1.33	2.78	1.03	1.32	1.36
6	Gamma-Curcumene	0.01	-	0.50	-	-

7	AR-Curcumeme	0.18	-	1.12	0.18	0.31
8	Beta-Farnesene	-	-	-	-	0.88
9	Beta-Bisabolene	-	-	-	0.01	1.42
10	Trans-Nerolidol	0.02	0.03	6.08	0.30	-
11	CIS-Alpha-Santalol	55.15	47.30	13.85	47.39	17.08
12	Trans-Alpha - Bergamotol	5.11	6.27	2.33	5.18	8.51
13	Epi-Beta-Santalol	4.49	3.22	1.17	3.96	1.76
14	CIS-Beta-Santalol	18.89	18.78	7.48	23.20	10.41
15	CIS-Nuciferol	1.93	4.14	11.21	4.18	-
16	Trans-Nuciferol	0.48	0.69	3.49	0.92	2.13
17	CIS-Lanceol	1.80	1.80	3.13	1.44	41.22

Indian Sandalwood oil has 90% Santalol content, in respect of Australian Sandalwood oil, which is in the range of 38-39% only. The age of the tree also plays a vital role along with other agro-climatic conditions in the Santalol content in sandalwood oil. Indian Sandalwood oil contains 50 to 60% of alpha santalol & remaining 15 to 25% beta santalol, which plays a vital role in high class perfumes as a base, fixative, modifier and enduring fragrance ingredient.

Colour of heartwood and oil content

The superiority of wood is generally judged based on colour, weight and from the parts of the tree from which it is taken.

2. THE CLASSIFICATION OF INDIAN SANDALWOOD IN THE TRADE:

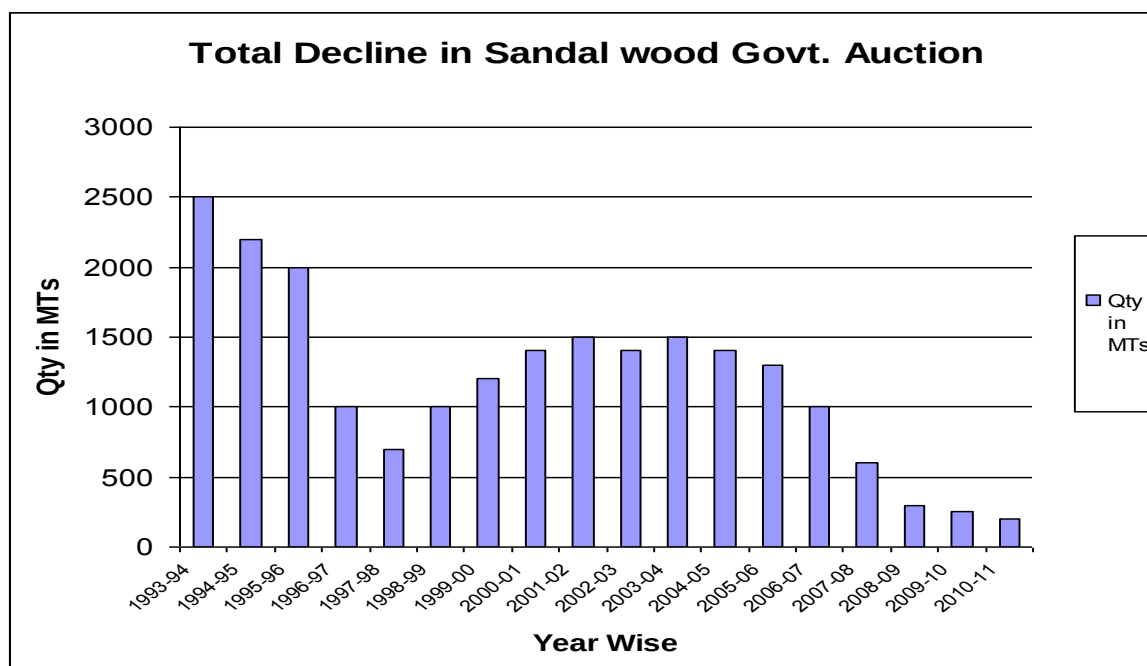
The classification is enumerated in to 18 classes as follows.

1. First class billet. (Vilayat budh)
2. Second class billet (China budh)
3. Third class billet (Panjam)
4. Ghotla (billets of short length)
5. Ghat badla
6. Begardad
7. Roots (First class)
8. Roots(Secondclass)
9. Roots (Third class)
10. Jajpokal (First class)
11. Jajpokal (Second class)
12. Ain bagar
13. Cheria
14. Ain chilta
15. Hatrichilta
16. Milva chilta
17. Basola bukni
18. Saw dust powder

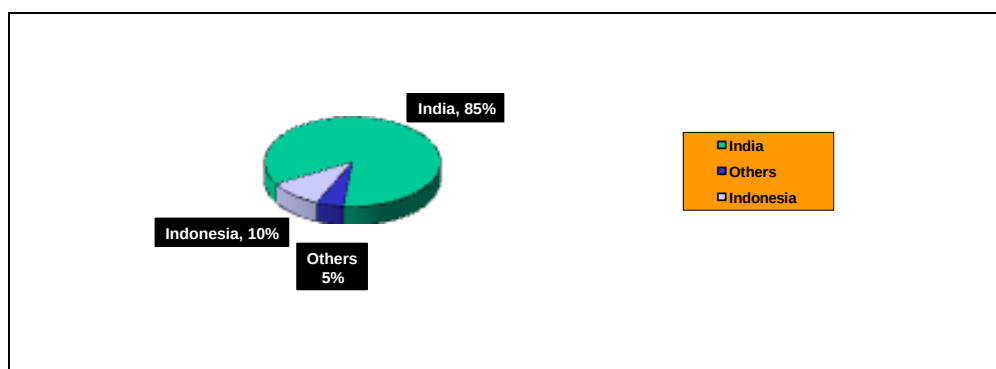
Present scenario Sandalwood production in India;

Due to rampant smuggling, illegal trade of sandalwood and the declining the area of cultivation, the production of sandalwood may reach to 300 - 400 MTs/annum.

The fall in decline of Sandalwood sale in auctions conducted by different state Governments in India.



The Global production Details of Santaum Album & Oil Production



With the Indian Sandalwood supply being limited and expensive, industries dependent on sandalwood are on the look of alternates, such as Western Australian Sandalwood oil, Fiji and New Caledonia Sandalwood and oil, South African Sandalwood oil etc.

Legal aspect of sandalwood

Sandalwood plants are widely distributed in the southern states like, Karnataka, Tamil Nadu, Andhra Pradesh and Kerala, hence sandalwood is defined as a “forest produce”, although the “Indian Forest Act” does not have any special provisions for sandalwood.

Meanwhile, the Indian government categorised Chandana as one of 32 recognised medicinal plant. However, the government of India and the concerned departments have to decide whether these medicinal plants come under the Forest Act & Rules, as medicinal & aromatic plants do not. The legal hassles created by sandalwood trade regulation result from the fact that there is no comprehensive regulation applicable to the entire country. Hence, clandestine trade is flourishing and the sandalwood population declining, verging on extinction and sandalwood is now classified as one of the endangered plant species in India.

Realizing the sharp decline in the sandalwood population in their states and having accepted that they cannot be the custodians of sandalwood any more, the Karnataka and Tamil Nadu Forest Departments amended the Sandalwood Act in 2001 and 2002 respectively and made the grower himself a owner of the sandalwood as per the Amended Act. Further, Govt. of Karnataka already made amendments on the sale of Sandalwood through Forest Dept. & Govt. Departments to eliminate the clandestine trade and to encourage farmers to take cultivation of Sandalwood on commercial scale during the recent years.

Uses of Sandalwood Oil

Some of the major industries depending on sandalwood oil:

- Attar industry
- Perfumery
- Soaps and toiletries
- Chewing scented tobacco
- Pan Masala
- Pharmaceutical applications

The production of Attars has occurred in India for centuries, it is a blend of sandalwood oil and flower oil, such as rose petal, jasmine, kewda etc. The quality of attar depends on the concentration of flower effervescence with in sandalwood oil. Numerous types of attar products are made in India and it forms an important constituent for the manufacture of incense sticks and Scented tobacco, Pan Masala, Zarada, Gutka etc.

The word Sandal is derived from Chandana (Sanskrit). The Wood & Oil has been used as one of the main materials in Indian medicine for centuries. It is said that sandalwood finds its use in human life, particularly Indian culture and civilizations from “Cradle to Cremation”.

3. PHARMACEUTICAL USE

Sandalwood oil was used traditionally to treat skin disease, acne, dysentery, gonorrhea & number of other ailments. In traditional Chinese medicine, sandalwood oil is considered as an excellent sedating agent.

The characteristic strong, woody, pleasant odour & medicinal properties are mainly due to α & β – Santalols. Indian Sandalwood oil contains the highest amounts of α & β - Santalol compared to any other sandalwood oil produced in the world. The α -Santalol posses anti bacterial properties & β -Santalol possesses sedative properties, whereas synthetic sandalwood boosters do not contain these active ingredients.

Today sandalwood essential oil is considered in aromatherapy to be effective in treating dry skin, general skin irritation & acne besides acting as a mood enhancer. It is effective in the treatment of bronchitis, dry persistent coughs, laryngitis as well as sore throats. It may also help in to relive diarrhea, nausea & some cases of cystitis, fever, dermatitis, arthritis, hyperacidity, insomnia, stress, anxiety etc.; the paste of wood or infusion is a good dressing for eruptive skin disease.

Furthermore, it is used as a tonic for hyper active mind and is considered to be an anti-depressant, as it can help to relive heat, agitated emotional states and relief people from stress & worry. It can also be used as a sedative, astringent, disinfectant to genitourinary tract, diuretic & stimulant. It is also a diaphoretic & aphrodisiac.

4. PERFUMERY USAGE

Sandalwood Oil is a natural fixative for all the top class perfumes. As regards the perfume, Cosmetics & Soap Industries, East Indian Sandalwood Oil is one of the most important natural fixative ingredients. No composition of the heavy or oriental class of perfume is complete without an ample dose of this oil. Its sweet, powerful & long lasting odour makes it an excellent natural fixative in the scenting of soaps and it blends very well with all kinds of perfume composition.

It is pertinent to note that, Indian Sandalwood Oil usage has declined substantially by the European perfumery houses in view of the non-availability of sustainable and ethical supplies of quality sandalwood oil. Hence, it would be prudent to review the commercial cultivation of sandalwood on a large scale in view of the huge demand in the domestic as well as global market. This would conserve the sandalwood species and to restore our heritage, since the sandalwood tree is on the verge of extinction and classified as one of the endangered plant species.

Future of Sandalwood in the World:

The production of sandalwood was picking up the momentum by the year 2011 onwards, since the major plantation company in Australia, M/s TFS Ltd., had planted about 5000 hectares of the Indian Sandalwood by scientific methods. They expect harvesting by the year 2011 in first installment. Furthermore, they are also planning about 2000 hectares in the Kemberly region of Western Australia. There is a high demand for Indian Sandalwood because of its unique fragrance quality, its use in medicines, cosmetics, beauty aids & paradigmatic shift of the consumers towards the natural products.

Additionally, since 2003, Karnataka farmers have also been showing active interest in cultivating sandalwood on a commercial scale in view of the liberalization of the sandalwood trade and amendment of the Forest Act & Rule and granting of ownership to the private patta land owners.

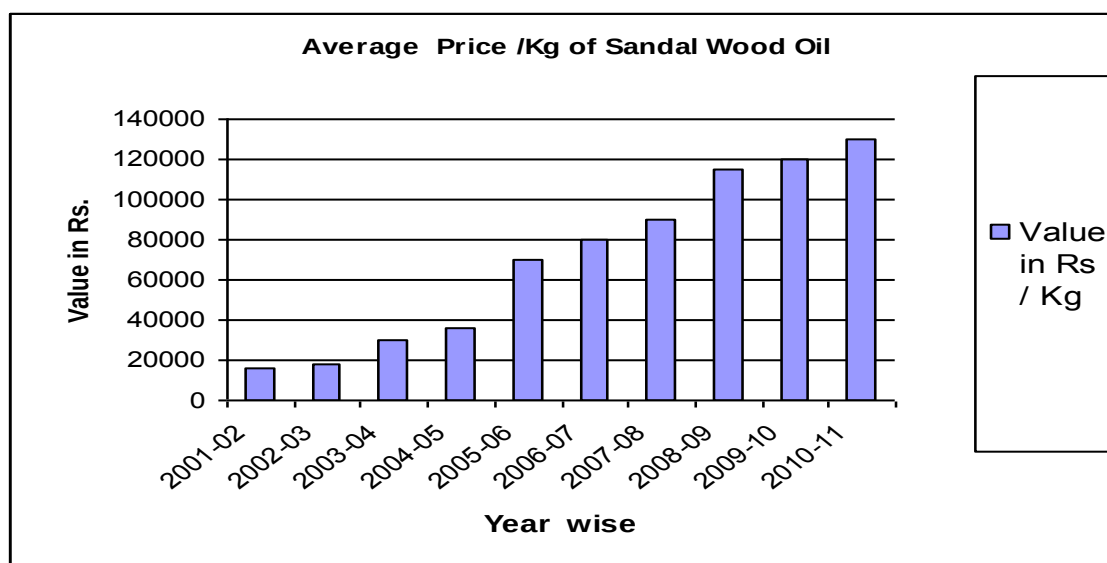
In India, the National Medicinal Plant Board & National Horticultural Mission are assisting sandalwood cultivation and inter-planting with other medicinal plants through their State Agencies. There has been a healthy response from the private land owners for commercial

cultivation and the harvesting of commercially planted sandalwood in India is expected by the year 2015 onwards, particularly in Karnataka. Furthermore, many farmers and entrepreneurs are setting up plantations of Indian Sandalwood in the states of Gujarat, A.P., M.P, Maharastra, Rajasthan & Assam on a large commercial scale of some 5000 hectares.

Assistance from the commercial banks & other financial institutions for the farmers & entrepreneurs in India is yet to pick up the momentum. Hence there is urgent need of intervention of the Indian government, particularly from the NABARD and even for Foreign Direct Investment (FDI). However, countries like Australia are encouraging companies who are entering into the plantation crops by extending huge rebates from income tax in the context of investment made towards the maintenance of eco balance. Moreover, several countries such as China, Australia, Thailand, Costarica, Cambodia are Srilanka are also venturing into Santalam Album plantation because of its fragrance characteristics and economic feasibility coupled with the huge demand for natural products worldwide

Price trend

The price of Indian Sandalwood of good heartwood class at present is over Rs.6500 per kilogram and that of oil is over Rs.1,23,000 per kg, from the legal & ethical sources. The price at the international market is about 15 to 20 % higher than the domestic market. Though there is ban on the export of bigger logs of wood from India, these nevertheless reach the world market. The annual increase of price is going at a premium of more than 30 percent.



The exhausted powder is used in incense stick to Dhoop manufacture and resin is also extracted from it for which is being used as fixative in woody kind of fragrances.

International Conference on the Art and
Joy of Wood

19-22 October 2011

Presentation on
GLOBAL EMERGING TRENDS ON
SUSTAINABLE PRODUCTION OF
NATURAL SANDALWOOD

From the House of *Mysore Sandal*
(KS&DL)

WELCOME

TO

PRESENTATION ON GLOBAL EMERGING TRENDS ON SUSTAINABLE PRODUCTION OF
NATURAL SANDALWOOD - 21.10.2011

By

V.S. Venkatesh Gowda,
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vsagowda@yahoo.co.in

KARNATAKA SOAPS & DETERGENTS LIMITED, BANGALORE-INDIA

INTRODUCTION:

- Sandalwood is the fragrant heartwood of some of the species of genus *Santalum* of family *Santalaceae*.
- The most notable members of this group are *Santalum album*, Indian Sandalwood & *Santalum spicatum*, (Australian Sandalwood).
- Sandalwood has been valued for centuries for its fragrance, wood working and various purported medicinal qualities

Role of KS&DL on sustainable production of Sandalwood

- KS&DL a State owned Company in India having the legacy of over 95 years in the production of natural Sandalwood oil and Sandalwood oil based products.
- KS&DL working for accelerating sustainable development of Sandalwood requirements aims at meeting the needs of society present and future.

Agro-technology of cultivation of Sandalwood

- Sandalwood tree is partial root parasite, requires another host tree by its side, through which it draws nutrient for its good growth.
- Sandalwood can be grown in variety of soil with pH ranging from 7 to 8.5, with area temperature ranging from 5° to 50°C. It is not region specific and can adapt to different environmental conditions.

- In natural conditions Sandalwood tree takes more than 7 years to produce scented heartwood and its growth is restricted due to climatic factors, soil, vegetation, fire, grazing and human interventions.

- Under these stress conditions fully developed tree requires about 30 to 35 years for harvesting.
- Where as the plantation grown trees produce heartwood formation in about 3 to 4 years and develop good heartwood in about 12 to 15 years.
- Harvesting at this age is much more economical and commercially viable.

Cultivation Practices

- Seeds are available in two seasons, April May and September to October; both the seeds perform alike with respect to germination.
- Well-developed healthy seedling of 6 to 8 months old is ideal for planting in the field

- Some of the plants identified for intercrops are, grafted Amla or gooseberry (*Phyllanthus emblika* or *Emblika officinalis*), or grafted Tamarind (*Tamarindus indica*), or grafted Pomegranate (*Punica granatum*).

Quality of Sandalwood oil:

- The quality of Sandalwood oil is assessed on the basis of the total Santalol content by GLC method along with the other physico chemical characteristic viz., optical rotation, refractive index, specific gravity etc.,

- The Indian Sandal wood oil has 90% Santalol content, in respect of Australian Sandalwood oil is in the range of 38-39% only.
- The age of the tree also play vital role along with other Agro climatic condition.

Colour of heartwood and oil content ;

- The superiority of wood is generally judged based on colour, weight and from the portions of the tree from which it is taken.

THE CLASSIFICATION OF INDIAN SANDALWOOD IN THE TRADE:

The classification is enumerated in to 18 classes;

1. First class billet. (Vilayat budh)
2. Second class billet (China budh)
3. Third class billet (Panjam)
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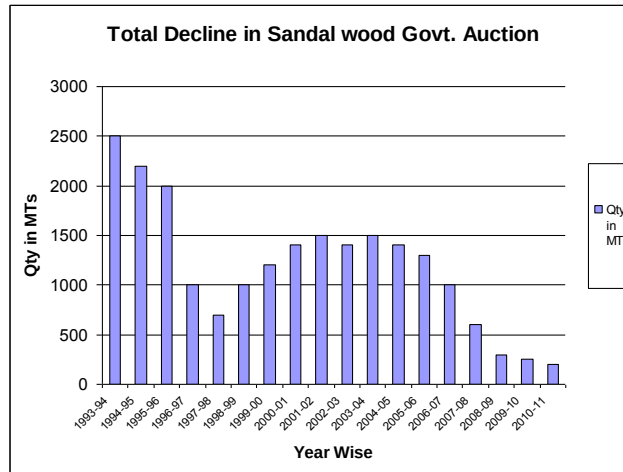
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Present scenario of Sandalwood production in India;

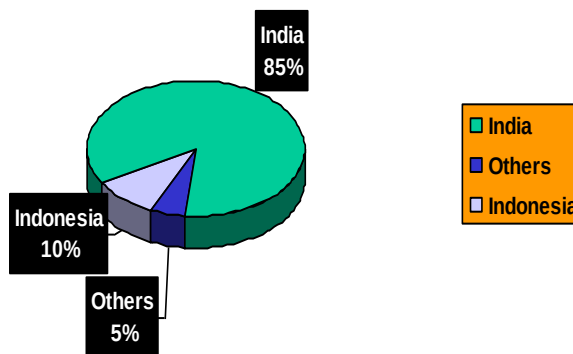
- Due to rampant smuggling on illegal trade of Sandalwood and declining the area of cultivation of Sandalwood the production of Sandalwood may reach to 300 - 400 MTs/annum.

- **There is a decline of Sandalwood sale in auctions conducted by different state Governments in India in the recent years.**

Decline of Sandalwood sale



The Global production Details of Santalum Album & Oil Production



- In view of the Indian sandalwood supply is being limited and expensive, industries dependent on Sandalwood are on the look of alternates, such as Western Australian sandalwood oil, Fiji and New Caledonia sandalwood and oil, South African sandalwood oil etc.

Legal aspect of sandalwood

- Sandalwood plants are widely distributed in the southern states like, Karnataka, Tamil Nadu, Andhra Pradesh and Kerala, hence, defined sandalwood as a “forest produce”, where as “Indian Forest Act” does not have any special provisions for sandalwood.

- The legal hassles faced by the Sandalwood trade regulation is that there is no comprehensive regulation applicable to the entire country.
- The clandestine trade is flourishing and Sandalwood population declining which is in the verge of extinction and Sandalwood is classified as one of the endangered plant specie in India.

- Karnataka and Tamil Nadu forest departments have amended the Sandalwood Act in 2001 and 2002 respectively and made grower himself as a owner of the Sandalwood as per the Amended Act.

- Govt. of Karnataka already made amendment on the sale of Sandalwood through Forest Dept. & Govt. Departments to eliminate the clandestine trade and to encourage farmers to take cultivation of Sandalwood on commercial scale during the recent years.

Uses of Sandalwood Oil:

- The word Sandal is derived from Chandana (Sanskrit). It is said Sandalwood finds its use in human life particularly Indian culture and civilizations from **Cradle to Cremation.**

- Some of the major industries depending on sandalwood oil:
 - Attar industry
 - Perfumery
 - Soaps and toiletries
 - Chewing scented tobacco
 - Pan Masala
 - Pharmaceutical applications

PHARMACEUTICAL USE OF SANDAL

- Sandalwood oil was used traditionally to treat skin disease, Aroma therapy, acne, stress, anxiety, bronchitis, dysentery, gonorrhea & number of other ailments.

PERFUMERY USAGE:

- Sandalwood Oil is a natural fixative for all the top class perfumes. As regards the perfume, Cosmetics & Soap Industries, East Indian Sandalwood Oil is one of the most important natural fixative ingredients because of its sweet, powerful & long lasting aroma.

Future of Sandalwood in the World:

- There is a good demand for Indian Sandalwood because of its unique fragrance quality, its use in medicines, cosmetics, beauty aids & paradigmatic shift of the consumers towards the natural products.

Sandalwood cultivation in Karnataka

- In addition to the above since 2003 Karnataka farmers are also showing active interest in cultivating the Sandalwood on commercial scale in view of the liberalization of the Sandalwood trade and amendment of the Forest Act & Rule and granting of ownership to the private patta land owners.

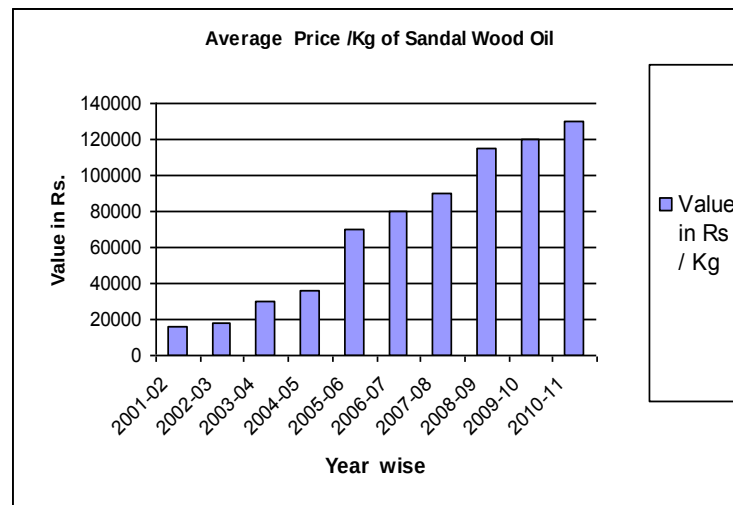
- Under 'Grow More Sandal' programme, KS&DL has entered into an Buy-back MoU with over 250 farmers/growers of the State & equal number of farmers have enquired for Commercial cultivation of Sandalwood on 'Share & Prosper' basis and it spreads over 5000 acres of land.

NMPB ASSISTANCE

- In India, National Medicinal Plant Board & National Horticultural Mission are assisting through their State Agencies for cultivation of Sandalwood along with the other medicinal plants as one of the haustorial plant with Sandalwood.

- Further, several countries in worldwide viz., China, Australia, Thailand, Costarica, Cambodia & Srilanka are also venturing into Santalum album plantation because of its fragrance characteristics and Economic feasibility coupled with huge demand for natural products worldwide

Price trend



Scope of Cultivation of Sandalwood

- The Scope for cultivation of Sandalwood is very much encouraging.
- There is a wide gap between demand & supply.
- Govt. of India encouraging by extending the subsidy through National Medicinal Plant Board and National Horticultural Mission for the growers of Sandalwood along with other houstarial plants.

- This would definitely generate Green cover, reduce Eco impact, conservation of nature, Santalum album specie from the verge of extinction.
- This would also facilitate the poverty alleviation, rural employment and economic empowerment of the growers

Saplings when 1 Month Old



Saplings when 2 Months Old



Saplings when 3 Months Old



Saplings when 4 Months Old



Progress of the tree girth

Growth Sandal Wood Tree



1 - Year



3 - Years



9 - Years



14 - Years

• **Cultivation of Sandalwood - Economic Feasibility in Indian Context**

• No.of Sandal Plants per (Hectare)	:	500 Nos
• No.of Primary Host Plants	:	500 Nos
• No.of Intermediate Host Plants	:	500 Nos
• No.of Long term Host Plants	:	500 Nos
• Cost of Sandalwood Seedlings Rs.12 x 500	:	Rs.6000-00
• Cost of Primary Hosts(Rs.2/- each)	:	Rs.1000-00
• Cost of Intermediate Host(Rs.10/-)	:	Rs.5000-00
• Cost of long term Hosts(Rs.10/-)	:	Rs.5000-00
• Cost of Transportation, Pit formation	:	
• Planting, watering etc.,	:	Rs.20000-00
• Cost of Drip Irrigation	:	Rs.100000-00

Recurring Expenditure for 15 years

• Security & Vigilance @ Rs.36000 per yr.	:	Rs.540000
• Weeding & Soil work expenses(8 yrs)	:	Rs.16000
• Irrigation facilities for 8 years	:	Rs.16000
• Fertilizers/Manure etc., for 8 years	:	Rs.40000
• Management of Pests & diseases Supervision etc., for 15 years	:	Rs.375000
• Land & other infrastructure	:	<u>Rs.1000000</u>

TOTAL EXPENDITURE (AFTER RECONING
THE INVESTMENT, INFLATION 5% &
INTEREST AT 12% ON INVESTMENT : Rs.48,00,000/-

Expected yield of Heartwood after 15 years

- No. of Sandalwood trees eligible for extraction after taking 10% as mortalities theft etc., : 450 Nos.
- Qty. of Heartwood expected (20kg per tree) : 9000 kgs
- Qty. of Sapwood (30kg per tree) : 13500 Kgs
- Average cost of Heartwood per kg : Rs.3500/-
- Cost of sapwood per kg : Rs.65/-
- Approx. cost of 9000kg of Heartwood : Rs.31500000/-
- Approx. cost of 13500kg of sapwood : Rs.877500/-
- Estimated profit from inter crops : Rs.120000/-
- Total : Rs.32497500/-
- NET ESTIMATED PROFIT AFTER RECONING EXPENDITURE OF Rs.48,00,000/- : **Rs.2,76,97,500/-**



Vision of KS&DL

- Our Vision is to produce the best quality Sandalwood & Sandalwood Oil 'from Soil to oil' from the legal & ethical sources on sustainable basis through commercial cultivation of natural Sandalwood.

- Our Vision is to produce the best quality natural Sandalwood oil based Soaps, Cosmetics, Beauty aids, Wellness products, Health & Hygienic products along with Oral care / Dental care products through continuous innovation and excellence to meet the global standards for improvement in quality of life and making our planet more sustainable

Mission of KS&DL

- KS&DL Research centre constant endeavor is continuously working on upgrading the products quality formulation of all the products viz., Soaps, Detergents, Cosmetics, Beauty aids, Wellness products, Health & Hygienic products and Oral care products, Agarbathi, Dhoop including newer products with the heightened regulatory measures to meet the highest International quality standards viz., FDA & REACH guidelines.

- The major thrust of R&D is committed for developing the natural essential oil based products using the natural Sandalwood oil as base to achieve the new paradigm of competitiveness, for natural based products to maximum customer satisfaction, to meet the customer requirements & expectations.

- Our Mission would be to get the best value for money paid by our customer. The products are conceived with the concept of aromatherapy, to gain the visibility of the supply chain in the shelf and creating a business for the future by meeting ISO: 9001-2008 & ISO:14001-2004 guidelines and making KS&DL a world class FMCG PSU.

- I hope with this presentation, the participants would definitely benefit for venturing into the cultivation of Sandalwood as one of the potential commercial crop in the present as well as in future to meet the growing demands for the Sandalwood



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Sustainable Supply of Global Sandalwood for Industry

H S Ananthapadmanabha² and V S Venkatesha Gowda³

Abstract

There are 16 recognised species of sandalwood in the world; broadly they can be grouped as East Indian sandalwood, Australian sandalwood, Hawaiian sandalwood and sandalwood of the Pacific Islands. Many of these are under the threat of extinction due to over exploitation. Some countries are taking steps to cultivate using modern techniques to save these species. East Indian sandalwood, Santalum album L., is the queen among the species yielding supreme quality essential oil much required by the perfume and allied industries. India was producing large quantity of sandalwood oil, meeting over 80 percent of world demand over the past decades, but due over exploitation and various other reasons the quantity of production has come down drastically.

Many sandalwood based industries have come up recently in India as well as abroad on its proven importance and sustainable supply of wood and essential oil. Based on the importance of natural sandalwood oil, many countries like, Australia, Sri Lanka, Thailand, Cambodia, Costa Rica, Pacific Islands etc. are trying to grow different species of sandalwood to meet global demand; India is not lagging behind in its attempt to grow more sandalwood to bring back the past glory and very soon it may meet demand of both the domestic and international market.

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³ Karnataka Soaps and Detergents Limited, Sandal City, P. B. No. 5531, Bangalore - Pune Highway, Bangalore 560 055, India (vsaigowda@yahoo.co.in)

1. INTRODUCTION

The sandalwood and sandalwood oil industry is one of the oldest in the world of perfumes. It has long been traded for its fragrant wood and essential oil. Since this oil can blend well with most natural essential oils, it is in more demand in perfumery industries. Synthetic substitutes have been produced as early as 1960, but are in no way identical to that of the natural material to replace it in the perfumery industry.

New sandalwood based industries evolved after 1990 using more and more natural sandalwood oil, due to this there was over exploitation of this species around the world, consequently the production is on the decline. The essential oil and allied industries can absorb more than 15,000 tonnes of sandalwood annually.

There is no concise literature available in the market containing information on all species of sandalwood, regarding respect of distribution, availability and its economic importance, which would be of interest to foresters and scientists to improve the species for economic potential and to the traders for their marketing innovations.

The genus 'Santalum' grows naturally throughout the Pacific and Eastern Indian Ocean regions. Sandalwood trees are evergreen ranging in size from tall shrubs to large trees. They grow in a variety of climates ranging from Australian desert to sub-tropical New Caledonia and at elevations from sea level to 5000 meters. It is distributed in the peninsular India, parts of Malaysia, Australia, New Zealand and Polynesia extending to the Hawaiian Archipelago and Juan Fernandez Islands. The species belongs to this genus are usually partial root parasitic plants, equipped with special structures on its root that penetrate the roots of host plants to obtain nutrients.

Some of the species furnish fragrant heartwood, known as sandalwood, yielding different kinds of sandalwood oil.

Sandalwood is the fragrant heartwood of some species of genus *Santalum* (Santalaceae). All sandalwood oil or fragrant wood traded in international market comes from species in the genus *Santalum* (Family Santalaceae). The genera contain 16 recognised species, and more than 12 varieties, distributed throughout the world. Out of them only five species, produce commercially exploitable scented heartwood (*S.album*, *S.yasi*, *S.spicatum*, *S.austrocaledonicum* and *S.lanceolatum*). These are important species for their fragrant scented heartwood and for essential oil. Other species of *Santalum* also produce fragrant heartwood and oil; however their contribution to essential oil industry is limited. The sandalwood wood is also an excellent material for carving and to make curious handicrafts.

All species occur in natural forest in different habitats. Most of the species are over exploited and are under threat as endangered species. The demand for the scented heartwood and natural sandalwood oil is increasing and the supply is on the decline. Because of inconsistent supply, the price is fluctuating and has gone up very steeply, making it difficult to obtain for various industries. The only alternate left is to produce sandalwood commercially with high input and management technique to make a short-term rotation crop.

There are more than 56 species and varieties of 'Santalum' mentioned in the literature, based on the morphological characters.

Different species (Var) of Santalum occurring in the world

- | | |
|-------------------------------|----------------------------|
| 1. Santalum acuminata | 29. Santalum acuminatum |
| 2. Santalum album | 30. Santalum angustifolium |
| 3. Santalum austrocaledonicum | 31. Santalum boninense |
| 4. Santalum cognatum | 32. Santalum crassifolium |
| 5. Santalum cunninghamii | 33. Santalum ellipticum |
| 6. Santalum cygnorum | 34. Santalum haleakalae |
| 7. Santalum diversifolium | 35. Santalum hornei |
| 8. Santalum freycinetianum | 36. Santalum lanaiense |
| 9. Santalum homei | 37. Santalum leptocladum |
| 10. Santalum involutum | 38. Santalum macgregorii |
| 11. Santalum latifolium | 39. Santalum margaretae |
| 12. Santalum longifolium | 40. Santalum mitchellii |
| 13. Santalum marchionense | 41. Santalum myrtifolium |
| 14. Santalum mida | 42. Santalum ovatum |
| 15. Santalum murrayanum | 43. Santalum persicarium |
| 16. Santalum obtusifolium | 44. Santalum preissianum |
| 17. Santalum papuanum | 45. Santalum salicifolium |
| 18. Santalum preissii | 46. Santalum yasi |
| 19. Santalum raiateense | 47. Santalum affine |
| 20. Santalum venosum | 48. Santalum capense |
| 21. Santalum cuneatum | 49. Santalum densiflorum |
| 22. Santalum fernandezianum | 50. Santalum hendersonense |
| 23. Santalum insulare | 51. Santalum lanceolatum |
| 24. Santalum littorale | 52. Santalum majus |
| 25. Santalum megacarpum | 53. Santalum multiflorum |
| 26. Santalum oblongatum | 54. Santalum paniculatum |
| 27. Santalum pelgeri | 55. Santalum pyrularium |
| 28. Santalum spicatum | 56. Santalum obstfolium |

However, currently only 16 recognised species have been identified in ‘Santalum’ and their geographical occurrences in the world are as follows;

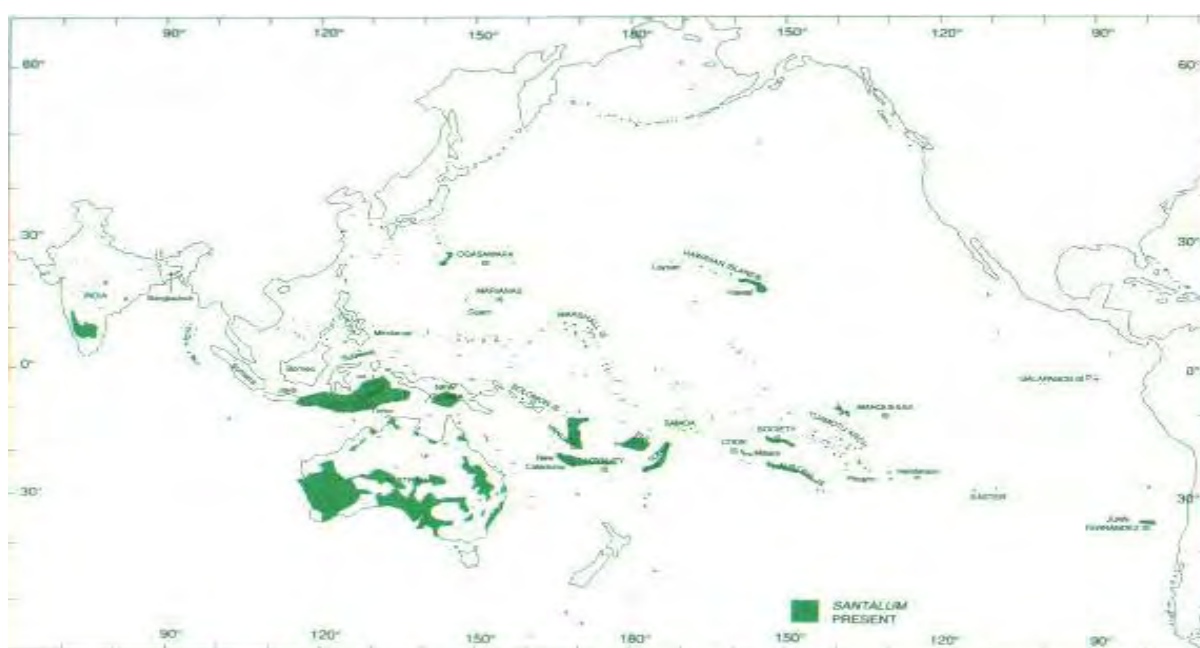
Species and varieties

- *S.album* L
- *S.austrocaledonicum* Viell
- *S.boninense* (Nakai) Tuyama
- *S.lanceolatum* R.Br.
- *S.macgregorii* F.Muell
- *S. Obtusifolium* R.Br.
- *S.yasi*. Seem
- *S.freycinetianum* Gaudich
- *S.haleakale*. Hillebr
- *S.ellipticum* Gaudich.
- *S.paniculatum* Hook&AM.
- *S. fernaandezianum* F.Phil.
- *S.insulare* Bertero
- *S.acuminatum* (R.Br. A.D.C.
- *S.murrayanum* (T.Mitch) C.A.Gardner
- *S.spicatum* (R.Br.) A.D.C.

Geographical occurrence

- Australia, Indonesia, India
- New Caledonia, Vanuatu
- Bonin Islands
- Australia
- Papua New Guinea
- Australia
- Fiji, Tonga
- Hawaii Islands (O’ahu.Moloka’I)
- Hawaiian Islands (Maul)
- Hawaiian Island
- Hawaii Islands
- Jaun Fernandez Island
- Society Islands (Tahiti)
- Australia
- Australia
- Australia

Map of Santalum distribution in the world.



2. EAST INDIAN SANDALWOOD

The genus represented by *Santalum album* Linn., produces rich scented heartwood and oil. Its wood is known commercially as “East Indian Sandalwood” and the distilled essential oil from it as “East Indian Sandalwood Oil”. Sandalwood oil is one of the oldest perfumery materials and is economically important. Both the wood and oil are used in incense, jaw-sticks, perfumes and soaps and in medicine and are of great commercial importance. Sandalwood is one of the finest woods for carving, since it is closely grained with fewer knots. It is used for making idols, boxes and other curios of exquisite beauty. Wood and oil of *S.yasi* is almost similar to that of *S.album*.

Production and marketing

The Indian average production of wood during 1965 to 1975 was about 4500 tonnes, and most of it was used for oil production. The natural forest resource of sandalwood has been over exploited, there by the elite population source have disappeared from the forest. Due to change in the forest policy, “that the dead and the dried sandalwood trees to be removed from the forest”, chances of natural regeneration occurring in the forest is increased, however, it is not enough to meet the growing demand.

The annual harvest drastically on the decline from 2004-2005 to only 1000 tonnes and then during 2010 it has reached the bottom level of merely 500 tonnes.

Similar trend on the decrease of sandalwood production has occurred in Indonesia, however their contribution of wood and ail to the international market is less than 10 percent. During 2010 there is ban on cutting of sandalwood from the natural forest to effect regeneration.

Sri Lankan contribution to the sandalwood industry is too small, but efforts are on the cultivation of sandalwood by private participation.

Australia has realized the importance of Indian sandalwood and is making commercial progress. They will be world leader of the sandalwood industry in the near future.

Many corporate bodies and farmers in India have come forward to grow sandalwood as a commercial drop, with the hope that this movement may reduce the gap between the demand and supply.

3. AUSTRALIAN SANDALWOOD

Sandalwood is an integral part of the history and ecology of Australia. There are six species of *Santalum* grown naturally, *Santalum spicatum*, *S. album*, *S.lanceolatum*, *S.murrayanum*, *S.accuminatum* and *S.obtusifolium*. Out of six species only three species, *S.spicatum*, *S.album*, and *S.lanceolatum* yield commercially important scented heartwood and oil.

S.spicatum, popularly known as West Australian sandalwood is also one of the important species producing scented heartwood and oil. Wood has been exported to different countries since 1844. The oil has a different chemical composition and has better medicinal properties. The oil is used in perfumery, incense sticks, soaps and toiletries and aromatherapy. The wood

is also used in carving. Recently it has become an alternate source of essential oil for sandalwood based industries.

Wood production is on the decline, and adequate conservative methods to limit the annual harvest are being taken by the government. Since 2000 large plantation activities are being taken up by corporate bodies to meet the growing demand...

S.lanceolatum is the second major type of sandalwood native to Australia; the heartwood contains fewer odours and yields comparatively less oil; the oil mixes well with other sandalwood oil. The scented oil is used in perfumery industry.

S. accuminatum is also a native species of Australia and the trees are cultivated for fruits rather than oil. The timber is hard, usually used for furniture making and is not scented.

S.murrayanum is a small shrub or a small tree growing to 4 meters with spreading branches. The wood is not perfumed and bark is more or less smooth. The tree has no commercial value.

S. obtusifolium. Is a small shrub growing up to 2.6 m., the wood is not perfumed and has no commercial value.

4. PACIFIC ISLAND SANDALWOOD

S. austrocaledonicum, is an important species growing in New Caledonia and Vanuatu islands, scented heartwood is used for making beautiful handicraft items and the oil produced from heartwood is highly scented and are sold as New Caledonian oil or New Caledonian sandalwood oil. The oil is highly priced and very much sought after in the perfume industries.

The species has been over exploited commercially, and annual harvest exceeds 100 tonnes.. Sandalwood contributes substantial forest revenue to the island. Attempts are being made to conserve the species in different pacific islands..

S. yasi grows in Fiji and in Tonga islands, its scented heartwood yield high quality sandalwood oil. Fijians and Tonganians scent coconut oil during marriage ceremonies, in which the bride and bridegroom are dusted with powdered heartwood.

The fruit and flowers are similar to that of *S.album*, but the leaves are oblong. The heartwood is yellow and highly scented. It has been reported that native Fijian species *S.yasi* is able to naturally hybridise with *S.album*. The seeds collected from *S.yasi* trees in mixed plantation with *S.album* gave 20% hybrid seeds. Hybrid sandalwood seedlings showed growth rate almost twice to that of *S.yasi*, achieving over 2.5 m height in two years.

Sandalwood oil is similar to that *S. album* and the oil yield is about 7 percent. Sandalwood has been over exploited. Annually about 100 tonnes of wood are exported to different countries.

5. HAWAIIAN SANDALWOOD

Four species of sandalwood are found distributed on the Island. They are small shrubs or trees typically 5 to 10 m or larger at maturity. All species exhibit considerable morphological variations and numerous traditional varieties are recognized. Wood is traditionally used in the Pacific islands for carvings, cultural uses and is burnt as insect repellent.

All species are attractive, especially when in flower and suitable for home gardens.

1. *Santalum ellipticum*
2. *Santlum freycinetianum*
3. *Santalum haleakalae*
4. *Santalum paniculatum*

Sandalwood has strong history and is particularly culturally attached to different religions. The product derived from it has been in use for several centuries. Other species of *Santalum* are only of academic interest since their production and contribution to the essential oil industry is limited; however, they are the important species of the region contributing to the cultural heritage and use, but due to over exploitation of the species, many have disappeared or in the endangered list.

Santalum macgregori, called Papua New Guinea sandalwood, is another species producing scented heartwood and oil used in perfumery.

Several non-*Santalum* species (e.g. *Osyris tenuifolia*, *O. laceolata* from East Africa and *Amyris balsamifera* L. from West Indies) are also used as sources of “Sandalwood” type. The less fragrant wood and the distilled oil are different when compared to true sandalwood.

Different *Santalum* species occurring in different parts of the world have some characteristic features of their own and are culturally attached to the region. Some of the species of *Santalum* which yield scented heartwood and essential oil can be used to make a gene bank to improve the species commercially. Studies are required to utilize the adaptive nature of *Santalum* species to different habitats.

Some of the wood properties and charectertics of sandalwood oil are very interesting.

6. WOOD PROPERTIES AND CHARACTERISTICS

S.album	S.spicatu m	S.lanceol atum	S.accumin atum	S.astrodon icum	S.yasi	S.ellipti cum	S.freycinati anum	s.macgre gori	S.insul are
HW is heavy and durable, offers pleasant strong scent, yellow or brown in appearance on distillation yield 4 to 6% oil	HW is dark brown, less strongly scented. wood on distillation yield 2 to 2.5% oil	HW is brown slightly scented. Wood on distillation yield 2% oil	HW is not scented	Hw is light brown, hard highly scented. Wood on distillation yield 2 to 3% oil.	HW is yellowish brown, hard oily, strong scented. Wood on distillation yield 4 to 7% oil	It is called Ilahi sandalwood. HW is fragrant. Wood on distillation yield 1% oil or less.	Wood is called frecinet sandalwood. wood is slightly scented and the distilled oil is called Tahiti sandalwood oil. Oil yield is about 2%	HW is light brown, less perfume d.Oil yield is about 3.5%. the quality of oil is low.	HW is less scented . Ethanol concent rate from wood gives fragran ce.

Sandalwood

Fragrance Of The World
(Sustainable Supply)

H.S. Ananthpadmanabha

Santalum album

- **Distribution :**

- ◆ India
- ◆ Sri Lanka
- ◆ Indonesia
- ◆ Fiji
- ◆ Australia
- ◆ China
- ◆ Pacific Islands

Australian Sandal Wood

- ◆S. spicatum
- ◆S. lanceolatum
- ◆S. accuminatum
- ◆S. obtusifolium
- ◆S. murrayanum

Sandalwood in Pacific Islands

- ◆S. austrocaledonicum
- ◆S. yasi
- ◆S. macgregori
- ◆S. insulare
- ◆S. bominense
- ◆S. Fernandezianum

Hawaiian Sandalwood

- ◆ *S. elipticum*
- ◆ *S. freycinetium*
- ◆ *S. haleakalae*
- ◆ *S. paniculatum*

All Santalum sps are root parasites



Sandalwood Flower



Nursery bed



Seedlings Transferred To Poly Pots



Sandalwood Nursery



Sandalwood Nursery



Planting In The Field



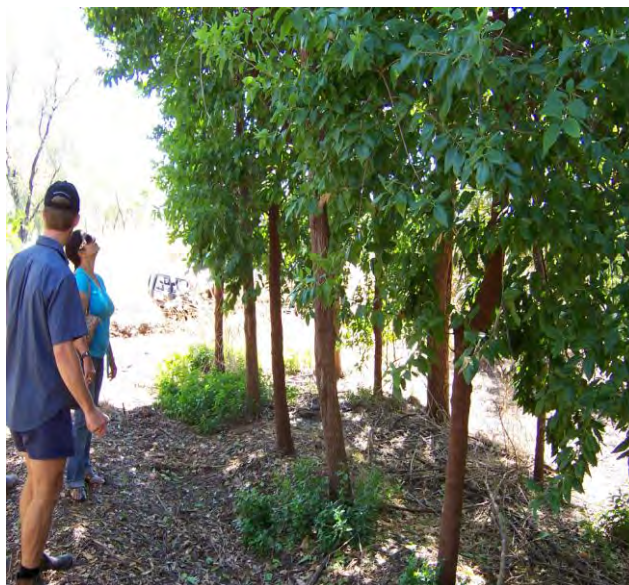
Planting Instrument



Sandalwood Plantation in Australia



Sandalwood Plantation in Australia



Sandalwood Plantation in Karnataka



Sandalwood Plantation in Sri Lanka



Sandalwood Plantation in Sri Lanka



Sandalwood Plantation in Sri Lanka

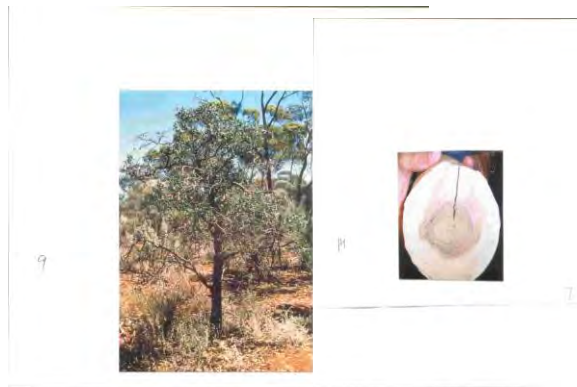




Attar Preparation



S.spicatum





NATURAL REGENERATION

- Alternative method of regenerating sandal
- Need an effective management system
- Thousands sprout only a few will persist
- Fittest & those that secured host survive



TREE IMPROVEMENT

- Santalum yasi
- Santalum album
- S.yasi x S.album F1 Hybrid

Seed trees



Wood core drilling



S.YASI X S.ALBUM F1 HYBRID

- Hybrids have potential to combine desirable characteristics of both parents
- S.yasi x S.album F1 hybrid is more vigorous, faster-growing, and more adaptable, and produces oil faster than the parents
- F1 hybrid is produced when the 2 parents are grown close to each other



S.yasi

S.album





MASS PRODUCTION OF CUTTINGS

- Juvenile cuttings of young seedlings of can be rooted but not mature trees
- Past trials affected by watering problems and lack of staff
- One MSC student currently doing thesis on shoot production and root cuttings

The collage consists of three images: a young seedling in a forest, a hand holding a small rooted cutting, and a person kneeling in a forest recording data.

Sandalwood Activities in Papua New Guinea



Introduction

Since new interest was rekindled in 1996, the work in sandalwood has been somewhat slow, especially in awareness and educating resource owners in sandalwood growing areas in the Central, Gulf and more recently in the Western Provinces of Papua New Guinea.

Despite the slow progress, it is however, pleasing to report that some measure of success have been achieved in the attempt to promote and develop sandalwood in the country as a low volume high value species.

Sandalwood Activities in Papua New Guinea



Current Work

- **Seed Collection**

- First collection was made in 1997 and distributed for trials in Australia, FRI and Kuriva in the Central Province..
- Second seed collection was done by NTSC and FPCD in August, 2001
- Third seed and germplasm collection was done by FRI and CSIRO September, 2001
- In October, 2002, PNG was fortunate to attend the Regional Workshop on Sandalwood Research, Development and Extension in Noumea, New Caledonea.
- Fourth seed and germplasm collection was again carried by FRI and CSIRO in 2004 when materials collected in 2001 failed.

Sandalwood Activities in Papua New Guinea



Nursery Trials

- Pot host trials began at FRI in 1997.
- Work on various germination techniques also began in 1997 with the pot host trials
- Extensive work on germination technique and various germination medium done at FRI this year and internally reported in October, 2005.



Sandalwood Activities in Papua New Guinea



Ex-situ Conservation

- Three attempts have been made so far at ex-situ conservation as already mentioned above. Of the three trials, only the Markham Bridge trial is promising while the other two failed due to fire and poorly drained site.
- The Leron site got burnt and the LBG site is still growing but poorly.

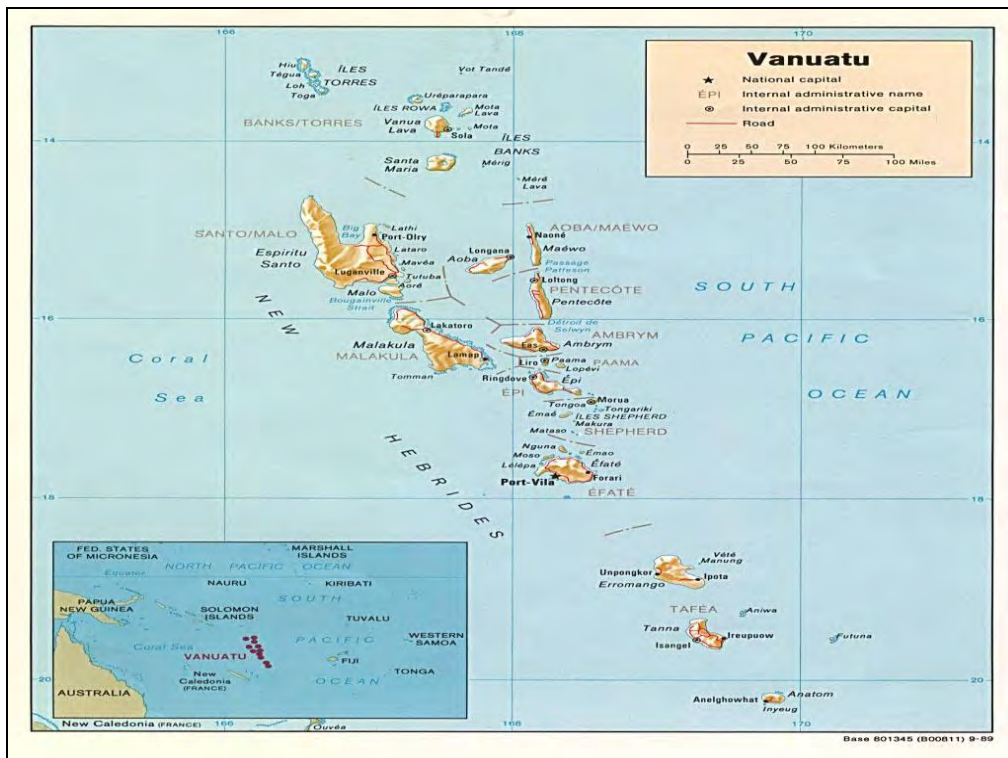


Sandalwood Activities in Papua New Guinea



Seed Storage

- Sandalwood seed storage and germination tests are still being carried out. So far all seed stored for more than six months have either shown very low germination or none at all.
- Some desiccation work is also being done in the hope of hastening germination by reducing the seed moisture.



Trade and Industry cont..

- The Forest Policy allows for an Annual harvest of 70 ton heartwood.
- Currently 80 ton heartwood was shared between the 2 existing buys
- In yr 2000, 73 ton of Sandalwood worth Vt31,727,850 while the value of logs was Vt32,974,910 for 39,860 cubic meters

Harvesting & Transporting Sandalwood logs to Vila



Sandalwood Seedling Ready to
be Transported to Local Farmers



Sandalwood Seedlings in the
Nursery

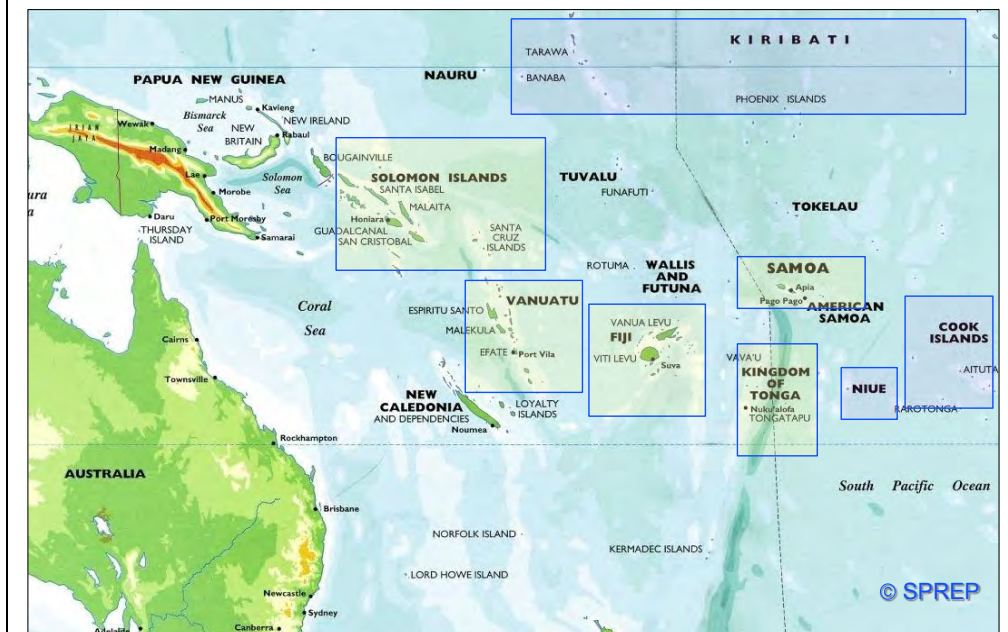
Farmers Sandalwood Plot



Sandalwood work in Tonga



PACIFIC ISLAND NATIONS PARTNERS



Tonga



Heartwood – S.yasi

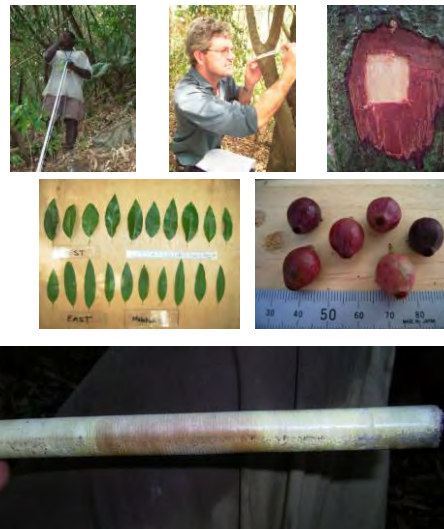




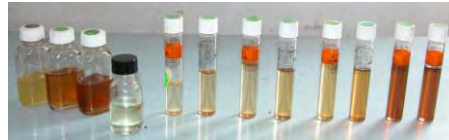
Methodology

• Tree

- Leaf length & width
- Fruit diameter
- Trunk diameter
- Tree height
- Depth of heartwood
- Colour of heartwood & bark blaze
- Est. bud, flower & fruit number
- Heartwood core sample
- Dried leaf sample
- Herbarium specimen



Oil & Heartwood



Variation In Heartwood





Thank You

Sandalwood: The Saviour of Ecological Balance and Super Wealth Creator

Ramesh Chandra Mishra⁴

Abstract

Nearly 25 species of the genus Santalum L. commonly known as sandalwood are awaiting their turn to transform the ecological balance of nature after suffering serious setback and gross depletion due to indiscriminate hacking in the past. The wild existence of the leading species Santalum album L. has suffered to the highest level. Natural as well as artificial regeneration could conceivably rejuvenate their existence and thus provide an extremely valuable natural resource that could be harvested on a sustainable basis

Planned plantations of these species, individually or in various combinations, is capable of fulfilling almost all the luxuries of the futuristic progressive civilization, mainly through their fragrant and beautiful wood and its products. Considering their semi parasitic nature, additional advantages can also accrue through the intercropping of more than 300 host plants. The flow of food, fodder, fuel, fibre, fruits, flowers and fragrance is likely to provide additional sources of income. Collectively they can form a basis for lucrative and exploitative trade in future.

Although the initial establishment of plantations is challenging, once established, sandalwood trees withstand all the vagaries of nature due to their tough, hardy and tenacious nature. Moreover, they possess good regeneration potential and an ability to colonise new and suitable sites. The species can be planted practically anywhere with the help of available modern technologies.

The present paper enumerates, describes and pinpoints the suitable facets of modern planting, maintenance and protective techniques suitable for various circumstances. The existing research gaps which need the immediate attention of the scientists have also been pinpointed.

The production and utilization of woods of this type is perhaps the need of the day.

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SANDALWOOD

THE SAVIOUR
OF ECOLOGICAL BALANCE
AND SUPER WEALTH CREATOR

Ramesh Chandra Mishra

- ▣ Ex Head Division of Extension
Indian Lac Research Institute,
Namkum, Ranchi, (I.C.A.R.)
- ▣ Chairman,
Friends of Santalum Society of India,
Lucknow.

SUPREMO

SANDALWOOD

WOOD IS GOOD

but

SANDALWOOD

is

WONDER WOOD

the

SUPER WOOD

SANDALWOOD TREE

▣

▣

▣

▣

▣

▣

▣

NOBLE TREE

and

DIVINE TREE

VIRTUALLY

a

SAINT

SCENTED WOODY PLANTS

▣

▣

▣

▣

▣ Kati Na Santi Mahishu Mahiruhah

▣ Surabhipusprasalphalalyah

▣ Surbhiyanti Na Koapi Cha

▣ Bhuruahaniti Yashoasti Param Tav
Chandan

:

▣ So many trees
bearing fragrant
flowers and
juicy fruits exist
on the Earth, but
none of them O
Sandal can
compete with
your greatness

GUARANTEED SURVIVAL

Anye vriksha apekshyante,
Poshkaanshan sada bahoon
chandanastu bina sarvan
Vardhate asaar bhumishu

Other trees grow on comparatively fertile soil with sufficient nutrients, but the sandal wood grows everywhere even on waste lands.

ETERNAL FRAGRANCE

**Rogagrasta vinashyanti ,
Paryantelan vinashayan .
Anyevrikshashchandanastu,
Rugnoapyanyan sugandhyet.**

While other diseased trees perish and continue to contaminate , Diseased sandalwood tree, however, continues to spread fragrance even after death

FAMILY SANTALACEAE

- ▣ A major group of Angiosperms
- ▣ 2525 species
- ▣ 577 accepted plant names
- ▣ 39 genera including SANTALUM

GENUS: SANTALUM L.

- ▣ 25 species
- ▣ 15 species produce highly aromatic wood
- ▣ *Santalum album* L. leads them all
- ▣ Mostly root hemi-parasitic
- ▣ Few are stem parasites as well
- ▣ Some bear nutritious edible fruits
- Seeds contain nutritious endosperm
- ▣ Seeds also contain useful oil

SANTALUM: DISTRIBUTION

- ▣ Ranging from **India** through **Malaysia** to the **pacific Islands** as far as **Hawaii** and the **Juan Fernandez islands** off the coast of **South Africa**
- ▣ *S. album* is the only species found on the Asian mainland
- ▣ Only *S. album* is found in Indian subcontinent
- ▣ Endemic species : Australia=5, Hawaii =4 ;
S. fernandezianum of Juan Fernandez (Chile)=
Is on the verge of extinction

S. album RETROSPECT

- 1792 - RULER'S GREED IMPRISONED THE HERITAGE
Tipu Sultan of Karnataka declared Royal Tree
- 1978-79 TRADE POLICY WORSENERD THE SITUATION
Indonesia banned export: → Supply void →
→ India stepped in to fill → Prices spiraled →
→ Mindless wild harvesting → Smuggling.
- 1996 ROAD TO HELL WAS PAVED
Export quotas → Auction system →
→ Oil exporters compelled → Closure of Factories
- 2000 GOOD SENSE PREVAILED BUT HALF HEARTED
Legal restrictions remodeled half heartedly

ECOLOGICAL PERSPECTIVE

MALADIES

- ▣ Dwindling primary forest cover
- ▣ Wild harvesting of forest products
- ▣ Modern Agriculture
- ▣ Increasing urbanization
- ▣ Industrialization
- ▣ Greenhouse effect
- ▣ Global warming

REMEDIES

- ▣ Planting trees near habitations
- ▣ Scientific exploitation of forest products
- Mixed horticultural plantation on wasteland

CARBON SEQUESTRATION

Single mature tree

Absorbs 48 lbs CO₂/y

Stores 13 lbs C /y

Releases O₂ for two



Single American

Generates 2.3 tons CO₂/y

If plants one tree each

Will offset 5% H.A.E.

An Indian is of course not so expensive



GLOBAL WARMING

- ▣ Global Temperature will Rise by 5.8 °C by 2100

CONSEQUENCES:

- ▣ Maximum Human Survival is Likely for 7500 Years

REMEDIES:

- ▣ Tree Planting is Cheapest Means
- ▣ Sandalwoods are Ideal
- ▣ Cost Effective and Efficient
- ▣ Due to Multiplier Effect

PROBABLE PLANTING SITES

- ▣ Urban and Rural Households
- ▣ Wasteland
- ▣ Degraded Forests
- ▣ Vacant Government land
- ▣ Government and Private Institutions
- ▣ Sanctuaries and Megaparks
- ▣ Betel Vine and Other Vine Yards as Props
- ▣ Other Suitable Places

NATURAL REGENERATION

- ▣ Existing Sandalwood groves and spots all over the country may be surveyed and preserved as seed production and processing cum nurseries
- ▣ Fencing subsidies may be granted and purchase guaranteed
- ▣ The sites may be augmented with other Santalum species for natural breeding
- ▣ Abandoned Govt. farms may also be developed similarly for future

RESEARCH NEEDS

- ▣ Germination
- ▣ Rigorous host plant screening
- ▣ Seed technology , processing ,priming etc.
- ▣ Nutritional studies
- ▣ Mycorrhiza
- ▣ Developing host- independence
- ▣ Induction of heartwood and oil formation
- ▣ Seed oil studies and utilisation
- ▣ Non destructive sampling /Bark and other correlations for harvesting decisions

Organizational Proposals

- ▣ International Santalum Research Institute
- ▣ Sandalwood Promotion Council
- ▣ National Sandalwood Research Institute
- ▣ Sandalwood Research and Development Centers
- ▣ Seed Production -cum-Processing Centers

LAWS

No Forest Laws

For the Land Owner

Growing Sandalwood Tree(s)

Anywhere

POETIC VERSES

POETRY

Darde- sar ke vaste
Chandan lagana hai mufeed
Iska ghisna aur lagana
Darde -sar Eh bhi to hai_

Atishaya ragad kare jo koi
Anal prakat chandan se hoi

MEANING

Sandalwood is ideal for
the treatment of headache
but making a paste of it
(wet griding) is not a less
headache

Even sandalwood will
generate fire , if somebody
rubs it excessively

PRAYER OF GODESS SARASWATI

Shvetakshasutrahasta Cha
Shveta Chandan Charchita!
Shevata Veenadhara Shubhra
Shvetalankar Bhu Shita
Shvetapadmasana Devi
Shvetapushpapi Shobhita
Shvetambardhara Nitya
Shvetagandhnulepana

-
Padmapuranam

- O Goddess, sitting on a white
seat- decorated with white
flowers on a white sheet
fully smeared with white
fragrance, you sit in lotus
pose, wearing a white thread
on the wrist which is
drenched with white
chandan : you hold a white
veena (musical instrument)
you are decorated with
white jewellery

□ - Padmapurana

TEAKNET – The International R&D network on Teak

K Jayaraman⁵ and M P Sreelakshmy⁶

Abstract

TEAKNET, established in 1995, is an international network of institutions and individuals interested in teak. Its members are mostly growers, traders and researchers as well as policy makers and others who have a profound interest in teak. TEAKNET was established to address the issues of the global teak sector. The goal of TEAKNET is to transform the global teak sector from its current suboptimal state to that of a dynamic entity for the benefit of all stakeholders of the sector. Its mode of operation is through collective discussions and persistent follow up actions. Issues are identified through periodical workshops and meetings of the stakeholders. The most basic activity of TEAKNET is information exchange which is achieved through its website www.teaknet.org and the TEAKNET Bulletin. The members have certain additional privileges with respect to access to information supplied by the organization.

By linking the various institutions across the world, the network really acts like a virtual research and development organization for the species. Teak is one of the best high quality timber species of the world. Teak is successfully grown in many tropical countries. The species holds high promise for meeting the hardwood requirement of the globe which is expected to be on the rise. Its cultivation needs to be extended to more regions, productivity levels need to be enhanced through the use of improved planting material and better cultural practices in order to meet the growing hardwood crisis. Unlike many food crops, demand for teak is highly elastic and thus depends to a great extent on efficient marketing mechanisms. But for that, the many features that make teak attractive are the hardy and adaptive nature of the species, the high level of returns and the superior quality of wood. Apart from networking, TEAKNET also undertakes much promotional activities on teak and its products.

This presentation makes a broad sketch of the current activities of TEAKNET and provides a futuristic outlay for its functioning. The perspectives are built taking into consideration the global situation with respect to forestry in general and the hardwood sector in particular.

Keywords: Teak, R & D Network, Teaknet, Information exchange

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1. INTRODUCTION

Teak (*Tectona grandis* L.f.) is a versatile timber known for its quality, durability and strength. It is used largely in furniture industry and construction of buildings, ship and boat making, for veneer and as poles. Teak is an undisputed leader of high value tropical timbers. It is always referred to as standard timber for comparative evaluation of quality and utilization potential of other tropical hardwoods. Teak is being grown in plantations in more than 36 tropical countries across the globe although its natural occurrence is limited to India, Laos, Myanmar and Thailand.

TEAKNET is an organization established to promote teak and was operating from Myanmar with the support of FAO of the United Nations. The headquarters was shifted to India in 2008. Presently, Kerala Forest Research Institute hosts the TEAKNET Secretariat by providing logistic support and infrastructure facilities. TEAKNET is governed by an international Steering Committee consisting of representatives from FAO, ITTO, Forest & Landscape, KFRI and other organizations around the world. The primary function of TEAKNET is to address the issues related to the global teak sector. The players of the sector are growers, traders, industrialists, researchers and policy makers. Issues are identified through organizing workshops and meetings of the stakeholders and solutions sought through discussions.

2. CURRENT ACTIVITIES

The most basic activity of TEAKNET is information exchange which is achieved through its website www.teaknet.org. The website provides a plethora of information related to teak by way of reference to publications, directories of researchers, traders and growers, information on events related to teak at an international level and information on technological developments. TEAKNET has a newsletter called TEAKNET Bulletin and also runs a global teak information center at its Secretariat.

Since its inception in 1995, TEAKNET has been holding a series of workshops, meetings and conferences on several topics related to teak. The proceedings/reports of these conferences are widely circulated which are expected to spur actions from the concerned. The latest of the series have been the international conference on 'Production and Marketing of Teakwood: Future Scenarios' conducted in June 2009 and the international training workshop on 'Innovations in the Management of Planted Teak Forests' held in August-September 2011 at Peechi, India.

3. FUTURE ACTIVITIES FOR TEAKNET

The global scenario with respect to teak has been undergoing changes over the past several years. Over time, there has been a shift in the ownership of forests to the private sector, with smallholders becoming major producers of teakwood. This has led to planting of teak in nontraditional areas. Teakwood being in short supply, we should expect a continued spurt in demand and consequent price increases. Competition from alternative products may also increase but their use is generally being discouraged on account of environmental problems. Demand for certified timber and the need for certification of teak plantations are emerging as

strong cases. Issues related to climate change and trends toward conservation efforts are more and more apparent.

The future perspectives are to be built on the gaps in the current scenario. As regards teak, poor productivity and poor marketing have been identified as blocks in the progress on the sector.

Presented below are a number of means by which transformation can be accomplished in the global teak sector, along with the impact these activities can bring about.

Activity	Impact on the sector
Continuance of secretarial activity	Information exchange
Database on teak resources	Better perspectives through outlook studies
International network of sample plots in the Asia-Pacific Region	Optimal management of plantations
Market intelligence on teak prices and availability of timber	Efficient marketing
Training programmes on cultivation and management of teak	Capacity building
Meetings of traders, growers and researchers	Better plans and policies
Research support on specific themes	Productivity enhancement
International consultancy assignments	Problem solving
Developmental activities on teak resources	Expansion of area

TEAKNET intends to generate funds for these activities through its membership fees and donor contributions. A glimpse of the services that can be offered by TEAKNET can be obtained from the following list.

- (i) Members are entitled to have access to all the information available with the Secretariat. Such information may include not only scientific information but also that of interest to traders like availability and price of teakwood, plantations or products from teakwood.
- (ii) Invitations to periodical national or international meetings of the members wherein expert discussions are held on latest developments in cultivation, trading, processing or policies.
- (iii) Members will have the privilege to present and discuss common issues of their interest and suggest action plans leading to the solutions. TEAKNET could arrange to send resolutions from such meetings to the concerned on behalf of the members.
- (iv) As part of a long term strategy, TEAKNET plans to provide research support, training or consultancy services for any topical issues concerned with teak. TEAKNET would make deliberate attempts to generate funds for such purposes by approaching donor agencies across the globe.
- (v) Exchange of materials is yet another service that is thought of but will be subject to all the international regulations involved.

The activities of TEAKNET have mostly been confined to Asia-Pacific so far. Of late, the network is being extended to Africa and Latin America. The measurable output from these activities will be reflected in higher plantation productivity, higher production, quality products, better marketing and affordable prices for the products. If this happens during the ensuing years and continues so further, the purpose of TEAKNET will be fulfilled.



TEAKNET - International R & D network on teak

Teak

Teak (*Tectona grandis* L.f.) is a versatile timber known for its quality, durability and strength.

It is used largely in furniture industry and construction of buildings, ship and boat making, for veneer and as poles.

Teak is an undisputed leader of high value tropical timbers. It is always referred to as standard timber for comparative evaluation of quality and utilization potential of other tropical hardwoods.

Teak is being grown in plantations in more than 36 tropical countries across the globe although its natural occurrence is limited to India, Laos, Myanmar and Thailand.

TEAKNET is an organization that was established in 1995 to promote cultivation and trade of teak



TEAKNET

What is TEAKNET?

TEAKNET is an international network of institutions and individuals interested in teak.

Its members are mostly growers, traders and researchers apart from policy makers and others who have a stake in teak.

TEAKNET is governed by an international Steering Committee consisting of representatives of FAO, ITTO, DANIDA and other organizations around the world.

TEAKNET was established in 1995 and was operating from Myanmar. The HQ was shifted to India in 2008.

KFRI hosts the TEAKNET secretariat by providing logistic support and infrastructure facilities.



TEAKNET

What does TEAKNET do?

Primary function :

TEAKNET addresses issues related to the global teak sector.

The stakeholders /players of the global teak sector are

Growers,
Traders,
Industrialists,
Researchers,
Policy makers

Mode of operation : Issues are identified through organizing workshops and meetings of the stakeholders and solutions sought through discussions.



TEAKNET

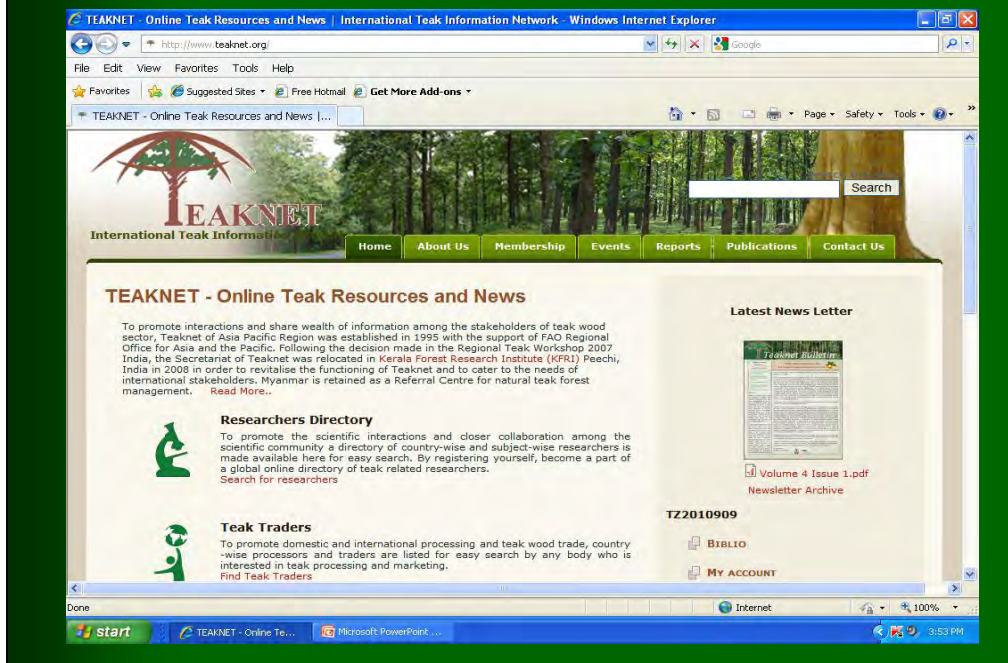
Activities of TEAKNET

Information sharing is the most fundamental activity of TEAKNET

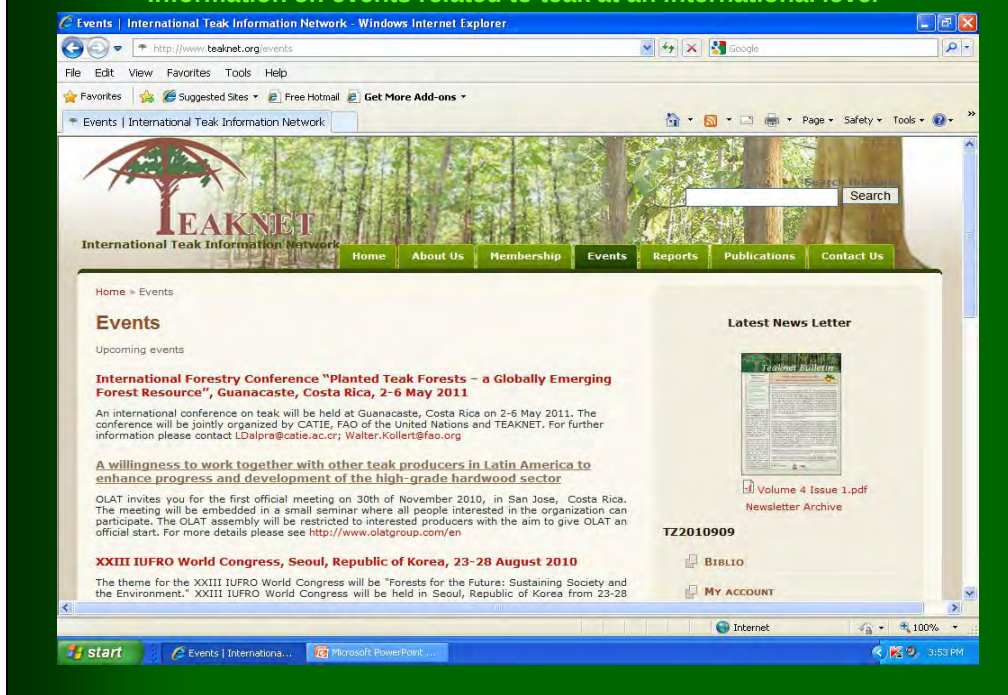
(1) Provides information on teak through its website www.teaknet.org

The website contains directories of growers, traders and researchers,
Information on events related to teak at an international level,
Information on publications and developments in technology.

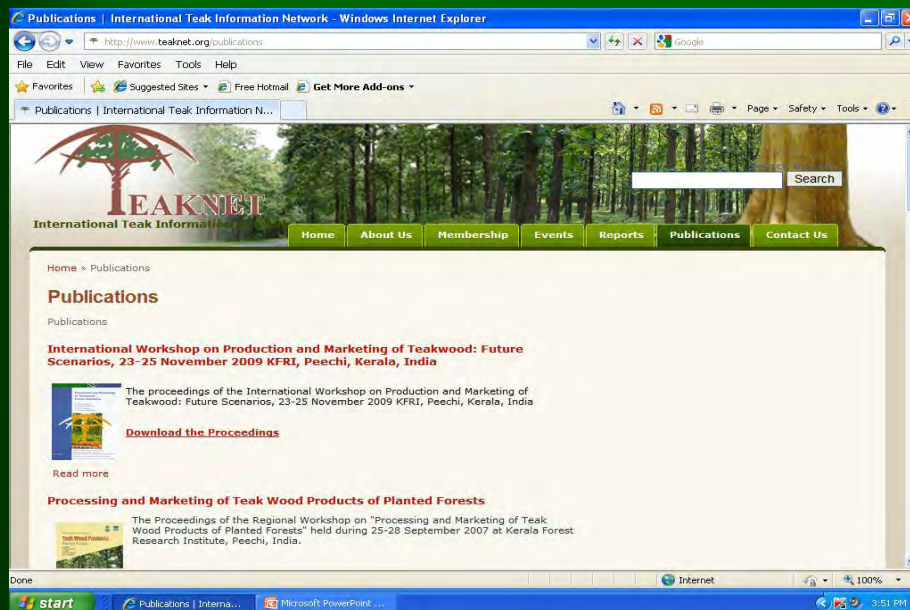
Directories of growers, traders and researchers



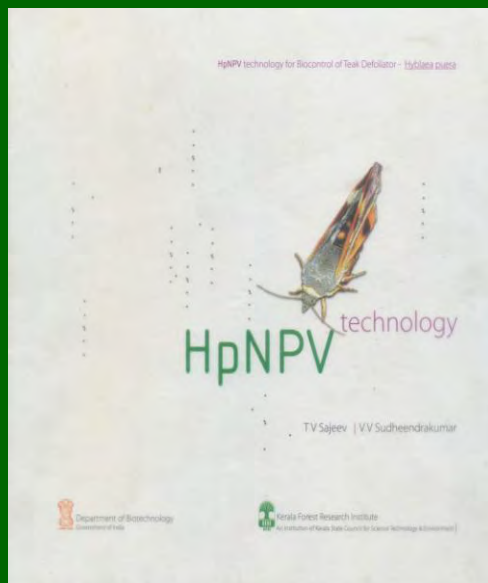
Information on events related to teak at an international level



Information on publications and developments in technology



Information on publications and developments in technology



Information on publications and developments in technology

Teak Planner

Teak Planner functionally is a growth simulator for teak plantations. Its scope of application is the range of growing conditions that is available in Kerala. This programme can be used to identify the optimum thinning schedule and rotation age for even-aged teak stands under a range of site quality and management levels. The optimum thinning schedule is that which maximizes the net present value of cash flows, out of a variety of possible thinning schedules in a plantation. It also enables the user to make an investment plan by providing information on net present value (NPV), internal rate of return (IRR), benefit cost ratio (BCR) and payback period (PIR) for a range of management options. The software is also an effective tool for financial valuation of the growing stock for commercial purposes.

The input data at the first level consists of interest rate that is to be used for discounting purposes, site quality class and weeding intensity. The system can then generate mean diameter at 5th year which is the starting point of simulation assuming an initial planting intensity of 2500 trees per ha. In case, the user wants to optimize purchase cost of a plantation or maximize the returns from a purchased plantation, the corresponding input values can be entered and can proceed further. With the input data that is supplied, the programme identifies the optimum thinning schedule for the stand under consideration and displays the number of trees to be retained at 5 yearly intervals with information on several associated stand features like mean diameter of trees, volume of standing crop, accumulated yield from thinning and mean annual increment in total volume (MAI).

It also displays the NPV, IRR and BCR. The optimum rotation age can then be taken as the age at which NPV reaches its maximum. This programme thus fills in the need for a self-contained user-friendly software for finding out optimum thinning schedule and associated stand features for any given stand.

One additional feature is that the user is supplied with the option of making the financial projections either under 'constant' levels of teak timber price, input cost and management interventions or under 'varying' rates. This option provides the user a whole scenario of possible projections and every time the simulator identifies the best thinning schedule to be followed to maximize the returns.

The simulator has been built using Visual Basic software. The equations used for projecting the different stand features were developed using long-term data gathered from permanent sample plots laid out in teak plantations in Kerala. Whole stand models based on Richards function with biologically meaningful parameters formed the basis of diameter and volume growth functions.

Kerala Forest Research Institute,
An Institution of Kerala State Council for
Science, Technology and Environment,
Peechi - 680 653, Kerala, India

Contact person : Dr. K. Jayaraman, KFR, Peechi 680 653, Thrissur, Kerala, India

Information for Researchers, Growers and traders

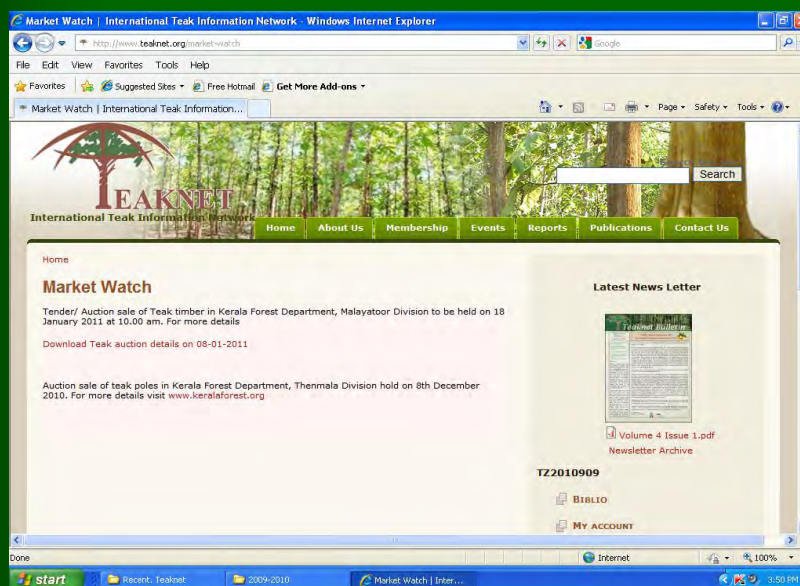
Market watch

Growers' tips

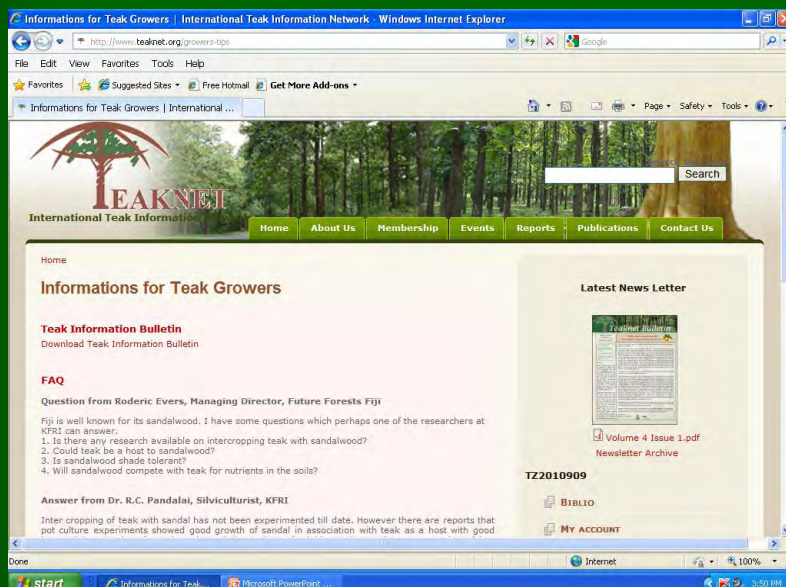
Researchers' corner

The screenshot shows the TEAKNET website with a navigation bar at the top. Below the navigation bar, there are logos for KFR, TEAK21, and IUPRO. A section titled 'Related Sites' lists various organizations. On the right side, there is a 'Download' section with a link to 'Download first assessment' and a button labeled 'Market watch'. A red arrow points from the 'Market watch' button in the left sidebar to the 'Market watch' button on the right side of the page.

Market watch



Growers' tips



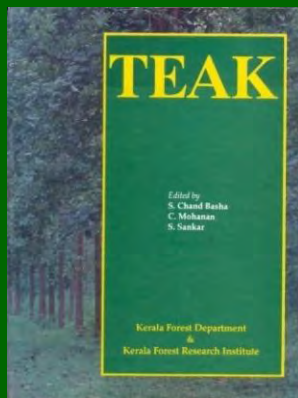
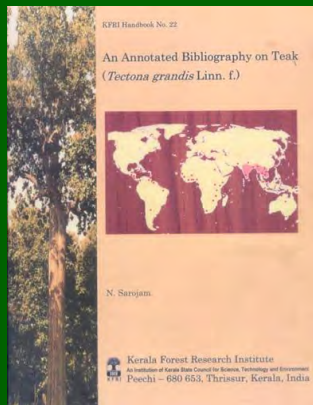


TEAKNET

Activities of TEAKNET

(3) Runs a global teak information center at its Secretariat

TEAKNET Secretariat has a collection of literature on teak consisting of research papers and other materials. Members are entitled to call for any information available with TEAKNET.



TEAKNET

Additional Activities of TEAKNET

(4) Conducts regional/International conferences on themes related to teak

The last international workshop was held in November 2009 at KFRI, Peechi. Proceedings available in the TEAKNET website.

(5) Arranges training programmes on cultivation and management of teak.

An international training programme on 'Innovations in the management of planted teak forests' was held during 31 August – 3 September 2011 at KFRI, Peechi with support from FAO, Bangkok.

(6) Undertakes studies related to teak at international level.

Efforts to develop an international database on teak are underway.

What future holds for TEAKNET?

Objective : To bring about transformations on the global teak sector.

Question : What kind of transformation and under what context?

The current context of forests and forestry as regards teak

1. Shift in the ownership to the private sector, small holders becoming major producers of teakwood.
2. We should expect a continued spurt in demand and consequent price increases.
3. Competition from alternative products may also increase.
4. Demand for certified timber and the issue of certification of teak plantations.
5. Climate change issues and trends toward conservation efforts.

The gaps in the current scenario

1. Poor productivity
2. Poor marketing

What future holds for TEAKNET?

Transformations on the global teak sector

Activity	Impact on the sector
Continuance of secretarial activity	Information exchange
Database on teak resources	Outlook studies
Market intelligence on teak prices and availability of timber	Efficient marketing
Training programmes on cultivation and management of teak	Capacity building
Meetings of traders, growers and researchers	Better plans and policies
Research support on specific themes	Productivity enhancement
International consultancy assignments	Problem solving

Funding sources for TEAKNET

Annual Membership Fee -	Annual Amount (USD)	Lifetime Amount (USD)
Individual	25	250
Institutional/Organization	250	4000
Donor contributions		
	Amount (USD)	
DANIDA	10000	
FAO	18000	





TEAKNET
(International Teak Information Network)

Application for Membership/Renewal of Membership

Name _____

Institution/Organization/Company _____

Designation _____

Mailing Address _____

Tel. _____ Fax _____ E-Mail _____

Professional Category: ☐ Researcher ☐ Trader ☐ Grower ☐ Others (Specify) _____

In case of individuals, please provide the following details:

Passport Number _____ Date of Issue _____ Place of Issue _____

Issuing Authority _____

In case of Institutions, please provide the following details:

Public Sector/ Private Sector _____

Registration details of the organization _____

TEAKNET Membership Number if already a member: _____

Date: _____ Signature _____

Type of membership sought (Tick the one applicable): **Annual fee from the date of enrollment (USD)**

	<u>Individual</u>	<u>Organizational</u>
☐ Individual	25	250
☐ Institutional/Organization	250	4000

The payment of fee may be made either through demand draft or money transfer.

☐ Enclosed my bank draft for USD _____
(The Demand Draft may be drawn in favour of Director, KARI Forest Research Institute payable at Thiruvananthapuram, India and sent to the address given below)

OR

☐ Transferred USD _____ to Account No. 328902010019286 of the Director, KARI at Sakthi Arcade Branch of the Union Bank of India with Swift Code UBININ33H

Please retain this form in original to the Coordinator, TEAKNET, KARI, along with CD or money transfer details.
In the case of individuals, a copy of the passport photograph (self) will be needed.

Dr. K. Jayaraman,
 TEAKNET Coordinator,
 Kari Forest Research Institute, Panch 585, Thiruvananthapuram District,
 Kerala State, India
 Email: coordinator@teaknet.org



Services offered to TEAKNET Members

Members are entitled to have access to all the information available with the Secretariat.

Such information may include not only scientific information but also that of interest to traders like availability and price of teakwood, plantations or products from teakwood.

Invitations to periodical national or international meetings of the members wherein expert discussions are held on latest developments in cultivation, trading, processing or policies.

Members will have the privilege to present and discuss common issues of their interest and suggest action plans leading to the solutions. TEAKNET could arrange to send resolutions from such meetings to the concerned on behalf of the members.

As part of a long term strategy, TEAKNET plans to provide research support, training or consultancy services for any topical issues concerned with teak. TEAKNET would make deliberate attempts to generate funds for such purposes by approaching donor agencies across the globe.

Exchange of materials is yet another service that is thought of but will be subject to all the international regulations involved.



Impact on the global teak sector

Goal :

To transform the global teak sector from its current suboptimal state to that of a dynamic entity for the benefit of all stakeholders.

Sector development Indicators :

Higher productivity,
Higher production,
Better marketing, resulting in better flow of timber across the regions,
Affordable prices for the products,
Better quality products

Short term target :

If this happens during the next 5 years and continues so further, the purpose of TEAKNET will be served.

REDISCOVERING WOOD: THE KEY TO A SUSTAINABLE FUTURE
THE INTERNATIONAL CONFERENCE ON THE ART AND JOY OF WOOD

BANGALORE, INDIA

19 OCTOBER – 22 OCTOBER 2011



PART 3 - POSTERS

Rethinking of Wooden Heritage- An Overview

Sankara Rao¹

The use of wood may be traced to the pre-historic period. It was used in different forms like making fire, fuel, boxes, tools, toys, domestic articles, building materials of habitats, pillars, doors, gateways transportation, ritualistic symbols, marriage, palanquins, musical instruments, oil expellers etc. Since the ancient past to the present day, wood and wooden craft have been in continuous promulgation in human society. Indian craftsmen have used wood as one of the important mediums of art expression from the very beginning, mainly because of its availability and ease of use. We still use age old wooden objects and other things in our households because of their long standing use. They are traditional and have been passed on from one generation to the next, and the wisdom, wealth and variety of these works of art and craft is one of the most important cultural inheritances of mankind. The wooden material culture, knowledge and technology of our tribal and rural artisans and craftsmen has a rich heritage in this very old craft of wood carving that reflects the artistic skills on objects of design, function, utility, aesthetics, style and composition of wood and wooden art is highly appreciated in the present society. Wood craft is widely prevalent all over India, but with much regional, provincial and local variety.

The present paper is aimed to discuss various wood and wooden material culture objects of the Indira Gandhi Rashtriya Manav Sangrahalaya (National Museum of Mankind), Bhopal in Central India, Madhya Pradesh, which is one of the largest ethnographic museums in India. The museum is intended to represent, promote and preserve the material culture of different states across the country and also dealt with large scale wooden objects for documentation, display in different exhibitions, research and reference. It also focuses on the social, economic, cultural and environmental importance of wood. It also puts emphasis on how aspects of culture can facilitate creativity, imagination and divergent thinking of wooden art and crafts and how this can be affectively utilized as a learning process a joyful experience.

¹ Indira Gandhi Rashtriya Manav Sangrahalaya, (National Museum of Mankind), Post Bag No. 2, Shamla Hills, 462 013, Madhya Pradesh, INDIA (drpsrao2010@gmail.com)

Biofuel From woody (Lignocellulosic) Biomass for a Sustainable Future

Vindhya P Tewari²

Abstract

Using crops to make liquid fuel is not a recent idea. Biofuels are not only preferable to petrol but that there is also hope for biofuels' environmental and social redemption. The International Energy Agency (IEA) has laid out a 'roadmap' to ramp-up the use of biofuels from around 2% of global transport fuel today to 27% by the year 2050. Each year, more than 40 million tonnes of inedible plant material, including wheat stems, corn stover and wood shavings from logging, are produced. Turning these discarded, woody bits of plants into 'second-generation' biofuels has huge appeal. Two important methods are involved in taping this second generation biofuel from lignocellulosic wastes i.e. Biochemical and Thermochemical. Among these, Thermochemical methods coupled with FT Reaction pays the way to liquid fuel which can readily useful by present spark engine.

Fast-growing species can be grown on polluted soil, which also helps to reduce soil contamination. These trees convert carbon dioxide into biomass more rapidly than most other plants. Advanced biofuels hold promise of an escape from their predecessors' food-versus-fuel conundrum. Biofuels have been hailed as key to reducing our fossil-fuel dependence. Avoidance of energy crops vying with food crops for land use requires careful selection of species. Second-generation biofuels have their own drawbacks. Large-scale, second-generation biofuel production may take five to ten years. The inedible parts of plants feed the next generation of biofuels. But extracting the energy-containing molecules is a challenging task.

Keywords: Woody biomass, lignocellulose, fermentation, digestion, liquefaction, pyrolysis, gasification, second generation biofuel

² Institute of Wood Science & Technology, Bangalore, INDIA (vptewari@icfre.org)

1. INTRODUCTION

Energy from biomass accounts for 15 percent of energy consumed worldwide and up to 90 percent in some developing countries (FAO, 2004a). Wood energy accounts for 7 to 9 percent of energy consumed worldwide, and up to 80 percent in some developing countries (97 percent in Bhutan, 93 percent in Burundi, 92 percent in Nepal, 80 percent in Paraguay). Woodfuels account for 60 percent of global forest product consumption (FAO, 2004b). Forest biomass is one of the resource available plenty in the nature. 600 million tons of agricultural residues and 25 million tons forest residues are produced annually in India. More than 2 billion people are dependent on woodfuel for cooking, heating and food preservation and several million people are involved in the production, distribution and sale of fuelwood and charcoal (UNDP, 2000). Indian contribution in World Woodfuel production is 17%.

Using crops to make liquid fuel is not a recent idea. As far back as the nineteenth century, Rudolf Diesel designed his eponymous engine to run on vegetable oil or peanut oil. And Brazil has mandated the addition of sugar-cane-derived ethanol to its fuel since 1929 (Graham-Rowe, 2011).

The most controversial aspect of biofuels is the perceived competition for farmland. The advances in biofuels and agriculture may send this trade-off speeding towards the history books.

Biofuels are not only preferable to petrol (gasoline) but, with technological advances, there is also hope for biofuels' environmental and social redemption. Annual output of bioethanol and biodiesel had exploded from 16 million litres worldwide in 2000 to more than 100 million litres in 2010.

The International Energy Agency (IEA) has laid out a 'roadmap' to ramp-up the use of biofuels from around 2% of global transport fuel today to 27% by the year 2050. Biofuels, according to the IEA, could displace enough petroleum to avoid the equivalent of 2.1 gigatonnes of carbon dioxide emission each year if produced sustainably — about as much as net carbon dioxide absorbed by the oceans (Fairley, 2011).

In May 2011, the Intergovernmental Panel on Climate Change (IPCC) issued a report on renewable energy projects concluding that biomass can by mid-century sustainably provide up to 300 exajoules — more than four times the biomass needed to meet the IEA target of 27% of the worlds' transportation fuel coming from biofuels.

2. BIOFUEL FROM WOODY BIOMASS

Each year, more than 40 million tonnes of inedible plant material, including wheat stems, corn stover and wood shavings from logging, are produced. Turning these discarded, woody bits of plants into 'second-generation' biofuels has huge appeal (Sanderson, 2011).

The woody material that gives plants their rigidity and structure comprises three main types of carbon-based polymer — cellulose (35-50%), hemicelluloses (25-30%), and

lignin (15-30%) — collectively called lignocellulosic biomass and tightly bonded by physical and chemical interactions. When taken apart, these polymers yield chemical components that can be used to make biofuels.

At present, the best way to break apart these lignocellulosic materials and extract their chemicals for fuel production involves heat and strong chemicals. Conversion of lignocellulosic biomass is more complex due to presence of polysaccharide molecule and hence requires further enzymatic treatment to produce ethanol from sugar.

For now, enzymatic biofuel remains at pilot scale. The enzymes so far discovered are not very efficient, to employ these techniques on a large scale is unsustainable — the existing process consumes more energy than is contained in the molecules it releases (Sanderson, 2011).

The good news is that there are alternative sources of enzymes. Some creatures happily survive on a diet of wood. So perhaps humans just need to find out how these enzymatic processes work and then apply them in an industrial setting.

Cellulose is the best source for glucose because it is highly available, renewable, and does not compete with the food supply. However, this raw material is not soluble in conventional solvents and very resistant to chemical and biological transformations. Although optimistic and pessimistic hypotheses around the transformation of cellulose over solid catalysts can be formulated, regarding the knowledge accumulated on the hydrolysis of cellulose over the last century, current practice has demonstrated that there is indeed promise (Rinaldi and Schuth, 2009).

Advanced biofuels hold promise of an escape from their predecessors' food-versus-fuel conundrum (Graham-Rowe, 2011). The problem is their presently higher production cost compared with first-generation biofuels and petroleum fuels. At the moment, advanced biofuels are far from competitive — but that should change. The IEA estimates that by 2050, cellulose-based biofuels will be produced for as little as 75 US cents per litre-equivalent. But bridging the gap will require continued investment, research and development. But the ground is shifting back towards biofuels, partly owing to a series of natural disasters and societal shifts that have heightened the urgency of avoiding petroleum.

Biomass can be converted into useful forms of energy using a number of different processes. Conversion of biomass energy is undertaken using two main process technologies, Bio-chemical/Biological and Thermochemical, for producing energy from biomass. Factors that influence the choice of conversion process are:

- Type and quantity of biomass feedstock.
- Desired form of the Energy
- Environmental standards
- Economic conditions.

3. BIOCHEMICAL CONVERSION

Biochemical conversion encompasses two process options:

- Fermentation (Production of ethanol)
- Digestion (Production of biogas, a mixture of mainly methane & CO₂)

3.1 Fermentation

Fermentation is used commercially on a large-scale in many countries to produce ethanol from sugar crops (e.g. sugarcane, sugar beet) and starch crops (e.g. maize, wheat). The biomass is ground down and the starch is converted by enzymes to sugars, with yeast then converting the sugars to ethanol. But the conversion of lignocellulosic biomass (such as wood and grasses) is more complex, due to the presence of longer-chain polysaccharide molecules and requires acid or enzymatic hydrolysis before the resulting sugars can be fermented to ethanol. Such hydrolysis techniques are currently at the pilot stage. While conventional processes for ethanol production use only the biomass components like sugar and starch, R&D focuses on advanced processes that utilize all available lignocellulose materials like cellulose waste, cereal straw and food processing waste (McKendry, 2002). India is one of the largest producers of ethanol and currently all commercial ethanol production in country uses molasses as feedstock. However, most of it is consumed for application in liquor and chemical industries and surplus availability can barely support the demand created by mandatory 5% blending of ethanol in gasoline implemented several states (Sukumaran et al., 2010).

3.2 Anaerobic digestion

Anaerobic digestion is the conversion of organic material directly to a gas, termed biogas, a mixture of mainly methane and carbon dioxide with small quantities of other gases such as hydrogen sulphide (EU, 1999). The biomass is converted by bacteria in an anaerobic environment, producing a gas with an energy content of about 20–40% of the lower heating value of the feedstock. Anaerobic digestion is a commercially proven technology and is widely used for treating high moisture content organic wastes. Biogas can be used directly in spark ignition gas engine and gas turbines and also it can be upgraded to higher quality i.e. natural gas quality, by the removal of CO₂ (McKendry, 2002).

3.3 Limitations of biochemical conversion

Biochemical routes, however, face some challenges such as:

- High pre-treatment
- Enzyme costs
- Low fermentability of mixed sugar stream
- Generation of inhibitory soluble compound (e.g. acetic acid, furfural etc.)
- Biochemical routes produce only ethanol
- In biochemical process, especially fermentation process, ethanol is produced from crops like sugarcane, wheat etc. but in a country like India with the

worlds second largest population to feed, sparing food crops for ethanol production is not an option

4. THERMOCHEMICAL CONVERSION

Thermochemical conversion provides following four options:

- Combustion
- Pyrolysis
- Gasification
- Liquefaction

4.1 Combustion

The burning of biomass in air is called combustion. This process can be used over a wide range of outputs to convert the chemical energy stored in biomass into heat, mechanical power or electricity using various items of process equipment. Combustion of biomass produces hot gases at temperatures around 800–10000C. It is possible to burn any type of biomass but in practice combustion is feasible only for biomass with a moisture content <50%, unless the biomass is pre-dried. Net bio-energy conversion efficiencies for biomass combustion power plants range from 20% to 40% (McKendry, 2002). In India, till March 2005, power generation capacity of about 302 MW was commissioned through 54 projects (MNES, 2005). A further capacity addition of about 270 MW through 39 projects was reported to be under implementation.

4.2 Pyrolysis

Pyrolysis is the conversion of biomass to liquid, solid and gaseous fractions, by heating the biomass in the absence of air to around 500⁰C. The conversion of biomass to bio-crude with an efficiency of up to 80% (Anon, 1993; EU, 1999; Anon, 1996) has been achieved. Problems with the conversion process and subsequent use of the oil, such as its poor thermal stability and its corrosivity, still need to be overcome.



4.3 Liquefaction

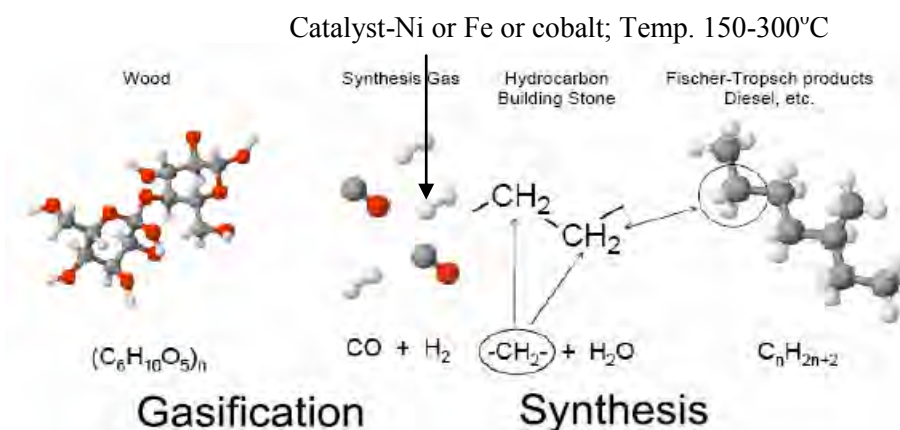
Thermochemical liquefaction is conversion of biomass in to a stable liquid hydrocarbon using low temperature and hydrogen pressure. The interest in liquefaction is low because the reactors and fuel feeding system are more complex and more expensive than pyrolysis process.

4.4 Gasification

Gasification is the conversion of biomass into a combustible gas mixture by the partial oxidation of biomass at high temperatures, typically in the range 800–900⁰C.

Biomass gasification results in production of combustible gases consisting of Carbon monoxide (CO), Hydrogen (H₂) and traces of Methane (CH₄). This mixture is called the Producer Gas. The gas produced can be burnt directly or used as a fuel for gas engines and gas turbines to convert the gaseous fuel to electricity with high overall conversion efficiency or it can be made into liquid form in the presence of Catalysts (Ni, Fe, Co), in high pressure and heat. The gasification ensures high conversion efficiency, producing net efficiencies of 70–80%. In India, at present, there are 1900 gasifier running successfully by support of Ministry of Non-conventional Energy Sources (MNES) having power production of 100 MW (MNES, 2008).

Gasification coupled with catalytic conversion to liquid using Fischer-Tropsch (FT) process, Biomass to Liquid Technology (BTL), proved to be an efficient technology for biofuel production. FT synthesis can be characterized by unavoidable production of wide range of hydrocarbon products (olefins, paraffin and oxygenated products). FT synthesis is in principle a carbon chain building process where CH₂ groups are attached to the carbon chain. The reaction is dependent of catalyst mostly an iron or cobalt catalyst, Ruthenium (Ru) can also be used as catalyst but its availability is low. In FT coupled gasification, the synthesis gas produced by gasification may be fed into FT reactor where the chain growth takes place thus producing a wide range of hydrocarbons like gasoline and bio diesel. The largest Coal to Liquid (CTL) producer is Germany (IEA, 2007).



Biomass to Liquid (BTL) has many advantages (NTNU, 2005) such as:

- Fits to any diesel engine / current infrastructure system
- Sustainable / renewable and almost CO₂ neutral
- Clean fuel – no SO_x, high reduction in NO_x and particle emissions
- Significantly higher yield per acre than 1st generation bio-fuel.
- High energy density (~ 40 MJ per Liter)
- Highly stable – storage & transport not an issue
- Produced domestically – creates jobs
- Broadest feedstock base of any biofuel
- Energy security

4.5 Merits of thermochemical conversion (specially Gasification) (Sims *et al.*, 2010)

- Thermochemical routes can be employed to produce a range of longer chain hydrocarbon from synthesis gas.
- The synthesis gas can also be converted to methanol as well as to higher alcohols for transport fuel application using modified catalyst to provide better yield.
- Although combustion and Pyrolysis have been considered as one of the processes for biomass energy conversion but conversion of biomass by gasification into fuel suitable for use in gas engine increases greatly the potential usefulness of biomass as renewable resources.
- Gasification is a robust proven technology that can be operated either as a simple low technology system based on a fixed bed gasifier.
- Unlike combustion, where oxidation is substantially complete in one process, gasification converts intrinsic chemical energy of the carbon in biomass into a combustible gas in two stages.
- The gas produced can be standardised in its quality and can be used to power gas engines and gas turbines or used as a chemical feedstock to produce liquid fuels.

5. SUGGESTIONS AND REMARKS

To avoid the energy crops vying with food crops for land use requires careful selection of species. Fast-growing species of willow or poplar trees, for example, can be grown on polluted soil, which also helps to reduce soil contamination (Graham-Rowe, 2011). These trees convert carbon dioxide into biomass more rapidly than most other plants — a trait that should translate into high biomass yields.

Progress in biofuels requires not just technical advances, but a level of predictability in the economic and policy terrain. The problem is a lack of consensus on how to measure environmental impacts of biofuels.

Biofuels have been hailed as key to reducing our fossil-fuel dependence, yet their environmental and social impacts remain uncertain (Robins, 2011). A biomass-based fuel needs to be cheap and energy dense (Savage, 2011). With BTL process, lignocelluloses biomass can efficiently be used to produce biofuel which can directly be used in spark ignition gas engine.

Second-generation biofuels have their own drawbacks. They still require land, and even plants that need minimal input will compete with food crops for some resources (Graham-Rowe, 2011). Large-scale, second-generation biofuel production may take five to ten years. The inedible parts of plants are feeding the next generation of biofuels. But extracting the energy-containing molecules is a challenging task.

The biggest hurdle faced by these second-generation biofuel technologies is not a dearth of clever science. It is the lack of brave investors willing to take a gamble on a new technology and the absence of enforced legislation that would encourage the production of cellulosic biofuels over first generation crop-based fuels (Sanderson,

2011). Until these problems are solved, woody plants will be able to cling tight to their stash of fuel for a little longer.

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Heritage Wood Craft: Perspective on Decay Management

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Abstract

The tradition of wood-carving has existed in India and other countries from ancient times. The early wood-carved temples bear witness to the craft. Wood-carved temples and chariots still exist in different places in India and each region has developed its own style of carving influenced by local traditions and wood varieties. Most places of worship include large carvings of mythical figures like half-man, Garuda, Hanuman and lion etc. Folk forms in woodwork include toys, puppets and religious objects and carvings. Wooden cultural properties are degraded by microorganisms when moisture, oxygen and other environmental factors are favorable for microbial growth resulting in disfigurement and spoiling the beauty of carvings by change of color and shape. Fungi produce large numbers of spores and when these spores liberated from infected heritage buildings/ carvings to the indoor air, it can be regarded as organic dust. These spores can, like other types of dust, result in sediment on surfaces or it could be inhaled by occupants and deposited on the mucosal surface of the upper airways and in the eyes. Repeated exposure to large amount of fungal propagule risks the development of specific allergic reactions.

Management of these sculptures in good condition by controlling the environment around a susceptible biodegradable material is still the most frequently used method of preventing biological decay. Correct identification of the fungal material is important, as not all fungi are equally destructive. Some rots are present in timber when it is cut or are acquired during storage. Management of decay and health problems in heritage buildings and wood craft is a complex issue and requires a multidisciplinary integrated approach, which combines the skills of pathologist & architects and with environment monitoring. One can enjoy the traditional wood craft following proper management strategies. Details of the decay problem and their management are dealt in the present paper.

Key words: Wood-artifact, decay fungi, and culture-heritage

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1. INTRODUCTION

The custom of wood-art has existed in India and also in many countries from primeval times. In India, each region has developed its own style of carving influenced by local traditions and wood varieties. Folk forms in woodwork include toys, puppets and religious objects and carvings. In many places in India, wood-carvers work wonders.

In south Kanara (Karnataka), life-size wood carving of Buddha figures are common. Mysore has an intricate form of ivory-inlay on wood that can be seen on the ceilings and doors of the Mysore Palace. In Orissa, the main deity of the famed Puri temple, Lord Jagannath, is reproduced in wood. Nagaland has a tradition of manufacturing statues as well as commemorative pillars in wood. Most places of worship include large carvings of mythical figures like half-man, Garuda, Hanuman and lion. In West Bengal, clay houses have large wooden pillars and beams with intricate carvings. In Kashmir, houses are lined with wood, with ceilings in geometrical patterns and lattice-worked windows made up of pieces of wood. The state also produces items like decorative wood panels on ceilings, furniture, screens, boxes and bowls, mostly prepared from walnut wood, which is found in abundance. Ahmedabad in Gujarat is a witness to some of the finest ornamental carvings of balconies in old homes. Bedposts and cradles and toys for children are also made here. The Tanjore dolls of Tamil Nadu made of wood form a part of the rituals in temples that also have carved wooden pillars. In Andhra Pradesh, Tirupathi's red dolls are sold at the temple complex. Kerala has one of the richest traditions in woodcarving. Old homes have carved doors and windows.

Different durable species are used for this wood-art. Wood indoors or exposed to outdoors conditions can last for centuries without any decay problems provided the wood is not exposed to moisture or any other hazardous conditions. Historic and archaeological woods are important cultural objects that provide valuable information about the past. Wood in the environment, however, is deteriorated by a wide variety of biotic and abiotic processes. Usually, wood that survives long periods of time is recovered from environments that limit degradation. Even in some of the most extreme terrestrial sites, such as in desert or polar ecosystems, the adverse and restrictive environment allows wood deterioration to occur. Wooden works are degraded by microorganisms when moisture, oxygen and other environmental factors are favorable for microbial growth resulting in disfigurement and spoiling the beauty of carvings by change of color and shape. Although deterioration may take place slowly, substantial degradation can occur over time. Recent findings have indicated that salts and other non-biological agents can have a significant impact on the integrity of historic and archaeological woods (Blanchette et al. 2002) and biological decay by soft rot fungi can be common (Blanchette et al. 2004). Weathering and decay are the main cause which influences the service life of wood and wood-art. Weathering of wood in turn leads to decay problems. Tackling these two problems and managing them is a very important aspect to maintain the heritage of wood-art in good condition.

Decay problems in Wood-art

Wood deteriorates rapidly from a variety of different biotic processes when exposed to different environmental conditions. When moisture, oxygen and other

environmental factors are favorable, fungus will grow and devastate the appearance of the art-work. Archaeological woods recovered from most environments suffer from some form of bio-deterioration. Wood destroying fungi cause extensive losses to wood products throughout the world. Historic and archaeological woods that survive long periods of time are usually found in environments that limit decomposition. However, these woods are rarely found free of microbial attack. The wood destroying fungi associated with decay in archaeological wood are seldom identified and little is known about these organisms (Blanchette, 1991). 'Huts in the Ross Sea Region' of Antarctica built by Robert F. Scott and Ernest Shackleton (1902 – 1911), 'Canadian High Arctic' erected during the Franklin era (1852) were studied by the U.S. expeditions. These investigations were done to better understand decomposition processes occurring in Polar Regions and to develop conservation efforts to preserve these important international historic sites. Additional investigations were also done on wood structures located in relatively arid sites built in the southwestern United States by Native North Americans. Decay assessments were done and samples obtained from wooden beams and supports in mud brick great houses erected approximately 1000 years ago in what is currently Chaco Culture National Historic Park and Aztec Ruins National Monument located in New Mexico, USA.

Major agents of wood deterioration causing disfigurement and decay are filamentous fungi. The vegetative or non-reproductive part of the life histories of the filamentous fungi brings about the invasion and colonization of damp wood through the apical growth of hyphae and penetrates the wood by eating different parts of cell wall. The decay process under ideal conditions is a linear continuum that begins with a few innocuous spores and ends when the wood is destroyed or mineralized. When conditions are unfavorable, fruiting bodies (Sporophore) are formed and shed the spores, which alight on damp wood and life cycle continues. The characteristic softening, discoloration and eventual disintegration of wood takes place in decaying process in timbers and also large numbers of spores are liberated from fungi in infected heritage buildings/ carvings to the indoor air, which can be regarded as organic dust. These spores can, like other types of dust, sediment on surfaces or it could be inhaled by occupants and deposited on the mucosal surface of the upper airways and in the eyes leads to the development of specific allergic reactions.

Decay caused by soft rot fungi was the major type of degradation found in woods from the historic sites in Antarctica and the Arctic. Many different *Cadophora* species were found including *C. malorum*, *C. luteo-olivacea* and *C. fastigiata*, as well as several unique species not previously reported. Soft rot fungi were also found affecting the woods from the Native American great houses in 'New Mexico'. Several *Scytalidium* like isolates were found as well as other undescribed Ascomycetes. Historic wood in contact with the ground at these arid sites were also colonized by basidiomycetes including brown rot fungi. Currently, molecular characterization and phylogenetic analyses are providing a more complete understanding of the fungi causing damage to wooden archaeological structures in different environments. Additional information is now needed on the biology and ecology of these unique organisms in order to properly conserve these wooden structures and prevent their continued degradation from wood destroying fungi. Soft rot fungi appear to be very prevalent in extreme environments that restrict the growth of white and brown rot fungi (Blanchette, 2000). Visually, soft rot may resemble other forms of decay but microscopically the decay patterns produced are distinct. They consist of two forms of

degradation: type 1 and type 2. Soft rot fungi that cause type 1 attack grow into the lumina of wood cells and penetrate the secondary cell wall (Daniel and Nilsson 1998, Eaton and Hale 1993). As the hyphae grow in the wall, degradative enzymes are produced and cavities inside the wall are formed. Chains of conical-shaped cavities follow the microfibrillar structure of the cell wall producing a spiral of elongate holes inside the secondary wall. Type 2 attack is characterized by an erosion of the secondary wall as the hyphae grow in the cell lumina (Eriksson et al,1990, Daniel and Nilsson,1998). The wall is progressively eroded from the cell lumen toward the middle lamella and in advanced stages of degradation the entire secondary wall may be removed. The middle lamella, however, is not degraded. Several studies have investigated the various types of decay that have occurred in historic and archaeological woods (Blanchette, 2000, Blanchette et al., 1994). Active wood destroyer *Serpula lacrymans*, under appropriate conditions are able to destroy buildings in several years. Characterization of the decay is important since it provides information on the type of attack that has taken place, the extent of degradation and current condition of the wood. Few studies, however, have been done to identify the microorganisms involved in the decay processes taking place in historic and archaeological wood. Russian wooden architectural monument- St. Nicholas church ensemble in the village of Kovda in Murmansk region at the shore of Kandalaksha Bay of the White Sea (Stephen J Kelley, 1954) are destroyed due to *S. lacrymans*.

Outdoor wood-art faces the problem of photo-degradation, where lignin and cellulose are degraded by forming free radicals and this process is accelerated by the presence of oxygen and moisture along with bio-degradation with fungal invasion. Protection is very important to guard the heritage wood art from damage. The type of protection to be adopted may vary with type of art work and whether it is kept indoor or outdoor and the type of environment etc.

Restoration strategy and protection of wood-art

The rate of wood decay is an important factor to bear in mind when choosing a restoration strategy for wooden architectural monuments/artifacts. Carrying out restoration hurriedly often leads to the destruction of authentic monuments because of restoration strategy fails to take into account the natural conservation of the wood caused by the biological equilibrium between wood decomposing organisms established during the period of a monuments life. This equilibrium results in minimizing of dangerous fungi activity and prevents the active growth and spread of the dangerous building rot fungi. As for old buildings that have been in existence for centuries, contamination by the fungi also happened long ago. This monument represents an example of natural wood conservation as well as an appropriate restoration that has lead to the destruction of this unique monument.

Many factors influence the microbial invasion, colonization and consequent deterioration of wood. These include the nature of the substrate itself (wood), the situation in which wood is exposed, the environmental conditions in that situation and the presence or not of any preservative treatment in the wood. Moisture content of timber is usually most critical factor in the establishment and continuation of decay of timber in heritage buildings/wood sculptures, and it may have an influence on the type of decay that develops. The moisture content of timber is related to the humidity or dampness of its environment. Conversely, in buildings which are correctly designed,

constructed and maintained and well-aerated where the wood artifact will not absorb moisture, the wood will be free from fungal attack. When wood is too dry (below 20%), the decay will be arrested. When, wooden monuments/artifact cannot be kept dry and constantly exposed to humid condition, treatment with wood preservatives is necessary. Wood preservatives contain toxic substances designed to inhibit the activity and viability of organisms.

In situ protection of wood in structure poses a real challenge. Portable/small wood-art objects are easy to handle and can be kept under controlled conditions or may be subjected to treatment or some safety measures can be adopted to prevent decay. A large number of chemicals are available for restoration of damaged objects and their future preservation. The choice and use is however limited as some of the chemical leaves the stain or alter its natural color. Depending on necessity, chemical preservative and type of treatment may be decided.

There are two commonly available inexpensive materials that will kill rot in wood and prevent its recurrence. First, there are borates (borax-boric acid mixtures) which have an established record in preventing rot in wood and in killing rot organisms and also wood-destroying insects in infested wood. Second, there is ethylene glycol, most readily available as auto antifreeze-coolant. Glycol is toxic to the whole spectrum of organisms from staphylococcus bacteria to mammals. Both borate solutions and glycol penetrate dry and wet wood well because they are water-soluble; in fact, penetration by glycol is especially helped by its extreme hygroscopicity. Glycol penetrates rapidly through all paint, varnish, and oil finishes (except epoxy and polyurethanes) without lifting or damaging those finishes in any way. One can treat all of the wood-art without removing any finish. The dyes in glycol antifreeze are so weak that they do not discolor even white woods. Once bare wood has been treated with glycol or the borate solutions and become dry to the touch it can be finished or glued. If a borate solution leaves white residues on the surface, it will have to be washed off with water and the surface allowed for drying.

Polyethylene glycols and various types of monomers have been used for impregnation of wood to make them dimensionally stable. These bulking treatments can keep the wood fairly dry and protect it from fungal attack (Mitchell, 1972).

Chromic acid treatment on wood surface has been found to enhance resistance to photo-degradation (Feist, 1979) and fungus (Nagaveni et al, 2001). Similar results were reported from 'Ammonical copper-chromate (ACC)' and 'Ammonical copper-chromate arsenate (ACCA)'. Treating the wood surface with resorcinol solution prior to treating with acid-copper-chromate improves the permanence of chemical in wood as well as imparted natural brown color. Other effective coatings for protection against weathering are Cupriethylene diamine, Copper molybdate and Copper ferricyanide.

Pentachlorophenol dissolved in mineral solvents and containing paraffin wax are water repellant preservative (WRP) is an excellent wood preservative for long protection of wood against mold fungus, insects and even water. Water repellants consisting of resins dissolved in mineral spirits with addition of wax have also been found to perform well (Feist and Marz, 1978). Some paints are fungus resistant paint, which may be used for humid area where wood art is kept. Special formulated paints

containing preserving chemicals can protect wood against decay (Hoffmann et al 1973). The basic principle of such protection is to keep the water out. Water repellent preservatives are better for overall protection of wood sculpture.

Outdoor protection of wood needs specially formulated systems, especially in situations where the natural look of the wood surface to be maintained. Application of monomers like Methyl-methacrylate and their in-situ polymerization may restore the degraded surface and protect the wood from future degradation (Fiest and Rowell, 1982).

For complete protection of wood, incorporation of toxic chemicals in the wood is necessary. Since it is not possible to impregnate chemicals without pressure treatment fumigants such as Chloropicrin, Methyl isocyanate and N-methyl-dithio-carbonate) may be encapsulated in gelatin for slow release of the chemical and can be expected to be effective for period of 10- 15 years or even more depending on exposed conditions.

The chemical preservation mentioned should be adopted depending on the situation of the wood art, type of fungal attack and its environmental factor association. If one understands the situation, management strategy can be adopted accordingly and this cultural heritage can remain undisturbed so that future generations can enjoy the beauty of wooden art work.

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Indian's Choice of Timbers as Reflected in Wood Import Through South Indian Seaports

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Abstract

*The present paper analyses India's choice of timbers as reflected in the woods imported through five south Indian seaports viz., Chennai Port (Tamil Nadu), Cochin Port (Kerala) New Mangalore Port (Karnataka), Tuticorin Port Trust (Tamil Nadu), and Visakhapatnam Port (Andhra Pradesh) during the years 2004-09. The study revealed that these ports imported 120 types of wood species from 62 countries. The total quantity of wood imported was 51.229 Cu. M. lakhs during the period in which the major wood species imported was Teak logs, *Tectona grandis*. (23.528 Cu. M. lakhs) followed by Gurjan logs, *Dipterocarpus* sp. (9.176 Cu. M. lakhs), Pyinkado logs, *Xylia* sp. (6.331 Cu. M. lakhs), Beech logs, *Fagus* sp. (4.982 Cu. M. lakhs), Maple logs, *Acer* sp. (4.246 Cu. M. lakhs), Merbau logs, *Instia* sp. (2.011 Cu. M. lakhs) and remaining woods to the tune of 0.955 Cu. M. lakhs. The analysis indicated teak as the most preferred wood species in India as it forms 45.93% of wood imported and these findings are presented in this communication.*

Keywords: India, wood import, *Tectona grandis*

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1. INTRODUCTION

Wood is one of the most important renewable natural resources available to man. It is perhaps the first material used by man since time memorial when he was roaming the icy wilderness and is prevalent in our everyday lives and in the economy at large (Bell and Rand, 2006). Until this century wood was the single greatest material aid and comfort in every century of our ancestors lives. It is the prime product of forests for diverse industrial and structural applications. Contrary to common but incorrect perceptions, use of wood is in fact ever increasing, more so in developing countries like India (Rao, 2002). On a worldwide scale, the industrial use of wood approximates that of cement and steel and far exceeds plastics (Schulz, 1991). Along with new uses, more and more applications of wood are being re-discovered and documented, especially its importance as an environmentally friendly material that is remarkably reusable, recyclable, biodegradable and more importantly, as a renewable natural resource. Because of the many advantages in its usage, it is put to a myriad of applications. India is a timber deficient country meeting major demands by wood imports and is importing wood and forest products to the tune of approximately US\$1,028 million every year (FAO, 2000). According to International Tropical Timber Council survey, India is emerging as a major importer of tropical timber (Duncan, 2003) with the demand predicted to rise from 60 million Cu. M. in 2005 to 153 million Cu. M. in 2020, and domestic production is likely to meet only 60 million Cu. M. (Lawson and Hemery, 2007). This paper analyses the Indian's choice of timbers as reflected in the woods imported through south Indian seaports viz., Tuticorin Port Trust (Tamil Nadu), New Mangalore Port (Karnataka), Chennai Port (Tamil Nadu), Cochin Port (Kerala) and Visakhapatnam Port (Andhra Pradesh) during the years 2004-09 and the findings are presented.

2. MATERIAL AND METHODS

Details of woods imported through five south Indian seaports viz., Chennai Port (Tamil Nadu), Cochin Port (Kerala), New Mangalore Port (Karnataka), Tuticorin Port Trust (Tamil Nadu), and Visakhapatnam Port (Andhra Pradesh) during the years 2004-09 were collected from the concerned Plant Quarantine Stations of south India and Directorate of Plant Protection Quarantine and Storage, Faridabad. Chennai port is the third oldest among the major 12 ports of India and is an emerging hub port in the East Coast of India. It is strategically located and well connected with major parts of the world and is the hub port on the Indian subcontinent. The port of Cochin is located on the south west coast of India, at Willingdon Island in the state of Kerala. It is a natural seaport, which is located strategically close to the busiest international sea routes. Mangalore port is on the West that imports wood required for most parts of Karnataka, Kerala and some parts of Andhra Pradesh, Maharashtra and Tamil Nadu. Tuticorin port has been a centre for maritime trade and pearl fishery for more than a century. This natural harbour with a rich hinterland activated the development of the port, initially with wooden piers and iron screw pile pier and connections to the railways. The Port of Visakhapatnam is the Gateway to the east coast of India. It plays a crucial role as the middle-point distribution base for Southern, Eastern, Central and Northern states of India. The data collected on the wood imports were analysed following standard procedures.

3. RESULTS AND DISCUSSION

The data collected indicated that India imported wood from 62 countries through the five south Indian seaports from 2004-2009. Total quantum of 51.229 lakhs Cu. M. wood was imported through these ports during the survey period. Among the ports Chennai port imported 20.328 lakhs Cu. M. from 35 countries followed by Tuticorin imported 12.748 lakhs Cu. M. from 27 countries, Mangalore imported 9.534 lakhs Cu. M. from 22 countries and Visakhapatnam and Cochin ports imported 7.199 lakhs Cu. M. 1.4204 lakhs Cu. M. respectively from 16 countries each (Table 1). Among the countries, Myanmar is the major wood supplying country (39.67%) followed by Malaysia (13.12%), Congo (9.77%), Ghana (8.11%), Ivory Coast (8.01%), Benin (4.40%), Papua New Guinea (4.31%), Togo (3.00%), Cameroon (2.17%), Denmark (2.00%) and Germany (1.97%). Other African countries contributed less than one percent of wood supply to India through these seaports (Table 2). Among the wood species imported Teak logs, *Tectona grandis* was dominant with 45.93% followed by Gurjan logs, *Dipterocarpus* sp. 17.91%, Pyinkado logs, *Xylia* sp. 12.36%, Beech logs, *Fagus* sp. 9.72%, Maple logs, *Acer* sp. 8.29%, Merbau logs, *Instia* sp. 3.93% and remaining woods 1.86%. (Table 3). It indicated that teak is the most preferred species of usage in south India as reflected by the wood imports through these major five south Indian seaports. Teak (*Tectona grandis*) is one of the world's premier hardwood timbers, rightly famous for its mellow colour, fine grain and durability (Pandey and Brown, 2000). Its resistance to termites, fungi and other wood destroying agents is remarkable. This has made it very popular and there is regular demand by the Indian traders and consumers (Somaiya, 2005).

The countries, which are exporting teak to India, include, Myanmar, Malaysia, Thailand, Indonesia and many African and Tropical American countries. Somaiya (2005) commented that the list of countries supplying teak to India is exhaustive and thanks to the demand for teak in India that those countries are able to sell their products. The ever-increasing need for teak timber has resulted in large-scale plantations, both within and outside its range of distribution and it is a species of significant ecological and socio-economic importance throughout the tropics. The largest manufactures of teak products are Indonesia, Thailand and India (Katwal, 2005). It is clearly the most preferred timber species for production of high quality sawn wood and veneer. It has been found to be eminently suitable for multiple end uses and is as a reference species for end-use classification of a number of tropical hardwoods (Rajput and Gulati, 1983). The worldwide demand for teak is much greater than the available sources (Dupuy, 1990) and India is still the biggest market for teak only (Somaiya, 2005). As the indigenous supply of teak diminishes and the demand continues to increase, it is vital to grow teak towards increasing production. It is likely that teak continues to be the choice of Indians and will occupy top most position in solid wood usage in India.

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Table1. Detail of south Indian seaports in which the wood is imported.

Sl. No.	Exporting Country	Seaport in which the wood is imported from 2004-2009				
		Chennai	Cochin	Mangalore	Tuticorin	Visakhapatnam
1.	Australia				+	
2.	Belgium	+	+		+	
3.	Benin			+		+
4.	Brazil	+				
5.	Cameroon	+		+	+	+
6.	Canada	+		+	+	
7.	Columbia	+			+	
8.	Congo		+	+	+	+
9.	Costa Rica	+				
10.	China	+		+	+	
11.	Denmark	+		+	+	
12.	ElSalvador	+				
13.	Ecuador					+
14.	Fiji	+				
15.	France	+	+	+		+
16.	Gabon	+	+	+	+	+
17.	Ghana	+	+	+		+
18.	Georgia	+				
19.	Germany	+	+	+	+	
20.	Guatemala					+
21.	Guyana			+	+	+
22.	Hungary					
23.	Indonesia	+	+		+	

24.	Italy	+	+	+		
25.	Ivory Coast	+	+	+	+	+
26.	Latvia	+				
27.	Liberia					+
28.	Madagaskar				+	
29.	Malaysia	+	+	+	+	+
30.	Myanmar	+	+	+	+	+
31.	Maldives		+			
32.	Netherlands				+	
33.	New Zealand	+		+	+	
34.	Nigeria	+				
35.	Panama	+				
36.	Papua New Guinea	+		+	+	
37.	Philippines				+	
38.	Poland		+			
39.	Portugal			+		
40.	Romania	+				
41.	Sierra				+	
42.	Spain	+				
43.	South Africa				+	
44.	Solomon Islands	+	+		+	
45.	Singapore	+		+		
46.	Srilanka			+	+	
47.	Sudan				+	
48.	Sweden		+			

49.	Taiwan					+
50.	Tanzania					+
51.	Togo			+		
52.	Tena	+				
53.	Thailand					+
54.	Turkey	+				
55.	Uganda			+		
56.	Uruguay		+			
57.	U.A.E.	+				
58.	U.K.		+			
59.	U.S.A.	+			+	
60.	Vietnam	+				
61.	Venezuela	+				
62.	West Africa				+	
	Total countries	35	16	22	27	16
	Total quantity of wood imported (Cu. M. lakhs)	20.328	1.4204	9.534	12.748	7.199

+ indicate wood imported

Table 2. Major wood supplying countries and the quantum of wood imported in the south Indian seaports from 2004-2009

Sl. No	Wood supplying Country	Wood supply (%)
1.	Myanmar	39.67
2.	Malaysia	13.12
3.	Congo	9.77
4.	Ghana	8.11
5.	Ivory coast	8.01
6.	Benin	4.40
7.	Papua New Guinea	4.31
8.	Togo	3.00
9.	Cameroon	2.17

10.	Denmark	2.00
11.	Germany	1.97
12.	Gabon	1.00
13.	West Africa	0.91
14.	Indonesia	0.83
15.	Guyana	0.73

Table 3. Quantity of various wood species imported in South Indian seaports during 2004-2009.

Wood species	Quantity (Cu.M.T in Lakhs) imported	Percent import
Teak logs, <i>Tectona grandis</i>	23.528	45.93
Gurjan logs, <i>Diptherocarpus</i> sp.	9.176	17.91
Pyinkado logs, <i>Xylia</i> sp.	6.331	12.36
Beech logs, <i>Fagus</i> sp.	4.982	9.72
Maple logs, <i>Acer</i> sp.	4.246	8.29
Merbau logs, <i>Instia</i> sp.	2.011	3.93
Others	0.955	1.86
Total	51.229	

Engineered Wood for sustainable Design and Construction

Dr. Shantharam Patil⁶ and Ms. Roshan Shetty⁷

Abstract

Architects, engineers and builders face significant challenges in the 21st century and among them, global environmental challenges must be a priority for our profession. On a planet with finite natural resources and an ever-growing built environment, engineers of the future must consider the environmental, economic, and social sustainability of structural design. Wood is the only building material on the planet which is naturally renewable, recyclable and leaves a lighter footprint than any other. Wood has a strong tradition in Indian culture and has always been one of India's major building materials. Thanks to its qualities and new technologies it is still one of the finest materials available to protect us and our environment. The main advantages are its physical and aesthetic qualities, workability, environmental sustainability, flexibility of space arrangement, dry construction, industrial production and comparative cost effectiveness. Wood works in accordance with nature and continuously inspires new directions in the design and construction of timber buildings. Excellent wood architecture, constant research and extensive experience with an understanding of timber construction make India one of the world's major wood architecture countries. As a construction material, it has been used very early next to stone, owing to its good material and mechanical properties. Different building types require different building component characteristics. To use them efficiently and economically a good understanding of the material, mechanical properties, structural and dynamical behaviour under various conditions are needed. This paper explores the properties and behaviour of timber in building structures and components. Although construction is never fully benign for the environment, designers and builders can make choices to minimize the impact. Wood plays an important part in sustainable design as shown by scientific analysis.

Keywords: Engineered wood, Mechanical properties, Strength, Structural, Grain, Stress

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1. INTRODUCTION

Protection and shelter against wind, rain and cold is a very basic need for mankind. Since ancient times, wood has been the most important material used for this purpose. Wood is a traditional building material because of its strength, availability and low cost. It is readily available and inexpensive because it is a natural, renewable material. Compared to other building products such as steel, wood is easily manipulated and assembled on-site which saves time and money.

As a structural material, wood offers some key advantages over other materials in earthquake performance. Wood is strong and lightweight, hence ground accelerations do not generate as much energy in wood buildings as in other buildings. Traditional wood frame homes make use of many types of wood products such as studs, girders joists, plywood, and trusses. The use of wood in many of the building's structural aspects allows the builder to save money without sacrificing strength or durability. Wood also gives flexibility to the builder to accommodate unique features and custom designs.

Wood can also be made into structural insulated panels (SIP-Figure 1). SIP's are a building material made of two wooden structural boards sandwiching an insulating material. Structural insulated panels have been used since the 1930's. Recently, SIP's have been becoming more and more popular. One reason is that they are a green alternative to the conventional use of studs and joists. SIP's are also very versatile as they can be used in residential, commercial and industrial. Another reason for their popularity is that less skilled labor and a lesser amount of time are needed to construct a building with SIP's than traditional lumber frame.

Structural insulated panels help improve the building envelope by providing greater thermal insulation. A building envelope, which includes the roof, walls, foundation, doors and windows, is the outer shield that protects a home from the environment. To provide a comfortable living environment, it is important to control the inside conditions from the outside conditions. To be reasonable, this has to be done in an efficient and cost effective way. SIPs help promote a tight envelope because they limit the amount of holes or entries for air to the inside or outside of the home. They also have a high insulating value with minimum thermal bridging which makes them ideal for extreme climate conditions. This results in a comfortable living environment. Structural insulated panels are used for walls, roofs, and floors. The structural faces are made of two oriented-strand boards (OSB) and the inner insulation is made of polystyrene, polyurethane or polyisocyanurate foam board.

The term “engineered wood products” is generally taken to refer to both materials and building elements fabricated with wood as a dominant material.

There are three broad groupings of engineered wood products:

(i) Structural elements cut from board or linear forms of homogeneous material.

Examples of these would be

- (a) slabs of Paralam, Scrimber, glulam, laminated veneer lumber,

- (b) board material in the form of plywood, oriented strand board, laminated strand lumber and
- (c) linear material such as finger-jointed lumber.

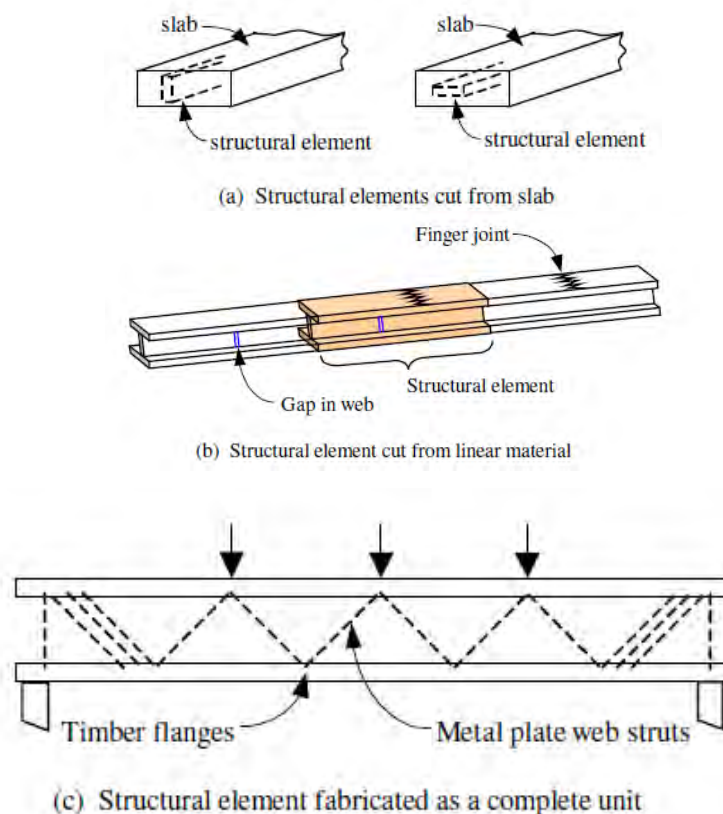
(ii) Structural elements cut from slab, board or linear forms of composite material.

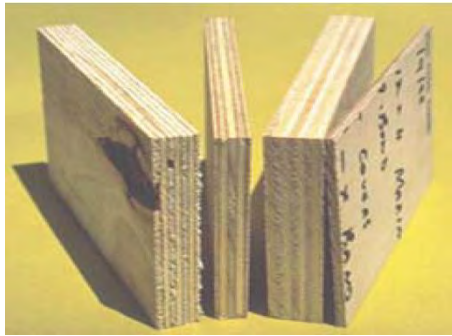
Examples of these include

- (a) boards of non-uniform layup,
- (b) sawn hardwood end-joined by metal plate connectors and
- (c) I-beams fabricated from a mixture of board and slab material.

(iii) Composite elements fabricated as complete structural elements.

Examples of these three types of engineered wood structural elements are illustrated in Figure 1.

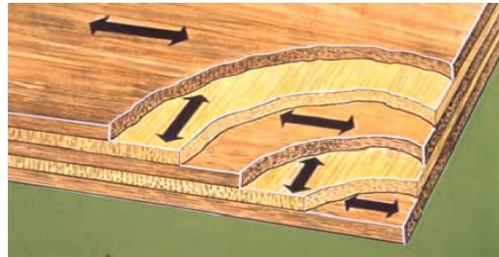




Structural Plywood



Glue Laminated Timber



Cross Lamination



Structural Laminated Veneer Lumber



Figure 1 Examples of Composite wood structural elements

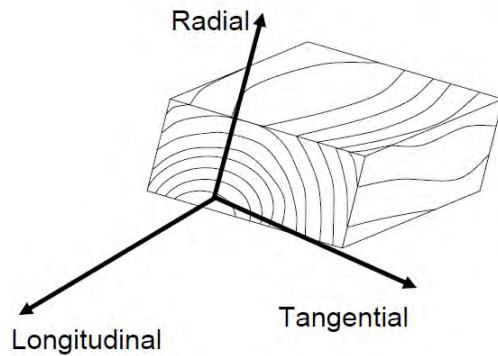
2. MECHANICAL PROPERTIES OF WOOD

Wood can be used in many popular structural forms from the light duty repetitive small structures to the larger and heavier framing systems used in commercial projects. Because wood has a high strength to weight ratio, dead load is a smaller component of the total load factor than for heavier material. Many mechanical properties of wood, such as bending and crushing strength and hardness, depend upon the density of wood; denser woods are generally stronger. Wood density is determined largely by the relative thickness of the cell wall and by the proportions of thick-walled and thin-walled cells present. The cells that make up the structural elements of wood are of various sizes and shapes and are firmly bonded together. Tiemann (1951) in his authoritative review of wood and other structural materials, concluded “weight for weight, dry wood without defect is stronger than steel. Because of its cell structure, wood has different strength properties in different grain directions and is therefore categorized as an anisotropic material. Different building types require different building component characteristics. To use them efficiently and economically a good understanding of the material properties, geometric properties

(aspect ratio, fibre orientation, stacking sequence – Figure 2), mechanical properties, structural and dynamical behaviour under various conditions are needed (Bodig and Jayne 1982). This paper explores the mechanical properties and behaviour of timber in building structures and components.

- Stress – It occurs when a load acts on a solid timber (column or beam). The force per unit area is called stress. Stresses – Tension, Compression and Shear (Figure 3 and Figure 4).
- Strain – The external forces deforms the shape and size of the timber. The change in length per unit of length in the direction of the stress is called strain.
- Bending – Determines bending tensile stresses, compressive stresses and shear stresses.
- Top half is under compression and bottom half is under tension. Maximum stresses are at upper and lower surfaces. No tension or compression at mid point – Neutral axis (Figure 5).
- There is a linear relationship up to the proportional limit. When stress is removed strain is completely recovered. Below the proportional limit ratio is constant – Young's Modulus (Figure 6).
- Tension strength parallel to grain – Important for bottom member (chord) in wood truss (Figure 7).
- Shear strength parallel to grain – Often determines of load capacity of short beam (Figure 8).
- Compression strength parallel to grain – Important in piles and columns (Figure 9).
- Compression strength perpendicular to grain – Important in design strength at connection strength between wood members and beam supports (Figure 10).
- Breaking strength (MOR) – Determines a load a beam will carry. MOR is accepted criterion of strength, although not a true stress as it is only true to the proportional limit (Figure 11).
- Toughness – Measure of amount of work needed to break small specimen by impact (Figure 12).
- Tension perpendicular to grain – Important in design of connections in buildings (Figure 13).
- Resilience – Measured by amount of energy absorbed when a timber is bent in the elastic range.
- Side hardness – Resistance to denting (e.g. Flooring)
- Work to maximum load – Measure of energy of member as it is slowly bent.
- Modulus of elasticity (MOE) – Measure of resistant to bending (directly related to stiffness of a beams) also a factor in the strength of a long column.
- Modulus of elasticity parallel to grain (Young's Modulus) – Measure of resistance to elongation or shortening of a specimen under uniform tension or compression.

Basic Wood Material Properties



Wood is orthotropic

- Varies with moisture content
- Main strength axis is longitudinal - parallel to grain
- Unique, independent, mechanical properties in 3 different directions
- Radial and tangential are "perpendicular" to the grain – substantially weaker

Figure 2: Basic Wood material properties

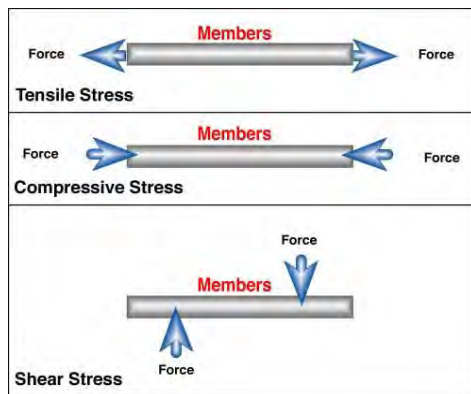


Figure 3: Forces on members

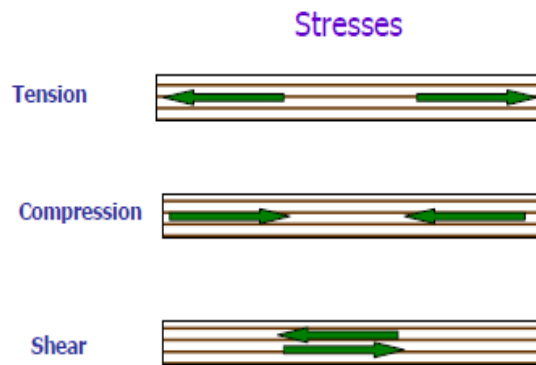


Figure 4: Stresses on members

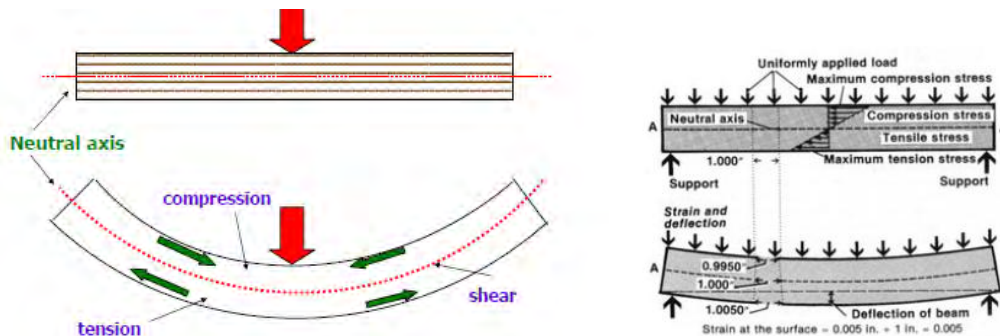


Figure 5: Bending

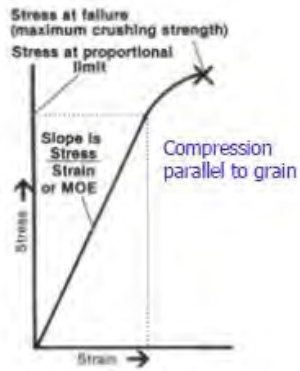


Figure 6: Stress strain curve

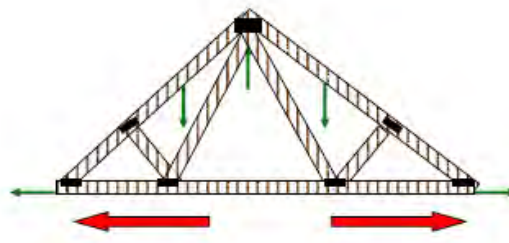


Figure 7: Tension strength parallel to grain

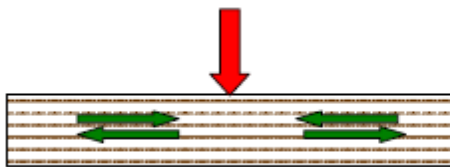


Figure 8: Shear strength parallel to grain

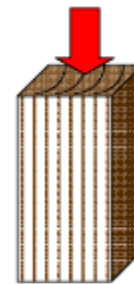


Figure 9: Compression strength parallel to grain

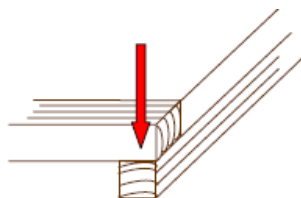


Figure 10: Compression strength perpendicular to grain

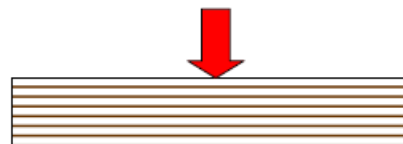


Figure 11: Breaking strength



Figure 12: Toughness perpendicular to grain

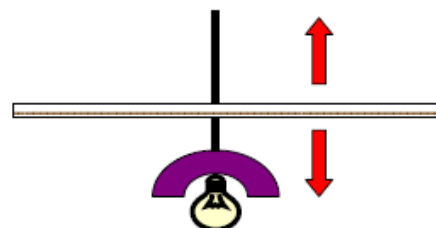


Figure 13: Tension strength

3. CONCLUSIONS

Future research related to engineered performance technology is essential for accurate prediction of static and dynamic behaviour, product innovation and for trade. Product innovation is particularly important as a means of coping with changes in resources, changes in regulations related to environmental concerns and changes in competition arising from the introduction of new building systems. Additionally it is quite likely that there will be an increasing trend towards the development of many new composite structural systems that combine wood with other materials so as to optimise the use of the available building material resources.

4. ACKNOWLEDGEMENTS

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Abstract

Hairatjit Kaur⁸ and Sangeeta Gupta

Abstract

Qualitative and quantitative features of shrub genera of 5 families viz. Caprifoliaceae, Loganiaceae, Melastomataceae, Myrtaceae and Oleaceae are studied to confirm the established relationship between wood anatomy and ecology. Moisture regimes of the genera are well revealed by Mesomorphy ratio, which incorporates vessel lumen diameter, vessel density and vessel element length. High Mesomorphy ratios were observed in genera from wet habitats in families: Melastomataceae and Myrtaceae. Low Mesomorphy ratios were obtained in shrub genera of dry habitats in families Caprifoliaceae, Loganiaceae and Oleaceae. Helical thickenings correlated with dry localities are found on vessel walls in Caprifoliaceae, Loganiaceae and Oleaceae. This aspect of correlation between wood anatomy and ecology can be used in reclamation of barren lands where ecology of the area can be used to decide the shrub genera to be planted in the concerned area.

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Studies on Silviculture and Wood Utilization of the Most Expensive and Rare Rosewood Species in China

Liu Sheng-quan⁹

Abstract

Dalbergia odorifera T.Chen, belonging to family of Leguminosae is the native species in Hainan province in China, what's more, it is the most expensive and rare rosewood species in China. The species is deciduous tree with smooth branchlets, coarse branches, alternating pinnate compound leaves, axillary panicle, ligulate oblong and swelling centrally pods. The tree is called heliophilous. High temperature and humidity can be favorable for the growth of this species. Propagation is achieved with seeds and cuttings. The heartwood can be formed within 5 years on average and is crimson, reddish-brown to deep reddish-brown with strong luster and dark brown or black strips. The grains are interlocked or swirls. The vessels, longitudinal parenchyma cells, fibers and xylem rays are all stratified. The beautiful ruleless figures are called grimace on the tangential section. Excellent wood properties and long-last spicy odor of the wood are overwhelming among various kinds of wood. So the wood has been used extensively especially like deep-dark and elegant furniture which can release aroma in persistence and last for hundred years without rotting. Moreover, this species can be of important medical use. With the decline of this species and the large market demand, more attention on the silviculture and utilization of the plantation of this species has been given in China.

Key words: *Dalbergia odorifera* T.Chen , Rose wood Species, silviculture, wood utilization

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The Technology of Modifying Fast-Growing Wood Used to Promote Higher-Value Wood Use and Sustainable development

Junwen Pu¹⁰

Abstract

This article gives an extended introduction on the state of the art of wood modification worldwide.

The structural properties and biological durability determine the limits for the use of wood. Until recently, the only industrial applied method to improve the durability of wood was impregnating with toxic wood preservatives. Modification of wood aims at improving the durability in an environmentally friendly way, not by toxifying. Apart from durability, properties like dimensional stability, hardness and adsorption behaviour are also improved by modification. These improvements make wood an appropriate material in many more applications than untreated wood.

Fast-growing wood is treated with chemical agents in order to improve natural wood deficiencies, which can enhance the physical and mechanical performance, decay resistance, ageing resistance, fire resistance, and dimensional stability. It can also improve wood's color, texture, and increase value-added. Chemical modification is employed to overcome these drawbacks to the use of wood and transform it from an unpredictable material to high-value timber products with desired and predictable engineering performance.

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Wood from Eucalypt Plantation: One of the Most Sustainable ways to Resolve Wood Shortage Problems

Yaojian Xie¹¹

Abstract

Eucalyptus as an exotic tree was first introduced into China in 1890. It was planted in parks as ornamental tree originally. However, until the 1950s, China only planted Eucalyptus mainly in Leizhou Peninsula and some places of southern Guangxi. Now eucalyptus has become one of the most important trees for developing fast-growing forest plantation in southern China. There are 3.6 million hectares of eucalypt plantation in China today, which are located mostly in Guangdong, Guangxi, Hainan, Yunnan and Fujian provinces. The development of eucalyptus plantation is still in expansion now and in the near future.

A huge amount of wood is consumed in China every year. According to the State Forestry Administration, 340 million m³ of wood will be needed in 2015 in China, but the total wood production in China is only 190 million m³. So there will be a significant shortage of wood. How to resolve this problem? One of the best ways is to establish eucalypt plantations. It is estimated that by 2015, there will be 4 million hm² of eucalypt plantation in China. This means 60 million m³ sustainable eucalypt wood can be produced per year, making an important great contribution.

Utilization of eucalyptus wood products is varied. Firstly, eucalyptus wood is used on a large scale for pulp making, about 2.0 million T pulp in southern China is made from eucalyptus wood every year, with new pulp mills soon to be opened. The second largest usage of eucalyptus wood is for artificial boards, includes fibra-board and plywood. The total production of artificial boards in China in 2007 was 74.0 million M³, which was No.1 in the world. China has the technology to use very small amounts eucalyptus wood ($\Phi 6\text{cm}$) to make plywood. The third usage is for sawn timber. However, this is limited due to the scarcity of wide diameter eucalyptus trees in China. Almost all plantations are short rotation and produce only narrow diameter timber.

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White Cedar – The Wood of Royal Heritage

S.Mohan¹², S.H.Jain, G.Ravikumar and K.Murugesan

Abstract

White cedar, scientifically termed as Dysoxylum malabaricum Bedd. Ex Hiern, and locally known as vellakil, purippa in Kerala; bilibudlige, bilidevadari in Karnataka and pureppa, vellaiyagil in Tamilnadu in southern part of India, is a top canopy tree species mostly found in Evergreen forests of Malabar, Anamalai and Travancore hills of the Western Ghats in India. The species is highly valued for its scented timber and proven medicinal value. It is used for making coconut oil casks. It is much sought after wood for paneling, joinery, cabinet making etc. Freshly felled timber gives a good fragrance. Wood contains oil, which is used for ear and eye disease. In some parts of Southern India White cedar wood is used for construction purposes such as beams, doors, windows, decorative paneling, tool handles, artificial limbs and rehabilitation aids, coorperage, chess pieces, mathematical and engineering instruments etc. A house constructed with this wood is considered to be indicative of the richness or the aesthetic sense of the person. In Kerala, a state in the southernmost tip of India, furniture and cabinets made of this prized wood are given to a bride as a token/ gift from parents to show the royal nature of their family heritage. It is believed that in most of the places of religious importance the bottom portion of the door frame is invariably made of this royal heritage wood. The artistic and cultural importance of white cedar wood is discussed in this paper.

Key words: White cedar, *Dysoxylum malabaricum*, royal heritage, coorperage, decorative paneling

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1. INTRODUCTION

Dysoxylum malabaricum Bedd. Ex Hiern, belonging to the family Meliaceae, locally known as vellakil in Kerala, bilidevadari in Karnataka and vellaiyagil in Tamilnadu, is a lofty tree of the climax forests (Fig 1). It is commonly known as White Cedar. The tree grows up to 40 to 45 metres height and attains a girth at breast height (gbh) of about 4 to 5 metres. The trees are distributed in the Evergreen forests of Western Ghats from North Kanara southwards, ascending to 3000 ft. It tends to be gregarious and is frequently found in association with *Artocarpus hirsuta*. The sapwood is yellowish white and the heartwood brownish grey with yellow tint turning darker on exposing, usually faintly striped along the grain, straight or narrowly interlocked, grained, even and fine textured, lustrous and sweet scented. It is hard, strong, elastic and heavy. The specific gravity of the wood ranges from 0.64 to 0.81. The weight of the wood ranges from 46 to 48 lb/cu. ft. The wood is of great artistic and cultural important.



Fig 1. *Dysoxylum malabaricum* Bedd ex Hiern., Vella agil, the scented wood of Western Ghats

1.1 Cultural, Medicinal and Economic Value

White Cedar is a constituent of “ashtagandha”, which produce a fragrant smell. Wood is used for the production of incense sticks. It is also used in the absence of sandal. But there is no Sandal wood tree in a forest in which there is Vellakil (Nair and Nair, 1985). Vellakil is used to fumigate the “Yaga”, an offering to God and “Homa” centres. Fumigation of *Dysoxylum malabaricum* is very important in the “Oorukootam” or Kurichiya country. This tree is mainly seen in dense forests and sacred groves. In ancient times no one was ready to exploit the sacred groves as a part of the custom, because of that these trees are still protected.

Decoction of wood is useful in arthritis, anorexia, cardiac debility, expelling intestinal worms, inflammation, leprosy & rheumatism (Kumar, 2005). Flavopiridol, although being a totally synthetic compound, has as the basis of its novel flavonoid structure a natural product, rohitukine, isolated as the constituent responsible for anti-inflammatory and immunomodulatory activity from *Dysoxylum binectariferum* Hook.f. (Meliaceae), which is phylogenetically related to *Dysoxylum malabaricum* Bedd. Flavopiridol is one of the over 100 analogs synthesized during structure-activity studies, and was found to possess tyrosine kinase activity and potent growth inhibitory activity against a series of breast and lung carcinoma cell lines (Sausville et al., 1999). Wood oil is used in treating ear and eye disease (Jain and Dafilips, 1991). In Sidha, the plant is known as Agil and is used as a substitute for *Aquilaria malaccensis* (Kumar, 2005).

The timber of white Cedar is highly reputed. The wood is an important constituent in the perfumery and plywood industry. The wood is also used for making motor truck bodies, furniture, carts, railway carriages, Toys and textile wooden accessories like bobbins (Gopimani (1991), It is used for the frame work of carts and carriages.

1.2 Other uses of the White Cedar wood

White Cedar is primarily used in the west coast of India for cooperage. It is eminently suited for making casks required for storing and transporting coconut oil, as it does not discolour the oil or allow it to percolate through. It is much sought after wood for paneling, joinery, cabinet making etc. Freshly felled timber gives a good fragrance. In some parts of Southern India, especially in Kerala, White Cedar wood is used for construction purposes such as beams, doors, windows, photo frames, tool handles, artificial limbs and rehabilitation aids, chess pieces, mathematical and engineering instruments etc. A house constructed with this wood is considered to be indicative of the richness or the aesthetic sense of the person. In Kerala, a state in the southernmost tip of India, furniture and cabinets made of this prized wood is given to a bride as a token/ gift from parents to show the royal nature of their family heritage. It is believed that in most of the places of religious importance the bottom portion of the door frame is invariably made of this royal heritage wood.

1.3 Use of White Cedar wood in snake bite treatment in Kerala

The Kani tribe of the Western Ghats of Kerala applies 'Vishakallu', a medicated stone with anti - poisoning properties to the affected area (snake bite). The ingredients that go into the making of 'Vishakallu' are pebbles from the river, Tulsi or Holy Basil leaves (*Ocimum sanctum* - Lamiaceae), Leaves of Perumthumba (*Anisomeles malabarica* - Lamiaceae), Heartwood of Chandanam (*Santalum album* - Santalaceae), *Dysoxylum malabaricum* (Vella Akil- Meliaceae).

Mode of preparation of 'Vishakallu'

Pebbles are ground, mixed with the other ingredients and made into paste and wrapped with 7 leaves of *Aristolochia tagala*. It is baked on fire made by burning wood of Chuvannakil (*Chukrasia tabularis* – Meliaceae; native to India and Sri Lanka) *Dysoxylum malabaricum* (Vella Akil- Meliaceae), or sandalwood, holy basil and camphor. This baked cake is covered with paste of termite mound soil and again

baked on a low fire. The soil coat is removed and the cake is soaked in water for an hour, covered with paste of *Pittosporum neelgherrense* - Analivegam (Pittosporaceae) stem bark. The whole thing is baked again and covered with stem bark of *Kunstleria keralensis* (Fabaceae) and sun dried. This 'stone' is stored in burnt cow dung ash and *Nicotiana tabacum* - Pukayila (Solanaceae) leaves (Tobacco).

Mode of administration of 'Vishakallu'

It is administered only by experienced tribal healers. The stone is directly applied to the bitten part. It sticks there and absorbs the venom from the wound. During this operation, Lord Siva is propitiated by chanting mantras. When all the venom is absorbed the stone falls away automatically. The stone is immersed in cow's milk for detoxification for 2 hours. It is again dried and stored in cow dung ash. It is believed from experience that it can be used 20 times.

1.4 Chemistry of White Cedar Wood

No work on the chemistry of the wood has been reported so far but for a recent research study by Mohan S et al., (2010) to know the chemical compounds of *Dysoxylum malabaricum* wood. It was found that the wood powder on hydro-distillation yielded an essential oil (0.60%w/w). GC-MS analysis of the oil showed the presence of 63 compounds of which 24 have been identified amounting to an area of 80.21 % and 35 unidentified compounds (19.79%) with less than 0.1 % area. The major component is α -Muurolene (11.75%) along with 10 components which are more than 2.5% in composition namely T-Muurolol (5.08%), δ -Cadinene (4.75%), Hexa hydroxy Naphthalene (4.14%), Benzene[1-chloro-4(1-methylethyl)](4.06%), Azul [1,4 dimethyl-7-(1-methylethyl)](3.82%), 1,4-Cyclohexadiene(3.73%), Viridifloral (3.23%), T.Cadinol (3.06%), α -Elemene (2.99%) and α -Copaene (2.51%).

α -Muurolene, the major compound is used in the manufacture of flavouring agents and food industry especially in dairy products, fats and fat emulsions, confectionery, cereal and cereal products, meat and meat products etc. The high content of α -Muurolene i.e 11.75% in *D.malabaricum* makes it a very good source for this compound.

2. CONCLUSION

It is seen that the traditional and aesthetic value of White Cedar wood is well known. White cedar wood has got cultural, medicinal and many other uses. Recently chemistry of the wood essential oil has been studied and an important compound used in the manufacture of flavouring agents has been identified. The regeneration of this species from seeds is very low, leading to dwindling forest populations. Concerted efforts should be made by research organizations and forest departments to study the chemistry and regeneration of this economically important wood.

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Sandalwood - History and Chemistry in the Art and Joy of Mankind

S H Jain¹³, G Ravikumar, C Sowmya, S Mohan and K Murugesan

Abstract

“Chandana”, the Sanskrit name ascribed to Santalum album Linn, was known and used in India from earliest historic time, before Christ, the Ramayana and Mahabharata. Sandalwood has been intimately associated with human civilization since time immemorial. It has fascinated artists and craftsman, this wood is nature’s gift to mankind. Vedas and puranas are the oldest codified literature in Indian context and such treatises quote uses of sandalwood for medicinal and cosmetic purpose. Essential teachings of Jainism and Buddhism schools too advocate oral and external uses of sandal. Kautilya’s text on ancient Indian economics considers sandalwood as precious forest product. Sanskrit text of the medieval period throw light even on the quality tests, classification and types of sandal. Sandalwood oil is one of the oldest known perfume materials with 4000 years of uninterrupted use. The fixative property and tenacious aroma of its oil is due to presence of major odoriferous sesquiterpenic alcohol - α -santalol and β -santalol, (70-90%), and thirty other minor/trace compounds. It is synergistic of a specific combination of all major and minor constituents naturally present in sandalwood oil that give its valuable woody, sweet fragrant and persistent odour. The human olfactory nerves are specific to the scent of the santalols. If the chirality (arrangement of the atoms in the molecule) of the santalols is changed to the molecule’s mirror image, the human nose cannot detect the fragrance. Apart from its importance as a supreme satisfying source of fragrance, it finds use in not only in religious purpose, but also healing, particularly in management of mental disorders. Pre-Christian era Indian medicinal texts like the Charaka Samhitha along with later texts such as the Asthanga Samhitha make thorough reference to sandal use. In the modern patent era it is essential to look into its medicinal properties such as anti-herpes, antiseptic, antipyretic, diuretic, stimulant and for treatment of bronchitis, dysuria, gonorrhea and urinary infections etc. Drastic decline in production and high price of sandalwood have restricted its utility in recent decades. The importance of chemical constituents of sandalwood oil, its role in the history of utility by mankind and market trend is discussed in this paper.

Key words: Santalum album, mankind, α -santalol and β -santalol, fragrance

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Abstract

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Abstract

In India, socio-economically significant and ecologically important trees are considered very sacred and worshipped. Vedic traditions established the principles of ecological harmony since ancient times – not because of the imminent environmental disaster, but for the spiritual healing and physical association with better ethical awareness and moral responsibility. Red Sanders (Pterocarpus santalinus) is one such species which has been of great importance in India since time immemorial. In the past, red sanders wood was used for carved and decorated pillars in many towns in India. Its significance can be understood by the fact that still it is found in most of the houses in the villages of India. The heartwood of red sanders is carved into vessels and statuettes. The high quality red sanders is widely used domestically to make furniture and carvings, agricultural implements, poles, carts and picture frames, and carved house posts. In South India, there is a great tradition and culture and long standing history, wherein a pair of doll (male and female) made up of red sanders is compulsorily presented to the married couple even today. The wood powder is also used as a facial mask and is believed that it rejuvenates and makes the skin glow. Heartwood of red sanders has a great demand in foreign markets. The export value of the wood was rediscovered almost in 1940s when Japanese found in a certain class of timber a special quality ideally suited for the manufacture of a popular musical instrument called 'Shamisen', traditionally presented to a newly wedded couple. In the 1930s, Japan commenced to import Indian red sandalwood (red sanders) for the manufacture of the traditional shamishen musical instrument and this market remains important today at a level of several hundred tonnes per annum. The traditional significance (art), cultural values (joy) of red sanders wood is discussed in this paper.

Key words: Red sanders, carvings, heartwood, cultural and shamishen

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Wood Artifact vis-a-vis Plantation Timbers

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Abstract

Timber art and exclusive timber furniture manufacturers offer a design service that can create innovative designs to suit individual taste, whims & fancies. Woodcraft and furniture of aesthetic value is principally manufactured by primary timbers. As these species are fast depleting due to tremendous increase in daily needs, plantations help to substitute the source of timber. Plantation grown timbers are already in use for various purposes such as sculptures, religious artefact, furniture and other building material, etc. Fast grown plantation species have different timber characteristics including their resistance against biodegrading agents from that of the same species grown in native forests and it is vital to know their decay resistance before putting in to use for the specific purpose, which adds more value for plantation timbers.

*In this connection, durability against decay fungi and termites of different age group of *Acacia auriculiformis*, *A. mangium*, *Grevillea robusta*, *Eucalyptus terreticornis*, *Maesopsis eminii*, *Melia dubia*, *Ailanthus malabaricum* and *A. excelsa* from plantation have been evaluated. Eight-year-old *Tecomella undulata* grown under a social forestry programme in Tamil Nadu has been evaluated for natural durability and it was found that heartwood is resistant to fungi as well as termites at this age which may be used for timber and other woodcraft work as mature wood. Ten years and above aged trees of *Acacia auriculiformis* and *E. terreticornis* were durable and may be used making wood artifacts without any problems of biodeteriorating agents. Probable uses of other tested plantation species vis-a-vis age are given in detail depending on their resistance against biodeteriorating agents.*

Key words: Durability, decay-resistance, decay fungi and biodeterioration

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1. INTRODUCTION

The natural forests used to be the only source of commercial timber in tropical timber producing countries. In the past several years however, governments have begun implementing strict conservation policies, which have curtailed the harvest levels from the fast depleting natural resource base. To meet their respective wood requirements and at the same time to re-vegetate denuded areas, most tropical countries have started to embark in tree plantation programs. Trees in plantations grow fast because of intensive management. These plantations help to reduce the environmental impact of cutting trees for timber. Plantation timbers are environmentally sustainable, as no actual forest has to be cut down for it. There are several countries where forest plantations are highly important in the provision of goods and services. Worldwide, an estimated 15% of plantations in tropical countries are established to reduce the pressure of natural forest.

Countries which are among the largest plantation nations in the world include India (3.2 million ha), New Zealand and the United Kingdom (1.9 million ha each), Australia (1.8 million ha), Malaysia (1.6 million ha) and South Africa (1.4 million ha). Ninety nine per cent of New Zealand's industrial wood came from plantations in 1997 (FRA, 2000), and industrial wood products are the third largest export. The most readily available plantation timbers in many countries are softwoods such as Hoop Pine, Radiata Pine and Slash Pine. It was erroneously believed for decades that radiata was the only commercially viable species that could be cultivated here. Of late, many tree species are grown as plantation including Teak, Eucalypt, Acacia species etc. In India, Sri-lanka, Indonesia, Malaysia, Thailand and other Southeast Asian countries, rubber-wood obtained from plantation after extracting latex are put to use for various purpose such as door and window profiles, matting, flooring and furniture. Use of rubber wood as timber for a range of purposes has made revolution in wood industry.

As customary timber's availability is in short supply, several species of plantation timbers are already used for different purpose including wood-artifacts. But, their uses are limited as plantation timbers are fast growing and they have the problems of fungal attack, especially when exposed in humid conditions. The information on some of the common plantation timbers available in Karnataka, their role in artifacts and durability against fungi is discussed in the paper.

Methods and materials

Timber from 5, 10, 15 and 20 year old plantations were procured both from low and high rain fall area, converted in to test samples and they were exposed to wood decay fungi as per IS standards (IS-4873). After assessing the decay loss, timber species were grouped under different durability class (Bakshi, 1967 and ASTM, 1981). Species taken for test were *Acacia auriculiformis*, *A. mangium*, *Grevillea robusta*, *Eucalyptus terreticornis*, *Maesopsis eminii*, *Melia dubia*, *Ailanthus malabaricum* and *A. excelsa*.

Availability of plantation timbers and their uses

Acacia auriculiformis, *A. mangium*, *G. robusta*, *E. terreticornis*, *M. eminii*, *M. dubia*, *A. malabaricum* and *A. excelsa* are grown in Karnataka and different age group of timbers is available in Karnataka and also elsewhere in India. Their main uses as timber and additional use for wood-artifacts are given in table-1 and their durability against decay fungi is given in table-2.

A. auriculiformis and *A. mangium* plantations came up in the beginning to serve the purpose of fuel, as they had good calorific value. Slowly, it found its place in the pulp and paper industry and packing cases. Recently, it is also recognized for tools & tool handles, sports goods and artistic furniture and other handicraft work. Timber of this species is durable (table-2) (Nagaveni *et al*, 2002). Though there is little variation in their weight loss against decay fungi with different age group, all 4 age groups of timber come under resistant class (class-I) as per Bakshi, 1967 and ASTM, 1981.

Between two *Ailanthus* species, *A. excelsa* is a perishable timber against decay fungi (class-IV) and *A. malabaricum* falls between resistant to moderately resistant groups (II & III) (Venmalar *et al*, 2011). But these species are used in handicraft, to prepare cheap quality toys and cricket bats. Eucalyptus species have durable wood. But young plantation timber of 5 and 10 year old timber comes under resistant group (II), where as mature wood from above 15 year old plantation showed very good resistant against decay fungi (Class-I). Timber used for many handicraft works including good carvings.

The *G. robusta* tree produces an attractive and easily worked wood for veneers, ornamental paneling and parquet floors in the world furniture trade where it was marketed as “lace-wood” and this timber also used for other small handicraft work. It is a moderately durable timber (III & II).

Timber of *M. eminii* is grouped under non-resistant to moderately resistant group. Wood is used for light construction, boxes and crates, picture, slate frames, plywood and also used handicrafts and some furniture. *M. dubia* timber is grouped under non-resistant to moderately resistant class (IV & III). Wood is used for pulp, packing cases, cigar boxes, ceiling, planks, veneer industry, tea boxes, and ply-board, agricultural implements, pencils, matchboxes, splints, kattamarams, musical instruments. This wood is also used for furniture, small toys.

T. undulata is one of the species used for various artifact products such as drums, carvings, furniture, artistic turning, handicrafts, idols and idol base, photo frames in addition to agriculture implements. This is an important indigenous tree species found in the hot desert areas of Rajasthan State in India known as Marwar teak. This tree is grown in different states as plantation. Wood from 8 year old plantation grown in Tamil-Nadu was tested for its durability against decay fungi and results showed that wood is highly durable even at 8 year old plantation (Nagaveni *et al*, 2002).

Conventional species of timber were used for various utility were obtained from natural forest, when they were available in plenty. Of late, due to paucity of wood, it is enforced to utilize plantation timbers for various purposes. In different countries the practice of utilizing plantation timbers are well known. In many European countries,

timbers were procured only from plantations, which were exclusively grown to meet the demand of timber. Forest plantations were originally established to provide industrial timber, mainly in those countries, such as South Africa or the United Kingdom, which had a small natural forest estate. But since the mid-1980s forest plantations have assumed greater importance as a source of wood in almost all countries, whatever their forest cover is less, thus often taking pressure off from the natural forest.

According to a 2007 sustainability report issued by the Ministerial Conference for Protection of Forests in Europe (MCPFE), plantations cover about 16 million hectares, or 7.9% of the total forest area in Europe excluding the Russian Federation. These intensively managed tree crops are important for wood production in several countries and form a very large share of forest area in Ireland (85%), the UK (55%), and Denmark (62%). Plantations also account for more than 10% of the forest area in Belgium, Luxembourg, Portugal, Belarus, Turkey, France and Albania. Plantation areas in Europe are increased by 2.8 million hectares in the period 1990 to 2005 at an annual rate of 180,000 hectares. A key trend in the forest sector of North America and increasingly, in Europe in recent years, has been growing interest in timberland as a potential private sector investment.

In Australia, Churches, homes, sculptures and religious artifacts, and fine furniture pieces are all handmade and have all been carved with only plantation timber exclusively of mahogany and teak by Fine Woodcraft Gallery. Australia Fine Woodcraft (established 1970), was awarded the Western Australian Hall of Fame Award in 2000. Ninety nine per cent of New Zealand's industrial wood came from plantations in 1997 (FRA, 2000), and industrial wood products are the third largest export.

India (3.2 million ha) is among the largest plantation nations in the world. Different tree species are grown to meet demand. Understanding durability and management of decay helps to add the value for the plantation timbers and is an effort to retain the footprint of wood-arts, without compromising on the style and beauty of each item.

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Table-1. Main uses of timber with additional use for wood-artifact

	Species	Main uses	Artifact uses
1	<i>Acacia auriculiformis</i>	Paper, furniture, tools & tool handles, packing cases Sports goods	Handicraft, furniture
2	<i>Acacia mangium</i>	Paper, furniture, flooring, decorative veneer, MDF, particleboard and fuel wood.	Handicraft, decorative veneer, Cabinets, turnery, floors
3	<i>Ailanthus excelsa</i>	Matchwood boxes and match splints, Packing cases, Catamarans	Sword handles, Spear sheath, cottage industries for making wooden toys and cheap quality cricket bats
4	<i>Ailanthus malabaricum</i>	Match splints,	Decorative veneer used in religious functions as dhoop, and in the incense stick and perfume industry
5	<i>Eucalyptus terreticornis</i>	Construction, furniture, Slate frames	Furniture, handicrafts and carvings.
6	<i>Grevillea robusta</i>	Furniture, packing cases, flooring, paneling, plywood and the manufacture of small wooden items such as bobbins and pencils	Furniture, Toys, ornamental paneling, parquet floors and handicrafts.
7	<i>Maesopsis eminii</i>	Light construction, boxes and crates, picture, slate frames, plywood.	Handicrafts and furniture. Bark is used in the Congo region as a roofing material
8	<i>Melia dubia</i>	pulp packing cases, cigar boxes, ceiling, planks, veneer industry, building and construction materials, agricultural implements, pencils, matchboxes, splints, kattamarams, musical instruments, tea boxes, and plyboard, outriggers for boats. It is also a good fuel-wood	Furniture, small toys.
9	<i>Tecomella undulata</i>	Agriculture implements, furniture	Drums, carvings, furniture, artistic turning, handicrafts, idols and idol base, photo frames

Table-2. Plantation timbers of different age and their durability against decay fungi

Timber age	<i>A. auriculiformis</i>		<i>A. mangium</i>		<i>A. excelsa</i>		<i>A. malabaricum</i>		<i>E. terreticornis</i>		<i>G. robusta</i>		<i>M. eminii</i>		<i>M. dubia</i>		<i>T. undulata</i>	
5 Yrs	10.5	I	10.8	I	45.8	IV	29.9	III	21.5	II	20.95	II	45.87	IV	45.8	IV		
10 Yrs	10.5	I	9.5	I	45.6	IV	25.5	III	17.9	II	17.04	II	42.19	IV	34.5	III		
15 Yrs	7.9	I	7.2	I	43.7	IV	13.7	II	6.55	I	14.75	II	27.42	III	22.5	III	-	-
20 Yrs	6.9	I	5.9	I	38.7	IV	11.2	II	5.85	I	10.77	II	26.93	III	20.5	III	-	-

Picking From a ‘Wood-getable’ Market

Shakti Singh Chauhan¹⁶

Abstract

Wood is, and will remain, important to human society. The current trends of depleting natural forest resources and shrinking choices for various end-uses are promoting multiple uses of fast-grown plantation timber. Today, forest plantations have become the major source for solid wood, engineered wood, wood based composites, and pulp and paper applications. With the remaining primary forests being dedicated to conservation, the trend is expected to continue in the future too. It is also imminent that the luxury of using different species for different end uses will be replaced by multiple uses for the same species. At this juncture, it becomes critical to exploit the full breadth of variability in the plantation species to suit various applications. One way of addressing the issue is to exploit inherent variation in wood quality traits (density, stiffness, shrinkage, fibre dimensions, microfibril angle, chemical composition etc.) to tailor trees for specific end uses. However, prior to achieving this target, the approach should be to segregate available material according to their suitability for specific end uses. Today, the market is full of apparently identical but inherently variable material, which when converted into products affects product performance and consumer satisfaction ultimately. Consequently, an adverse psychological drive of ‘bad wood’ can permeate through the society. It is important to recognise that there is no bad wood; it is just ignorance, improper processing and poor end-use selection. In this conference I will emphasize on adaptable approaches for segregating wood for different end-uses.

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Insect Invaders Subduing the Art and Joy of Wooden Assets in India

O K Remadevi¹⁷

Abstract

Wood as a material is very durable and in sheltered environments it can last undiminished for thousands of years, imparting ambience, glamour and joy. Being a structural material, wood is shaped and articulated into our livelihood needs such as wardrobes, cots, tables, dressing tables, chairs etc. In India various wood products are manufactured from the sapwood as well as heartwood of durable and also non-durable commercial species. Timber in the finished articles or wooden structures in buildings is highly prone to insect attack in Indian conditions. Wood boring insects have become rampant in the recent past due to large scale use of untreated secondary perishable timber species.

In India, the handicraft industry is considered the second largest industry next to agriculture. Many skilled artisans have adopted wood crafting as their livelihood, carving out beautiful artifacts from diverse timber species. The attack by powder post beetles diminishes their value in both the national and international markets. The wood packing industries in India, consume 6.81 million m³ of wood for packing fruits, vegetables, tea, tobacco, textiles and machinery. Since the government has imposed a ban on the felling of trees in natural forests, many short rotation timbers and exotic timbers are being used. Powder post beetles which attack sapwood comprise the lyctid, bostrychid, anobid and cerambycid beetles. These are the most common pests in the household furnitures and wardrobes, which are made of plywoods and blockboards. The pest problems are due to ignorance, negligence or poor management. As a result, insects enjoy wood as their food and abode and the art and joy of wood is a function of insect dominance. They diminish the life and worth and subdue the art and joy of wooden assets in India.

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Wood Identification of Expensive Woody Art Collection Mostly Expensive Religious Images Deposited at San Agustin Church, Intramuros, Manila

Arsenio B Ella¹⁸ and Emmanuel P Domingo¹⁹

Abstract

Identification of expensive religious images like wooden religious statues from the wood art collections of PAGREL Museum deposited at San Agustin Church, a UNESCO World Cultural Heritage in Intramuros, Manila was conducted following request from the owner of the museum.

As the statues were painted, identification was based principally on the structure of the wood. The primary problem that was encountered in the course of wood species identification was how to locate the true cross section of the object. A cut was made in a portion that would not mark the appearance of the statue. In many instances the base part of the statues is curly grained, possibly obtained from a buttress or some are in advanced state of decomposition. In a few instances, some component parts have been replaced with different species.

*Among the principal species identified were those of molave (*Vitex parviflora* Juss.), batikuling (*Litsea leytenensis* Merr.), narra (*Pterocarpus indicus* Willd. forma *indicus*), makaasim (*Syzygium nitidum* Benth.), santol (*Sandoricum koetjape* (Burm. f.) Merr.), marango (*Azadirachta excelsa* (Jack) Jacobs), kamatog (*Sympetalandra densiflora* (Elmer) v. Steen.), batitinan (*Lagerstroemia pyramidalis* Koehne forma *batitinan* (Vidal) Furt. & Sris.), dungon (*Heritiera sylvatica* Vidal), acacia (*Samanea saman* (Jacq.) Merr.), and a miscellaneous species, malapingingan (*Trichadenia philippinensis* Merr.). A total of 60 statues were identified. Furthermore, a short write-up on woods for their catalogue was received and corrections were made particularly on the existing binomial of the species.*

Keywords: wood identification, religious images, statues, San Agustin Church, Intramuros UNESCO World Heritage

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INTRODUCTION

The San Agustin Church is the oldest existing church in the Philippines, and was originally built in 1571. It is an essential tourist destination in Manila for those who are interested in Philippine history and culture. The present structure is actually the third to stand on the site. It has 14 side chapels and a *trompe-l'oeil*. Up in the choir loft are the hand-curved 17th century seats made of molave (*Vitex parviflora* Juss.), a beautiful tropical hardwood.

The San Agustin Church lies inside the walled city of Intramuros located in the capital city of Manila. It is the first European stone church to be built in the Philippines designed in a Spanish architectural style. It also houses the legacies of the Spanish conquistadores, Miguel Lopez de Legazpi, Juan de Salcedo and Martin de Goiti who are buried in a tomb underneath the church.

Over the centuries the church has withstood wars, looting, fires, earthquakes and other calamities. It also endured the Japanese occupation of Philippines during the World War II. It served as the concentration camp for prisoners and the hideout for Japanese soldiers with their hostages during the last days of the Battle of Manila.

Among the seven churches in the walled city, it was the San Agustin Church that remained standing after the liberation of Manila in 1945. Only its roof was destroyed by the bombardment of Intramuros by American-Filipino forces. Together with three other ancient churches in the country, it was designated as a UNESCO World Heritage Site as one of the “Baroque Churches of the Philippines” in 1993.



San Agustin Church along with the other ancient churches in the country-Nuestra Señora de la Asuncion; Paoay Church; and Miag-ao Church.

San Agustin Museum

The monastery was originally used as the living quarters of the Augustinians, as well as serving as classrooms, refectory, vestry, library and infirmary.

It was destroyed by British forces in 1762, by the American soldiers in 1898 and during the Japanese and American liberation war in 1945. The monastery was converted into museum in 1973 and the Halls were restored. The family of Don Luis Araneta, a rich clan in Manila took over the ownership and management of the museum, and thus PAGREL Museum was born.

Tropical Philippine Woods – An important component of San Agustin Church and Museum

The San Agustin Church has ornately carved wooden doors (*Vitex parviflora* Juss.) depict floras and the statues of St. Agustin, Sta. Monica and the Augustinian symbols. Indicating Chinese influence, four dogs stand at attention at the base of the building.



Ornately carved wooden doors.

The *trompe-l'oeil* ceiling painted by Italian artists Cesare Alberoni and Giovanni Debella in 1875 brightens the church interior (Figure 3). Hand-carved 17th century church pews made of molave (*Vitex parviflora* Juss.) are placed in the quire area. The Coro is made up of sixty-eight intricately carved kamagong (*Diospyros discolor* Willd.) choir stalls overlaid with narra (*Pterocarpus* spp.) inlays. The interior is also vested with a heavily gilded pulpit (with native flora and pineapple as its motifs), and a very ornate altar.



Trompe-l'oeil ceiling



Ornate altar



Heavily gilded pulpit (with native flora and pineapple as its motifs)



Entrance



Bell

Entrance/Bell

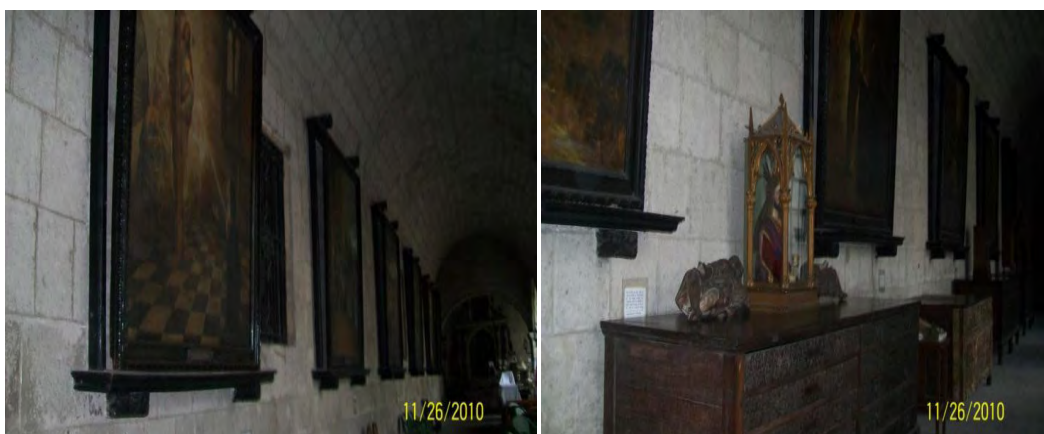
One gains entrance to the museum through the old poster's lodge where a 3,400 kilogram bell stands. It was taken down in 1927 from the belfry damaged by the earthquake of 1863.

Sala Recibidor

It houses the present PAGREL Museum of the San Agustin Church. It showcases the San Agustin Ivory Collection, wood art and antique collections, wooden statues and religious images of the late Don Luis MA. Araneta. Furthermore, a magnificent XVIIIth century wooden retablo of the Intramuros Administration are neatly kept in this place.



Corridors



The four corridors of the first floor of the museum exhibit oil paintings done by Filipino painters Enriquez, Fuster and others in the early XXth century. The paintings portray Saints and celebrities of the Augustinian Order.

PAGREL Museum: Historical and Cultural Aspects of Wooden Cultural Heritages and Wood Materials

There was a view that identification of species used for these wood art collections would augment the appreciation of these religious statues by wood enthusiasts, students and the general public. In this regard, Ms. Elvira Araneta, daughter of Don Luis contacted the wood anatomist of the Forest Products Research and Development Institute (FPRDI). The principal author was a member of the team who conducted wood identification of these expensive woody art collections. The activity was carried out on 15-18 October 1985.



Wood identification for the general public is one among the manifold technical assistance activities rendered by the FPRDI. From the wood-using industries and from private sectors, many of those interested in the utilization of our timbers had come for our assistance. Their concern is not only on the identity of the specimens but also on other technical information among which are: (a) the distribution and supply of the species; (b) the substitutes either to a foreign species or to a given local species if the supply is limited; (c) various properties of the wood (physical, mechanical, working, seasoning, etc.); and (d) uses of the wood. These are some of the usual observations. The challenge regarding these problem areas is great, particularly of (a) and (b), so that the need to broaden our knowledge on these respects is essential to meet the desires of the end-users.

Wood Identification for the General Public

One among the manifold technical assistance activities rendered by FPRDI aside from wood identification/identification of specimens, other technical information which include among others:

- Distribution and supply of the species;
- The substitutes either to a foreign species or local species if the supply is limited;
- Various properties of the wood physical, mechanical, working, seasoning, etc.; and
- Uses of the wood.

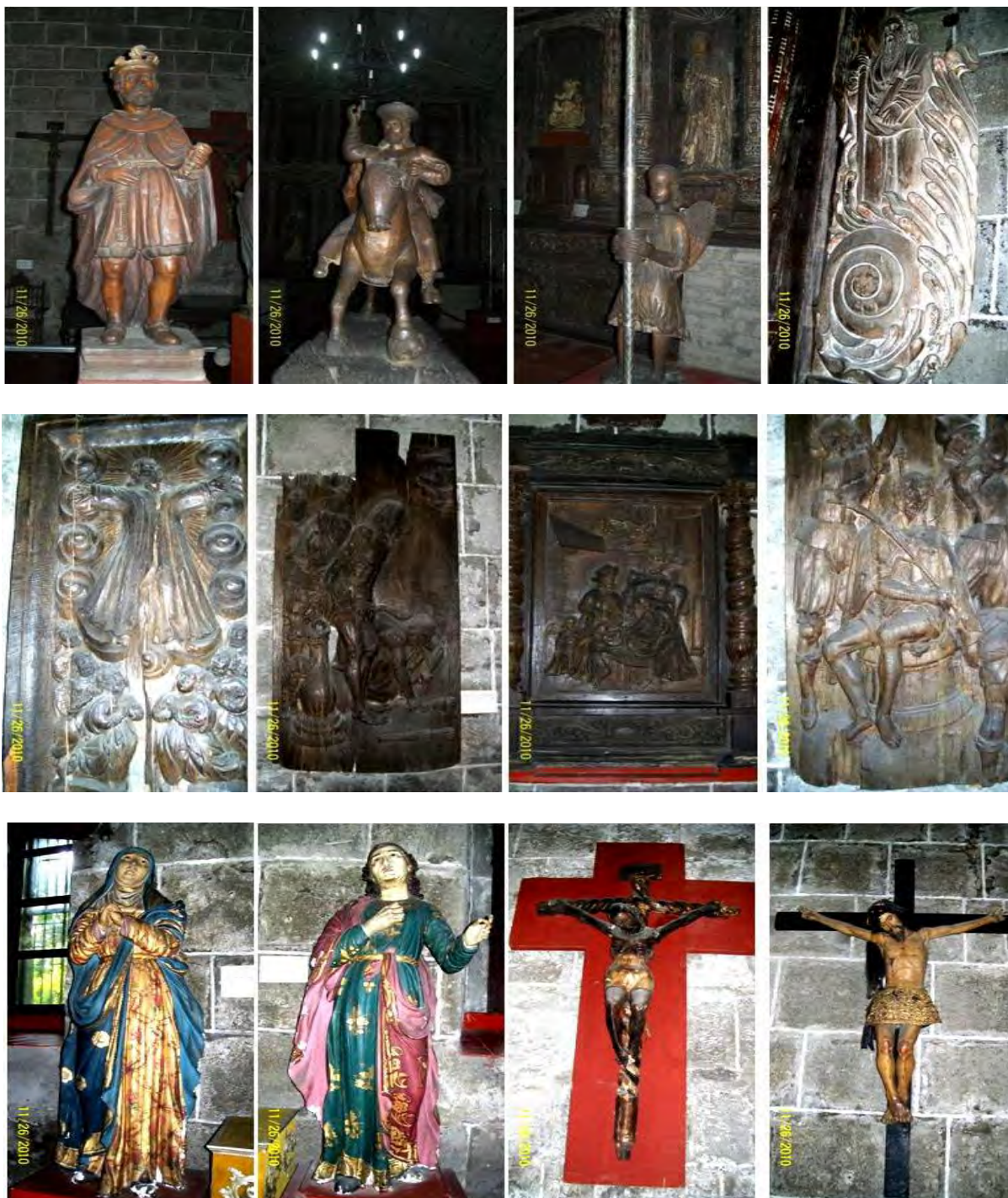
Characteristics of Wood (Details for Examination of Wooden Statues)

Even without the aid of a hand lens or with just the naked eye, wood has easily recognizable structural features useful in species identification. Termed as gross features, they include the wood's physical properties (color, odor, taste, weight and luster or gloss) and those attributed to wood structure (grain, texture, rays, parenchyma, etc.).

The statues were brought outside the church and put (one at a time) in a place where there was sufficient light for easy scrutiny and identification. Inasmuch as the statues were painted or finished with varnishes, we relied principally on the structure of the wood. Equipped with a hand lens, we tried identifying the wood species where these wooden statues were carved. A problem we experienced was to locate the true cross section of the object. A cut was made in a portion that would not mark the appearance of the statue. In many instances the base part of the statues is curly grained, possibly obtained from a buttress, or some in advanced state of decomposition. In a few instances, some component parts have been replaced with different species. These antique religious wooden statues were collections from different parts of the Philippine archipelago by the Araneta family.

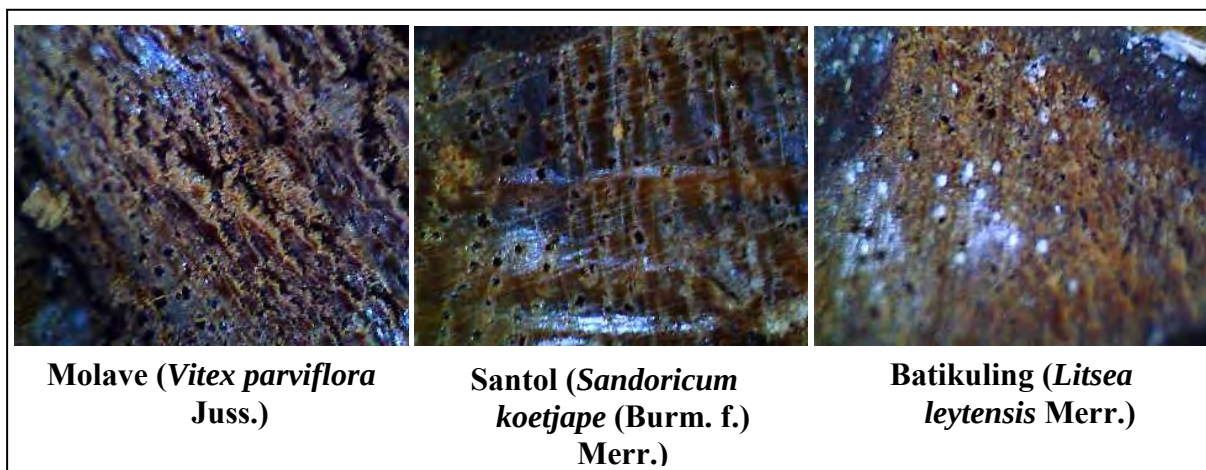
A total of 60 statues were identified. Some of these are the following: St. Joseph of Nazareth, Holy Water Font, the Holy Trinity, the Ascension, St. Michael the Archangel, vase-like Altar Finial, St. James the Greater or Santiago de Compostela, a standing angle, St. Paul, St. John the Baptist, St. Ferdinand, Sta. Rita de Cassia, Sorrowful Mother or Virgen de Dolorosa, St. John the Evangelist, St. Dominic, liturgical chair, Mexican crucifixes known as "Cristos de Caña", Jesus scourging at the Pillar, Jesus crowned with thorns, St. Agnes, St. Luke, carrozas (carriages), Corner altar dedicated to St. Thomas of Villanueva, St. Peter Martyr, Dominican St. Vicente, St. Rita, etc. These were all carved during the 18th century and collected from different parts of the Philippine archipelago (pls. refer to photos).







Among the principal species identified were those of molave (*Vitex parviflora* Juss.), batikuling (*Litsea leytenensis* Merr.), narra (*Pterocarpus* spp.), makaasim (*Syzygium* spp.), santol (*Sandoricum koetjape* (Burm. f.) Merr.), marango (*Azadirachta excelsa* (Jack) Jacobs), kamatog (*Sympetalandra densiflora* (Elmer) v. Steen.), batitinan (*Lagerstroemia pyriformis* Koehne forma *batitinan* (Vidal) Furt. & Sris.), dungon (*Heritiera sylvatica* Vidal), acacia (*Samanea saman* (Jacq.) Merr.), and a miscellaneous species, malappingan (*Trichadenia philippinensis* Merr.).



Macro/microscopic characteristics of some wood species identified (Magnification 7X).

CONCLUDING REMARKS

PAGREL Museum in the San Agustin Church with expensive wood art collections is indeed a great treasure of Philippine arts and culture. Correct identification of these religious statues and images has added to their appreciation especially among wood enthusiasts and scientists. Further, antiques and woodcrafts that made the San Agustin Church, viz., the ornately carved, wooden doors, church pews, coro and ceilings, altar, tabernacle and certainly the wooden statues has truly made the church historical and cultural aspects of wooden cultural heritages, thus, the title of a UNESCO World Cultural Heritage.

ACKNOWLEDGMENTS

The authors wish to extend their heartfelt gratitude to the family of Don Luis Araneta, owner of PAGREL Museum for their cooperation and unselfish attitude to have allowed them to take photos of available wood art collections, e.g., wooden saints and other religious images deposited at San Agustin Church in Intramuros, Manila.

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Wood Based Industry Development in Bhutan

Ugyen Tenzin²⁰

Abstract

Bhutan's total land area is 38,394 square kilometers with forest coverage of 72.5%. Though rich in forest resources, the wood-based industry is facing acute shortage of timber supplies. Of the total registered wood-based firms, numbering 151, only 68 (45%) are fully operational. Recently, most of the saw mills and furniture houses were shut down as they could not get timber as per their requirement.

Most saw mills use old technology, in some cases up to forty years old, and as a result of which the recovery rate of sawn timber is very low, approximately 70% on an average. With rapid development taking place in Bhutan, the demand for timber from the construction sector is increasing every year giving huge burden to our forest resources.

If all the 68 fully operational sawmills operate at their full installed capacity, the timber requirement is 500 cft per day, which is far higher than the Natural Resources Development Corporation Limited's (NRDCL's) supply capacity. Considering the Government's planned activities for the next five years, the total demand for timber stands at 9.95 m cft per annum including rural supply of 6 m cft. The NRDCL & Department of Forest and Park Services' (DoFPS's) supply capacity is only 8.1 m cft per annum including rural supply. This leaves the supply gap of approximately 1.85 m cft of timber per annum for the next five years.

Hence, it is high time that the wood-based industries upgrade their wood-processing technology to increase yields by reducing waste and making better economic use of the limited resources. It is also time that the wood-based industries invest in technologies to make use of the wastes generated by them to produce other secondary value added products.

There are varieties of technology choices available in the market such as Woodmizer (US), Lucas (Australia), JAI Sawing Machines (India) and Sawing machines from China. Most of these new machines have higher recovery rate of about 80% and have several other advantages in terms of power consumption, less man-power requirement, better-cut quality, environmental-friendly operations and less waste generation.

It is observed from the study that the saw millers are willing to invest in modern sawing technology if the supply of timber is assured by the DoFPS and NRDCL in order to sustain their business. It is also expected that the government provide them assistance in terms of providing finance with subsidized interest rate on loans availed from the financial institutions. Other assistance expected is to provide tax-holiday for at least ten years.

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Beauveria Bassiana, a Potential Mycopathogen for Management of Helopeltis Antonii Infesting Woody Trees

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Abstract

Agro-forestry is found to be the most desirable strategy for maintaining social, economic and ecological sustainability in India. Insect pests are the most important group of organisms causing injury to plants in agro forestry systems. Helopeltis anotonii commonly known as the tea mosquito bug has a wide host range of 17 plant species representing 13 families in India. It is considered as a serious pest of neem, allspice, apples, black peppers, annatto, camphire (Lawsonia Alba), cinchona, grapevine, guavas, Moringa oleifera, jamboes or rose apples (Eugenia jambos), mangoes, Eucalyptus sp. cotton, mahogany, and drum stick. Nymphs and adults of H. anotonii mostly attack younger and softer parts of the plant, such as leaves, petioles, shoots, buds, inflorescences. They feed by sucking those plant parts and while they are sucking the plant fluid, they pump a secretion which contains a highly toxic substance. Feeding on tender leaves by young nymphs causes necrotic lesions. Meanwhile, feeding on inflorescences causes drying of the flowers and feeding on a growing tip or bud (primordial) can kill the bud. Seedlings can also become severely stunted and sometimes die from Helpless attack.

Many pests suffer from natural epizootics and therefore systematic research on insect pathogen holds great promise in forest insect pest management practices as it facilitates maintenance of the bio-diversity of forest fauna and flora leading to sustainability and value addition of wood and its products. An entomo-pathogen B.bassiana isolated from H. anotonii by Indian Institute of Horticultural Research, Bangalore, India recorded significant reduction in pest population under field conditions on Guava, a tree species of agro forestry. Based on the present results it could be inferred that H. anotonii could be controlled by insect pathogen B. bassiana leading to sustainability and value addition of woody trees.

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1. INTRODUCTION

In this era of global warming, fast degradation of land productivity and other environmental hazards, forestry is increasingly relevant with respect to natural resources and socio-economic sustainability. Agro-forestry is found to be the most desirable strategy for maintaining social, economic and ecological sustainability in India. However, Insect pests are the most important group of organisms causing injury to plants in agro forestry systems. Therefore, the management of insect pests in these systems is crucial to sustained production, and even farmers have recognized this as a priority issue for agro forestry research. Among the various insect pests of forestry, the tea mosquito bug *Helopeltis antonii* is reported to be a major pest of woody trees in spite of several insecticidal ingredients, such as the tetranortriterpenoid azadirachtin, the neem tree, *Azadirachta indica*, is attacked by a large number of insect pests, of which the tea mosquito bug *Helopeltis antonii* is a major example, causing about 15% damage to seedling (Ahmed, 1984, 1998, 2008, Onkarappa and Kumar 1997). Devasahayam and Nair (1986) recorded that *H. antonii* has a wide host range of 17 plant species representing 13 families. Among the major economic crops attacked by *H. antonii* are cacao (*Theobroma cacao*), tea (*Camellia sinensis*), cashew (*Anacardium occidentale*). Other reported feeding hosts are allspice, annatto, apples, black peppers, campfire (*Lawsonia alba*), cinchona, grapevine, guavas, *Moringa oleifera*, jamboes or rose apples (*Eugenia jambos*), mangoes, *Eucalyptus* sp. cotton, mahogany, red gram, and drum stick

Nymphs and adults of *H. antonii* attack younger and softer parts of the plant, such as leaves, petioles, shoots, buds, inflorescences and fruits. They feed by sucking those plant parts and while they are sucking the plant fluid, inject toxic saliva. The general symptoms are the discolorations and presence of necrotic areas or lesions around the entry point of labial stylet of the insect into plant tissue. These lesions darken with age as the tissue around the puncture dies. Feeding on tender leaves by young nymphs causes necrotic lesions meanwhile feeding on inflorescences causes drying of the flowers and feeding on a growing tip or bud (primordial) kills the bud. Lesions on fruit appear as brownish or black and die on the tree and may drop off. Older nuts are not killed but reduced in their size and circular lesion spots result in the reduction of quality. Seedlings can also become severely stunted and sometimes die from *Helopeltis* attack (Swaine 1959; Ohler 1979). The damage by the insect is dependent on the tree species, time of attack and varies from 20- 70 per cent across tree species of neem to guava.

Many pests suffer from natural epizootics and therefore systematic research on insect pathogen holds great promise in forest insect pest management practices as it facilitates maintenance of the bio-diversity of forest fauna and flora leading to sustainability and value addition of wood and its products (Ahmed, 1991).

This paper reports on the efficacy of an insect pathogen *Beauveria bassiana* against *H. antonii*, a pest of woody trees of forestry in India.

2. MATERIALS AND METHODS

a. Source of the pathogen *B. bassiana*

The Indian institute of Horticultural Research, Bangalore has isolated a myco-pathogen from an adult insect that was identified as *Beauveria bassiana* (Ganga Visalakshy and Mani, 2010). The pathogen was pure white and had covered most of the insect body except the head and legs (Fig. 1). The pathogen was isolated to pure culture and initially mass cultured on potato dextrose agar.

b. Mass multiplication of entomopathogen *B.bassiana*.

To prepare solid mass production media conidia from two weeks old culture plate was collected in sterile water to make the concentration of 2×10^6 /ml. 200 gram of sorghum was weighed and taken in 500 ml conical flask to which 150 ml of clean tap water was added, plugged with non absorbent cotton and autoclaved twice at 121°C and 15psi for 15 min. to avoid contamination. After autoclaving flasks were allowed to cool down and clumps inside the flasks separated by shaking flasks vigorously, then each flask was inoculated with 1 ml of *B.bassiana* spores having 2×10^6 concentration/ml. Then all the flasks were incubated at 25 ± 10 °C for 30 days in normal day and night photoperiod for the mycelia growth and sporulation. After complete growth, they were tested for number of spores per gram using haemocytometer and number of viable spores per gram using CFU. For the experiment 10 g of the above solid media is dissolved in 1 L water to make the recommended dosage of 1×10^9 spores/ml.

c. Efficacy against *H. antonii* under field conditions.

The efficacy of *B. bassiana* against *H. antonii* was carried out under field conditions in Heassrghatta on guava. The experiment included three treatments, *B. bassiana* @ 1×10^9 spores/ml, chemical insecticide Lambda-cyhalothrin @0.5ml/L and unsprayed control. Each treatment had four trees, where each tree is considered as a replicate. Two sprays were given at onset of fruit set at 15 days interval. Observations on the effect of *B. bassiana* on *H. antonii* were made once the fruits are hardened (stage not preferred by the insect). For recording data, four branches were randomly selected from each side of the tree and number of fruits damaged by the pest and healthy fruits on these branches were separately recorded. The observations were pooled as number damaged per tree later converted to percentage.

3. RESULTS

Efficacy against *H. antonii* under field conditions.

Results indicated significant reduction in fruit damage in the treatments as compared to control trees. The IIHR isolate *B. bassiana* recorded 4.87 % fruit damage as compared to 62.2% in untreated check. Lambda – cyhalothrin that recorded lowest fruit damage of 2.29%. *B. bassiana* is reported as an effective biological control agent of tea mosquito bug, *H. theivora* Waterhouse (Hemiptera: Miridae) in Assam (Hazarika et al., 2009).

It is concluded that IIHR isolate of *B.bassiana* is a promising biological control of *H. antonii* could be recommended as an alternative to application of chemicals to manage in woody trees of India and many other countries of the world. It has been recommended Many pests suffer from natural epizootics and therefore systematic research on insect pathogen holds great promise in forest insect pest management (Ahmed,1991). Management of *H. antonii* by using this insect pathogen holds great promise in forestry as it leads to bio-diversity conservation in forest ecosystem thereby resulting in sustainability and value addition of woody trees and its products.

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Bacillus Subtilis B2, a Potential Bioprotectant for the Control of Sapstain on Rubber Wood

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Abstract

Rubber wood after the extraction of latex is an alternative species for the conventional timbers in the wood based industries in Kerala. But its utilization is restricted due to the bluish back fungal staining caused by Botryodiplodia theobromae. Due to environmental and health hazards caused by chemical preservatives, biological control strategy for preventing the sapstain using antagonistic microorganisms is adopted. Among the several microorganisms screened, the bacterium Bacillus subtilis B2 was identified as a potential bioprotectant for sapstain. One of the antifungal antibiotics, Iturin A produced by the bacterium was identified using HPLC. B. subtilis B2 was found to be effective in controlling the sapstain in the field.

Key words: *Bacillus subtilis*, *Botryodiplodia theobromae*, sapstain, antagonism, rubber wood

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1. INTRODUCTION

Natural forest resources are being depleted day by day. The growing demand for conventional timbers can be met to some extent by utilizing rubber wood as an alternative. Fungi cause different types of damages such as surface growth (mould), sapstain, soft rot and decay (Subramanian, 1983). The hot and humid climate of Kerala is favourable for the growth of sapstain fungi and moulds on soft wood species. Among the different sapstain fungi, *Botryodiplodia theobromae* Pat., an important ubiquitous facultative wound pathogen which is widely distributed in tropics and sub tropics causes bluish-black discolouration on rubber wood (Florence et al., 1999). *B. theobromae*, the dominant stain fungus does not reduce the wood strength much (Blanchette et al., 1992) but will affect the economic importance of the timber.

Protection of wood and wood products from fungal deterioration is achieved mainly through chemical wood preservatives. But health hazards and environmental pollution due to various preservatives necessitates seeking alternative methods to prevent fungal infection. Biological control, based on microorganisms to suppress fungal infection offers a potent substitute to synthetic chemicals. The use of bacteria as a biocontrol agent is investigated highly because the biochemical, genetic analysis and mass production of bacteria are more precise than fungi. Several microbes such as *Agrobacterium*, *Pseudomonas*, *Bacillus*, *Alcaligenes*, *Streptomyces* etc. were reported as bacterial biocontrol agents (Liang et al., 1982; Weller, 1988; Gutterson, 1990; Dowling and O'Gara, 1994). The bacterial antagonists assume their antagonistic effects mainly by the production of antifungal antibiotics and many of these antibiotics have been characterized and identified as peptide antibiotics (Katz and Demain, 1977). Among them, iturin A has very less toxicity and allergic effect on animals (Quentin et al., 1982) and stands as a candidate for environmentally safe biological pesticide (Phae et al., 1992).

The objective of the study was to isolate, screen and identify possible microorganisms antagonistic to the stain fungus *Botryodiplodia theobromae* and to identify the antagonistic principle responsible for the fungal inhibition.

2. MATERIALS AND METHODS

2.1. Isolation of antagonistic microorganisms, detection of antagonistic activity and identification of the effective bacterium

Microorganisms were isolated for antagonistic ability from the soil, compost and wood. Samples were serially diluted and isolated using Starch Casein Agar for actinomycetes, Soil Extract Agar for bacteria and Rose Bengal Agar for fungi. From the isolates, the microorganisms showing antagonism were screened on Potato Dextrose Agar using dual culture technique (Johnson and Curl, 1972). In one method the selected pure cultures were streaked on the periphery of the petri dish and allowed to grow. After one week, a 5 mm dia mycelial disc taken from actively growing culture of test fungus was inoculated on the opposite side of the test microbe. In the second method, pure culture was grown at three equidistant positions on the PDA plate and the fungus was inoculated at the centre. After incubation for 7 days at $28 \pm 2^\circ\text{C}$, the radial growth of *B. theobromae* and the zone of inhibition were observed. Three replications were maintained for treatment and control. From the screened cultures, the very efficient bacterium B2 was selected against *B. theobromae*. Gram staining and biochemical tests were done for identifying the bacterium.

2.2. Amplification of 16S rRNA

Genomic DNA preparation of B2 was done adopting the protocol of Ausubel et al. (1994). To characterize the bacterial strain, the small ribosomal RNA unit was amplified by PCR using the conserved primers (forward 8F-F 5' AGTTGATCCTGGCTCAG 3' and Reverse 1492 – R 5' ACCTTGTTACGACTT 3') (Sacchi et al., 2002). The PCR reaction mix (25µl) was made by mixing the following components. 1µl of template DNA, 0.125µl of each primer, 0.5µl of 10mM dNTPs, 5µl of 5xHF buffer, 1.25µl Phusion DNA polymerase and 17µl of sterile distilled water. Amplification was carried out as follows: A preliminary denaturation step was done at 98°C for 30 S, followed by 35 cycles at 98°C (denaturation), 20 S at 40.4°C (annealing) 25 S at 72°C (extension) after 35 cycles, a final extension of 10 minutes at 72°C was done. The PCR product was checked by electrophoresis and was sequenced at MWG BIOTECH, Bangalore for species identification.

2.3. Production, extraction and identification of antifungal antibiotics

The B2 strain was cultured in 100 ml chemically defined medium (2% glucose, 3% peptone, 0.5% yeast extract, 0.1% KH₂PO₄, 0.05% MgSO₄, 0.01% CaCO₃, 0.01% NaCl) at 37± 2°C, 100 rpm for 2 days. After incubation, the culture was centrifuged at 12000 rpm for 15 minutes at 4°C. To check the antifungal activity of the bacterial extract, 1 ml of the filter sterilized bacterial filtrate was poured to a well bored in the PDA medium. An 8 mm dia mycelial disc taken from the edge of an actively growing culture of *B. theobromae* was inoculated at the opposite side. The plate was incubated at 28 ± 2°C for one week for observing the antagonism. The cell free culture broth obtained from the chemically defined medium was acidified by HCl to pH 2. The precipitation was collected by centrifugation and the solid was air dried overnight. It was then extracted with ether for 6 h in a soxhlet extractor to remove nonpolar biologically inactive impurities. The remaining solid was dissolved in methanol and the solution was chromatographed on a reversed-phase absorbent C-18 column.

2.4. HPLC Analysis

An authentic sample of Iturin A from Sigma Aldrich, US and methanol, water and acetonitrile of HPLC grade from Merck were obtained for HPLC analysis. Sample was analyzed by reversed-phase C-18 HPLC. Chromatography was performed on a Shimadzu model SCL-10AVP controller equipped with a Shimadzu model SPD-M 10AVP photo diode array detector. The Column used was Shimadzu model CTO-10 ASVP, Luna 5u C18 (2) 100A, 250 x 4.6 mm. The mobile phase was 65% water and 35% acetonitrile. The flow rate was 0.75 mL/min. The range of detection wavelength was set from 190 to 800 nm.

2.5. Wood block tests

Fresh rubber wood blocks (7 x 5 x 1cm), steam sterilized at 15 lb/in² for 20 minutes were dipped in B2 bacterial culture (10⁷ cfu/ml) and its filtrate, grown in chemically defined medium. The treated blocks were inoculated with *B. theobromae* and kept in sterile Petri dish with a moist filter paper. Wood blocks dipped in sterile water and inoculated with the test fungus were kept as control and incubated at room temperature. Results were observed after one month.

The field-testing was done during the month of July (southwest monsoon) and November (northeast monsoon) at Evershine Packing Industries, Ollur, Thrissur. Fresh rubber wood planks of 500 x 100 x 15 mm thickness were used for testing. After removing the sawdust, wood planks were dipped in

the bacterial culture (10^7 cfu/ml) for 10 minutes. The excess solution from the wood planks was drained by keeping them in slanting position and stacked closely and openly. For both seasons, the same pattern of stacking was followed.

Close stacking: In a single stack, there were a total of 30 planks. For close stacking 3 replicate stacks were maintained for both treatment and control. In each stack, one row consisted of 5 planks and in each stack there were six rows.

Open stacking: Open stacking was made in such a way that a space of 50 mm was left in between planks. All the planks were arranged in criss-cross pattern. The control planks were also stacked in the same manner. Observations for the growth of fungi in both the stacks were recorded after one month. All the planks were arranged on the floor under a shed. At the end of the treatment period, the planks were observed for fungal growth on the surface and assessed visually using the rating index given in Table 1. The planks were planed for observing the internal stain.

Table 1. Rating index for mould/stain/decay fungi

Rating	Mould/stain & decay
0	No fungal growth
1	<10%
2	10-25%
3	26-50%
4	51-75%
5	76-100%

3. RESULTS

3.1. Isolation of antagonistic microorganisms, detection of antagonistic activity and identification of the bacterium



Fig. 1. Bacteria at three portions

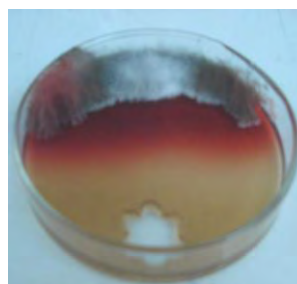


Fig. 2. Zone of inhibition of *B. theobromae* developed by the *B. subtilis* B2 culture filtrate

The microorganisms isolated for screening against *B. theobromae* from various source materials include: 30 actinomycetes, 10 bacteria and 16 fungi from compost, 14 actinomycetes, 5 bacteria and 7 fungi from rubber wood and 9 actinomycetes, 4 fungi and 9 bacteria from soil. Among the antagonistic microbes, one highly effective bacterium, B2 isolated from the compost was selected. The bacterium B2 showed strong antagonism in the dual culture towards the fungus (Fig. 1). The culture filtrate of the bacterium also inhibited *B. theobromae* (Fig. 2).

3.2. Identification of the bacterial strain (B2)

From the gram staining and biochemical tests, the bacterium B2 was identified as *Bacillus* species. In PCR amplification the 16S rRNA of B2 genome was amplified to around 1400 bp using the specific forward and reverse primers for *Bacillus* genus. When the sequenced 16S rRNA gene was analyzed in BLAST nucleotide analyzer, it showed 99% similarity to *Bacillus subtilis* and thus the isolated antagonist B2 was confirmed as *Bacillus subtilis* B2 and it is deposited in the gene bank with accession no FJ445405.

3.3. Production, extraction and identification of antifungal antibiotics

The antibiotics produced by *Bacillus subtilis* were isolated and extracted. One of the antibiotics extracted was identified as Iturin A using HPLC with an authentic Iturin A standard (Figs. 3a & b). The retention time of the standard Iturin A was 4.878 and the maximum absorbance was noticed at 254 nm. In the sample, at the same retention time, 4.837, a peak was observed and the UV spectra of both peaks were similar and proved to be the same compound. The extra peaks observed in the chromatogram represented other antibiotics.

Fig. 3 a. Chromatogram of iturin A standard and sample

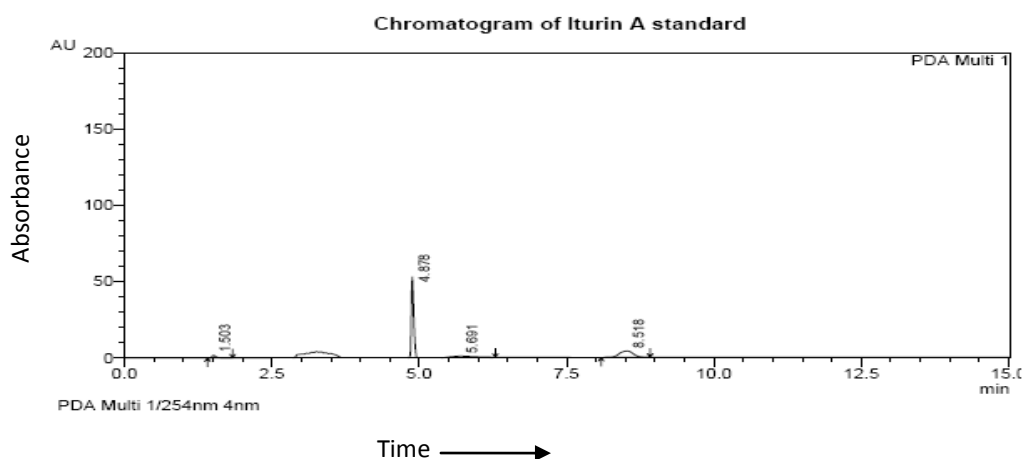
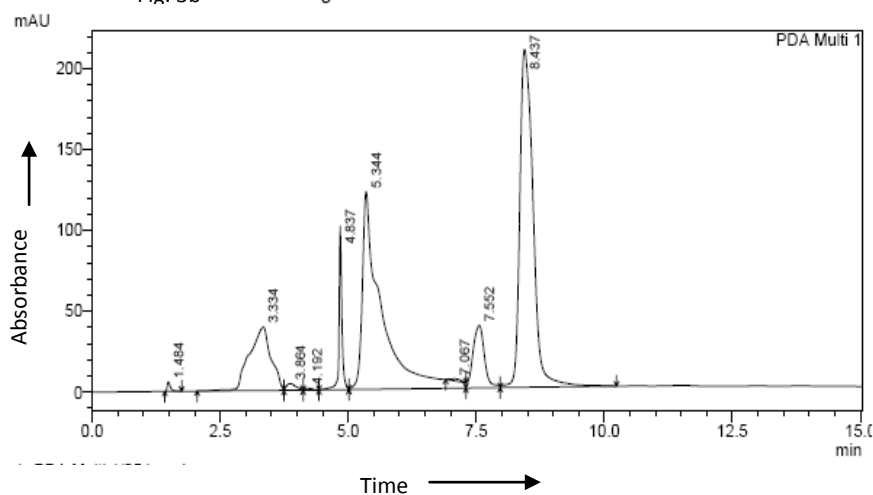
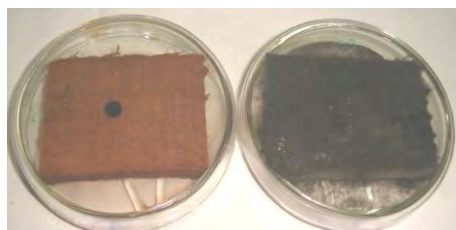


Fig. 3b Chromatogram of Bacillus subtilis Antibiotics



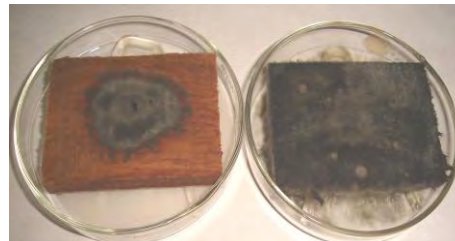
3.4. Wood block tests: No growth of the *B. theobromae* was observed on the wood blocks dipped in *B. subtilis* B2 culture in the laboratory (Fig. 4). In the wood blocks dipped in culture filtrate, the growth of *B. theobromae* was very much restricted when compared to control blocks (Fig. 5).



Treated

Control

Fig. 4. Wood blocks treated with *B. subtilis* B2



Treated

Control

Fig. 5. Wood blocks treated with culture filtrate of *B. subtilis* B2

Close stacking				Open stacking			
<i>Bacillus subtilis</i> B2 treated		Control		<i>Bacillus subtilis</i> B2 treated		Control	
Surface growth % (Rating)	Inner staining % (Rating)	Surface growth % (Rating)	Inner staining % (Rating)	Surface growth % (Rating)	Inner staining % (Rating)	Surface growth % (Rating)	Inner staining % (Rating)
8 (1)	1.7 (1)	57 (4)	24.7 (2)	2 (1)	0	15 (2)	9 (1)
9 (1)	2.5 (1)	55.3 (4)	24 (2)	2.5 (1)	0	12.7 (2)	7.7 (1)
9.6 (1)	2.5 (1)	51.5 (4)	22.5 (2)	1.5 (1)	0	13.5 (2)	8 (1)

Table 2. Rating of the open and close-stacked planks treated with bacterial culture in north east monsoon

In the field, open stacking inhibited the fungal infection during northeast monsoon than the close stacking (Fig. 6, Table 2). When compared to northeast monsoon, the percentage of sapstain was less in bacterial treated planks than the planks treated in southwest monsoon.



Fig. 6. Surface growth of *B. theobromae* on the control planks

4. DISCUSSION

In the present study the bacterium *B. subtilis* B2 has been proved as a biocontrol agent against sapstain fungus, *B. theobromae* on rubber wood both in the laboratory and field. Several workers have proved the effectiveness of *B. subtilis* as a biocontrol agent against stain and surface fungi (Feio et al., 2004; Bernier et al., 1986; Seifert et al., 1987).

The mechanisms of biological control are generally classified as competition, parasitism and antibiosis. Inhibition may be due to the production of antifungal metabolites (Podile and Prakash, 1996) or due to nutrient competition (Bernier et al., 1986). Since, in vitro assays showed that the culture filtrate had antifungal capability; the inhibition of fungal growth may be due to the production of antifungal metabolites. Evidences suggest that the principal mechanism of this antifungal action involves the production of antibiotics (Fravel, 1988).

Bacillus species are well known producers of antibiotics (Gueldner, et al., 1988; Rossall, 1991; Gong, et al., 2006). A wide range of antibiotics are produced by *Bacillus* sp. such as Iturin A, Mycosubtilin, Fengycin and Bacillomycin by *B. subtilis* (Rossall, 1991), Bacitracin by *B. licheniformis*, and Polymixin by *B. polymyxa* (Katz and Demain, 1977). Analytical reports of the *Bacillus subtilis* B2 showed that the main antifungal compounds were the antibiotics and one among them was Iturin A. The major role of Iturin A as antifungal peptides in biocontrol was studied by Gueldner et al., (1988) and Gong et al., (2006). Iturins are a group of similar cyclic lipopeptides with high antifungal activity, which can modify the membrane permeability and lipid composition and inhibit the mycelium growth and sporulation of fungi (Latoud et al., 1987). Various studies have been carried out on the isolations and antifungal activities of the iturin group antibiotics (Peypoux et al., 1985; Besson and Michel, 1986; Eshita et al; 1995). But the effect of antifungal antibiotics on sapstain fungus *B. theobromae* was studied for the first time in this trial. Iturin A, along with other antibiotics proved to play a major role in inhibiting the growth of sapstain fungus, *B. theobromae*.

In the field the planks treated in northeast monsoon season was giving good protection against sapstain than the planks treated in southwest monsoon. The reason for the low percentage of control in south west monsoon season may be the presence of high amount of fungal growth due to the congenial atmospheric condition such as high humidity and high moisture content. In Kerala the maximum amount of rain is recorded during southwest monsoon.

In order to get maximum protection from fungal growth, the quantity of antibiotics produced in the bacterial culture must be increased. A further study is needed for mass production of *B. subtilis* B2 and enhanced production of antifungal antibiotics.

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Bio-Pallets from Waste Wood and Agriculture Residues: A Path to a Sustainable Future

Dr. Beena Patel²⁴

Abstract

Abellon's core purpose is to increase energy access globally in a sustainable manner. Harnessing bioenergy via bio-pellets, Abellon strives to balance amongst food, fodder, fiber and fuel. While making a sustainable use of leftover organic residues, it develops the opportunities to "Go Green". It reduces GHG emissions & local pollutants, while avoiding any interference with existing agricultural practices and land use patterns.

Towards its sustainable energy generation efforts, Abellon is keen to position and harness the rich potential of bioenergy – a source of energy which is abundantly available in nature – through manufacturing and selling bio-pellets – made from leftover agricultural and wood residues.

Bio-pellets– Pellexo – provide a carbon-neutral, sustainable alternative to conventional fossil fuels, (mainly coal and lignite) used in the industries. It substantially lowers particulate emissions, while allowing remarkable consistency and burn efficiency. Pellexo is used at the industrial, community and retail sectors. At industrial level, it is used for utility requirement for industrial units having FBC boilers, Traveling grate boilers, Thermic fluid heaters, Hot air generators and for co-firing in large thermal power plants. At community level, it is can be used at community cooking stoves and large spaces such as malls, educational institutions, etc. At retail level, it is used at the pellet stoves in domestic / home heating and cooking applications.

Pellexo includes Environmental, Social and Economic Benefits. Pellexo has a calorific value of 4100 kcal/kg. Energy produced would be approx. 4.7683 kilowatt hour (kW·h)/kg. Coal and Lignite are replaced by Pellexo. One tone of Pellexo replaces 1.5 tonnes of lignite. One tonne of Coal replaced with Pellexo can reduce 1.7 tonnes of CO₂. It reduces deforestation, local air, water or ground pollution, reduces indoor air pollution and improves waste management. Wealth generation from wood and agriculture residues results into economic growth of farmers, rural development through employment generation.

Key Words: Agriculture residues, bioenergy, bio-pellets, environment, sustainable energy

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1. INTRODUCTION

The Abellon Group is committed to contribute towards nation building through its diverse business and social activities. Abellon operates businesses with a triple bottom line approach of achieving economic, social and environmental objectives. Through its presence in sectors such as clean energy, agriculture and genomics research, Abellon aims to create businesses that provide financial inclusion to the ‘bottom of the pyramid’, preserve the environment, even while generating a good economic return on capital (FIGURE-1).

Figure 1: Abellon Group companies



Abellon CleanEnergy aims at increasing energy access globally in a sustainable manner, through non-revenue generating agriculture residue collection platform called “poornakumbha” which mainly supports the bioenergy initiatives of Abellon in terms of uninterrupted biomass sourcing. Poornakumbha is a sustainable, community-development-centric approach added to Abellon's sustainable business model. It mainly supplies agriculture biomass for pellets manufacturing operations through “decentralized collection model”.

Towards its sustainable energy generation efforts, Abellon is keen to position and harness the rich potential of bioenergy – a source of energy which is abundantly available in nature – through manufacturing and selling bio-pellets – made from leftover agricultural residue. Our bio-pellets – Pelleexo – provide a carbon-neutral, sustainable alternative to conventional fossil fuels, (mainly coal and lignite) used in the industries. It substantially lowers particulate emissions, while allowing remarkable consistency and burn efficiency.

On a larger term, Poornakumbha support Abellon's vision of achieving inclusive rural development. This vision is actualized through various initiatives in the rural community undertaken by Poornakumbha.

2. AIM AND OBJECTIVE

Abellon's core purpose is to increase energy access globally in a sustainable manner. India, as an emerging country strives to meet the growth rate of Indian economy at about 8.6%. As a developing

nation, it is also working to meet Millennium Development Goals (MDGs) and following COP15, it has pledged to cut 20-25% emissions by 2020 from 2005 levels.

Harnessing bioenergy via bio-pellets, Abellon strives to balance amongst food, fodder, fiber and fuel. While making a sustainable use of leftover organic residues, it develops the opportunities to Go Green. It reduces GHG emissions & local pollutants, while avoiding any interference with existing agricultural practices and land use patterns.

Largely, it includes Poornakumbha to promote an inclusive, innovative and supportive growth model which also boosts the rural economy through generating significant income & employment opportunities to farmers.

3. “PELLEXO”-BIOPELLET PRODUCTION

The raw materials, agriculture residues and wood waste are directly sent to pre-processing units for reducing the size of feed material. The uniform raw material is conditioner with water if required to maintain humidity. The material transferred to pellet mills through rotary feeder. The Pellet mill is main processing unit wherein two rotors are stable & Die is rotating and cutter is cutting the finish material (pellet). Using Peddle conveyor, Pellet travels to Counter flow cooler. This cooler cools the pellet upto ambient temperature. The cooler is equipped with auto level sensor and grate mechanism for sufficient retention time (FIGURE-2). In Downstream, the pellet comes in vibrating screen wherein the fine particles are separated and pellets are stored in loose form as well as bagged and sealed with stretch wrapping machine.

Figure 2: Pellexo Production plant



4. PRODUCT QUALITY ASSURANCE:

The quality assurance department daily monitors raw material and finish good quality parameters. Ash and moisture contents are critical and checked daily for every raw material arrives at plant. While presence of unwanted materials like plastics, threads, clothes peice, etc are inspected visually. Pellets are analyzed for its bulk density, moisture and mechanical durability. Periodically the pellets are also tested for calorific value, ash, chloride, sulfur, nitrogen content and fines generated at the end of production (James, 2005). Diameter and length of pellets are also physically measured as a part of quality assurance (Anna Wolf et al., 2006).(Table-1). The QA department is equipped with all required instrumentation like hot air oven, muffle furnace, analytical balances, bomb calorimeter and ligno tester for durability testing (Brigitte Hahn, 2004). The equipments are calibrated periodically for quality performance.

Table 1: Specification of Pellexo pellets

Sr.	Property	Unit of Measurement	Range
1	Diameter	mm	6 – 8
2	Length	mm	3 - 40
3	Moisture	As received, %	≤ 10
4	Net Calorific Value	As received, MJ/Kg	>16.0
5	Ash	% dry	< 1.0
6	Bulk Density	Kg/m ³	≥ 650
7	Nitrogen	% dry	0.3
8	Sulfur	% dry	0.05
9	Chlorine	% dry	0.5
10	Arsenic	mg/kg dry	≤ 1
11	Cadmium	mg/kg dry	≤ 0.5
12	Chromium	mg/kg dry	≤ 10
13	Copper	mg/kg dry	≤ 10
14	Lead	mg/kg dry	≤ 10
15	Mercury	mg/kg dry	≤ 0.1
16	Nickel	mg/kg dry	≤ 10
17	Zinc	mg/kg dry	≤ 100
18	Ash melting behavior	degree C	>1200

5. PRODUCT APPLICATIONS

Pellexo is used at the industrial, community and retail sectors (FIGURE-3). At industrial level, it is used for utility requirement for industrial units having FBC boilers, Traveling grate boilers, Thermic fluid heaters, hot air generators and for co-firing in large thermal power plants. The product is suitable for all types of combustion system without modification in combustion system. It significantly improves energy output and thereby efficiency of production. At community level, it can be used at community cooking stoves and large spaces such as malls, educational institutions, etc. At retail level, it is used at the pellet stoves in domestic / home heating and cooking applications.

Figure 3: Pellexo Bioenergy Pellets



6. PRODUCT BENEFITS

6.1 Clean Development Mechanism (CDM) benefit

Pellexo uses these agriculture residues in a more efficient and innovative manner, so as to harness the energy in biomass. Pellexo are manufactured in customized sizes, which make them suitable for various industries. Use of 10,000 tones per day of bio-pellets replaces 5600 tones per day of coal, reduces 3746400 tones of CO₂ per year generating revenue in terms of Clean Development Mechanism (CDM) benefit.

Coal, Lignite and other fossil fuels are replaced by Pellexo. One tonnes of Pellexo replaces 1.5 tonnes of lignite. We estimated that the client would successfully reduce 1.5 tons of CO₂, as well as other local pollutants such as SO_x, NO_x and SPM by replacing 1 ton of coal with Pellexo, resulting in significantly improved workplace and surrounding environment.

CDM benefits to be availed to the clients, for which Abellon has an in-house team of CDM experts who help the clients understand the CDM mechanism, take appropriate actions to comply with the same, obtain CDM approval for their projects, and ultimately, gain the financial and environmental benefits accruing from the same in the form of Carbon Emission Reduction (CER). Preparation of case study based on successful replacement of fossil fuels and resulting environment and economic benefits to the clients (Milind et al., 2000). Pellexo also helps our clients to meet their Pollution Control Obligations, adds scope for earnings through CDM and assists them in branding their organizations as clean, green and environmentally responsible.

6.2 Environmental Benefit

- Pellexo has a calorific value of 4100 kcal/kg. Energy produced would be approx. 4.7683 kilowatt hour (kW·h)/kg
- Coal and Lignite are replaced by Pellexo. One tone of Pellexo replaces 1.5 tonnes of lignite.
- 1 tonne of Coal with Pellexo can reduce 1.7 tonnes of CO₂.
- Reducing deforestation, reducing local air, water or ground pollution, reducing indoor air pollution, or improving waste management.

Table 2: Pellexo pellets and comparison of emission with conventional fuel.

Fuel	GCV (Kcal/kg)	Displacement with pellexo (ton to ton)	CO2 Emission per ton of consumption	Ash (%)	Sulfur (%)	SOx (Kg/tonne)	Moisture (%)
Lignite	2500 - 3000	1.36-1.64	1.64	25-35	1 to 4	20 -80	20 -40
Indian coal	3500-3800	1.07 -1.17	1.52	20-30	0.5 -1	10/20/11	05/20/11
Important coal	5000-5500	0.75 – 0.82	1.53	10	0.5 - 0.7	10/15/11	05/15/11
Pellexo	4100	1	Carbon Neutral	<5	0.5	10	<10

6.3 Social and Economic Benefits

- Wealth-out-of-Waste (WoW): Approached 102 villages for collection of agri-residues to be supplied for Abellon's Biomass initiatives.
- Employment Generation from the entire initiative: About 15000 Income Generation Programs for farmers – Krushisabha: About 385 rounds of Krushisabhas organized till date Addressed about 14,000 - 15,000 farmers in 210 villages of Gujarat, India. 20% increase in annual income of farmers i.e. raise of US\$ 218 per person/annum
- Inclusive rural development initiatives: Education enhancement through providing knowledge for English and Computer in rural schools.

7. CONCLUSION

Pellexo is highly dense, compressed, low moist material which is primarily derived from compacted agricultural residue or waste wood. It has been proven to be effective bio fuel that can be utilized in many energy generation system. It is environmentally friendly and carbon neutral compare to other conventional fossil fuel. Pellexo is currently used at national and international level for domestic and industrial energy generation.

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Bamboo as Substitute of Wood for Sustainable Development

Neera Sarmah²⁵

Abstract

To generate the employment for rural communities. To create awareness of environmental issues. To understand the benefits of taking care of Bamboo. To understand the holistic approach of Bamboo. To have continual improvement in Bamboo Related Activities. To attain a sustainable quality of life among the forest dwellers through local up-skilling and development of handicrafts.

Steps towards meeting objectives: identify various local skill potential and kinds of available raw material; fine tune the skill potential and raw material availability, skill enhancement procedures with market viability; devise product associated Capacity Building capsules & Action Plan; create market opportunities worth Rs. 6500 crore with an investment of Rs. 2600 crore, enabling 5 million families of artisans and farmers crossing the poverty line (AS PER NBM).

Skill Enhancement: Identify and short list Trainers-Facilitators in the fields of design possessing latest technological skills. Create Master Crafts Persons, with upgraded skill, awareness in technology, efficiently communicative and sound in various marketing strategies. Deliver further training to create good artisans. Exclusive selected few product should be produced by highly skilled artisans, resulting in uniformity of size and shape & easy mkt. Continuous skill up gradation.

Innovative Designing. Bi-focal approach for product development. Emphasis on products for the masses -affordable. easily maintainable and sustainable design, Select skilled artisans for specialization to produce quality product with an eye on the International Market. Introduction of new designs. Use new technologies and Grow into something else, rather than keeping on repeating the same design, because it was successful earlier. Continuous adaptation of new global designs.

Uniqueness of Bamboo. Bamboo sprouted again after the Nuclear Bomb blast in Japan. Can grow on de-graded soil. In Columbia & Ecuador Bamboo are used for fishing. In Europe Bamboo is used for the production of Rayon. Bamboo houses can sustain in the earthquakes of 7.6 richter scale. In China for the Construction of Bridges the Bamboos are used today also. Bamboo shoots are rich in Thiamine, Vit B, Potassium, Cellulose & aminoacid, 17 enzymes & also minerals like selenium. Italian Government is planning to purchase the Bamboos from India, Tanzania & Ecuador. Few Bamboo varieties can reach the height of 60 mtr or more. Substitute for tobacco plantation. Bamboo serves as the best wind-break. Most assured profitable crop for the farmers. Bamboo for our Earth. Wind Break. Absorbs maximum green house gases. Helps to reduce the temperature by 3 to 4 degree celsius. Halts soil erosion & land slides. It is a self manuring plant. Produces maximum quantity of Biomass. Can have Inter cropping or mixed cropping successfully. Benefits of Bamboo Power. Environment and Eco Friendly. Avenue generation activities for equal distribution of economy. Employment availability in rural areas. Resource Utility, profitable farm activity. Replacement of wood to save our forest and wild-life. Healthy socio-economic life. Bamboo Power Implementation Benefits in Mountain Tourism. A step towards controlling Global Warming. Balanced forest/nature. Easily re-cyclable. Healthy utility for human being. Employment opportunities. Self reliance. Reversal of ecological degradation of bio-diversity.

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Scope: Handicraft development safest tool for eco-sustainability of the forest communities. It has potential for strengthening Local livelihood- poverty alleviation. Design creation and careful mrkt survey sine-qua-non for any success. Create industry sponsored plantations of all such imp species.