PROCEEDINGS OF THE WORKSHOP

FORESTS FOR POVERTY REDUCTION:

Changing Role for Research, Development and Training Institutions

17–18 June 2003 Dehradun, India

Editors H.C. Sim, S. Appanah and N. Hooda

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FOREWORD

An enormous challenge awaits developing countries in the Asia-Pacific region. The region as a whole has seen a dramatic economic transformation in the last 30 years. However, these benefits have eluded significant portions of its population. The existence of such extreme poverty makes its removal the region's most critical development challenge. Quite a significant number of the poor are forest dwellers or from the communities living close by. By virtue of that association alone, it can be said that forest-dependency has led to their impoverishment, yet these forests can also be the solution to their indigent condition.

This would come as a surprise to most though. In former times, most forests belonged to local rulers, and villagers had complete access to most of the non-timber forest products. The people lost their access to such wealth following consolidation of the forest lands into forest reserves to be managed by the government authorities. Most of the governments focused management towards production forestry to support the timber industries and increase their foreign exchange earnings. Poor people's dependence on forests was usually relegated to themes such as minor forest products.

Readjusting our focus back to the socio-economic role of forests would require considerable adjustments to the system. For a start, forest policies would have to be revised so as to prioritize the role of forests in meeting the needs of forest-dependent communities. Agencies that are involved in forest management would have to rethink considerably their strategies, and restructure their departments to take on roles that previously were given minor attention. This would also require engaging personnel with completely new skills in subjects such as participatory processes, community approaches, gender issues and other poverty reduction strategies. The work does not end here. The role of research institutes is pivotal to the success of new programmes in poverty alleviation. This would require a considerable revision of the research agenda, and likewise the hiring of people with new skills. Additional attention would have to be given to transfer of technology, extension, and effective implementation of these new programmes.

A number of participatory research methodologies have emerged recently. Innovative approaches for development and diffusion of poverty alleviation technologies are being pioneered in many parts of the developing world. There is also growing recognition that local community organizations can assist in natural resources management, utilization and development planning; and can play a critical role in facilitating community level application of basic and strategic research results and in translating them into highly adoptable and profitable technologies. However, disparities in scientific capacity and capability, coupled with the often archaic and bureaucratic administrations, in the developing and underdeveloped countries, have hindered the effective adaptation and application of these technologies.

All in all, we see considerable work ahead for many forestry institutions in the region. But most of all, there is a need for considerable transformation in their objectives, agenda, and the products they will have to deliver. This workshop, the first in the series of three workshops held in 2003 on the theme of *Forests for Poverty Reduction – Exploring the Potential*, was organized to share the experiences hitherto gained from poverty alleviation initiatives by forestry research and development agencies in the Asia-Pacific region. These proceedings, a collection of papers presented during the workshop, could serve to increase the recognition of the role of forestry in poverty reduction, as well as the awareness of policy-makers and specialists on the need for a more pro-poor focus in their undertakings.

Forests have great influence on the welfare and economy of human society. In developing countries the linkage between forests and the people is more intense due to higher dependence of the people for their livelihoods. Considerable work lies ahead to bring about the desired results of using forests for alleviating poverty. The renovation of the forestry institutions represents the beginning.

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Key papers were invited from several eminent speakers from all over India for various themes related to poverty reudction. Representatives from national forestry agencies in a number of countries in the region also presented their countries' status reports. The workshop participants represented a mix of foresters, scientists, NGOs, bureaucrats, academicians and scholars, from countries in the Asia-Pacific region. We wish to thank all of them for their contributions during the workshop and also for the preparation of this proceedings.

We are also indebted to all our colleagues in ICFRE for their help, and thanks are due to all the support staff and our office team for their painstaking efforts. The unstinting support from Dr Y.P. Singh, Dr Mohit Gera, Dr Anita Srivastava and Smt. Neelu Gera specially acknowledged.

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Welcome address

R.P.S. Katwal*

Dr Oudara Souvannavong, FAO Representative, Rome; Dr Baskaran Krishnapillay, Executive Secretary, APAFRI; Dr Simmathiri Appanah, Senior Programme Officer, FORSPA, Bangkok; Dr Sim Heok-Choh, Executive Director, APAFRI; Padam Shri Chandi Prasad Bhatt; distinguished delegates, members of media, print as well as electronic, ladies and gentlemen, I am extremely delighted to welcome you all today to this Asia-Pacific Regional Workshop on "Forests for poverty reduction: the changing role for research, development and training institutions". We were looking forward to this opportunity for long, the idea was floated in Sri Lanka during December 2002. The meeting was originally slated to be at Delhi in April, but could not be held due to the outbreak of the SARS epidemic.

Forests have great influence on the welfare and economy of human society. In developing countries the linkage between forests and the people is more intense due to higher dependence of the population for the fulfillment of their daily needs. But today the forest ecosystems have become fragile and are much less productive and under an acute form of degradation.

In India, of the 576 000 villages approximately, 175 000 villages are located in and around forests and the predominantly tribal population consisting of about 350 million people has a symbiotic relationship with the forests. They are substantially dependant on the nearby forests for their livelihood requirements. Though 19.27 percent of the landmass in India is under forests, only 11 percent is under good forest cover. With 1.8 percent of the world's forests, we have to meet the needs of 17 percent of the world's human and 18 percent of the livestock population.

One-third of the country's area is stipulated to be brought under tree cover and to achieve this an area of 29.70 million has to be brought under plantation. For this an investment of Rs. 50 billion is needed as against the present availability of Rs. 16 billion.

The problem of forest management is linked to the rural poor and overuse of the resource. An increase in the population in the previous century has put severe pressure on scarce natural resources in India. The long gestation period of the forests has led to a situation where a big gap exists between the demand and supply for timber, fuelwood, fodder and non-wood forest products.

Though poverty is in both urban and rural areas, rural poverty is of greater concern as approximately 67 percent of the population resides in rural areas and is predominantly dependant on forests to fulfill their basic needs. The process of development has been such that the benefits of the green revolution and other developmental activities could not be passed on in a uniform manner and consequently a separate class of rural poor consisting of marginalized groups (mainly scheduled castes and landless) has emerged. This has resulted in disparities in incomes. The people living in and on the forest fringes have particularly been affected adversely.

The process of degradation of natural resources and inequity in the society can be reversed if focus is maintained on the following aspects:

- increase in income from the forests to the target groups;
- empower landless and marginalized groups;
- establish processes and mechanisms which can provide cushion in times of environmental imbalances like floods, droughts, cyclones, etc.

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Efforts need to be undertaken at all levels to ensure that the development process is pro-poor. It requires informed and pro-poor policy-making, strategy planning and programme formulation. The forestry research during the past century has been focusing on the basic disciplines of silviculture, forest product utilization, wood technology, entomology, pathology, mensuration and soil science, etc. Though all these are of immense relevance for furthering the development of forestry science, today the focus has to shift to research which can bring quick changes and improve the economy of the poor, leading to poverty reduction.

The purpose of carrying out forestry research today should be to generate benefits for poor people by the application of new knowledge to natural resource management. This shall include livelihood strategies based on the sustainable use of the forests including wildlife habitat and planning strategies to sustain the livelihoods of poor people dependent on forests adjacent to croplands. The three basic things which are essential to the rural poor are fuelwood, fodder and small timber for agricultural implements and house construction.

The fuelwood requirement was estimated to be 390 million m^3 , while recorded production from the forests is estimated to be 56 million m^3 , which leaves a gap of 334 million m^3 .

Against a total requirement of 1 712 million tonnes of cattle feed, the availability from non-forestry sources is only 664 million tonnes. The gap is met from forest areas leading to heavy pressure on the fragile forests. There is demand for 55 million m^3 of wood but the availability is only 29 million m^3 , thus there is a gap of 26 million m^3 .

Field-based research has to focus on these major issues with standardization of permutations and combinations where silvi-pasture can be encouraged with improved soil and moisture conservation techniques. Slope management has to be such that maximum water is conserved for enhancement of soil productivity and moisture retention. Promotion of user-managed research is an essential step in the right direction.

There are several specific development projects which are being carried out. Their conventional mandate of reducing poverty within a geographical area could be met more effectively if they could:

- identify sub-groups of poor people more clearly and target them specifically;
- improve prioritization and sequencing to reduce the risk of elite capture;
- mainstream crosscutting themes such as gender and environment more strongly. The role of women, though acknowledged, has to be researched from the point of view of mitigating their hardships;
- interpret principles of learning, ownership and sustainability in a more pragmatic manner.

The success of any research activity will depend upon its organization in the states and utilization of extension services to carry research from the laboratory to the field. Under this scenario, investment in research, the need for strengthening of human resources for forestry research, training requirements and strengthening of forestry extension, will have to be attended to.

There is a need for a user-friendly and problem-solving thrust in research planning and extension. An example can be cited regarding exploitation of age and growth projections for community managed forest areas and the prevailing calculations have to be modified for coppice and non-coppice areas. The rate of growth in different management systems and compatibility with NWFP at the forest floor and in understory have to be studied.

In a world where there is still so much extreme poverty, inequality and environmental degradation, the concept of technology leapfrogging acquires a new and special meaning.

The best technologies are those that create sustainable livelihoods. They must facilitate the fulfillment of basic human needs and promote basic attitudes of self-reliance. Promoting local water harvesting structures, energy-efficient stoves, biomass-fuelled power stations are such technologies, which strive to fulfill the basic needs of the society. While promoting such technologies, care should be taken that women who face the brunt of poverty are at the centre of development.

There is the possibility of developing eco-farming models under adverse agro-climatic conditions with integrated approaches to land and water management. The ultimate goal of development initiatives is not only to meet the immediate needs of the rural poor, but also to reverse the trend of natural resource depletion.

From the above scenario it is evident that a poverty reduction strategy focusing only on rapid economic growth is unlikely to significantly improve the situation of the poor. Both equity and sustainable growth are required. Poverty reduction would work best when the poor are made more productive so they can contribute to economic growth themselves. A two-way exchange of goods and services in the form of agriculture from non-tribal villages and value-added forest products from tribal villages seems to make ecological as well as economic sense.

A number of participatory research methodologies have emerged recently. Innovative approaches to development and diffusion of pro-poor technology are being pioneered in many parts of the developing world. However, disparities in scientific capacity in a globalizing inter-regional system of research network and the paucity of suitable institutional mechanisms to build on the combined strengths of all research partners and institutions remains a challenge.

There is a growing recognition that local community organizations are often better equipped than their upstream research partners in providing insights into traditional research practices and innovations. They are better placed to help in organizing the communities in natural resource management, utilization, and development. This is because they have access to location-specific, agro-ecological and socio-economic information and can play a critical role in facilitating community-level application of basic and strategic research results, and in translating them into highly adoptable and profitable technologies.

This Workshop is being organized to assess the experiences hitherto gained and to identify measures to strengthen these efforts in the Asia-Pacific region as these countries share many things in common.

Your valuable inputs during the course of this Workshop will help in laying the foundation for the bright future of forest dwellers and millions of stakeholders by ensuring livelihood initiatives through forest enrichment. The recommendations resulting from this Workshop are also expected to lay down a road map for research institutions to plan their strategies for reduction of poverty. I am sure that with your wholehearted participation this Workshop shall be a grand success.

I once again heartily welcome you and wish you a pleasant stay in the sylvan surroundings of Doon Valley.

Thank you very much.

Introduction: towards forestry institutions for the twenty-first century

S. Appanah*

Do we still need forestry institutions? And with that, do we still need forestry research? I had the enormous mishap of entering into discussion on the subject of forests with a chief minister of a small state in Asia. His argument was that if countries in the Middle East can do without trees, why are we overly concerned with keeping forests? It was of course disingenuous of him – some of his likes are mainly interested in approving logging concessions to a favoured few. I carefully pointed out that the Middle East, fortunately for them, is awash with black gold, and we with green gold. With some small effort, ours is renewable and theirs not. Unlike this isolated case, in all my other meetings of this nature, there was a clear consensus that mankind will need its forests, and likewise the need for forestry institutions.

If that is indeed the case, are our forestry institutions meeting their demands adequately? The stakes are high indeed. If our political masters conclude that our work is ineffective, we are in for the chopping block. Against this reality, the onus is on us to ensure that our work is meaningful, has impact, and the benefits reach the people in need, and the future for forestry is vouchsafed.

If we take a look at forestry across the region, the trend unfortunately seems to go along a predictably poor route. Only three decades ago, many countries in the region were exporters of timber and wood products. Since then, some of them had to take drastic actions, including logging bans to conserve the remaining forests. This was out of concern for environmental degradation. Forestry's contribution to GDP (as measured using current methods) has clearly declined, and likewise, the country's annual budget allocations for the sector have seen a downward spiral. Many are now timber importers both for domestic needs as well as for further processing and re-exporting. More of the domestic timber needs are met from plantations, farm- and agroforests. Next, the countries that are currently on the producer side too are beginning to show declines in their resources and annual harvests. I may be painting a bleak scenario, but it is becoming reasonable to assume that in the not-so-distant future the natural forests are unlikely to be major source of timber.

Against this backdrop of declining forest resources is an increase in poverty in the region. Although the region has had a burst in economic growth in the last decade, today more poor are living in the region than anywhere else on earth. Another conundrum is the association of gross poverty with forests; most of the poorest are living in forests or in the margins. FAO has pointed out that 1.2 billion people in developing countries depend on trees on farms to generate food and cash, 350 million people live in or next to dense forests and rely on them for subsistence or income, and millions more depend entirely on tropical forests for their survival. This clearly emphasizes how intensely human beings, especially the poorest are dependent on trees and forests for survival. This is not to conclude that forests have impoverished them, rather the governments are largely to be blamed for their indigent state.

For almost a century, forestry institutions in the region were mostly devoted to managing the vast timber resources, and gave scant attention to forest-dependent people's needs. The forests were extensive and the populations small to make a severe dent on them. The main beneficiaries were the government coffers and a small group of people heavily involved in commercial logging activities. The poor and forest-dependent people remained by and large marginalized and unprotected. With the unprecedented growth in human populations in the last half a century, the demand on forest land and other products had grown steeply. This

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led to overexploitation and degradation of forest resources to such a degree that the consequent environmental problems are beginning to overwhelm us. The natural reaction in many countries has been to swing towards greater conservation, locking away remaining forests. This has greatly affected the poor who are dependent on forest resources from public lands. The result is heavy encroachment and continued degradation of the forests.

It has finally dawned on us that conservation is near impossible unless we meet the needs of the poor communities, and better still involve them in the work. So the big question is whether forests can be used to alleviate poverty? While it is germane to our discussions, for the present we have to assume it is possible, and examine how forestry institutions can bring about the results? This endeavor of course, fits in quite well with the United Nations' Millennium Development Goal. Poverty reduction strategies are thus becoming the framework for development planning and implementation, and are guiding the operations of many donors and international development agencies. So, are our institutions, the planning, management, research, extension, and training agencies, capable of delivering the results? This is the main focus of this workshop.

This enquiry is relevant and timely. One simple clue would be to take a quick glance of the annual reports of forest departments in the Asia-Pacific region, and scan our local and regional forestry journals. They are revealing: for example, the contents of one issue of the Journal of Tropical Forest Science (2003) had articles on vegetative propagation, tree wealth of tribal people, microbial biomass, macronutrients, remote sensing, fruit size, mycorrhizae, genetic variation, growth periodicity, growth performance, and forest type classification. Only one-eleventh of the articles relate directly to poverty issues. This trend is even repeated in a national journal such as the Indian Forester – Volume 130 (nos. 4–6) contains only one article that relates to poverty issue, four indirectly, and the rest (36) deal with traditional forestry subjects such as plantation genetics, silviculture, canopy management, wood utilization, insect pests, seed germination, and thereof. What it means is that many institutions are still trying to solve problems that bear little relation to current needs.

This may be too simplistically arrived at, but it does convey an important message. Perhaps our institutions need to review their work, and revamp their strategies and priorities to deliver that expected of them. This workshop, the first in a series on the theme, "Forests for Poverty Reduction," looks at the institutional needs in order to be able to meet these new challenges.

In the welcome address, R.P.S. Katwal stated that the benefits from the green revolution and other developmental activities could not be passed on in a uniform manner, and this has resulted in a separate class of rural poor, those living in and near forest fringes. Their over-dependence on public forest lands has resulted in further loss and degradation of the forests and environment. Such inequities need to be reversed by increasing their income, empowering them, and establish processes and mechanisms to cushion them against hardships. C.P. Bhatt, a leading social worker in the region, opened the discussion (Chapter 3) by emphasizing that forestry research in India is poorly done, and has not identified people's needs, problems and their expectations. There is a clear mismatch between the needs of development programmes and the priorities of research institutions. Exacerbating the situation, some of the useful research does not get transferred from the laboratory to the field. But such expressions may not be revealing the primary cause. However, in a well-thought out presentation on how forestry evolved in the Indian subcontinent, S. Shanmughasundram (Chapter 13) clearly places the blame on the government and forestry institutions for the current predicament. He outlined forestry development in the country into four phases or generations, when radical shifts in forestry objectives and concepts took place. The first was the 'Forestry for Conservation' that led to consolidation and appropriation of communal forest land by the states. This began the alienation of rural people from access to their forests. The second 'Forestry for Economic Development' resulted in the states trying to generate income from forests. High attention to timber management was given but it only resulted in loss of forest capital and biodiversity. The wealth though did not trickle to the poor communities. The third was 'Forestry with People' which recognized the need to include rural people in the restoration of degraded forests. Many innovative ideas such as participatory forestry and joint forest management were born as a result. But overall, these schemes still used the poor merely as cheap labour. Troublesome issues of equity and ownership remained unresolved, and the poor remained unenthusiastic to such schemes. The fourth, and current one, is referred to as 'Forestry for People.' This calls for integration of forestry in the rural life, with focus on using the resources to alleviate rural poverty.

But before we embark on a major endeavour, it would be better to find out where the poor are, what conditions lead to their impoverishment, and what developmental options can be mustered to reverse the condition. K.D. Singh, in a survey of "Forest and Poverty" (Chapter 14) attempts to grapple the issue. By geo-referencing forest cover, forest area and village data, the spatial correlation in distribution of poor, their occupational patterns, and their distance from the forests can be derived. This would be essential information to base any development strategy. One can argue about why we need to devote so much energy to study the character of poverty. Instead, why not transfer our energy directly to poverty eradication efforts? That would be fine when dealing with tiny pockets of poverty. But when the scale and depth of poverty is expressed in the millions, information about distribution and character would be essential for formulating major

development work. Along the same lines, A. Shariff *et al.* (Chapter 15) presented their findings on the socioeconomic and human development profiles of scheduled tribes and scheduled castes in India.

It is one thing to know the character and demography of poverty, but even more critical would be investigations on how such poverty can be alleviated. Not unsurprisingly, an overwhelming number of researchers linked non-wood forest products (NWFP) intimately with the poor, whether they are forest dwellers or those living in the margins. In keeping with that tradition, we have several presentations in this workshop. For a start, P.P. Bhojvad (Chapter 9) looks at research issues in the value chain of NWFP for poverty alleviation of forest dwellers. He highlights the research needs for sustainable management of NWFPs. In light of the findings, he goes beyond to identify the changing roles of research institutes, forest managers and trainings institutes. A.V. Sagar (Chapter 16) next looks at tribal development and the marketing of non-timber forest products. He gives special attention to how cooperatives formed for marketing such products can bring better returns to the people. The theme is further pursued by P.L. Soni and V.K. Varshney (Chapter 11) who attempt to link poverty alleviation through value addition of NWFPs. They point out correctly that research efforts are inadequate, too thinly spread out, and there is a lack of linkage between different institutions involved in NWFPs development.

Other researchers looked beyond NWFPs as a means to alleviate poverty. These include: (i) report from Zhang *et al.* (Chapter 24) on the role and application of community forestry in mountain development in China; (ii) P. Kant and R.P.S. Katwal's proposal (Chapter 6) to incorporate environmental goods and services from forests for poverty alleviation; (iii) M.K. Singh's study (Chapter 7) on Joint Forest Management scheme in India; (iv) S.S. Negi's study (Chapter 19) on the experiences gained from participatory forestry; and (v) the work of M. George *et al.* (Chapter 12) on agroforestry for poverty alleviation and environmental restoration.

But if this workshop had dealt with issues relating to community forestry, NWFPs, ecological services and what not, we would have missed the point. Our main purpose is to look at how forestry institutions should re-engineer themselves to meet the new challenges of meeting the needs of the poor. Most forestry institutions have been caught somewhat unprepared for the change in demands. Whereas, traditionally the work was focused on timber management from forests mostly owned by the state, today foresters have to look far beyond this narrow dimension. People's issues are paramount, and a typical forester has to contend more with issues ranging from conflict resolution, ownership sharing, participatory processes, NWFPs, and so on. The research institutions have had to shift away from typical subjects as silviculture, mensuration and management, and more into policy related issues such as governance, tenure, taxation, multi-sector planning, certification and thereof. Similar demands are made with the ministries, NGOs, extension and training bodies. The curriculum for forestry education has to be completely revised if the training is to meet the rapidly changing needs.

In keeping with this need, several valuable discussions followed on issues of research, development and training. Let us start with the research issue. At the very start, R.P.S. Katwal in his welcome address calls for efforts to be undertaken at all levels to ensure that development process is pro-poor. He points out that research should shift away from basic disciplines such as silviculture, entomology, wood technology, etc., to income-generation activities geared for poor people, which would include fuelwood, fodder and small timber. In another presentation, P. Kant and R.P.S. Katwal (Chapter 6) go further to identify R&D requirements. They point out that the Joint Forest Management in India has achieved only modest success as it remained confined to NTFPs such as small timber and fuelwood that have remained in the non-monetized economy. They propose research to include environmental goods and services like carbon sequestration, soil and water conservation, ecotourism, etc., to enhance income generation for the poor people. In view of the changing demands on forests, forestry research institutes have been set up for the single purpose of developing technology to meet the needs of the poor. P.K. Shukla and S.S. Bisen (Chapter 5) describe the work of Tropical Forest Research Institute, Jabalpur, India, as a case in point. This institute has developed appropriate agroforestry models, popularized cultivation of medicinal plants among farmers, and introduced multi-use of forest flora. The institute pays additional attention to user uptake of the results to ensure the findings reach tree growers and farmers. Along the same vein, A.K. Rana and N. Gera (Chapter 4) express concern that in the prevailing forestry research systems, the intended beneficiaries have not adopted the technologies to the desired extent. The reasons include inadequate linkages between research institutions and user groups, mainly due to lack of extension efforts, and failure to integrate technologies with the development process. The way to overcome some of these constraints is to ensure that the target groups are not only beneficiaries but are also active partners in the R&D process. The role of research institutions have to be broadened to integrate livelihood support systems, health and nutrition, education and capacity building, revival and strengthening of traditional knowledge systems and development of marketing channels. Further fine-tuning the ideas, K.S. Rao (Chapter 8) calls for forestry research institutes to minimize curiosity-driven research, pursue research that meets society's needs, and give greater consideration to socio-economic issues. F.A. Polisco (Chapter 22) also calls for a major change in the way forestry research institutions work. He proposes greater facilitation or direct transfer of technology to the users, building capacities of communities in sustainable management, and influence policy

development that is pro-poor. Indonesia (Chapter 30) has likewise, undertaken a series of improvements to its forestry research institutions, such as capacity development, and formulating new strategies that take into account local community participation in forest management. Recognizing that most of the forest management problems such as encroachment and illegal logging stem from poor social and economic conditions, a new research centre for social and economic research for forestry has been set up. In keeping with the changing demands, even academic institutes have begun to move, for example the College of Forestry and Natural Resources (University of the Philippines) has revised its curriculum and shifted its research focus into socio-economic issues and forestry (E.O Peralta, Chapter 21).

Perhaps the thrust of the meeting has dealt with reformation of research institutions and the research agenda to meet the challenges of using forests for poverty alleviation. However, other presentations, while not with the same intensity, do recognize the need for training institutes, policy makers and development organizations to have clear and paramount roles in this initiative. Several country reports (e.g. D. Tshering, Chapter 23) made general recommendations along these lines. There are also calls for policy revisions, legislation, decentralization, greater participation, and increasing the social forestry programmes. Proposals are made for introducing national forest programmes which incorporate poverty alleviation strategies into forestry plans and policies. In some cases the concepts have moved beyond theory to practice, as in the case of the Peoples Protected Areas (PPAs) in Chhattisgarh, India. R.C. Sharma (Chapter 17) describes the creation of 32 PPAs, each covering around 15 000 ha of forest land, in the newly created State of Chhattisgarh in India. Considering more than 50 percent of the people living in and around the forests depend for their subsistence on them, the Forest Department is looking into management models with appropriate entitlements to enhance the welfare of the people. In the same realm would be the Community-Based Forest Resources Management (CBFRM) strategy adopted in the Philippines (F.A. Polisco, Chapter 22).

The concept of using forests for poverty alleviation is beginning to gain recognition in the Asia-Pacific region. This is clearly indicated in the country reports. Viet Nam (Chapters 25 & 26), for example, has prioritized forest protection and forestry development which are linked to poverty reduction. Supporting policies and legislation have been approved, and departments are beginning to make the adaptations to implement forestry programmes that include land allocations for households, 5 million ha reforestation programme and improvement of agricultural practices so less pressure is exerted on forest land. Community forestry projects have become the mainstay in Bangladesh (Chapter 29), and are getting more attention in Myanmar (Chapter 31): these are geared towards better landuse efficiency, employment generation, environmental stability, and greater social equity.

Perhaps the country that can best exemplify the shift from traditional timber-production focus to a pro-poor forest management is Nepal. K.C. Paudel (Chapter 20) gives a brief on the developments. Nepal took the initiative to involve local people in the management and utilization of forests for improving livelihoods of local communities in the 1970s. It began with the creation of the Community Forestry Programme. This was followed by the Leasehold Forestry Programme. Some 1 million ha of forest area are now under such management. In keeping with this, the policies are being formulated to transfer government-owned land to the communities. In the 1980s, the Forest Department began involving local people into managing protected areas. To support these developments, the government initiated several measures to increase capacity of local forest users in forest management, participatory methods, revenue sharing mechanisms, and greater women participation. Meanwhile, research was stepped up in propagation and establishment of multi-purpose tree species, forest management in the mountains, agroforestry, and biomass estimations. Appropriate harvesting and processing techniques for key NTFPs have been developed and disseminated. The government recently created a high level coordination committee for promoting high value NTFPs. Yet, Nepal still recognizes problems exist in several areas, such as limitations in planning and management, poor transfer of technology, inadequate links between researchers and users, benefit-sharing mechanisms still in infancy, and low investment into forestry research.

In conclusion, it would be incorrect to claim that a workshop like this has successfully identified all the key institutional issues and provided the strategies and directions to take. However, the workshop has been able to articulate the problem effectively, and push for change across the board. Nevertheless, overall it can be claimed that a definite shift in the thinking is taking place. Countries in the region are taking cognizance of the decline and degradation of their forest resources, the impoverishment of the landless people, and the need to link forest conservation and management to that of poverty alleviation. These will require almost a complete re-engineering of our forestry institutions. Institutional changes, albeit hesitant and uncoordinated, have begun. The experiences gained by countries such as Nepal would provide models for adaptation. The huge innovations in social forestry in India will provide additional direction. While more thought should be given to a number of issues, particularly in the structure and organization of the institutes, new skills are also needed. Gone are the days when a diameter tape and notebook were the forester's equipment. People are going to be his biggest challenge – dialogue, engagement, and meetings would fill his portfolio. But nothing will happen unless we are prepared to change. As Gandhi said, "We must be the change we wish to see in the world." As we transform ourselves, so will our world.

3 In forestry lies the prospect of economic progress

Padam Shri Chandi Prasad Bhatt*

INTRODUCTION

In spite of industrialization and the various alternative employment options available in the twenty-first century, natural resources provide the biggest livelihood opportunities to a large population in the world and in India. In underdeveloped and developing countries, two-thirds to three-quarters of the human population is dependent on the forest and land for their livelihood. The weak point of this situation is that natural resources are not being utilized in a development-oriented manner for providing livelihood strategies. Natural resource removal is not able to foster the socio-economic progress in an effective manner.

The land available for natural resources is limited. This valuable resource has given way to scientific research and development of new techniques to enhance productivity per unit area of land. Agriculture has always been a major source of livelihood but it has reached a stage of saturation with no further scope for expansion. Forest resources therefore become the second largest source that together with agriculture and annual husbandry can provide major livelihood opportunities to the rural communities.

It is a well known fact that forests not only protect our valuable soil, provide clear air but also provide a strong basis for agriculture and industrial progress. Forest dwellers and people living near forest areas depend on natural forests for their nutritional requirements, agricultural implements, raw material for cottage industries and fodder for livestock. Forests therefore become an important life support system for employing large number of people.

It is essential to have a certain proportion of land under forests to maintain the microclimate of the area and to promote socio-economic development of the local people. National Forest Policies of India (1952, 1988) have emphasized on bringing more and more land under forest cover and increasing the canopy cover and productivity of the existing forest areas. However, the strategies required for implementing the guidelines are not available within the legal framework.

DEGRADATION OF FORESTS HAS INCREASED POVERTY, UNEMPLOYMENT AND MIGRATION TO URBAN AREAS

Analysis of poverty has highlighted the fact that forest degradation has resulted in unemployment of a large number of households, their livelihood primarily based on agriculture, animal husbandry, forest-based art, crafts and industry (including bamboo and cane products) and collection and processing of forest fruits, gums and medicinal plants.

As a result they are compelled to depend on untraditional livelihood alternatives. This has happened because unlike agriculture, forestry has not been developed like an industry with a practical work plan and not enough investment has been made in developing and disseminating technical forestry work.

It is a fact that the forest area of India is much less than desired and the existing forest land is low in canopy cover and productivity. This has adversely affected the livelihood of village communities, dependent on forests. On the other hand forest based industries are looking for substitutes to the traditional raw material. They have even started importing these raw materials from other countries.

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India is rich in forest areas as well as human resources. Yet forestry has not emerged as a major industry because of lack of appropriate vision and planning. A people friendly forestry programme with sufficient technical and financial assistance can provide a basis for self-dependent and sustainable development of natural resources just like agriculture. A few ideal examples of sustainable development in the field of forestry already exist in different parts of the country. These can provide as role models and can be replicated in other parts of the country.

ABUNDANCE OF FORESTS AND ECONOMIC PROGRESS

Uttaranchal is rich in forests. With a geographical area of 53 483 km², the forest area is 34 662 km² (64.8 percent). Even after excluding the forest area above the tree line, rocky patches and river, we still have sufficient forest area, which can be potentially developed into high-density cover.

Uttaranchal has two-thirds of the area under forests (64.8 percent) and yet dense forest cover is only one-third (35.56 percent). It is a major task to increase forest density in the remaining forest areas. This task has not been achieved because it still continues to be a government programme and not a people's programme. A major reason for this is that 68.7 percent of the forest area (23 827 km²) is under reserve forests, 30.8 percent of the forest area (10 673 km²) is under protected forests and under the custody of the Forest and Revenue Department. About 20 percent of the protected forests are with Panchayat forests (2 368 km²). So by and large 92.5 percent of the forest area is under the control of government and only 7.5 percent of forest area is under the direct control of the village community.

Uttaranchal government started the Joint Forest Management Programme with World Bank financial assistance over a very small area of forest land under the control of Panchayats (7.5 percent of forest area). However, the need of the hour was to develop 92.5 percent of the remaining forest area in village forest with the help of local village community to further strengthen the resource base of agriculture, animal husbandry, and small scale cottage industry that would eventually provide local employment and boost the local economy.

CHIPKO MOVEMENT FOR SOUND AGRICULTURE AND FORESTRY PRACTICES

The Chipko *Andolan* (Movement) from the very beginning suggested that forest development and village economy are closely interlinked. It envisaged the strengthening of the village workforce, their training in forestry and to decentralize all the forestry protection and development activities. It also emphasized on including environmental awareness programmes in all levels of education and to stop the removal of forest products with the help of contractors. However lessons learnt from this success story have not been incorporated in forest management plans of India. The lessons learned from the good work done by the villages covered under the Chipko *Andolan* need to be extended to the other parts of Uttaranchal. *Dasholi Gram Swaraj Mandal* developed an ideal model of forest protection and development under the Chipko *Andolan* two decades ago. This can be a role model for forest development in the hilly state of Uttaranchal. *Dasholi Gram Swaraj Mandal* strongly feels that a plan based on local needs and future possibilities will motivate and strengthen the local workforce to strike a balance between ecological and economic development. It has done extensive participatory study on the major problems in the villages of Uttaranchal.

In some villages animals did a lot of crop damage. The villagers were not able to reap the benefits of their hard work. They also have a lot of problems regarding fodder and fuelwood. They could barely make enough to provide for one square meal. An agroforestry model was developed to find solutions.

Some villagers were motivated to construct a high stonewall along their agriculture field. The wages for making the stonewall were paid by the *Dasholi Gram Swaraj Mandal*. The wall was constructed in such a manner that land between agriculture field and forest could be used for planting of fodder producing and fruit bearing trees. This work in the Bemru village of Dasholi Vikas Khand has shown encouraging results.

Construction of wall has resulted in crop protection from wild and domestic animals and increased crop production by $1^{1/2}$ times. The fodder production has doubled and resulted in two distinct benefits. Firstly, availability of fodder near the village has reduced the time of fodder collection by village women. Earlier they were able to collect only 1 head-load of grass in the whole day. Now they are able to finish all their household chores and get 2 head-loads of fodder and use the remaining free time looking after their children and other productive activities. Secondly availability of sufficient fodder in the area has promoted development of animal husbandry. The milk production has increased one-and-a-half to two times. People have started selling the surplus milk to a milk diary. Fruit production has also contributed to economic change. Sale of fruits in the open market now gives them the purchasing power to buy essential goods and services.

Production of forest produce traditionally used by local artisans can promote the local craftsmanship. For example *Ringal* (bamboo) is used for the production of local products. A large number of households traditionally dependent on *Ringal* for livelihood have lost their traditional way of living because of depletion of the raw material from the forest area. No efforts have been made to increase the production of *Ringal* in the natural forest and to introduce it in agriculture.

Collection of fruits, vegetables and medicinal plants has been a major source of livelihood for a large number of households. Scientific management of forest resources by using sustainable harvesting methods can increase the quantity and quality of forest products. We need to develop a workable strategy to promote this.

RESEARCH REACHING THE COMMON MAN?

Lack of research and technical inputs in the field of forestry has been a major draw back. There is no dearth of forestry research institutes in the country. Very useful research done by these institutes has not been transferred from laboratory to land. We have new scientific achievements, advanced people friendly technologies, development programmes and sufficient resources. In spite of all these we are not able to promote productivity of forests and bring more and more area under forest cover as per the targets laid down by the planners. There could be a shortfall, which must be identified and put right to achieve the ideal situation.

This workshop must deliberate on the priorities of the forestry sector and explore ways and means to execute them. I feel that there is a lack of coordination between the identification of people's needs, problems, their expectations and the planning process. There is a gap between the thinking process of planners and the work culture of the implementing agencies. In a similar manner there is a gap between the need of the development programmes and research priorities of research institutions.

There is a need to plug this with a coordinated effort of various agencies (local people, research institutes, forest planners and executers) involved in forest development. We need to formulate a policy that is based on the grassroots level needs and is implementable.

Forestry for poverty alleviation – role of research institutions

A.K. Rana* and Neelu Gera*

ABSTRACT

Although India has made substantial progress since independence, a considerable proportion of population still lives in conditions of extreme poverty, characterised by lack of access to productive assets, information and knowledge of natural resources besides basic rights and services, resulting in exclusion and marginalisation of these people from the development process. Due to the large population and widespread poverty, natural resources are subjected to enormous pressures. Research institutes have a major role to play in view of the widening gap in demand and supply of important forest products, unabated degradation and inadequacy of existing resources and importance of conserving complex ecosystems. FRI Dehradun has developed a number of technologies relevant to the programmes for poverty alleviation, empowerment of masses and integrated development of villages. Some of these, such as the development of substitutes for forest products, extraction of natural dyes, rehabilitation of mined areas, pencil making with hand tools, agroforestry models and cultivation techniques of medicinal plants are highlighted in this paper. However, an important constraint to the operation of the forestry research system has been that the intended beneficiaries have not adopted technologies to the desired extent. Probable reasons being inadequate linkages between research institutions and user groups due to inadequate extension efforts and failure to integrate technologies with the development process.

INTRODUCTION

India is one of the oldest civilizations with a rich cultural heritage, but inhabited by many poor people. The country supports approximately 16 percent of the world's population with only 2.5 percent of the world's geographic area. With the turn of the new millennium, we have already crossed the one billion mark with an average density of 324 persons per km² (Forestry Statistics India 2001). With a decadal growth rate of 21 percent, the population is projected to reach 1.25 billion by the year 2010. It is estimated that about 70 percent of the population and 80 percent of those below the poverty line live in rural areas. This includes people who live in resource-poor regions, lack productive assets, skills or capacities and those who are inadequately organised.

Since independence, India has made substantial progress in terms of improvement in basic social indicators such as health, nutrition and education. While the life expectancy has doubled, infant mortality has been halved and literacy rate has risen, a considerable proportion of population still lives in conditions of abject poverty.

Poverty, in general, is characterized by the lack of access to productive assets, basic rights and services such as health and education, besides access to information and knowledge of natural resources. Poverty thus results in exclusion and marginalisation of the people from the development process. Due to the large human and cattle population and widespread rural poverty, the natural resources of the country are subjected to enormous pressures. A major proportion of these people are directly dependent upon these resources for their survival needs. The burden of poverty is more obvious on the rural women, already subordinated by the social structure.

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These women carry the burden of meeting the basic subsistence needs of food, fuel, fodder and water in the face of widening demand and supply gap, increasing environmental degradation and diminishing access to natural resources.

With the increasing recognition of the importance of forests for environmental health, energy and employment, the National Forest Policy of 1988 lays emphasis on scientific forestry research and adequate strengthening of the research base for rural and tribal development. The broad priority areas identified in the policy include improvement of productivity, effective conservation and management of existing resources and development of substitutes to replace wood and wood products. The policy also gives due consideration to the symbiotic relationship between forests and people, by emphasizing special attention to integrated development programmes. The Science and Technology Policy 2003 also identifies the need to provide food and health security for all on a sustainable basis as an important objective to be achieved through technological developments.

The research institutes therefore have a major role to play in view of the diverse research requirements for the development of "Science and Technology" in the country. While there is a strong need for conservation of our natural resources, there is an equally important need to harness their potential on sustainable basis for the benefit of the society.

The gradual realization about the widening gap in demand and supply of important forest products, inadequacy of the existing resources, their unabated degradation and the importance of conserving the complex ecosystems guided the forestry research in the country as well as at the Forest Research Institute, Dehradun. With better understanding of the changes in the state of the environment and forestry resources, coupled with the enhanced knowledge levels, the institute took up the challenges of research with much broader objectives during the last three decades. Accordingly, a number of technologies have been developed which have direct relevance to the programmes for poverty alleviation, empowerment of the masses and integrated development of villages. Some of these technologies (Anonymous 1999, 2000) are highlighted in this paper.

IMPROVED PLANTING STOCK FOR HIGHER PRODUCTIVITY

Forest Plantations are a powerful tool in the continuing efforts of foresters to increase productivity. Increasing demand for forest products and services on one hand and decreasing land area available for forestry on the other, has necessitated raising of plantations under various combinations on farm lands and other non-forest lands. The availability of quality planting material for such plantations through research is required. A combination of intensive site preparation with the use of uniform, well-grown genetically-improved nursery stock, planted at uniform spacing, increases growth and yield, reduces rotation length, facilitates tending and harvesting operations and improves the wood quality. This will not only assure better economic returns to the farmers, but also reduce pressure on the remaining natural forests.

Seed technology

The suitability and quality of the seeds have a major effect on the success of plantations raised from them. It costs almost the same to establish a plantation from poor seed, as it does from seed of high genetic potential. However, differences in the quality of plants produced and economic returns can be vast. The seed technology developed at the institute aims at production of quality seeds though various improved technological practices like seed collection, processing storage and pre-sowing treatments for effective germination. Of the various low cost and user-friendly technologies developed, a few are listed below:

- Seed processing including extraction and drying for Azadirachta indica
- Seed storage techniques for prolonged viability for *Azadirachta indica*, *Casuarina equisetifolia*, *Albizzia lebbek* and *Acacia nilotica*.
- Processing for improved germination in Acacia nilotica, Albizzia lebbek, Bambusa arundinacea, Strychnos nux-vomica, Tamarindus indica and Tectona grandis.

These technologies aim to realize the economic benefits by not only reducing the cost of nursery operations significantly by limiting the area of nursery to raise a calculated and desired number of seedlings, but also by production of uniform stock, thus increasing the efficiency of transplanting operations and reducing the cost. The expenditure on seed collection, extraction and processing is also reduced with optimum storage conditions.

Tissue culture of bamboo

Tissue culture protocols have been developed for large-scale rapid multiplication of *Dendrocalamus strictus*, *D. membranaceus*, *D. asper*, *Bambusa vulgaris* and *B. arundinacea*. The technology is very useful, where conventional methods of multiplication are either not available or are inadequate to fulfill the demand. This involves the use of plant tissue culture where a small plant part is cultured on artificial medium with the combination of growth regulators. A complete plant with root and shoot system is developed on synthetic medium by providing suitable light and temperature conditions.

Agroforestry models

Agroforestry, the land use system that incorporates woody perennials with agricultural crops, help the farmers to cope with loss of crops due to drought, reduce soil and water loss, utilize off-season precipitation and meet the requirements of fodder, fuelwood, fiber, timber and other forest products, besides improved food production. Accordingly, a number of agroforestry models have been developed with different species of trees, agricultural crops and herb species, for example:

- Poplar-Sugarcane-Turmeric Block Plantation Model with benefit-cost (B/C) ratio of 3.06.
- Poplar-Sugarcane-Wheat-Chari-Potato-Maize-Bajra Block Plantation Model (B/C ratio 2.58)
- Poplar-Sugarcane-Wheat-Chari Block Plantation Model (B/C ratio 3.47)
- Poplar–Sugarcane–Potato–Barseem–Chari Block Plantation Model (B/C ratio 3.01)

SUBSTITUTES FOR WOOD AND OTHER PRODUCTS

Katha from Uncaria gambier

The production of katha from the heartwood of khair (*Acacia catechu*) tree has been known for a very long time. However, shortage of khair wood prompted the institute to screen other suitable sources for making katha. One such source is *Uncaria*, a small genus of woody, climbing shrubs found mostly in tropical Southeast Asia. *U. gambier* produces the well-known gambier or pale catechu, but it has not been cultivated in India so far. The cost of production of gambier katha is much less than that from *A. catechu*. The technology would save khair trees and thus help in environmental conservation.

Jigat substitute

Machilus macrantha (Lauraceae) and *Litsea chinensis* (Lauraceae) trees are important to the survival of the agarbathi (incense stick) industry in India, which is dependent on the bark of these trees. Powder of the bark, known as 'Jigat', functions as an adhesive or binder in agarbathi. Over the years, the expansion of agarbathi industry has inflated the demand for Jigat, leading to indiscriminate felling of these trees, which is a valuable component of the evergreen and semi-evergreen forests of the Western Ghats and the north eastern states. Substitute for Jigat has been developed from agro-based biopolymers. The technology not only avoids the use of forest-based raw material but is also economically very competitive.

Natural dyes from forest waste

Processes have been developed for the extraction of natural dyes from some abundantly occurring plant materials of forest origin. Methods have also been developed to use these dyes on silk, wool and cotton. These dyes can be used by handloom as well garment designing industries, which export their products to developed countries like Germany and Denmark, where the use of azo dyes have been banned. Due to environmental awareness, the natural dyes obtained from plants and animals are the dyes of 21st century. The forest biomass can be used for the production of dyes on cottage scale, generating employment for the people through value addition to the non-wood forest product and creating an additional source of revenue.

CONSERVATION AND REHABILITATION OF NATURAL RESOURCES

Rehabilitation of mined areas and overburden spoils

Surface mining operations drastically affect the productivity of the land as an appreciable thickness of overburden is required to be removed to reach the ore resource. Starting from removal of vegetation and topsoil, the ecology, socio-economic conditions and hydrology of the areas are also adversely altered. Conventional afforestation practices to revegetate mine derelict lands do not effectively rejuvenate the disrupted ecological functions, emphasizing the need for site-specific eco-restoration technologies. FRI has developed the ecorestoration technologies for surface mined phosphate mines, which have already been transferred to many companies. The salient features of the technology include an ecosystem approach towards restoration and use of ecologically and socio-economically viable species.

Cultivation techniques of NWFP species

The institute endeavours to undertake *in-situ* and *ex-situ* conservation of medicinal plants. Cultivation techniques of a number of economically important and endangered medicinal and aromatic plant species have been developed and transferred to various institutions, NGOs and pharmaceutical industries. The species include *Abelmoschus moschatus, C. citrates, Cymbopogon martini, Catharanthus roseus, Mentha arvensis, M. spicata, Ocimum kilimandscharicum, Rauwolfia serpentina, and Withania somnifera.* The technology will help to reduce pressure on forests besides being an excellent income generating activity.

OTHER LOW COST TECHNOLOGIES

Pencil making with hand tools

Pencil manufacture is a complex process undertaken in modern factories, with almost all operations being carried out by mechanical appliances. FRI has developed a set of hand tools for making pencils on a cottage industry scale, with the main objective of providing additional source of income to the rural people. The industry can be organised in community development blocks on a cooperative basis. The technology has an added advantage that it can be easily and effectively integrated with literacy programmes at the village level.

Portable essential oil distillation unit

Essential oil bearing plants are very valuable as they are the sources of perfumes, cosmetics, flavouring agents and aromatic chemicals, which are also used as antiseptics, deodorants, repellents and medicines. A simple portable distillation unit of 50 kg capacity has been developed for distilling oil from essential oil bearing grasses like *Cympopogon martini* and *C. citratus* besides other leaves, roots etc. The cost of the unit is about Rs. 14 000 and is more efficient as the yield of oil is 30 percent more than the traditional ones. The distillation unit can be easily transported to the felling site/field.

Colouring and ammonia fumigation of wood

There is often consumer resistance in the use of plain looking secondary plantation grown woods like poplar for furniture, in comparison to traditionally used darker decorative grained woods like teak, sissoo, rosewood and walnut. The present methods of staining and artificial grain development, based on Aniline base dyes, are not only costly, but also hazardous for health, inconsistent and develop unnatural looking grains. The process of ammonia fumigation developed by FRI gives permanent shisham, teak and walnut appearance in otherwise dull and plain looking timbers. The process is simple, inexpensive, and effective and can be adopted by small entrepreneurs, as it works out to be nearly 50 percent cheaper over conventional methods of staining.

Wood plasticisation and bending

Wood bending is an ancient craft and is of key importance in many industries, especially in manufacture of furniture and sports goods. The traditional steam bending technique has several limitations in quality and number of species of wood that can be bent. Recent work carried out at FRI has helped to overcome these limitations by using vapour phase ammonia plasticisation technique, enabling a wider choice of species for production of bentwood components for a variety of commercial products. The technique would economize

the use of wood without affecting the functional requirements of the products, as the current practice to obtain bent wood components is from wider sections, where there is lot of wastage of timber.

Preservative treatment of secondary species

Eucalypts have been planted in many states of the country to meet the growing demand for wood and has emerged as an important species for manufacture of doors/windows and joinery. It is, however, prone to termite attack, requires protection for giving long service life and is also refractory to treatment. ACA treatment technology has been developed for the treatment of such refractory wood species to make it suitable for joinery purpose. The method has been used on a commercial scale for the treatment of eucalyptus wood for door/ window panels for which no other method was available. By this technology the eucalyptus could be economically used with the treatment cost of about Rs. 900 per m³.

Conversion technique for eucalypts and poplar

Plantation grown woods like eucalypts and poplar, though extensively available, pose problems in producing standard quality sawn and seasoned material. Major problem in its utilization is the warping in sawn timber that occurs on the saw itself and further warping and splitting in portions near the pith that occurs in subsequent air or kiln seasoning. Processing technology has been developed for their economic utilization for doors, windows, furniture and many other value added products. Recent improvements in sawing and seasoning of eucalypts and poplar have enabled them to be commercially adopted for furniture, door and windows in states like Punjab, Haryana and Uttar Pradesh with cost advantage of about 35–45 percent relative to traditional products from species like sisoo and teak, etc.

Besides these, a number of other technologies have been developed, which include utilization of juvenile wood of eucalypts and poplar for furniture, utilization of poplar for doors/windows, afforestation techniques for stress sites and agroforestry models for different agro climate regions.

ROLE OF RESEARCH INSTITUTIONS

An important constraint to the operation of the forestry research has been the lack of a method, based on the systematic application of the tested technologies for the benefit of the target group (NFRP 2000). The intended beneficiaries have not adopted technologies to the desired extent. One of the obvious reasons being inadequate linkages between research institutions and user groups, probably due to insufficient outreach efforts. Inadequate linkages, on one hand lead to lack of information on constraints in adopting technologies and the modifications needed, while on the other hand lead to insufficient impetus to augment suitable research efforts.

Direct Impact		Indirect Impact	
Human Welfare Conservation and Productivity	Institutional	Scientific	
 Adoption of new technologies. Sustainable production. Sustainable management of natural resources. Resource conservation. Improve environment Extension of developed technologies. 	 Capacity building Training and education. Networking and collaborative research. Improved research processes. Improved institutional effectiveness. Improved capacity of work force. Improved quality of knowledge adopted. 	 Advances in science and technology. Increased knowledge and understanding of the problems. New and improved research tools and approaches. Adaptive and applied research. Contribution to better environment. Contribution to better life. 	

Impact of forestry research

Modified from Guevara (1999).

Policy interventions

The experiences over the last few decades indicate that economic growth, and targeted interventions alone are not sufficient to eradicate poverty. The essential precondition to growth should, therefore be participatory planning. The role of the target group should not only be as a beneficiary but also to act as partner in guiding

the process of research and development. This requires institutional strengthening at grassroots level and bottomup micro-planning in identifying village priorities through participatory approach. This can turn the poor communities from mere beneficiaries to active partners in the research and development process.

The National Science and Technology Policy 2003 directly addresses the problem of poverty, identifying one of its objectives as "To mount a direct and sustained effort on the alleviation of poverty, enhancing livelihood security, removal of hunger and malnutrition, reduction of drudgery and regional imbalances, both rural and urban, and generation of employment by using scientific and technological capabilities along with our traditional knowledge pool". However, there is lack of direct attention of this issue in National Forest Policy of 1988, that addresses the issue through increased productivity, sustainable utilization of resources, and effective conservation and management of resources besides adequate strengthening of research support.

This, therefore, calls for adequate policy revision. Generation of new and adoptable technologies and screening of available technologies for their direct impact on poverty is needed. This has to be followed by widespread dissemination through networking and support for the vast unorganized sectors of our economy. The forestry research institutions thus have their role cut out for them "to ensure food, agricultural, nutritional, environmental, water, health and energy security of the people on a sustainable basis".

Stakeholder driven approach and empowerment

Traditionally, the organization of research has always been highly compartmentalized. There is a strong need to rejuvenate the linkages between the researchers and the stakeholders. The lack of adequate linkages between researchers and stakeholders result in insufficient interaction and understanding of the needs. The absence of networking and sharing also results in lack of development of proper extension methods for successful transfer of technologies. The stakeholders are thus unable to benefit from the research programmes. The research institutes, therefore, need to develop adequately strong linkages with the stakeholders to understand their needs, and develop technologies. A paradigm shift in the attitude of forestry researchers towards stakeholders is needed. An integrated and holistic approach is needed with the concerted effort of all the stakeholders (Sharma 2003).

Empowerment through participation involves recognition that local people, through their knowledge and experiences, decide what is best for their development. True participation occurs when decisions by the government, services provided by the state, control of external productive resources and priority setting are carried out in conjunction with beneficiaries of these actions (Guevara 1999). James Gustave Speth in his address to UNDP in 1993 stated, "Sustainable human development is participatory. It can only be achieved when people have an opportunity to participate in the events and processes that shape their lives; where entrepreneurs, women, non-governmental organizations, and others in civil society are empowered to take initiative and participate in both open markets and effective governments, and where pluralism prevails and human rights and access of information to all parties are guaranteed". Thus the new paradigm of forestry for sustainable development must include participation, equity and environmental conservation.

Livelihood support, health and nutrition

There is a strong need for collective and individual endeavours at the level of target groups as well as research institutions and development agencies to undertake activities for income generation, development and operation of community support infrastructures and creation of assets.

Forests are still called the foster mother of agriculture. In most parts of the country, forests provide an essential supplement to the nutritional status of the family. In times of food scarcity, the tubers and rhizomes provide sustenance to fight hunger. In other times, the food from forest provides essential nutritional supplements in the form of vitamins and minerals. It is, therefore, important that nutritional aspects should constitute an essential component of the package of activities at the village level.

While a number of technologies have been developed to be implemented at the grassroots level, there is need to build the capacities of hitherto marginalized groups, especially women, to become actors in development productive employment and education need to become the entry points. Research institutions can actively associate themselves with NGOs as well as government organizations to initiate projects for integrated social development, for example, community based initiatives by women's groups to start collective farming, processing of forest produce and pisciculture. The education and health interventions will converge with regeneration of livelihoods and productive employment to ensure positive impacts on the society especially the marginalized sectors.

Increased availability of even a single resource, say, for example water or fuel would lessen the women's burden and provide them with time and opportunity to take up income generation activities such as gum collection, crafts and fodder production. Capacity building of women and youths can also be done through developing cadres of para-professionals, not only for primary health care but also for activities like rainwater harvesting, developing and maintaining biogas units, etc. Research institutions have a very important role to play in this field by organizing training workshops to train these para-professionals.

Reviving and strengthening traditional knowledge systems

While issues of sustainable agriculture, health, nutrition and education can be addressed through strengthening of community based organizations, there is a strong need to focus on improving, adapting and reviving local technologies not only for health and nutrition but also for water harvesting in traditional ponds, use of traditional methods of agriculture etc. For example, while the modern high yielding varieties require high inputs interms of fertilizers, pesticides and water requirements, the traditional pest and drought resistant varieties can provide equally good harvest with low inorganic inputs (www.undp.org.in). R&D institutions need to actively associate themselves with programmes for revival of such practices, besides developing strong linkages with community and NGOs. Research institution can also pay a lead role in setting up seed banks of important species and in adapting traditional technologies of rain-fed agriculture to rehabilitate degraded lands.

The importance of traditional knowledge in the field of health care needs no explanation. The importance of documentation of this knowledge is being talked about, the world over. Building on traditional knowledge in the field of medicinal plants, will not only help to preserve it for posterity, but also aim at optimal use of forest resources besides helping the community to take control of the health of its members. Research Institutions can help to take up research on traditional systems of healthcare so as to contribute to fundamental advances in health care, help to develop effective commercial products as well as appropriate norms for their standardization and validation. They also can have a key role to play in development of technologies for value addition to indigenous resources for their optimal utilization. This will have a direct impact on the health care as well as sustenance at the grassroots level.

The process of globalization is leading to a situation where the collective knowledge of the societies, normally used for common good is converted to proprietary knowledge for commercial profit of a few. Research organizations need to actively associate themselves with development of IPR systems to protect scientific discoveries and technological innovations arising out of tradition and indigenous knowledge.

Education, empowerment and capacity building

Education not only refers to formal education or literacy status, but also enhancement of the knowledge level of the society as well as the individuals to become partners in development. The research institutions can build upon the emerging concept of para-professionals to enhance capacity of the community to access facilities and serve the poor. Para professionals are people from with in the community or group who can be trained through capacity building to deliver the services to the society as well as provide feed back to the institutions. For example in accessing technology, to serve poor peoples needs, and exposure to and understanding of that technology, its appropriateness, implications and sustainability is important. The R&D institutions thus have a role to play not only in development of appropriate user-friendly technologies but creating enabling environment and building leadership within community.

Genuine forestry development manifests itself in the alleviation of poverty and the basic problems could be addressed by a four-pronged strategy, which could be outlined as:

- To ensure education, training and capacity building of stakeholders.
- To augment research and its validation.
- To develop extension and technical cooperation programmes for the validated research results.
- To ensure appropriate participation and empowerment through suitable methodologies and policies.

Ultimately the research output can only be judged by its impact on development. The research institutions must therefore reorient themselves to "bridge the knowledge gap, i.e., disparity in the capacity to generate, acquire, disseminate and use scientific and technical knowledge, which is the most vital difference between the rich and the poor" (IDRC 1991).

CONCLUSIONS

The creation and implementation of plans for sustainable management of forests through integrated forest strategies is one of the central mechanisms for poverty alleviation programmes. It is not only important to view forest resources as effective potential tool for poverty alleviation but also to understand the connection between poverty and deforestation. Poverty is often viewed as one among the many causes of degradation of natural resources. With no better alternatives, forest destruction and degradation become short-term solutions to many of the burdens imposed by poverty. It is equally true, however, that for poor people who live in and near forests, and those who live in places where woodlands have been destroyed or degraded, silvicultural interventions can be effective in regenerating and rehabilitating such forests. This could be instrumental in reducing poverty by providing increased and sustained employment in the production and processing of timber

and non-timber forest products. We must now agree that unless poverty is alleviated, the forests will continue to be lost. It is therefore, important that the natural resources especially forests are recognized as primary poverty fighting assets. An integrated and holistic approach is important to amalgamate the ideas from different disciplines and sectors to achieve successful sustainable forest development.

Forestry research institutions can play a leading role in the development of integrated forest strategy (Figure 1). As one of the major stakeholders, the research institutions can take up the challenges to develop ecologically sound practices, provide training for capacity building, ensure validation and extension of technologies, as well as develop information systems to integrate research outputs with cross-sectoral linkages. Creating an integrated strategy requires the interactions of forests with other sectors of the economy. The forest research institutions have the knowledge, experience and expertise to take up this challenge. Such institutions can thus play a pivotal role in utilizing the tool of knowledge to attain economic power by playing a decisive and beneficial role in improving the well being of all sections of our society. They can have a central role in raising the quality of life of the people, particularly the disadvantaged sections of the society, in creating wealth for all by utilizing natural resources in a sustainable manner and by protecting our environment.



Figure 1. Integrated forest strategy

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5 Forestry research intiatives for poverty reduction

P.K. Shukla* and S.S. Bisen*

ABSTRACT

Tropical Forest Research Institute, Jabalpur, is one of the premier institutions under ICFRE, working for the forestry research needs of four central Indian states, viz. Madhya Pradesh, Chhattisgarh, Maharashtra and Orissa. Developing appropriate models of agroforestry, popularizing cultivation of medicinal plants among the farmers, developing conservation methods of multiple-use forest flora, developing species-specific biofertilizers for enhancement of productivity in natural forest, value addition of NTFPs, including bamboo, are some of the works among the thrust areas addressed by the institute. The institute has also taken care to take the results to the user groups so as to make the forest ventures more attractive and economically viable. Some of the technologies developed by the institute are described in this paper.

INTRODUCTION

Poverty is not an income determined outcome alone and therefore, increasing attention is now placed on the capability factors of poverty. It is a multi-dimensional phenomenon and it is always difficult to disentangle its causes and consequences. The nature and quality of governance largely determine the results of development efforts and success of poverty alleviation strategies, irrespective of the quality of design and amount of investment.

Poverty alleviation has found its place time and again as the goal of national plans and policies of Government of India with very little success on the ground. The strategies to overcome poverty should be diverse, recognizing the differences among people and their opportunities for sustainable living standards. Rural masses in India, particularly tribals, are poor because they have not acquired essential assets since they live in remote areas, where the resources available have not been properly identified and utilized.

Central India is well known for its rich and vast biodiversity, owing to its diverse climatic zones. Nonwood forest products (NWFPs) are distributed in all bio-climatic zones ranging from dry deciduous to tropical coasts. Collection and marketing of NWFPs is a way of life for poor people, especially in predominantly tribal areas, to meet their daily needs.

Central India also has different types of NWFPs, which can be a very good source for social upliftment. However these are not being utilized properly and are being destroyed as people are unaware of their importance. Tropical Forest Research Institute, Jabalpur, has taken initiatives in this direction by way of carrying out research on propagation, multiplication and suitable value addition at local levels. The research carried out so far is on a few selected plant species having good potential in indigenous as well as international market.

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TECHNOLOGIES FOR POVERTY ALLEVIATION STANDARDIZED AT TFRI

Mushroom cultivation

Mushrooms are saprophytic fungi that convert decaying matter into their own food. The major commercial use of mushrooms is for food. However, many species are inedible or poisonous, so the ability to identify these fungi is critical to harvesting and cultivation. Mushrooms are also cultivated for other uses, such as bio-pulping processes, to reduce some of the toxic materials in municipal dumps and as dyes for textiles. There are several species of forest mushrooms, which are used for such commercial purposes. TFRI has developed technology for cultivation of two common edible mushrooms with the objectives of introducing them to the rural masses to enhance their income. The technology includes:

- Preparation of spores (seed) of white button mushroom (Agaricus bisporus) and oyster mushroom (Pleurotus ostreatus Florida)
- Standardization of substrates (compost) for cultivation of these mushrooms.
- Standardization of crop production techniques in tropical climate of central India.

Two crops of white button mushroom and year-round cultivation of oyster mushroom can be undertaken. Cultivation of Agaricus bisporus (25 trays; 1 m x ¹/₂ m x 0.20 m) can give profit of Rs. 2650 per winter season. Cultivation of oyster mushroom (500 bags; 30 x 35 cm) can give profit of Rs. 5530 per month.

Cultivation of Ganoderma lucidum, a medicinal mushroom

Ganoderma lucidum mushroom is also called Ling-zhi in Chinese or Reishi, Saru-no-koshikake and Mannendake in Japanese. Traditional Chinese medicine (TCM) values Reishi as the highest ranked medicine. Ganoderma *lucidum* naturally occurs in the sal forest of India. It is also a parasite on several multipurpose trees like Albizia procera, Leucaena leucocephal and Pongamia pinnata, etc. TFRI has worked on standardization of technology for the commercial cultivation of this mushroom and to promote its cultivation by developing simple methodology, which can be adopted by the rural poor:

- Preparation of spores (seed) of Ganoderma lucidum has been standardized.
- Cultivation technique on different substrates viz, logs and wood chips have been standardized.
- Cost-benefit ratio is being worked out. Preliminary trials indicated highly beneficial results.

Vegetable dyes

A number of plant species (Table 1) growing naturally in central Indian forests, like Butea monosperma, Eclipta alba and Lawsonia inermis, are the important sources of vegetable dyes. Flowers, leaves, roots, fruits of many native plants growing naturally in the forest can be utilized for extracting dyes. With the advent of synthetic dyes, demand of these natural vegetable dyes had come down drastically, but nowadays several synthetic dyes are being banned for human consumption as well as for cosmetic use. Importance of natural vegetable dyes that are safe and eco-friendly is once again being realized. TFRI has initiated a research programme to extract vegetable dyes from available natural sources and develop cheaper technology for dye extraction.

Botanical name	Common name	Family	Plant parts employed	Percentage of crude dve	Colour of dve	Use
Bixa orellana	Annatto	Bixaceae	Seeds	15–17 (O+W)	O-Yellow; W-Orange	Colouring cheese, drinks, margarine, cosmetics
Butea monosperma	Palas	Papilionaceae	Flowers	30–35 (W) 9.2 (W) sugar free	Yellow	Drinks, fabrics
Woodfordia fruticosa	Dhawai	Lythraceae	Flowers	19-54 (W)	Reddish brown	Tanning leather, fabrics
Eclipta alba	Bhringaraja	Compositae	Leaves	16 (O+W)	Blackish- brown	Colouring of hair, Hair oil, Hair tonics
Lawsonia inermis	Mehandi	Lythraceae	Leaves	16 (W)	Reddish- brown	Colouring of hair, Cosmetics
Nyctanthes arbor-tristis	Harsingar	Oleaceae	Corolla tubes	30 (W)	Yellow	Beverages, Soft drinks

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W - Water soluble dye; O - Oil soluble dye

Forest - a natural source of saponins

Saponins are glycosidic compounds, characterized by their surface active properties. Nowadays these compounds are gaining importance due to a variety of pharmacological and physiological activities. TFRI has taken initiatives to survey and identify plant resources rich in saponin contents and to study their properties for medicinal as well as insecticidal uses. The following have been investigated and show potential. With further value addition, they can be utilized for commercial purposes:

- Asparagus recemosus roots contain 3.79 percent saponin.
- Sapindus mukrossi seeds contain 14-20 percent saponin.
- *Madhuca indica* seeds contain 7–9 percent saponin. Saponin-free cake can be utilized for cattle feed or as manure.

Food from forest

Natural forests are reservoirs of fruits, rhizomes, roots and leaves, which are very rich in carbohydrates, proteins, starch and minerals. The tribal population living in the forests utilizes these as food supplements. At present these valuable resources are either under utilized or over utilized, whereas they have potential to provide sustained income to the forest dwellers. TFRI has initiated work on standardization of technologies for the extraction of starch and carbohydrates that can be further utilized for making neutraceuticals. Work on standardization of technologies for extraction of starch and carbohydrates from plants like *Curcuma angustifolia* and *Curculigo orchioides* is currently in progress.

New raw material for incense

Over exploitation of the bark of *Litsea* and *Machilus* has brought these two tree species to threatened status. A cheaper substitute for these two species has been found in *Hyptes suaveolens*, a weed growing in the forest of central India. Technology for making incense sticks utilizing mucilage from seeds of this species has been standardized.

Conservation and cultivation of medicinal plants

India is included among the 12 mega-biodiversity nations. Nearly 15 000 plant species are being used as medicine, from this diverse flora. Medicnial plants are living and irreparable resource, which is exhaustible if over used and sustainable if used with care and wisdom. Importance of medicinal plans has been overlooked in the past. However, at present medicinal plants are looked upon not only as a source of affordable health care but also as a source of income. According to WHO report, over 80 percent of the world population relies on traditional medicine largely plant-based for their primary healthcare needs. The position cannot be sustained further because, on the one hand, forest cover is steadily shrinking and on the other, the requirement of medicinal plants and herbs is increasing steeply. In order to conserve the gene pool of medicinal plant reserves and standardize their cultivation techniques, *ex-situ* conservation is very much needed. TFRI has taken the task of conserving medicinal plants, rare, endangered and threatened species, and bamboo of Satpura and Vindhya region by establishing medicinal plant garden at the TFRI campus.

Cultivation and propagation techniques of rare, endangered and comercially important species like *Chlorophytum borivillianum* (safed musli), *Curcuma caesia* (kali haldi), *Acorus calamus* (bach), *Gloriosa superba* (kalihari), *Crataeva magna* (varun), *Strychnos potatorum* (nirmali), *Abelmoschus moschatus* (muskdana), *Asperagus recemosus* (satawar), *Plumbago zeylanica* (chitrak), etc. have been standardised. The institute has also promoted cultivation of these species in the farmers fields by extension activities.

Bio-technology

TFRI has established a well-equipped bio-technology laboratory with trained scientific staff. The institute has started a programme of developing protocols for tissue culture of bamboo and rare, endangered and threatened species of medicinal plants. There are also very good facilities for vegetative multiplication in mist-chamber and green-house-conditions. Tissue culture protocols of five *Bambusa* and three *Dendrocalamus* spp. are available at TFRI.

AGROFORESTRY MODELS

Agroforestry combines agriculture and forestry technologies to create integrated, diverse, productive, profitable, healthy and sustainable land-use systems, with the purpose of sustainable development. Practices are focused on meeting the economic, environmental and social needs of people on their private lands. Agroforestry practices are *intentional* combinations of trees with crops and/or livestock that involve intensive management of the interactions between the components as an integrated agroecosystem. These key characteristics are the essence of agroforestry and are what distinguish it from other farming or forestry practices. To be called agroforestry, a land-use practice must satisfy all of these criteria. Combinations of trees, crops and/or animals are intentionally designed and managed as a whole unit, rather than as individual elements that may occur in close proximity but are controlled separately. Keeping the above fact in mind, integrated cropping models have been developed at TFRI for central Indian condition. These include:

Babul-paddy model

Integration of MPTs like babul with agriculture crop provides a number of products to supplement the income and also enhances yield of the agriculture crops.

Teak-safed musli model

Integration of safed musli with teak utilizes the idle space of teak plantations and provides intermittent income to the growers.

Bach-paddy model

Integration of bach with paddy is a beneficial combination for paddy growers.

Silvi-olericultural model

Vegetables like bhindi, carrot, radish, spinach, cowpea and tomato can be integrated with multipurpose tree species like *Dalbergia sissoo* (sissu), *Albizzia procera* (safed siris) and *Acacia nilotica* (babul) resulting in additional perennial yield of vegetables and thus early income to the growers/farmers.

INTERNATIONAL COLLABORATION

International collaboration for funding and promotion of the aforesaid technologies is sought from the following funding agencies to help in poverty alleviation programme:

Agency	Activities
EC-FAO Partnership Programme	Data collection for sustainable forest management in ACP
(Projct – GCP / INT / 679/EC)	countries, Asia and the Caribbean
IUCN/SSC Medicinal Plant Specialist Group (MPSG), Ontario, Canada	Medicinal plant conservation and rational, sustainable use.
Overseas Development Institute (ODI), UK	To inspare and inform policies, leading to poverty reduction.
Trade Records Analysis of Flora and Fauna in Commerce (TRAFFIC), Cambridge, UK	Marketing of NWFPs including medicinal plants.
Forest Research Institute Malaysia, Kuala Lumpur, Malaysia.	Processing and utilization of forest resources, bio-technology, forest economics, investment oppurtunities, information technologies and commercialization of forestry R&D.
Forest Products Division, Forestry Department, FAO	To develop practical inventory guidelines for resources providing NWFPs to achieve sustainable forest management.
Training Center for Tropical Resources and Ecosystem Sustainability (TREES), University of Philippines Los Baños, College of Forestry and Natural Resources, Laguna, Philippines.	Participatory approaches in forestry and natural resources development.

6 Environmental goods and services for poverty alleviation: R&D issues

Promode Kant* and R.P.S. Katwal*

ABSTRACT

Forests have a significant potential of alleviating poverty in the rural areas. The joint forest management (JFM), which is a focused approach to exploit this potential, has achieved only modest success in meeting this objective. This is because the JFM has been confined to NTFP, small timber and firewood that are either in the non-monetized sector of the economy or are restricted to raw material collection with little value addition thus restricting their contribution to income enhancement. There is a possibility of expanding the scope of JFM to include in its fold environmental goods and services like carbon sequestration, replacement of fossil fuel, biodiversity conservation, soil and water conservation and ecotourism in addition to the conventional forestry products with the participants sharing the economic values attached to these goods and services that they help produce. This would require a whole range of research and development activities to set up the necessary framework. Research is needed on tree selection and rotation, to place economic values on various grades of these goods and services, modes of transfer of economic values to the communities involved in JFM, and its apportioning between the constituents of the communities and the commitments from the communities in return. Research is also needed for the development of best forestry practices for different bio-geographic zones and evolving appropriate working plan prescriptions to produce suitable combinations of the targeted environmental goods and services for optimizing economic returns in ecologically sustainable manner. The possibilities of linking these services to the international protocols in the field of conservation of natural resources, global warming, intellectual property rights and world trade have to be explored to take advantage of flow of technology and money from North to South as also ways of setting up equitable market systems for these goods and services.

INTRODUCTION

Poverty pervades the entire developing world and India alone has almost 200 million people living below the poverty line. The problem of poverty is a multidimensional web with a myriad of causes some of which are illiteracy, lack of resources, degradation of lands, poor infrastructure, dissipation of resources in nonproductive activities, failure to channelize the human energies in appropriate directions, extreme corruption, wrongful appropriation of knowledge of the poor without adequate compensation and illegitimate profiting by traders and trading nations at the expense of the poor, to name just a few. There is internal synergy between these causes that imparts them further complexity.

Forests cover about one fifth of India's land mass and is the single largest land based resource that has the potential of reducing poverty of the people of this country and, indeed, it has supported the poor to meet their basic requirements over the long and chequered history of this country. But in the preceding few decades the capacity of the forests to cater to the poor has eroded. The reasons ascribed above to poverty in general also apply to the forestry situation. There is lack of understanding of the true role of forests in the well-being of the people, forest lands have become degraded on account of overuse and mismanagement, the investment in the sector has not kept pace with the removals and the few resources available to the forestry sector are often put to non-productive uses. Further, the knowledge of the people about the utility of the various components of forest ecosystems in their surrounds, particularly medicinal plants, remains largely untapped

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and there is illegitimate profiting by a few at the cost of most. And the human energies of the people most affected that, properly utilized, could have led to a revival of the sector, are dissipated in activities which only puts further stress into the system without achieving much as is evident in the nature of some of the futile agitations and disturbances noticed in several parts of the country.

JOINT FOREST MANAGEMENT

About three decades back initial hesitant steps were first taken in India to address some of these problems and enhance the potential of forests in reducing poverty in the countryside by the involvement of the human energies and genius of the people living in the neighbourhood of the forests. The Joint Forest Management (JFM) was indeed the first focused approach to address the issues of poverty and ecology in a synergistic manner. Over the years the JFM has evolved into a fairly mature forest management system with its own underlying principles and standardized practices.

There has been much deserved praise of the JFM in enhancing the reach of the poor to the forestry resource and it has doubtless provided relief in some areas to the very poor but there is indication that results are falling short of the expectations of the people leading to a falling interest in JFM. There is a realization that the income generation from many of the JFM areas may have already peaked. One reason for this is the limited product base of the JFM that is largely restricted to the fuel wood, non-timber forest products (NTFP) and small timber. Further a large part of the fuelwood and NTFP collected falls in the non-monetized part of the economy where barter, semi-barter and collection for self-consumption predominates. While there is much to commend in these market systems in physically isolated communities these systems tend to work to the disadvantage of the poor in places where the only isolation from the others is the isolation of poverty. The reason is that the prices of products traded in these systems do not keep pace with the general inflationary trends in the society and the relative prices of these goods remain depressed compared to the rising costs of other goods and services that the poor has to pay in the general market. The barter system also limits the price negotiating capacity of the poor thereby compounding his disadvantage.

Increasing value additions and market access

Another reason for low-income accruals to the JFM participants is the meager value additions and poor market access that characterizes the forest based rural economy. Enhanced levels of value addition and better market access has good potential of bringing increased incomes and a lot of attention has been paid to this aspect in the preceding decade. But these efforts have had limited success for a variety of reasons one of which is that these activities can benefit only those who have the capacity for requisite skill acquisition and ingrained or acquired entrepreneurship abilities. This may keep a large part of the women and older poor outside reach, as many may not have the time, social permission or the physical ability to acquire skill and abilities. Another major cause is that of inability to create an enabling legal and policy environment in which the related processing industry accesses only the legally harvested and appropriately value added product from the JFM participants. Even where such laws and policies have been enunciated the implementation leaves much to be desired and unaccounted trade is the norm rather than exception.

Expanding area base of JFM for increasing incomes

Continued low levels of income accruals from JFM has led to demands for more forest lands being brought under the purview of the JFM communities in the hope that larger extent of forest lands would provide more resources to be shared. But there is a limitation on the extent of forests that can be transferred to the care of the individual JFM communities as it raises the possibilities of conflict between neighbouring communities and also reduces the forest lands under the exclusive conservation areas. It is because the individual JFM community areas can be increased only by transferring forests from adjacent conservation zones or from those under the care of another JFM community.

An alternative to expanding area base

Incorporation of high value forest goods and services within JFM may provide a very significant enhancement in return to the participating communities. These are carbon sequestration, raising bio-fuels to replace fossil fuels, water conservation, soil conservation, biodiversity conservation and aesthetics and ecotourism; but the JFM participants have not yet staked claims on these services produced by them. Their claims have been limited to the products that have been sold traditionally by the forest departments. Thus this semi-privatization of forest resources has brought no new innovation in the product range yet and it is perhaps time to think of these possibilities.

Carbon sequestration

Forests role in carbon sequestration under the clean development mechanism (CDM) has major potential for income enhancement in JFM areas where lands are available for reforestation and afforestation, i.e., lands that were not forested as on 31.12.1989. Increased C-sequestration through appropriate forest management practices like protection and gap planting in an existing forest, however, does not qualify for financial benefit under CDM – a limitation at present which might be addressed at a later date by the United Nations Framework Convention on Climate Change (UNFCCC). Till that happens the JFM lands eligible for carbon credits under the Kyoto Protocol would be only those that were not forested as on 31.12.1989. Since most lands under JFM in India do not qualify for this description Kyoto Protocol may not bring much benefit to the existing JFM areas. But it can make expansion of JFM activities to presently non-productive common lands possible and thus contribute to poverty alleviation.

Too high hopes over the CDM might, however, be misplaced particularly in the context of JFM where the issues of additionality and leakage prevention may bring burdens over the JFM communities that they are ill equipped to handle and may discourage them. The high transaction costs and the prevailing low prices of carbon credits also are not very encouraging.

Replacement of fossil fuels

Replacement of fossil fuels by renewable energy sources qualifies for carbon credits under the CDM. Fuel wood is an excellent replacement for fossil fuels used in households and minor industries. JFM communities could grow firewood not only for themselves but also for sale and earn saleable carbon credits for fossil fuel replacement. This would also enable expansion of JFM into neighbouring common lands as discussed above.

Water conservation

Global fresh water consumption doubles every 20 years. There is thus a huge ever-increasing demand for fresh water and for quality drinking water. Forests in the watersheds greatly influence the local water cycle and improve water quality. Dry season water availability in forest streams and wells in the catchments near forests is considerably higher in well-forested watersheds. The increase in non-rainy season water availability and quality improvement due to afforestation of the watersheds is quantifiable. It should be possible for JFM participants to stake claim to the increase in water availability due to improved forests and negotiate for appropriate water prices from the down stream users for the additional waters.

Soil conservation

Siltation of ponds and small water bodies is a serious problem for rural communities and governments spend large sums every year to desilt these. Regeneration and protection of watershed forests decreases soil erosion significantly. This decrease in soil erosion is quantifiable and economic benefits from reduced siltation can be calculated and transferred to the JFM communities responsible for creating these services.

Biodiversity conservation

The international community and most national governments are deeply concerned about the threat to biodiversity of the earth. This concern is now being widely shared by the civil societies in general. This concern is exhibited in a number of international treaties and increased allocations for bio-diversity conservation in multilateral, bilateral and national projects. JFM zones, being in the area of human influence, are specially vulnerable to biodiversity losses. The JFM participants, with technical and financial support, can ensure biodiversity conservation in their areas of operation. Their impact on bio-diversity can be measured to a degree and they could be compensated for their efforts financially.

Aesthetics and ecotourism

Forests enhance aesthetics and may result in increased tourist traffic flows to existing tourism destinations and may even create new destinations. Increased earnings could be quantified and shared in an appropriate manner with those responsible for creating these aesthetic values.

Developing markets

These new goods and services require the creation of new markets as the existing markets either do not place value on these goods and services or discount them severely. New markets grow organically over long periods of time through errors and course corrections. This organic growth can also be speeded up by an appropriate research and development strategy to broaden the base of forest goods and services. Research is needed for optimization of production of these goods and services, measurement of goods and services delivered, economic valuation of these goods and services and determining the key players in the market. Research is also needed to make appropriate choices of forest species suitable for producing these new range of goods and services and maximizing their production at least cost. Another important area of research is on working plan prescriptions for managing forests to produce these results.

Production optimization

Production optimization would require research to establish ecologically sound models for optimizing the product mix to give greatest economic satisfaction to the participating JFM communities for all bio-geographic zones and JFM sizes. With this sharp change in the expected outputs from JFM a fresh look at the appropriate choices of forest species would be needed along with ways of maximizing their production at least cost in JFM settings. Another important area of research would be to translate these research findings into working plan prescriptions to enable the JFM communities to manage forests to produce these results at least costs.

Measurements

The methods of measurement of these goods and services available today are neither credible nor cost effective. Research is required to be undertaken for creating such credible and cost-effective measurement methods for carbon sequestered, increase in supply of water in dry seasons, decrease in soil wash with increased forest cover and for deciding the parameters indicative of bio-diversity conservation.

Economic valuation

The JFM communities would be able to enter the market with greater confidence if they have access to data on the true economic values of the goods and services that they produce. There is a general lack of a wide base of knowledge for these products and, therefore, research on economic valuation of all these goods and services and their various combinations is an urgent requirement. Related to this, and perhaps even more important, is the field of research on the issues of leakage, additionality and rotation in relation to carbon sequestration and bio-diversity conservation

Legal and policy research

In a normal situation of market development enabling policies and laws develop as a need of the society. However, to hasten the development of market for these goods and services it would be necessary to create an enabling environment to begin with. This calls for a thorough research in this field. Further in the case of these goods it would also be necessary to establish who, and to what extent, are the producers and to what extent they can demand payment for services rendered by them. Research would also be necessary to establish practices and benchmarks for fair negotiations between the producers and consumers.

CONCLUSIONS

Poverty alleviation capacity of JFM would be significantly enhanced by expanding the product base of the JFM by incorporating in its fold the environmental goods and services like carbon sequestration, fossil fuel replacement, water conservation, soil conservation, biodiversity conservation, enhanced aesthetics. But the market for these new goods and services has to be developed through the tool of research as its organic growth would take too long a time. The R&D efforts must concentrate on the optimization of production of these goods and services, measurement of goods and services delivered, their economic valuation and establishing an enabling legal and policy framework for such a market to function and flourish.

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JFM and poverty alleviation: an analysis

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ABSTRACT

The knowledge about interdependence between natural and social systems enforces the need to implement the Joint Forest Management Programme (JFM) in a more holistic, integrated and flexible development framework. The JFM Programme in India has great relevance for developing nations which have predominantly agrarian economy and the population is dependent upon forests for subsistence. The JFM in India has given a new thrust and direction through the 62 890 JFM committees covering 14.25 million ha of forest land in 27 states. This has resulted not only in rejuvenating the forest cover but also brought socio-economic changes in the life of the communities living in and around the approximately 175 000 forest predominant villages in the country. There has been a paradigm shift but the need is to have a holistic approach to forest and natural resource management with development of concept of livelihood initiatives through people's participation for forest enrichment. Poverty alleviation is linked not only to hunger satiation but for fulfilling the basic human needs of providing shelter, clothing, clean water, education and health care. It is a paradox that where more forests exist, there is higher degree of poverty and to mitigate this problem several policy initiatives have been tried but still much is required to be done. How productivity in the forest can be increased to meet the challenge of growing fuelwood, fodder and timber demands is the biggest challenge. The second challenge is to provide gainful employment and generate produce which can be harvested sustainably. The right approach is to manage JFM Programme by setting national objectives which should include multi-tier plantation, NTFP propagation and technological inputs which are low-cost and locally adaptive based on the principle of care and share. The enabling environment for sustainable livelihood option is participation of the forest communities with scope for local ingenuity, innovation and capacity building of the stakeholders for poverty alleviation through Joint Forest Management.

INTRODUCTION

Over the years, more than half of India's 76.53 million ha of forests have become degraded resulting in ecological crisis and immense hardships for the forest-dependent people in and around the forest areas. The dependence on forests is so much that over two-thirds of the rural population and half the urban population use fuelwood for cooking purposes. About a quarter of India's livestock population is almost totally dependent on forest lands. Nearly 70 percent of India's population uses traditional medicine which comes from the forests. Forest based activities are often an important source of cash income for the poor especially during lean season (MoEF 2002). The JFM Programme in India has given a new thrust and is of great relevance for developing nations who have predominantly agrarian economy and the population is dependent upon forests for subsistence.

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PRIORITIES AND PARADIGM

That forests and poverty alleviation have a direct relationship is proven beyond doubt. But it is also true that poverty is higher in vicinity of higher forest cover. Among the priorities that have become prominent in development policy planning worldwide since 1980, the followings have particularly influenced the JFM policy:

- The re-conceptualization of governance: responsibility for development planning and implementation is increasingly seen as a neglected set of partnerships among state, civil society and private sector partners.
- Participatory approaches to development based on empowerment through organizational development among poor and marginalized people.
- Faith in the value of micro-enterprise based on local initiative in small production units coupled with a desire to bring these under some degree of formal state support and control (Sundar *et al.* 2001).

IMPACTS OF JFM

The JFM Programme has led to several positive impacts like:

• Improvement in the condition of forests – This is corroborated by the fact that in the past few years the overall forest cover of the country has increased by 3896 km² and dense cover by 10 098 km². Incidence of illicit felling has declined. A study carried out by the Andhra Pradesh Forest Department has indicated that between 1996 and 1999, dense and open forest covers have increased by 18 percent and 22 percent respectively. One of the more immediately visible ecological effects of JFM has been the recovery of fodder resources in JFM areas.

In the study by Indian Institute of Forest Management (IIFM) of village forest committees in the Jhabua Division of Madhya Pradesh, it has been found that the average saving of a household by augmentation of fodder from the area has been Rs. 3000 per annum (Bahuguna 1993). The prolific growth of understorey vegetation in many instances, has led to increased bio-diversity and relatively rapid increase in wild herbivore populations.

- **Increase in income** The committees have benefited from the employment generated under JFM Projects through micro planning, sale of non-timber forest products and bamboo yield, etc. Many VFCs have sustained the level of community funds, which are used for local developmental activities and personal loans, thus lessening the bondage of money lenders. In Jhabua alone the village fund is over Rs10 million as per UNICEF study. At the end of 2000–2001, total community funds under JFM were Rs.557 million (US\$11.6 million) in seven states of Andhra Pradesh, Chattisgarh, Manipur, Tamil Nadu, Tripura, Uttar Pradesh and Uttaranchal (MoEF 2002).
- **Reduction in encroachment** In many places JFM has helped reduce area under illegal encroachments. For instance in Andhra Pradesh nearly 12 percent of the encroached forest land (38 158 ha) has been vacated since the JFM programme was initiated (Mukherjii and Rangachari 2000). Many VFCs in Madhya Pradesh have got no encroachment resolution passed and previous encroachments were vacated.
- **Involvement of NGOs** The JFM programme has led to a considerable involvement of NGOs and community-based organizations though the degree of involvement and number vary from state to state. In the six states, as per figures available from Andhra Pradesh, Manipur, Tamil Nadu, Tripura, Uttar Pradesh and Uttaranchal, 1061 NGOs are actively participating in JFM Programme.
- Change in attitude and relationship One of the most significant impacts of JFM programme has been the change in the attitude of local committees and forest officials towards each other and towards forests. It was unthinkable in pre-JFM days that Divisional Forest Officer will sit and discuss with the villagers while now even top forest management is easily accessible to villagers as department has accepted the role of facilitator. Several JFM related training programmes have been initiated.

The overall strategy of JFM is as described in Figure 1.





PRESENT SCENARIO

The JFM Programme covers 14.25 million ha of forest land in 27 states through 62 890 committees. Among the many independent and isolated attempts that were made by forest departments in different states for eliciting community participation during the 1980s and 1990s, the Jhabua experiment in the State of Madhya Pradesh was unique. The Jhabua District was reeling under frequent droughts, poor productivity of natural resources – forests and agricultural lands, mass out-migration in search of livelihoods, and illegal and illicit withdrawal of forest products, when the forest department undertook the Joint Forest Management Programme. This programme not only attempted to tackle problems of forest destruction, but was also aimed at generating options for poverty eradication and employment as a crucial step for reducing pressure on natural resources (TERI 2000).

Some states have shown a spurt of initial growth and subsequent stagnation while others who were dormant for years have shown remarkable progress in later years. Yet many others, with enormous forest wealth, despite facing extreme difficulties in managing them, have not made significant strides. In some cases, the JFM movement gathered steam with the thrust coming from externally assisted projects, but lost the momentum when the projects came to an end.

The enhancement of the quality of life of forest dependent communities, through efficient, participatory, multiple-use management, equitable distribution of returns and establishing long lasting demand-spurred systems of environmental governance and justice, is possible by:

- integrated development of land based resources along watershed approach;
- ensuring institutional, financial and ecological sustainability;
- establishing accountability and transparency in management practices;
- · creating institutional mechanism for empowering local communities to meet the objectives.

Forests have been identified and recognized as one of the natural resources on which the local people are dependent and extract fodder for their cattle, fuel for energy, non-timber forest produce (bamboos, cane, medicines, fruits, fibre and flosses, etc.) for their domestic needs and timber for house construction and furniture.

Ecological security is the foundation of equitable and sustainable development. Forest conservation through community participation ensures ecological security and sustainable development (Roy 2003). However, mere subsistence is not enough to ensure long term sustainability. Therefore, while ensuring sustainable forest management over a period, JFM should contribute more than subsistence needs and in the 'JFM Plus' phase it should help in raising the living standard of the community through value addition of forest produce (ICFRE 2001).

The need is to have a holistic approach to forest and related natural resource management. The Dr C.H. Hanumanth Rao Committee, which looked into the working of the Drought Prone Area and Watershed Development Programme in the country during the last 30 years found that it had not worked primarily because people were not involved in the planning, implementation and management and the programmes made no provision for capacity building.

LIVELIHOOD SYSTEM

The 'Livelihood System' means developing the forests in a manner that the outputs from the forest provide the community with substantial economic benefit in perpetuity to attain a satisfactory level of life. The schematic representation in Figure 2 explains the concept of Livelihood Initiatives through Forest Enrichment (LIFE).





The following criteria for success of such initiative are envisaged based on the performance indicators:

Criteria	Parameters for success	Performance indicators
Technical	Improved ecological conditions	i. Better availability of fodder, fuelwood and other NTFPs, etc.
		ii. Status of regeneration by Regeneration Survey
		iii. Increased availability of fodder, fuelwood and timber from non-forest land
Institutional	Effectiveness of training and	i. Behavioural change in Forest Department staff
	operationalising of principles of shared responsibility	ii. Relationship between Forest Department and community
Institutional	Performance of villages and District level initiatives	 In terms of meeting, activities, participation, and responsibilities
Sustainability	Cost-effective eco-development	i. Employment generation and diversification
	activities	ii. Value addition of goods
Equity	Empowerment of marginalized	i. Economic empowerment
	groups and women	ii. Social empowerment
Participatory	Voluntary contribution	i. Increased development fund
Participatory	Better forest management	i. Rotational grazing
		ii. Rotational patrolling
		iii. Decrease in forest offences
		iv. Control of forest fires
		v. Removal of encroachment from forest land
Financial	Expected returns on investment	i. Intermediate returns
		ii. Expected final return

It has been found in the programme that, until an analysis of the socio-economic conditions and forest dependency for various goods and services is done, it is not possible for the Forest Department to involve local communities. Therefore a sound knowledge of their culture, tradition, social and economic conditions is a must. To take these measures, an exercise of priority setting by communities is essential. The priorities should be clear and their solution should come from the stakeholders mainly.

THE RIGHT APPROACH

The JFM Programme has to be managed in future with the following objectives:

- suitable silvicultural practices especially the raising of nurseries like use of mulches, clonal propagation, etc.;
- quick growing species to be developed;
- suitable model of multi-tier plantation to be evolved and demonstrated;
- the high yielding varieties of NTFPs to be propagated and demonstrated;
- multiple uses, high yielding varieties of fuelwood, fodder, and fruit bearing species, are to be planted for improving the economic condition of the people.

Once the JFM Programme provides the local people with alternative solutions as per the above objectives, the local communities' response to the programme will be positive and they will be convinced not to overexploit the available forest resources in the vicinity of the villages. The keenness to work in collaboration with the Forest Department shall also be more and all activities that are detrimental to forests will be reduced.

The technological inputs should stress on strengthening the existing forests by enrichment planting, soil and moisture conservation works, multiple shoot cutting in coppice species for clean boles and availability of fuelwood and fodder production linked to increased milk production. The stress should be on the principle of care and share through socio-silviculture planning process.

The heart of enabling environment for sustainable livelihood option is participation by the forest based communities living close to forest land. It is not sufficient that forest community is 'involved'. In planning process promoted through JFM Committee, forest communities should be motivated and organized into an institution which should undertake micro-planning of public and private lands for afforestation. The planning process has to be democratic and well informed.

The PRA exercises separately with men and women groups and then jointly with all are extremely useful and should cover:

- forest resources in the village: public and private lands;
- its status in terms of degradation;
- uses and availability of various tree species in the forest land, other public lands and farmlands;
- gaps between local availability of produce and the requirements of the forest community;
- uses and availability of various grasses and shrubs;
- uses and availability of various non-timber forest produce;
- seasonality of employment opportunities and needs in the village.

For participatory management to be genuine, there should be enough scope for local ingenuity and innovations to contribute to management practices that would be owned by the JFM Committee. Capacity building by way of practical and theoretical training, and dissemination of success stories in vernacular language have to be the inbuilt components in all programmes (Katwal and Singh 2002).

HOW TO SUSTAIN JFM GAINS?

The approach of JFM has created a positive environment to improve livelihood systems of forest dependent communities and address the root cause of rural poverty in remote areas. Forestry alone, however, cannot provide the necessary linkages and mechanisms affecting the multifaceted problem of rural poverty. Therefore, a multi-pronged approach is needed to develop sustainable livelihood support systems under JFM.

The key areas which need attention are:

- Income generation activities for landless and women.
- Food security through Grain Banks especially in the forest fringe villages which suffer from crop failure due to low irrigation potential and difficult terrain.
- Grazing and livestock management and promotion of non-conventional energy.

NGOs can have a major supportive role in initiating and operationalising Income Generating Activities (IGAs) on collective basis. They can work as catalyst in solving marketing issues, value addition and raw material availability.

FUTURE PROSPECTS AND CONCLUSIONS

Several questions arise concerning implementation of JFM on a sustained basis. Studies have to be undertaken to find out whether the impoverished women and men, who are compelled to resort to unsustainable forest use for survival are able to switch to sustainable resource use through JFM programme.

There is a growing trend to increase the number of JFM Committees. The increase would need to be guided by the capacity of the field level forest staff and their ability to effectively coordinate and monitor the progress. Otherwise these committees remain only on paper with not much of attitudinal change. The other issues which need attention are resolving intra committee and boundary conflicts. The entire JFM mechanism has to be process-based rather than individual-based.

Given the broader concept of poverty and the broader framework for understanding poverty, as well as the global context for poverty alleviation, the framework of actions to attack poverty should be built on three pillars, empowerment, security and opportunity. These are well engraved in the JFM mandate.

Poverty alleviation is linked not only to hunger satiation but for fulfilling the basic human needs of providing shelter, clothing, clean water, education and health care. It is a paradox that where more forests exist, there is higher degree of poverty and to mitigate this problem several policy initiatives have been tried but still much is required to be done. To achieve higher progress, land has to be made productive and cattle have to be healthy. A combination of short and medium rotations and coppice system needs to be evolved for a variety of tree species being planted under JFM for faster economic gains. How productivity in the forest can be increased to meet the challenge of growing fuelwood, fodder and timber demand is the biggest challenge. The second challenge is to provide gainful employment and generate produce which can be harvested sustainably. The right approach is to manage JFM Programme by setting national objectives which should include multi-tier plantation, NTFP propagation and technological inputs which are low cost and locally adaptive. The emphasis has to be on participatory process through community based economic development, sustainable management of local resources and policy feedback.

JFM has to be taken as a means of forest development and not an end in itself. There is no short cut. Each area has specific requirements and no two JFM Committee areas can be similar in problems and solutions. Though basic approach may be the same, still implementation techniques differ. But such an integrated approach shall benefit the people, government and civil society in general. Agriculture, water harvesting and land conservation practices have to be meticulously adapted to local conditions.

Participatory forestry programmes must develop mechanisms to distribute benefits down to individuals, households and targeted groups within committees to play a meaningful role in poverty alleviation. In addition we have to put governance in 'mission mode' for a more pragmatic approach to JFM.

Every technology should have an ideology behind it to give it direction and meaning and every technology to be socially relevant should have a strategy to give it realism and experience. For achieving this in renewed perspective, the theme of any technology package under JFM programme should be to give maximum production in the shortest period; conserve forests and utilization of all that grows in the forests to meet people's needs.

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Wood science and technology R&D can contribute to poverty alleviation

K. Satyanarayana Rao*

ABSTRACT

Mankind is currently re-discovering the values of wood, especially its value as an environmental friendly material that is reusable, recyclable, and biodegradable, besides its carbon sink effects. This important bioresource is one of the most useful materials around the world and its usage is both extensive and widespread. In India, it fulfills several key needs of the society. Production and use of wood in a way that sustains its supply will be a key element in sustainable forestry. R&D in Wood Science and Technology is aimed at generating environmentally sound technologies that promote usage of wood in a more responsible manner through better process and product technologies. Extensive use of these technologies can play a significant role in value addition, higher income and employment generation, tree biodiversity conservation, and enhancement of carbon sink, with least ecological costs. However, in the changing global and domestic scenario, Wood Science and Technology R&D cannot limit itself only to technology generation but to gear itself to develop pro-active/ catalytic strategies in developing Researcher-user linkages. This paper attempts to identify areas that R&D institutes could consider for realizing their full potential in addressing these issues and aiding poverty alleviation. The need for developing Institute-Industry-user group "Partnerships" is emphasized as this approach is paying rich dividends elsewhere in bridging the gap between knowledge providers and users.

INTRODUCTION

It is increasingly becoming clear that Research Institutes should aim not only at technology generation but also address and tackle socio-economic problems through appropriate development and technology transfer activities. This is reiterated in the new "Science and Technology Policy 2003" of the Government of India enunciated by the Honourable Prime Minister in January 2003. One of the main objectives of this policy is "to mount a direct and sustained effort on the alleviation of poverty, enhancing livelihood security, removal of hunger and malnutrition, reduction of drudgery and regional imbalances, both rural and urban and generation of employment, by using scientific and technological capabilities along with our traditional knowledge pool. This will call for the generation and screening of all relevant technologies, their widespread dissemination through networking and support for the vast unorganized sector of our economy". The need for Science and Technology to be more directly linked to social needs, and to use it as the key problem-solving instrument in all endeavours is recognized in the new policy and is one of its major thrusts. (Anonymous 2003a, Joshi 2003).

R&D in Wood Science and Technology is aimed at generating environmentally sound technologies that promote usage of wood – the only naturally produced, renewable structural material we have – in a more responsible manner, through appropriate 'process and product technologies'. More extensive use and improvements in these technologies can play a significant role in tree biodiversity conservation, enhancement of carbon sink, with least ecological costs in management and use, besides generation of income and employment through improvements in product quality, value addition. This is expected to increase a stable forest enterprises

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base and aid in poverty alleviation. To guarantee that Forest Product Institutions continue to progress in this challenging work and provide tools for optimal use of wood, it is necessary that forest products R&D to gear itself up and make necessary adjustments for advancing Sustainable Forestry.

Pursuit of a strategy for achieving an economic growth rate of 8 percent during the Tenth Plan period, in a country like India, where natural resources are under immense pressure while aiming at the same time "eco-efficiency" and "sustainable communities", calls for bold departures from existing practices in each of the major sectors. "Eco-efficiency" aims at "producing more from less resources" while "sustainable communities" are realized only when all stakeholders are able to achieve both "sustainable production" as well as "sustainable use/consumption" (Moni 2003). Many gaps that are impeding rational utilization of this most ecological of raw materials need to be urgently addressed.

ISSUES

• Minimize curiosity-driven research and step up research driven by society's needs, giving due consideration to socio-economics.

The National Forestry Research Plan (NFRP 2000) developed by the Indian Council of Forestry Research and Education (ICFRE), is an excellent example and a right step in this direction. This plan is the outcome of 26 state level workshops followed by eight institute-level workshops, a national-level workshop and developed through a multi-stakeholder participation. During the workshops, the research users, managers, and researchers identified and prioritized research problems and research themes. Being transparent, participatory and bottom up in its approach, it has ensured the involvement of all the SFDs and other stakeholders, thus minimizing "curiosity-driven" or "fancy" research and is in operation since 2000.

• Adopt a mission mode approach for wood product development encouraging the full tree-to-product cycle.

India has launched a "National Mission on Bamboo Technology and Trade Development" (NMBTTD) and its action plan was released in April 2003. This plan charts out a strategy for organized production, processing and use of bamboo as a major poverty eradication tool. It is projected that the bamboo mission programme will enable about 5.01 million families of artisans and farmers to cross the poverty line (Anonymous 2003b). The Planning Commission, Government of India is also proposing a National Mission on "Bio-diesel" which aims at production in quantities sufficient to enable its blending with HSD to the extent of 20 percent in 2011–12. This would require planting of *Jatropha curcas* on 11 million ha of land in and outside the forest. The demonstration project envisaged under the plan is proposed to be implemented in a mission mode with six more missions (Anonymous 2003c). Such initiatives are very useful in the present context and address a long-felt gap.

- In developing forest products, forest product research will have to continue and increase its effort paying attention not only to the technical quality of the product itself, but also the environmental quality of the product and of the production processes.
- Conduct Life-Cycle Assessments (LCAs) on wood products that take into account the environmental effects of a product over its entire life span, from extraction and production to use and eventual disposal.

Wood, in recent years, has been facing substitution pressure from other materials such as synthetics, concrete, cement, steel, ceramics, glass, aluminum and other non-renewable materials. It is to be understood that the ultimate competition for timber markets, whether the source is from "certified" or "non-certified" forests, is from those who want to displace wood with non-wood substitutes. Forestry and forest products researchers have paid too little attention to produce reliable figures of the environmental advantages of using wood products. Such analyses need to take into account both raw material acquisition and use of products during their entire life span, from extraction of raw material, and production to use and eventful disposal. Such studies, known as Life Cycle Assessments (LCAs), are aimed at indicating how advantageous it can be to use wood from an environmental perspective. Such information, at present, is very scanty and the special benefits of using wood products, are not getting addressed in the methodologies of LCAs yet. Future competitiveness of wood products depend on their environmental quality "not the quality which is claimed but that one which can be proved" (Thoroe 2003). Researchers in Wood Science and Technology have a great responsibility to provide such data and help forestry and forest industries to use them to try to convince consumers, traders,

architects and decision makers of the advantages of wood. The environmental advantages of using of wood, vis-à-vis other materials, need to be urgently established through LCA studies. The prevailing negative image of the forest products industry in some quarters, as the main cause for deforestation has to be reversed. LCA studies that extend producer responsibility to include the entire life cycle of products remain both a challenge and opportunity to forest product research, to moderate such concerns.

- Facilitate development of wood industry through innovative research that aims at production and use of wood that sustains its supply, integrating wood science and technology with tree improvement programmes where necessary.
- Strengthen both vertical and horizontal linkages between various stakeholders. Encourage multidisciplinary research and institutional collaborations.
- Facilitate a favourable operational regime for adopting scientific processing and improvements in utilization through strengthening/developing R&D institute-academia-industry-user group linkages. At present, the user-manufacturer-researcher linkages are extremely weak and "inter-twinning" arrangements between R&D institutes and industry are virtually non-existent.

Innovative approaches are necessary to enable industries and enterprises (eg. saw millers and processing units) to adopt and popularize sustainable technologies through approprite "partnerships" and "inter-twinning arrangements", with other stakeholders, especially the R&D institutes and user groups. Investments by private sector in promoting environmentally sound technologies need to be compensated appropriately. This is crucial for speeding the much needed technology absorption by the society.

An examination of the wood processing industry in India indicates that it is characterized by a large number of small-scale units that are generally unorganized and disperse with the exception of a few paper mills and panel product manufacturing units, which are in the large/medium-scale sector. The pace of technology adoption and change in the industry has also been extremely slow. Improvements are needed at all stages of operations - when wood is harvested, processed and utilized. For instance, even though with a rate of return of as much as 175 percent, if a monetary value is placed on the wood saved through prophylactic treatment alone, there is little evidence of this simple technique being adopted (Bajaj and Bhat 1996). Studies have also shown that pressure treatments enhance durability of a variety of timbers. Adoption of such simple and well proven treatment technologies has the potential to save a huge quantity of timber every year amounting to saving millions of well grown timber trees. This is in addition to other benefits such as reduction in investments, widening the choice of species for different end-uses, etc. However, the quantity of timber being treated in the country is negligible. Unfortunately, the potential of wood preservative technologies as an important tool for forest/tree conservation has never been fully realized in India (Kumar 1999). Reasons are many, but certainly a favourable operational regime for scientific processing, especially wood treatment, does not seem to exist. There is no legislation, no incentives or disincentives warranting a new wood use policy. There is also considerable scope to enhance the processing efficacy of saw mills and wood recovery rates by following simple improvements. The rate of return on investments in a programme of saw milling could produce improvements of as much as 120 percent (Bajaj and Bhat 1996). It is against this backdrop that the development of partnerships assume paramount importance.

A recent example of the institute-industry partnership initiative from India is the Advanced Wood Working Training Centre (AWWTC) at Bangalore. This centre is established by the Institute of Wood Science and Technology (IWST), Bangalore, recently in partnership with the Italian Wood Working Machinery and Tools Manufacturers Association (ACIMALL), Milan, and the Italian Trade Commission (ICE), Mumbai. This training and research centre aims to enhance and enable the Indian wood products manufacturing industries capabilities, promoting them to attain a globally competitive position in the areas of manufacture of value-added wood products by using state-of-the-art machinery. The centre is located at the Institute's premises in Bangalore. IWST provides the necessary infrastructure facilities for the centre. The machines are provided by the ACIMALL. The ICE, which promotes Italian technology and products in different countries operating through a network of hundred branches all over the world, provides the recurring costs of the centre. In today's highly competitive environment, the stringent market condition demands products and services of high quality and at a competitive price. Despite its vast potential in employment and income generation and availability of some of the bestknown tropical timbers, the wood product industry in India has generally remained underdeveloped. This is particularly so in the mechanized wood processing segments aiming for domestic and international markets. Three of the identified critical needs in development of this sector are (i) properly trained personnel, (ii) precise, state-of-the-art machinery, and (iii) strong, industry-R&D institute-user group linkages. This international collaborative effort is expected to:

- Provide direct links between the wood manufacturing industry, R&D institutes and the government;
- Enhance technical levels and competitiveness of Indian wood-product manufacturing industry;
- Develop customized training programmes;
- Promote and catalyse industry support applied research, and
- Help solving technical as well as shop floor problems.

As the Italian woodworking machines are among the best in the world, the proposed centre has a potential to eventually develop into a research, education and technology transfer centre of excellence, through this international partnership. The response of the industries has been overwhelming so far, and the outlook very promising.

• To ensure wide access and to popularize technologies to user groups, develop CFC's (Common Facility Centres) jointly with local communities, industry, NGOs and concerned government departments with R&D institutes acting as catalysts/facilitators).

Example: A Common Facility Centre (CFC) for development of bamboo handicrafts at Angamaly, Kerala.

Angamaly, a small town in the Trichur district of Kerala is one of the 'bamboo clusters' in the country. Bambusa arundinacea, Ochlandra travancorica (a reed) and other bamboo species are abundantly available in and around Angamaly. The livelihood of over 25 000 artisans, engaged in mat weaving craft is dependent on income from bamboo. They possess skills such as bamboo cutting, splitting and slicing. Their income, however, remains very low as they are engaged only in bamboo mat weaving. The Development Commissioner (DC), Handicrafts, Ministry of Textiles, Government of India, has facilitated through a partnership involving a local NGO, the local Panchayat and the user groups to operationalise a Common Facility Centre (CFC) to upgrade their traditional skills. The DC made available the machinery for operations. R&D institutes, like IWST and the National Design Institute, Ahmadabad, are involved in the training of the artisans. In this model, the Development Commissioner, acting as a facilitator, has mobilized funds to be used for machinery, arranging training programmes, consultations, etc. The local Panchayat has come forward to provide land and building for establishing the CFC and the work shed. The local NGO, the Christian Association for Rural Development (CARD), has taken initiative to implement the programme. During the project period, the NGO will facilitate formation of a society to have a larger representation and identify up-market centres so that the standard of living of artisans will improve. After the project period, the society will function on a self-sustained basis. This CFC is in operation since 2002 and the progress is very promising. There is need for establishment of more such partnerships/arrangements for improving the quality of products, income and living standard of the artisans.

CONCLUSION

With a contribution of over US\$400 billion to the global market economy, of which US\$130 billion is traded internationally, wood continues to be an important bioresource in the economics of many countries. Despite the introduction and availability of many modern materials, wood accounts for nearly 46 percent of industrial raw materials. Worldwide, the industrial use of wood approximates that of cement and steel and far exceeds the plastics. The total harvested volume of wood (3.5 billion m³) exceeds the volume of all the other materials combined. Contrary to the common, but erroneous perception, use of wood, is in fact, ever increasing, more so in a developing country like India. This is partly because mankind is currently re-discovering the values of wood, especially its value as an environment friendly material that is reusable, recyclable, biodegradable and more importantly, a renewable natural resource.

The wood products industry in India is one of its oldest and most durable industries. In spite of tremendous pressures and market downturns, this industry has survived and has fulfilled several key needs of the society. However, the woodworking and manufacturing is mostly unorganized. The traditional craftsmen and carpenters constitute its major workforce and the income generated never really reflect their potential. Upscaling this sector to open the doors for augmentation of economic opportunity, income and employment, is a long-felt need. Value-added wood products have immense economic and marketing opportunities. Fortunately, India is bestowed with over 4500 wood yielding species that include some of the best known and highvalue tropical hardwoods like teak, rosewood, mahogany, red sandal, etc. Yet, we are, today a nett importer of wood and wood products and exports are marginal. This situation needs to be reversed.

In the post-GATT environment and in the globalised context, competitive ability is an imperative for achieving success in both external and local markets. Science and Technology (S&T) are key tools to achieve this competitiveness. The rapidity with which S&T is moving ahead calls for new strategies like inter- and multi-disciplinary, multi-institutional approaches and in some cases, multi-country participation. Today, more than ever before, there is a need for partnerships – between R&D institutes, market/business developers, financial bodies, and policy markers. Developing industry-institution partnerships proved an effective strategic tool in almost all developed countries in achieving competitiveness and success for Industries. A new vitality needs to be infused to the woodworking sector in India. R&D in wood science need to be pro-active in keeping pace with the changes to realize their tremendous potential to play a beneficial role in advancing the well-being and economy of our society and in poverty alleviation.

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NWFPs for poverty alleviation: research issues

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ABSTRACT

For most of the world's rural households, NWFPs (non-wood forest products) provide essential food and nutrition, medicine, fodder, fuel, thatch and construction materials, mulch and non-farm income. These products are particularly important in relieving the 'hunger periods' in the agricultural cycle, and in smoothing out other seasonal fluctuations. Sustainable management of NWFPs, therefore, can provide employment during slack periods of the agricultural cycle, and provide a buffer against risk and household emergencies. Poor households in forest fringes in particular, depend on these products for their livelihood because they usually have more access to the forest than to other resources. Furthermore, for the same reason – greater dependence on open-access forests and, for lack of other options women usually rely more than men on NWFPs for household use and income. In many places, women are responsible for the household activities that involve forest-based foods and medicine, as well as fuelwood. In this respect NWFPs are particularly important to women, addressing their needs for food security and nutrition. Moreover, in local, national and international markets, forest foods and medicines contribute substantially to national economic growth. NWFPs are therefore important to three main groups; namely (a) rural populations (the largest group) who have traditionally used these items for livelihood social and cultural purposes; (b) urban consumers (a smaller group, but growing faster), who purchase these items; and (c) traders and product processors, whose numbers in the NWFP sector increase as urban markets for these products grow. However, not much attention has been paid to various research needs to examine the sustainable management of these products for rural development. The paper highlights these research needs, which are essential to achieve sustainable NWFP management leading to poverty alleviation of forest dwellers and also identifies the changing roles of research institutes, forest managers and training institutes in light of these research needs.

INTRODUCTION

At the national level, India produces more than enough food to feed its people, but regional disparities leave a significant segment of the population without access to adequate nutrition and basic services. Official data show a reduction in the number of rural people living below the poverty line, however there are pockets where poverty is concentrated, particularly in remote rural areas where the level of development is low. Labour migration from these pockets to economically productive areas is an increasing phenomenon. Populations living close to fringes of forests – the ecosystem people are one such category of masses, which have been reported to be poor. Furthermore, a number of tribal communities, in different forests of India have a long tradition of growing and using NWFP plants. However it is also true that these species do not result in adequate remuneration to these communities, which is not commensurate to their sale price in national and international markets.

Non-wood forest products have attracted considerable global interest in recent years due to increasing recognition of their contribution to household economies and food security, to some national economies, and to environmental objectives such as the conservation of biological diversity. Some 80 percent of the population

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of the developing world uses NWFP for health and nutritional needs. Several million households world-wide depend heavily on these products for subsistence consumption and/or income. At a local level, NWFPs also provide raw materials for large scale industrial processing, including for internationally traded commodities such as foods and beverages, confectionery, flavours, perfumes, medicines, paints or polishes. Presently, at least 150 NWFPs are significant in terms of international trade, including honey, gum arabic, rattan and bamboo shoots, cork, forest nuts and mushrooms, essential oils, and plant or animal parts for pharmaceutical products. However, all over world these commodities are characterized by inequitable distribution of usufruct, which is biased towards national and international traders.

It is somewhat surprising, therefore, that in spite of all the current analysis, discussion, and debate, several basic questions related to the ecological, socio-economic and technical aspects of non-timber forest products sustainable management have yet to be addressed. For example,

- Why protocols for resource survey have not been developed?
- Despite the potential for disaster, why only few of the vulnerable NWFP species are today protected by legislation?
- What are the actual ecological impacts of harvesting commercial quantities of non-timber products from a forest?
- Are some species or resources more resilient to the effects of continual harvesting than others? What can be done to minimize these impacts?
- What sort of monitoring activities, management practices, and silvicultural techniques can be used to insure that the resources being harvested are not overexploited?
- What forces have prevented the development of an organised market channel for NWFP species?
- Why is there a general lack of awareness amongst the masses and especially the gatherers / collectors about these species?
- What prevents farmers from adopting the cultivation technologies for NWFP species developed by research institutes?

The discussion in the previous section clearly indicates that NWFP management and trade are regulated by forces such as market, industrial demand, tribal needs, international pressures, forest management and government policies. Therefore, a successful management strategy for NWFP species should involve these economic, ecological, social and environmental inputs. An effort based only on ecological considerations such as creation of *ex situ* and *in situ* conservation areas or reserves without addressing the socio-economic, and technical issues is not a viable option. The present paper is intended to address the interaction of such factors and provides suggestions for the sustainable management and conservation of NWFP species.

RESEARCH ISSUES

The sustainable management of NWFP resource essentially must take into account the ecological, economic and socio-cultural sustainability aspects.

Ecological Sustainability

Inventory

Resource inventory and assessment of NWFPs is a problematic area. Inventory has often been restrictively understood as a listing of species (both of economic and environmental values or importance). In fact, the inventory besides listing of species must always consist of the actual state of occurrence, density and potentially harvestable quantities per unit area with reference to a specific management unit of a forest. The inventory must also prescribe the safe harvesting limit of each species that is being extracted or is likely to be harvested.

Given the current status of scientific knowledge, reliable information is not available on the total resource availability of any of the NWFP species, not even of such species that are being extracted on commercial scale. In the absence of any such information/data, therefore, it is not possible to achieve sustainable management and monitoring for the development of the NWFP resources for subsistence use and trade leading to poverty alleviation of forest dwellers. Therefore, a greater emphasis has to be given to address these issues, before NWFP based forest management can be realized successfully.

Table 1. Productior	n of non-wo	od forest p	roducts duri	ing 1987–200	Q								
Products							Year						
(,000 tonnes)	1987-88	1988-89	1989–90	1990–91	1991–92	1992-93	1993-94	1994–95	1995–96	1996–97	1997–98	1998–99	1999–2000
Sal seed	21.29	23.81	54.58	0	0	0	0	18.53	27.62	87.51	12.58	57.78	78.74
Bidi leaves	505.53	531.5	556.04	0	0	0	0	542.76	322.16	112.25	744.35	384.94	400.81
Canes	1.61	6.26	42.6	0	0	0	0	65.14	34538	5.02	2.1	18.69	2.02
Resin	98.32	105.59	117.59	0	0	0	0	88.23	169.24	26.02	18.34	14.35	0.96
Gums	13.82	4.09	1.39	0	0	0	0	21.1	3.04	3.56	-	2.14	2.42
Lac	9.11	68.97	1.06	5.77	6.01	8.28	7.28	9.07	0.1	0.08	0.75	0.02	0.31
Drug and spices	12.05	11.49	18.66	26.53	62.81	23.33	18.16	21.57	59.78	41.21	62.7	0	0
Grass and fodder	304.49	332.47	119.98	1021.95	161.79	421.62	113.34	74.91	64.06	62.98	418.53	213.85	45.78
Tanning material	20.22	23.4	22.4	20.27	20.42	8.39	11.52	10.46	8.35	19.06	4.93	0	0
Others	318.44	229.7	68.58	0	0	0	0	10039.27	7782.12	111.91	197.94	69.94	165.95
Bamboo	642.38	829.76	1934.59	660.12	754.64	721.34	455.4	822.63	632.54	1186.05	3629.79	1119.67	1261.86
Total national	1947.36	2337.64	2937.47	1734.64	1005.67	1182.96	605.7	1171.67	9069.01	1655.65	5093.01	1881.38	1958.51
production													
Source: Data modified	d from Indian	Forest Statis	stics Report (ICFRE), 1987,	1996, 2000	and 2001.							
Conversion Table													
Weight of standard bi	ag of Bidi lea	ives: 40 kg			Canes: K	aps = 1 billet	; 1 bundle =	= 50 billet					
Resin: 1 blaze (Lip ar	nd Cup Meth	od) = 1 kg, (l	Rill Method) =	= 3 kg		1 billet	t = 3.65 met	re, 1 running	metre = one	-metre billet			
Bamboo: 1 Notional t	fonne = 2400	running met	re		\$	'eight of one-	metre piece	= 0.5342 kg					
Weight of 1000 clums	s of bamboo	= 1 tonne			Grass an	d fodder: 1 t	oundle = 35	kg					

At Forest Research Institute (ICFRE) Dehradun some studies have been conducted on the resource assessment of few NWFP species, especially the medicinal plants in Garhwal Himalaya as well as the Shivalik hills of Haryana in India. Forest Survey of India has also taken lead in resource quantification of NWFP resources in the country. In the absence of any standard methodology for assessing the resource quantitatively and also due to the fact that realization of such an inventory has to be updated time and again, this venture becomes not only time consuming but a very expensive proposition. It is, therefore, suggested that at the beginning of this process the field knowledge of the local communities may be utilized under JFM (Joint Forest Management) programmes for assessing the extent of resource, its abundance and density in the project areas and identifying such areas for potential extraction of the produce.

Auto-ecology and syn-ecology

Another aspect that requires consideration for sustainable management is the need for an integrated ecological approach to achieve sustainable management of the NWFP resource. It is well known that plant species in any given community coexist and interact in such a fashion that the resources of a microclimate are optimally utilized by all the components of the community. However, very limited information is available in the literature on these auto-ecological and syn-ecological interactions with regards to NWFP species. Therefore, it is possible that removal of one species may disturb the dynamics of the others and vice versa and subsequently may affect the existing community equilibrium. Greater scientific inputs are, therefore, desirable in this direction. The local communities, especially living in and around the forest areas, have adequate indigenous knowledge of maintaining the ecosystem on sustainable basis. This traditional knowledge treasure could be effectively made use of by the Forest Managers in developing site-specific programmes for assuring ecological sustainability of the ecosystem and planning wise use of the resources for the community interests and involvement in forest management simultaneously.

Production of NWFP

It is a well-accepted fact that 60 percent of the NWFP production in the country is traded as unrecorded removal. Further, the data on recorded and unrecorded removal or extraction of NWFP is neither systematic nor structured. However, in recent years, there has been proliferation of studies aimed at estimating their contribution to household income, consumption and employment generation potentials and opportunities. The production data for this paper has been essentially modified and adopted from Forest Statistics Report (ICFRE, 1987-2001) and pertains to only the recorded removal of NWFP from different state forests of India (Tables 1 and 2). It is clear from these tables that the increasing or decreasing trends of production reflected therein cannot be relied upon as indicators of sustainability of forest ecosystems or production. For example sudden increase in production of Sal seeds during the years 1997, 1999 and 2000 - could be due to exceptionally good seed years, which is characteristic to many tree species, while a lower resin production could be due to availability of imported resin, which is much cheaper than that extracted from national forests. In general, however, the trends for removal of medicinal plants show a continuous increase over the period under reporting (1987–2000), while there is a recorded decline of gums, resins, canes, lac and tanning material during the years. In order to solve this problem, it is suggested that for recording NWFP production from forests the active participation and help of local communities under the JFM programmes must be sought. The state forest departments may also take serious efforts in recording the production with the computerization of its establishment.

Sample plots

Since NWFP represent removal of specific plant parts to whole plant, different range of values will represent sustainable limits. The cyclic nature of flowering, fruiting, seed production and sporadic nature of distribution of species further complicate the issues of estimation of production potentials etc. Establishment of sample plots is required in various management units in different forest areas for determination of potential production of various NWFPs and for the estimation of sustainable harvest limits, which can be used without impairing the natural regeneration of the species. These plots may be monitored on long term basis with the active help and cooperation of the local communities and research institutions.

Medicinal plants 000' MT	1996–97	1997–98	1998–99	1999–00	2001–02*	2004–05*
Export	32.88	37.23	37.98	36.62	NA	NA
Import	4.18	3.00	4.66	4.19	NA	NA
Demand	NA	97.79	106.45	120.82	160.54	272.62
					GR** (15.1)	GR** (16.7)
Total	37.06	138.02	149.09	131.63	160.54	272.62

Table 2. Trends of export, import and demand of medicinal plants

* Projected

** Growth rate

Source: Demand study for selected medicinal plants, Vol-1 (a), 2001-2002, Centre for Research Planning and Action, New Delhi

Sustainable harvesting limits

Majority of the NWFP species especially the shrubs and herbs are largely extracted by destructive harvesting. This aspect is very critical not only for the regeneration/sustainability of the resource in the long run but also for ecological stability and sustainability of the ecosystem. Collectors of NWFPs are usually illiterate and are not conversant with the scientific methods of harvesting. Research institutions can play a key role in creating the awareness by the respective states amongst the collectors as well as the forest staff by supplying the scientific information on how to harvest different species on non-destructive basis. More often the local people are far more conversant with the identification of various NWFPs especially the medicinal plants existing in the area than the foresters. This knowledge of the local communities can be used in training the forest staff to effectively manage and prevent the pilferage of these vital resources from the project areas by unauthorized agencies and individuals. These efforts will also bring in the mutual understanding between the local communities can help the state departments to further train the forest staff in identification of various NWFP species by organizing a need based training courses.

Resource augmentation

Another important aspect of ecological sustainability is augmentation of the existing resource. Various research and development institutions have recently developed the techniques for mass multiplication of a number of NWFP species especially the medicinal plants. These technologies can be effectively utilized by states to undertake restorative and enrichment planting of the degraded forest areas for augmenting their existing resources.

Economic Sustainability

It is a fact that the success of any NWFP management is predominantly dependent on the economic returns to the stakeholders (local communities). The programmes must ensure equitable distribution of economic proceeds from various NWFP items to all members of the forest community. In order to make the programme more successful and economically vibrant, technical inputs like grading, preliminary processing and value addition of the produce using local or simple energy efficient technologies are required. Many research and development institutes have developed simple and effective techniques and tools to this effect. For example, solar or drum dryer techniques of drying the NWFPs, extraction of dyes from forest biomass waste and biofertilizers has been developed recently by various institutes. Research organizations thus can play a significant role in value addition of the NWFPs to ensure better economic returns to the stakeholders. Moreover, such institutions can help the states to develop technologies to suit their local or regional needs. Further, these institutions can also help in developing product development and quality control mechanisms to ensure competitive marketing of the produce. These initiatives would bring in stability in the current uncertainties of marketing the produce and facilitate conversion of the sporadic income through NWFP into a regular sustained income generating activity and thereby assuring better community involvement in the management programmes as well as enhanced economic returns and development of the stakeholders.

Socio-cultural Sustainability

In order to build a strong and sustainable partnership forest management must take into account the issues of human sensitivity in terms of local needs of the people, their specific cultural and traditional norms, rituals and beliefs. It must be borne in mind that ecological and environmental issues are although of prime importance for the resource managers, it is the economics that is more important to the community participants. Therefore, it is also important to use the wisdom and knowledge of the local communities with respect to specific species that would give more efficient methods in terms of sustainability of the resources and ensuring greater community participation. This wisdom, however, must be amalgamated with the scientific inputs to achieve the desired results. Local communities can be trained and actively involved in the collection of seeds and other planting materials, nursery development and production of planting stocks etc. As such due emphasis must be placed on capacity building of people at all levels. In this context, the scientific knowledge gained by research institutes can be effectively used to train the local communities in various aspects of cultivation, nursery establishment and production of planting stock, non-destructive harvesting and collection, processing and value-addition of NWFPs.

APPROACH

The studies on the aspects explained in preceding section should aim to assess the current status of database, resource inventory, harvest and management systems, marketing aspects, interest and perception of various stakeholders, utilzation and processing, and finally national and international trade and policy issues of these species. The SWOT should succeed this, ETOP analysis of these various aspects involved in the sustainable management of NWFPs. The main aim of the study should be to suggest modifications and improvements in the above mentioned socio-economic, ecological and technical aspects of NWFP management.

DEVELOPMENT OBJECTIVE

The long-term development objective of the studies should be: "to contribute to the conservation of national forests and enhance the well-being of local communities and people in India through the sustainable management, use and development of non-wood forest resources by local people".

TARGET GROUPS

The research should address the (potential) needs and concerns of institutions and people whose policies, programmes and actions are affecting the management, use and development of Non-Wood Forest Resources. They can be grouped in four:

- Those who collect, organize and analyse information to provide the analytical basis for formulating policies and defining development plans and strategies involving NWFPs;
- Those who define and choose policies, programmes and strategies, including the prioritization of projects, activities and the allocation of resource inputs to these;
- Those who execute programmes and strategies, and implement the projects and activities; and
- Those who derive income and have their livelihoods dependent on NWFP gathering, processing and trade.

IMMEDIATE OBJECTIVES, OUTPUTS AND ACTIVITIES

The immediate objectives of the research projects should be:

- To enhance national and state institutional capacity for the development of Non-Wood Forest Resources and Products, involving relevant governmental, scientific and educational institutions, NGOs, (inter/national) development organizations and individuals.
- To contribute to national and state policy development with respect to the sustainable management, use and development of non-wood forest resources.

- To contribute to sustainable, community-based forest management, improved NWFP resource assessment and harvesting techniques, and improved production, processing, trade and marketing of important NWFPs in India.
- To provide support to activities and initiatives that aim to enhance the organizational and entrepreneurial capacity of local people using NWFPs, incorporating social and cultural values and traditional knowledge information and communication systems and practices.

CONCLUSION

Discussion in the previous sections has identified various ecological, environmental, technical and socioeconomical aspects, which need to be addressed comprehensively by developing organizations and research and training institutes. Moreover, there must be a clear-cut delineation of the duties and responsibilities of all the stakeholders to ensure an effective implementation of the NWFP management. Role definition is thus very important and must be addressed seriously. Further, collaboration may be required in different stakeholders due to overlapping nature of NWFP management, harvesting, value addition and marketing aspects (Table 3).



Figure 1. Components of sustainability of NWFP for poverty alleviation.

 Table 3. Role identification of the Forest departments, local communities and research and development organizations leading to NWFP sustainable management and poverty alleviation

Stakeholders activity	Forest departments	Local communities	R & D institutes
Protection and augmentation of resource	-	-	_
Resource quantification	-	-	-
Determination of harvest limits	-	-	-
Harvesting of resource	-	-	
Grading and processing		-	-
Product development		-	-
Marketing	-	-	-
Capacity building	-	-	-
Legal issues	-		-

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10 Non-wood forest produce (NWFP) for poverty reduction

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ABSTRACT

Besides timber, India's forests are a great repository of many non-wood forest produce, which can be harvested on a non-destructive basis. Medicinal plants are among the most important NWFP in India. According to World Health Organization (WHO), 80 percent of the people in developing countries rely on traditional natural medicines and 85 percent of the traditional medicines involve the use of plant extracts. In India, millions of people residing in and around forests rely on NWFP for their subsistence and more than half of the employment generated in the forestry sector is related to NWFP. Medicinal and aromatic plants provide critical livelihood support as well as affordable and culturally relevant sources of health care for a large number of South Asia's poor. The dependence of tribal and marginalized population to eke out their livelihoods based on the income drawn from these and other related plants is more pronounced in the uplands of South Asia than other parts of the region. At present, 90 percent of medicinal plants are collected from the wild, generating about 40 million man-days employment. Under the Vanaspati Van Scheme of the Department of Family Welfare, 275 000 ha would be allocated for medicinal plants conservation and generating 50 million man-days by involving NGOs, federations, societies, cooperatives and individuals. The National Medicinal Plants Board is actively involved in poverty alleviation by way of involving rural people in the cultivation of medicinal plants. Quite a large number of projects have been funded through contractual farming system by the board with the involvement of all types of stakeholders associated with the sector. Cultivation of medicinal plants may become an economic activity, which would eventually bring prosperity to the growers.

NWFP FOR POVERTY REDUCTION

Geography of India with climatic conditions varying from tropical to alpine has resulted in an enormously rich biodiversity. It is amongst the 12 mega-biodiversity countries of the world. Of the total land area of 328 million ha, about 22 percent (74.74 million ha) comprises the notified forest area in India. This is only 1 percent of the productive forest area of the world, it supports 15 percent of the world's human population and massive livestock population. On the world map of forest resources, India is classified as a forest deficit zone. Out of 74.74 million ha, 25 million ha contains only sparse growth and 14.74 million ha is unproductive. Thus, only 35 million ha of forest is well wooded.

Besides timber species forests are also a repository of many non-wood forest produce (NWFP). By definition, NWFP is the forest produce other than timber, which can be harvested on a non-destructive basis. It includes all goods of biological origin other than wood in all its forms, as well as services derived from forests. They include a number of goods such as fodder, fibres, flosses, food and food additives, fertilizer (bio-mass), medicinal plants and herbal potions, phyto-chemicals and aromatic chemicals, fatty oils, latex, gums, resins and other exudates and different kinds of animal products (honey, wax, lacquer, silk, etc.).

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Medicinal plants are among the most important NWFP in India. According to WHO, 80 percent of the people in developing countries rely on traditional natural medicines and 85 percent of the traditional medicines involve the use of plant extracts. Medicinal plants grow in about 80 percent of forest in India. Around 70 percent of India's medicinal plants are found in tropical areas among the dry and moist deciduous vegetation, *viz*. Western and Eastern Ghats, Aravali and sub-tropical regions of Himalayas. Although less than 30 percent of the medicinal plants are found in the evergreen and temperate habitats, they include species of high medicinal value.

In India, millions of people residing in and around forests rely on NWFP for their subsistence and more than half of the employment generated in the forestry sector is related to NWFP. Medicinal and aromatic plants provide critical livelihood support as well as affordable and culturally relevant sources of health care for a large number of South Asia's poor. The dependence of tribal and marginalised population to eke out their livelihoods based on the income drawn from these and other related plants is more pronounced in the uplands of South Asia than other parts in the region. The increasing interest in medicinal, aromatic natural dye and other NWFP plants especially their growing commercialization, has raised important socio-economic and ethical issues. These have also highlighted vital gaps in the knowledge about the sustainability of the trade based on these plant resources, the impact of exploitative trading on local economy, and the deteriorating status of the natural habitats. At present, 90 percent of medicinal plants are collected from the wild, generating about 40 million man-days of employment (part and full). Under the Vanaspati Van Scheme of the Department of Family Welfare, 275 000 ha would be allocated for conservation and cultivation of medicinal plants and this would generate 50 million man-days of employment by involving NGOs, federations, societies, cooperatives and individuals.

International market of medicinal plants is over US\$60 billion per year, which is growing at the rate of 7 percent. India at present exports herbal material and medicines to the tune of Rs.4.463 billion only, which can be raised to Rs.30 billion by 2005. China and India are the two largest producers of medicinal plants, having more than 40 percent of global biodiversity.

The National Medicinal Plants Board is actively involved in poverty alleviation by way of involving rural people in the cultivation of medicinal plants in the country. During recent past, quite a large number of projects have been funded through contractual farming system by the Board with the involvement of all types of stakeholders associated with the sector. During the last two years the Board has sanctioned 324 projects on different aspects (Table 1) worth Rs.230 million and generating 3 million man-days of employment during the project period.

	Number of		Number of
	projects		projects
Ex-situ conservation	43	Contractual farming	79
In-situ conservation	16		
R&D	36	Promotional (GOs)	67
Extension	24		
Demonstration plots/Herbal gardens	17	Promotional (NGOs)	34
Marketing	8		
Total for 2001-2002	144	Total for 2002-2003	180

Table 1. Total projects sanctioned by the National Medicinal Plants Board, 2001-2003

Cultivation of medicinal plants may become an economic activity, which would eventually bring prosperity to the growers.

Value addition of NWFPs

P.L. Soni* and V.K. Varshney*

ABSTRACT

Managing forests sustainably in order to improve rural economy, NWFPs hold prospects. An important concept in exploitation of NWFPs is adding value locally. Value addition of NWFPs has attracted attention because gathering and processing activities can be managed by the rural people, with a greater portion of the end product revenue accruing to those who manage the forest resources. Local processing includes grading, purifying, storing in congenial conditions to reduce post-harvest losses, and improving thereby the product quality to fetch higher price. NWFPs in India are derived from over 3000 species. These include medicinal plants, edible plants, starches, gums and mucilage, oils and fats, resins and oleo-resins, essential oils, spices, tannins, insecticides, natural dyes, bamboo and canes, fibers and flosses, grasses, bidi leaves, etc., which have been traditionally used for livelihood, and social and cultural purposes. However, processing of NWFPs into valueadded products through simple technologies is limited. Research needs for improving the situation include prospecting, screening, evaluation and classifying NWFPs' yielding plant species, and identifying candidate species, and adequate technology for development of value added products.

INTRODUCTION

Realization of the great dependence of the poor on forests is quite recent. Bringing poverty focus into forest management implies more deliberate efforts to link sustainable livelihood for poverty reduction with sustainable forestry. However, increased population pressure, continuing loss and degradation of forest resource, increased market demand or newly found needs make the situation difficult. Non-wood forest products (NWFPs) are goods of biological origin other than wood derived from forests. NWFPs are a group of under-exploited but potentially promising resource for sustainable livelihood of poor people in rural areas. An important concept in understanding these prospects is sustainable exploitation of NWFPs and adding value locally.

In India, most rural people use some forest products and many obtain part of their income from forestbased activities. For instance, collection of tendu leaves provides part-time employment to about 7.5 million people. A further 3 million people are employed in bidi processing; and another 3 million people are involved in lac (resin) production. About 0.75 million earn income from sericulture; about 0.55 million people are employed in bamboo-based craft enterprises and about 0.13 million households are involved in tassar silk cultivation (Jha and Jha 1985, Arnold 1995). At the local level, NWFPs also provide raw materials for large scale industrial processing, including processing of internationally traded commodities such as foods and beverages, confectionery, flavourings, perfumes, medicines, paints and polishes, etc. At present at least 150 NWFPs (e.g. honey, gum arabic, rattan, edible bamboo, cork, forest nuts and mushrooms, essential oils, and plant and animal parts for pharmaceutical products, etc.) are significant in international trade.

Many people living in and near forests are unaware of the potential of the resources for income generation because they lack access to information on processing possibilities. Processing of NWFPs adds value to them. Value addition of NWFPs has attracted international attention because gathering and processing activities

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can be managed by the rural people, with a great portion of the end product revenue accruing to those who manage the forest resources. Market oriented production often goes through several levels of processing. The higher the level of processing carried out near the source, more of the product value can be retained locally. This offers the prospect for improving local employment, income and livelihood. At the national level this can also support production of consumer goods from NWFPs (e.g. perfumes, cosmetics, fiber extraction, ropes, handicrafts, etc.) and help increase foreign exchange earnings (FAO 1995). Included amongst the value added processing activities are to reduce post-harvest losses through grading, purifying, storing in congenial environment, to reduce the weight and volume of raw products, to increase their standardization and guarantee consistent quality and acceptability in multiple markets (Clay 1995). NWFP- based industries are generally less polluting, less destructive of environment and amenable for vertical and horizontal integration (FAO 1995).

Several reports and studies provided indication of the current and potential importance of NWFPs in the Asia Pacific region. The region is reported to be the richest in terms of product diversity and the volume and value of trade of NWFPs and every country of the region has a long list of species, either used locally or traded in the local or international markets (Nair 1995). China and India are by far the world's largest producers and consumers of NWFPs. China dominates the world trade in NWFPs followed closely by India.

NWFPs of India

India is one of the 12 mega-biodiversity centres and harbours about 50 000 plant species accounting for 7 percent of the world's flora (Dayal *et al.* 1999). Out of these, about 3000 species yield economically exploitable NWFPs (FAO 2002). These include medicinal plants, edible plants, starches, gums and mucilages, oils and fats, resins and oleo-resins, essential oils, spices, drugs, tannins, insecticides, natural dyes, bamboos and canes, fibres and flosses, grasses, bidi leaves, animal products and edible products. According to the Centre of Minor Forest Products, Dehradun, 325 species producing NWFPs are very common and have a base in major industry, 879 species are used locally, 677 species are potentially useful only locally, and 1343 species can be described as 'other lesser known' (FAO 2002). Most of India's 50 million tribal people receive a substantial proportion of their cash and in-kind income from NWFPs, while about 200 to 300 million village people depend upon products from forests in varying degrees (Shiva 1995).

The estimated total value of the most economically important NWFPs in world trade is about \$ 11 billion annually (Wilkinson amd Elevitoh 2003). At the national level over 50 percent of forest revenue and about 70 percent of forest export revenue comes from NWFPs, mostly unprocessed and raw (Prasad 1999). Small-scale forest-based enterprises, many of which rely on NWFPs, provide up to 50 percent of the income for about 25 percent of India's rural labour force (Tewari and Campbell 1995). The forestry sector provides about 2.3 million man-years of employment. Of this about 1.6 million man-years are related to NWFPs. It is estimated that NWFPs are capable of generating 4 million man-years of employment annually, if their full potential is exploited. Most of the NWFPs are collected in a particular season although they are utilized all year round and as much as 50 percent spoil during storage (FAO 2002). Most NWFPs currently provide employment during only part of the year because processing of these NWFPs is still poorly developed. Since these products occupy an integral place in the international market, ample opportunities exist for enhancing export earnings by developing suitable facilities for processing, drying, storage, packaging and marketing. Improved labour intensive technologies for processing NWFPs would increase the employment opportunities for longer periods of the year and ensure high prices for the product(s).

Major constraints in processing of NWFPs

Harvested products reach the market, local or foreign, after primary processing in the form of cleaning and grading. The potential of many NWFPs is not being utilized fully because of insufficient knowledge and experience on appropriate processing techniques and lack of product development. In addition, extracting, processing, production and marketing of most NWFPs are carried out in traditional ways using worn-out equipment or obsolete methods. Development of processing technologies has stagnated at the level of preliminary processing. Most processing of NWFPs for local use is carried out in units which are small, dispersed, financially weak, primitive in technology and poorly managed. They lack infrastructure and employ unskilled persons, often working on part time basis. These constraints restrict immense potential for value addition, especially in the case of pharmaceuticals and cosmetics (Nair 1995). This has also put negative impact on producers/ collectors of NWFPs.

Value added transformation of NWFPs is labour intensive and stresses on quality and reliability of supply. But lack of technology, skilled manpower, management expertise, capital for investment and marketing skills, coupled with inadequate information on resource and resource development, limit sophisticated or refined downstream processing and often export is confined to primary products. The products of comparatively larger

establishments carrying out primary processing for export, undergo further processing/refinement in developed countries. These impact adversely on enterprise survival rates (FAO 1995). Significant value addition is done in importing countries, the benefits of which seldom trickle down to the raw material suppliers.

The NWFP scene is still trader dominated where the emphasis is on generating income through trading. Impact of research on resource conservation, management and development of new products has been negligible and research tends to be preoccupied with traditional products with uncertain future. The substantial efforts on taxonomy and chemical characterization are not effectively followed up to develop marketable products. Enhanced awareness on the long term potential is yet to be translated to action and the efforts to take advantage of the widening product market are far from adequate (Nair 1995).

Research efforts are far from adequate and spread too thinly in several aspects, contributing to their ineffectiveness. Impressive achievements with respect to production and processing have occurred mainly for plantation crops cultivated on a large scale. Technological improvements with respect to production and processing especially with regard to a large number of products in the subsistence sector have been negligible. Research is focused on traditional areas and products, with very little efforts to develop new products and uses. Another weakness identified is the lack of linkages between different institutions. Interaction between universities, R&D institutions and industries is poor, resulting in a substantial proportion of the research remaining unused or no research being undertaken on priority concerns of the processing sector (Nair 1995).

To improve the situation, there is an urgent need for a well defined approach to research. One of the specific areas is: prospecting, screening, evaluation and classifying NWFP plant species and identifying candidate species, and adequate technology for development of value added products. New technologies will substantially alter the scope for utilization of NWFPs' new products and usage will emerge while traditional uses will fade out.

STARCHES FROM FOREST TUBERS AND SEEDS

Starch, after cellulose, is the principal carbohydrate photosynthesized by plant. The most important sources of starch are cereal grains (40–90 percent), pulses (30–70 percent) and tubers (65–85 percent). Total world production of starch is estimated to be 18 million tons (Guilbot and Mercier 1985), extracted mainly from maize (10 million) and potatoes (2.5–3 million), and the rest is derived from wheat, rice, manihot, sorgham and sago. About 50 percent of the starch produced in the world is intended for food purposes. Other than as a food stuff, starch can also be used as a coating, sizing and flocculating agents, chemicals and building materials (Guilbot and Mercier 1985). Starch or its derivatives also find industrial applications as an auxiliary material to provide special functions such as binder, thickener, protective colloid, etc.; raw material for production of new products, fillers for polymers to improve their total properties; components of synthetic polymers for synergistic effects; active material for production of pharmaceutical and agro-chemicals. Through simple process technolgies, native starch can be modified into useful products as it is dispersible in cold water and exhibits a higher reactivity than cellulose. In addition, starch is very susceptible to partial or total hydrolytic degradation by acids or enzymes to yield oligomeric or monomeric products which can be further modified.

Realizing the potential of hitherto untapped potential of forest tubers and seeds as alternatives for production of -commercial starch and its value added transformation into products, investigations were made in which a number of tubers seeds such as Pueraria tuberosa, Dioscorea ballophylla, Amorphophallus campanulatus, Stephania glabra, Pueraria thomsonii, Canna edulis and seeds of Shorea robusta, Cassimiroa edulis, Careya arborea and Aesculus assamica were screened for their starch contents and evaluated for their physico-chemical properties and compared with those of commerical starches i.e. maize and tapioca starches (Soni and Agarwal 1983, Soni et al. 1985, and others). These studies have shown that starches isolated from forest tubers and seeds have comparable properties with commercial starches. Five starches from tubers of Pueraria tuberosa, Dioscorea ballophylla, Amorphophallus campanulatus, Canna edulis and seeds of Careya arborea have higher water binding capacity then maize and tapioca. Unique feature of the forest origin starches is that their gelation temperature are higher than the maize and tapioca starches. Amylograph studies of most of the starches have shown high peak viscosity and less retrogradation than the maize and tapioca starches. Starch isolated from defatted sal seeds has more N, P, lipids, amylose and water binding capacity than those of other starches studied. Despite its low and seemingly restricted swelling, the sal starch is much more soluble at any particular degree of swelling. Paste viscosity curve showed that it was stable on continued cooking. These unique physico chemical properties of sal starch has generated interest in the starch industry.

Above studies have led to identify following candidate species for their exploitation as alternative source of commercial starches: *Canna edulis*, *Pueraria tuberosa*, *Amorphophallus campanulatus*, *Careya arborea*, *Cassimiroa edulis* and defatted sal seeds. *Canna edulis* is known to have been used for making noodles in China and Viet Nam.

Starch is an abundantly available source for making dextrin. Dextrin as understood commercially are the degradation products obtained by treating starch in a variety of ways. Dextrin is being marketed in several forms such as powders, granulated particles, thick viscous liquids and white paste. Dextrin exhibits greater solubility and a wide range of solution viscosities. Dextrin finds important application in industries like adhesives, cosmetics, electro plating, textile, paper, food and pharmaceuticals, etc. (Bhatt *et al.* 2000). However, the process used for the transformation is complex involving the use of catalyst or enzyme, time consuming and expensive. A simple process has been developed for conversion of starch into dextrin which completes in a short period of two hours without the use of catalyst/enzyme. Rheological and adhesive properties, and tackiness of dextrin so produced was found better than those of the commercial samples.

SEED GUMS

Galactomannan gum industry is a fast developing industry because of many uses of these gums in food, paper, textile, petroleum, pharmaceuticals, cosmetics, paints, detergents, agriculture and a large number of related industries (Rani *et al.* 2000). In the past two decades, this biopolymer has provided solution to a large number of industrial problems. Industrial applications of these gums are due to their wide range of solubility and solution viscosities which depend upon their structures, molecular weight, and mannose-galactose ratio.

Source of these gums are in the endosperm of plant seeds of the family Leguminosae. The leguminous crops owing to their capacity to utilize the atmosphere N for their growth generally do not require expensive nitrogenous fertilizers and increase the soil fertility and can be cultivated on marginal land. A great diversity of legumes is found in India, enough potential to cope with the increasing demand of seed gums in national and international markets. Development of seed gums thus would boost the galactomannan gum industry in the country which in turn would not only generate livelihood opportunity to reduce the poverty but also would improve the productivity of soil without costly fertilizers. Development of simple processing methods for value addition of these gums is also seen as a practical proposition for generation of additional employment opportunities for the rural people.

During the past several years, studies on galactomannan gums have been carried out at the Forest Research Institute, Dehradun. Studies have isolated gums from seeds of *Leucaena leucocephala* (Subabul) in 30 percent yield and *Cassia tora* in 32 percent yield through simple and cost effective processes (Soni *et al.* 1984, *and others*). The gum derived from Leucaena was also found to be suitable as a wet-end additive in paper making (Soni *et al.* 1984) and as a thickener in textile printing using reactive dyes (Teli *et al.* 1996).

Physico-chemical studies of *Cassia tora* gum has revealed its viability in industrial applications. The gum acted as a flocculant when used for mud settling in sulphited sugar cane juice and in treatment of water of paper mill (Soni *et al.* 2001). In textiles printing, the thickening properties of the gum was found to be comparable with that of sodium alginate (SA), the commercial thickener used in textile printing. However, blending of the SA with the gum in 1 : 1 ratio was found to be a suitable alternative (Soni and Teli 1999). It has also been found effective to achieve optimum strength properties of mill pulp consisting mainly of bleached eucalyptus pulp supplemented with bamboo (12 percent) and pine (2 percent) pulps and bleached bagasse pulp mixed with 20 percent softwood pulp (Soni and Pal 1996).

Through chemical derivatization, *Cassia tora* gum has also been transformed into value-added products such as carboxymethylated, cyanoethylated, carbamoylethylated quarternized and grafted *Cassia tora* gum for their utilization in various industries (Sharma *et al.* 2002, and others). Similarily guar gum (*Cyamopsis tetragonoloba*) the commercial gum, was also modified into derivatives (e.g. carbamoyethylated and grafted guar gum) of industrial importance (Sharma *et al.* 2003d). These modified products of *Cassia tora* and guar gum have good potential as effective and ecofriendly substitutes of synthetic flocculants which are expensive and cause environmental and health hazards in their production and use. Flocculation is a process whereby finely divided or dispersed particles are aggregated together to form large particles of such a size so as to cause their settling or agglomeration of tiny particles to form flocs which settle and cause clarification. Materials which are used in fast solid-liquid separation are called flocculants. Flocculants have wide spread applications to treat chemical effluents in various chemical industries. Modified *Cassia tora* gum was also used as beater additive in paper making. It was found to be effective in improving the dry strength properties of paper (Soni *et al.* 2000).

Extensive work to find out new sources of seed gums has been carried out at NBRI, Lucknow (Kapoor 1999). It includes the chemical investigation of about 200 species belonging to different genera of Leguminosae. It is found that almost all the species of *Cassia, Crotolaria, Sesbania* and *Indigofera* occurring in India are rich in gum content whereas few species of *Bauhinia, Caesalpinia* and *Desmodium* contain appreciable amount of gum. Genera like *Acacia, Canavalia, Erythrina, Tephrosia, Pterocarpus*, etc. are poor in gum. It has been demonstrated (Kapoor 1999) that the seeds of *Cassia angustifolia* could open new avenue for the production

of seed gum. The seeds are bigger in size and contain about 50 percent of endosperm. The gum is characterized by having high range of mannose with useful viscosity properties. The studies have also shown that the seeds of *C. alata, C. grandis, C. siamea, C. nodosa, C. didymobotrya, C. occidentals* have great potentialities to become the new source of gums. Similarly various species of *Crotolaria, Caesalpinia, Mimosa, Gleditsia, Priotropis* and *Sesbania* could also be exploited for the commercial production of seed gums. However, for commercial viability factors like habitat, availability, cost of collection, seed size and endosperm content are required to be considered.

GUM EXUDATES

Exudate gums, also known as natural gums, are the secretions from trees and bushes. Today several of these natural gums are still common articles of commerce. Important gums such as gum karaya (*Stercuilla urens*), and gum ghatti (*Anogeisus latifolia*) have got immense use as food additive. These exudates when secreted by the plant are viscous, gummy liquids but when exposed to air and allowed to dry, form hard, glassy masses. The physical appearance and properties of natural gums are of utmost importance in determining their commercial value and their end uses. These vary considerably with botanical sources, climate, soil, age, absorbed impurities, treatment after collection and storage. India produces 20 000 tonnes of exudate gums in which gum karaya alone contributes about 15 000 tonnes. India earns around Rs. 1200 million by the export of gums (Soni and Bhatt 1999). However, the trade suffers a draw back of adulteration of the gums which make them unfavourable for their incorporation into formulation of products.

Gum ghatti is the exudate of *Anogeisus latifolia* but it is always mixed, sometimes to the extent of 40 percent, with the gums from other sources such as *Albizia*, *Azadirachta*, etc. This admixing restricts its acceptability in food applications. A simple process was developed to purify the gum ghatti and shaped to noodle form.

Mesquite gum obtained from *Prosopis juliflora* contains high content of tannin compounds which inhibits its application as a commercial food additive. A simple process to purify the gum and remove tannin compounds has been developed. The purified gum in tablet formulation by direct compression and wet granulation method was evaluated and compared with commercially used *Acacia* and *Tragacanth* gums. Results of binding and suspending properties of mesquite gum showed its suitability to be used in pharmaceutical formulation like other natural gums (Khanna *et al.* 1997).

ESSENTIAL OILS

Essential oils are highly volatile aromatic oily substances that can be found in many plant parts. Such oils are called essential because they are thought to represent the very essence of odour and flavour. These oils are stored as microdroplets in specific cells, glands or ducts, either in one particular organ of the plant or distributed over many parts, e.g. leaves, barks, roots, flowers or fruits. They are used in many industries for adhesives (e.g. cements, pastes and glues and tapes), pharmaceuticals (e.g. medical and veterinary preparations), cosmetics and toiletries (e.g. perfumes and sprays, creams, deodorants, colognes, shaving preparations, powders, soaps and detergents), paints (e.g. distempers, diluants, paint removers, air fresheners and cleaning fluids), paper and printing (e.g. carbon paper, crayons, ink, labels, wrappers, writing papers and ribbons), insecticides (e.g. sprays, repellants, attractants and disinfectants), foods and beverages (e.g. liquors, convenience foods, flavouring agents, preservatives and sauces), petroleum (e.g. cream deodorant, solvents and lubricating oils/waxes), textiles printing (e.g. deodorants, upholstery materials, finishing materials), rubber and plastics (surgical gloves, rubber toys, water proofing compounds, general plastics), motors (e.g. polishes, cleaners, seat upholstery and other plastic goods) and dental preparation (e.g. tooth pastes, mouth washes, antiseptics and cements) (De Silva and Atal 1995). The important essential oils produced in India come from sandalwood, lemongrass, palmarosa, *Eucalyptus* spp. and khus.

Apart from the above described applications of the essential oils in various industries they are widely used in aromatherapy. Aromatherapy can help in easing a wide assortment of ailments, aches, pains, and injuries while relieving the discomforts of many health problems. It also helps in restoring both physical and emotional well being by relieving depression and anxiety, reducing stress, relaxing, uplift spirit, sedation or stimulating. It is the active chemical composition and aroma of the essential oils which provide therapeutic benefits. Oils such as eucalyptus, sandalwood, lemon, bergamot, etc. have powerful antibacterial and anti viral properties, which unlike other pharmaceutical drugs do not leave behind dangerous toxins. There are many ways to use essential oils for their therapeutic and balancing properties. These include inhalation, bath, massage or breathing. About 55 essential oils are known for their therapeutic effects (Varshney *et al.* 2001). Some of the good examples of the essential oils having therapeutic properties and obtained from forest species are sandalwood (from *Santalum album*), cedar wood (from *Cedrus* spp., *Juniperus* spp.), eucalyptus (from *Eucalyptus globulus*), pine (from *Pinus sylvestris*), citronella and palmrosa (from *Cymbopogon* spp.) etc.

Steam distillation is the most common method for isolation of essential oils. This involves generating steam and passing it through the plant material to carry off the volatile constituents. Though the process sounds simple in theory, the actual commercial process for greatest efficiency and quality varies widely, depending upon the characteristics of the raw material and the final product (De Silva and Atal 1995). Other processes such as enfleurage (e.g. oils from flower of jasmine and rose), solvent extraction (e.g. oleoresins from species such as ginger, pepper, cardamom, etc.), cold expression (e.g. citrus oil), etc. are also used.

The world trade in essential oils and their value-added products is vast. World production of essential oils (excluding turpentile oil) is estimated to be about 105 000 tonnes to the tune of US\$ 922 million. India stands at third position with a share of about 16 percent. Indian production of the essential oils is estimated to be 17 000 tonnes valued about US\$ 195 million (S.C. Varshney, Personal Communication, 2001).

Primary processing of the essential oil in form of post-harvest operation, e.g. drying and storage of the plant material, and down stream processing (e.g. rectification) add value to the oils. The requirement for post-harvest operations are beyond the means of most rural enterprises. However, such processing centres may be operated near the source by the government or cooperative societies to feed national industries improving thereby the local employment and income.

Rectification of the essential oils can produce pure isolates of added value. Depending on their end uses this may consist of one or more of the following:

- · removal of moisture, colour and sediments
- removal of undesirable compounds in order to improve the odour characteristics, stability and sustainability
- isolation of highly valued compounds
- enrich the oils by removing or adding other fractions

Rectification of the oils is done by fractionation. As suggested by De Silva and Atal (1995) it could be carried out in some developed rural areas having small scale processing with backup from national research institution to carry out the analysis and develop the fractionation parameters. This needs more training and equipment and may not be possible in certain rural communities or for forest dwellers. Alternatively fractionation of the oils could be carried out at a central facility which can afford to invest the funds and personnel required for this activity. These pure isolates could further be processed to produce high value aromatic chemicals which have an export market. These aromatic chemicals can be used in blending of perfumes and flavours for local industries.

Essential oils produced in India could be divided into the following categories (S.C Varshney, Personal Communication, 2001):

- Essential oils for fragrances (exotic): 40-45 tonnes
- Essential oils for flavours (exotic): 1200-1400 tonnes
- Essential oil for processing: 16000 tonnes.

It is evident that most of these oils are meant for processing and therefore, there exist innumerable possibilities for their value addition. This includes isolation of valuable constituent in high purity and their transformation into useful derivatives. For example, processing of eucalyptus oil obtained from *Eucalyptus globulol* could isolate valuable constituents (e.g. globulol, eudesmol, viridiflorol and farnesol) constituting 5–6 percent of the oil. The residual oil left after separation of these constituents can be sold at lower prices. Isolates of various essential oils such as citral, citronellal, caryophyllene, geraniol, cis-3-hexanol, himachalene, pulegone/ isopulegone, isomenthol, l-limonene, linalool, methones, neomenthol, 3-octanol, α and β -pinenes, terpinolenes, etc. are available with processing units. Many value-added products can be obtained by further processing these isolates.

Besides above, R&D efforts should also be directed to explore new oils having greatest economic potential as flavours, fragrances and therapeutic agents. Efforts should also be extended to locate such oils, which contain valuable minor constituents, e.g. germacrene-D, β -damascenone, β -and γ - endesmol, isoeugenol, lavandulol, cis-rose oxide, etc.

Vitex negundo is of medicinal/pesticidal value. The leaf oil of this species is found to contain 66 compounds. The main compounds were viridiflorol (19.55 percent), β -caryoplyllene (16.59 percent), sabinene (12.07 percent) and α -terpineol (9.65 percent) (Singh *et al.* 1999). The oil also showed 100 percent mortality against the stored grain pest, *Sitotroga cereallela*, infesting wheat, seeds and thus has potential to be developed into a pesticide (Singh *et al.* 2002). The oil isolated from flowering twigs shows the presence of 94 compounds of which 28 compounds were identified with viridiflorol as chief constituent (Singh *et al.* 2000). Both these oils could be a good source of viridiflorol, which has biological acitivity as antiacetylcholinesterase agent, IC 50 = 25µg/ml (Duke 1995).

Needles of *Cephalotaxus harringtonia* var. harringtonia is of medicinal value. Investigations were made to isolate essential oils from the needles and flowering twigs produced oil with 31 compounds. 17 compounds were identified with β -caryophyllene (27.9 percent, 31.3 percent); α -humulene (11.4 percent, 10.6 percent), germacrene-D (9.5 percent, 13.0 percent), γ -cadinene (8.9 percent, 5.5 percent) and β -elenene (8.3 percent, 10.9 percent) as major constituents. (Mehndiratta *et al.* 2003).

Essential oils from different parts of *Shorea robusta* were isolated and characterized (Kaur *et al.* 2001 and others). The oils obtained from leaves, heartwood and resin showed the presence of 20, 24 and 37 compounds of which 8, 9, 17 and 9 compounds, respectively were identified. α and β -caryophyllens (4.55 percent and 28.27 percent, respectively) were the main constituents in the leaf oil while germacrene-D was the chief constituent in resin oil (29.57 percent) and heartwood oil (31.79 percent). Presence of caryophyllenes in leaf oil suggests its possible use as anti carcinogenic as the caryophyllens are reported to be potential anti carcinogenic agents. Heatwood oil can be a good source of germacrene-D as it is a valuable sesquiterpene needed by many perfumers.

Agar oil, obtained by the steam distillation of agar wood, is highly priced in perfumery. Distillation of this oil is very slow, and the odoriferous constituents distill over only towards the end of the distillation. An inexpensive modification was suggested which employs hydrodistillation of the chips in which a solution of common salt is used in the place of water. Water from the distillate is returned to the still in the beginning of the distillation and at the end of distillation. Clear separation of the oil could be achieved by saturating the distillate with common salt. The oil obtained was comparable to that obtained by the indigenous method and the yield (0.54 percent) was higher by about 20 percent.

Bulk of the camphor produced in India is synthetic camphor produced from α -pinene. Investigations have revealed that leaves of *Ocimum kilimandscharicum* on distillation yield an essential oil (2.5–5.8 percent) which contains more than 50 percent camphor. A cheap method of isolation and purification of camphor from this oil was developed. Production of camphor from *Ocimum kilimandscharicum* can easily be adapted as cottage industry because of the inexpensive nature of process, and the plant can be cultivated easily using techniques developed by FRI.

Perfumery compounds have also been prepared from pine needles which are plenty in the pine forests. On an average, one ha of well stocked chir pine forest sheds about 10 tonnes of pine needles per annum. Pine needles, by chlorofom extraction, gave 1.08 percent wax which on hydrolysis gave a mixture of hydroxy acids in 62 percent yield. The acid mixture was converted to a mixture of macrocyclic lactones with long lasting musk odour in 61 percent yield (Dayal *et al.* 1989).

LEAF PROTEIN CONCENTRATES (LPC)

Short supply of good quality protein to meet the requirement of increasing animal and human population has necessitated the search for additional sources. The unconventional sources of protein which include oilseed meals, fish protein concentrate, single cell protein and perhaps algal and leaf protein have tremendous scope for developing of low cost protein foods. Out of all the unconventional sources of protein, leaf protein appears to have better exploitation in the light of excessive photosynthesis and availability of abundant lush green vegetation (Srivastava and Mohan 1989).

Leaf proteins have been found to have greater nutritive value than most of the pulses, resembling skimmed milk in the diet of infants recovering from Kwashiorkor. Leaf protein has been advocated as a potential source for human consumption (Oelschlegel *et al.* 1969). Trees have also been suggested as a possible source of leaf protein food (Mohan and Srivastava 1981) in addition to already identified weeds, cultivated crops and wild plants. Moreover production of leaf proteins from trees have unique scope as they do not involve recurring cost of cultivation.

Realizing the importance of the leaf protein concentrate (LPC) in poultry and human nutrition, and potential of trees for production of LPC, a number of tree species such as *Morus alba*, *Cassia fistula*, *Sesbania grandiflora*, *Gliricidia maculata*, *Moringa oleifera* and *Leucaena leucocephala* have been studied for leaf protein extractability and chemical composition of recovered LPC to judge their suitability for the bulk production of LPC (Mohan and Srivastava 1981). *Cassia, Sesbania, Gliricidia* and *Morus* showed fairly good extracability of protein N (45.1, 45.9, 37.4 and 33.8 percent, respectively). They also yielded crude products having good nitrogen content of 6.58, 6.86, 7.00 and 6.44, respectively. *Sesbania* leaves showed the highest LPC recovery of 9.44 g/100 g of fresh pulp while *Gliricidia* LPC showed highest percentages of protein and ether extracts of 43.8 and 15.1, respectively and lowest ash of 3.60 percent.

Studies carried out by Srivastava and Mohan (1989) have demonstrated that LPC from mulberry leaves could be utilized as human food or as nutritious feed for silkworm, poultry and cattle. The importance of leaf protein fractionation which results in chloroplastic and cytoplasmic fraction has been emphasized in poultry

and human nutrition (Mohan and Srivasatava 1984). Variability in composition and nutritive value of these fractions from various plant species has been reported (Betschart and Kinsella 1974). The biochemical composition and nutritive value of the leaf protein fraction from *Morus alba*, *Gliricidia maculata* and *Sesbania grandiflora* have been reported by Mohan and Srivasatava (1981). Cytoplasmic leaf protein fraction from *Sesbania grandiflora* were found to be suitable for human consumption while the choloroplastic fraction for use in poultry feed.

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12 Participatory agroforestry for poverty alleviation in Coimbatore District, India

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ABSTRACT

Population pressure and inadequacy in rural income generation have resulted in increased degradation of forests in many countries. Land, which provides incomes, for both the landowners as well as the landless, can be sustainably managed to prevent rural poor from over-exploiting the forests. The basic issue is to optimize land use and maximize the turnover of investment. This requires comprehensive research and management inputs. Working towards this approach the Institute of Forest Genetics and Tree Breeding (under ICFRE) and Shanti Ashram, a non-governmental organization, implemented a project with the assistance of United Nations Development Programme (UNDP). The objectives were to capacitate the institutions in the study area, develop village and land-use plans and guide in agroforestry development and further catalyse other income generation activities. The project was implemented in a block of 26 villages with the goal of achieving poverty alleviation through creation of self-help groups. The project also trained community-based organizations in participatory rural appraisal and further implemented agroforestry strategies in the farmers' lands. The research institute provided quality planting material, land-use plans and training to several hundred farmers. The non-governmental organization resulted in effective technology implementation by rural self-help groups. The train for the income generating activities. The synergy of research institution and the non-governmental organization resulted in effective technology implementation by rural self-help groups.

INTRODUCTION

The Earth Summit 1992 produced the United Nations Framework Convention on Climate Change (UNFCCC), Convention on Biological Diversity (CBD), the Agenda 21, non-legally binding authoritative statement of principles for global consensus on the management, conservation and sustainable development of all types of forests, as well as decision to embark on efforts to negotiate a convention to combat desertification. Many of these obligations can be put in practice only if interest of the community are incorporated with the overall protection of the environment. Much of the fringe areas of forests are surrounded by villages whose sustainability and livelihood are dependent on the forests. Very often, even the agricultural practices in the area are dependent on the water yield from the forests. Therefore, the vagaries of weather affect the farm yield and the pressure on the forests. Also, the landless and the poor exploit the forests, as they do not have any resource to depend on.

Therefore, the need for involving local people in managing the forests enable them to optimally utilize their farmland. Forest research institutions can provide inputs and facilitate extension services to optimize the objectives of poverty alleviation programmes on sustainable basis. The concept of sustainability, whether it is for forests or farm revolves around the following factors: (a) growth, (b) yield of marketable product, (c) financial yield, (d) profitability, (e) creation of value, (f) working capacity, and (g) infrastructure performance like water supply and protective functions. Only when these criteria are adequately addressed, the people will fulfill the obligations of managing and preserving forests with respect to environment. Keeping this in view, the Institute of Forest Genetics and Tree Breeding (IFGTB) applied the research technologies in a composite

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block around Coimbatore through participatory agroforestry systems addressing the issue of poverty alleviation so that environmental restoration can be stimulated. The work was carried out under the UNDP project by Shanti Ashram, a non-governmental organization and IFGTB. Various developmental activities were carried out in the Perur Block.

PROJECT SITE

Perur Block consists of four town panchayats and 26 villages, with a population of 120 000. The total area is around 10 000 ha of which the nett sown area is 25 percent. According to available statistics, more than 30 percent of the area falls under wasteland. Considering the availability of land for tree cropping and the technical expertise available locally, Shanti Ashram and IFGTB implemented participatory agroforestry for poverty alleviation and environmental restoration with UNDP support.

OBJECTIVES

The main objectives of the project were:

- Enhancement of capacity of the people of Perur Block and surrounding areas to carry out and support agroforestry and tree planting activities.
- Development of comprehensive village-level land-use plans and detailed implementation plans to guide agroforestry development, tree planting and improved land-use in Perur Block.
- Catalyse the agroforestry tree planting and market-oriented value-adding initiatives for farmers, farmwomen and villagers in Perur Block with technical inputs and supporting services.

EXPECTED OUTPUTS

- Establishment of work plans and implementation mechanisms
- Set up farmers' training centre to provide technical support and training
- Train 250 farmers and 250 farm women in agroforestry practices
- Constitute youth and women groups to promote and sustain agroforestry and environmental awareness
- Train and develop participatory rural appraisal and gender teams

ACTIVITIES

The activities designed for the project were:

- Gather gender-based data for land-use plans
- Develop land-use plans involving farmers and farm women
- Gather data on rainfall, temperature, soil characteristics, women workload, fuel, fodder and water availability for land-use plans and suitability maps
- Develop sustainability through market linkages in agroforestry produce
- · Establish village nurseries and procure planting materials
- · Conduct information dissemination workshops/seminars
- · Assist villagers/community-based organizations with financial assistance from the local banks

WORK DONE

- Awareness creation on agroforestry, land-use planning and tree species preferred by the farmers were carried out through participatory rural appraisal technique, implemented in all the 26 villages.
- Enhancing the capacity of the people was achieved through the workshops conducted at Shanti Ashram, IFGTB and at the villages.
- Village land-use plans were prepared by collection of data on soils, rainfall and soil analysis and expert discussions in all the 26 villages with farmers on their existing agricultural and tree crops and other preferences.
- Dissemination of information on agroforestry was done through display of charts at prominent places in the villages, and pamphlets and posters distributed to the villagers.
- Seedlings raised by IFGTB were supplied by Shanti Ashram as per the requirements of the people.
- The farmers were taken to other model farms in neighbouring areas where agroforestry is being practised as exchange visits for on the spot study.
- The farmers were also given hands-on training on vermicompost making, grafting and propagation and raising of seedlings by IFGTB.
- The Ashram also utilized the services of 200 school children from over 10 schools in Perur Block (the Green Brigade). With necessary training in environment and agroforestry, their services were used to promote awareness in tree planting and environmental restoration.

To enable the farmers to establish nurseries to meet the seedling requirements, trainings was offered by IFGTB on nursery care and management and grafting techniques. The trainings was conducted in the institute so that the farmers could see the various stages of nursery management. They were given hands-on training on grafting and supplied with tools required for grafting. To identify site-specific trees, IFGTB collected soil samples in the 26 villages of the block for analysis. Based on the soil analysis, the farmers were given soil health cards indicating the nutritional status of the soils and the trees suited for each area. Apart from this, an expert from the State Department of Agriculture visited the 26 villages and held meetings with the villagers to discuss about the crops cultivated and the trees preferred by the villagers. For this purpose, 35 meetings were arranged in the villages attended by 1186 farmers.

Since the aim of the project was raising trees in wasteland to protect the environment, meetings were organized to create environmental awareness to the villagers. Apart from villagers, students selected from 10 schools in Perur Block, which formed the Green Brigade, were also exposed to agroforestry and tree planting. During the period of the project, 28 such meetings were organized benefiting 2091 villagers and school children. The Green Brigade planted trees specifically in schools and in houses and conducted environmental rallies.

The objective of preparation of village level land-use plans was achieved using Participatory Rural Appraisal technique. To start with, the field staff of Shanti Ashram and selected members of communitybased organizations were given training in PRA. Three such trainings were organized involving 94 participants. These PRA teams visited all the 26 villages in Perur Block and carried out the exercises. In all, 1304 villagers, including women and youth, participated in the PRA exercises. In PRA exercise, the techniques of village mapping, seasonal calendar, matrix scoring, etc. were used to gather details on the land available for planting. The Institute of Forest Genetics and Tree Breeding, utilizing the soil, rainfall, temperature and other information, prepared the detailed land-use map for all the 26 villages.

To catalyse agroforestry with technical and supporting services, the Shanti Ashram with help of IFGTB prepared extension materials like posters, pamphlets, videos and charts and displayed them in prominent places in the villages for wider exposure. The members of the Green Brigade through songs and street plays during the Sarvodaya Fortnight, created awareness on agroforestry in the villages. With the help of the IFGTB, more than 80 000 quality seedlings were distributed to the farmers for planting. For wider exposure of the farmers on agroforestry, six tours were arranged to places of importance on agroforestry in Tamil Nadu, Kerala, Andhra Pradesh and Karntaka, benefited 295 farmers. IFGTB also arranged farmers exchange visits to nearby areas where farmers had already taken up agroforestry. To provide income during the gestation period, training in income generation activities were conducted on mushroom cultivation, bee keeping, fruit juice, jam and pickle making, paper bag making, and areca sheath plate making.

OUTPUTS

- Creation of well-equipped farmers' training centre
- Nine tree growers' associations with more than 250 members
- Well-trained PRA team
- · Several hundred farmers and farm women trained in agroforestry

SUSTAINABILITY AND REPLICABILITY

In any development programme, the most important aspect is the sustainability of the project after withdrawal of implementing agencies. In the present project as regards the sustainability, the major issues expected were, supply of quality seedlings in the villages at a reasonable price, demonstration of agroforestry to willing farmers to take up tree planting and solving the problems of felling, transporting and marketing of the trees. This has been achieved in the project through the establishment of ten village level nurseries in panchayat common lands along with the development of infrastructure facilities like fencing, watering and implementation sheds.

The villagers trained in nursery care and management are expected to take up raising of tree seedlings in these nurseries to meet the local demand. Quality seedlings will be supplied at reasonable prices. To serve as demonstration units, ten model farms were established in Perur Block. These model farms have various combinations of tree crops that can be raised for optimal use of land to have a regular flow of incomes. These farms were established in individual holdings, provided with facilities like fencing and watering. The farmers maintain such model farms to help demonstrate to neighbouring farmers the need for taking up similar activities in their areas. To act as a link between the villagers and the officials, tree growers' associations have been established. These associations help in promoting agroforestry and help the farmers in felling, transporting and marketing of the trees. They will act as a link between the villagers and Department of Forestry and the commercial banks.

The participatory agroforestry project for poverty alleviation and environmental restoration in Perur Block has allowed for the creative partnership between the different stakeholders. It has given Perur a model where governmental and non-governmental agencies can collaborate in newer initiatives of poverty alleviation. The dimension of "technology transfer" has seen the coming together of a premier institute like the Institute of Forest Genetics and Tree Breeding, a network of community-based organizations across Perur with a rich experience of over a decade and Shanti Ashram. This model can provide a template for further replication across the state and indeed the country.

When large numbers of villages are involved, extending services to the scale required is a big challenge for IFGTB. In this approach, it was handled through Shanti Ashram and village – villager interactions. The network of voluntary trainers was created. The data analysis village-wise, farmer-wise, category-wise and land utilization and profitability require more refinement. Appropriate sociological software development is required to determine acceptable strategies, hesitancies (with warning flags) and market knowledge. Continuous value addition is essential to overcome low value trap. Wiring up of villages is important but no proper methodology is available for demand forecasting. This is important to move the people out and away from the forests. More efficient farm management is the key to ensure social fencing of the forests.

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13 Forestry for poverty alleviation – the fourth generation paradigm

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ABSTRACT

The paper distinguishes the radical shifts of forestry in its objectives and concepts as generations. Four generations are recognized. They are Forestry for Conservation, Forestry for Economic Development, Forestry with People and Forestry for People, respectively. The current generation is the fourth one. The results and experiences of the past three generations are briefly narrated. The First Generation 'Forestry for Conservation' led to the consolidation and appropriation of forests to state ownership. The alienation of rural people from forest access began. The Second Generation 'Forestry for Economic Development' emerged at states' interest to generate income from forests. It had experimented with different silvicultural systems. This generation had ended with the loss of forest capital and biodiversity. 'Forestry with People' is the third generation. It had recognized the indispensability of the support of rural people for the restoration of degraded forests. Social Forestry Project was implemented with the objectives of meeting the forest requirements of rural people. It advocated participation and joint venture in forestry. The people whose participation is sought for a joint venture are poverty prone. Now, the concern of foresters extended beyond forests to poverty alleviation of people at the forest interface. 'Forestry for People' is the fourth generation. The characteristics of Indian poverty in general and rural poverty in particular are spelt in order to show the dimension of the problem. The paper calls for radical transformation of socio-economics and integration of forestry in the rural life in order to establish a composite system in theory and practice. The systems approach as suggested therein is recommended as the way to alleviate the problem of rural poverty.

INTRODUCTION

Forestry in India is more than 150 years old. During this long span of practice, forestry experienced radical changes and transformations with the changing socio-economic scenarios. At every changing scenario, forestry had to regenerate itself to suit the new paradigms that emerged along with the change. The planks on which forestry is placed and the focus, with which forestry is concerned mark the distinctions between generations. Forests and villages are the two principal planks, and forests and people are the two principal focuses. Together they recognize four generations (Table 1).

able 1.	Four	generations	in	Indian	forestry	
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Focus on Hierarchy	Forests	People
Forests	Generation I	Generation II
Village	Generation III	Generation IV

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Looking back at the changing situations from the inception of scientific forestry under the British, three generations have been born. To day forestry is at the doorstep of the Fourth Generation. There are three players who constitute the paradigm of forestry; they are the state, forest department and people. The state functions as the stipulator of policies, forest department as provider of technology and the people as recipients of the benefits. In all the generations forests are at stake. Therefore the survival of the forests departs department or players are prepared or qualified to play effectively. The impacts on forests from the past three generations are recalled in order to prepare us for safeguarding the interests of forests in the fourth generation.

GENERATION I

'Consolidation of Forests' was the First Generation Forestry. Borrowed from British it began in the later half of the nineteenth century. It was pursued chiefly to consolidate the existing forests and then to appropriate them into the ownership of state. In the process, forests were protected from the access by rural people. In order to sustain the state ownership of the forests a system was set in motion. Accordingly the forest department was established, and forest policies were enunciated with the enactment of forest statutes. The process was justified stating that the forests were to be conserved for safeguarding the environment. Forestry of the first generation built up its expertise in consolidation and protection of forests from people. Forests referred to in village revenue records were notified and brought under the state ownership through forest acts. Reserved forests were delineated into sections and beats as protection units and placed under the responsibility of exclusive uniformed personnel of the state. Forest laws enacted with punitive provisions dealt with those indulging in anti-forestry activities.

The intention of the First Generation, namely consolidation of forests and appropriation to the ownership of state, was virtually achieved. The extent consolidated as reserved forests in this manner at national level was about 22 percent. People at the forest interface were alienated from forest use for the first time in history.

GENERATION II

'Forests for Economic Development' was the Second Generation Forestry. It emerged at the instance of the states' interest to generate new income for the government and to increase aggregate income of the country through supply of timber, fuelwood and other forms of wood and non-wood forest produce for the development of industry-based and allied business activities. Forest department was geared up for this new generation. Forests which were deemed in the first generation forestry as the protector of environment and hence a resource to be conserved were now treated as resources of material harvest. Forest colleges and research institutions provided the technology for the harvest. The term scientific forestry was introduced. The knowledge on forestry was chiefly on harvest systems in different forest formations. This generation had experimented with different silvicultural systems for the sustenance of material production and development of forest produces.

Eventually two sets of activities emerged, harvest systems and plantation systems. Both systems were of European origin but tested in Indian forests. 'Selection' and 'clear-felling followed by plantation' systems were adopted for harvest of timber and allied wood forms. 'Clear-felling with coppice regeneration' or 'clear-felling followed by plantation' systems were adopted for harvest of fuelwood and small timber. While wet evergreen forests and in certain cases moist deciduous forests were subjected to selection system, dry deciduous, dry thorn and dry evergreen forests were subjected to 'clear-felling with coppice regeneration' system.

Enormous quantities of timber, fuelwood, bamboo and many kinds of non-wood usufructs were harvested from forests. Economic benefits accrued and it helped to increase the State's income and the aggregate income of the economy. Concurrently new markets for these produces came into existence and new kinds of utilization of forest produces were invented. A new genre of forest contractors was born who mattered much in the making of forest policies, forestry technology and produce markets.

The 'clear-felling systems with coppice regeneration' was not suited to the forests where it was tested. Cox (1920) had forewarned the danger of adopting the clear felling system of harvest stating that the system designed for the oak forests of Europe was not suited to Indian conditions. Nevertheless the system was continued for a long period. As a result the forests underwent serious degradation, terms of forest structure, green cover, biodiversity, density and productivity.

The system of 'economic plantations' did not yield the expected economic benefits. It had met with success only partially. Plantations raised with teak and eucalyptus species alone were available for harvest at their rotations and others were not. The primary cause of failure was the lack of organization to manage the newly created plantations. Wherever new organizations in the form of corporations were constituted plantations yielded benefits to the economy. The earlier organization (forest department) that was meant for

First Generation Forestry had least applied to the production forestry of the Second Generation. While economic benefits from forest plantations were not forthcoming for want of organization, wood harvest from natural forests had ended in forest degradation due to inappropriate technology. The economic benefits that accrued from this generation did not flow to the interface people. Benefits least trickled down to reach them. Once again the interface people were alienated from forests and forest uses.

The sum total of the end-results of the past two generations was that vast stretches of forests had become degraded. The estimated figure of degraded forests in Tamil Nadu State was about 7000 km². It accounted for 41.86 percent over the area of the allocated forest types and 30.84 percent over the area of the forests of the State.

Forestry was now concerned with repairing the damage done to forests. The authority had initiated measures to restore the degraded forests. Firstly, ban on felling of natural forests for harvest of materials was imposed as a state policy in 1975. The ban was contemplated under the assumption that forests were resilient, hence would revert back to their original composition and structure if given rest from disturbance. Secondly, restoration was attempted on degraded forest areas through artificial regeneration under 'afforestation' schemes. This too did not achieve its objectives.

The alienated interface people had continued to remove from forest growth whatever that emerged, graze their white cattle and goats, set fires thereby giving no chance to the renewing ability of the forests. The newly created forest market during the Second Generation provided an enlarged demand for forest produces. When the Second Generation was called off, the institutions emerged under the generation should have become defunct but it did not happen. It not only continued to survive but became functionally more active. The impact was on forests. Eventually the expected resurrection did not take place and forests deteriorated further.

GENERATION III

Under the circumstances the realization came that restoration of forests was feasible only in association with the people. Therefore restoration of forests was planned with the cooperation of people. Forestry with the People was the Third Generation Forestry. For the first time the process to reverse alienation of interface people was seriously contemplated, but the focus still remained on the forests. In accordance with this new concept many new but radically different strategies were devised to enlist people's cooperation and participation. The strategies were contemplated under the assumptions that people resorted to theft for want of wood and non-wood requirements. Hence by providing forest resources close to villages the needs of the people could be met, which in turn would desist people from going to forests. People who had resorted to smuggling of forest goods were unemployed poor, hence by providing employment and thereby a source of income, it would end forest theft. In accordance to these premises Social Forestry Project was conceived and implemented.

New organization within the parent forest department was brought in to implement this new generation of forestry. Village wastelands in the category of village commons were utilized for raising wood lots. In Tamil Nadu State tank foreshores had accounted for an extent as large as 270 000 ha for raising Karuvel (*Acacia nilotica*) plantations. These plantations were subjected to 'clear-felling with coppice regeneration' system with 10-year felling cycles. The project was in operation for over 15 years commencing from 1981.

The contribution of the project to the state was very significant in respect of wood production, revenue generation and employment opportunities. Wood production in the form of fuelwood and small timber was in the order of 24.75 million tonnes The revenue generated from corresponding harvest of plantations was about Rs 1165 million. The revenue was shared equally between government and the *Panchayat*, the democratically elected village body. Free technology was provided to encourage tree cultivation in private holdings with commercial timber species. Many new policies were stipulated in support of the project.

The results were at great variance to the objectives. The materials particularly fuelwood and small timber were moved away from villages to cater to the demands elsewhere. The paradigm created in the Second Generation subverted the benefits of the Social Forestry to its advantage. In other words the recipients of materials produced and the revenue generated thereon were not the rural poor for whose sake the Social Forestry Project was conceived but the urban non-poor. The portion of revenue placed at the hands of village body was not duly channelled to benefit the poor. The opportunities of employment that were provided by the project were temporary.

In the implementation of Social Forestry Project the government insisted on the policy of handing over the woodlots for the ultimate management by the *Panchayat*. The policy did not spell out details of the management system. Rules and regulations in the management of woodlots were not laid. Eventually when the control of social forestry plantations was handed over to *Panchayats* it was done without any proper definition of authority either to exclude out-group members or to regulate the behaviour of in-group members who had participated in the project. Hence such handing over of authority invariably ended in failure. In pursuance of the policy, the newly created social forestry wing of the forest department gradually dissipated. Under these circumstances the Third Generation Forestry with People did not take off.

GENERATION IV

Close on the heels of the Social Forestry Project, new schemes such as Interface Forestry and currently the Tamil Nadu Afforestation Project were launched. These new schemes addressed the interface people directly seeking cooperation and participation for the restoration of degraded forests of the state. The scope of ascertaining the cooperation and participation of interface people was widened with an offer of forests cooperation and participation were contemplated for addressing the problems of the others. Forest department is advocating joint ventures.

The people whose participation is sought for a joint venture are poverty prone. Now concern for forestry cannot go to forests alone and it has to extend to the people of the forest interface. The first priority concern of the rural people is poverty. This is a new arena, and foresters have neither the understanding nor the skills to manage problems of rural poverty.

FORESTRY FOR POVERTY ALLEVIATION

There are two types of poverty, one that is inherited due to social distinctions and the other acquired from the development policies followed over the years. The former is concentrated in the rural areas and the latter in urban areas. Forestry of the Fourth Generation places the forest resources at stake for alleviating rural poverty. It lays its hope on the assumptions that constitute the two elemental strategy of poverty alleviation. The first element of the strategy is generation employment. Forestry by the nature of technology is labour intensive (nearly 70 percent of investment goes towards labour). It is equally intensive in both harvest systems and plantation systems. Labour is employed in very large numbers and at many stages of operation of the stated strategy is to provide basic economic and social services. Forestry of the Fourth Generation looks further ahead and adds a third element to the strategy. It is to augment the productive capacity of forests and lands at the forest interface.

Primarily the life style of rural population is agricultural occupation. Forests are the biological resources situated in the neighbourhood of rural settings. The material wealth of forests is accounted in the form of fodder, manure, timber, fuelwood, medicines and in times of scarcity food as well. These materials satisfied the household and occupational requirements of rural people. Thereby, historically a cultural linkage has evolved between rural people and forests of the neighbourhood. Rights for the forest produce from the neighbourhood forests have turned out to be a tradition. The tradition was extinguished during the First Generation Forestry. The rural people lost their viable source of materials required for their livelihood. The Fourth Generation Forestry would reassert the mutual and holistic dependence between forests and people. In short it is the revival of the age- old healthy tradition.

Next, this Fourth Generation would generate employment by undertaking series of labour-intensive activities both in the forests and the interface villages. The activities include afforestation, water harvest and soil conservation works. The employment would facilitate money flow to the poor. The water harvest and soil conservation measures would augment the ground water resources at the interface villages. A syndrome effect is foreseen; restoration of forests back to nature would ameliorate the climate for better life, the augmentation of water resources would lead to change in land-use pattern of the village for better utilization; increased source of income to the otherwise marginal land holders; agricultural sector would provide new employment opportunities etc, etc. Ultimately an economic process would set in towards its logical end namely the removal of poverty from the rural scene. Optimism in deed!

THE PARADIGM

Rural social life is ridden with class conflicts. There is an ethics that prevails in rural society, which stipulates 'what class of people to what kind of employment'. It makes an ethnic divide among rural population, which is far more superior to any kind of structural change mooted towards poverty removal. No institution exists to redress the class conflicts and ethnic divide. *Panchayat* is the only institution legally established but it is a political institution hence irrelevant for effecting socio-economic process in favor of development.

Rural economic life is in a land trap. People who once got into agriculture as an occupation could neither live in it nor could leave out of it. Any kind of improvement in land use is of little significance. Benefits of increased production or productivity from improved land use or technology are appropriated by the prevailing market mechanism, which works to the benefit of urban rich. The same entrapment would hold good for the forest produces generated from forests, community lands or private holdings as well. The target people are not a motivated lot for freeing themselves from poverty. Their enrollment to employment is not an occupation but a lifestyle. There is a cultural link to this attitude. The motivated lot if any, looks at urban life and migrates. The migrating section of the population is educated or professionally qualified and skilled. It seeks employment from manufacturing and service sector in the urban market. This is a drain on human resources from rural to urban areas, very akin to the drain from the country. The people who stay back in villages are those in land trap, less resourced folks and the unmotivated fatalists.

The assumption that labour employment would alleviate people from poverty is not tenable because the kind of employment would only provide at best a day-to-day escape from poverty but not permanently. Further it is a temporary phenomenon, not sustainable.

Under the prevailing rural characteristics placing forests at stakes for alleviating rural poverty could be a misplaced objective. It is like betting on the proven lame horse.

CONCLUSIONS

- The feasibility of freeing rural people from poverty trap probably lies in consolidating all resources of villages, which includes forests as well, into a composite. Village with its composite resources has to be made into an estate and treated as multi-product enterprise. The economy of the village estate has to be deemed as the country but in microform.
- Rural compatible and friendly technology, transfer of not only the technology but also human resource to village has to be institutionalized.
- Migration of human resources from villages has to be monitored and such migrated human resources should be subjected to certain specified commitments to parent villages.
- The norms of production and pricing between manufacturing and primary sectors have to be universalized.
- Budgetary exercises should address material production and distribution as well and the exercises should start from village estate to national level.
- The organization of forest department needs to be reconstituted with establishment of watershed-based village units at the base level, in place of sections and beats and the hierarchy built there upon.
- Studies have shown that resurrection of forests is highly correlated to the intensity of monitoring composed to the technological input. Therefore, in order to intensify the field monitoring, the system that prevailed during the First and Second Generation Forestry should be made a mandatory function for all the cadres of the forest department.
- All cadres of forest department need to be transformed from police to sociological mindset. Forest education and research institutes have to impart this transformation to the foresters' genre. Socio-economic and anthropological subjects may have to dominate the forestry curricula.
- Forest policy shall explicitly stipulate the mutual rights and duties between forests and the people. Similarly forest policy on utilization of forest-based produces has to be stipulated. The policies have to be incorporated under appropriate laws made specifically for the purpose.
- Forestry of this paradigm is socially and economically interlinked with people. Therefore it is politically relevant that forest portfolio is always placed under stewardship of the chief minister of the state or prime minister of the country as the case may be.

Poverty is now an integral part of rural economy. Rural economy is in shambles because of the poverty entrapment. Until the rural economy is freed from the trap, staking forest resources to poverty alleviation is a serious risk. We need a kind of forestry that is capital-safe and at the same time people-supportive.

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14 Forest and poverty: a survey study

K.D. Singh*

ABSTRACT

The paper aims to develop a methodology for a survey and study of relationship between forests and forest dwellers using the Adilabad district of Andhra Pradesh, India, as an example. The first part describes the research on establishing an integrated information system for such studies by geo-referencing forest cover, forest reserve and census village data. This is followed by a detailed analysis of spatial correlations in the distribution of tribal and non-tribal populations and their occupational patterns as a function of distance from the forest. Dynamic changes in the population during 1961–1991 and the resulting process of deforestation are presented with a view to illustrate the need for livelihoods in the face of increasing population in a subsistence economy. Finally, implications of findings for tribal development are discussed and conclusions drawn with a view to promote a location-specific (bottom up) approach to planning in the tribal regions.

INTRODUCTION

The highest concentration of the biological diversity occurs in the remaining natural forest and geographically inaccessible parts of the country. These are also the areas with highest concentration of the tribal population, who live in social and geographic isolation and partly survive on subsistence agriculture (both shifting and permanent) and partly on a range of products gathered from forests with very little processing and manufacturing activities. Thus, these people are among the poorest of the poor and most vulnerable of the vulnerable to natural calamities.

It is generally believed that the tribal people have lived in harmony with nature and customarily protect forests for their well being and to a vast number of them, forests are their well loved home, their livelihood, their very existence (Dhebar Commission Report 1961, p.125). The symbiotic relationship between forest and tribal people is well known and reported. They regard various species of forest as their kith and kin (Totems). Stephen Fuchs mentioned about the prevalence of 150 varieties of animals and 87 species of plants as totems by Mundas of Chota Nagpur in Bihar (Fuchs 1973). A recent study by the Forest Survey of India using multidate satellite data shows (1997), however, a high rate of on-going deforestation in most of the tribal districts numbering about 150. The two observations *viz.* deforestation and tribal attachment to forest's, are difficult to reconcile. There must be some fundamental change in the region, which is giving rise to such improbable developments.

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OBJECTIVES

With the above background in mind, I tested the following hypotheses:

- Geography and ecology are major determinants of the life style and economic development in the tribal areas, resembling a land locked state.
- Deforestation is arising from the need for more subsistence agriculture land to feed the growing population in an ecologically fragile and land-locked region. This vicious cycle needs to be broken to achieve sustainable development.

MATERIAL AND METHODS

Adilabad Revenue Division, containing 325 villages of the Adilabad district, was chosen for the study. The division forms a part of the Tribal Sub-plan Districts and is reported to have poverty head count ratio of 50 percent unchanged since 1980. The area was intensively surveyed during 1970s by Pre-investment Survey of Forest resources, GOI, and again in 1996 by World Bank assisted Andhra Pradesh Forestry Development Project. The variables included in the research are:

Spatial (i.e. Map) data

- ecological zones (based on climate)
- topography
- reserve forest boundaries
- village boundaries
- road and railway network
- · location of cities and urban centers
- multi-date satellite TM data for the study area

Attribute data (*viz*. Statistical tables: single date or time series) mostly from Census of India 1961–1991 at village level, which provide comprehensive information on ethnic composition, literacy, vocation and many other variables.

Data sources: The village level map was taken from National Census Report 1991; the control points from topographic map of the Survey of India, Dehradun and digital data like roads and cities taken from FAO Global Forest Resources Assessment 1990 GIS Archive. The Forest Cover Map was derived from Forest Survey of India.

GIS Procedure: The layers for reserve forests, blocks and villages were transformed from hard copy into digital format and geo-referenced. The following procedure was used:

- The borders of the different themes (forest reserves, villages, etc.) were drawn on an acetate with a 0.2 mm pen. At least four tic marks were drawn on the acetate and their ID and coordinates reported in a file.txt.
- The polygons drawn on the acetate were scanned at 200 dpi, black and white and saved as compressed .tif file.
- The files .tif were imported into Arc/Info GIS and vectorized. For corresponding tic marks, tic points were added.
- The cover was then edited to clean all the superfluous arcs. All the needed corrections were done.
- To geo-reference the map, a cover of just tics was created and projected. The cover with the polygons was "transformed" on the tics cover earlier projected.
- The polygon labels were added and coded.

Statistical analysis: A correlation analysis was performed using "proportion of tribal to total population in a village" (termed p) as the dependent variable and "other village characteristics (like altitude, distance from road, etc.)" as independent variables. In addition, a time series of demography and socio-economic data was compiled for tracing the increase of demand for more agriculture land on a per capita basis. To study the land use and forest changes, a special technique was used called interdependent image interpretation (FAO 1995).

MAJOR FINDINGS

Methodology of data integration

The study found that census maps in themselves do not provide an adequate basis for geo-referencing village maps. However, it is feasible to create a reliable village level GIS by supplementing Census village maps with control points extracted from Survey of India Maps. Other existing GIS data could also be integrated, as listed earlier, which enhance the value of village level GIS. It is hoped that the methodology of establishing village level GIS would be of wider interest in India and that National Census would consider using the approach to prepare a nationwide village level GIS database for the whole country. This will support planning of a bottom up strategy for tribal and rural development.

Correlation among village parameters

"Proportion of tribal to total population in a village" (termed p) was correlated with other village variables (see Table 2). Correlation analysis identifies key determinants of spatial distribution of tribal population: altitude, distance from road and city centers. The location on a higher altitude implies greater risks of land degradation and increased needs for soil and water conservation measures. These handicaps are over and above poor health and literacy cited earlier in Table 1. Progressive increase of distance from the market as well the nearest road means that tribal people have to spend systematically more of their energy and time than others in both selling their produce to and obtaining inputs from the market. Tribal cultivators, especially on the forest fringe, are among the poorest section of marginal farmers living under poverty line as shown in Table 1.

Table 1 shows that p is negatively correlated with distance from forest, in other words, tribal population tends to be located in forest proximity; a higher p is also associated with increasing altitude and distance from roads and city centers. Finally, the tribal population has negative correlation with total population meaning that the proportion of tribal declines as total population increases.

Table	1.	Correlation	among	village	characteristics
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Village variables	Correlation with proportion
Village Valiables	of tribal population in a village
Distance from forest	-0.55
Village altitude	+0.47
Distance from road	+0.21
Distance from city	+0.46
Total population	-0.36
Vocation as cultivators	-0.39
Manufacturing vocation	-0.23
Non-workers	-0.57

Note: Villages with no population have been excluded to avoid division by zero.

Social stratification

Among the geographic variables, distance from forest was most significant. Therefore, data was tabulated by distance of villages from forest in three classes as given in the first column of Table 2.

Forest distance class	Number of villages	Population density No/km ²	Ratio of tribal to total population (p)	Altitude (m)	Distance from road (km)	Distance from city (km)
< 1 km	122	74	78	418	3.3	8.3
1–5 km	145	135	56	372	2.6	5.7
5 km +	98	195	30	249	2.1	4.9

Table 2. Chara	cteristics of v	villages at	varying	distances	from	forest	reserve
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Source: Census of India, 1991.

Occupational pattern in village groups

To study land use and occupational pattern of tribal and non-tribal population, villages were reclassified in two ethnic categories: 1) dominantly tribal, if the proportion of tribal to total population (p) was more than 0.5; and 2) non-tribal if the proportion was less than 0.5, both with reference to census in 1961. Statistics on the occupational pattern in the two categories of villages by forest distance class is given in Table 3.

Туре	Forest	Number	Village	Popu	lation	00	Occupational pattern		
of	distance	of	size	Total	Tribal	Cultivators	Manufacturing	Non-	
village	class	villages	(ha)	Iotai	mbai	Guillivators	Manufacturing	workers	
Non-trib	al								
p < 0.5	1	33	1006	911	359	386	21	444	
	2	91	752	1328	235	504	58	674	
	3	79	614	1058	71	413	26	554	
	All	203	740	1155	192	450	40	590	
Tribal									
p > 0.5	1	89	776	396	328	192	3	185	
	2	54	542	363	282	175	3	172	
	3	5	512	420	284	201	4	202	
	All	148	682	385	310	186	3	181	

Table 3. Occupational pattern in villages by forest distance and ethnic classes

Source: Census of India, 1991 and 1961.

The following conclusions are drawn:

- Cultivation is the major source of livelihood. This is marginal in nature being upland with small farm sizes and low level of inputs. The handicap, caused by ecology and geography in the form of higher off-road and on-road costs increase as p increases.
- Manufacturing is the least important sector in tribal villages irrespective of the distance class. The average is 3 per village compared to 40 in the case of non-tribal villages.
- Non-workers are almost the same size as workers. They mostly live on seasonal jobs and forest gathering for their survival.

Forest dependence

Hours spent to various livelihood activities are a good indication of their livelihood means. The following data were taken from an intensive survey done in a development block of Orissa with dominantly tribal population. It may be noted that forests are the sole supplier of subsistence during January to March every year extending occasionally till May.

Activities/year	Total hours	% share	Days spent	Survey particulars
Wet Cultivation	374	12.8	47	Total HH :1025 (1990)
Shifting cultivation	590	20.2	74	Population: 4090
Wage earning	144	4.9	18	Size: 3.89 persons/HH
Forest Collection	928	31.8	116	Literacy : 2.9% in 1980
Others	544	18.6	68	: 7.92% in 1990
No work	340	11.7	42	Schedule tribes: 87.97%
Total	2920	100.0	365	

Table 4. Time spent on various livelihood activities by Kutia Kandha Tribes in Orissa

Source: Kutia Kandha Tribes of Tumudibandh Block Phulbani District of Orissa, 1998.

Dynamic changes in village population

A comparison of population in 1991 with 1961 shows that during the 30 years total population in non-tribal villages multiplied by 1.7, but in tribal villages by 2.3. However, tribal population in non-tribal villages grew by 2.2 times and in the tribal villages by 2.1 times. This finding is strange, but could be explained by the fact that some of the growth in tribal population is due to reclassification of non-tribal into tribal to get privileges intended for the latter and partly due to their migration into tribal villages to own land by illegal means.

Туре	Forest	Demog	graphic de	velopment	of village	by decade	e and fore	st distance	e class
of	distance	19	61	19	71	19	81	19	91
village	class	Tribal	Total	Tribal	Total	Tribal	Total	Tribal	Total
Non-	1	114	444	134	591	254	744	353	911
Tribal	2	105	802	117	985	178	1091	231	1328
	3	40	608	48	737	50	853	68	1058
	All	81	668	93	825	141	942	188	1155
Tribal	1	132	160	172	251	213	314	324	396
	2	156	183	174	236	240	301	276	363
	3	189	256	216	332	284	431	278	420
	All	142	172	174	248	225	313	305	385

 Table 5. Population growth in villages, non-tribal and tribal, during 1961–91

Source: Census of India from years 1961, 1971, 1981 and 1991.

Deforestation trends and path of land use changes

Using the method described earlier, the following change matrix was obtained for the district.

	Forest cover classes in 1994 image										otal
Forest cover classes in 1988 image		Open forest	Long fallow	Fragmented forest	Shrubs	Short fallow	Other land cover	Water	Plantation	histo im '000	orical age ha %
Closed forest		7.0			0.5		5.1			12.6	30.6
Open forest	0.1				3.3	0.2	6.9			10.5	25.5
Long fallow											
Fragmented forest											
Shrubs	0.1	0.1					15.7		0.1	16.0	38.8
Short fallow											
Other land cover	0.1								0.1	0.2	
Water					0.8		0.5			1.3	3.2
Plantation	0.3					0.4				0.7	1.7
TOTAL '000 ha	0.6	7.1			4.6	0.2	28.6		0.1	41.2	
recent image %	1.5	17.2			11.2	0.5	69.4		0.2		100.0

Table 6. Land and forest cover change assessment in Adilabad district of Andhra Pradesh

According to this study, the forest area of Adilabad district in 1994 was 649 600 ha and had declined by 29 400 ha during 1988–94 *viz*. by 7350 hay⁻¹ (at the annual rate of -1.13 percent). As forests constitute major source of livelihood of the tribal people, progressive deforestation means their progressive impoverishment.

The last row in Table 6 shows that 69.7 percent of changes involve a transfer of land to other land cover (*viz.* agriculture). The other changes involve transformations like transfer of closed forests into open forests to shrubs, which could be termed as land degradation. The deforested and degraded lands, especially in hilly terrain, are prone to soil erosion unless proper control measures are taken to arrest it. Continuing subsistence and shifting agriculture result in reduction of yield per unit area and eventual loss of land for cultivation purposes.

If it is so happening, then what is the incentive for deforestation and whom does it serve and whom does it hurt? Continued overuse of forests also results in deforestation when all trees have been used up. The two result in less and less availability of forest produce to the local population, in absolute terms and much less in per capita terms. Worst hit are the non-workers (i.e. landless) within the tribal community.

DISCUSSION

The demographic expansion in villages in all forest distance classes, with increase of non-working population combined with decrease of forest area and land degradation must be adding to economic hardships of the forest dependent population in general. Forest Survey of India (1997) reports that deforestation is on-going in most of tribal districts of the country. This, in particular, is disturbing because the same report states: "Forests have played a key role in the tribal economy and have been a source of subsistence and livelihood to them. It is a common belief that tribals have lived in harmony with nature and customarily protected forests for their well being". Has some thing basic changed in the life and belief of the tribal people and why?

Agriculture, as practised today, contributes mainly to subsistence without securing a sustainable growth in economy to absorb the need of rising population. Investments in agriculture are not paying because the terrain is inhospitable and soils not suitable for getting high yielding crops without irrigation and fertilizer inputs. Even if they mange to produce enough, they do not have competitive advantage in marketing due to cost of transport off- and on-road. Agriculture will thus remain a source of auto-consumption only. On the other hand, financial incentive to agriculture motivates tribal people to cut down forest and engage in agriculture, even if it is not sustainable.

The agriculture production in the study area is also subject to uncertainty because of droughts, which occur every 2–3 years, when water becomes scarce even for drinking. There is urgent need to adopt water conservation and appropriate cropping practices to regulate the water supply. The impact of subsistence farming including shifting cultivation on the down stream water supply is not well known.

The productivity of agriculture outside the study area is continuously rising because of commercialization, use of relatively high level of inputs and better cropping practices. To give an example, during 1964–95 on an All-India basis, the area under wheat rose 1.6 times, total production 4.8 times and yield per ha 14 times. The increase of production is creating marketing problems and government has to intervene to support minimum prices to farmers through a procurement drive.

Instead of subsistence agriculture, the people could be provided food under the "food for work programme" of the government of India. This will take away the need for subsistence agriculture in the area and replace the same by a land use, which has competitive advantage and enables value addition and enhances the income and employment opportunities. This would, however, require techno-economic studies and land evaluation which will identify and promote ecologically as well as economically sustainable land use, keeping in view developments in side as well as out side the area. Such a change may be difficult to achieve in the existing administrative system run on departmental lines; but they have important bearing on the long-term economic development of the people in the area and need to be implemented to break the vicious cycle of incorrect land use and poverty.

The tribal people of Andhra Pradesh live in areas, which are geographically inaccessible and ecologically very fragile. Any strategy for their sustainable development must take into account these two constraints. In these areas, focus should be on building of forest assets owned by community and promotion of harvesting, processing and marketing of wood and non-wood products by the community. The greening of the deforested and degraded landscapes will result not only in sustainable development of the tribal people, but also result in direct benefits down-stream people through improvement in agricultural production due to improved soil and water conservation up-streams.

The Working Group of Tribal Development (1978–1983) recommended that tribal development and forestry development should become two integrated goals and meet the basic needs of tribal economy should be provided on priority basis in all forest schemes.

Forest products in the country have easy market outlet and are selling at relatively high prices. Many of the non-timber products have even an international market. India is exporting presently about 100 million dollars worth of non-timber forest products. A strategic question is: can the production, collection, processing and marketing of timber and non-timber products be organized which provides the tribal and non-tribal people, living in relatively inaccessible regions, a major source of income and employment, pride and power?

In the whole chain of processing and value addition, the share of primary production, which tribal people get, is a very small fraction. The idea should be to engineer a development alternative, which has comparative advantage and is sustainable in view of the local geography, ecology and social realities of the site in relation to the outside world.

CONCLUSIONS

With special reference to the area studied, the following facts have been observed which may help to solve the above puzzles:

- Geography is a major limiting factor, which makes buying inputs from market and selling outputs to it more expensive and adds to problems created by ecological factors.
- Ecology does play a key role in constraining the land use options available to the people. The land is marginal in nature and can support subsistence agriculture and does not provide a basis for agricultural self-reliance.
- The tribal population has more than doubled in the last 40 years, increasing the pressure on land, both under forests as well as agriculture. Non-working populations pose a serious social problem.

- There has been significant influx of non-tribal population in the tribal areas, which adds to existing pressure on forest and agriculture lands.
- The agriculture production outside the tribal lands, compared to the 1960 level, has increased four folds due to continuing R&D, availability of inputs and Government support to production in form of subsidized fertilizer, irrigation, etc; and price support to keep agriculture prices from falling.
- Land use incentives (in particular for agriculture) may be serving cross-purposes and providing incentives for deforestation and non-sustainable use of land and hurting the interest of forest gatherers, who survive on forests.
- Manufacturing is not well developed in tribal villages, in spite of the fact that it could add value to primary production, open opportunities for income and employment, and especially when forest resources are at hand, not available in non-tribal areas.
- A two-way exchange of goods and services in the form of agriculture from non-tribal villages and value added forest products from tribal villages seems to make ecological as well as economic sense. This, however, requires a system view of development, which transcends narrow departmentalized considerations.

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ANNEX 1

SOME STATISTICS ON KUTIA KANDHA TRIBES OF TUMUDIBANDH BLOCK PHULBANI DISTRICT OF ORISSA

Wet Cultivation 374 12.8 47 Total HH :1025 (1990) Shifting cultivation 590 20.2 74 Population : 4090 Wage earning 144 4.9 18 Size: 3.89 person/HH Forest Collection 928 31.8 116 Literacy : 2.9% in 1980 Others 544 18.6 68 : 7.92% in 1990 No work 340 11.7 42 Scheduled tribes: 87.97% Total 2920 100.0 365 Distribution of holdings
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House hold observed 108 Villages 70 No land 23 (21%)
Land types (ha)Area cultivated/HH< 1 ha54 (51%)
Total 2.011 1–2 ha 26 (24%)
Lowland 0.411 2 ha +5 (5%)
Mid/highland 0.474 All 108 (100%)
Hill slopes 1.126
Source Income per HH (Rs/year) Forests sole supplier if
Agriculture 3024 subsistence during Jan to
Other (Non-forest) 821 March every year extending
Total 3845 till May
Total expenditure/HHRs. 4367Imbalance =
Consumption including 3884 3845-4367= -522
food, clothing, wine (2277,467,566,269)
tobacco, festivities, etc.
Cost of Cultivation 452
Crops Area /HH Yield(Q)/HH Value /HH Cost /HH
Paddy 0.411 5.6 784 121
Ragi 0.333 2.9 580 74
Maize) 0.141 1.5 300 32
Vegetable 5 0.141 0.5 100
Pulses) 1 1 2 0.7 420) 225
Oilseed
Total 2.011 3024 452
Crop (foothills) Yield (Quintals/ha) Cost per ha
Paddy 13.6 (Range13.4–15.5) 294
Ragi 10.0 (Range 6.7–12.4) 222
Maize 10.3 (Range 7.5–11.1) 227
Crops on hill slopes 12.1 200

(HH = household)