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TEAK RESOURCES AND MARKET ASSESSMENT 2010

(*Tectona grandis* Linn. F.)

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Cover photo:

An old planted teak forest at Wayanad, Kerala, India. Photo K.M. Bhat, Kerala Forest Research Institute

Contents

List of tables

List of figures

Preface

The Teak Resources and Market Assessment 2010 (TRMA 2010) is a special study of the Global Forest Resources Assessment 2010 (FRA2010). It aims to present updated country level information on teak (*Tectona grandis*), which is one of the emerging hardwood resources in the world. The assessment was conducted through a standardized questionnaire sent to 69 countries, which used the existing networks of FRA national correspondents and the members of Teaknet, an international teak information network managed by the Kerala Forest Research Institute (KFRI), India. These contact persons proved to be effective and knowledgeable communication channels, who forwarded the questionnaires to qualified experts with access to the required data on teak. The data and information given in this report have thus gone through a well-established process of data collection, processing, validation, compilation and analysis. In general, however, it must be stated that many national experts found it difficult to provide the required data. The figures and the information that was provided by the reporting countries are given in annex 5.3.

Acknowledgements

The participation of national experts from many institutions in teak growing countries has ensured that the best and most recent data, information and knowledge on teak resources and markets have been made available and are shared with other colleagues. FAO thanks all contributors for their vital collaboration. A list of all contributors by country is provided in annex 5.1.

We wish to acknowledge as well inputs from Dr. Kadiroo Jayaraman, the Teaknet Coordinator from the Kerala Forest Research Institute, India, and Mr. Jim Ball, Consultant to FAO, who has reviewed the first draft of this report and has provided useful comments and information.

Summary and Conclusions

1. **Global significance of teak.** Teak is a small proportion of world timber production and trade. The estimated market share of teak logs in total tropical round wood production is less than 2% but in terms of value it is much larger, since teak is part of the high-value hardwood market, and is a major component of the forest economies of many tropical countries. Planted teak forests have attracted large investments from the private sector in Africa, Asia and Latin America. Globally, they constitute the only planted hardwood resource that is increasing in terms of area.

2. **Survey coverage.** The Teak Resources and Market Assessment 2010 (TRMA 2010) was conducted in 2011 in 69 countries, 9 of which reported that they do not grow teak. 43 countries reported that they grow teak, but of them only 38 countries were able to give data on the species.

3. **Teak areas.** Natural teak forests are estimated to cover 29.035 million ha in India, Lao PDR, Myanmar and Thailand. Almost half of the total is in Myanmar. The area of planted teak forests reported by 38 countries is estimated to be 4.346 million ha, of which 83% is in Asia, 11% in Africa, and 6% in tropical America. Taking into account the data missing from 22 teak-growing countries, this figure certainly underestimates the actual area of planted teak forests.

4. **Planted teak – a globally emerging hardwood**. Planted teak is the only valuable hardwood that constitutes a globally emerging forest resource. Compared with previous surveys, the planted teak area has increased greatly in Africa (Benin, Ghana, Nigeria, United Republic of Tanzania), Central America (Costa Rica, El Salvador, Guatemala, Nicaragua, Panama), South America (Ecuador, Brazil) and Asia (India, Indonesia, Myanmar, Lao PDR).

5. **Age class distribution and rotation age**. Planted teak forests are predominantly (77%) younger than 20 years. The prevailing age class distribution shows recent efforts to establish planted teak forests, but the current enthusiasm of many corporate and private investors for planted teak will maintain the youthful age structure and, in order to improve the economic rate of return, will tend to shorten the rotation period. This will lead to a significant increase in the supply of small-dimension logs grown in short rotations not exceeding 20 years.

6. **Ownership.** In Africa, Asia and the Caribbean most planted teak forests are owned by governments, generally the forestry or agricultural administration, but in Central and South America state governments own merely between 1% and 12% of planted teak forests, while the private sector holds 88% in Central America and 99% in South America. Teak is not currently a priority species in community forestry, although there are a number of cases of smallholder teak plantations which have contributed to the improvement of rural livelihoods.

7. **Growth performance.** The reported growth rates of planted teak are contentious. Many growth predictions continue to appear on the internet and in literature, predicting very high growth rates above 20m^3/ha/year. The actual long-term productivity of planted teak has, however, often turned out lower than predicted. Teak is not a fast growing species

per se. Its growth performance depends on the quality of the planting material and the best management practices. The mean annual increment (MAI) reported by 26 countries appears rather modest and lies, for most regions, between 2 and 14 m^3/ha/year, except for some high-intensity investment schemes in Central and South America.

8. **Log removals.** A volume of ca. 0.5 million m^3 is currently estimated to be harvested in natural forests and 1.5 to 2 million m^3 in planted forests if all teak producing countries were accounted for. The world's total teak supply from natural and planted forests adds up to 2 to 2.5 million m^3, of which at least 60% are cut in India, Indonesia and Myanmar. The estimated market share of teak logs on the total tropical roundwood production is less than 2%. In value terms a much higher share can be expected, but there are no data to support this.

9. **Supply from natural teak forests and genetic resources.** Myanmar is the only country producing quality teak from natural forests as India, Lao PDR and Thailand have logging bans in natural forests or log export bans in place. A maximum sustainable supply of quality teak from Myanmar is likely to be in the order of 400,000m^3/yr or less. In future it can be expected that the sustained production of teak logs from natural forests will be further limited due to increasing deforestation and competition for environmental services. Hence, the supply trend points to a continuing decline in the volume and quality of natural teak and it is imperative to initiate a program for the conservation of natural teak forests if the genetic resources of natural teak are to be sustained.

10. **Global teak market trends.** The global teak market has been and will continue to be governed by trends in the Asian market. Asia holds more than 90% of the world's teak resources and India alone manages 38% of the world's planted teak forests. The high international demand for general utility teak has broadened the traditional teak supply base from natural forests in Asia to include fast-grown, small-diameter plantation logs from Africa and Latin America.

11. **Indian demand dominates the market.** The major teak trade flows worldwide are directed towards India, while its own considerable teak production is processed within the country. Eleven out of fourteen reporting countries name India as their number 1 importer, absorbing 70% to 100% of global teak exports including shipments of plantation logs and sawn timber from Africa and Latin America. In Africa, significant exporters are Benin, Ghana, the United Republic of Tanzania and Togo. In Latin America, Ecuador, El Salvador, Guatemala and Brazil, are important teak exporters (no information was available from Costa Rica and Panama).

12. **Price and quality.** Obtaining prices for teak logs and sawn timber proved to be difficult. No common international log grading rules have been established, most exporting countries' definition of log dimensions turned out to be different, and the use of various measuring units for dimension and volume further complicated the price survey. As a general rule it can be established that teak prices are very closely related to wood quality. Quality in teak is determined by dimension, bole shape (roundness and straightness), heartwood/sapwood ratio, regularity of annual rings, number of knots, colour, texture and the soundness of the butt log. Teak from natural forests in general possesses many of these features to some extent and sells at comparatively high prices. Logs from planted teak forests are typically smaller in size and will hardly ever reach the dimension, quality features and prices of logs grown in old-growth forests.

Resumen y conclusiones

1. **Significado global de la teca.** La teca representa una pequeña proporción de la producción mundial de madera y del comercio. El aporte estimado de los troncos de teca en el mercado, en comparación con la producción global de madera tropical en rollo, es inferior al 2%, pero en términos de valor es mucho mayor, ya que la teca es una parte del mercado de madera de alto valor y un componente importante en las economías forestales de muchos países tropicales. Los bosques plantados de teca han atraído grandes inversiones del sector privado en África, Asia y América Latina. Al nivel mundial es la única madera dura que está aumentando en términos de área plantada.

2. **Cobertura de la encuesta.** La evaluación de los recursos y mercados de teca 2010 (ERMT 2010) se llevó a cabo en 2011 en 69 países, 9 de los cuales informaron que en ellos no crece la teca. 43 países informaron que en ellos crece la teca, pero, de ellos, sólo 38 países fueron capaces de proporcionar datos sobre la especie.

3. **Áreas de teca.** Se estima que los bosques nativos de teca cubren 29.035 millones de hectáreas en India, RDP Lao, Myanmar y Tailandia. Casi la mitad del total está en Myanmar. El área de bosques plantados de teca reportado por 38 países se estima en 4.346 millones ha, del cual 83% está en Asia, 11% en Africa y 6% en América tropical. Teniendo en cuenta los datos que faltan de 22 países donde crece la teca, esta cifra por cierto subestima el área real de los bosques plantados de teca.

4. **Teca plantada - una madera dura emergente a nivel global.** La teca plantada es la única madera dura valiosa que constituye un recurso forestal emergente a nivel global. En comparación con encuestas anteriores, el área plantada de teca aumentó considerablemente en África (Benín, Ghana, República Unida de Tanzania), en América Central (Costa Rica, El Salvador, Guatemala, Nicaragua, Panamá), en América del Sur (Ecuador, Brasil) y en Asia (India, Indonesia, RDP de Lao).

5. **Distribución de clase por edad y edad de rotación.** La mayoria de los bosques plantados de teca (77%) es menor de 20 años. La distribución de clase por edad predominante demuestra los esfuerzos recientes para establecer bosques plantados de teca. Sin embargo, el actual entusiasmo de muchos inversionistas corporativos y privados por la teca plantada mantendrá la estructura de edad joven y, con el fin de mejorar la tasa de rentabilidad económica, tenderá a bajar la edad de rotación. Eso conducirá a un aumento significativo en el suministro de troncos de pequeñas dimensiones, los que fueron producidos en rotaciones breves que no superan 20 años.

6. **Propriedad.** En África, Asia y el Caribe los gobiernos, o sea las administraciones forestales o agricolas, poseen la mayoría de bosques plantados de teca. No obstante, en América Central y América del Sur los gobiernos solo poseen de 1% a 12 % de los bosques plantados de teca, mientras que el sector privado posee 88% en América Central y 99% en América del Sur. Actualmente la teca no es una especie preferida en el manejo forestal comunitario, aunque hay algunos casos de plantaciones de teca en propiedad de pequeños agricultores que vienen contribuyendo al mejoramiento de los medios de vida rurales.

7. **Crecimiento y rendimiento.** Las tasas de crecimiento reportadas de teca plantada son contenciosas. Muchas predicciones de crecimiento siguen apareciendo en Internet y la literatura, que proveen tasas muy altas de crecimiento superiores a 20m^3/ha/año. No obstante, la productividad real de teca plantada a largo plazo resultó a menudo inferior al previsto. La teca no es una especie de rápido crecimiento en sí. Su rendimiento depende de la calidad de las plantas y de la aplicación de buenas prácticas de manejo forestal. El incremento medio anual (IMA) reportado por 26 países parece bastante modesto y está, para la mayoría de las regiones, entre 2 y 14 m^3/ha/año, excepto en el caso de algunos planes de inversión de alta intensidad en América Central y América del Sur.

8. **Tala de troncos.** Se estima que actualmente un volumen de aproximadamente 0,5 millones de m^3 se talará en bosques nativos, y de 1,5 a 2 millones de m^3 en bosques plantados, si todos los países productores de teca se tuvieran en cuenta. De esta forma, el suministro de teca total mundial procedente de bosques nativos y plantados se llega a calcular entre 2 a 2.5 millones de m^3, de los cuales al menos 60% se talan en India, Indonesia y Myanmar. El aporte estimado de los troncos de teca en el mercado, en comparación con la producción global de madera tropical en rollo, es inferior al 2%. Se puede anticipar un aporte mucho mayor en términos de valor, pero no hay datos que apoyen esto.

9. **Suministro de bosques nativos de teca y los recursos genéticos**. Myanmar es el único país que produce teca de alta calidad procedente de bosques nativos, una vez que la India, RDP de Lao y Tailandia han puesto en vigor prohibiciones de tala en sus bosques nativos o bloqueos de exportación de madera en rollo. Es probable que el suministro máximo sostenible de teca de calidad de Myanmar esté en el orden de 400.000m^3/año o menos. En el futuro, se puede anticipar que la producción sostenible de teca en rollo de bosques nativos será más limitada debido a la creciente deforestación y la competencia por servicios ambientales. Por lo tanto, la tendencia del suministro apunta a un receso continuo del volumen y de la calidad de teca nativa. Así las cosas, se requiere iniciar un programa para la conservación de bosques nativos de teca a fin de que los recursos genéticos de teca nativa se sostengan.

10. **Tendencias globales en el mercado de la teca**. El mercado global de la teca ha sido y seguirá siendo regido por las tendencias en el mercado asiático. Asia posee más de un 90% de los recursos mundiales y solo la India maneja el 38% de los bosques plantados de todo el mundo. La alta demanda internacional de madera de teca de utilidad general ha ampliado la base tradicional de teca procedente de los bosques nativos asiáticos para incluir troncos de pequeño diámetro y de crecimiento rápido producidos en plantaciones de África y América Latina.

11. **La demanda india domina el mercado.** A nivel mundial los mayores flujos comerciales de teca se dirigen hacia la India, mientras que su propia producción de teca considerable se procesa dentro del país. Once de los 14 países que han informado sobre el comercio internacional mencionan a la India como el primer importador, que absorbe de 70% a 100% de las exportaciones globales de teca, incluyendo las entregas de madera en rollo y aserrada de plantaciones de África y América Latina. En África, los exportadores importantes son: Benín, Ghana, la República Unida de Tanzania y Togo. En América Latina, Ecuador, El Salvador, Guatemala y Brasil son exportadores importantes de teca (no había información de Costa Rica y Panamá).

12. **Precio y calidad.** Resultó difícil obtener precios de madera de teca en rollo y aserrada. Dado que no se habían establecido normas internacionales comunes sobre la clasificación de troncos de teca, la definición de las dimensiones de troncos en la mayoría de los países exportadores resultó ser distinta, y, aún más, el uso de distintas unidades de medida para la dimensión y el volumen complicaba el levantamiento de precios. Por regla general se puede constatar que los precios de la teca están estrechamente relacionados con la calidad de la madera. La calidad de la teca luego se determina por la dimensión, la forma del fuste (la redondez y la rectitud), la proporción de duramen y albura, la regularidad de los anillos de crecimiento, el número de nudos, el color, la textura y la sanidad del corte de la primera troza. La teca de los bosques nativos en general posee muchas de estas cualidades hasta cierto grado, así que se vende a precios comparativamente altos. Las dimensiones de los troncos de los bosques plantados son típicamente más pequeños y casi nunca alcanzan la dimensión, la calidad, las propiedades y los precios de troncos producidos en bosques nativos.

1. Introduction

Teak (*Tectona grandis* Linn. f.) is recognized for its physical and aesthetic qualities as one of the most important and valuable hardwoods in the world (Keogh 1979, 2009; Tewari 1992). Although it takes only a marginal position in the volume of world timber production and trade, teak together with mahogany (*Swietenia macrophylla*), red cedar (*Cedrela odorata*) and Indian rosewood (*Dalbergia sissoo*) are the tropical hardwoods most in demand for the luxury market and for heavy duty applications.

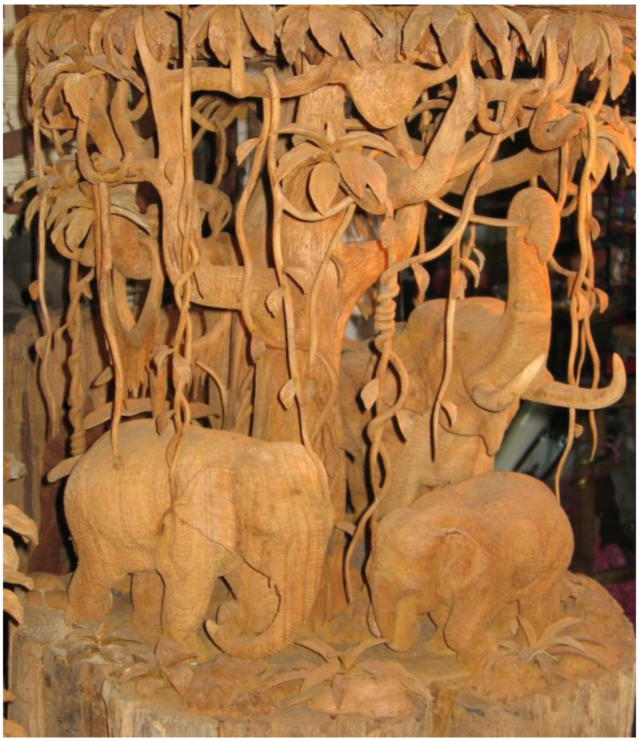

Figure 1: A decorative teak carving from Thailand
Photo W. Kollert

Teak is used for ship building and yacht furnishing, heavy duty construction and railways, high-class furniture, decorative building components, veneers, flooring, and utility poles for transmission lines. In 1896 Brandis attributed the high market value of teak to its excellent durability in tropical climates and its resistance to termite attack and fungi, and praised teak as it is easily worked, does not warp or split, takes a beautiful polish, and can be floated at harvest in contrast to many other heavy hardwoods of comparable quality (Brandis 1896). For many tropical countries teak represents the best opportunity to produce quality timber and is thus of major importance to their forestry economies (Keogh 1996). In recent years, the establishment and management of planted teak forests have attracted large investments from the corporate sector in Latin America, Africa and Asia.

Natural teak forests occur in only four countries in the world: India, Lao PDR, Myanmar and Thailand. Sites suitable for vigorous teak growth are confined to tropical zones around the equator below 1000 metre altitude, with annual rainfall in excess of 1 500 mm, and fertile, deep and well drained soils. The ancient kings of Myanmar and Thailand considered teak to be a royal tree and placed it under stringent royal proclamation and protection. In the 19th century India was the world's leading teak producer. Under the British colonial government, large quantities of teak were exported to Europe, mainly for shipbuilding and luxury furniture. After India's independence in 1947, forest resources became increasingly threatened, until India's central government decided to ban teak logging altogether since 1980. India's timber production thus dropped sharply and was replaced by mass imports. Today the Indian teak industry is highly dependent on imports from Myanmar, West Africa and Latin America.

Since the 1980s, supplies of teak wood from natural forests have started to dwindle and teak has been grown increasingly in planted forests throughout tropical Asia, Africa, Latin America and Oceania. Having been introduced in Java, Indonesia, probably between four hundred to six hundred years ago, the challenges to grow and sustain planted teak forests are better understood there than in most other tropical hardwoods (Pandey and Brown 2000). Indonesia has established extensive teak plantations managed by the state forest enterprise Perhutani, and many tropical countries have followed suit under public, corporate and private ownership - including farmers from the agricultural community. In southern India (Karnataka, Kerala and Tamil Nadu) this has caused considerable changes in rural landscapes, where teak plantations are often found in the middle of arable lands (Demenois *et al*. 2005).

FAO and its member states soon became aware of the growing significance of teak on a global scale. Upon recommendation of the Seventh Session of the FAO-Conference held in 1953 a Teak Sub-Commission was established as a subsidiary of the Asia-Pacific Forestry Commission (APFC). It held its first session in Bangkok in February 1956 with 36 representatives from 11 member countries. The second session took place in Bandung, Indonesia, in June 1957. The Teak Sub-Commission comprised two technical working parties, one on ecology, seeds, silviculture and protection, and one on management, utilization, marketing, grading, statistics and trade (FAO 1968). Additionally, an independent study group on teak grading rules was established under the direct supervision of a permanent committee. The Teak Sub-Commission noted that the exchange of information on the production and trade in teak could be of mutual advantage to both the importing and exporting countries and suggested that such information be submitted by teak growing countries on a half yearly basis (FAO 1956). Unfortunately the work of the Teak Sub Commission stalled in the early 1960's. The 11th session of the FAO Conference in 1961 transformed the Teak Sub-Commission into a joint body of the Asia-Pacific Forestry Commission (APFC) and African Forestry Commission (AFC), but it did not in fact materialize. The FAO Council, in October 1966, decided that the work of the Teak Sub-Commission be incorporated into the former Committee on Forest Development in the Tropics. The Teak Sub-Commission held its last session in Rome in 1967 and since then has been defunct (FAO 1968).

2. Previous teak resources assessments

In the period from 1975 to 2005 several teak resources assessments had been conducted by different authors. Their results are not directly comparable as they apply different survey methods and the results show wide differences, especially for some countries, but they do give useful indications of trends (Del Lungo 2001). They are summarized in the following section.

2.1 Hedegart (1976), Keogh (1979) and Tewari (1992)

In 1992 Tewari published a monograph on teak, in which he compiled a comprehensive dataset on teak resources, partly based on the previous works by Hedegart (1976) and Keogh (1979). Natural teak forests were reported to comprise 29.4 million ha, while the planted teak resources of 34 countries were estimated at 1.3 million ha, of which India, Indonesia, and Nigeria took 87% of the total. A summary by region is in table 1.

Table 1: Estimated global teak resources in the 1970s
(number of reporting countries in brackets)

Continent/Region	Natural forests 1000 ha	Planted forests 1000 ha
Africa (9)	--	99
Asia (13)	29 420	1 185
Caribbean (2)	--	10
Central America (6)	--	2
Oceania (2)	--	2
South America (2)	--	1
World (34)	**29 420**	**1 300**

Source: Tewari 1992, based on Hedegart 1976 and Keogh 1979

2.2 FAO Forest Resources Assessment 1990/1995

The first systematic assessment of planted teak forests was conducted by FAO in 1990. Its dataset was originally presented in FAO Forestry Paper 128 '*Forest resources assessment 1990: tropical forest plantation resources*' for 33 countries (FAO 1995). Later, this 1990 dataset was updated to 1995 in order to establish a link between the Global Forest Resources Assessments 1990 and 2000 (FAO 2001).

The country reports submitted for the Global Forest Resources Assessments 1990 indicated that teak was the most widely planted high-quality hardwood species. The global area of planted teak was reported to be *ca*. 2.25 million ha, a figure also used by Ball *et al*. in 1999. The major teak-growing countries were India (44%) and Indonesia (31%). Thailand, Myanmar, Bangladesh and Sri Lanka also had significant areas under planted teak. In tropical Africa Nigeria, Ivory Coast, Sudan, Ghana, Togo, and Benin had major areas of planted teak. In tropical America the total area of planted teak was estimated at about 33 000 ha, of which 43% were in Costa Rica and 23% in Trinidad and Tobago (see table 2).

Table 2: Planted teak forests by region 1995
(number of reporting countries in brackets)

Continent/Region	Planted teak forests 1000 ha
Africa (10)	109
Asia (11)	2 108
Caribbean (2)	8
Central America (6)	23
Oceania (2)	3
South America (2)	3
World (33)	**2 254**

Source: Pandey and Brown 2000, and pertinent working documents

The FAO forest resources assessment 1990/1995 estimated the planted teak area larger by 1 million ha than the estimate of Tewari in 1992, though both assessments use an almost identical list of teak growing countries. At around the same time Centeno reported the area under planted teak forests at 3 million ha based on available statistics, literature and own calculations (Centeno 1997).

2.3 Teak survey in Central America, 1998

A survey conducted in 1998 in Central America found that the total area planted with teak was 40,815 ha, of which 58% was planted in Costa Rica, 32% in Panama, 6% in El Salvador and 4% in Guatemala (De Camino *et al*. 2002, see table 3). In relation to the total planted forest area, teak constituted 18% with most in Panama (49%) and El Salvador (38%).

Table 3: Area planted with teak in Central America in 1998

Country	Total planted area (ha)	Area planted with teak (ha)	% of teak
Costa Rica	135 498	23 475	17
Panama	26724	13 135	49
El Salvador	6584	2 488	38
Guatemala	12444	1 717	14
Nicaragua	32754	n.a.	n.a.
Honduras	8647	n.a.	n.a.
Belize	2245	n.a.	n.a.
Total	**224896**	**40 815**	**18**

Source: De Camino *et al*. 2002

2.4 FAO Forest Resources Assessment 2000

The Global Forest Resources Assessment 2000 (FRA 2000) was the most comprehensive survey since FAO first reported on forest resources. It included a survey of forest plantations by 8 species groups, among them *Tectona grandis* (FAO 2001). The teak plantation area reported by 31 countries was estimated at 5.716 million ha, with the bulk being in India (45%) and Indonesia (26%). In this survey, Brazil for the first time reported a teak plantation area of 14 000 hectares. A summary by region is provided in table 4.

Table 4: Teak plantation area by region as reported in FRA 2000
(number of reporting countries in brackets)

Continent/region	teak plantation area 1000 ha
Africa (8)	208
Asia (13)	5 408
Caribbean (1)	9
Central America (5)	66
Oceania (2)	7
South America (2)	18
World (31)	**5 716**

2.5 Synthesis of previous assessments

From 1975 to 2000 a number of attempts have been made to measure the extent of teak forests in the world. Even though the results of these surveys are hardly comparable, it can be concluded from previous assessments that the total area of natural teak forests was about 29 million ha and the area of planted teak forest shows an increasing trend over the period from 1.3 to 5.7 million ha.

Myanmar, India and Indonesia are the teak 'heavyweights' at the global level and hold by far the bulk of the world's teak resources. In Africa Nigeria, the Ivory Coast and Ghana have grown in significance as have the smaller countries in Central America and the Caribbean such as Costa Rica, Panama, El Salvador and Trinidad and Tobago.

Furthermore, teak was apparently of no particular significance in South America until 2000; ever since then some South American countries such as Brazil, Ecuador and Columbia have reported that the areas under planted teak are increasing.

3. The Teak Resources and Market Assessment 2010

3.1 Objectives and method

The Teak Resources and Market Assessment 2010 (TRMA 2010) aimed to update, evaluate and expand the available data and information on natural and planted teak forests in all teak growing countries that were selected according to previous assessments and references from the literature. There were a total of 69 countries, all of which have their major land area between the Tropic of Cancer and Tropic of Capricorn (a list is given in Annex 5.3). In early 2010 a standardized questionnaire of six pages was sent by electronic mail to all selected countries in four languages (English, French, Portuguese and Spanish). The parameters surveyed in these questionnaires were forest area, age class distribution, ownership, growth performance, wood removals, international trade and timber prices. The questionnaire is at Annex 5.2.

Initially the questionnaires were sent to the national correspondents for the Global Forest Resources Assessment 2010. Most of them could not report on teak resources for lack of statistical data, but provided the names of other experts in forestry departments, research institutes, universities and the private forestry sector, who were contacted in the second stage of the survey. Where no response was received, up to three reminders were sent to the given contact.

After receipt of the completed questionnaires all reported figures were subject to a plausibility check; those data which were perceived as unrealistic or doubtful for a particular country were reviewed in cooperation with the respective contact person or with the FAO regional offices, and corrected if indicated. The time period from the first transmission of the questionnaires until the receipt of the last answers spanned eight months. A global response rate analysis is given in table 5 and a break-down of responses by region in table 6.

Table 5: Questionnaire response rate

	Countries	%
Questionnaires sent to	69	100
Answers received by	52	75
Teak reported to grow in	43	62
Data on teak available in	38	55

Table 6: Questionnaire response rate by region

	Countries in						
	Africa	Asia	Carib-bean	Central America	Oceania	South America	Total
Questionnaires sent to	26	16	5	7	5	10	69
Answers received by	19	12	4	7	3	7	52
Teak reported to grow in	12	12	4	7	3	5	43
Data on teak available in	10	10	3	7	3	5	38
Share (%)	38	63	60	100	60	50	55

Out of 69 contacted countries 17 did not respond to the questionnaire, though at least 2 reminders were sent. Most non-responses were small countries with an insignificant area of teak. Among the 52 reporting countries, nine countries did not grow teak. Zambia and Zimbabwe, for example, sent excellent data sets, which did not, however, refer to *Tectona grandis*, but to *Baikiaea plurijuga*, which is known in international markets as Zambezi teak.

Of the 52 countries which returned the questionnaire, 43 confirmed that they grew teak. Of those, 5 countries reported that they did not have any data or information on the species. Eventually, 38 out of 69 contacted countries (55%) reported usable data on teak resources among whom were the South-East Asian 'heavyweights' Myanmar, India, and Indonesia. 'Reporting' in this context does not imply the receipt of a full data-set on all parameters, but rather a report on some parameters only. Hence, the number of reporting countries turned out different for most parameters. In few cases, missing data were supplemented by information from published reports, 'grey' literature and from personal contacts.

The countries that appear best-informed on teak resources are the small countries in Central America, where all contacted countries were able to report usable data on teak. In African countries the availability of data and information was found to be lower than in other regions (see table 6).

3.2 Data quality

The TRMA 2010 is a useful reference to assess country situations and trends, and there is no better up-to-date information on teak resources available at the moment. The users of these data should, however, be aware that the information provided has some flaws and must be treated with care. In general, the data was obtained from different sources, among them government departments, research institutions, universities and private companies (a list of contributors is provided in annex 5.1). In most cases the country correspondents found it difficult to source, retrieve or estimate data on teak in the absence of reliable and accurate statistics at the species level. In large countries (e.g. India) national-level data had to be aggregated from reports of many provinces, territories or forestry divisions, where teak had been planted. In South and Central American countries planted teak forests are mainly owned by corporate companies, smallholders and farmers, whose decisions in natural resource management are usually not recorded in national forestry statistics. In conclusion it is likely that the reported areas of planted teak forests stand at the lower end and underestimate the real situation - but by an unknown amount.

3.3 Results

3.3.1 Forest Areas

Natural Teak Forests

Figure 2: A natural teak forest in Bago Yomas, central Myanmar.
Teak does not grow naturally in pure stands. Natural teak forests are mixed deciduous or tropical evergreen forests with a proportion of teak between 4% and 35%. Photo W. Myint.

In 2010 the area of natural teak forest in India, Lao PDR, Myanmar and Thailand combined was estimated at 29.035 million ha, almost half of it growing in Myanmar. That country is well known for its classical selection system for the management of natural teak forests, which was formulated in the late 1800s and is still in force (FAO 2001). Most of its natural teak forests have productive functions (26.3 million ha or 91%), while substantial teak forests with protective functions only cover 2.6 million ha (see table 7). Myanmar is also the only country of relevance to producing teak from natural forests for the international market; India, Lao PDR and Thailand all have logging or log export bans in place.

If the area data of the 2010 assessment are compared with those published by Tewari in 1992, it appears that natural teak forests have reduced by 385,000 ha globally (-1.3%). Substantial declines are particularly notable in India (2.1 million ha), Myanmar (1.1 million ha) and Lao PDR (68.5 thousand ha). In Thailand a complete ban on logging in natural forests was introduced in 1989 which may have contributed to the recovery of natural teak forests; they are reported to have increased by 2.9 million ha. Thailand is said once to have had 16 million ha of natural teak forests (Steber 1998).

Table 7: Area of natural teak forests by country, 1976/1979 and 2010

	1976/1979* (1000 ha)	2010 (1 000 ha)		
		Production	Protection	Total
India	8 900	6 810**	0	6810
Lao PDR	70	0	1.5	1.5
Myanmar	14 600	10 820	2 659	13 479
Thailand	5 850	8 744	0	8 744
Total	**29 420**	**26 374**	**2 661**	**29 035**

* based on Tewari 1992
** 3.54 m ha (share of teak > 25%) + 3.27m (share of teak < 25%)

Planted Teak Forests

Figure 3: A well-managed, 5-year old teak plantation in Guanacaste, Costa Rica
Photo W. Kollert

In 2010 the global area of planted teak forests reported from 38 countries was estimated at 4.346 million ha, of which 83% grew in Asia, 11% in Africa, 6% in tropical America and less than 1% in Oceania (see table 8). In order to calculate the regional totals, the country reports missing from eight countries (3 in Africa, 2 in Asia, 2 in Oceania and 1 in South America) were complemented by data from the Forest Resources Assessment 1990/1995 (FAO 1995).

Taking into account the data missing from 22 teak-growing countries, these figures certainly underestimate the actual planted teak forests in the world. It appears, however, that Asia continues to dominate the production of teak, as it holds more than 95% of the world's natural and planted teak resources, and more than 80% of the world’s planted teak resources. The three teak heavyweights are India with 1.667 million ha of planted teak forests (38% of the total), Indonesia with 1.269 million ha (29%) and Myanmar with 390,000 ha (9%). In 1998, the teak area in India was reported to be 7 million ha of natural forests and 1.5 million ha planted forests (Subramanian *et al*. 1999), estimates which match well with the figures reported for 2010. Indonesia’s teak plantations in 2005 were reported to comprise only 200 000 ha, which appears to be a gross underestimate (Guizol et al. 2005).

Table 8: Area of planted teak forests by region
(number of reporting countries in brackets)

Region	1000 ha	%
Africa (10 of 19)	469.80	10.8
Asia (10 of 16)	3 598.04	82.8
Caribbean (3 of 5)	15.32	0.4
Central America (7of 7)	132.78	3.0
Oceania (3of 5)	8.13	0.2
South America (5of 8)	122.30	2.8
World (38 of 60*)	**4 346.37**	**100**

*9 contacted countries (7 in Africa, 2 in South America) did not grow teak

Countries of tropical Africa report about 470 000 ha planted teak forests (11% of the total), of which Ghana (214 000 ha), Nigeria (146 000 ha) and Benin (26 000 ha) have the largest areas. The Ivory Coast did not report, but Maldonado and Louppe (2000) reported from SODEFOR (société de développement des forêts, 1998), that teak was the main plantation species in the Ivory Coast, covering almost 52 000 ha in 1998 and accounting for half of the country's forest plantations.

Countries of tropical America (Caribbean, Central and South America) have established 270 000 ha (6%) planted teak forests, of which Brazil (65 000 ha), Panama (55 000 ha), Ecuador (45 000 ha), Costa Rica (31 500 ha) and Guatemala (28 000 ha) have significant shares. For the Global Forest Resources Assessment 2010 Brazil in its country report reported a planted teak forest area of 67 072 ha (FAO 2009), which matches with the area reported in the TRMA 2010.

The ten countries with the largest area of planted teak forests, which cover 93% of the reported area, are shown in figure 4.

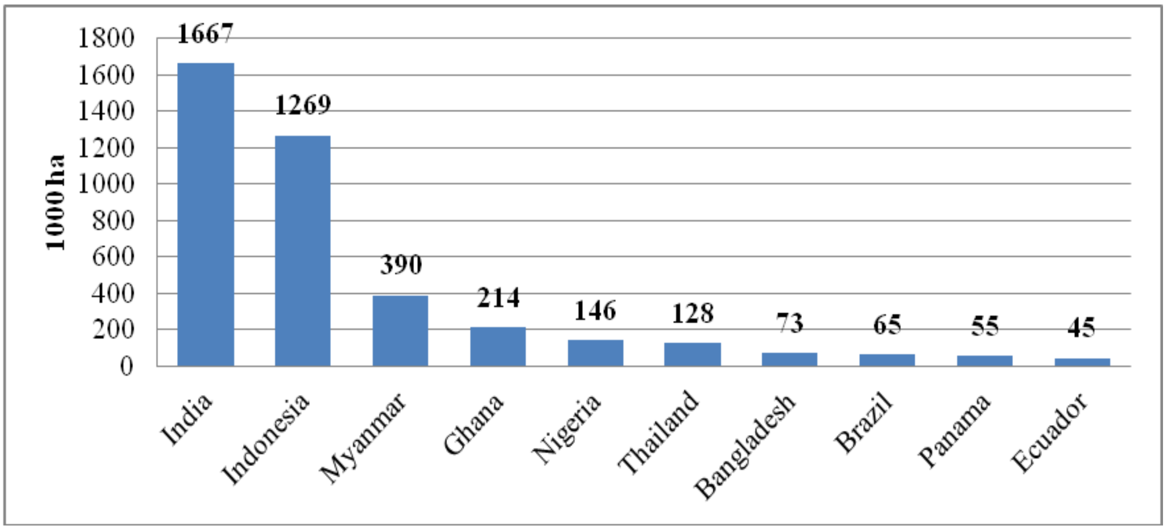

Figure 4: Ten countries with the largest area of planted teak forests (1 000 ha)
(Note: the figure for Bangladesh is taken from FAO 1995)

The frequency of planted teak in the forest landscape of each teak growing country can be illustrated by the ratio of the planted teak area to the total land area. It shows that Trinidad and Tobago, Ghana and Panama have the highest proportion of planted teak forest in the landscape, ranging from 7.4 and 17.5 per mill (‰)[1] of the land area (see fig. 5).

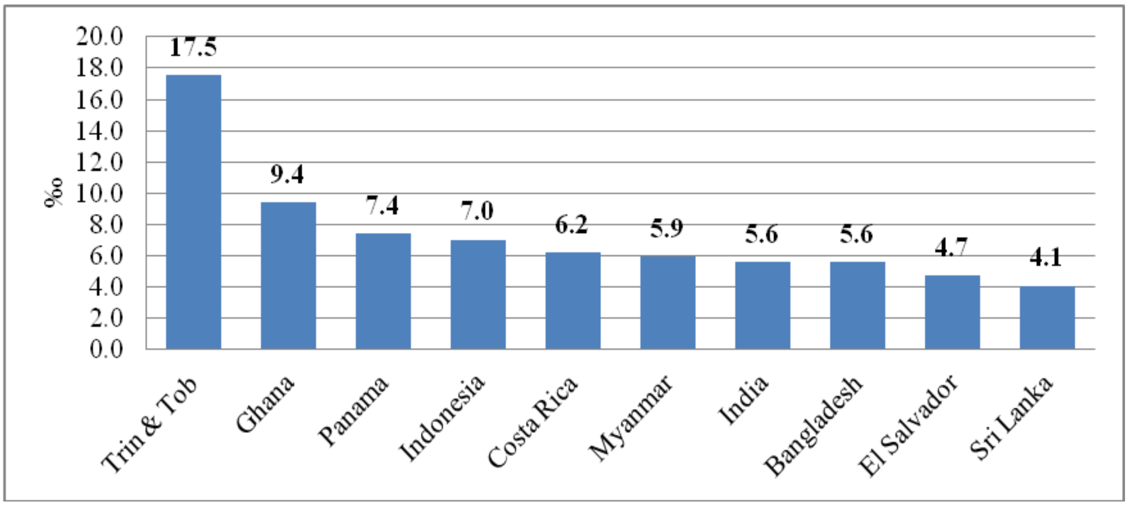

Figure 5: Ten countries with the highest teak coverage in the landscape (‰)

[1] per mill is a tenth of a percent or one part per thousand

Planted teak – a globally emerging forest resource

The data presented in the TRMA 2010 suggest that planted teak forests have increased globally, compared with previous surveys. In 1976/1979 the global area of planted teak forests was estimated at 1.3 million ha (Tewari 1992). FAO's Forest Resources Assessment 1990/1995 reported an area of 2.3 million hectares, while the TRMA 2010 estimates a minimum area of 4.3 million ha. Figure 6 graphically displays the area change in planted teak forests in some countries within a period of 15 years from 1995 to 2010. In this graph the figure placed on top of the bars indicates the increase of the planted teak area since 1995 in each particular country. For example, in Ecuador, the planted teak area of 2010 is 45 times the area reported for 1995, while in Ghana it is 21.8 times.

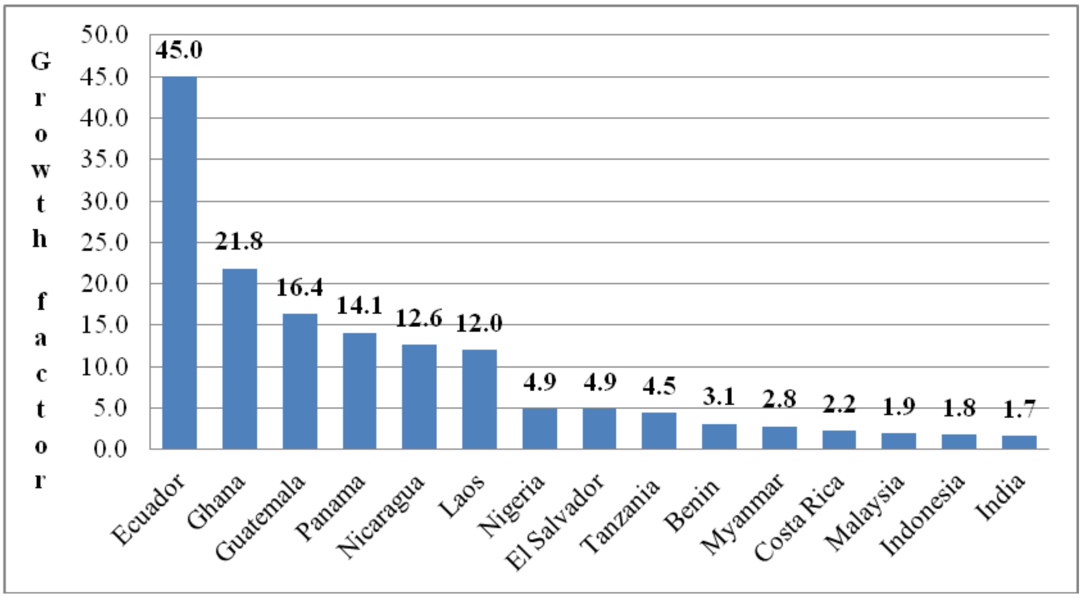

Figure 6: Area change in planted teak forests from 1995 to 2010

In this context it is interesting to note that Brazil does not appear at all in the previous teak resources assessments of 1976, 1979 and 1995, the main plantation species in Brazil then being pines and eucalypts. Brazil has reported a planted teak area of 65 000 ha to the TRMA 2010, which has been confirmed by the report of the Brazilian Association of Forest Plantation Producers (ABRAF) to ITTO (ITTO 2010b). Currently, the federal state of Mato Grosso in central Brazil has the largest teak plantations, although the country has several geographic regions with climate and soil conditions suitable for teak.

3.3.2 Age class distribution of planted teak forests

Planted teak forests are predominantly young. Their age class distribution shows a very similar pattern in all 33 countries that have reported on this parameter, which is presented for all countries combined in figure 7. Almost 77% of planted teak forests fall within the age class from 0 to 20 years, and 18 % in the age class from 21 to 40 years. Only 5% of the planted teak forests are older than 40 years. The only exception to this pattern is Trinidad and Tobago, where 70% of the planted teak forests are older than 40 years, and Thailand and

Myanmar, which both feature a higher share of stands from 21 – 40 years (61% and 30% respectively).

The prevailing age class distribution is an indication of increased efforts to establish and manage planted teak forests in the past 20 years and this pattern is very likely to persist in the future. The current enthusiasm by many corporate and private investors for planted teak will tend to shorten rotation periods and thus allow higher rates of return leading to a significant increase in the supply of small-dimension logs.

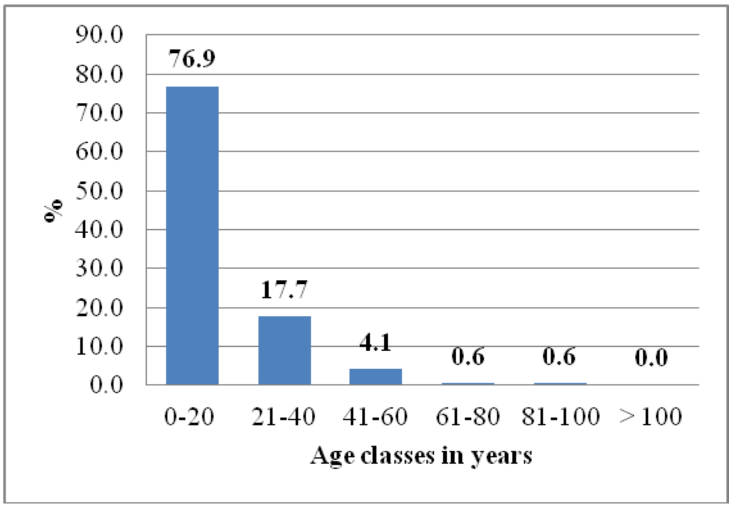

Figure 7: Age class distribution of planted teak forests

3.3.3 Ownership

In Africa (70%), Asia (72%) and the Caribbean (65%) most planted teak forests are owned by government entities, generally the forestry or agricultural administration (see fig. 8). In India until the late nineteen sixties the state forestry departments were the sole agencies establishing and managing planted teak forests. Commercial teak plantations were grown for the first time in 1968 by the Maharashtra Development Board, a limited public sector company. Subsequently, other forest development corporations in other Indian states followed suit. From 1990 onwards a growing number of private companies and farmers realized the value of teak and invested in plantations and agroforestry production systems (Subramanian *et al*. 1999). As a result the share of planted teak forests owned by private companies and smallholders in India is increasing.

In Central and South America the situation is different from the other regions. Here, state governments only own between 1% and 12% of planted teak forests, while the private sector combined holds 88% (57+31) in Central America and 99% (65+34) in South America. Corporate owners by far own most of the resource (see fig. 8).

Teak is not currently a priority species in community forestry, although there are a number of cases of smallholder teak plantations which have contributed to the improvement of rural livelihoods in Latin America. Unfortunately, the forestry departments in many countries do not assume an active role in teak cultivation or provide a forestry extension service to smallholders who have embarked on teak cultivation (Kent and Rodríguez 2011).

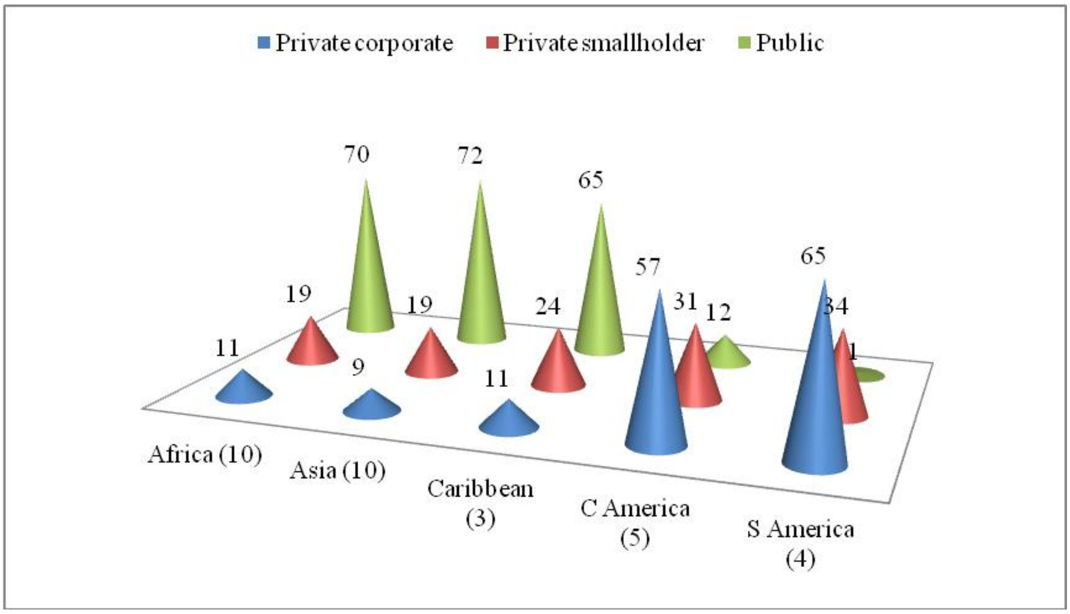

Figure 8: Ownership (%) of planted teak forests by region
(number of reporting countries in brackets)

3.3.4 Growth performance and rotation age

Teak is primarily grown for timber production. Hence, growth rate and the dimensions required by the markets play a decisive role in determining silvicultural practices and harvesting age. The growth performance of teak is a contentious issue. Many predictions of teak growth continue to appear on the internet and in literature, predicting very high growth rates above 20 m^3/ha/year aiming to encourage investment. Some private plantations in India report incredible growth rates from 47.7 m^3/ha/yr to 79.4 m^3/ha/yr (Subramanian et al. 1999). While such figures are theoretically possible over small areas on ideal sites they are unlikely to be achieved over larger areas and over the entire rotation period.

It is often overlooked that teak is not a fast growing species *per se*. Its growth performance depends on the quality of the planting site, the improvement of the planting material, and applied silvicultural practices. Further, good nursery, establishment and management techniques, such as site preparation, pest and disease control, weed control, the judicious use of fertilizer and frequent and early thinnings can influence the growth of teak considerably (FAO 2001). If all these conditions are met then average growth rates of up to 15m^3/ha/yr over a 20 - 25 year rotation may be achievable.

Many countries have developed yield projections or tables for teak (see examples in table 9), but Ball *et al*. pointed out in 1999 that the actual volume at harvest age obtained from teak plantations from different site classes and countries tends to be much lower than the yields indicated in the projections.

Table 9: Mean annual increment (MAI) from some teak yield tables at 50 years rotation age

Country	MAI min $m^3/ha/yr$	MAI max $m^3/ha/yr$
Ivory Coast	4.3	9.5
India	2.0	10.0
Indonesia	9.6	17.6
Myanmar	4.3	12.0
Nigeria	6.8	13.3
Trinidad and Tobago	3.9	6.5

Source: Bermejo et al. 2004 ; Pandey and Brown 2000

A study from Costa Rica reported MAI of between 0.71 to 24.4 m^3/ha/ yr for 33 different plantation sites aged between 3 and 37 years (De Camino *et al*. 2002). Reported growth rates from planted teak forests in India owned by government entities ranged from 11.3 m^3/ha/yr (best site quality, age 20) to as low as 2.0 m^3/ha/yr (lowest site quality, age 65) (Subramanian et al. 1999). These results correspond closely with growth rates measured in Malaysia of 14.8 m^3/ha/yr (best site quality, age 21) to 1.6 m^3/ha/yr (lowest site quality, age 65) (Bacilieri *et al*. 1998). Yields obtained from thinnings and final fellings in Kerala state, India, were reported to average 2.5 m^3/ha/yr (FAO 1985). Katwal (2005) indicated that the productivity of teak plantations in Nilambur, India has declined in areas which had a long history of teak cultivation. He reported a meagre 2.85 m^3/ha/year on average for a rotation of 53 years. In Indonesia the average growth rate (MAI) at harvest varied between 40 and 90 years and yielded 2.91 m^3/ha/yr (FAO 1986). Indonesia's state forestry enterprise Perum Perhutani reported an average MAI of 3 m^3/ha/yr at a 70-year rotation period (Pandey and Brown 2000).

The growth performance and rotation age reported to the TRMA 2010 are compiled in table 10. The table only gives minimum and maximum MAIs as a separation into comparable yield classes was not possible.

Table 10: Mean annual increment (MAI) and rotation period by region
(number of reporting countries in brackets**)**

Region	MAI (m^3/ha/yr)		Rotation period (yrs)	
	Min	Max	Min	Max
Africa (7)	3	21	4	60
Asia (5)	2	14	20	80
Caribbean (3)	3	12	20	65
Centr. America (5)	5	30	6	30
Oceania (2)	5	12	20	30
South America (4)	10	27	20	30
World (26)	**2**	**30**	**4**	**80**

The mean annual increment (MAI) reported by 26 countries appears rather modest for most regions except for Central and South America, where planted forests are mainly owned and managed by the private sector (see chapter 3.3.3).

It may be concluded that average growth in most of the world's teak plantations is low and probably under 5 m^3/ha/year with the exception of some high-intensity investment schemes. Besides, it appears that the productivity of older plantations and plantations that are in their second or third rotations may decline, particularly on poor sites. In this context it should be noted however, that growth rates are also a matter of entrepreneurial objectives. A yield of 5 m^3/ha/yr might be perceived to be perfectly acceptable for community planting whereas for international investors this would be considered extremely low (Coillte Consult 2006).

Rotation periods are rather short and span in most cases 20 to 30 years. This only allows for the production of small-dimension logs, which are not in demand on the international market. Yet, this lesser-quality teak is suitable as a multi-purpose timber for less-demanding building purposes, furniture, flooring, reconstituted wood products, woodfuel and utility poles for transmission lines. Good quality logs for high-end uses, which have special technical and aesthetic properties, can only be produced in longer rotations. In India rotation periods in natural moist deciduous forests vary between 50 and 150 years (Tewari 1992).

3.3.5 Log removals 2010

Log removals from planted teak forests were reported from 26 countries. Asia, as expected, reported the highest log volume removed at 523 000 m^3, of which 87% (453 613 m^3) was from Indonesia and another 10% (53 472 m^3) from Thailand. India did not report on log removals. In Africa significant log removals are reported from Benin (64 460 m^3) and the United Republic of Tanzania (60 000 m^3); in Central America from Costa Rica (74 153 m^3) and El Salvador (54 259 m^3). In South America removals were reported from Ecuador (73 630 m^3) and Brazil (67° 282 m^3). A considerable volume of low-dimension teak logs is produced from thinnings in planted forests for use as utility posts and poles. This, however, is in general not recorded and does not appear in national statistics.

Table 11: Log removals from planted teak forests by region 2010
(number of reporting countries in brackets**)**

Region	Log removals 2010 m^3
Africa (7)	141 146
Asia (5)	522 710
Caribbean (3)	13 367
Centr. America (5)	128 478
Oceania (2)	0
South America (4)	140 912
World (26)	**946 613**

The production of mature teak is restricted to the traditional producers Myanmar, India and Indonesia, both of which produce some large dimension logs from planted forests. Myanmar reported removals of 538 340 m^3 teak logs from natural forests in 2010, which is above the estimated Annual Allowable Cut of ca. 420 000 m^3 (Myint 2010). It can be forecast that the production of teak logs from natural forests in Myanmar will reach its sustainable limit at some time in the fairly near future and that there will then be a continuing decline in the volume and quality of natural teak.

There are very few estimates of the total commercial teak volume harvested globally from natural and planted teak forests. Katwal (2005) estimated a global teak production of at most 1 to 1.5 million m^3 per year from planted forests. Based on more recent figures reported for TRMA 2010 we can reasonably estimate that a volume of ca. 0.5 million m^3 may be harvested in natural forests and 1.5 to 2 million m^3 in planted forests if all teak producing countries are accounted for. Hence, the world's teak supply from natural and planted forests adds up to 2 to 2.5 million m^3 yearly, of which at least 60% is cut in India, Indonesia and Myanmar. This estimate must be further adjusted upwards to allow for illegal logging in natural forests and unrecorded harvesting by small farmers and local communities.

In 2010 the total production of tropical industrial roundwood in ITTO producer countries was reported to be 138.4 million m^3 (ITTO 2010a). The estimated market share of teak logs in total tropical roundwood volume production thus is short of 2% only. In value terms a much higher share can be forecast but there are no data to support this suggestion.

3.3.6 International trade in teak

The reporting countries found it difficult to report quantitative figures on the international trade in teak roundwood and sawntimber. The data and information provided in questionnaires and written communication were, however, useful in supporting a qualitative evaluation of the prevailing trade flows, complemented by references in the literature.

From these sources it becomes apparent that the teak market has been and will continue to be governed by trends in the Asian market. Asia holds more than 90% of the world's teak resources and India alone manages 38% of the world's planted teak forests. The growth in international demand for general utility teak has broadened the traditional teak supply base from natural forests in Asia to include fast-grown, small-diameter plantation logs from Africa and Latin America.

Teak is a well known and preferred species in India with demand sustained by strong construction activity and economic growth (ITTO 2010a). The country reports and written communications suggest and that the major teak trade flows worldwide are directed towards India, while its own considerable teak production is processed within the country. Eleven out of fourteen reporting countries name India as the world's main importer, absorbing 70% to 100% of global teak exports, including shipments of plantation logs and sawntimber from Africa and Latin America. The market competition from Africa and Latin America has affected to some extent the traditional producers of teak from natural forests in Myanmar, who have lost Indian customers to new market entrants (TEAKNET 1998).

Katwal (2005) has acknowledged that the demand for teak in India has increased several-fold during the past five decades. This strong in-country demand makes India the biggest consumer of plantation grown teak in the world and a downturn in the Indian market would result in a drastic impact on the total market for small-dimension teak worldwide (Somaiya 2005).

Other significant teak importers are China, various EU-countries such as Germany, Italy and Switzerland and the USA, the latter sourcing teak timber mainly from Africa and Latin America. Myanmar and Indonesia look set to maintain their monopoly on premium-quality products in the high-end luxury market. Growth in this market however is limited by supply as plantation-grown teak does not yet have a high-quality image on the international market (Coillte Consult 2006), and it is questionable whether it will ever reach such quality standards given the trend to shorter rotation periods. In 2009, Indian importers have reported shortages of Myanmar teak and were seeking alternative supplies which included plantation teak logs from Ghana, Benin, Sudan and the United Republic of Tanzania (ITTO 2010a).

In Africa, significant exporters are Ghana, Benin and Togo (both logs and sawntimber), and the United Republic of Tanzania (sawntimber), but quality tends to be low. Ghana has a log export ban in place but it excludes plantation logs and the country appears to be a large exporter of chemically-treated teak poles for power supply and telecommunication lines (WaKa 2009). The Ivory Coast, which did not report to the TRMA 2010, was earlier reported to be among the most important teak exporters in Africa (Maldonado 1999) and exports of teak from the Ivory Coast destined to satisfy demand in India accelerated from a trickle to over 120,000 m^3 by 1997. Maldonado and Louppe (2000) have warned that teak exploitation in the Ivory Coast may have already exceeded the sustainable capacity of the country's resource base. They also confirm that India has become the Ivory Coast's almost exclusive customer, accounting for 99% of exported Ivorian teak logs.

In Latin America Ecuador and El Salvador (sawntimber), and Brazil (roundwood), are important teak exporters, but there was no information available from Costa Rica and Panama.

Only a few countries in Africa and Latin America process teak logs to semi-finished or finished products prior to export. Most traders tend to export roundwood to feed the Indian demand for teak. In India, local wood processing mills apply artisanal manufacturing procedures, work at lower costs, and are technically and organizationally well-suited to working with small-diameter logs. Under these circumstances teak growers in Latin America claim that the export of teak to India as roundwood yields a higher return than the processing to and export of finished or semi-finished products (Camacho 2011).

3.3.7 Teak price and quality

Considering the declining supply from natural teak forests, the long-term prospects for plantation-grown teak appear promising, and demand is likely to increase. Much information on teak prices, in particular from short-rotation plantations, is found in the literature and on the internet, but it is rather difficult to interpret it due to a lack of background information and necessary detail. They are mostly based on a case-by-case basis, and there are no systematic or consistent grading rules with corresponding values for particular products. Available teak prices correspond to a mix of heterogeneous material from different countries that represent wood harvested from plantations with different silvicultural treatments and timber quality (Coillte Consult 2006). Some of these data qualify as wishful thinking rather than a reflection of actual values. For this reason much controversy has been generated in several countries by the promotion of teak plantation investments based on fabulous growth and yield projections and unrealistic pricing scenarios, which have provided opportunities to exaggerate rates of return and deceive even cautious investors (Pandey and Brown 2000).

Natural teak forests are a precious resource and good-quality teak is selling at comparatively high prices. In the July 1995 issue of the National Geographic magazine it was reported that some teak trees from natural forests can be worth USD 20 000 (Swerdlow 1995). Quality in teak is determined by factors such as dimensions, bole shape (roundness and straightness), heartwood/sapwood ratio, regularity of annual rings, number of knots, colour and texture. Another important factor is the soundness of the tree core; badly managed plantations or teak on poor sites often exhibit heart rot at ground level, the most valuable segment of the tree. Many of these factors are linked with age and tree size.

The supply from old-growth natural teak forests is declining and the quality of naturally-grown teak has deteriorated. Plantation teak improves where good management practices are applied, and it can be expected that there will be an increasing overlap in terms of ‘quality’ between natural and plantation grown teak in future years. Myanmar, for example, has four grades of veneer logs and three grades of sawlogs (see figure 9). By 1998 first and second veneer grades were no longer available for export at depots in Yangon. By 2000, third and fourth veneer grades were 1% and 10% respectively of the volumes available at the beginning of the 1990s (Coillte Consult 2006). Balooni (2011) reported that the share of top quality A-grade teak in Indian timber auctions has declined steadily for many years.

Figure 9: Second grade veneer logs from Myanmar
Photo W. Myint

Logs from planted teak forests are typically smaller in size and will hardly ever reach the dimensions grown in old-growth natural forests. As a result they do not have the same technical characteristics of natural teak and do not reach such high prices. The standard range of products obtainable from planted teak forests that are harvested at young age are short boards, scantlings and mouldings. They will be 5 to 15 cm in width and up to 3 m in length, and most of them have a distinct colour pattern marked by the dark-brown core and the yellowish sapwood (see figure 10). But they are very suitable for the manufacture of furniture, parquet flooring, picture frames, boat parts, gift items and carvings.

Figure 10: The “ripple”pattern of a table top made from small-dimension teak logs
Photo W. Kollert

The 2010 survey of log prices for teak logs and sawntimber proved to be particularly difficult, as no common international log grading rules have been established and countries use several measuring units for log volumes and dimensions (e.g. diameter, circumference, cm, feet, board feet, hoppus tons etc.). Further, the perception by the countries of log dimensions (small logs, medium logs and big logs) turned out to differ considerably from the stipulations given in the questionnaire of the TRMA 2010 (see table 12).

Table 12: Perceptions of log dimensions in different countries

	Small	Medium	Large
		cm at midpoint	
TRMA 2010 questionnaire	< 24	24-48	> 48
Indonesia	< 10	10-30	>30
Lao PDR	<20	20-25	>25
Myanmar	<19	19-28	>28

The average prices of teak logs reported by 19 countries for TRMA 2010 are shown in table 13. They indicate that:

- domestic market prices of plantation logs grown in Africa and Latin America are at about the same level across the 3 dimensions small, medium and large
- domestic market prices in Asia are higher than in Africa and Latin America; the difference in prices increases with size, it amounts to 18% for small size, 40% for medium size and 66% for large logs.
- dimensions matter: in all three regions the prices of larger logs are 2 to 4 times higher than the prices of smaller logs
- quality matters: (a) there is a marked difference in prices of plantation grown teak produced in short rotations as compared to teak from natural old-growth forests and (b) the price gradient also applies to the quality grades of teak logs from natural forests.

Table 13: Average teak log prices
(number of reporting countries in brackets)

	Planted teak, domestic market prices at the log yard USD/m^3		
	small	**medium**	**large**
Africa (6)*	124	203	271
Asia (5)	149	282	448
Latin America (8)	129	199	267
	Natural teak, FOB prices USD/m^3		
	low grade	**sawing grade**	**veneer grade**
Myanmar	1,022	1,864	4,111

* in Africa export prices are reported to be 1.8 times the domestic market prices

Large dimensions and high quality combined reduce the attractiveness of commercial investments in teak as the longer rotation and capital commitment periods and the greater investment risks may only partially be compensated by higher timber prices. The long rotation coupled with an expected lower return on capital invested has made it difficult to interest private investors in high-quality teak production without supportive, secure and stable government policies. The widespread practice of establishing and managing teak plantations on short rotations, not exceeding 20 years, will continue to lead to a significant increase in the supply of small-dimension teak on the international market and continue to make the luxury item of former times a general utility timber.

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5. Annexes

5.1 List of contributors by country

REGION/COUNTRY	RAPPORTEUR
Eastern and Southern Africa	
Kenya	**Mr. Kefa Mwaura Wamichwe,** Head Forest Planning & Information Systems, Kenya Forest Service
Malawi	**Mr. Kasizo Chirambo,** Principal Forestry Officer, Planning Unit, Government of Malawi
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United Republic of Tanzania	**Mr. Hans Lemm,** Kilombero Valley Teak-Company
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Northern Africa	
Mauritania	**Mr. Outhmane Ould Boubacar,** Ingénieur principal, Correspondant suppléant du FRA 2010, Chef de service forêts et pâturages, Direction de la Protection de la Nature, Nouakchott
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Oceania	
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Fiji	**Mr. Stephen Clark,** General manager, FUTURE Forests
New Zealand	**Mr. Jordan Tapusoa,** Acting Policy Analyst, Information and Analysis Science, Information and Risk Directorate, Policy Science and Economics Branch, Ministry of Agriculture and Forestry
South America	
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Guyana	**Ms. Anna Mohase,** Guyana Forestry Commission, Government of Guyana
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Peru	**Ms. Armando Quispe Santos,** Arborizaciones E.I.R.L, Lima

5.2 Questionnaire (English version)

No……

Questionnaire on Teak

(TECTONA GRANDIS)

YEAR 2010

INTRODUCTION

This questionnaire on teak is intended to generate country level information on teak resources across the globe. It has been compiled by the Food and Agriculture Organization of the United Nations in Rome (FAO) in cooperation with TEAKNET, an international teak information network currently managed by the Kerala Forest Research Institute, India.

Response to the questionnaire is crucial to allow country, regional and global analyses of status and trends in teak forest development and to assist in improving formulation of policies, preparing outlook studies and undertaking planning, management, monitoring and reporting.

We understand the difficulties that forestry experts may find in providing such information, however in view of the total lack of detailed statistical data on teak, aggregated data and/or best professional estimates are also very much appreciated. In case there is no information available please put a note "n.a." (not available).
We thank you very much for your cooperation!

CONTACTS

For queries in completing this questionnaire please contact one of the following persons:

Mr. Walter Kollert, FAO – E-mail: walter.kollert@fao.org
Mr. Alberto Del Lungo, FAO E-mail: alberto.dellungo@fao.org
Ms. Lucia Cherubini, FAO E-mail: lucia.cherubini@fao.org

Question 1: Area of Teak Forest 2010, Forest Function and Age-Class Distribution

Definitions: Teak Forest Categories and Forest Functions

Natural Teak Forest:	Forest of native/indigenous species with a share of teak of 30 percent or more in its growing stock
Planted Teak Forest:	Forest of teak established through planting or seeding for the production of wood or non-wood products and/or for the provision of environmental services. The share of teak in the growing stock is above 30 percent.
Productive function	Forests serving primarily for the production of various commodities, e.g. roundwood, firewood, fibre and non-wood forest products. Production forests bear no legal, economic or technical restrictions on wood production.
Protective function	Forests providing a wide range of environmental services, e.g. the protection of soil and water resources, conservation of biological diversity, protection from wind, coastal protection, protection of natural/cultural features including national parks and nature reserves.
Other function	Forests serving any other than productive or protective function

In the following Table 1, please indicate area (1000 ha) of teak forests in your country, the share of teak in these forests and the forest function for year 2010.

Table 1

Forest categories	**Area (1000 ha)**	**Share of teak (%)**	**Forest function**		
			Productive (1000 ha)	**Protective (1000 ha)**	**Other (1000 ha)**
Natural teak forest					
Planted teak forest					
Total					

In Table 2 please provide information on the age-class distribution of natural and planted teak forests with production function. The percentage given should refer to the forest area with production function given in Table 1. Please note that the **horizontal total by age classes should tally to 100%**.

Table 2

<table>
<tr><th rowspan="2">Forest categories</th><th rowspan="2">Production area from table 1 (1000 ha)</th><th colspan="6">Age classes</th></tr>
<tr><th colspan="2">young (%)</th><th colspan="2">middle-aged (%)</th><th colspan="2">old (%)</th></tr>
<tr><td>Natural teak forests</td><td></td><td colspan="2"></td><td colspan="2"></td><td colspan="2"></td></tr>
<tr><td></td><td></td><td>0-20 yrs (%)</td><td>21-40 yrs (%)</td><td>41-60 yrs (%)</td><td>61-80 yrs (%)</td><td>81-100 yrs (%)</td><td>> 100 yrs (%)</td></tr>
<tr><td>Planted teak forest</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
</table>

Comments (if any):	

Question 2: Ownership of Teak Forests 2010

Definitions

Public ownership:	**trees** are owned by the State (national, state and regional governments) or government-owned institutions or other public bodies including cities, municipalities and villages
Private ownership (corporate):	**trees** are owned or legally used by private companies, co-operatives, corporations, industries, private religious and educational institutions, pension or investment funds (generally large-scale). The land may or may not be owned by a public body.
Private ownership (smallholders):	**trees** are owned by individuals or families generally on small scale. The land may or may not be owned by a public body.
Other ownership:	**trees** not classified as publicly or privately owned. Ownership of **trees** may not be defined or is unknown (e.g. customary land use rights).

According to the above definition, list in Table 3 for year 2010 the area of teak as percentage of the total area reported in Table 1 by ownership categories and forest function (production, protection, other). Please note that **horizontal totals by ownership categories should tally to 100%**.

Table 3

Forest categories	Public ownership			Private corporate ownership			Private smallholder ownership			Other ownership		
	Prod	Prot	Other	Prod	Prot	Other	Prod	Prot	Other	Prod	Prot	Other
	%	%	%	%	%	%	%	%	%	%	%	%
Natural teak forest												
Planted teak forest												

Comments (if any):	

Question 3: Production of Teakwood 2009

In Table 4 please indicate for natural and planted teak forest the minimum and maximun values for the mean annual increment (MAI) and the rotation period in your country as well as the removals of teakwood in 2009.

Table 4

Forest categories	Mean Annual Increment (m^3/ha/yr)		Rotation period/ age of harvest (years)		Removals of teak logs 2009 (m^3/yr)
	Min	Max	Min	Max	
Natural teak forest with production function					
Planted teak forest with production function					
Total					

Comments (if any):	

Question 4: International Trade of Teakwood 2010

Please indicate in Tables 5 and 6 the international trade with teak roundwood and teak sawnwood in year 2009, if possible by country of origin and destination.

Table 5

Teak-Imports	Volume (m^3)	Countries of origin (in order of importance) and estimated percentage of trade with this country
Roundwood		1)..,...........%
		2) ....,...........%
		3) ....,...........%
Sawnwood		1) ....,...........%
		2) ....,...........%
		3) ....,...........%

Table 6

Teak-Exports	Volume (m^3)	Destination countries (in order of importance) and estimated percentage of trade with this country
Roundwood		1) ....,...........%
		2) ....,...........%
		3) ....,...........%
Sawnwood		1) ....,...........%
		2) ....,...........%
		3) ....,...........%

Question 5: Price of Teakwood 2009

Definition of log dimensions

Big logs	are logs above 48 cm diameter (>150 cm girth) at midpoint under bark
Medium logs	are logs from 24 to 48 cm diameter (75 to 150 cm girth) at midpoint under bark
Small logs	are logs below 24 cm diameter (<75 cm girth) at midpoint under bark

Please indicate in Table 7 an average teakwood price for the year 2009 by forest categories. If possible differentiate between prices for the domestic and export market.

Table 7

Forest categories	Domestic market prices			Export market prices		
	big logs	medium logs	small logs	big logs	medium logs	small logs
	USD/m^3	USD/m^3	USD/m^3	USD/m^3	USD/m^3	USD/m^3
Logs from natural teak forests						
Logs from planted teak forests						

Comments (if any):	

Finally we would like to request you to give your contact details in case we may have any queries. **Thank you very much for your cooperation!**

Country Name

Contact Person

Email

Telephone

---END OF QUESTIONNAIRE---

5.3 Data tables by country

List of countries included in the survey

Eastern and Southern Africa	South- and Southeast Asia continued
1. Kenya 2. Malawi* 3. Mozambique 4. South Africa* 5. Uganda 6. United Republic of Tanzania (Tanzania) 7. Zambia* 8. Zimbabwe*	35. Malaysia 36. Myanmar 37. Nepal 38. Pakistan 39. Philippines 40. Sri Lanka 41. Thailand 42. Viet Nam
Northern Africa 9. Mauritania* 10. Sudan	**Caribbean** 43. Cuba 44. Dominican Republic 45. Haiti 46. Jamaica 47. Trinidad and Tobago
Western and Central Africa 11. Benin 12. Burkina Faso 13. Burundi* 14. Cameroon 15. Côte d'Ivoire (Ivory Coast) 16. Gambia 17. Ghana 18. Guinea 19. Guinea-Bissau 20. Liberia 21. Mali 22. Nigeria 23. Rwanda* 24. Senegal 25. Sierra Leone 26. Togo	**Central America** 48. Belize 49. Costa Rica 50. El Salvador 51. Guatemala 52. Honduras 53. Nicaragua 54. Panama **Oceania** 55. Australia 56. Fiji 57. New Zealand 58. Papua New Guinea 59. Solomon Islands
East Asia 27. China 28. Japan **South- and Southeast Asia** 29. Bangladesh 30. Bhutan 31. Cambodia 32. India 33. Indonesia 34. Lao PDR (Laos)	**South America** 60. Argentina 61. Brazil 62. Colombia 63. Ecuador 64. French Guiana* 65. Guyana* 66. Paraguay 67. Peru 68. Suriname 69. Venezuela

* country does not grow teak (*Tectona grandis*)

Planted teak area (1 000 ha) by function

Legend:

n.a.	teak is reported to grow in this country, but no information is available
--	no teak (*Tectona grandis*) is reported to grow in this country
m	response missing, country did not report
red figures	figures taken from Pandey 1995 to calculate regional totals

Country	Production	Protection	Other	Total	
Kenya	n.a.	n.a.	n.a.	n.a.	
Malawi	--	--	--	--	
Mozambique	m	m	m	m	
South Africa	--	--	--	--	
Uganda	6.34	0.00	0.00	6.34	
United Republic of Tanzania	12.48	0.00	0.00	12.48	
Zambia	--	--	--	--	
Zimbabwe	--	--	--	--	
Eastern and southern Africa	**18.82**	**0.00**	**0.00**	**18.82**	
Mauritania	--	--	--	--	
Sudan	14.85	0.00	0.00	14.85	m
Northern Africa	**14.85**	**0.00**	**0.00**	**14.85**	
Benin	23.00	1.00	2.00	26.00	
Burkina Fasso	1.00	0.00	0.00	1.00	m
Burundi	--	--	--	--	
Cameroon	n.a	n.a	n.a	n.a	
Ivory Coast	29.23	0.00	0.00	29.23	m
Gambia	m	m	m	m	
Ghana	214.00	0.00	0.00	214.00	
Guinea (Conakry)	2.00	0.00	0.00	2.00	
Guinea-Bissau	m	m	m	m	
Liberia	1.09	1.64	0.16	2.90	
Mali	2.00	1.00	0.00	3.00	
Nigeria	146.00	0.00	0.00	146.00	
Rwanda	--	--	--	--	
Senegal	2.00	0.00	0.00	2.00	
Sierra Leone	m	m	m	m	
Togo	9.00	1.00	0.00	10.00	
Western and Central Africa	**429.32**	**4.64**	**2.16**	**436.13**	
Africa	**462.99**	**4.64**	**2.16**	**469.80**	
China	n.a.	n.a.	n.a.	n.a.	
Japan	m	m	m	m	
East Asia	**0.00**	**0.00**	**0.00**	**0.00**	
Bangladesh	72.90	0.00	0.00	72.90	m
Bhutan	0.14	0.00	0.00	0.14	m
Cambodia	n.a.	n.a.	n.a.	n.a.	
India	1,667.00	0.00	0.00	1,667.00	
Indonesia	1,269.00	0.00	0.00	1,269.00	
Lao PDR	33.00	0.00	0.00	33.00	
Malaysia	6.00	0.00	0.00	6.00	

Country	Production	Protection	Other	Total	
Myanmar	390.40	0.00	0.00	390.40	
Nepal	2.00	0.00	0.00	2.00	
Pakistan	m	m	m	m	
Philippines	0.00	1.00	0.00	1.00	
Sri Lanka	26.30	0.00	0.00	26.30	
Thailand	128.00	0.00	0.00	128.00	
Vietnam	0.50	1.50	0.30	2.30	
South- and Southeast Asia	**3,595.24**	**2.50**	**0.30**	**3,598.04**	
Asia	**3,595.24**	**2.50**	**0.30**	**3,598.04**	
Cuba	4.35	1.70	0.23	6.28	
Dominican Republic	m	m	m	m	
Haiti	n.a	n.a	n.a	n.a	
Jamaica	0.03	0.01	0.00	0.04	
Trinidad and Tobago	9.00	0.00	0.00	9.00	
Caribbean	**13.38**	**1.71**	**0.23**	**15.32**	
Belize	0.10	0.00	0.00	0.10	
Costa Rica	31.50	0.00	0.00	31.50	
El Salvador	9.76	0.00	0.00	9.76	
Guatemala	28.00	0.00	0.00	28.00	
Honduras	0.45	0.00	0.00	0.45	
Nicaragua	7.96	0.00	0.00	7.96	
Panama	55.00	0.00	0.00	55.00	
Central America	**132.78**	**0.00**	**0.00**	**132.78**	
Central America & Caribbean	**146.15**	**1.71**	**0.23**	**148.10**	
Australia	5.00	0.00	0.00	5.00	
Fiji	0.10	0.00	0.00	0.10	
New Zealand	n.a	n.a	n.a	n.a	
Papua New Guinea	2.16	0.00	0.00	2.16	m
Solomon Islands	0.87	0.00	0.00	0.87	m
Oceania	**8.13**	**0.00**	**0.00**	**8.13**	
Argentina	10.00	0.00	0.00	10.00	
Brazil	65.44	0.00	0.00	65.44	
Colombia	1.72	0.00	0.00	1.72	m
Ecuador	45.00	0.00	0.00	45.00	
French Guyana	--	--	--	--	
Guyana	--	--	--	--	
Paraguay	n.a.	n.a.	n.a.	n.a.	
Peru	0.05	0.00	0.10	0.15	
Suriname	m	m	m	m	
Venezuela	m	m	m	m	
South America	**122.21**	**0.00**	**0.10**	**122.31**	
World	**4,334.72**	**8.85**	**2.79**	**4,346.37**	

Age class distribution of production forest (1000 ha)

Country	0-20	21-40	41-60	61-80	81-100	> 100	TOTAL
Kenya							
Malawi							
Mozambique							
South Africa							
Uganda	6.34	0.00	0.00	0.00	0.00	0.00	6.34
United Republic of Tanzania	10.36	2.12	0.00	0.00	0.00	0.00	12.48
Zambia							
Zimbabwe							
Mauritania							
Sudan							
Benin	17.11	2.23	3.66	0.00	0.00	0.00	23.00
Burkina Fasso							
Burundi							
Cameroon							
Ivory Coast							
The Gambia							
Ghana	181.90	29.96	2.14	0.00	0.00	0.00	214.00
Guinea (Conakry)	0.40	0.30	1.30	0.00	0.00	0.00	2.00
Guinea-Bissau							
Liberia	0.27	0.82	0.00	0.00	0.00	0.00	1.09
Mali	0.00	0.20	1.40	0.40	0.00	0.00	2.00
Nigeria	94.90	36.50	14.60	0.00	0.00	0.00	146.00
Rwanda							
Senegal	0.06	0.94	0.90	0.10	0.00	0.00	2.00
Sierra Leone							
Togo	6.43	2.07	0.46	0.05	0.00	0.00	9.00
Africa (10 countries)	**317.77**	**75.14**	**24.46**	**0.55**	**0.00**	**0.00**	**417.91 1000ha**
	76	**18**	**6**	**0**	**0**	**0**	**100%**
China							
Japan							
Bangladesh							
Bhutan							
Cambodia							
India							
Indonesia	1000.86	162.94	75.51	13.83	15.61	0.00	1268.75
Lao PDR	29.04	3.96	0.00	0.00	0.00	0.00	33.00
Malaysia	4.80	0.60	0.60	0.00	0.00	0.00	6.00

Country	0-20	21-40	41-60	61-80	81-100	> 100	TOTAL
Myanmar	274.84	115.56	0.00	0.00	0.00	0.00	390.40
Nepal	0.40	1.60	0.00	0.00	0.00	0.00	2.00
Pakistan							
Philippines							
Sri Lanka	10.05	16.25	0.00	0.00	0.00	0.00	26.30
Thailand	49.92	78.08	0.00	0.00	0.00	0.00	128.00
Vietnam	0.11	0.34	0.05	0.00	0.00	0.00	0.50
Asia (8 Countries)	**1448.90**	**392.17**	**82.11**	**14.92**	**16.84**	**0.00**	**1954.95 1000 ha**
	74	**20**	**4**	**1**	**1**	**0**	**100%**
Cuba	4.35	0.00	0.00	0.00	0.00	0.00	4.35
Dominican Republic							
Haiti							
Jamaica	0.03	0.00	0.00	0.00	0.00	0.00	0.03
Trinidad and Tobago	0.40	2.17	4.92	1.41	0.10	0.00	9.00
Belize	0.04	0.00	0.06	0.00	0.00	0.00	0.10
Costa Rica							
El Salvador	0.88	8.89	0.00	0.00	0.00	0.00	9.76
Guatemala	28.00	0.00	0.00	0.00	0.00	0.00	28.00
Honduras	0.29	0.16	0.00	0.00	0.00	0.00	0.45
Nicaragua	7.85	0.11	0.00	0.00	0.00	0.00	7.96
Panama	55.00	0.00	0.00	0.00	0.00	0.00	55.00
Australia	5.00	0.00	0.00	0.00	0.00	0.00	5.00
Fiji	99.00	0.00	1.00				100.00
New Zealand							
Papua New Guinea							
Solomon Islands							
Caribbean, Central America, Oceania (11 countries)	**200.84**	**11.32**	**5.98**	**1.41**	**0.10**	**0.00**	**219.65 1000ha**
	91	**5**	**3**	**1**	**0**	**0**	**100.00%**
Argentina	10.00	0.00	0.00	0.00	0.00	0.00	10.00
Brazil	65.44	0.00	0.00	0.00	0.00	0.00	65.44
Colombia							
Ecuador	44.10	0.90	0.00	0.00	0.00	0.00	45.00
French Guyana							
Guyana							
Paraguay							
Peru	0.05	0.00	0.00	0.00	0.00	0.00	0.05
Suriname							
Venezuela							
South America (4 countries)	**119.59**	**0.90**	**0.00**	**0.00**	**0.00**	**0.00**	**120.49 1000ha**
	99	**1**	**0**	**0**	**0**	**0**	**100.00%**
Total (33 countries)	**2087.10**	**479.53**	**112.55**	**16.88**	**16.94**	**0.00**	**2713.00 1000ha**
	77	**18**	**4**	**1**	**1**	**0**	**100.00%**

Ownership of planted teak forests (% of production area)

Country	PRODUCTION			
	Public ownership	Private corporate ownership	Private smallholder ownership	Other ownership
Kenya				
Malawi				
Mozambique				
South Africa				
Uganda	1.70	0.00	98.30	
United Republic of Tanzania	30.00	70.00	0.00	
Zambia				
Zimbabwe				
Eastern and southern Africa				
Mauritania				
Sudan				
Northern Africa				
Benin	62.96	0.72	36.32	
Burkina Fasso				
Burundi				
Cameroon				
Ivory Coast				
The Gambia				
Ghana	64.00	11.00	25.00	
Guinea (Conakry)	95.00	0.00	5.00	
Guinea-Bissau				
Liberia	100.00	0.00	0.00	
Mali	90.00	0.00	10.00	
Nigeria	70.00	20.00	10.00	
Rwanda				
Senegal	93.00	0.00	7.00	
Sierra Leone				
Togo	90.00	10.00	0.00	
Western and Central Africa				
Africa	**70**	**11**	**19**	
China				
Japan				
East Asia				
Bangladesh				
Bhutan				
Cambodia				
India				
Indonesia	100.00	0.00	0.00	
Lao PDR	0.10	2.90	97.00	
Malaysia	0.00	80.00	20.00	

Country	PRODUCTION			
	Public ownership	**Private corporate ownership**	**Private smallholder ownership**	**Other ownership**
Myanmar	94.82	0.00	5.18	
Nepal	100.00	0.00	0.00	
Pakistan				
Philippines	100.00	0.00	0.00	
Sri Lanka	98.00	2.00	0.00	
Thailand	52.30	0.00	47.70	
Vietnam	100.00	0.00	0.00	
South- and Southeast Asia	**72**	**9**	**19**	
Asia				
Cuba	100.00	0.00	0.00	
Dominican Republic				
Haiti				
Jamaica	0.00	33.00	67.00	
Trinidad and Tobago	95.00	0.00	5.00	
Caribbean	**65**	**11**	**24**	
Belize	60.00	10.00	30.00	
Costa Rica				
El Salvador	0.00	0.00	100.00	
Guatemala	0.00	93.00	7.00	
Honduras				
Nicaragua	0.00	85.70	14.30	
Panama	0.00	95.00	5.00	
Central America	**12**	**57**	**31**	
Central America & Caribbean				
Australia				
Fiji	1.00	99.00	0.00	
New Zealand				
Papua New Guinea				
Solomon Islands				
Oceania				
Argentina	0.00	100.00	0.00	
Brazil	0.00	100.00	0.00	
Colombia				
Ecuador	0.00	60.00	40.00	
French Guyana				
Guyana				
Paraguay				
Peru	3.00	0.00	97.00	
Suriname				
Venezuela				
South America	**1**	**65**	**34**	

Mean Annual Increment, rotation period, removals

Country	PLANTED – PRODUCTION FUNCTION				
	Mean Annual Increment (m3/ha/yr)		Rotation period/age of harvest (years)		Removals of teak logs 2010 (m3/yr)
	Min	Max	Min	Max	
Kenya					
Malawi					
Mozambique					
South Africa					
Uganda			30.00	60.00	
United Republic of Tanzania	6.00	15.00	20.00	40.00	60,000.00
Zambia					
Zimbabwe					
Eastern and southern Africa					
Mauritania					
Sudan					
Northern Africa					
Benin	5.00	12.00	4.00	50.00	64,460.00
Burkina Fasso					
Burundi					
Cameroon					
Ivory Coast					
The Gambia					
Ghana	11.00	17.00	15.00	30.00	
Guinea (Conakry)					
Guinea-Bissau					
Liberia	2.60	15.70	25.00	40.00	241.12
Mali					
Nigeria	10.00	21.00	20.00	60.00	
Rwanda					
Senegal					
Sierra Leone					
Togo					16,444.75
Western and Central Africa					
Africa	**2.60**	**21.00**	**4.00**	**60.00**	**141,145.87**
China					
Japan					
East Asia					
Bangladesh					
Bhutan					
Cambodia					
India					
Indonesia	2.00	14.00	20.00	80.00	453,613.00
Lao PDR					
Malaysia					

Country	PLANTED – PRODUCTION FUNCTION				
	Mean Annual Increment (m3/ha/yr)		Rotation period/age of harvest (years)		Removals of teak logs 2010 (m3/yr)
Myanmar	7.38		40.00		538,340.00[2]
Nepal	3.00	4.00	25.00	40.00	2,770.00
Pakistan					
Philippines					
Sri Lanka	4.00	8.00	30.00	40.00	14,034.00
Thailand	4.00	5.00	30.00		52,293.00
Vietnam					
Asia	**2.00**	**14.00**	**20.00**	**80.00**	**522,710.00**[3]
Cuba	3.00	5.00			
Dominican Republic					
Haiti					
Jamaica			20.00	30.00	
Trinidad and Tobago	3.00	12.00	50.00	65.00	13,367.00
Caribbean	**3.00**	**12.00**	**20.00**	**65.00**	**13,367.00**
Belize					
Costa Rica	12.00	18.00	6.00	30.00	74,153
El Salvador	8.00	12.00			54,259.00
Guatemala	5.00	30.00	16.00	30.00	
Honduras			20.00	25.00	66.00
Nicaragua					
Panama	12.00	16.00			
Central America	**5.00**	**30.00**	**6.00**	**30.00**	**128,478.00**
Central America & Caribbean					
Australia	8.00	12.00	20.00	25.00	
Fiji	5.00	12.00	22.00	30.00	
New Zealand					
Papua New Guinea					
Solomon Islands					
Oceania	**5.00**	**12.00**	**20.00**	**30.00**	
Argentina	11.00	13.00	20.00	25.00	
Brazil	10.00	27.00	20.00	25.00	67,282.00
Colombia					
Ecuador	12.00	24.00	20.00	30.00	73,630.00
French Guyana					
Guyana					
Paraguay					
Peru	10.00	15.00	25.00		
Suriname					
Venezuela					
South America	**10.00**	**27.00**	**20.00**	**30.00**	**140,912.00**

[2] Log removals from natural forest
[3] Without Myanmar

Price of teakwood

Country	LOGS FROM PLANTED TEAK FORESTS					
	Domestic market prices			Export market prices		
	Big logs	Medium logs	Small logs	Big logs	Medium logs	Small logs
	USD/m^3	USD/m^3	USD/m^3	USD/m^3	USD/m^3	USD/m^3
Kenya						
Malawi						
Mozambique						
South Africa						
Uganda						
United Republic of Tanzania					503.06	301.62
Zambia						
Zimbabwe						
Mauritania						
Sudan						
Benin	220.00	150.00	100.00	450.00	300.00	200.00
Burkina Fasso						
Burundi						
Cameroon						
Ivory Coast						
The Gambia						
Ghana				550.00	350.00	250.00
Guinea (Conakry)						
Guinea-Bissau						
Liberia				300.00	200.00	150.00
Mali						
Nigeria	300.00	250.00	150.00			
Rwanda						
Senegal						
Sierra Leone						
Togo	292.00	208.00	123.00	667.00	542.00	323.00
Africa	**270.67**	**202.67**	**124.33**	**491.75**	**379.01**	**244.92**
China						
Japan						
Bangladesh						
Bhutan						
Cambodia						
India						
Indonesia	337.10	279.70	164.69			
Indonesia (Perhutani)	554.00	289.00	141.00			
Lao PDR	106.00	95.00	71.00			
Malaysia						

Country	LOGS FROM PLANTED TEAK FORESTS					
	Domestic market prices			Export market prices		
	Big logs	Medium logs	Small logs	Big logs	Medium logs	Small logs
	USD/m^3	USD/m^3	USD/m^3	USD/m^3	USD/m^3	USD/m^3
Myanmar				721.00	577.00	
Nepal						
Pakistan						
Philippines						
Sri Lanka	445.87	198.16	123.85			
Thailand	796.50	548.50	245.00			
Vietnam						
Asia	**447.89**	**282.07**	**149.11**			
Cuba						
Dominican Republic						
Haiti						
Jamaica						
Trinidad and Tobago	220.00	176.00	132.00			
Belize						
Costa Rica		234.00				
El Salvador	110.30	66.18	44.12			
Guatemala						
Honduras					350.00	
Nicaragua		90.00	70.00			
Panama	275.00	150.00	70.00			
Australia						
Fiji						
New Zealand						
Papua New Guinea						
Solomon Islands						
Oceania						
Argentina						
Brazil		400	225			
Colombia						
Ecuador	380.00	280.00	230.00			
French Guyana						
Guyana						
Paraguay						
Peru						
Suriname						
Venezuela						
Latin America	**267.06**	**199.45**	**128.52**			