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TEAK 2000

A Consortium Support Model for greatly increasing the contribution of quality tropical hardwood plantations to sustainable development

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International Institute for Environment and Development

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1996

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Cover photo: Amazon Teak Foundation

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Executive Summary

Most of the high-grade tropical hardwood timber entering the world market originates from natural forests (FAO 1993). Supplies of this material will be restricted in the future as a result of deforestation, degradation and increasing demands on the forest to produce a balanced output of goods and services. This paper examines the potential alternative of establishing sufficient areas of teak plantations to produce a significant output of high-grade timber on a sustained basis, which might also relieve pressure on natural forests and contribute to the sequestration of carbon.

During the 1980s, plantations were mainly established for non-industrial, agroforestry and social purposes (Pandey 1990). This was due in large part to the increasing recognition that many industrial plantations were poorly planned and did not adequately address environmental and social concerns. In other words, to a non-holistic approach to forest conservation and development. It is now clear that plantations can be planned for social benefit and environmental stability, as well as for the production of quality hardwood.

The excellent wood quality, versatility of end uses and relative ease of establishment of *Tectona grandis* (teak) indicate that it will continue to be the most significant and widely used quality industrial plantation hardwood species in the tropics. However, it is clear that teak plantations established in the past have fallen short of their potential, and that a new approach is demanded for future programmes.

A **Consortium Support Model** (CSM) is proposed. As the name suggests, it is a system under which support (financial and technical) is given to groups (consortia) of teak growers to enable them to produce more and better quality teak in a socially and environmentally preferred manner. It is believed that research and investment targeted at a consortium will be more effective than if it is attempted to provide assistance to individual growers. The CSM is designed to satisfy environmental requirements as well as the mutual benefit of investors, growers, processors, local communities and the market itself. This model recommends that teak be planted only in sites where good growth rates and good quality timber can be achieved. It proposes support for financial, technical, research and quality control matters, to ensure the most economically-viable, socially-desirable, and environmentally-friendly production of teak in significant quantity over several countries. The Model also includes links to forest certification and labelling, to attest independently to the quality of production, and to "brand" the product. Ways in which social and environmental benefit can be assured are outlined.

The intention of this paper, "Teak 2000", is to elicit response to the Consortium Support Model, to gauge whether sufficient interest exists to take steps to translate the Model into a working reality. Plantation activities cannot, of course, substitute for all the other forest conservation and development activities which are taking place in the tropics. Plantations should complement and support the latter in a balanced system, to sustain the output of all possible goods and services from forests, woodland and plantations *as a whole*. It is contended that if any one aspect of forestry development in the tropics is ignored, other aspects will suffer. Yet it is also important that certain minimum social and environmental services are provided in every *individual forest area*. Hence there is room for improvement, to get things right in the teak plantations of the future, and in their contribution to land use patterns for sustainable development.

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Raymond Keogh
Nairobi, January 1996

Foreword

Many observers of forestry are rightly concerned with deforestation, and with the many environmental, social and economic losses that accompany this. There are many causes of this. At IIED, we are particularly interested, however, in the conditions that cause societies to move from a predominant situation of deforestation to one of tree planting and sustainable forest management.

The reality today is that forestry is no longer solely about the large blocks of remaining natural forest that are looked after (often ineffectively) by government authorities. It also concerns fragments of these forests, plantations large and small, and individual trees planted in places where they are most needed, by many different types of people. The changes in utility brought about by this process of fragmentation and planting, and how they affect the different groups of people, are extremely important. In some places, small elites alone have benefitted. In contrast, sustainable land use patterns result from trees being left, and being planted, in places where they are of economic, social and environmental benefit for many groups.

Plantations are areas of perennial tree crops; they are not direct substitutes for natural forests. However, there are many reasons for treating the environmental and social impacts of plantations with objectivity and for applying the precautionary principle. Notably plantations do not conserve biological diversity or regulate major watersheds in the way that natural forests do. However, plantations can provide substitutes for certain natural forest *goods* (particularly timber) and *services* (particularly carbon sequestration). In many cases, plantations can be much more suitable than natural forests - for large and regular supplies of wood pulp and sawn timber, for example - and in some circumstances this could also take the pressure off natural forests, in which production methods for wood products bring too many environmental and social ill-effects.

Much tropical hardwood is still cut from natural forests, a process often accompanied by many adverse impacts and associated costs. With world demands for wood rising, with the growing consensus that this wood should not come from unsustainable forest practices or natural forest clearance, and with many needs in the tropics e.g. for cheap and sturdy housing, unmet, it is acknowledged that there is a strong potential for major investment in tropical hardwood plantations.

It is true that there are many objections to large scale plantations, raised by different interest groups. Many are vehemently opposed to "monoculture". IIED is currently examining the basis of these objections. Already, it is clear that what is being objected to under the labels "plantation" or "monoculture" tends, in fact, to cover several dimensions, many of which become confused: notably biodiversity; the complexity of ecological networks and links; age diversity; use and product diversity; stakeholder/rights diversity; visual diversity; rates of change; or external inputs intensity. Any proponent or critic of plantation schemes needs to look closely at all these dimensions, at the trade-offs within and between them, and other dimensions which local stakeholders deem to be important.

Plantations have not always been readily accepted within land use patterns. Higher acceptability has been achieved on land with few competing claims. However, good land will have to be used for quality hardwood growth. Hence it is even more important to address the social (especially tenure), economic and environmental aspects of plantation systems within land use patterns. Part of the solution is better government understanding of where plantations are appropriate, and where they are not, together with appropriate technical support in partnership with the land owners and investors. Greater attention will also be needed to obtaining secure and stable policy and financial envi-

ronments for plantation investments - something that has always hindered plantations in the past. A critical need is to have in place long-term, innovative funding mechanisms. For example those that provide a stake or incentive to local communities and land users.

We believe that this document by Raymond Keogh proposes many of the elements that will be required for successful hardwood plantations. It is based around a partnership model - involving the main groups with an interest in making sure plantations are profitable and sustainable under local circumstances. It proposes a financial mechanism which will increase efficiency, long-term stability and, ultimately, allow tropical hardwoods to compete with substitutes (not the least of which are temperate hardwoods). It proposes a research mechanism to make sure that all growers, big and small, have access to the best technical resources and build on the best practice. And it allows for the incorporation of certification and labelling procedures. This is vital if teak and other tropical hardwoods are to be produced sustainably, and to re-create the market niche they began to lose as a result of (partial) public understanding of deforestation problems. Confidence needs to be restored. This requires a major, coordinated effort and incentives, as proposed in Teak 2000.

Whilst Raymond has rightly emphasised the virtues of teak, we believe that the approach has to be used for other hardwood species including those of such genera as *Mansonia, Gmelina, Albizzia, Schyzolobium, Khaya, Shorea* (and other *dipterocarps*) or *Eucalyptus* as appropriate to the site and market. More especially, we are interested in the support it could offer for developing highly-valued native hardwoods that have yet to be cultivated. Indeed, a single-species "miracle" solution rightly arouses suspicion in many, and a multi-species approach may sit more easily in areas where teak is not the most appropriate tree. None the less, we cannot think of a better "flagship" species than teak, provided the opportunity is taken to review the many lessons offered by past teak plantations and their impacts.

IIED is happy to publish this discussion document, in the hope that it will contribute to the debate on how to create the right incentives for sustainable plantations. The document does not have all of the answers; yet it is a bold proposal which deserves attention. The next step is to develop a business strategy, depending on the response to this document.

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London, June 1996

The Role of Teak

Many tropical forest tree species are in demand by the timber trade but, with a few notable exceptions such as teak (*Tectona grandis*), they are difficult to grow in plantations (Kanowski, et al., 1992). "Most species have evolved in highly competitive environments of forests composed of many species and ages of trees. Many species are shade tolerant and will grow only in small gaps in mature forests. Such species are usually unsuited to growing in pure stands or in open environments when young. Attempts to grow them in such circumstances usually result in chlorosis and decline or in fatal insect attacks" (Sharma 1992). Pest and disease problems prevent some species from growing consistently well, especially in humid areas. For example *Agathis* plantations in Queensland, Australia have been devastated by the coccid, *Conifericoccus agathidis*.

Teak is the most widely cultivated quality hardwood species, constituting, in 1980, *about 75% of the area under high-grade tropical hardwoods or 11% of the total area of* tropical forest plantations (Grainger, 1988). In 1990, teak constituted only 5% (estimated at 2.2 million hectares) of the reported total area under tropical plantations, of which more than 90% was located in Asia, mainly Indonesia, India, Thailand, Bangladesh, Myanmar and Sri Lanka (Pandey, 1990). Although the figures are from different sources, this apparent drop in teak's proportion may reflect the relative lack of importance compared with other purposes and species. Information on the area occupied by particular species within plantations is scarce (FAO, 1993).

The reasons for the relatively wide use of teak where quality hardwoods are planted are its ease of propagation, establishment and management, as well as its reputation for excellent wood quality. It is one of the most valuable multi-purpose timbers of the world. Its properties include:

- strength with lightness
- durability
- dimensional stability
- non-corrosion
- ease of working and seasoning
- and termite, fungus and weather resistance.

It has a wide range of end uses including bridge and wharf construction; furniture; *cabinet work; railway sleepers; and general carpentry. It is highly prized as a ship*-builder's timber; it is suitable for carving and lasts well in contact with the ground. This property derives from the heartwood, which begins to form from about the sixth year.

For these reasons, teak will retain its importance into the next century. It can provide quality timber and is the main plantation species discussed here, although other hardwoods appropriate to site and market conditions should not be ignored.

Teak's potential for carbon sequestration, along with other plantation species, is important. If the area needed to supply 10% of hardwood lumber demand in 1990 (ie 1.5 million ha) was totally planted to teak producing a mean annual increment of 10m^3/ha/year, and if the area continued to be grown under the species on a sustained basis, it would have the capacity to retain in the order of 150 million tonnes of carbon (Finch *et al* 1991). There are other species with comparable growth and fixation rates, which can make substantial contributions to total sequestration, and which can be grown in areas where teak may not be able to attain so large a mean annual increment.

Photo: American Teak Foundation

Careful selection of seed provenances determines key economic factors, notably stem straightness

A Question of Balance

Large areas of new quality hardwood plantations may, in some circumstances, contribute to the sustainable management of natural tropical forests. Notable circumstances are where plantations can produce goods for which natural forests would otherwise be subject to unsustainable demand. If, however, natural forests are unsustainably-used for other reasons - such as their being cleared in response to demands for agricultural land and products - then plantations clearly will not remove such pressure.

Sustainable management of forests and woodlands has been widely debated. Here *sustainable management* is defined as 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 harmonised manner, and in a way which does not reduce the forests' capacity to provide such goods and services on a continuing basis.*

Forest services include: water supply; conservation of soil; maintenance of the environment to protect livelihood and conserve human culture; conservation of flora and fauna (biodiversity) and their habitats; maintenance of carbon dioxide reserves.

Forest goods include: biomass for energy; wood and non-wood forest products.

In defining sustained management of forests, one concept should be understood and accepted. This is that *each unit area of forest cannot provide a sustained output of all desired forest goods and services.*

Lack of clarity about this concept has led to misunderstanding amongst conflicting interest groups. The concept has far-reaching implications and it forces a further qualification of what is meant by sustained yield:

If sustained yield of all goods and services cannot be obtained from each area of forest and woodland, then it must be proportioned amongst the whole. If the total forest and woodland area of a country is considered as the forest entity, this area should sustain most, if not all, goods and services. Applying this concept it is the overall *balance* of roles within the different parts which becomes of ultimate importance. Hence the importance of defining, at national level, a Permanent Forest Estate (PFE) comprising production, protection and mixed classes of forest under various types of ownership which, together, meet current and likely future needs for forest goods and services.

Nevertheless ecological knowledge and understanding have advanced to the point where it is possible to establish plantations with multiple objectives which ensure that a large number of defined goods and services are met from a relatively small area. Such "complex plantations" are described in some detail in Sargent and Bass (1992). It is not suggested that complex plantations can or should replace natural forest. But they can contribute to the overall balance of forest goods and services within a country or region.

The question remains whether the establishment of teak over relatively large areas is a good thing? The principal objections which have been raised against the growing of the species in even-aged plantations are presented below, and counter-arguments are given. Much of the information is derived from Kadambi (1972) and the author.

It is contended that, where site selection is careful and where adequate attention is paid to social and environmental issues, teak can provide a very useful plantation species.

Objection	**Counter-argument**
Plantation teak causes site deterioration and soil erosion and it grows slowly after about 20 years.	While growth of some Burma plantations has, according to reports, slowed seriously by age 20 or earlier, continued rapid growth has been observed in India especially West Bengal, Tamil Nadu, and Kerala. No soil deterioration (except erosion) has occurred in Burma, or in India in Kerala and Mysore. It is reported that some site deterioration may have occurred in the drier parts of central India. Soil erosion in teak plantations, both in Burma and India, has been confined to areas where undergrowth has been cleared and where burning has been excessive. Management which maintains a protective understorey of favourable species can probably avoid both soil erosion and site deterioration under pure stands of planted teak.
Plantation teak develops excessively fluted boles and epicormic shoots.	There is no sound evidence for excessive fluting purely as a function of its growth in plantations. Any prevalence of knots and defects due to epicormic shoots is at least partially hereditary, and considerably dependent on growing conditions.
Plantation teak is subject to excessive attack by bee-hole borers, defoliating insects, and mistletoes.	Attack by bee-hole borers appears to be somewhat more severe in plantations, although differences are small where attacks are heavy. Defoliators (*Hybalea puera* and *Hapalia machaeralis*) are reported to be no more serious in plantations than in natural forest in India: Tamil Nadu, Maharashtra, Orissa and Mysore. Generally, however, defoliator attacks are more serious in pure teak plantations, especially where there is no undergrowth. Attack by mistletoes (*Loranthus* spp.), though, is less severe in natural forests than in plantations. In general, the risk of insect attack is considerably reduced where good site selection has been carried out and teak is growing well.
Timber from plantations is of inferior quality.	Tests of plantation grown teak have shown it fully equal in strength qualities to natural teak of comparable growth rate. Selection of seed and appropriate management during the growth of the plantations should produce timber on good sites, equal in all respects to natural grown teak.
Pure teak is difficult to regenerate.	Good management (protection of seedlings) can often overcome the difficulty of regenerating teak plantations. Plantations in some areas (eg Benin) are managed on the basis of natural regeneration (Lutz, 1991).
After several rotations, teak will deteriorate the site.	We do not yet have enough information to verify this, but the growth of second rotation crops at Nilumbar suggests the opposite. Even if certain deficiencies do arise after several rotations, it may be possible to rectify them by providing one or more rotations of an alternative species in a somewhat similar fashion to rotations of agricultural crops. More research remains to be done.
Teak competes for good agricultural land which could supply food crops.	Planting on good soils does not necessarily affect food supplies, but teak is a legitimate competitor to non-food producing crops like cotton (cotton can be much less environmentally friendly than teak, as eg. large quantities of insecticides are often used during its cultivation). Assessments which take into account social and environmental costs and benefits (as well as financial ones) should be carried out before the land use decision is made.
Teak with its linked industry may provide largely male employment without all of society benefiting from it.	Teak can provide male employment where this suits the development objectives of an area. In most circumstances, a balance of male and female income into a society will have a more beneficial effect than a topsided development which segregates one gender for exclusive treatment. This underlines the need to support a balance of activities according to local needs.
Not only is teak planted in monocultures, but these normally cover large areas of homogeneous blocks.	There is no in-built requirement to plant teak in large blocks. However, to offset the pressure on natural forests to supply hardwoods (as well as to sequestrate carbon in significant quantities - although this would never be a principal reason for planting teak) the most effective method available is to establish large and efficient plantations or teak farms. A relatively small area of teak, compared with other monocultures (eg 14% of the total area under coffee), would provide significant volumes of quality timber. The risk to the environment and the crop itself from disease and other problems is minimized, if the cultivation is carried out correctly and on appropriate sites. Mosaic planting, in non-intimate mixtures with other species or land uses, is an option which allows the development of large or small blocks which are divided from each other, and these are useful against disease and for fire control (Sargent 1990), and allow for wildlife corridors through the plantation estate.
If plantations supply large amounts of quality timber efficiently, they may also undermine the total value of natural forest stands, thereby leading to their more rapid destruction.	The answer does not reside in a debate of: 'natural forest OR plantations'. A sensible balance should be struck between the two systems in which both complement each other. By doing so, the cutting rotation and the intervention cycle can be adapted to suit the growing conditions in natural forest areas and thus pressure to produce unsustained output is alleviated directly. In addition, mixed hardwood production is guaranteed (teak and natural hardwoods) which adds diversity to the final output.

Photo: Amazon Teak Foundation

The "stump" method is a proven, suitable practice for the propagation of teak plants

A Practical Example from Benin

In Benin, plantation teak provides at least 25% of local sawnwood demand and relieves pressure on the little remaining natural forest.

The Benin Government, with German development assistance (GTZ), has taken a pragmatic approach to the establishment and management of teak. In La Lama, the last remnant of the country's semi-deciduous forest has been surrounded by a 'buffer' of teak plantations and local people have been resettled[1] from the immediate vicinity of the natural forest itself, to an area which is benefitting from an agroforestry project. Plantations are regarded by the local people as a form of cultivation, whereas natural forest tends to be seen as wasteland and ripe for exploitation and removal. Thus, the plantations form a type of natural shield for the forest. Between the natural forest and the plantations is a degraded border into which the natural forest is being allowed to regenerate, and encouragement is also being given, in small experimental areas, through enrichment planting of appropriate species.

Close to Bohicon, an area of about 6,000 ha of poor teak, the bulk of which was established between 1966 and 1975, has had little or no management for many years. The area is flat; thus erosion is minimal. A poor provenance (or mix of provenances) and repeated burning has resulted in stems of very poor quality. None the less, because of the activities of the present project, some 1000 jobs - or 2000 at peak seasons - are being provided between the forest and sawmill. This represents about 9000 people who benefit directly (if the family members of those employed are included). This is a rural industry which helps to take pressure off the suburbs of the capital city. From the mill's output a sizeable carpentry industry has grown up around teak. In fact, the sawmill provides at least 25% of local sawnwood demand in Benin (on 0.0005% of the land area) which relieves pressure on the little remaining natural forest in the country. In addition to wood for carpentry, fuelwood is produced in the sawmill.

If, as is planned, the teak forest can be converted from a series of plantations of a narrow age-range, into a forest with a normal age spread[2], the potential for increasing quality of output, as well as volume, is considerable. In addition, there is the prospect of improving the provenance(s), by segregating out the worst of the local material through processes of natural regeneration (which is prolific in the area) and by importing teak seed with superior traits. Teak from Tanzania has been established in the project area, with initial results showing improvements regarding the age of flowering (in general, the later teak flowers, the better it is for final stem structure).

But a full evaluation of the Benin Project, in terms of social, environmental and economic costs and benefits (see p.14), has not been made. Some benefits are clear, however: the natural forest of La Lama could well have disappeared; the timber which the plantations supply in Benin would have to have been found elsewhere; and the plantations are also providing foreign exchange from sales of sustainably produced hardwood in Europe. While the Project is providing many benefits to local communities, the net social benefits (given the fact that some communities were relocated) are not proven.

None the less, the success of these plantations *indicate* that teak, and other hardwoods, have beneficial roles to play in sustainable development. But there is still much room for improvement.

1. From a social and humanitarian point of view, far better solutions than removing people from an area have been found, e.g. by giving local communities responsibility for managing the resource and by defining use rights. In Vietnam, for example, forest loss has been successfully countered by allocating forest land and by giving management contracts to the people (Howard 1995).

2. A normal forest - in the ideal sense - is one which contains a roughly even spread of age classes, each of which embraces an area of ground of approximately equal proportions and equal production potential.

Room for Improvement

The process by which teak plantations have been managed in the tropics in the past has generally been inadequate.

There are many disappointing teak plantations throughout the world. These are based on poor-quality genetic material, or are located on inadequate sites, and/or are badly managed. In many plantations, insufficient attention has been paid to maximising social and environmental benefit. In Asia, extremely poor growth rates of between 2 and 3 m^3/ha/year are reported. It is estimated that the average yield obtained in Kerala and Bangladesh could be doubled, while in Indonesia, it is considered that six times the yield should be obtainable (Pandey, 1992). There are very few well-managed teak plantations in Central America and the Caribbean. There is much room for improvement. The aim should be to obtain at least 8 m^3/ha/year (feasible on all suitable sites), to ensure goods and services are adequately provided and to distribute the benefits, notably profits, equitably amongst the actors (principally producers and the local population).

Best Growth Rates

Some of the highest teak production data found in yield tables and presented in the literature are shown in the graph (figure 1) for Cote d'Ivoire, India, Indonesia, Sri Lanka and Trinidad. These examples are given by way of illustration, to give a sense of scale of the possibilities for teak production. The upper curve, representing total volume accumulation through time for Indonesia, surpasses most observations around the world. The maximum mean annual increment produced, in this case, is 21m^3/ha at 15 years of age and the annual increment is maintained at or above 15m^3/ha up to 80 years.

We do not know what the maximum production potential is for the species. Crop nutrition, which in theory should be able to augment growth, is a complex field of study and universal predictions of increased growth rates, based on fertilizer applications, are unreliable. Genetic improvement is in its infancy and it will be many years before it will be possible to forecast growth from relationships between genetic strains and site.

It must also be remembered that maximum observed growth rates tend to be the exception, under field conditions, rather than the rule. For these reasons, predictions of growth rates for new or young plantations must be based on indicators which themselves rely on careful scientific studies of actual growth found under similar environmental conditions.

Normal growth rates in teak are generally lower than pines, eucalyptus or other softwood species. It must be remembered that teak is planted for high valued timber and not for rapid volume production; in fact a very rapid growth rate is likely to be detrimental to the quality of the wood produced.

Figure 1: Best production in teak

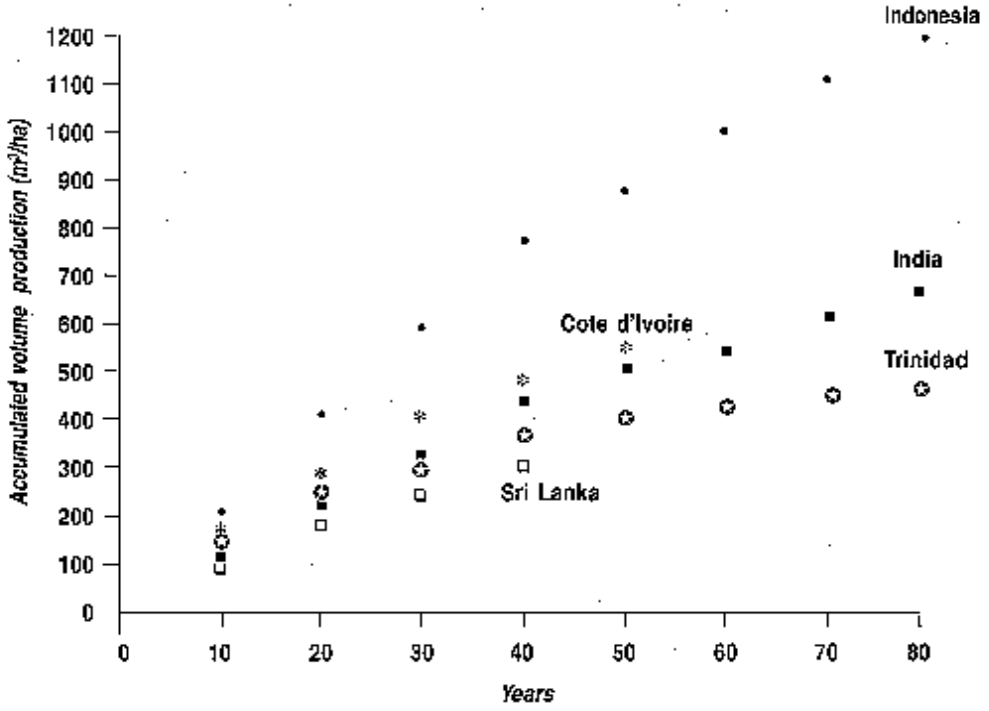


Figure 1 is constructed using the following data:

Table 1: Best production in teak

Year	*Accumulated volume production (m³/ha)*				
	Indonesia •	**Cote d'Ivoire** *	**India** ■	**Trinidad** ✪	**Sri Lanka** □
10	207	179	123	130	110
20	412	295	226	250	192
30	591	393	318	330	249
40	784	489	416	380	301
50	880	579	500	413	
60	1002		564	440	
70	1106		616	460	
80	1200		648	479	

Sources: Maitre n.d.; Pandey 1983; Miller, 1969; and Maddugoda, 1993.

The graph illustrates some of the highest recorded production figures for teak around the world. Teak is not grown for its volume production but to produce high value timber.

Where teak continues to be planted with a view to offsetting timber demand pressures on the natural forest, it should be treated as a quality product with a quality market in mind. To do this correctly it is necessary to avoid the mistakes of the past. A new departure is demanded. It is necessary to treat the species separately from species of lesser quality and to satisfy certain requirements, which include:

- adequate long term finance
- best reproductive material
- rigorous site selection
- high quality management
- a quality product for a quality market
- social desirability, and equitable sharing of profits and environmental acceptability

These are considered in turn, below.

Long Term Finance

It is well known that, due to the relatively long rotations involved with teak and other hardwoods, it is difficult to find investors who are prepared to lock up financial resources over the long time required to produce large-dimension material. Such difficulties particularly face local investors in tropical countries. International financial support, and a consortium approach, could help with the necessary stability.

A comprehensive survey of financial organizations that are willing to invest in plantations, and a comprehensive examination of special facilities and incentives, has yet to be carried out. An investigation of insurance and pension funds; surcharges raised on hardwood imports; forest bonds; tax and other incentives, and other instruments and institutions should be made. Direct support from international funding agencies under environmental budgets, are another alternative where hardwood plantations are shown to have a direct or indirect but positive impact on natural forests and/or where carbon sequestration is being facilitated. Whilst it is unlikely that international aid agencies could finance large-scale plantation development, their support in the form of "seed money" and back-up mechanisms would be invaluable.

By discriminating in favour of good-quality sites and high-quality genetic material, the returns on investment are more promising. In Ecuador, for example, Tobar (1987), estimated real internal rates of return of between 5.4 and 12% over a range of sites and using a spectrum of costs and returns.

Best Reproductive Material

Much research has been undertaken with teak provenances: Danida/FAO work on international provenance trials, which began in the early 1970s, is a good example (Keiding, 1977). However, supplies of superior quality genetic material (with few exceptions) are not available on a commercial scale; this is partly due to export restrictions on seed from countries in which teak is native. Seed is available mostly from areas in which the species is not native, such as East Africa and Latin America.

In the short run, much teak will have to be planted with the best local material available. Much can be done to systematically identify, select and improve existing local parent stock. In the past, governments have been relied upon to do this work, but their poor record to date suggests that the private sector might beneficially be involved with international research organizations and funding agencies.

Obtaining large amounts of seed for a large-scale increase in teak plantations could present formidable problems. The best way forward is to set up a special plant reproductive programme, to produce commercial quantities of growing stock to supply the planting programme. Financing would probably need to originate in part from the planting programme itself. Improved genetic material would be reproduced initially from the best local sources available. Tissue culture could also be used and, as the programme developed, better strains could be introduced into the plantations.

Photo courtesy of the Royal Botanic Gardens, Kew

Teak in the Central Range Reserve plantation, Trinidad. Photo taken in 1915 by C.S. Rodgers, 20 months after the sowing of seed. Mr Rodgers was responsible for introducing teak into the country from Tenasserim in Myanmar (Burma) in 1913 for plantation purposes. This is a photo of one of the first, if not the first, plantations on the island. A sizeable resource has been established from these small beginnings.

As regards provenance identification of local stocks, particularly outside the natural range of teak, the observation is often made that the original source is unknown. However it is almost certain that *more information is available than is commonly realised.*

Centres, which are known to have issued seed consignments on at least one occasion in the past, are likely to have supplied them on other occasions also. Summit Botanic Gardens in Panama was such a centre and supplied seed to Honduras, Cuba, Nicaragua, Costa Rica, Guatemala, Colombia, Jamaica, Haiti and the Dominican Republic (Keogh, 1980).

Persistent and painstaking detective work on existing records is necessary, to identify other centres of historic seed supply, with follow-up genetic finger-printing where parent material still exists. In this way, it is fairly certain that the jigsaw of provenances and strains outside the natural range of teak could be unravelled, and the results used to conserve the genetic base and improve the choice of material in a practical way.

Rigorous Site Selection

Teak grows best in a warm tropical climate in which there is:

- a dry season of 3-5 months ("dry month" being defined as that in which 50 millimetres or less of precipitation are accumulated);
- rainfall of about 1500 to 2000 millimetres per year, and a mean annual temperature of 22-27 degrees centigrade.

Thereafter, good soil is the most important site requirement for teak. It should be deep, well-drained, flat or slightly sloping alluvium with a homogenous profile. As the slope of the ground increases, the danger of erosion also increases unless an adequate understorey can be established or maintained. *If good quality sites are not available then teak should not be planted.* Teak is a quality product and must only be planted on quality sites. It would not be acceptable to embark on a large-scale planting programme using the lax methods of site selection of the past.

Most difficulty will be encountered in deciding how far to digress from the ideal site before planting becomes unacceptable. As a rule of thumb, plantations should be able to produce an average of at least 8m³/ha/year mean annual increment over the first 40 years of the rotation. Older plantations on the same site type are a good guide to production potential. Where no plantations are available, for comparison, the sites should be close to the ideal.

High Quality Management

Considerable advancements are possible through the practical application of what is already known about the management of teak. If the best genetic material available is chosen; if only good sites, yielding an average of 8 m³/ha/year or more are accepted for planting; and if the best known methods of management are employed for teak plantations of the future, an abundance of good quality timber will be available.

However, research must continue, for there are many local conundrums which need to be solved before large-scale plantations can be established or managed. Many of these questions might be solved through Intermediate Research (research which is geared to providing short-term practical solutions for field managers, based on the best information available (IDI, 1991)).

Obtaining new information which is relevant, and divulging it quickly, are the twin objectives of Intermediate Research. The results are intermediate rather than optimal but allow managers to progress, knowing that they are doing so on the best information available. The information will be updated as fresh material comes to light. Hence the important component of monitoring. For example, there is a need in many countries to refine growth predictions as a basis for planning, forecasting and general day-to-day management. One of the most economic methods of gathering new information quickly is to obtain it from similar areas which already possess the information. Information obtained on a regional or country-to-country basis is particularly useful, especially where (as in the case of Central America, the Caribbean, and West Africa) common ecological zones straddle several countries.

A Quality Product for a Quality Market

To enter a quality market, many of which tend to be environmentally-discriminating (and increasingly socially-discriminating), hardwood suppliers must be able to:

- guarantee the consistency of supply;
- offer the required dimensions;
- provide a versatile product; and, increasingly
- show independent evidence of the environmental and social quality of production; and provide a 'labelled' commodity to distinguish it from other products.

Certification and Labelling

Forest certification is conducted by an independent party, to demonstrate that adequate confidence has been provided that forest management is in conformity with a specific standard of management eg. good management or even sustainable management. It works through a mix of assessing the management systems and documentation of the forest enterprise, and checking of actual performance in the forest. *Labelling* is the means by which timber is guaranteed to have originated from those forests or plantations which have been certified as being well-managed, and is segregated from other products. It is practised through inspection of records, a parallel chain of custody record accompanying the timber, and/or physical timber labelling (Upton and Bass 1995).

There has been much debate about how this can be carried out in practice. Whatever means is used, it will be necessary for suppliers to satisfy their customers that the products on sale are the result of environmentally- and socially-sound practices. Where plantations are combined with natural forest management, there is an onus on the supplier to guarantee both sources. If this cannot be done, then some of the best markets will be closed. On the other hand, growers and processors, who can guarantee labelled products, carry considerable advantages in the market place.

Consistency of supply

Plantations which can supply only relatively small amounts of timber, on an erratic basis, cannot expect to capture markets which need the continual supply of large volumes. Under these circumstances, growers cannot expect to receive prices which will match those available in the better markets even if the quality of product is first class. For this reason new plantations will have to be established according to a plan (however general); they will have to be developed on a relatively large scale, and they will have to be located in such a way that economies of scale apply.

Required dimensions

If timber can be processed close to the growing area, and if it can be dried and sawn accurately to the dimensions required by the target market, then considerable savings can be made and higher prices obtained, compared to the situation where the material must be transported over long distances in the round or in the semi-processed state without drying. (Transport costs and growth rates tend to be the critical factors in plantation profitability.) By processing the material close to the growing area, more benefits accrue to the initial processors, and if growers participate in the conversion of the timber their returns are enhanced. Returns may be further enhanced by producing value-added items. Schemes which enhance the returns to growers will encourage them and their financial backers to support new hardwood plantations.

In the early years of plantation growth, only small-dimension material is available. However, these plantations could be planned together with sustainable natural forest management so that, for the enterprise in question, output of large dimension material is being produced as the plantations mature.

In other cases, where no natural forest exists to supply a supplementary volume of large dimension material, the plantations may be grown on short rotations, with a proportion of the area being grown on to reach long rotations. Here, the proportion of long rotation stands will increase through time.

In addition to conventional sawing, other types of wood processing machines are on the market which can add value to the product. One such machine (a veneer lathe) converts relatively small dimension material into veneer.

Versatile product

Hardwoods are subject to swings in consumer fashions (at present the trend is towards light colours in furniture). Teak produces a highly versatile material. Demand outstrips supply. It is not fixed to one market; it is of use both indoors and outdoors. For these reasons, growers can be confident about future market demand.

Socially Desirable and Environmentally Acceptable Production, and Equitable Sharing of Benefits

To be sure plantations are contributing to *sustainable development* it is necessary to examine whether they are economically viable *and* socially desirable *and* environmentally acceptable, both locally and at broader (national) level. And, if there is a problem in reaching these goals at one level (national or local), the trade-off with benefits at the other level (local or national) would have to be deemed acceptable to the "losers". Such forms of analysis have not generally been prepared for plantations in the past; the proposed Consortium Support Model would have to include targets for, and monitor, such dimensions.

The last few years have seen a spate of work developing principles, criteria and guidelines for establishing and managing plantations in light of social and environmental needs. For example, ITTO (1993), Shell/WWF (1993) and American Forest and Paper Association (1993) for a balanced range of guidelines; Bass (1993) for social guidelines; and Howlett (1993) and Shell (1994) for environmental management respectively. The Forest Stewardship Council released its principles and criteria for plantations in 1995. These all cover many principles for "getting it right" with respect to neighbouring communities, broader social values, and local and wider environmental impacts. They will not be repeated here in detail.

However, it is worth looking at the Shell/WWF Guidelines (1993), as they are highly comprehensive and written with commercial plantations in mind. These deal with both tropical and temperate areas (although they do not always adequately distinguish between the two zones, nor the major differences within these zones). However, they note that environmental "effects will be highly case-specific.... few generalisations are valid for all situations". The guidelines include much on soil and water conservation and biodiversity issues. A great advantage is that they are integrated with guidelines on all other aspects, and thereby demonstrate how integral wise environmental management is to successful plantations. Hence the importance of good survey, prediction of impacts, planning of plantations in the context of regional planning, and extensive stakeholder participation in making the trade-offs between plantation productivity and other objectives.

While the Shell/WWF Guidelines are general, much more detail is given in the accompanying technical background papers. One of these is particularly sound in environmental aspects: Good *et al.* (1993) suggest the following for building *biodiversity* into plantation establishment:

- develop a good understanding of native habitats, food webs and specific interdependences - their needs for pollination, food supplies, nesting and cover sites, etc. at different successional stages;
- then design and provide a range of niches and habitats similar to existing

Photo: Amazon Teak Foundation

Despite a distinct dry season teak can, on very good soils, show impressive yields after only 20 years

ecosystems: by planting a diversity of native species; retaining large areas of natural forest within or adjacent to plantations, perhaps corridors to connect to older woodland; extending crop rotation in certain areas to allow for some mature trees; and designing a layout of different species/age classes and high edge/area ratio.

For *soil and water conservation*, Good *et al.* (1993) propose that "successful sustained plantation management will reproduce the beneficial effects of primary forest (protecting land against soil erosion and favouring soil processes which enhance fertility) as closely as possible". They offer useful scientific principles and again stress the importance of individual site study, rather than specific technical suggestions. They propose:

- careful site assessment;
- management practices which minimise soil damage, such as no/low use of heavy machinery, controlled low-temperature burning, and minimal removal of ground vegetation;
- conservative harvesting;
- leaving debris in the forest;
- limiting draining, ploughing and herbicide/pesticide use to areas where these are essential;
- avoidance of short rotations and whole-tree systems except on very fertile sites;
- avoidance of clear-felling;
- multi-purpose plantations, to cover for uncertainties in markets and environmental conditions; and

- use of mixed species, including nitrogen-fixers.

These principles reflect those which are now gaining much support in sustainable agriculture; research into how to make them operational, and the costs and benefits of the resultant systems (taking into account social and environmental costs as well as enterprise costs) is now highly desirable.

Evans and Hibberd (1993), in a further technical study for Shell/WWF, provide good guidelines on "best practice" for plantation development; this includes well-integrated environmental components in almost all of its guidelines. In addition to those already cited in Good *et al.*, the guidelines include:

- ensure security of tenure to encourage investment in environmental management;
- encourage public participation in plantation developments;
- zone areas to accommodate certain needs which it is impossible to integrate with other needs;
- use natural regeneration to meet broader objectives of management;
- balance yield gains in genetic improvement of trees with conserving genetic diversity for insurance against uncertainties;
- develop good understanding of pest and disease ecology/biology in local conditions, and adopt integrated pest management as opposed to indiscriminate pesticide use;
- strictly observe chemical handling procedures;
- choose native species rather than exotic species where growth performance is similar.

Concerning *social guidelines*, Shell (1993) suggests the following principles and requirements:

- the various social groups should be identified, as well as the leaders who make forestry and land use decisions, in order to identify the right people with whom to negotiate;
- a consultation process should be set up so that representatives of the whole community may be consulted, and the dialogue continued during the development;
- participatory inquiry techniques should be used at the appraisal stage, to appraise resources and issues *with* local people;
- tenure (both legal and customary) should be studied and clarified, and customary usage formally recorded or negotiated where necessary; and incentives tailored accordingly;
- needs, motivations, perceptions and aspirations of local people should be assessed, along with local methods of cooperation and conflict; the plantation should be managed such that changes in attitude may be responded to;
- particular attention should be given to consulting local women and assessing potential impacts upon them;

- the layout and boundary configuration should take into account cultural and societal values (eg amenity and landscape values);

- local needs should be considered in planning the species composition of the plantation;

- the plantation should increase the opportunities for economic activities among local people (eg. consideration of outgrower schemes).

- healthy and safe working conditions should be ensured;

- indigenous people should not be displaced or disadvantaged;

- forest lands and resources should be managed sustainably to ensure the needs of future generations are met;

- choice of site should take into account current use, especially where it is used for basic food production or is important for cultural reasons.

In few cases known to us are these guidelines, or similar ones, mandatorily applied; their application relies on commitment and voluntary efforts, but it is increasingly being spurred on by the concerns of the market and/or shareholders and (in some instances) by the decision to have forests certified. Although many guidelines have impressive coverage, they are based on relatively weak empirical evidence (more is known about unsustainable practice than what is sustainable) and all depend, to a greater or lesser extent, on interpretation in light of local conditions.

Because of this, forest enterprises are wise to set up *Environmental Management Systems (EMSs)*, to help them set realistic environmental (and social) targets, monitor them, and adopt a policy of continual improvement. Indeed, if such enterprises are to be successfully certified as practising socially- and environmentally-acceptable management, EMSs look to be almost essential.

Facilitating Processes

Few teak plantations are established, managed and converted under regimes which satisfy all the requirements discussed above. To carry out the operations properly and successfully, a facilitating process needs to be set up for the establishment of teak, with the specific aim of supplying good quality timber onto the market on a sustained yield basis while, at the same time, offsetting pressure on natural forests and contributing positively to carbon sequestration. The processes must be largely self-regulatory and designed to attract long term funding.

Proposed Consortium Support Model

It is possible to devise a range of theoretical models, each one of which could *support the appropriate expansion of teak and other hardwood plantations to meet the needs of local, corporate and national "stakeholders"*. The model applied must comply with requirements for quality plantation management (discussed above), and for this reason the particular model chosen is the Consortium Support Model (CSM). A diagram is shown in Figure 2. It covers financial support, genetic improvement, management, timber conversion, monitoring and marketing. The CSM provides a 'seed-to-sawdust' approach.

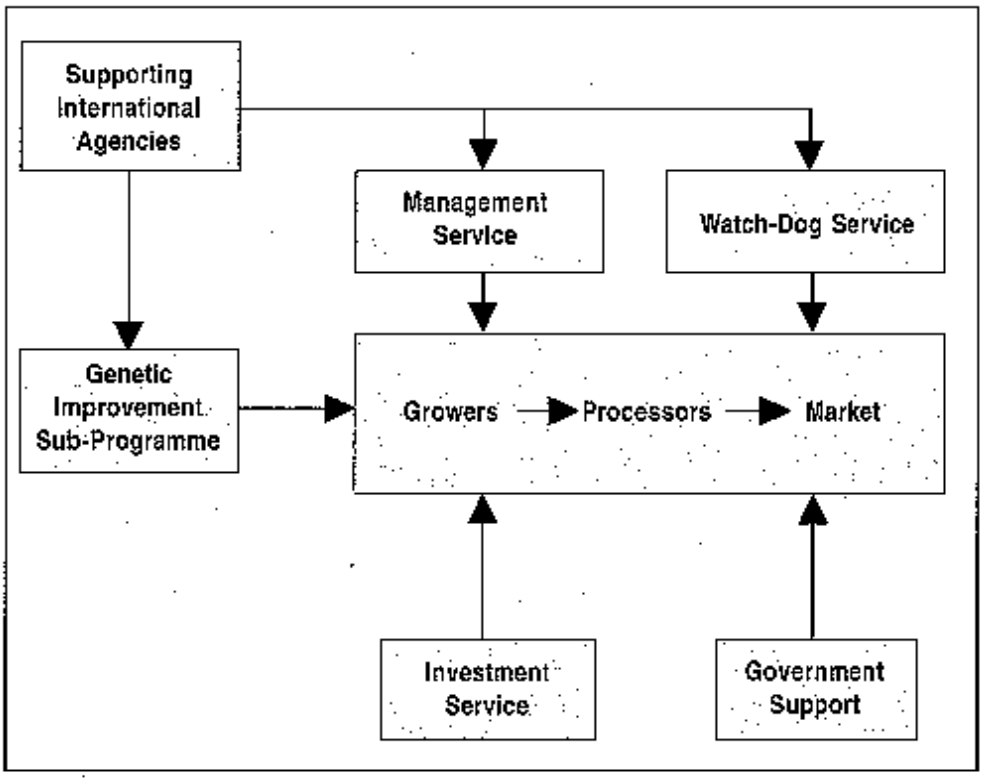
The programme recommended here is designed to overcome a significant disadvantage of growing hardwoods, namely: the disincentives which arise because funds must be locked up, without returns, over long periods. From the point of view of governments and donor agencies, investors and growers are helped to establish new hardwood resources which will offset pressure on the natural forest and contribute to carbon sequestration. The costs of the support mechanisms, which are needed to overcome disincentives, equate to the costs of environmental protection.

Rather than forming new organizations, the programme could be executed by entrepreneurs on a business footing. Some international organizations and agencies may be reluctant to support segments of the private sector and provide them with what may seem to be unfair advantages over other growers. To counter this, it needs to be repeated that, by and large, hardwood plantations have not been established properly in the past and, without encouragement, it is unlikely that they will be established properly in the future.

Photo: Amazon Teak Foundation

The reddish colour of the top leaves is an indication of favourable site conditions

Figure 2: Process diagram for the Consortium Support Model



Furthermore, the CSM scheme should be open to large and small growers who are prepared to conform to its standards. Entrepreneurs would be encouraged to avail themselves of the support mechanisms during early years when returns on investment are poor. Once the volumes of timber reach commercial dimensions, and financial returns begin to take effect, growers would become progressively less dependent on support mechanisms.

The components of the model, discussed in more detail below, are:

- the growers, processors, and the market
- supporting governments and international agencies
- support services (financial/ management/ watch-dog)
- a genetic improvement programme.

Growers, Processors and the Market

It is considered that the private sector is the most appropriate group to undertake the execution of the core activities of the programme (ie planting, processing, transportation and marketing of timber). In the CSM, growers register under a recognised consortium to avail themselves of the benefits of the programme. These *benefits* would include:

- access to high quality *international expertise* on finance and management
- availability of *long-term finance* from a range of investment institutions and schemes,
- access to improved and subsidised *genetic material* for planting, and
- maximized *returns* for the final produce.

New plantations may be planned on their own, or may be managed in conjunction with

natural forests. In the latter case, a comprehensive inventory of the resource must be carried out; and natural forests managed strictly according to standards locally-agreed as desirable. The plantation/natural forest combination is a strategy which overcomes some of the disadvantages of locking assets in growing plantations for long periods while returns are obtained in the short run from the sale of already mature timber.

Whatever approach is used, a detailed management plan has to be drawn up by each individual member of the consortium; the individual plans are the building blocks of the programme and must be compiled to high quality standards. The plan must indicate precisely the location of all timber extractions, the year in which they are carried out, and include means to prove that the cutting regimes are based on sound principles (eg. certification). The consortium forests, plantations and management plans are open to inspection by the watch-dog service. Where it is impossible to make a complete check of all consortium members, random sampling is carried out.

Individual management plans are brought together and an overall master plan drawn up. Individual growers are allowed to develop at their own pace; it is the responsibility of the management service to control the overall expansion of the plantations in a coordinated and sensible manner. In this way, growers who do not possess the scale of plantations to supply the more lucrative markets, on a sustained basis, are able to overcome this disadvantage through the collective strength of the consortium.

Proprietors of *existing teak plantations* may be facilitated to bring their existing resources under sound management regimes within the CSM, provided they have suitable plantations on appropriate sites and are prepared to formulate and conform to an individual management plan. *Government* forests may also be assisted but must conform in the same manner. Many government forestry services do not have a good record in forest enterprise management and accountability, and there may therefore be the possibility of governments contracting out the management of government-owned plantations, on terms agreed with the CSM.

Maximising the returns to growers is a core objective of the CSM: if growers are content with the scheme, they may encourage others to become involved and, as a result, the area under plantations will expand. Returns to growers are likely to increase the more they become involved in downstream activities. Consortium members may, therefore, decide to carry out the processing, transportation and marketing of their timber.

In the future, international markets are likely to be less receptive to tropical timbers originating from areas exploited without proper management. Pressure is increasing from the non-governmental organization (NGO) community within consumer countries to prevent the sale of timber which originates from exploited rather than managed areas, and/or to purchase wood from certified forests only.

In conclusion: market opportunities exist for producers of quality timber who can guarantee supplies from properly managed forests. The CSM aims to take advantage of this unique opportunity for hardwood growers, helping to guarantee a large total supply and good forest management. The price of timber from managed areas is likely to rise in real terms and, more importantly, access to environmentally-discriminating markets will be greatly skewed in favour of well-managed forests. However, competition from sustainable temperate hardwoods must be considered. While it would be unwise to forecast the scale of rise into the future, it is reasonable to expect that the returns based on today's prices will constitute the minimum returns available to growers.

Consortium timber should be distinguishable as an environmentally friendly product in the market place. To do this, (a) the forests must be *independently-certified*, and (b) the timber produced should be *labelled* under the trade name of the consortium. How can this be achieved? The CSM establishes a supply chain from grower to buyer, each

link of which is subject to monitoring, so that confidence is maintained that no 'mined' or otherwise 'contaminated' timber infiltrates the system. The first principle is to assume that each link in the chain will try to 'beat the system' and therefore a procedure is set up which 'seals all cracks'.

The scheme is based on the individual management plan. In any one year a member of the consortium is not allowed to supply a volume of timber which exceeds the amount stipulated in the plan itself. When timber conversion takes place, the resulting volume must bear a strong correlation with the harvested volume (this can be checked by using the average conversion ratios of the mill in question). Again: the species coming from the processing unit must be the same as the species supplied by the grower.

Supporting Governments

In the CSM, governments that are willing to develop new teak and other hardwood plantations within their territories, provide a support role rather than becoming directly involved in plantation management or in the conversion or transportation of the raw material. They are responsible for facilitating the process through appropriate incentives and concessions. These support facilities may take several forms and include tax incentives, enticements for setting up appropriate conversion plants, marketing support (including favourable export regulations) or a mixture of these facilities. In some cases they may facilitate long-term finance through grants.

Furthermore, registration of companies within a consortium, and the number of consortia to be established, are authorised by the host government. Government can withdraw support from those members of a consortium which are performing below the required standards.

The government agrees on the area it is prepared to support under hardwood plantations, how they are to be increased through time and in what region(s) of the country they are to be established. Two or more countries may cooperate with one another. A minimum size of timber catchment is programmed so that economies of scale prevail.

Governments in the industrialised countries that are willing to provide special facilities for imported labelled timber assist the programme indirectly. Donor governments may become directly involved by donating special funds to the international agencies to support the programme.

Supporting Services

Participating international funding agencies finance the supporting services, namely: the information, investment, management, and watch-dog components of the programme. They also support the genetic improvement programme.

Services are staffed by experts selected from relevant disciplines and are augmented in line with the development of the overall programme. They could be based in the supporting agency's head offices with field offices established if these are deemed necessary. Alternatively, some of the services could be operated by existing centres of excellence.

Information Service

A key element of the CSM system is the availability of up-to-date information, to assist management practices to improve. The management component of the CSM would, therefore, be backed by an Information Service which would act as a clearing-house for information on teak production, as well as other key tropical hardwoods. The Service would be responsible for coordinating with other sources of information, avoiding

duplication of effort, and providing CSM associated with the best possible advice on teak research, cultivation, management and marketing. In addition, it would provide guidance on the need for new research where gaps in information are identified.

Investment Service

The investment service is responsible for identifying the range of financial facilities available to consortium members and for mobilizing funds. These facilities may come from pension funds, compensation-for-pollution payments, levies on trade, government grants, (ethical) investment companies or direct from consortium members themselves. It is unlikely that a single source of investment could support the large scale planting programme envisaged. The investment service may establish special facilities like the issuing of forest bonds. The arranging of grants for machinery is another responsibility of the investment service. In addition it undertakes feasibility studies and any other action of a catalytic nature which benefits the overall programme.

Management Service

The management service is responsible for drawing up the overall programme, as well as specific regional or country sub-programmes. Growers avail of the service when devising their own feasibility and management plans and use it for consultancy back-up during programme execution. It would include (access to) social and environmental advice. The service could be subsidised in the initial years of the programme but, when plantations become commercially viable, growers should entirely fund its upkeep.

Watch-dog Service

The watchdog service consists of an interdisciplinary body of professionals belonging to reputable environmental and other relevant organizations. It is responsible for checks at all levels of the process to ensure that management is carried out to specific standards and that environmental damage is kept at acceptable levels. It, or another body, is responsible for tracking labelled timber from the growing areas into the market. Alternatively, the "watch-dog" could well be an independent certification body (of which there are at least seven fully in operation at present), possibly accredited to the Forest Stewardship Council, a group which accredits certification bodies.

Where the watch-dog service finds that growers fall short of reaching the minimum standards required at any stage of the process, they forfeit all benefits and must withdraw from the consortium for at least a minimum period. The host government supports the decision of the watch-dog service. For the programme to be effective, the advantages gained by growers and processors, through participation in a consortium, must far outweigh the advantages of working outside it.

The Genetic Improvement Programme

A genetic improvement programme is in the interest of growers, in order to guarantee planting material of the highest quality. It needs to be subsidised, at least in the initial stages, by international agencies. Once the product becomes available in commercial quantities, it will be possible to offset costs through sales to growers. The aim of the programme is to identify and utilize the best genetic material available, improve it where possible and bulk it for the production of planting stock; its aim is not to carry out research. However, backup support from a research establishment, with knowledge of the procedures, would be arranged.

Discussion and Conclusion

Forestry and environmental organizations, governments (both donor and recipient) and international agencies have a responsibility to address an aspect of forestry which has been neglected, namely: the development of new supply sources of quality timber in the tropics to offset pressure on the natural forest and, in so doing, to contribute to carbon sequestration and other benefits. Establishment of new hardwood plantations is one of the best methods to achieve this goal.

At present there are many potential investors and growers interested in producing quality hardwoods, like teak, but they are reluctant to do so because of a lack of knowledge, or because they do not wish to maintain their own assets locked within a growing resource over long periods.

On the other hand, exaggerated expectations of the growth and financial returns obtainable from teak plantations are enticing some investors, who have little knowledge of the species, to part with substantial sums of money and establish new plantations, often on inappropriate sites. In the long run such activities will act contrary to legitimate programmes and will be detrimental to the expansion of quality hardwood production in the tropics.

A special support mechanism is required to help investors identify reputable programmes and encourage them to make capital investment in the establishment of new hardwood resources. The Consortium Support Model is such a mechanism, which would provide the backup information on how to: establish and manage teak and other hardwoods to the highest environmental, social and silvicultural standards; source and identify long-term financial backing; and provide up-to-date forecasting on expected financial returns. It would also seek novel methods of raising investment funds for interested growers through willing financiers and financial organizations. And it would ensure independent certification of the quality of growers' forest management, and labelling of their products.

A new approach to establishing high grade hardwoods is demanded in the face of past failures. It is no longer acceptable to establish quality hardwood plantations in the same manner as other, less demanding species. The establishment of teak and other top-grade species needs to be treated as a separate forestry activity in much the same way as wine growing is separated from other less demanding agricultural activities. A specialist cadre of forester, qualified in the production of a top quality raw material, is also required.

The current proposal for TEAK 2000 presents an opportunity for investors and should allay fears that a large-scale development of plantations on commercial lines will increase competition amongst growers to the point of weakening timber prices. Competition from alternative materials (including temperate hardwoods) are unlikely to offset the demand for high-grade tropical hardwoods, especially in the light of increasing domestic demands.

A Consortium Support Model will not develop overnight. It needs to be discussed in an international forum, which can mould the concept into a working reality. An association of interested investors, growers, foresters, financiers, conservationists and industrialists, from a variety of backgrounds, including the international donor community, the developing countries, research and conservation organizations, international aid organizations and other appropriate bodies, would be an ideal way to prepare the groundwork for a new departure in establishing industrial hardwood plantations.

For this reason, TEAK 2000 has been published to obtain as wide a spectrum of views as possible on the concept and to obtain a list of interested individuals and organizations who would be willing to become active participants in translating the concept into a working reality. If sufficient interest exists in the concept and sufficient finance is made available, it is proposed to form an association entitled 'TEAK 2000' to bring the interested groups together at a world conference on the subject. Such a conference would be a spring-board for action.

To reiterate: the establishment of new teak plantations is not meant to distract from other activities of a forestry nature, including other plantations which are being carried on in the tropics. Rather, it is intended to complement them and, in so doing, produce a balanced output of goods and services from forests, woodlands and plantations as a whole. The argument is: if any one aspect of forestry development is neglected, other aspects suffer.

You are invited to submit your reactions in writing to:

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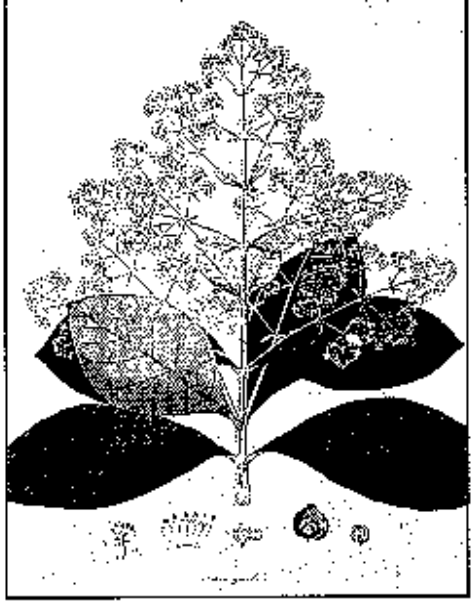

Photo courtesy of the Royal Botanic Gardens, Kew

TEAK 2000

This paper examines the potential of establishing sufficient areas of teak plantations to produce a significant output of high-grade timber on a sustained basis, which might also relieve pressure on natural forests and contribute to the sequestration of carbon.

The excellent wood quality, versatility of end uses and relative ease of establishment of teak indicate that it will continue to be the most significant and widely used quality industrial plantation hardwood species in the tropics. However, it is clear that teak plantations established in the past have fallen short of their potential for producing economic, social and environmental benefits. A new approach is required for future programmes.

A Consortium Support Model is proposed. Such a system would provide financial and technical support to groups, or consortia, of teak growers. It would enable them to produce more and better quality teak in a socially and environmentally preferred manner. The intention of this paper is to elicit response to the Consortium Support Model.

IIED's Forestry and Land Use Programme

The Programme addresses needs for productivity, sustainability and equity in forestry and land use. Its research and capacity-strengthening work focuses at the national level in developing countries. It involves:

- **policy processes:** supporting participation of multiple interests in policy analysis, formulation and monitoring
- **sustainability assessment** of forest management and use
- **capacity development** of governments, NGOs and communities for sustainable forest management
- the **development and monitoring of incentives** for sustainable forest management.
- The Programme occasionally **publishes materials** by other institutions and individuals, in the interests of debate. "Teak 2000" is one such contribution.

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