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THE FUTURE OF TEAK AND THE HIGH-GRADE TROPICAL HARDWOOD SECTOR

Solving the Tropical Hardwood Crisis
with Emphasis on TEAK

(*Tectona grandis* Linn f.)

by

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Comments and feedback are welcome.

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PREFACE

The purpose of the present booklet is to predict the nature of future teak plantations in the context of the wider high-grade tropical hardwood sector to which they belong. A case is made for the transformation of the teak component of the sector so that it can realize its full potential, and function as a lucrative developmental tool - lucrative in the sense that all stakeholders (large and small; rich and poor) stand to gain substantial benefits. These benefits are to be achieved in a manner that enhances processes designed to solving the current tropical hardwood crisis. This crisis is masked by an abundance of mined timber from natural forests and has arisen as a result of unprecedented levels of deforestation and forest degradation in the tropics. Taken to its logical conclusion - when unsustainable felling is no longer feasible because of critical depletion or inaccessibility - the only sources of supply will be relatively small areas of sustainably managed tropical forests and hardwood plantations. At that stage, the tropical hardwood crisis will become visible and the real importance of tropical timbers will be revealed.

Little value has been apportioned to the creation of tropical hardwoods in natural forests. As such the value of the standing material is distorted and we consume it as a free gift of nature. When hardwood supplies tighten in the coming decades several scenarios are possible: these woods will not be available or will be too expensive to consume. Alternatively, we can prepare now for inevitable shortages and ensure that forestry is able to maintain a balanced output of all goods and services potentially available from tree-covered lands.

Unfortunately, high failure rates in forestry development programmes are starkly in evidence despite decades of donor assistance. It appears that, no matter what solutions are proposed, forests in the tropics come out on the losing side. Since the 1970s, developers have reacted with scheme after scheme to combat the demise of tropical forests. A host of solutions have been proposed that have concentrated on social and community aspects; technical innovations like reduced impact logging; appropriate policies and good governance. All of these initiatives have achievements to show but they have not provided the desired level of success. Several causes are responsible, including segregation of efforts in tropical forestry (e.g. many entities fail to develop holistic links between natural forest management and plantation development or between private sector and community initiatives, tending - rather - to work behind artificial partitions and exclusively with actions geared towards poverty alleviation and environmental projects of limited scope). It is now time to realize that panacea-type solutions do not work. An open exploration of possibilities is necessary. A wide array of pragmatic solutions are needed and needed urgently. The proposals contained here are not a ‘cure-all’ solution; they are meant to complement other initiatives that are taking place in favour of tropical forestry.

This booklet represents a first step in a new departure. It outlines the most important signposts and milestones on the road-map to achieving the transformation of the teak sector. Innovation is a crucial part of this undertaking and the present work offers a number of possible approaches. Some of these can be put in place relatively easily; others will take longer. However, a wide range of ideas are included to stimulate debate. For this reason TEAK 21 is interested in your feedback.

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Executive Summary

1. Annual supply of high-grade tropical hardwoods depends mostly on deforestation and degradation of natural forests. The unsustainable nature of this output has created the tropical hardwood crisis. To solve the crisis future timber must arise from sustainably managed natural forests and complementary hardwood plantations. An attempt is made here to quantify future demand for tropical hardwoods and determine sources of sustained supply. Demand for tropical hardwoods is expected to rise to 136 million m^3/year by 2050.

2. It is not practical to satisfy total sustainable demand from natural forests alone. This is due to the expense of natural forest management, competition from hardwoods extracted from non-sustainable sources that do not bear the costs of sustained management, lack of understanding of management in complex tropical forests and incentives to maintain forests free of exploitation under climate-change-mitigation and conservation measures. It is concluded that the most realistic solution is to create a large hardwood production estate made up of plantations with accompanying natural managed forests.

3. Given assumed scenarios, the maximum amount of natural tropical forest under sustainable management by 2050 is estimated to be 36 million ha producing an output of 36 million m^3 annually. In order to make up the shortfall a high-grade tropical hardwood plantation estate of 10 million ha (producing an average output of 10 m^3/ha/year) would be needed to satisfy demand on a sustainable basis.

4. The required balance between sustained output arising from plantations and natural forest will become clearer in time and as deforestation levels change and fall off, which is expected to occur sometime between 2012 and 2025 - if not earlier. Besides, the area of natural forest under genuine sustainable management will also become clearer. Therefore, the macro-target for plantation expansion can be revised in time.

5. The arguments that low density plantation wood or alternative raw materials will diminish the need for tropical hardwood plantations and managed forests are shown to be inadequate given the likelihood that climate-change-mitigation measures and the need for energy conservation will put restraints on wood substitution. What is abundantly clear in the often contradictory set of arguments for and against substitutes is the need for a balanced approach to development.

6. Current output from natural teak forests and teak plantations are discussed. The total commercial volume emanating from these sources and alternative high-grade tropical hardwood plantations is in the order of several million m^3 and makes only a small contribution to the overall hardwood demand. In fact, it appears that both natural teak forests and plantations as a whole are being exploited on a non-sustainable basis and are part of the tropical hardwood crisis rather than a bulwark against it.

7. The purpose of the present booklet is to predict the nature of future of teak plantations and highlight their potential contribution to the wider tropical hardwood sector to which they belong. The teak plantation sector can be transformed from its present position of sub-optimal activities, through a phased approach, into a powerful and lucrative developmental tool that will provide basic solutions to overcoming the tropical hardwood crisis.

1. The Tropical Hardwood Crisis (The Challenge)[1]

Annual demand for tropical hardwoods is roughly 90 million cubic metres, equivalent to filling the Empire State building in New York more than seven times per month throughout the year. Most of this volume depends on deforestation and degradation of natural forests. The unsustainable nature of supply *is* the tropical hardwood crisis. To solve the problem future timber must arise from sustainably managed natural forests and complementary plantations.

The Scope of TEAK 21

TEAK 21 works to develop innovative solutions to the tropical hardwood crisis and provide the benefits of these initiatives to local communities. We concentrate principally on hardwood plantations which will be an essential component of any solution. As teak is the most important cultivated tropical hardwood, we focus on plantations composed mainly, but not exclusively, of this species.[2]

The Way Forward

Other than doing nothing, there are, basically, three approaches to solving the tropical hardwood crisis:

1. Increase the area of natural forest under sustainable management;
2. Develop large areas of sustainably managed plantations; or
3. Establish complementary areas of managed forests and plantations.

Which approach is best? This topic is explored next.

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[1] **Tropical Hardwoods** are understood to mean quality or high-grade timbers that can be used for top-of-the-range end uses like boat building, interior decor, panelling, quality indoor and garden furniture, decking and carving. Timber species in this category are sometimes called high-grade hardwoods, luxury woods, cabinet woods or speciality timbers.

[2] ***Tectona grandis*** Linn f.

Present Trends

The scale of annual deforestation that supplies most tropical hardwoods on the market (some 13 million ha) is equivalent to clearing a country the size of Bangladesh each year and has gone on relentlessly over the last 15 years. This situation cannot continue forever. Such practices are leading to inevitable restrictions as resources become exhausted or inaccessible.

All international efforts to prevent or significantly decrease deforestation since the 1970s have fallen short of their targets. It appears therefore that natural forest cut-back will run its course as it has done in most industrialized countries. Future rates of deforestation are uncertain. However, population growth is slowing and rapid urbanization of the population is occurring in many tropical countries. This could mean that the same pattern of cutback, followed by stability and eventual increase in tree cover - as experienced in the industrialized world - will be repeated in the tropics. In other words, deforestation will de-accelerate and tree cover will then be reversed as pressure on land diminishes.

Joseph Wright and Helene Muller-Landau state: [3]

> Today, population growth is slowing in many tropical countries, and an intense urbanization of the population is underway in virtually all tropical countries ... (p. 289)
> ... we expect that in the next 25 years the rate of net tropical deforestation will slow on all continents. Further, we predict a switch to a net increase in forest area in Latin America and Asia if not within 25 than [*then*] at least within 50 years, and in Africa within 100 years. The fundamental causes of such changes will be stabilizing human populations and thus stabilizing demand for agricultural commodities, increased non-agricultural economic opportunities in developing countries, and increased agricultural land use efficiency due to continuing technological improvements and their more widespread use. Our optimism is consistent with past changes in population size, agricultural yields, and cropland area in developing countries. ... there is reason to believe that in tropical countries in the future, as in developed temperate countries in the past, increasing per capita income will eventually bring increasing demand for environmental goods, including native forest protection ... (p.296)

A *laissez-faire* approach may self-right the deforestation problem in the long-run. In this case, development efforts might best be directed towards assisting tendencies that are taking place anyway, like rural to urban migration which will have fundamental impacts on the rate of deforestation.

However, a totally *laissez-faire* approach to the supply of high-grade tropical hardwoods could be detrimental. If present trends persist, the future outlook for the sustainable supply of these timbers, either from the natural forest or from plantations, is bleak. This is at a time when demand for tropical hardwoods, particularly domestic demand, is forecast to rise.

It can be argued that if tropical hardwoods are unavailable in the marketplace substitutes are likely to be found justifying a *laissez-faire* scenario. However, accepting such an approach is, in effect, tantamount to a decision that future generations will have to face extreme shortages of sustainable high-grade hardwoods. The real price to pay is likely to be increased pressure on remaining natural forests to give of their bounty either through fair or foul means. To take a decision of this nature is a risk that runs totally counter to most internationally recognized definitions of forest sustainability. One such definition is: *the management or stewardship of forest and woodland with the objective of providing a continued output of all goods and services desired by legitimate stakeholders, in a harmonized manner, and in a way which*

[3] Wright and Muller-Landau (2006).

does not reduce the forests' capacity to provide such goods and services on a continuing basis. This definition supports a **balanced** development of forestry in which no aspect is left out.

Sustainably Managed Natural Forests

Natural tropical forests have the potential to sustain, not only the output of timber, but a wide range of goods and services, including: non-wood products (like medicines, game, fruit, rattan, etc.), soil and water conservation, maintenance of biodiversity, maintenance of large quantities of carbon, protection of indigenous cultures, provision of landscape- amenity- and religious-values, support for recreation, tourism, research and education.

The annual allowable timber cut must, therefore, take into consideration the effects on the sustainable output of other goods and services and thus the allowable cut is less than the volume which could be removed if only timber had to be considered. Defining allowable cut, therefore, is a contentious issue and a spectrum of opinions has arisen, depending on viewpoints from a wide range of disciplines.

Ecosystem Management

In recent decades it is recognized that the concept of sustainable forest management (i.e. implying the management of the whole ecosystem) is a new and complex field and we may need several decades of research to achieve an adequate understanding of the workings of these intricate systems.

As the assessment of sustainability requires that the forest be in at least its third rotation and, as probably few, if any, natural areas have been managed consistently - in a commercial sense - and observed scientifically for such a period, it is not possible to demonstrate, conclusively, that natural tropical forests can been successfully managed sustainably outside traditional practices.[4] Furthermore, the more the problem is examined it appears we know less about the workings of these forests than we believed heretofore.[5] Management systems in natural forests, designed to supply timber, have had variable levels of successes, but most of these have been abandoned or are only applied on a minor scale.[6] In Bolivia, which has one of the best existing permanent plot growth and yield databases for natural tropical forests, it was found that recoverable volumes in the second harvest for regions varied from approximately 4 to 28% of the potentially harvestable volume in the first cycle considering all commercially marketable stems. This suggests that it may be unrealistic to expect future yields equal to that of what is, essentially, primary tropical forest.[7] The problem is not unique to Bolivia. Observations of this type have led sceptics to question the feasibility of managing

[4] Cassells (1993).

[5] Bowles *et al.* (1998).

[6] Catinot (1997).

[7] Dauber *et al*. (2005).

tropical forests under commercial timber operations.[8] Therefore a strong word of warning is appropriate regarding all production assumptions related to natural forest yield.

If natural forests are regarded as having little value or their use is restricted, then they may be cut faster than if they have tangible values. Therefore, the use-it-or-lose-it principle applies. But, it is at this point that opinions divide radically about the priority roles of the forests themselves.

Non-Technical Problems

Problems related to natural forest management are not confined to technical issues. Where other obstacles exist (e.g. weak governance, lack of political support for the forestry sector, poor policy enforcement, insecure tenure, conflicting subsidies, weak institutional capacity, corruption, etc.,) these must be removed or circumvented before sustainable forest management can work.

Short term and narrowly defined opportunity costs of forest clearance are generally more attractive than maintaining these ecosystems under forms of sustainable management, however sustainability might be defined. Several experts point out that, from a strictly financial perspective, it is sometimes more profitable to cut the trees and bank the profits than maintain a steady output of volume under a management regime.[9] This occurs where money accumulates at higher rates of interest in a bank compared to added value in a growing natural forest.

Timber - Not Always an Option

Because timber, produced under natural forest management conditions, is such a small proportion of total timber production, some conservationists argue that this commodity may not, realistically, play an important role in the widespread and long-term conservation of tropical forests.[10] Some question the wisdom of logging natural tropical forests that are not under immediate threat. Creating conditions for increased access may heighten the risk of destruction. Others suggest that the provision of increased funding for commercial logging is not a good option and that, to turn around deforestation and degradation, direct protection is the most appropriate course of action.[11] They suggest that, where the goal is to meet future global wood demand, then the obvious step is to develop plantations, rapidly, in areas that have already been deforested.

Deforestation will continue unabated for some time. During this period the sustainable management of natural forests, which is expensive, will have to compete with exploited forests. This means that the value of a sustainably managed log, which has to carry the extra costs of management, must compete in the marketplace against logs that are mined. Unfortunately, there is little contest. A review in CIFOR states:[12]

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[8] Rice *et al*. (1997).

[9] Rice *et al*. (1997).

[10] Dickinson *et al*. (1996).

[11] Bowles *et al*. (1998).

[12] CIFOR Polex July 17, 2000: *Dubious Dogmas*; http://www.cifor.cgiar.org/Publications/Polex/

> ... the only way companies can profitably log the large and rapidly increasing area of forests that are in their second rotation is if they do it illegally and / or in a non-sustainable fashion. This also applies to many unlogged forests with low value timber. Sustainable forest management for commercial timber production of such forests is often not economically attractive. That is one reason illegal and non-sustainable logging practices are so widespread. Under these circumstances no changes in concession duration or forest regulations can convince companies to sustainably manage their forests. To do so they would have to operate at a loss.

Therefore, the concept of extending sustainable management of natural forest to the extent that production could replace exploited timber in the short-run is flawed. For natural forest to produce, on a sustainable basis, the total volume of tropical hardwoods (90 million m^3) would require an effective area of 90 million hectares (assuming a commercial production of 1.0 m^3/ha/year).[13] This area of forest equals half the size of Indonesia or three times the size of Finland. The actual forest containing the effective area would be much larger in geographical terms. To achieve sustainability it would be necessary to carry out inventories, construct new access roads, hire and train workers, procure and deploy harvesting machinery, establish new industries and set up a large transport network. An undertaking of this magnitude represents an enormous logistic exercise in areas that have little or no infrastructure. It would necessitate the annual establishment of tens of thousands of kilometres of roadways. New roads often increase the risks for natural forests by increasing erosion and opening the way to alternative uses, including illegal activities and conversion to agriculture - unless strict protection of the area is maintained. Protection requires high levels of personnel. This scenario does not take into consideration economic realities on the ground. Quoting CIFOR again:[14]

> High transportation costs lead loggers to focus only on the most valuable tropical hardwoods and make it uneconomical for them to exploit other timber species. This makes sustainable forest management for timber practically impossible in many tropical forests.

In summary, factors opposing natural forest management for timber include:

- Expense in managing forests on a sustained basis, particularly as accessibility becomes increasingly difficult;
- Competition with tropical hardwoods extracted from non-sustained sources that do not bear the costs of sustained management;
- High species diversity with few commercial species;
- Incentives to maintain forest cover free of exploitation under climate-change-mitigation and conservation measures;
- Lack of understanding of sustainable management in complex tropical forests.

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13 ITTO (2006).

14 CIFOR Polex April 1, 1998: *Can Roads and Tropical Forests be Compatible?* http://www.cifor.cgiar.org/Publications/Polex/

Therefore, plans to replace the total current non-sustained hardwood output by material coming exclusively from managed forests are not possible to execute and must be discounted. That is not to say that tropical forest management is totally discarded; it will have a reduced role in sustainable production. However, **the overriding strength of natural forest is its conservation value**.

Sustainably Managed Hardwood Plantations

Assuming that deforestation will run its course over the next quarter century, at the end of this period (one rotation of teak) the tropical hardwood supply scenario will be considerably different. If the rate of forest cut-back decreases, as suggested by Wright and Muller-Landau (above), there will continue to be upward pressure on natural forests to supply hardwoods. However, access to these sources will be increasingly difficult due to lower rural population densities with associated lack of labour to extract the timber and a need to travel further into the forest to obtain supplies. At that stage, price increases of timber could make sustainable natural forest management more attractive. However, plantations could then become serious competitors if they exist. Of the three possible sources of tropical hardwoods (deforestation and degradation; natural forest management; plantations) plantations are likely to be the most economical way to provide the raw material in future.

There is a case to make for more efficient use of hardwoods, and some substitution is possible but increasing domestic demand will hamper efforts to provide a lasting solution using these methods alone. Sustainably managed high-grade tropical hardwood plantations, which provide positive economic, social and environmental benefits, are scarce. For these reasons new plantations are required on a large scale to produce renewable hardwoods for economic development, poverty alleviation and to decrease pressure on natural forests. Plantations that employ best management practices can be ten to twenty times more efficient, in terms of production, compared to natural forests.

It is often claimed that plantations have little direct effect on natural forests. To ensure that new plantations impact positively on natural ecosystems they must be designed in such a way to deliberately allow benefits to accrue. One such design is the 'harvest transfer' scheme. To illustrate this, consider an area of natural forest which would require, say, a 60 year period to recover after an agreed cut was extracted. Let us say that it would be uneconomic to cut $1/60^{th}$ of the forest per year but economic to cut double that area. It would make sense, then, to complete the extraction in 30 years. If plantations were to be developed over this 30 year period, at the end of the cycle the owners would agree to cease extracting timber from the natural forest for a further 30 years and step over to the plantations as a substitute for hardwood supply. The natural forest and plantation areas would not have to be contiguous nor even in the same country. Many such models are possible to envisage. The tropics now need to establish sustainable hardwood plantations of the right area and the right sort.

2. Future Tropical Hardwood Supply

An attempt is made here to quantify future demand for high-grade tropical hardwoods and determine sources of supply.

Future supply of tropical hardwoods depends on:

- Per capita hardwood demand;
- Supply from natural forests;
- The area of suitable plantations that can help satisfy demand; and
- The level of substitute materials available.

Hardwoods and Global Wood Consumption

The total per capita annual wood consumption worldwide, which was around 0.65 m^3/person in 1970, fell to 0.58 in 1996 and to 0.54 by 2004.[15] It may be argued that per capita consumption will continue to fall. However, there have been increasing concerns with global warming, a growing willingness on the part of stakeholders to take positive action, application of regulatory mechanisms linked to incentives for low-emission and low-energy technologies and penalties for the opposite. These factors are likely to function to ameliorate the negative effects of commercial activities on climate change. If prices begin to reflect the full costs of production, including the combating of atmospheric pollution, consumers and commercial companies will react by shifting to cheaper low carbon products.[16] In this case wood consumption is likely to increase.

Assuming an annual wood consumption of 0.54 m^3/per person and a population trend in line with the averages predicted by the US Census Bureau's International Data Base,[17] the total wood and tropical hardwood consumption between 2010 and 2050 is illustrated in Table 1. In this scenario, demand (real or latent) for tropical hardwoods will rise to 136 million m^3/year in the period. It is assumed here that demand is real and will be satisfied through plantations and natural forests managed sustainably.

A total plantation estate of high-grade tropical hardwoods, roughly equivalent to 14 million ha, with a sustained production of 10 m^3/ha/year would be required to satisfy future demand from cultivation alone.

Alternatively, an effective area of tropical forest of 136 million ha, sustaining an average commercial production of 1.0 m^3/ha/year would be required. As shown earlier, this is not practical. **The most realistic solution is to create a large hardwood production estate made up of plantations with accompanying natural managed forest**.

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15 Sutton (1999).

16 Stern (2006).

17 US Census Bureau (2008).

Table 1. Predicting high-grade tropical hardwood consumption 2010 to 2050

Year	Population	Wood Consumption	High-grade Tropical H'woods
	(000s)	(000s m3)	(000s m3)
2010	6,866,880	3,699,425	97,885
2020	7,659,292	4,126,324	109,180
2030	8,373,134	4,510,895	119,356
2040	9,003,223	4,850,346	128,337
2050	9,538,988	5,138,981	135,974

- Population figures based on US Census Bureau, International Data Base (updated 18 June 2008)
- Total wood consumption assumed to be 0.54 m^3/head (human population);[18] Sutton (1999) assumed that the per capita annual wood consumption worldwide would stabilize around 0.60 m^3/head to the middle of the twenty-first century.[19] Therefore, the estimate of 0.54 m^3/head appears conservative.
- Tropical hardwood timber assumed to be 3.5% of total wood consumption.[20]
- High-grade hardwoods assumed to be 75% of tropical hardwood timber.[21]

It is difficult to determine what the balance between plantations and natural managed forest might be in 2050. What is clear is that natural forest management will only be possible where accessibility is not difficult. This suggests that high volume producing secondary forests on the outer margins of natural forest masses are the most likely areas that could be managed in a practical and economic way. These are also the areas that are most vulnerable to encroachment.

The International Tropical Timber Organization (ITTO) estimates that 25 million ha of natural productive forest is being sustainably managed, which represents an increase of around 1.5 million ha per year since 1988 when virtually no sustainably managed forest existed.[22] If the rate of increase continues at this level, by 2050 there will be a further 66 million ha under sustainable management giving a total of 91 million ha. Assuming also that this is relatively high productive forest, the commercial output would be in the order of 91 million m^3/year.

However, considering that sustainable forest management is in its infancy, that little field-checking has been carried out to determine actual success rates, that yield levels and cutting cycles are uncertain and that formidable difficulties present themselves when considering any large-scale increase under natural forest management, it is wise to opt for a conservative view of potential future areas under sustainable timber yield.

Of the total current area under sustainable management, certified areas are limited to 10 million ha. If only certified forests are accepted as being 'truly' sustainable, then by 2050 the area under certification would amount to 36 million ha assuming that the rate of increase

[18] FAO (2007).
[19] Sutton (1999).
[20] Estimate based on ITTO (2007).
[21] Keogh (2000).
[22] ITTO (2006).

from 1988 to the present continues. Total commercial volume output from certified forests would be in the order of 36 million m^3/year in 2050. However, even certified areas are not free of problems. In Brazil which, according to ITTO had over one million ha certified in 2005,[23] only 12 Forest Stewardship Council (FSC) certified operations were engaged in selective logging and at least three cancelled or suspended their certified operations by the end of that year.[24]

Given assumed scenarios (discussed above), the total amount of natural tropical forest under sustainable management by 2050 will be between 91 million ha (questionable from the point of view of manageability) and 36 million ha (somewhat more realistic but by no means certain). In these cases, volume output would be between 36 and 91 million m^3 (assuming relatively high production forests). In order to make up the shortfall a high-grade tropical hardwood plantation estate of between 4 and 10 million ha (producing an average output of 10 m^3/ha/year) would be needed (Table 2).

Table 2. Natural-forest/plantation balance (2050) to satisfy sustainable hardwood demand (i.e. solve the hardwood crisis)

Probability based on Nat. Forest areas under SFM	Managed Nat. Forest m ha (2050)	Area of plantations making up shortfall (m ha)	Total high grade hardwood harvest (m m3)
Optimistic	91	4	135
Realistic	36	10	135

Of course the current high-grade tropical hardwood estate (in terms of productivity and area) must be subtracted from these figures to determine the area of new plantations to be established between now and 2050. The contribution of existing hardwood plantations to high-grade timber demand is discussed below and is shown to be relatively small. Current plantations, therefore, will have little effect on the overall target for 2050.

This discussion provides a crude initial sense of scale of the problem and solution. The predicted demand in Table 1 is liable to change as input factors like forest productivity, assumed human population growth and consumption levels change. However, within reasonable limits of change, the overall scenario is robust. For this reason the upper plantation target (10 million ha) is proposed to serve as a provisional target for new commercial tropical hardwood plantations. This macro-target is reachable. It is equivalent to the world's coffee harvest area and is less than the current annual rate of deforestation.

The required balance between sustained output arising from plantations and natural forest will become clearer in time and as deforestation levels change and fall off, which – as stated above - is expected to occur sometime between 2012 and 2025 - if not earlier.[25] Besides, the area of natural forest under genuine sustainable management will also become clearer. Therefore, the macro-target for plantation expansion can be revised in time.

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[23] Ibid.

[24] Keller *et al*. (2007).

[25] Moutinho and Schwartzman (2005).

Substitutes for Tropical Hardwoods?

The discussion on macro-targets aimed at balancing production between plantations and natural forests is incomplete unless the subject of substitutions - to replace tropical hardwoods - is addressed. The arguments that alternative materials will diminish the need for tropical hardwood plantations and managed forests are now examined.

Sources of wood substitutes

It is generally agreed that the commodity in short supply - on a sustained basis - will continue to be tropical hardwood logs and the harvest levels will be reduced quickly to more sustainable levels or they will drop abruptly with depletion of the growing stock.[26] In other words the tropical hardwood crisis, which continues to be masked artificially by unsustainable supplies from deforestation, degradation of natural forest and illegal logging, will manifest itself abruptly if ameliorative action is not taken soon. Relative scarcity and subsequent rising prices of tropical hardwoods may limit their consumption in lower quality markets and result in substitutions. In the medium-run, it is speculated that there is a potential for substitution arising from timber supply of new plantations (mostly low density woods) coming on stream around 2020, which is described as a 'blooming global surplus of commodity plantation timbers' estimated at around 900 million m^3.[27]

However, future supply may not result in simplistic patterns of substitution of tropical timbers. The non-coniferous timber production (c. 287 million m^3/year within ITTO consumer countries) made up mostly of temperate hardwoods, has been increasing since at least 2004.[28] Most of the increase in 2006-2007 went to satisfying accelerating domestic demand. At the same time, the production of tropical timber (the bulk of which is high-grade hardwoods) remained roughly stable in ITTO producer countries. These figures suggest that temperate hardwoods have little direct effect on the current hardwood supply in tropical countries. This pattern is in line with historic trends: there has not been a strong demand in the tropics for temperate hardwoods and there is likely to be a continued bias in ITTO producer countries in favour of tropical hardwoods.

Competition between tropical and non-tropical hardwoods is more likely to be experienced in temperate countries even though temperate hardwoods generally do not have the same timber properties as their tropical counterparts. It is suggested that temperate hardwoods followed by non-wood products, provide the toughest competition to high-grade tropical hardwoods in the furniture sector while in the joinery sector competition comes from softwoods followed by temperate hardwoods.[29] Furthermore, changes in technology and preferences favour growth in consumption of reconstituted products as opposed to that of solid wood such as sawnwood.[30] Solid wood is losing ground to Medium Density Fibreboard (MDF) throughout the Asia-Pacific region.[31] In line with these trends it is speculated that tropical hardwood

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26 Barbier (1996).
27 ITTO (2006a).
28 ITTO, 2007.
29 Odoom (2001).
30 Barbier (1996).
31 Odoom (2001).

(sawnwood) will be replaced by treated wood.[32] A wide range of wood treatment and reconstitution is available that can replace hardwoods (e.g. MDF with fake finishes and wood hardening). Expected strong economic growth in tropical timber producing countries, more modest demand growth in other consuming countries and declining supply of tropical hardwood logs is likely to produce a substantial shift away from export to domestic markets by the major tropical hardwood suppliers. Declining log exports will be offset only partially by increased product exports.[33] There is already a trend towards a reduction in imports of primary products and an increase in imports of secondary products in external markets.[34]

In other words, it is speculated that the mass market for speciality and decorative timber products, particularly outside producer countries, can be met in the short- to medium-term through non-wood materials, wood substitutes and technological developments that eliminate the technical differences between softwoods and hardwoods and reproduce the decorative finishes through overlays. However, in time temperate hardwoods will experience supply limitations and the deficit in producer countries will be large and difficult to satisfy with substitutes.

Trends opposing substitutions

An issue that is likely to influence fundamentally the future demand scenario for all woods and weaken the arguments for replacement of high-grade tropical hardwoods is action taken to ameliorate climate change. According to the Stern Review (2006) most climate models predict that a doubling of pre-industrial levels of greenhouse gases is likely to commit the earth to a global mean temperature rise of between 2^0 and 5^0 C with serious consequences on the environment, on world output and even on human life.[35] Business-as-usual is not an option. The review concludes that the risks of the worst impacts of climate change can be substantially reduced if greenhouse gas levels in the atmosphere can be stabilized between 450 and 550 ppm CO_2 equivalent compared to the current levels of 430 ppm CO_2 equivalent.

However, stabilization in this range requires that emissions be at least 25% below current levels by 2050 and it would already be difficult to stabilize atmospheric carbon at 450 ppm CO_2 equivalent.[36] Investment that takes place in the next 10-20 years will have a profound effect on climate in the second half of this century or in the next.

On the positive side action on climate-change-mitigation measures, which are likely to be supported by legislation and regulations, will provide significant business opportunities as new markets are created in low-carbon energy technologies and for low-carbon goods and services. These markets could grow to be worth hundreds of billions of dollars each year.[37] Sutton (1999) points out that a wood-based society would use less fossil fuel and produce less atmospheric CO_2 while permitting its population to still enjoy a high material standard of living. In this context, preference is likely to be given to materials which, like teak, require low energy inputs in their creation, are renewable, biodegradable, are naturally resistant to fungi and termites yet are free of toxic material, long lasting and aesthetically pleasing.

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32 Duery and Vlosky (2006).

33 Barbier (1996).

34 Duery and Vlosky (2006).

35 Stern (2006).

36 Ibid.

37 Ibid.

Where energy for the teak industry could be fuelled from wood waste, further environmental enhancements are possible.

Climate-change-mitigation measures will put restraints on wood substitution because most substitutes of wood require at least ten times as much energy as wood itself.[38] There is also predicted to be competition between forms of wood use, solid wood being its most efficient form from an energy point of view - which also favours hardwoods. Besides, the main factors considered to give tropical hardwoods a competitive edge are technical properties and appearance.[39] There are limits to demand for fake replacement products and Odoom (2001) observes that beyond the mass market, only the genuine article will do.[40]

Another point to take into consideration, when examining the future demand for wood, is the rapid development of countries like Brazil, India and China. They represent large potential demands for resources, which warns against the view that wood will be in over-supply. As such, the 'blooming global surplus of commodity plantation timbers' is likely to evaporate as it becomes a valuable renewable resource, particularly as a substitute material for other high-energy products. Besides, the forecasted 'tsunami' of low density wood is a prediction based on global estimates of area and productivity of new plantations and these forecasts may or may not be correct. They require careful verification. Rising prices for all woods will tend to make harvesting of natural forests more lucrative and maintain pressure on tropical ecosystems. For these reasons, it is risky to assume that a smooth substitution of high-grade hardwoods by a surplus of low density timbers will occur. In the short- and medium-run, a continued expansion of sustainably managed natural forests and an expansion of high-grade hardwood plantations is required for balanced forestry development.

In summary: **A sufficient area of managed high-grade tropical forest and hardwood plantations of the right quality standards is currently not available and must be established in the coming years if demand for tropical hardwood timbers is to be satisfied on a sustainable basis in the long run.** If not, a large latent demand will be satisfied mostly through materials that will put increasing strains on natural resources, including natural tropical forests and the use of these resources will run counter to efforts made to achieve sustainable development.

Investors and community growers who consider establishing high-grade tropical hardwood plantations in the short-term are to be encouraged **provided <u>quality</u> is the primary goal of these wood farms**.

Substitutes and balance

What is abundantly clear in these often contradictory arguments for and against substitutes is the need for a **balanced approach** to development. It is not a case of choosing tropical hardwoods **<u>or</u>** other woods. There is a strong argument to make for the establishment of high-grade tropical hardwood plantations and managing natural tropical forests on a sustainable basis. The key question is: what ultimate balance should be struck between land uses?

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[38] Sutton (1999).

[39] Odoom (2001).

[40] Ibid.

The world needs to satisfy the current and future demand for tropical hardwoods and this demand (at least domestic demand) is forecast to rise. A rational balance of roles and functions of all forests, both natural and man-made, is considered to be the best way forward. Forestry plantations are not *the* solution to protect natural tropical forests. However, they offer the best available solution to help provide an alternative supply of these timbers with minimum demand on land. They can, if carried out properly, be complementary to and release pressure on natural forests as suppliers of quality timber. More importantly, they can help natural forests play their crucial role in conservation.

One early consequence of a *laissez-faire* approach to tropical hardwood supply is likely to be mounting pressure for an upward redefinition of annual allowable timber-cut ceilings in natural forests, which could endanger the output of other goods and services and lead to further degradation and deforestation. Supplementary sources of hardwoods emanating from new high-grade plantations could assist in shifting a significant part of the harvest from natural sources to cultivation. This is the overall context in which the transformation of the teak component of the hardwood sector is viewed by TEAK 21. Before turning attention to this goal, an overview of the current teak component of the sector is provided.

3. The Current Teak Sector

Teak is widely known in the market place and has an excellent reputation for wood quality. It is in high demand and its cultivation is better understood than any other high-grade tropical hardwood, having been cultivated on a commercial scale for over 150 years in over 50 countries within and outside its natural range. It has long been recognized for its excellent wood properties, making it one of the most valuable multi-purpose timbers in the world. These properties, particularly for heartwood, include strength with lightness; durability; dimensional stability; non-corroding properties; ease of working and seasoning; termite, fungus, chemical, water and weather resistance and attractiveness. The versatility of its timber makes it eminently suitability for an array of end-uses that are well documented.

The current supply of teak depends on natural forest and plantation segments of the sector. These components are examined separately next.

Natural Forest Teak

Natural forest teak (referred to from henceforth as forest teak) is supplied almost exclusively by Myanmar (ex-Burma), which has about 16 million ha under the species. Other countries with indigenous teak (India, Thailand and Laos) have depleted their resources beyond the point of sustainable commercialization. Much of India's natural teak forests have been reduced to bushland, while in Laos their growing stock and area have suffered rapid degradation. In Thailand, forest teak has been so over-cut that logging and concessions had to be completely prohibited from 1983. A ban on clear-felling of forest teak also followed in India in 1987 and felling of teak was prohibited in indigenous areas of Laos from 1989.

There are ominous signs that Burma teak forests are not being managed sustainably. For example, evidence that the total potential harvest is in decline is clear from the annual allowable cut (AAC): it is now in the order of 400,000 m^3, down from 600,000 m^3 before 1996. At the same time the quantity of existing grades on offer at official tenders in the Yangon market is declining. There are no 1st Grade veneer logs and the volumes of 2nd and 3rd Grade veneer logs are ever reducing. Also, new, but inferior, categories of Saw-log Grades (SG) have appeared in 2000 and 2004; these new grades include SG-5 (Assorted) and SG-6 (Domestic)**.** Two additional grades (SG-7 and SG-8) appeared in 2007. Saw Eh Dah summarises the trends:

> The extent of natural teak forests is still reducing, the quality declining and the yield dropping ...[41]

The total extent of forest teak is shown in Table 3.

[41] Saw Eh Dah (2005).

Table 3. Area of natural teak forests

Country	Area ha
India	8,900,000
Laos	16,000
Myanmar	16,517,700
Thailand	2,500,000
Total	**27,933,700**

Estimated area early 1990s[42]

The official annual harvest from the natural forests of Burma is around 400,000 to 500,000 m^3/year. To this must be added any illegal timber extractions. Each year over 100,000 tons of teak have been logged illegally from Kachin and Shan states in northern parts of the country and smuggled into China.

Plantation Teak

Lack of good data inhibits a complete analysis of the entire hardwood plantation resource. However, a broad overview of available information and analysis is provided here. Teak, it has been suggested, makes up an estimated 74% of the area of tropical hardwood plantations. Other species in the category include: rosewood (*Dalgbergia*), which covers around 21% and mahoganies and other species, which make up the remaining area.[43] Table 4 shows estimates of the total area of teak plantations in the tropics for various years since 1980.

Table 4. Area of teak plantations by year

Year	Area (millions ha)
1980	1,300,000
1995	2,200,000
2000	5,700,000
2005	7,000,000

Estimated areas[44]

Comparing the four estimates in Table 4, it would appear that the total area of plantations has been increasing at an exponential rate. However, Del Lungo of the Food and Agriculture Organization (FAO) warns that different surveys of teak plantations over the years are not directly comparable and provide indications of trends only.[45] Furthermore, it is necessary to be cautious about the accuracy of the data, as illustrated by diverging estimates in the

[42] Gyi and Tint (1998).

[43] Odoom (2001).

[44] Teak area **1980**: Grainger (1988); **1995**: Ball *et al*. (1999; 2); **2000**: FAO, 2001; **2005:** Keogh, 2007

[45] Del Lungo (2001).

literature for particular countries.[46] For this reason, a comprehensive re-examination of the teak area was made by TEAK 21 when preparing this booklet. The database used consists of around 350 area-estimates for over 80 countries, embracing a time-period from the late 19th century up to the present.

Part of the confusion in area data is due to non-compatible definitions of plantation classifications between estimates. For example, FAO, through its Forest Resource Assessment (FRA), introduces the new forest class '*Semi-Natural Forests*' and consequently the Global Planted Forest Thematic Study 2006 includes the additional classification '*Planted Component of Semi-Natural Productive Forest*'.[47] The addition of this class elevated the teak area in India to 3.5 million ha, which is more than twice the normal estimates for teak in the country. There are many other reasons for confusion. Often the data depend on official releases by governments but the information is not always supported by field data. Gross figures may include areas designated to teak on which few or no trees exist. Statistics on planting often depend on seedling distributions from nurseries, rather than actual plant survival; losses are not always account for. Many estimates do not differentiate between afforestation and reafforestation and it is difficult to know what part of reported 'new planting' is in fact replanting following harvesting. Many plantations are smallholder owned which are usually not picked up in forest inventory data.

When taking into consideration the variation presented in the most recent data in comparison to older information, the best that can be said is that the current area of **teak plantations in the main countries where it is cultivated varies from a low of around 2.3 million ha to a high of 6.4 million ha**.

The average annual teak harvest depends on actual area covered in teak, its site productivity and the actual amount of timber extracted per hectare. Many teak plantations have been established on poor sites; many use inferior plant material and are managed badly and unsustainably.[48] Smallholder plantations are frequently abandoned and, as such, growth is often close to stagnation. Besides, in smallholdings, felling of better trees often occurs early in the rotation, inhibiting stands from reaching their potential yields. Also, the problems of ubiquitous illegal logging and land occupation for farming have led to the dramatic decline in standing stock in most age groups in, for example, Indonesia. In addition, a skewed age class distribution exists in plantations and long rotations are the norm. Some 65% of the teak area is under 30% of rotation age and average rotations are between 40 and 70 years.[49]

The volume emanating from community plantations that is used for local consumption is hard to estimate but may be in the order of several million m^3 worldwide. This generally consists of small diameters. It cannot be considered 'commercial' in the true sense and has little to distinguish it from timber species of lesser quality. The role of this timber cannot be dismissed but is separated here from the role of teak that can access domestic or international high-grade timber markets. Of concern here is quality commercial timber whether it originates from large or small-scale growers. The main focus of TEAK 21, therefore, is the sustainability of the commercial teak harvest.

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46 Ibid.

47 Del Lungo *et al*. (2006).

48 Bhat *et al.* (2005); various authors.

49 Del Lungo *et al.* (2006).

Expected reductions in output from deforestation and degradation of natural tropical forests will have a knock-on effect on remaining high-grade tropical hardwood plantations by increasing pressure to cut this material early. Already there is mounting pressure on forest resources, particularly in Asia due to a combination of increased demand, of log bans such as those in China, reducing concessions and reduced harvesting, particularly in Malaysia and Indonesia.[50] All this is affecting hardwood plantations.

Demand for good quality teak exceeds supply and, under these circumstances there is the real danger of over cutting through premature harvesting. If teak plantations are being exploited beyond their means to satisfy present demand, then the teak estate as a whole is degrading. Unfortunately, current plantation statistics are unable to indicate if degradation is occurring and, if so, at what rate. However, the literature suggests there are real reasons for concern.

In the 1990s, exports of teak from Côte d'Ivoire destined to satisfy demand in India accelerated from a trickle to over 120,000 m^3 (roundwood equivalent) in mid decade. By 2000 Maldonado and Louppe warned that teak exploitation may have already exceeded the productive capacity of the country's teak plantations.[51] This begs the question: what proportion of the global commercial teak harvest from existing plantations is non-sustainable? Katwal (2005) acknowledges that, in India:

> ... during the last five decades, the demand for teak has increased several fold, resulting in extraction of trees from old plantations and even from natural forests.[52]

The area under poor, badly managed and abandoned plantations is unknown but is considerable. Determining the percentage of teak in this condition is crucial in order to forecast correctly the expected output of quality timber from the overall teak plantation resource. Without more detailed knowledge and cognizance of the problems with existing data, it is clear that the average production of the resource as a whole is low.

On the other hand, high-input plantations or teak farms have been developed since the late 1980s, particularly in Latin America, based mostly on inward investments. Globally, these amount to around one hundred thousand ha and are developed specifically to produce commercial timber. Whereas their output, in terms of diameters and volume, is small this will change. In time they will become important sources of quality commercial tropical hardwoods and, because of their inherent levels of productivity are likely to shift the centre of gravity of plantation supply from Asia to Latin America if they continue at current rates of expansion.

There are few estimates of the total commercial harvest as a proportion of the global teak output from the plantation resource. However, the main teak producers accounted for, at most, 1 to 1.5 million m^3 per year in 1995.[53]

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50 le Clue and Brown (2006).

51 Maldonado and Louppe (2000).

52 Katwal (2005).

53 Sumantakul (1995).

Summary: The Teak Sector

The current supply of commercial teak originates from the natural forests of Myanmar and existing plantations. Myanmar has around 16 million ha under the species while the total area of plantations worldwide is in the order of 2.0 to 6.0 million ha. The **total harvest of commercial teak emanating from these sources was around 1.5 or 2 million m^3 in 1995**; natural forests supplied about 0.5 million $m^3$of this total. These are conservative figures as volumes from Africa and Latin America are not included. The volumes of other high-grade hardwoods (rosewood and the mahoganies) are also excluded. Nonetheless, the total commercial volume emanating from high-grade tropical hardwood plantations is low. It is in the order of several million m^3 and makes only a small contribution to the overall hardwood demand (90 million m^3).

It appears that both natural teak forests and teak plantations as a whole are being exploited on a non-sustainable basis and are part of the tropical hardwood crisis rather than a bulwark against it.

4. The Future Teak Sector

To establish a hardwood estate of 10 million ha (producing an average output of 10 m^3/ha/year) will take many years to achieve. It will require a large total investment of between € 50 and € 120 billion (today's costs). The resulting estate would provide an annual harvest of about 100 million m^3 of high-grade timber (roundwood equivalent) and sequester around 180 million tonnes of CO_2 each year. Further environmental efficiencies are achievable if wood waste is used to fuel the conversion plants of any resulting processing industry. Indeed, the widespread use of wood-based materials as substitutes for other non-renewable products is a viable option for reducing net CO_2 emissions with positive effects on climate. These benefits would arise in perpetuity from the envisaged hardwood estate that would cost less to establish and run over the whole rotation than the European Union's military expenditure in 2007 alone.[54]

Of course, to establish an estate of 10 million ha totally of teak would not be reasonable or feasible. However, teak would have a major role, particularly in the early stages of this development and it is the ideal species with which to introduce further variety and diversity into plantations. In an initial phase, say over the first 5 years (Phase I), a proportion (under 10% of the macro-target, or one million ha) could be established mainly with teak, placing emphasis on wood quality as well as the environmental and the social impacts of the estate. This is equivalent to planting 200,000 ha per year. To add value, the development could be set up in such a manner that it would function as a lucrative developmental tool for all stakeholders. How this might be achieved is explored next.

The Teak Sector in 2015

We 'fast-forward' to 2015 to the end of Phase I of the transformation of the teak sector when initial progress has been achieved. The individual teak plantation is significantly modified in its role and structure. Sites are still selected on the basis of deep, well drained, alluvial loam or equivalent soils that tend to have homogeneous profiles. Except for monocultures, planting limits on sloping ground (over 20 or 25%) are less important than previously because single teak trees can be grown with other vegetation, like bamboo or benign (non-competing) trees and commercial agricultural crops. Combinations of these types are known collectively as *industrial agroforestry*. A particularly interesting development is the combination of teak with other valuable tropical hardwoods. Under these circumstances soil erosion is less of a problem than it was in the conventional monocultures of the early years of the century because an adequate understory can be established. Fertility levels of the soil are important (particular emphasis is placed on the avoidance of acidic sites with low levels of calcium and magnesium). Good soil continues to be the number one site requirement for teak after precipitation.

Large-scale commercial plantations are seldom cultivated where the annual rainfall is less than 1500 mm. However, communities plant profitably down to a lower limit of 1200 mm because, although growth is less, they carry substantially less overheads and lower investor expectations

[54] http://en.wikipedia.org/wiki/List_of_countries_by_military_expenditures#List_of_countries_by_military_expenditure_as_a_percentage_of_GDP

than the large commercial companies. The requirement that the dry season be composed of 3 to 5 dry months (a "dry month" being defined as one in which 50 mm or less of precipitation are accumulated) is no longer sacrosanct. Movement into wetter areas has been a trend because growth tends to correlate positively with rainfall, but growers are conscious that these areas are difficult to work because of the continued danger of the 'teak syndrome' (a dying process of teak trees which tends to occur on locations without a clear dry season). For this reason, the planting border continues to be demarcated by a 'dry' season of several months though the definition has been refined to a 'period in which there is no surplus water' (i.e. precipitation and evapo-transpiration cancel each other out or leave a substantial deficit).

The most progressive commercial growers on new estates carry substantially less teak trees than the conventional monocultures of previous years. No company is now confined by spacing restrictions. This means that a flexible menu of silvicultural options is at the disposal of growers, allowing in theory unlimited planting patterns, including spacings down to 180 trees (7.5 m x 7.5 m) in which only the final crop is planted. However, most growers favor planting around 300 trees/ha (6 m x 6 m spacing or less). This allows these companies to avoid early thinning which are not profitable, provides them with space for other crops that give them early financial returns and means that all their thinning are lucratively commercial. Open-grown teak has allowed community growers to plant the species in an array of patterns that suit local requirements, including: intimate mixtures with crops, rows, lines, clumps, contour planting etc. Silvicultural flexibility allows growers to maintain a continuous forest cover as one crop rotation merges into another.

The single most important breakthrough permitting variable density planting came about as a result of genetic selection for specific gravity, strength and other desirable properties. It was long known that wood density in teak, unlike some conifers, does not suffer if diameter growth is increased by wide spacing or open-grown conditions.[55] It was also observed that heartwood percentage was, at least in some provenances, enhanced where diameter growth was rapid.[56] One residual problem was the extra juvenile wood that was produced during initial rapid growth. However, it soon became clear that the real problem with juvenile wood was not its strength properties but its lack of durability. This is now overcome by judicious exclusion of the relatively small inner core for timber uses that require high durability.[57] It is hoped that, through further genetic selection the non-durable core can be reduced or eliminated altogether, making the so-called 'juvenile wood' problem, a thing of the past.

In selecting genetic material for wide or open spacing it was necessary to ensure that the tree, while being an acceptable volume producer, would still maintain straight form in the main stem. The final problem to overcome was to ensure that post pruning re-growth of side branches could be controlled. This was solved through an understanding of the architecture of selected companion plants which provide enough shade to prevent epicormic branching. Besides, pruning is always carried out after the main flush of leaves is over.[58] Finally, some companies are experimenting with bud prevention on the pruned stem by using physical sheaths or applying chemical retardants. Genetic selection continues to have a role in this area too.

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55 Bhat and Indira (1997).

56 Kjaer *et al*. (1999).

57 Richter *et al*. (2003).

58 Briscoe and Nobles (1966).

Initially, when open-grown teak became a practical possibility, growers planted a wide array of companion plants. It soon became clear, however, that to obtain best results, the selections had to be made carefully. Now it is common for the mixes to be confined to specific teak provenances and particular provenances of companion trees or agricultural crops. Some of these combinations are also specific to particular site types. A mixed blessing is that these combinations and their linked management regimes are beginning to be patented.

The single most important breakthrough that enabled geneticists to begin their work on selecting acceptable open-grown teak provenances was not technical. In the early twenty first century the days of government-supported research were long past. Laboratories that were still involved in teak genetics never received sufficient levels of funding to develop the necessary 'critical mass' and take the process to the next stage of development. However, the large-scale growers and investors realized that, in order to overcome this impasse, sufficient funds would have to be made available. But the funding threshold necessary to make meaningful breakthroughs was always beyond the reach of any single commercial company. It was then clear to the more progressive players that co-operation was the only way forward.

Co-operation has made the selection of specific genetic material possible from a wide range of provenances worldwide. Particular companies that co-operated with each other set aside a proportion of their estates for experimentation. This meant that, on a relatively small area (from the point-of-view of an individual company) a large number of relevant questions could be answered. It was through the aggregation of the total experimental area worldwide that a large number of experiments were set up globally and replicated.

Local universities and international institutions still undertake the scientific work, which is supported by donor grants. The donors agreed to back this development on condition that the results were open to all, particularly community growers. It means that provenance experiments that were laid down throughout the tropics since the 1970s are accessible for inclusion into present studies. Transfer of germplasm around the world is not a problem because of links across an established network of scientific institutions. On the down-side, some countries are reluctant to provide what they consider is their national heritage to the scheme. Nevertheless, a sufficiently wide range of genetic material is available to ensure continued improvement from the accessible and available resource.

It became apparent during this work that a number of good provenances exist in the tropics which had been introduced during various donor projects and sporadic movements of seed to teak-growing countries during the twentieth century. However, the origins of these introductions were often unknown. To define extraneous provenances more fully and determine their pedigree back to their origins in the natural forest it was decided to classify them on the basis of genetic fingerprinting. This technique was extended to include the classification of the major provenances available to researchers in former teak trials where germplasm existed. It was also extended to the major historic seed distribution centers around the tropics, often botanic gardens which still contained sample trees. It soon became obvious that much would be gained by completing a genetic map of teak worldwide in terms of markers and geographic distribution. An unexpected advantage of genetic mapping is that companies can now introduce new varieties of certain provenances that have a proven 'track record' in their country, without waiting decades to demonstrate that they will adapt locally. At least the risk that these provenances will not form acceptable land races is considerably reduced. Another spin-off of this work is the discovery of several potentially valuable provenance hybrids throughout the plantation area.

A further advantage emanating from the completion of a genetic map of world teak is that most provenances in all teak-growing countries can now be classified. Where new strains appear they are added to the existing database. Another valuable output of this work is the ability of growers to identify or cross-check provenances in the nursery and/or in the plantation.

How did all this come about?

Strategic Steps that Transformed the Teak Sector

Early in the twenty first century it was realized that a lack of up-to-date and accurate information on teak plantation prices prevented a wide array of informed investment, management and market decisions from being made. Due to a lack of standards, lack of information and misinformation there was widespread uncertainty about prices and this turned away many potential investors from the teak sector, despite the 'green' nature of the investment and apparent lucrative returns.[59]

It was then suggested that the best way forward was to develop a transparent international pricing mechanism accompanied with a set of standard grading rules for plantations.[60] The entire teak sector was positioned to benefit immeasurably from the mechanism, and the rewards emanating from its implementation promised to outweigh the costs many times.

Once the pricing mechanism (a tender facility similar in nature to Myanmar's natural forest teak auction system) and accompanying grading rules were agreed internationally and introduced, it was possible to demonstrate how lucrative the investment could be. Returns of 10% or more (Internal Rate of Return) could be achieved (over inflation). As a result, many influential investors were attracted into the teak sector and investments grew steadily. Moreover, it was realized, after the recession that began in 2008, that the value of money could be conserved better in teak plantations than in the banking system or on the stock exchange. In this way teak grew into a recognized alternative asset class for investors.

In time it became possible to take the next most important step in transforming the sector. It was difficult, at first, to engage the donor community. Donors were uncomfortable working with the private sector, although many of their policy aspirations suggested that this would be a 'good thing'. The private sector was reluctant to participate in any co-operative venture with other commercial companies or the communities because they felt that they would lose their competitive edge and compromise their freedom. Besides, no one organization existed which had the mandate to cover all the facets of potential developmental co-operation that would incorporate the donors, the private sector, the communities, universities, research institutions and NGOs. No single body had the terms of reference to bring together, under one umbrella, all the facilitators to support a new and innovative approach to development.

The key to success came when each of the potential stakeholders became convinced that they could each reach their various goals more efficiently and cheaply through co-operation than

[59] Keogh (2009).
[60] Keogh (2007).

on their own. What was required, initially, was a change in attitude of the major stakeholders. However, this was not easily achieved.

The fear, on the part of large-scale growers that they would lose their competitive edge if they co-operated with other companies was very real but has largely disappeared. The best companies still compete by applying the highest level of management to their plantations as well as developing their own crop combinations. They are fully aware that the international teak genetic project has enabled strides to be made which would have been impossible or extremely costly without co-operation.

Co-operation extends beyond technical matters to schemes that incorporate the private and community sectors and these schemes are also supported by donor agencies. This allows the private sector to improve their financial returns and for the communities to receive equitable rewards for their input in these schemes.

Under normal circumstances it would not have been appropriate for organizations like aid agencies, development banks and NGOs, to support the private sector or participate in transforming a commodity sector. The issue of artificially distorting market forces was a particular consideration. Convincing arguments had to be made that the tropical hardwood sector was different. It was exceptional on several counts. The sector depended for its supplies on natural vegetation which, if not protected, would have had detrimental consequences for species and nature conservation, CO_2 release and global climate change. If alternative supply sources were not developed then these core ecosystems would be at increasing risk. For these reasons, the argument could be made that it was legitimate for the wider international community to support the hardwood sector in innovative ways.

Besides, it became apparent that limiting international approaches overlooked the enormous potential that could be leveraged by aid organisations through initiatives that enabled local communities and the private sector to combine forces for their mutual gain. Indeed the private and community sectors, working in unison, are the most appropriate entities for developing new plantations.[61] The donor community found that by holding up incentives to the private sector, which would help the communities, private entities were attracted to participate.

In simple terms, basic shifts in attitude allowed stakeholders to be receptive to making the radical changes necessary to enable the sector overcome its former limitations. It was recognized that exceptional steps had to be taken to achieve success and that a phased approach had to be introduced, to reach the ultimate goal. These steps had to be wide ranging and unlimited by conventional approaches. Innovation was essential. However, to achieve success in this difficult undertaking, a start had to be made somewhere. The first step was to change attitudes and the chief attitudinal changes that eventually came about after much discussion were the following:

- Commercial plantation growers (both private and community groups) no longer perceived themselves as totally separate entities but as complementary components of a common sector;

61 Keogh (2004).

- Commercial growers became aware of the potential that could be unlocked through shared programmes to speed up the advancement of applied teak technology, particularly in the genetic sphere;

- The international donor community, development banks, certifiers and relevant NGOs acknowledged the potential strength of the combined private and community sectors working in unison towards the creation of a powerful development tool in the form of a transformed teak sector; and

- Awareness amongst the producers that promotional campaigns (i.e. aggressive, sustained and professional marketing of high-grade tropical hardwoods) combined with educational campaigns aimed at architects, specifiers and end-users favour the demand for teak in quality markets of producer and consumer countries alike.

These attitudinal changes encouraged:

1. The private and community plantation owners to participate in common programmes, providing they were of mutual benefit;

2. Commercial growers to support scientific programmes that provided the critical mass to ensure the breakthroughs needed to create a flexible, high-quality, fast-growing planting stock (independent of spacing), thus allowing cultivators to benefit from a wide menu of silvicultural management options and mixed cropping; and

3. Donor agencies, certifiers and other NGOs to support undertakings that aimed at achieving activities outlined at 1 and 2 above.

Incentives were provided to overcome many of the disadvantages experienced by the communities, particularly in obtaining forest certification, which was too expensive for them. Another disadvantage that the communities suffered was the disparity in prices they received for their produce compared to the private sector because of their lack of knowledge of the value of their resource and their weak power of negotiation when selling timber.[62]

When the main certifiers encouraged private growers to incorporate communities under their certification regimes things began to change radically. Certifiers enabled private growers, who incorporated community growers into their forest certification systems, to gain an additional Fair Trade certificate for their timber. This allowed the private growers to access markets that were closed to them under normal circumstances.

Many other mutually beneficial arrangements began to emerge, including the long-term leasing of community land by the private sector, which reduced the costs of establishment and management for large companies. In return, the communities gained an equitable income. In other arrangements, development banks saw the opportunity to provide the private sector with low-interest loans (e.g. to establish sawmills) in return for incorporating community harvests into more lucrative marketing processes. In this manner the communities also gained higher returns.

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[62] Maldonado and Louppe (2000).

It became clear to the donor community and development banks that these arrangements were beginning to function as development mechanisms in their own right, with little donor expense. Thus, for a fraction of the cost of previous forestry projects – which in many cases had been shown not to work[63] – the donors now participate in these alternative development-type activities at the level of monitors or auditors rather than project drivers.

How was the system administered?

Rather than setting up a new entity at the beginning of this process, it was decided to bring together potentially interested stakeholders into a loose forum. Initially, the opportunity and freedom was given to stakeholders to participate without making a formal commitment. The forum began as a group of parties interested in exploring, openly, the way forward. It was seen to be unwise, at the start, to lay down restrictive rules and regulations. These were developed in time through the contribution of interested participants. Nonetheless, certain basic procedures were adhered to from the beginning, including:

1) The establishment of a secretariat composed of a co-ordinator and a secretary to oversee the advancement of the forum. This was done with a small financial commitment from interested parties.

2) The secretariat organized a series of meeting of the forum. A small number of interested and active participants (particularly donors, major international growers and investors as well as community representatives) participated.

3) The purpose of the first meetings of the forum was to:

- Develop an overview of the methods to be applied for co-operation;
- Obtain feed-back from the potential stakeholders;
- Define policy, objectives, and draw up a strategic plan;
- Lay down the steps to be taken to realize the main goals;
- Appoint a core group of active participants (executive body);
- Solicit the necessary financial support for the stages that followed;
- Begin projects on a business-like footing that mutually benefitted the main players.

Obtaining finance for the forum was not an un-surmountable problem once the main growers, investors and donors realized the benefits of co-operation.

The overall undertaking has been successful in that a second more ambitious phase of activity is being considered. It is conceivable that the second phase will continue to develop increasingly complex plantation structures with a more diverse species composition but, more importantly, will mobilize new sources of investment funding. Furthermore, the forum will become involved in promoting the sale of plantation teak and function to educate the users (architects, engineers and specifiers) about the availability and quality of the growing raw material.

63 Byron (1997).

5. Self Fulfilling Prophecy

It is the ambition of TEAK 21 to make the vision, expressed here, become self-fulfilling. What is needed now is to persuade a sufficient number of key individuals and institutions to participate.

To summarize: **the objective of the current proposal is to transform the teak plantation sector from its present position of sub-optimal activities, through a phased approach, into a powerful and lucrative developmental tool**. TEAK 21 has developed a mechanism which will assist in this process of transformation, called the Consortium Support System (CSS).[64] The CSS has been outlined and discussed in a number of works. A full list is available from the author.

As the first step in the 'new departure' of TEAK 21, **we are interested in your feedback** to see how the vision for the future of the teak sector might begin to be implemented.

Fortuitously, the Dutch company Terra Vitalis, together with the Costa Rican grower company Barca, the Instituto Tecnológico of Costa Rica (ITCR), the Asociación Nacional de Reforestadores de Panamá (ANARAP), Genfores (Cooperative for Conservation and Genetic Improvement) and TEAK 21 are cooperating to create an organization called Organización Latinoamericana de la Teca (OLAT) whose purpose is to develop standard grading rules for plantation teak, bring transparency to pricing in the marketplace and ensure an improved market for Latin American teak.

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64 Keogh (2002).

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7. Photos

Figure 1

Preparing a new asset class: mechanization of nursery operations for large-scale teak plantations (Courtesy Araguaia, Brazil)

Figure 2

Teak in the landscape: highly productive teak plantations in Latin America will shift the centre of gravity of supply from Asia to the New World if they continue to increase at current rates of expansion (Courtesy PanAmerican plantations, Costa Rica)

Figure 3

Environmentalists often allude to the inert nature of teak plantations. But, if the site is selected properly, as this photo of a 5-year old stand shows, a protective understorey layer can be established (Courtesy Terra Vitalis' plantations managed by Barca, Costa Rica)

Figure 4

The shape of things to come: mechanization of field operations is already a feature of large-scale plantations in South America (Courtesy Floresteca, Brazil)

Figure 5

Good quality teak is now found within and beyond its natural growing areas. Here a log of 'equatorial' teak in Sudan exhibits the high quality features sought by discerning markets (Courtesy Simon Kloos, C. Leary & Co. Ltd)