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ITTO Tropical Forest UPDATE

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A newsletter from the International Tropical Timber Organization to promote the conservation and sustainable development of tropical forests

Know your timber

The sustainable conservation and use of forests—sustainable forest management, to put it another way—requires an intimate knowledge of the resource and its governance. This edition of the TFU presents articles aimed at increasing knowledge on tropical timber so as to ensure the conservation of certain tree species, promote the legality of forestry operations, and add value to products in the international marketplace.

On page 3, Tereza Pastore and co-authors report on an ITTO project to develop a wood identification technique to assist in monitoring the mahogany trade. The technique involves the use of hand-held near-infrared spectrometers, and it has proved effective in field trials. It can distinguish not only

Near-infrared timber identification; assisting small enterprises in China to comply with CITES;* Pericopsis elata *in Ghana; new grading rules in Guyana; Tropical Timber Atlas; more

ITTO

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Cover image: A near-infrared spectrometer is used in the identification of *Dalbergia nigra* at the Forest Products Laboratory of the Brazilian Forest Service, Brasilia. *Photo: ITTO/LPF*

Above: African padauk (*Pterocarpus soyauxii*) is used to fine effect in the office building of the Ministry of Water and Forests in Libreville, Gabon. *Photo: Jean Gérard/CIRAD*

between mahogany and look-alike species such as crabwood, cedar and curupixá but also between mahogany samples with different origins. Among other things, the technique could be of assistance in ensuring compliance with the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), and it might also have a more general role to play in ensuring sustainable timber supply chains.

The article by Luo Xinjian (page 6) takes another tack on the theme of ensuring compliance with CITES in describing a project conducted in China, the aim of which was to increase awareness among timber importers about CITES regulations. The project used interviews and social media platforms to better understand the information needs of small and medium-sized enterprises (SMEs) specializing in tropical timber in the Yangtze River delta (the most important trade area for tropical forest products in China) and to generate useful information for them on their obligations under CITES. SMEs account for 90% of enterprises engaged in forest product imports in China, yet they are largely unaware of CITES and often fail to fulfil its trade requirements.

Margaret Appiah and Debora Baiden (page 12) present the findings of an ITTO project that investigated the distribution, conservation, market and trade status of *Pericopsis elata*, also known as afrormosia, in Ghana. *P. elata* is under heavy threat from logging and degradation, and the study concluded that the species might be moving towards local extinction in the country. The authors report that the Government of Ghana has now developed a policy for saving and regenerating the species, including by growing it in plantations and through enrichment planting in natural forests.

Pradeepa Bholanath (page 14) reports on an ITTO project that helped in the revision of Guyana's timber grading rules to align them with international standards. The revised rules, which are being rolled out through a training programme, are part of a strategy to strengthen the country's forest sector and increase its international competitiveness. According to Ms Bholanath, the overall outcome of the project, combined with other, complementary ITTO projects implemented in Guyana in recent years, is a stronger forest sector that is more competitive in international markets.

Jean Gérard and co-authors (page 19) introduce the *Tropical Timber Atlas*, the first new edition of this highly appreciated publication since 1990. The aim of the new edition, which is published in French (with a forthcoming electronic version in English), is to increase access to information on lesser-known tropical timber species and to serve as a vital reference book for industry operators. The atlas features the key characteristics and technological behaviour of 283 tropical timber species and 17 temperate species (the latter included for comparison), plus photos. The intention is to update the atlas regularly to provide users with readily accessible, timely and relevant information.

In combination, the articles in this edition of the TFU show that there is a need to disseminate further knowledge on tropical tree species and their management, use, conservation and governance. The work of ITTO, and of forest research and development agencies in tropical countries around the world, is far from done.

Closing in on mahogany ID with near infrared

A project in the ITTO–CITES Programme has successfully tested a field technique for identifying mahogany wood using near-infrared spectroscopy

by Tereza C.M. Pastore[1], Jez W.B. Braga[2] and Vera T.R. Coradin[1]

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On location: Project staff Tereza C. M. Pastore (left) and Liz F. Soares use two types of NIRS device to identify wood samples in a sawmill in Santa Cruz de la Sierra, Bolivia. *Photo: ITTO/LPF*

This article summarizes the recent findings of a project financed by the ITTO–CITES Programme aimed at developing a wood identification technique to assist in monitoring the mahogany trade.[1] Starting in March 2014, the project, which was implemented by the Forest Products Laboratory (LPF) of the Brazilian Forest Service (SFB) in close cooperation with the Institute of Chemistry at the University of Brasilia, undertook research initially proposed by LPF/SFB. The main goal was to establish a method for the *in situ* identification of wood species and their origins or provenances based on near-infrared spectroscopy and chemometrics (the science of applying statistical and mathematical methods to chemical data).

Background

The international effort to combat illegal logging and the associated trade in illegal wood products is hampered by a lack of timber identification tools. On the other hand, reputable wood dealers are increasingly being pressured to supervise their supply chains and to take steps to ensure that their products have been obtained legally. Tools are needed, therefore, to screen suspect material and identify timber.

Conventionally, wood identification involves a combination of macroscopic and microscopic techniques, in which many wood characters—such as colour, smell, brightness, texture and growth rings—of an unknown sample are compared with candidate species. When an expert wood anatomist is available to perform the identification, supported by identification keys that collate anatomical information on relevant species, this method can provide highly reliable forensic results. Nevertheless, few such experts are available to meet increasing demand for the identification of timber and wood products. Technological instrument-based methods for wood identification that do not require specialist knowledge are needed, therefore, to improve field-level inspections as well as forensic wood identification.

Near-infrared spectroscopy

A range of scientific methods has been developed independently with the potential to identify wood accurately, such as DNA barcoding, stable isotopes and dendrochronology. Near-infrared spectroscopy (NIRS) is a vibrational spectroscopy technique that measures the amount of radiation absorbed or reflected by a material when exposed to near-infrared energy. NIRS can be applied directly to solid timber, and it brings information from both chemical components and the physical structure of wood, thereby providing a "fingerprint" for a species.

NIRS is a powerful technique for wood assessment because it enables rapid, non-destructive analysis; it can be applied to solid samples; it requires minimal or no sample preparation; it does not generate chemical waste; and easy-to-use portable devices are available commercially. NIRS has been applied widely in studies of wood chemical and physical properties and is increasingly used in wood identification. Because of the lack of selectivity of the near-infrared spectra, however, raw spectra must always be used in association with multivariate analyses in order to obtain meaningful results. Spectra are analyzed to determine the likely taxon compared with a reference spectra database.

Laboratory results

The pioneering laboratory work of LPF/SFB was to classify the following Amazonian native wood species with similar appearances: *Swietenia macrophylla* King. (mahogany); *Carapa guianensis* Aubl. (crabwood or andiroba); *Cedrela*

1 The project was titled "Using the near-infrared spectroscopy (NIRS) technique on a pilot scale as a potential tool for the monitoring of the mahogany trade".

Reading the wood: Project team member Diego Carvalho obtains a NIRS reading directly from a cedar log at a sawmill in Seringal Novo Macapá, Acre, Brazil. *Photo: ITTO/LPF*

Figure 1: Countries involved in the NIRS field-testing

Note: The number of mahogany wood samples obtained in each country is shown in brackets.

odorata L. (cedar); and *Micropholis melinoniana* Pierre (curupixá).[2] A database was built with 132 milled samples obtained from different trees to ensure that the generated model for identifying species represented the range of variability of the various species. The next step was to study the possibility of using non-milled samples to simulate the situation found in real wood control and inspection procedures (see Pastore et al. 2011 and Braga et al. 2011 for details of this work).

In-the-field results

The main objective of the ITTO/CITES/SFB project was to subject the successful laboratory-based timber identification method to field conditions and, in so doing, to evaluate its viability, the time involved, and any associated risks. Thus, the aim was to use and operate the NIRS technology in the field, adapting and optimizing its performance in identifying the wood of *Swietenia macrophylla* and similar species. The strategy involved the following: acquiring two commercially available portable devices; transferring the identification model developed in laboratory conditions to these devices; and undertaking field missions in locations where mahogany is produced, thereby applying the method in field conditions.

Missions were conducted in the following locations: Seringal Novo Macapá Farm (Acre, Brazil); three sawmills in Brasilia (Brazil); one sawmill in Santa Cruz de la Sierra (Bolivia); and five sawmills in Escuintla and Petén (Guatemala). Samples for Mexico and Peru were obtained from the LPF's wood collection in Brasilia.

Identifying geographical origin

The identification of the geographical provenance of a timber sample is important for law enforcement. Illegal activities can occur at any stage of the timber supply chain, and they range in complexity from local illegal harvesting to international commercial supply chains. NIRS analysis can provide robust results in identifying the geographical provenance of wood samples. A first important finding of the project, published in the *IAWA Journal* (Bergo et al. 2016), is that the technique recognized mahogany samples obtained from 27 countries (mostly in the Americas) as true mahogany when compared with the look-like species crabwood, cedar and curupixá.[3] The second remarkable finding was that the technique (using a hand-held spectrometer) was able to separate mahogany wood samples collected in Bolivia, Brazil, Guatemala, Mexico and Peru with an accuracy of 89–100%. Figure 1 indicates the countries included in this study and the number of samples obtained in each country.

Increased number of threatened species identified using NIRS

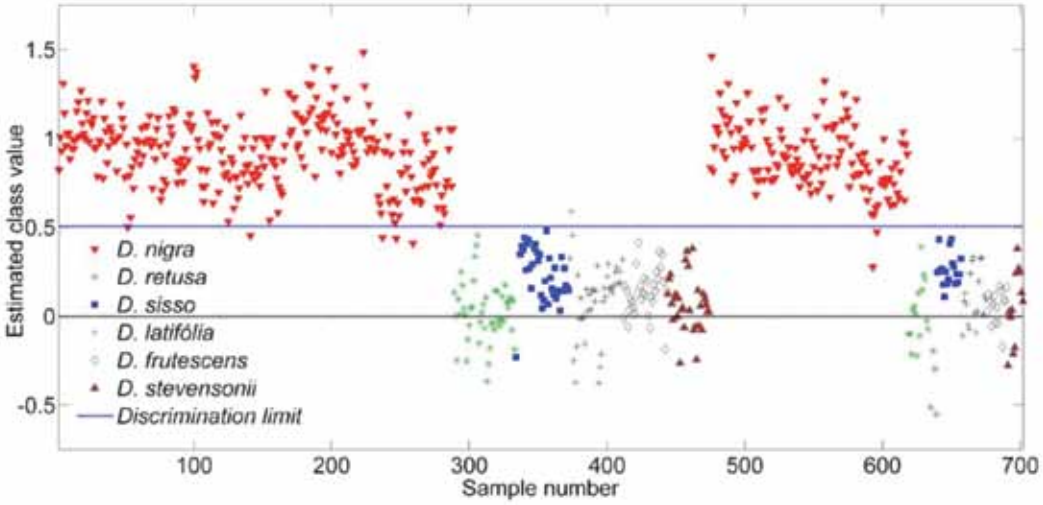
The project undertook a mission to the Forest Products Laboratory of the United States Department of Agriculture (in Madison, Wisconsin) to obtain near-infrared spectra for reference samples (i.e. wood collected with botanical material) of the following 18 wood species occurring in Brazil: *Bertholletia excelsa, Cariniana domestica, Cariniana estrellensis, Cedrela fissilis, Cedrela angustifólia, Dalbergia latifolia, Dalbergia cearensis, Dalbergia nigra, Dalbergia frutecens, Dalbergia sisso, Dalbergia retusa, Dalbergia stevensonii, Dalbergia spruceana, Dalbergia tucurensis, Lecytis pisonis, Eschweilera parviflora, Eschweilera couriacea* and *Swietenia humilis*. Most of these species are endangered and their international trade is regulated by CITES (and/or the Brazilian government prohibits felling, as is the case, for example, for *Bertholletia excelsa*). Figure 2 shows results for discriminating *Dalbergia nigra* (listed in CITES Appendix II) from other species of the same genus: an efficiency rate of 90% was obtained using a "partial least squares for discrimination analysis" (PLS-DA) global model.

In addition to these results, the number of Brazilian mahogany look-alike species has increased from three to six species, as described by Soares et al. (2017).

2 Mahogany and cedar are listed in Appendix II and Appendix III, respectively, of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES).

3 In this case, almost all samples were obtained from the Forest Products Laboratory in Madison, USA.

Figure 2: Results of the PLS-DA model for the identification of *Dalbergia nigra* in relation to other species of *Dalbergia*



Note: The *Dalbergia nigra* samples are plotted above the line labelled "discrimination limit" and the other *Dalbergia* species are plotted below this line; a few *Dalbergia nigra* samples appear below the discrimination threshold. About 500 samples were used to construct the calibration model (left) and about 200 wood samples were used to test the model (right).

Dissemination of the NIRS technology

The project demonstrated clearly that an identification model suitable for use in the field (and on dry samples) is now available for *Swietenia macrophylla*, *Cedrela odorata*, *Micropholis melioniana* and *Carapa guianensis*. Given that each range country has its own needs in mahogany wood identification, the project conducted seminars in Bolivia (25 participants comprising researchers, wood producers, forest research institutions and government representatives) and Guatemala (22 participants comprising academics, students, and representatives of governmental and non-governmental organizations) as part of efforts to increase the number of researchers investigating this issue.

Promising tool for wood identification

The project gained worldwide visibility, and today NIRS is recognized as a wood identification technology with great potential for expansion. The project's crowning achievement was the inclusion of the NIRS technology in the *Best Practice Guide for Forensic Timber Identification*, which was published by the United Nations Office on Drugs and Crime in 2016. According to this guide, NIRS is one of two instrument-based methods under development to assist in the rapid field identification of timber.

Next steps

The next steps for continuing wood identification and provenance research should involve:

1) consolidating the statistic model for identifying the geographical provenance/origin of mahogany wood in more producer countries in Latin America;
2) examining the feasibility of discriminating between species in the *Dalbergia* genus and similar woods;
3) expanding the model for discriminating between *Dalbergia nigra* and other *Dalbergia* species;
4) examining the ability of the NIRS method to discriminate between the wood of *Cedrela odorata* (listed in CITES Appendix II) and that of *Cedrela fissilis*; and
5) performing a pilot project involving customs operations.

Publications produced by the project can be found at www.itto.int/cites_programme.

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Building understanding of CITES in China

An ITTO project has helped small enterprises and tropical timber importers appreciate the need to comply with CITES rules in China

by Luo Xinjian

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Questions and answers: Meng Qian and Liu Ying interview the manager of a rosewood company in Shanghai as part of the ITTO project. *Photo: Wang Shaofang*

ITTO project TMT-SPD 023/15 Rev.1 (M)[1] was implemented between 2015 and 2017 by the Research Institute of Forestry Policy and Information (RIFPI), with technical and financial assistance from ITTO and in cooperation with the Chinese Academy of Forestry, the Chinese State Forest Administration (SFA) and the Shanghai Timber Trade Association and its members. The project relied, in part, on the output of a survey conducted by the Chinese Academy of Forestry in 2011 on small and medium-sized enterprises (SMEs) in the timber industry.

The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) has been increasingly concerned with the protection of endangered tree species since the 15th meeting of the CITES Conference of the Parties in 2010. China is one of the world's largest producers, consumers, importers and exporters of forest products, and it plays an important role—mainly as an importer—in the international trade of CITES-listed tree species. SMEs account for 90% of enterprises engaged in forest product imports in China, and they are crucial for meeting demand for forest products in both domestic and international markets. The project target area was the port of Zhangjiagang in Jiangsu Province, where one-third of China's total tropical log supply is imported each year. The Yangtze River delta has become the single most important trade area for tropical forest products, taking as much as 21.3% of China's total volume.

Rosewoods (timbers of certain species of *Dalbergia*, most of which are regulated by CITES; See Table 1 for specific names) and other rare timber resources have been highly favoured by Chinese consumers since the Ming dynasty (1368–1644). It takes several hundred years for some rare rosewood species to mature sufficiently for harvesting.

It has been found that SMEs (including importers of tropical timber) in China are unaware of the relevant laws and regulations associated with CITES, are unable to estimate the impacts of changes in CITES listings of tree species, and often fail to fulfil the trade requirements for CITES-listed tree species. With an increasing number of commercial tree species included in the CITES Appendices, it is necessary to systematically research and assess the impacts of CITES on Chinese timber enterprises. The development objective of ITTO project TMT-SPD 023/15 Rev.1 (M) was to contribute to the efforts of the Chinese government to meet its international commitments with respect to CITES-listed commercial timber species and thereby support tropical timber-producing countries in managing their forest resources.

The key problem to be addressed by the project was the weak capacity of tropical timber SMEs and importers to understand CITES regulations and the implications of failing to comply with those regulations. This weakness was due to a lack of assessment of how changes in CITES rules affect tropical timber markets and trade; a lack of systematic, up-to-date information on developments in CITES delivered to enterprises; a lack of training and awareness among SME managers on CITES regulations; and a lack of procurement policies in SMEs that take CITES into account. Small and medium-sized timber-processing and trade enterprises in China are mostly in small towns, where land is cheap. Many business owners are from local rural areas and have relatively low levels of education and limited access to technologies and information, resulting in little understanding of international

1 The project was titled "Supporting small and medium-sized forest enterprises and importers of tropical timber for better understanding of CITES and the need to comply with CITES rules in China".

Table 1: CITES-listed rosewood species identified in the China National Rosewood Standard

***Pterocarpus* genus**			
Category	**Species**	**Common name**	**CITES Appendix and listing date**
Sandalwood	*Pterocarpus santalinus*	Red sanders, red sandalwood	Listed in Appendix II on 16 February 1995
Palisander	*Pterocarpus erinaceus*	Ambila	Transferred from Appendix III to Appendix II on 2 January 2017
***Dalbergia* genus**			
Fragrant rosewood	*Dalbergia odorifera*	Scented rosewood	Listed in Appendix II on 2 January 2017
Blackwood	*Dalbergia fusca*	Black rosewood, yinzat	Listed in Appendix II on 2 January 2017
	Dalbergia latifolia	Indian rosewood, sonkeling, sonobrits, Bombay blackwood, rosewood, java-palisandre, angsana keling	Listed in Appendix II on 2 January 2017
	Dalbergia louvelii	Bois de rose	Moved from Appendix III to Appendix II on 12 June 2013
	Dalbergia melanoxylon	African blackwood, Mozambique ebony, African rosewood	Listed in Appendix II on 2 January 2017
	Dalbergia nigra	Brazilian wood, jacaranda	Listed in Appendix I on 11 June 1992
	Dalbergia spruceana	Jacararda, Brazilian rosewood	Listed in Appendix II on 2 January 2017
	Dalbergia stevensonii	Honduras rosewood	Transferred from Appendix III to Appendix II on 12 June 2013
Tamalan	*Dalbergia bariensis*	Neans nuon	Listed in Appendix II on 2 January 2017
	Dalbergia cearensis	Kingwood, violetta, violetwood	Listed in Appendix II on 2 January 2017
	Dalbergia cochinchinensis	Siam rosewood, paying, trac, krang hung	Listed in Appendix II on 13 June 2013
	Dalbergia granadillo	Cocobolo	Listed in Appendix II on 12 June 2013
	Dalbergia oliveri	Burma tulipwood, chingchan, tamalan	Listed in Appendix II on 2 January 2017
	Dalbergia retusa	Cocobolo	Transferred from Appendix III to Appendix II on 12 June 2013

obligations. CITES involves scientific terms and the identification of various species by their scientific names; it is difficult for SMEs to identify CITES-regulated species.

Accordingly, the specific objective of the project was to raise the capacity of SMEs and importers of tropical timber in the Yangtze River delta to understand and prepare procurement strategies and business plans to take into account changes in the CITES Appendices, with a view to improving market transparency and promoting trade in tropical timber from sustainable managed and legally harvested forests.

Target beneficiaries

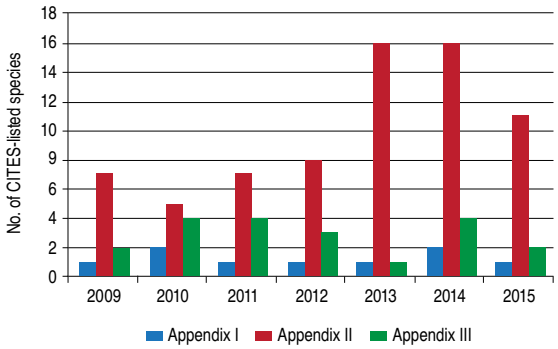
The project's target beneficiaries were:

- the SFA and China's Endangered Species Management Office, which formulate China's forestry and wood products trading policy;
- the General Customs Administration;
- SMEs processing tropical wood products;
- the Shanghai Timber Trade Association;
- domestic enterprises engaged in the trade of tropical forest products;
- foreign enterprises (exporters and importers) engaged in the trade of tropical forest products with China; and
- ITTO consumers.

China's trade of CITES-listed tree species

The CITES Trade Database shows that, in 2009–2015, China imported 28 CITES-listed timber species in 18 genera. Of those, two were listed in Appendix I, 22 were listed in Appendix II and four were listed in Appendix III; Figure 1 shows the import trend. Due to the rarity of the species, most of the imports involved small, ad hoc volumes; the exceptions were *Dalbergia* and *Aquilaria*, the imports of which were maintained at high levels. The main *Dalbergia* species imported by China in the period were *D. nigra, D. louvelii, D. stevensonii, D. retusa, D. cochinchinensis, D. tucurensis* and *D. granadillo*. *Bulnesia sarmientoi* and *Aquilaria* species were imported in the highest volumes.

Figure 1: Distribution of China's imports of CITES-listed tree species, by Appendix, 2009–2015



High value: Project officers and ITTO staff visit the showroom of the Hangguan Rosewood Company showing the ornate carving typical of traditional Chinese rosewood furniture. Photo: Luo Xinjian

More than 90% of CITES-regulated tree species imported in the period was for commercial use; a small amount was imported for exhibitions and, in some years, small quantities were imported for purposes such as educational use and scientific research. There were no imports of CITES-regulated tree species in the six years to 2015 for the purposes of artificial propagation, botanical gardens, medical use, justice or reintroduction. The main source countries of China's imports of CITES-regulated tree species were Argentina, Paraguay, Viet Nam and Singapore, followed by Japan, Malaysia, Indonesia, Germany and Thailand.

Of all China's imports of CITES-regulated tree species in 2009–2015, 61.3% were harvested in the wild, 19.1% were harvested before they were listed in CITES, 15.7% were artificially propagated, 3.1% were from confiscated sources, 0.2% were listed in Appendix I and artificially propagated, and the remainder (0.6%) were from unknown sources.

The import volume of the main endangered tree species reached a peak of 449 555 m^3 in 2010; thereafter, both import volume and value have shown decreasing trends. Specifically, the import volume has decreased continually since 2010; the import value, on the other hand, bounced back in 2014 before declining again. China's import value of endangered tropical tree species (Harmonized System code 4403499010) was low between 2009 and 2012 and increased in 2013 and 2014, when the rosewood market was "hot". Demand for rosewood began to weaken after 2014 as China's economy slowed from "high-speed" to "medium-high speed" and the central government issued strict policies.

China's imports of other endangered tropical tree species have also declined sharply. China imported only 8888 m^3 of logs of endangered tropical tree species in 2016 at a value at US$3.415 million, down by 72% from the peak in 2014. Those imports were mainly from the Democratic Republic of the Congo, the Congo, the Philippines and the Solomon Islands.

The inclusion of tree species in the CITES Appendices affects the import price of raw materials; generally it fluctuates for a short period and then stabilizes at a higher level. Traders incur the main impact of such price increases because manufacturers can adjust the volume of raw materials they purchase, depending on market demand, and shift costs to consumers. Therefore, traders (importers) bear most of the risks over the entire rosewood industry chain.

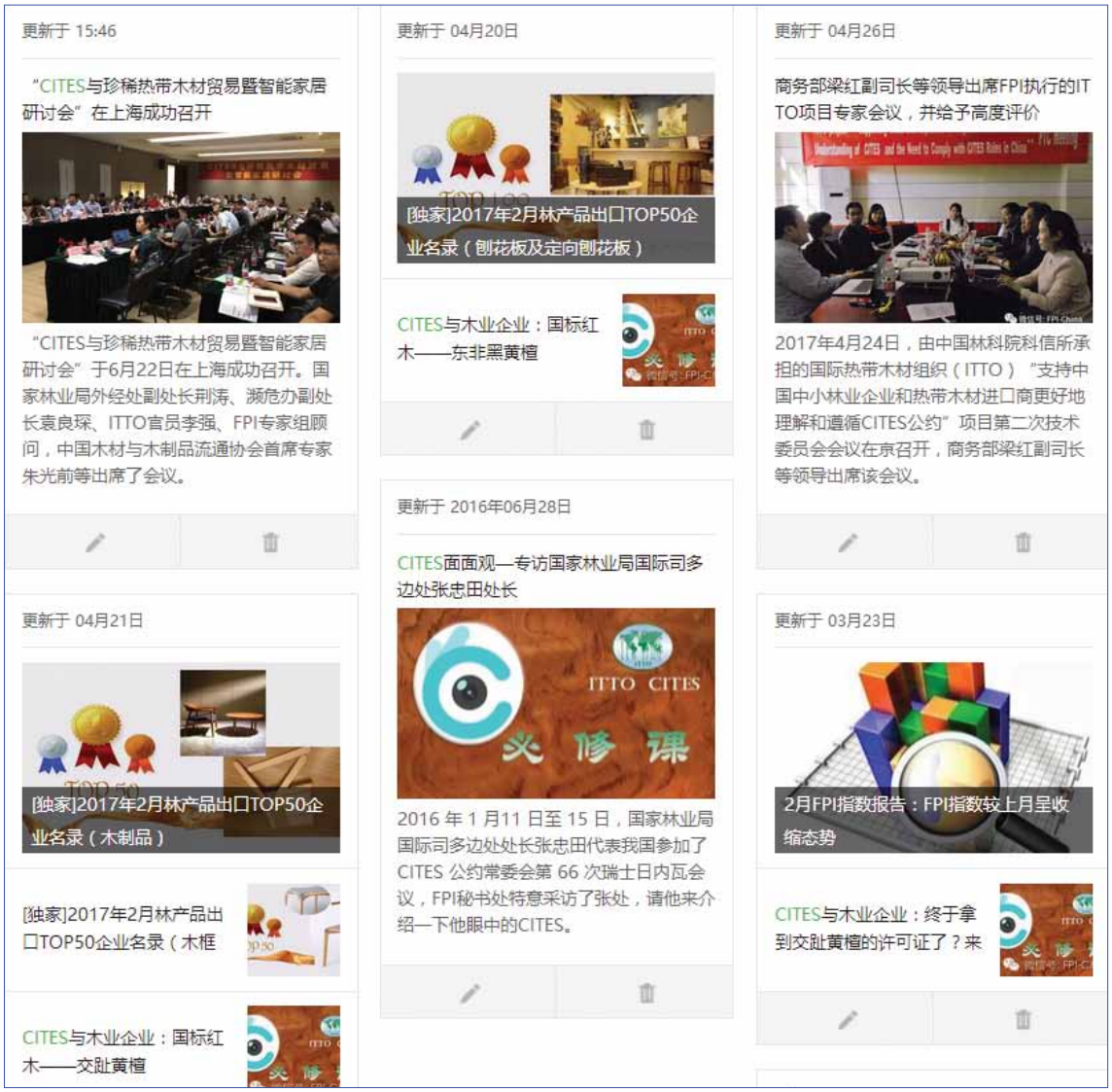
Project achievements

The project produced three main outputs:

1) a report titled *Analysis of Trends and Impact on China's Timber Trade of Commercial Timbers included in CITES;*
2) a web-based (and mobile-enabled) communication platform for the dissemination and exchange of up-to-date CITES information[2] (in Chinese); and
3) training workshops for 100 representatives of SMEs and importers in the project area.

Project activities and outputs were effective in achieving the specific objective, as set out in the project document, and also in creating awareness of the crucial importance of CITES.

2 www.chinafpi.org/cn/Supply_List.aspx?MC_ID=148



CITES chat: The FPI releases information about CITES through the WeChat social media platform.

WeChat

A significant project output was the establishment of the communication platform FPI WeChat (continued from ITTO project PD 017/09 Rev. 2, conducted from 2011 to 2013). RIFPI continues to run and finance this element of the project.

As of 28 June 2017, 4930 registered users and about 2000 enterprises—timber traders, timber manufacturers, timber sellers, freight terminals, timber associations, research institutions and government officers—were subscribed to the FPI WeChat platform, and information sharing was ongoing. The efficiency and quality of communication continues to improve. The project team conducted online courses (called "CITES and timber enterprises") on the FPI WeChat platform. CITES-related information (e.g. market news, expert opinions and policy changes) is shared regularly via the platform, and this is highly appreciated by subscribers. The SFA and the Shanghai Timber Trade Association support the platform as a way of sharing information and encouraging dialogue.

"FPI Wechat is a good information channel for SFA. It can help government authorities understand the enterprises' needs as well as the manufacturing and trade trends of the forest products industry. Because of the timeliness of the information released by the FPI, this information is referenced in the international negotiations and policymaking of SFA."
—Jing Tao, Deputy Director, SFA Division of Development Planning and Fund Management

Jing Tao, Deputy Director, SFA Division of Development Planning and Fund Management

Showcase: SMEs that process tropical timber products, such as this company in Shanghai manufacturing rosewood furniture, were among the project's target beneficiaries. *Photo: Luo Xinjian*

"FPI WeChat is a good channel for us to trace and monitor the export trends of wooden products, such as flooring, wooden window and door, etcetera. It has gathered the most authoritative trade data, the most influential experts, the most timely industry news of the forestry industry, and is playing an important role for enterprises to master the development of the industry."—She Xuebin, Chairman of Nature Company

Chinese importers and SMEs—at home and abroad—now have a better understanding of the market situation for tropical wood products and of the policy dynamics of CITES from the information delivered via the daily-updated FPI public WeChat account. With an increasing number of tropical timbers, especially rosewoods, under the management and monitoring of CITES, Chinese importers and industries face increasing challenges in international marketing. It is necessary to continue to research and share information on wood product markets to understand the requirements of CITES and national policies concerning such tree species.

Information on CITES will continue to be made available, and the two-way exchange of information will be facilitated between the decision-making departments of government, the CITES management authority, the CITES scientific authority, and SMEs. The difficulties faced by SMEs and importers, and their policy requests related to CITES, will be assessed regularly and results delivered to SFA officers; policy information on CITES will be passed to SMEs as promptly as possible. The outputs of the project have become an important reference point for both the SFA and SMEs.

The project team published two academic papers in China's core journals on the forest industry.[3] Few papers have previously been published that have analyzed the trade of CITES-listed tree species in China, and the papers published under the project therefore help fill a research gap. RIFPI has access to comprehensive international trade data, providing the basis for ongoing academic research on CITES.

Impact

The project attracted considerable domestic and international attention due to its excellent performance. It generated considerable momentum, interest, outputs and outcomes, and it laid the foundation for Chinese tropical timber-processing SMEs and importers in the project area to understand CITES and comply with CITES rules in China. For example:

- The project increased awareness among SMEs of the importance of sustainable forest management and protecting CITES-listed tree species.
- Research conducted under the project improved the implementation of CITES regulations and other policies and increased the capacity of SMEs to trade timber sourced from legal and sustainably managed forests.
- Training courses (both online and on-the-spot) provided by the project helped Chinese SMEs better understand CITES trade requirements and increased their understanding of the trade situation of CITES-listed tree species.

3 Meng Qian, Luo Xinjian, Liu Ying & Li Zhenghong 2017. Trade dynamics of the CITES-listed timber species. *World Forestry Research* 30(2): ; Meng Qian, Luo Xinjian, Liu Ying & Li Zhenghong 2017. The impact of new-added CITES-listed timber on Chinese timber enterprises. *Forestry Economics* (3) .

- The FPI communication platform and FPI WeChat provided (and continue to provide) opportunities and means for timber SMEs to increase their professional knowledge of CITES. More than 4000 subscribers can access FPI WeChat to obtain a wide range of market, trade and policy information on CITES.

Lessons learned

The following important lessons were learned from the project:

- The two-way communication mechanism between the project and SMEs was crucial, including training on CITES and field interviews.
- Field surveys should be conducted in stages, thereby allowing questions to be reformulated and added to in response to feedback during test phases.
- In assessing policies and recommending changes, it was crucial that the project carried out whole-industrial-chain investigations.
- RIFPI obtained good support and cooperation from all involved stakeholders, and no negative operational issues were encountered. RIFPI plans to maintain long-term cooperation with the government, SMEs, associations, research facilities, non-governmental organizations and identification agencies.

Future prospects

Based on the outcomes of the previous four meetings of its Conference of the Parties, CITES will continue to expand its coverage of timber species, especially tropical species, posing major challenges for Chinese timber importers. The ability of SMEs to overcome such challenges can be strengthened in the following ways:

- accelerating the preparation of guidelines for SMEs and strengthening CITES-related training;
- enabling online applications for CITES permit certificates to shorten approval times;
- strengthening management measures to enhance CITES enforcement capabilities;
- encouraging artificial propagation to reduce the consumption of wild resources; and
- strengthening international cooperation to jointly promote legal trade in wild fauna and flora.

To implement the above suggestions, it is necessary to continue research on markets for CITES-listed species to understand changes, impacts and future trends. Given that China has become the world's leading centre for the manufacture, consumption and trade of wood products, in-depth studies on Chinese SMEs will contribute to the sustainable development of global wood product markets.

RIFPI is continuing the project's most exciting and important output—the web-based communication platform. The platform continues to distribute up-to-date information on CITES to domestic stakeholders, gather feedback from those stakeholders, and facilitate communication between the SFA, the CITES management authority and related administrators.

The capacity of the ITTO-supported Tropical Forest Product Information and Consultation Center of China has been further enhanced. The project has translated ITTO's twice-monthly *Tropical Timber Market Reports* since the end of 2012 and distributed these to Chinese SMEs via the FPI WeChat platform. Subscribers to the platform continue to obtain exclusive news on the forestry industry (such as on CITES, international markets, expert views, import and export trade, and price trends) through WeChat. In addition, the platform is a good channel for communication between enterprises and government departments (such as the SFA and Customs). Via the platform, the government can promptly notify enterprises of the latest policy requirements and receive feedback on the difficulties faced by the private sector and suggestions for overcoming these. WeChat has strengthened the project team's links with stakeholders. All these efforts have laid a good foundation for future follow-up research on tropical wood product markets in China.

Further information on the project can be found by inserting the project code TMT-SPD023/15 Rev.1 (M) into the ITTO project search function at www.itto.int/project_search.

The long decline of afrormosia in Ghana

An ITTO project has found that illegal logging is driving this valuable timber species to local extinction

by Margaret Appiah[1] and Debora Baiden Bediako[2]

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Still standing? A mature *Pericopsis elata* in the Mpameso Forest Reserve, Ghana. *Photo: ©NDF*

Pericopsis elata is a valuable timber species that occurs in moist semi-deciduous forests with an annual rainfall of 1250–1500 mm. The tree is a leguminous species of the Fabaceae family, and the timber is popularly known under its trade name afrormosia. The natural range of the species is discontinuous, with several isolated substands in Ghana, Côte d'Ivoire, southeastern Cameroon, northern Congo, northeastern Democratic Republic of the Congo and southwestern Central African Republic.

Afrormosia timber, which is considered a substitute for teak, is highly valued in international markets, mainly for furniture and as a decorative veneer but also for interior and exterior joinery, stairs, flooring and boat building. Afrormosia timber is also suitable for heavy and light construction purposes, such as railway sleepers, vehicle bodies, interior trims, handles, ladders, agricultural implements, sporting goods, musical instruments, toys, novelties, boxes, crates, carvings, turnery and draining boards. In traditional medicine in the Congo, pulped *P. elata* bark is rubbed into scarifications as an anodyne.

Taking stock: Researchers measure *P. elata* in the field. Photo: ©NDF

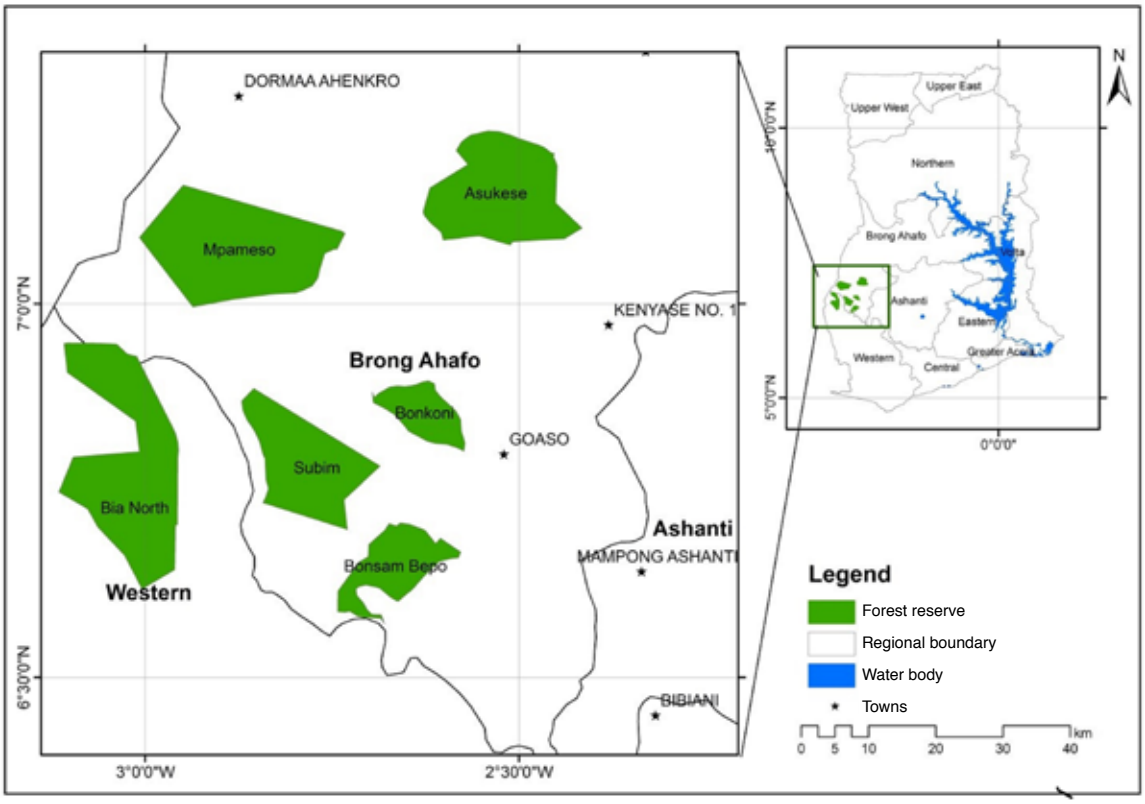
P. elata has been heavily logged in Ghana (one of its range states) for its highly valued timber. The timber was first exported from Ghana to England in 1948 (Bourland et al. 2012; Howland 1979). Today, the species is listed in Appendix II of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), which means that its international trade is not permitted without special authorization by the relevant authorities in exporting countries. This authorization is provided by way of CITES certificates issued by the CITES management authority on application by the exporter. In Ghana, the Wildlife Division of the Forestry Commission is the responsible authority for issuing CITES certificates.

P. elata is found in forest reserves in the moist semi-deciduous vegetation zone in Ghana's Western and Brong Ahafo regions, particularly the Juabeso, Goaso and Dormaa Ahenkro forest districts. It is under heavy threat from logging and the general degradation of the forests in which it occurs. In an effort to reduce pressure on the species caused by logging, the Forestry Commission classified *P. elata* as a restricted species for harvesting after its listing in CITES Appendix II in 1992. Besides this classification, however, nothing has been done to protect the species.

In a bid to assist the conservation of *P. elata*, the Nature and Development Foundation (NDF), with support from ITTO[1], conducted studies and made available up-to-date data on the distribution, conservation, market and trade status of the species in Ghana. The studies revealed that tree stock densities in the surveyed forest reserves are low, ranging from 0.013 to 0.526 individuals per hectare; the 10–29 cm diameter class contributes least (0.05%) to wood volume in the reserves studied.

1 TMT-SPD017/15 Rev.2 (M): "Improving sustainable *Pericopsis elata* conservation and trade regulation in Ghana".

Figure 1: Distribution of *P. elata* in Ghana



Source: Wildlife and Range Management GIS Lab, Kwame Nkrumah University of Science and Technology.

The natural regeneration of *P. elata* was also found to be unreliable, with recruitment into the exploitable intermediate and larger size classes often inadequate.

There are fears that *P. elata* is moving towards local extinction in Ghana. Even though the Forest Services Division has had an embargo in place on harvesting the species for the last decade in a bid to protect it, inspections of timber markets and sawmills in Accra and Dormaa Ahenkro conducted under the project showed the ongoing sale of afrormosia timber without any licences.

The resource life (i.e. the number of years that a species can continue to be used commercially at the current rate of extraction) of *P. elata* was found to be effectively zero. Thus, the species is under threat and is not being sustainably harvested.

In conclusion, the project has contributed to addressing an information gap in the sustainable management of *P. elata* in Ghana. Public awareness and interest in the species have been raised because a component of the project was to produce a video documentary[2] to assist advocacy and provide public education on the impacts of unsustainable logging and trade of afrormosia. This, in turn, has placed pressure on authorities to develop a policy for saving and regenerating the species. Thus, the Ghanaian government has begun developing plantations and is undertaking enrichment planting of the species within its range.

Hidden problem: Illegal sawn lumber lying in the forest. Afrormosia boards are in the middle of the stack. Photo: ©NDF

Publications and other materials produced by the project can be found by inserting the project codeTMT-SPD017/15 Rev.2 (M) into the ITTO project search function at www.itto.int/project_search.

2 https://www.youtube.com/watch?v=zwFbN8_uRBA

Making the grade

An ITTO project has helped in the revision of Guyana's timber grading rules to align them with international standards

by Pradeepa Bholanath

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Fully aligned: Purpleheart (*Peltogyne venosa*) timber from Guyana makes a fine boardwalk. *Photo: Michel Vernay/CIRAD*

Timber grading is fundamentally a tool for marketing and quality control and for ensuring that buyers know the characteristics and specifications of the wood they buy and that sellers know what to supply to meet buyer expectations. Grading can be done either by visual assessment—for example, based on size characteristics and the occurrence of visual defects such as knots—or by machine grading, which is done to test timber strength.

In Guyana, grading is normally performed only for exports, although there is no reason why it cannot be done locally should a customer request a certain grade of timber. Standardization promotes international recognition and acceptance, which is important for increasing markets for Guyana's timber and wood products; it can also encourage the use and marketing of lesser-used timber species.

ITTO project PD 687/13 Rev.1 (I): "Strengthening the performance of the wood-processing sector in Guyana through building local capacity and enhancing national systems that promote forest product trade and sustainable utilization of forest resources", which the International Tropical Timber Council declared completed in November 2016, strengthened Guyana's forest sector by increasing its competitiveness in international markets and enabling it to use forest resources more efficiently along the industrial value chain. One of the project's main outputs was the revision and development of guidelines for timber grading and export, which is the subject of this article.

Rationale for revising the grading rules

The 2016 revision of the Guyana Timber Grading Rules (GTGR) drew heavily on grading rules used in the main international markets for Guyanese timber (especially lumber). This was done to ensure that grading in Guyana is immediately comparable and compatible with grades in buyer countries, thus reducing the potential for confusion and differences in interpretation between sellers and buyers.

In revising the GTGR, the main guiding principles were to:

- include a wide range of opinions—both from within Guyana and among international partners—in a process of stakeholder involvement to reach consensus on the GTGR;
- simplify the rules so they are easier for graders, exporters and buyers to understand and apply;
- dovetail the GTGR with major international rules, especially those of the United States, the European Union and the Caribbean;
- focus on a few major product groups for grading while retaining optional grading for a range of minor products;
- refocus grading on visual strength grading for structural timbers and appearance grading for non-structural utility and decorative woods;
- provide a clear description of the defects most commonly encountered in Guyanese timber;
- review the inclusion of dimension tolerances in grades, consider setting ground rules, and address details in bilateral agreements between buyers and sellers;
- address moisture content in wood as part of the grading; and
- propose a "fit-for-purpose" grade for certain product groups in cases where products do not conform with regular grades but for which specifications are agreed between sellers and buyers.

Grading fundamentals

The GTGR 2016 is based on visual assessment rather than machine testing; essentially, it is founded on the assessment of defects and dimensional verification. A defect is any feature, whether occurring naturally in the living tree or produced in the process of lumber conversion, that affects the appearance or utility of sawn timber.

The GTGR 2016 permits the sorting of hardwood logs and lumber into groups and grades with intended end uses. The rules define the permitted incidence of several types of defect in each grade. Grades for major product types are based on those internationally recognized grades most applicable to wood exports from Guyana (Table 1), and grading is done according to tolerances: if a piece (or a proportion of pieces) fails on one or more tolerances, it cannot make the grade.

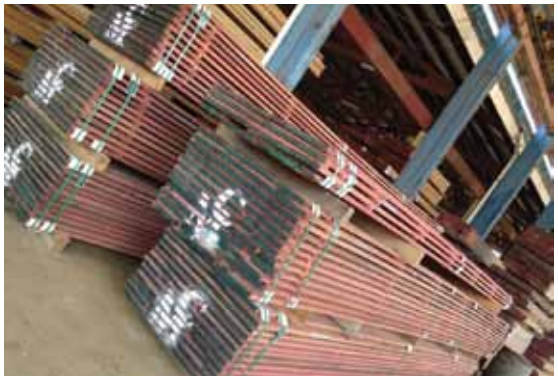
The GTGR 2016 comprises four main product groups, which are subdivided into product types and subsequently into individual grade distinctions. This streamlining of the framework structure means that some timber products may be classed as more than one product type. In this case, the seller, buyer or grader can select the most appropriate product type to grade against, according to the intended end use and market requirements.

GY01. Roundwood

Under the GTGR 2016, logs (GY01a) and piles (GY01b) are graded visually according to certain structural aspects and the occurrence and extent of (largely) natural defects. There are four grades (A–D) for logs and three grades (A–C) for piles; each of these product groups has a final fit-for-purpose grade.

For round logs, an approach to grading was adopted based on common practice in the United States in which relevant defects are assessed and recorded according to the four nominal faces of the log (tables 1 and 2).

The general wood products group (GY04) covers all categories of specialized products with generally relatively small or niche markets. Plywood and veneer are included in the 2016 version, along with a category for non-traditional wood products (without grades) covering exports of artistic or artisanal wood items, such as tree stumps.



More mora: *Mora excelsa* lumber dressed, graded and ready for export. Photo: Guyana Forestry Commission

Grading method and practice

Method for determining grade

The revised grading rules are based on the quality and quantity of "defects" in a piece or a parcel of pieces. Grading is carried out according to the type of forest product and its intended use. The system used in Guyana is visual; no machine strength testing is carried out.

Permissible defects are defined for each grade. A piece of timber is rejected if it has more defects than allowed for the product. For example, a railway sleeper found to contain sapwood in more than half its width at either of the rail seats is deemed not to meet the required grade and is therefore rejected.

Grading practice

In Guyana, the grading authority and rules exist to independently confirm and assess a predefined objective quality standard so that customers can purchase Guyanese timber with confidence. This function is fulfilled by the provision of advice to customers on timber quality assurance, by general supervision of timber production, by training graders, and by the routine monitoring of competence and performance. Only authorized timber graders may carry out timber grading.

Table 1: Compatibility between Guyanese sawnwood grades and international grades

Guyanese product group	Guyanese grade	Compatible standard	Grade
GY02—Structural timber	A	United Kingdom/Europe (BS EN 14081-1:2005)	HS
	B		Not applicable
	C		Not applicable
GY03a—Non-structural timber (utility timber)	A	United Kingdom/Europe (EN 975-1: 2009)	QFA and QF1a-b
	B		QF2 and QF3
	C		Not applicable
GY03b—Non-structural timber (decorative timber)	A	United States (National Hardwood Lumber Association—NHLA —Grading Rules for Hardwoods)	FAS
	B		F1F/Select
	C		No. 1 Common/No. 2A Common
	D		No. 3 Common

Table 2: Summary of GTGR 2016 structure

Product group*	Product type code	Product type description	Grading method	Possible grades
GY01—Roundwood	a	Logs	Visual strength** or appearance	A, B, C, D (FFP)
	b	Piles		A, B, C (FFP)
GY02—Structural timber		All types	Visual strength	A, B (FFP)
GY03—Non-structural timber	a	Utility timber	Appearance (defects)	A, B (FFP)
	b	Decorative timber	Appearance (cutting)	A, B, C (FFP)
GY04—General wood products	a	Profiled products	Appearance (defects)	A, B (FFP)
	b	Railway sleepers and crossings	Visual strength	A, B
	c	Transmission poles (round)	Visual strength	A
	d	Telegraph and electric cross-arms	Visual strength	A
	e	Fencing posts	Visual strength	A (FFP)
	f	Shingles	Appearance (defects)	A (FFP)
	g	Fencing staves	Visual strength	A (FFP)
	h	Hewn squares	Visual strength	A
	i	Non-traditional wood products	Not applicable	No grade
	j	Plywood and veneer	Appearance	A–D/1–4

Notes: FFP = fit for purpose. * Product groups are linked to the 2002 version of the GTGR as follows: roundwood covers raw wood in the round and includes logs and round piles; structural timber covers all timber intended for construction and engineering applications for which strength characteristics are of primary importance; non-structural timber covers all timber intended for uses for which strength characteristics are not paramount and equates to sawn timber for dressing and furniture manufacture; and the general wood product group covers sawn baulks (large scantlings) and all other sawn timber for building and construction.

** "Visual strength" grading refers to grading by assessing characteristics of a log or piece of lumber by visual characterization of specifications and defects; it is distinguished from "machine strength" grading, which uses mechanical equipment to test for strength characteristics such as bending and hardness.

In certain circumstances, such as at the request of customers or producers, the grading authority (the Guyana Forestry Commission) may approve grading by quality-control inspectors. Otherwise, the inspector carries out "check-grading" only. The grading authority does not accept liability for timber received in an unsatisfactory condition.

Specifications

Under the revised rules, a timber grader will not undertake any grading until true copies or extracts of the specifications of the timber to be graded and the contract made between the customer and the supplier are forwarded to the grading authority, along with an application for grading. Specifications must include the type of timber, quantity, size, grade, average width and length, multiple lengths, seasoning period, railway gauge (for sleepers) and any special conditions. The type of timber supplied is to be as specified in the contract.

Aligning with international standards

International Organization for Standardization

As part of the revision process, the Guyana Forestry Commission examined the following international standards:

- Solid timber in structural sizes—determination of some physical and mechanical properties (International Organization for Standardization—ISO—8375:1985).
- Solid timber—visual strength grading (ISO/CD 9709).
- Durability of wood and wood-based products—definition of hazard classes of biological attack—application to solid wood (ISO/DIS 12583-2).
- Timber structures—determination of characteristic values of mechanical properties and densities (ISO/CD 13910).
- Structural timber—requirements for machine-graded timber (ISO/CD 13912).

Table 3: Grading and building rules, various countries and regions, and Guyana

Country or region	Grading/building rules
United Kingdom/European Union	BS/EN 338:2003. Structural timber—strength classes BS 5756:2007. Visual grading of hardwood EN 975-1:2009. Appearance grading of hardwood EN 14081-1:2005. Strength-graded structural timbers: general requirements
United States	Grading Rules for North American Hardwoods (NHLA) Rules for the inspection and measurement of hardwoods and cypress (NHLA)
Caribbean	Caribbean Uniform Building Code (CUBiC)
Guyana	Guyana Standard: Building Code—Section 7: Use of Guyanese hardwood in construction (GCP 9-7:1999)

- Timber poles—test methods—determination of structural properties (ISO/AWI 15206).
- Timber poles—determination of characteristic strength values (ISO/AWI 15207).
- Durability of wood and wood-based products—preservative-treated solid wood (ISO/CD 15385-1).

Timber structural properties

The revised grading rules include classifications for durability and strength.

Durability

Durability, or natural durability (i.e. without preservatives), refers to the ability of wood to withstand decay and insect attack when exposed to the elements. In the GTGR 2016, species are divided into four natural durability classes—1A, 1, 2A and 2 (Table 4).

Class 1A timbers are highly durable under all conditions of exposure, including ground contact. In tropical conditions, ground contact life in service may exceed ten years; in temperate conditions, it may exceed 40 years. Class 1A timber species are also highly resistant to attack by insects, although full control of tropical subterranean termite attack may require soil poisoning with a contact insecticide. Aboveground service life with minimum protection is indefinite in all climates.

Class 1 timbers are very durable in protected exterior situations (e.g. construction, buildings and cladding) but are not durable when in ground contact. They are highly resistant to attack by dry-wood termites (*Cryptotermes* species). When used in non-ground-contact applications, Class 1 timbers may require further protection from subterranean termite attack, such as soil poisoning and the inclusion of termite shields in substructures.

Table 4: Common commercial species of Guyana—strength and durability

Botanical name	Common name	Strength group*	Strength class**	Durability class	Density (kg/m^3)	MOR (N/mm^2)	MOE (N/mm^2)	CS (N/mm^2)
Chlorocardium rodiei	Greenheart	F5	D70	1A	1005	240	24 500	98
Swartzia leiocalycina	Wamara	F5	D70	1A	1200	213	23 630	110
Eschweilera spp.	Kakaralli	F5	D70	1A	1120	182	21 635	77
Mora gonggrijpii	Morabukea	F5	D70	1A	1005	176	21 910	94
Peltogyne venosa	Purpleheart	F3	D70	1	960	155	16 860	79
Mora excelsa	Mora	F4	D70	1A	880	149	21 020	81
Aspidosperma spp.	Shibadan	F3	D70	1	913	175	22 185	91
Hymenaea courbaril	Locust	F4	D60	1	880	172	18 500	84
Humiria balsamifera	Tauroniro	F4	D60	1A	880	168	18 800	86
Moronobea coccinea	Manniballi	F4	D70	1	1005	161	22 650	66
Diplotropis purpurea	Tatabu	F3	D70	1	1005	156	18 000	88
Eperua falcata	Soft wallaba	F3	D60	1A	960	128	14 400	69
Goupia glabra	Kabukalli	F3	D60	1	800	122	14 700	62
Terminalia amazonia	Fukadi	F2	D60	2A	720	138	15 800	65
Symphonia globulifera	Manni	F3	D60	1	720	113	12 630	58
Carapa guianensis	Crabwood	F2	D50	1	560	111	11 800	59
Ocotea rubra	Determa	F2	D40	1	625	90	11 400	51
Catostemma commune	Baromalli	F1	D35	2	560	77	12 540	46
Protium decandrum	Kurokai	F2	D35	2A	560	110	12 890	61
Inga alba	Maporokon	F2	D35	2	560	95	11 800	53
Loxopterygium sagotii	Hububalli	F3	D40	1A	640	94	12 060	51
Parahancornia fasciculata	Dukali	F1	-	2	480	89	10 600	44
Alexa imperatricis	Haiariballi	-	D40	2	560	73	10 890	39
Ocotea oblonga	Kereti	F2	-	1	640	72	9 167	39
Trattinickia demerarae	Ulu	-	-	2	480	68	9 340	37
Quassia simarouba	Simarupa	F1	-	2	480	66	8 100	34
Virola surinamensis	Dalli	-	-	2	560	64	8 730	33
Jacaranda copaia	Futui	F1	-	2	480	60	8 900	31

* Strength group from the Guyana Standard: Building Code—Section 7. ** Strength class is tentative (except for greenheart, which is officially classified as D70) based on key mechanical data and the table of characteristic values provided in EN 338. MOR = modulus of rupture (also known as bending). MOE = modulus of elasticity. CS = crushing strength (also known as compression parallel to the grain).

Sources: Compiled from data provided by Tropenbos Series 15, CIRAD Tropix 7; USDA Forest Service Forest Products Lab.

Decorative effect: A dwelling in Georgetown, Guyana, with wamara (*Swartzia leiocalycina*) cladding. *Photo: Rafeek Khan*

Class 2A timbers are not durable under exterior exposed conditions, but they are suitable for internal finishing and furniture where *Cryptotermes* species are not a hazard. Only two of Guyana's 30 commercial species are in this class.

Class 2 timbers are low-density hardwoods that normally require treatment for external work, although they are very satisfactory for general construction and some are excellent for high-class joinery work.

Strength

Strength is a compound factor determined by several variables concerning the mechanical properties of wood. Table 4 provides typical data (from a range of published sources) on common strength factors as well as strength groups (from the Guyana Building Code) and *tentative* strength classes based on characteristic values provided in European Standard (EN) 338.

Creating a platform to support future trade

ITTO project PD 687/13 Rev.1 (I) delivered a much-needed revised standard for grading that offers greater conformance and uniformity with international trading requirements and is expected to have a positive impact on the trade of Guyanese timber. Training on the GTGR 2016 is being provided to inform a national roll-out of the revised version.

It is expected that the GTGR 2016 will support the ongoing European Union Forest Law Enforcement, Governance and Trade process in Guyana, likely to be finalized by the end of 2017. This output also builds on previous ITTO projects in Guyana, particularly the development of the Code of Practice for Processing Operations (see TFU 26/1), with the overall effect of strengthening the country's forest sector and increasing its competitiveness in international markets.

The revised Guyana Timber Grading Rules 2016 and other publications produced by the project can be found by inserting the project code PD 687/13 Rev.1 (I) into the ITTO project search function at www.itto.int/project_search.

The Tropical Timber Atlas

This fully revised edition presents information on 300 species and will serve as a vital reference tool for operators in the tropical timber industry

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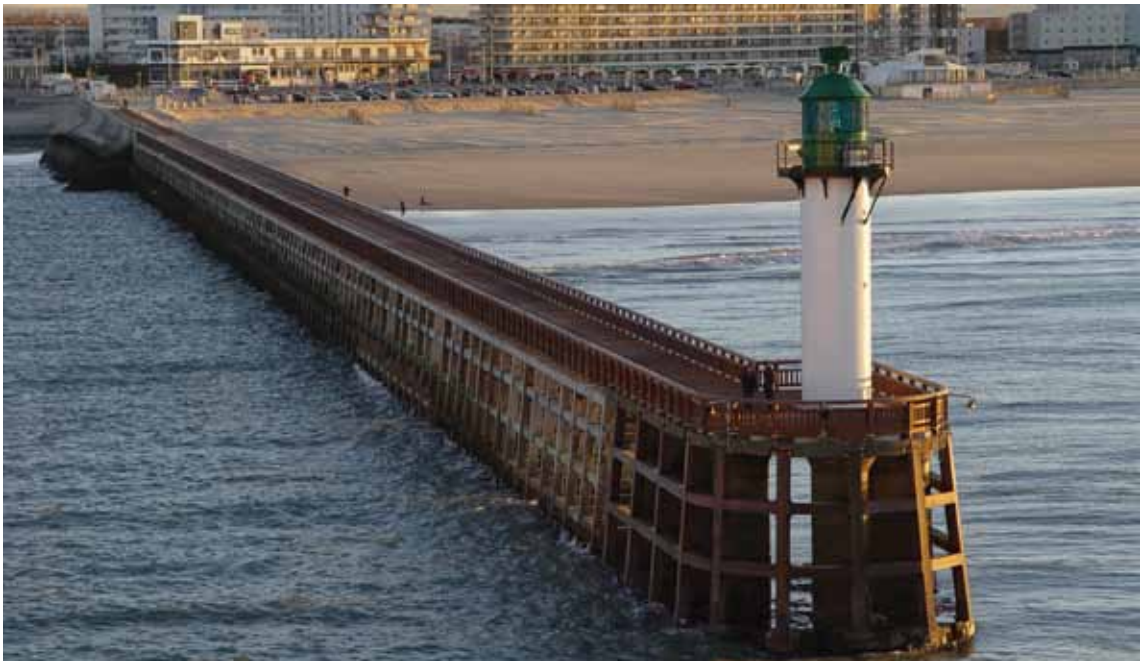


Wood for leisure: The jetty at Tillac, France. *Photo: Denis Delequeuche*

In the mid-1980s, ITTO commissioned the Tropical Forest Technical Center (*Centre technique forestier tropical*—CTFT) of the French Agricultural Research Centre for International Development (*Centre de coopération internationale en recherche agronomique pour le développement*—CIRAD) to design and implement software for managing technical information on tropical timber. The initial version was developed from the CTFT's "Tropical Timber" database, which is a compilation of the findings yielded over several decades of research on tropical wood. The aim, on the one hand, was to disseminate information on tropical timber and make it available to industry operators and, on the other, to help in promoting and developing markets for the use of tropical timber, particularly of lesser-known species.

Later, the CTFT/CIRAD team in charge of tropical timber further developed the software and increased both the number of described species and the featured characteristics. In the mid-90s, the software was transferred from DOS to the Windows operating system and disseminated under the name *Tropix*. Several updated versions were released by the former Tropical Timber Research Unit, which is now CIRAD's BioWooEB Unit.

The most recent version of the software (v. 7.5.1, released in 2015) presents the technical characteristics of 245 species, including 17 species from temperate areas. *Tropix*[1] is widely used by timber industry operators, both in France and abroad.

Three tropical timber reference books were published between 1986 and 1990 that drew on the CTFT/CIRAD data:

1) *Tropical Timber Atlas*, Volume 1, Africa, published in English and French in 1986 by CTFT and the International Technical Association of Tropical Timber (*Association Technique Internationale des Bois Tropicaux*—ATIBT);
2) *Tropical Timber Atlas*, Volume 2, Asia–Australia–Oceania, published in English and French in 1987 by ATIBT; and
3) *Tropical Timber Atlas of Latin America*, published in English, French and Spanish in 1990 by ITTO, CTFT and ATIBT.

Tropical timber industry operators still widely use these three publications, all of which are now out of print, but they expressed a desire for an up-to-date publication on tropical timber containing the data and information they need to adequately plan their businesses. Thus, it was decided to improve the data and information in the *Tropix 7* software and compile these in a single publication (both hardcopy and electronic) called *Atlas des bois tropicaux* (available in English in digital form as the *Tropical Timber Atlas*), which would replace the three-volume series on timber species, as listed above.

ITTO approved the provision of financial support for the design and production of the new publication under its Thematic Programme on Trade and Market Transparency. The result was project TMT-SPD 010/12 Rev.1 (M).[2]

Objectives

The project's development objective was to increase the use of tropical timber, particularly of lesser-known species. The specific objectives involved generating, collecting and compiling reliable and updated information on the technological characteristics and uses of tropical timber and making them available to all operators and stakeholders in the tropical forest sector. Thus, the new edition of the *Tropical Timber* Atlas will increase access to information on lesser-known timber species and serve as a vital

1 Available at tropix.cirad.fr

2 The project title was: "Atlas of Tropical Timber Species, 1st edition. Technological characteristics and uses of 273 tropical timber species (and 17 temperate species)".

Infinity and beyond: This terrace around an infinity pool on the island of Réunion, France, is composed of osanga (*Pteleopsis hylodendron*), a lesser-used tropical timber. *Photo: David Bodelu/Fibres Industries Bois*

reference tool for all relevant industry operators, including producers (e.g. forest managers, logging companies and policymakers), consumers (e.g. traders, processors, architects, builders, contractors and contracting authorities), research and educational institutions, and government authorities and decision-makers.

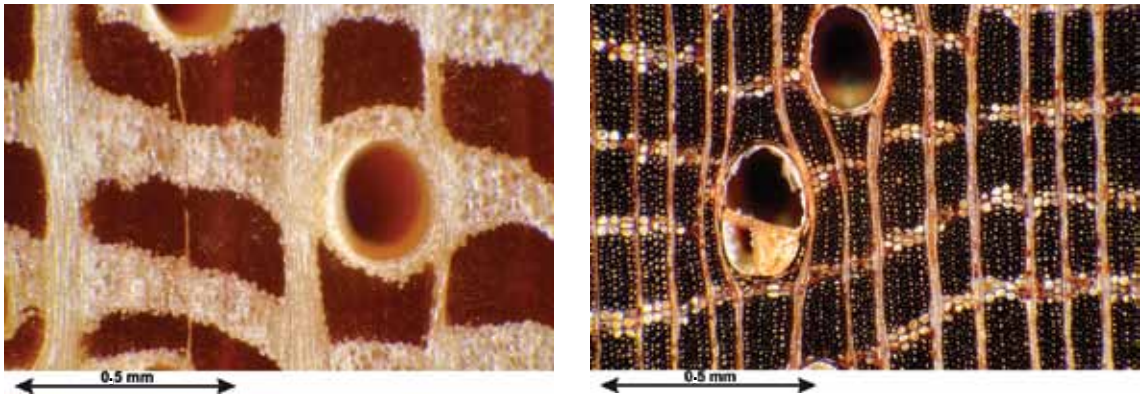
One of the project's strengths is that it was implemented in close consultation and collaboration with all relevant stakeholders, particularly private operators, from "upstream" forest managers to "downstream" users of tropical timber.

Content of the atlas

The *Tropical Timber Atlas* introduces the main characteristics and technological behaviour of 300 timber species, comprising 283 tropical species and 17 temperate species. The temperate species were included because industry operators want to be able to compare them with tropical species they may be considering for particular purposes.

For each of the described timber species, the following data and information are included:

- **Pilot name:** as contained in the Nomenclature générale des bois tropicaux (ATIBT 2016).
- **Botanical family and names:** as contained in ATIBT (2016).
- **Trade restrictions:** i.e. whether listed in the CITES Appendices.
- **Description of log:** diameter and thickness of sapwood; buoyancy; and the conservation of logs in forests.
- **Description of timber:** colour; sapwood; grain; and interlocked grain.
- **Physical and mechanical properties:** density; Monnin hardness; fibre saturation point; volumetric shrinkage coefficient; total tangential shrinkage (TS); total radial shrinkage (RS); TS/RS ratio; thermal conductivity; calorific power; crushing strength; static bending strength; and modulus of elasticity.
- **Wood natural durability and impregnation suitability:** resistance to fungi; resistance to dry-wood borers (lyctus, auger beetles, death-watch beetles); resistance to termites; impregnability of heartwood; and use class according to natural durability.
- **Preservative treatment requirement:** need for treatment against dry-wood borer attack or in the case of temporary or permanent moisture exposure.
- **Drying:** risk of distortion; risk of case-hardening; risk of checking; and risk of collapse. For each species, a drying schedule for steam kilns is provided for reference. Nine drying schedules are available, with each schedule including five successive phases: preheating (two phases), drying, balancing and cooling.
- **Sawing and machining:** blunting effect; recommended saw teeth; recommended cutting tools; and suitability for peeling and slicing.
- **Assemblage:** behaviour of wood during nailing, screwing and gluing.
- **Commercial grading:** appearance grading for sawn timber; and visual grading (if any) for wood structure.
- **Response to fire.**
- **Major uses:** the list of uses is non-exhaustive; it includes major known uses and should be validated in compliance with trade practices. Potential uses for timber species are directly linked to their technological properties. Some uses (e.g. traditional, regional and past uses) are included for information only.



Anatomy of a tree: These images of the wood of *Eribroma oblongum* (left) and *Dialium platysepalum*, obtained at 115X magnification, show the diversity of wood structure at the microscopic level.

Striking a chord: This exquisite electric guitar made of angelim rajado (*Zygia racemosa*), a lesser-used tropical timber, was created by Cosmik Guitar in Lille, France. Photo: Cosmik Guitar

- **Main common names in major producer countries** and commercial names in use in importing countries, where these differ from the pilot name given in ATIBT (2016).

At the front of the publication, detailed descriptive data sheets summarize all the above characteristics for each timber species and describe what makes them of interest for qualification or characterization. Each timber description is illustrated with three types of image:

1) two images of rift-cut and quarter slicing (or false-rift) timber;
2) two macro shots obtained using a microscope equipped with a camera showing magnified views of the natural wood surface after sanding and polishing—a magnification of 20X shows a cross-sectional view of the wood surface and a magnification of 115X shows a more detailed view of the wood's microscopic structure; and
3) an image of woodwork produced using the described timber species (e.g. in construction, construction parts, furniture, joinery, art artefacts and music instruments).

Prospects

The new edition of the *Tropical Timber Atlas* will be followed by later editions that will include:

- more descriptions of timber species—a planned second version of the atlas will describe 450 species;
- more properties, such as anatomic descriptions of timbers detailing the various parameters of the wood surface;
- properties not currently provided for all species (for example, lower heating value is given in the current edition for only 155 of the 300 timber species); and
- more illustrations, including of woodwork and uses for each species.

The *Tropical Timber Atlas* belongs to the users, who should take ownership of it. The atlas will be updated regularly to provide users with readily accessible, timely and relevant information. The authors welcome feedback, suggestions or proposals in connection with the contents and design of the publication.

Copies of the atlas can be obtained from the QUAE Editor at www.quae.com.

Publications produced by the project can be found by inserting the project code TMT-SPD 010/12 Rev.1 (M) into the ITTO project search function at www.itto.int/project_search.

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Fellowship report

A research study finds that tree species richness is highest in the core zone of a mountainous tropical forest reserve in northwestern Viet Nam

by Dao Thi Hoa Hong

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Collaborative research: ITTO Fellow Dao Thi Hoa Hong (centre) and local H'Mong people identify NTFP tree species in sample plots in the Ta Xua Nature Reserve. *Photo: Pham Kim Cuong*

This study was conducted in the Ta Xua Nature Reserve in northwestern Viet Nam, a region that has rarely been studied despite its high biodiversity potential. The study had three objectives: 1) to assess differences in the abundance of red-listed tree species in three conservation zones with differing levels of protection in the Ta Xua Nature Reserve and analyze whether such differences are related to human interference; 2) to analyze the tree community structure in the strictly protected core zone and the low-intensity traditional-forest-use buffer zone, and, in the case of differences, to identify the impacts of variables such as timber use, non-timber forest product (NTFP) use, tree diameter, tree rarity, and red list status, on differences in tree communities; and 3) to assess the abundance and determine the regeneration status of an iconic tree species, Fujian cypress (*Fokienia hodginsii*), and two other threatened tree species (*Aglaia spectabilis* and *Quercus platycalyx*).

Study area

The Ta Xua Nature Reserve (21°13'–21°26' N, 104°16'–104°46' E, Figure 1) is a protected area in northwestern Viet Nam within a biodiversity hotspot (Sobey 1998; Sterling & Hurley 2005). It includes a strictly protected core zone of near-natural forest; a buffer zone in which only low-intensity traditional forest use by the H'Mong people is permitted; and a restoration zone in which forest regenerates after shifting cultivation. The topography of the region is characterized by its high, steeply sloping mountains ranging in altitude from 320 m to 2765 m above sea level with inclinations of 30–40°. The climate is humid tropical, with high levels of precipitation, and it is influenced by the northeast monsoon. Annual precipitation ranges from 1600 mm to 1900 mm, and the average temperature is 20 °C.

Data collection

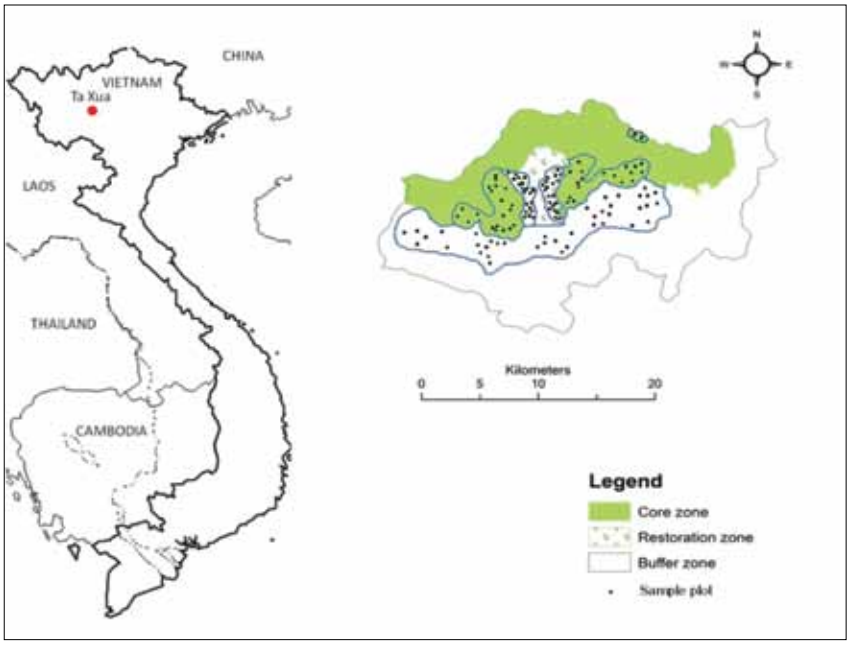
Forty random sample plots of 400 m^2 (20 × 20 m) were established in each zone of the Ta Xua Nature Reserve. In the sample plots, the diameter at breast height (dbh) was measured of all trees (identified to species) with dbh ≥ 6 cm. In this study, "threatened tree species" comprised all species in the sample plots listed in the IUCN and Vietnamese red lists of threatened species (IUCN 2014; Nguyen et al. 2007). A "locally rare tree species" was specified if its density was one, or less than one, individual per hectare (Pitman et al. 1999). The tree species providing NTFPs ("NTFP tree species") were identified directly by H'Mong people. Occurring tree species were assigned as "valuable timber species" based on standard textbooks of Vietnamese forest trees and Vietnamese economic forest trees (Tran & Nguyen 1993; Nguyen et al. 1996).

Additional information, such as percentage of canopy closure, soil pH, soil organic matter, soil texture, slope inclination, elevation, longitude, latitude, and numbers of footpaths and tree stumps, was also collected in each sample plot.

Zoned: The landscape of the Ta Xua Nature Reserve. *Photo: Dao Thi Hoa Hong*

Dirt work: A field worker collects soil samples in the Ta Xua Nature Reserve. *Photo: Dao Thi Hoa Hong*

Figure 1: Location of the Ta Xua Nature Reserve, and its three zones



Note: The actual study area (indicated by blue lines comprising the core zone, the buffer zone and the restoration zone) is 1000–1700 m above sea level. Sample plots (40 per zone) are indicated by black dots.

Statistical analysis

A t-test/Mann-Whitney *U* test and an ANOVA/Kruskal-Wallis *H* test were used to assess mean comparisons among the three conservation zones (significant if p value was ≤ 0.05). The predicted tree species richness was estimated using the Bernoulli product model, based on the Mao-Tau and Chao2 estimators (Chao 1987), by interpolating from 40 empirical plots and extrapolating to three times the number of empirical plots in each zone (Colwell et al. 2004; Colwell et al. 2012) using EstimateS software (Colwell 2013). The probabilities of tree and species absence in the buffer zone were modelled by logistic regression analysis. The relationships between forest structure and human interference variables and the abundance of red-listed tree species, NTFP tree species and valuable timber tree species in conservation zones were analyzed using canonical correspondence analysis and detrended correspondence analysis. Data analyses were conducted using Statistica (StatSoft 2014), PC-ORD software version 5.12 (McCune & Mefford 2006), and RStudio (RStudio Team 2015).

Results

There were 193 tree species in the core zone, 173 in the buffer zone and 135 in the restoration zone. Tree species richness, as predicted by the Chao2 estimator, was 254 ± 17 (i.e. mean ± standard deviation), 182 ± 5 and 158 ± 9 in the core, buffer and restoration zones, respectively. In total, 18 red-listed tree species (the IUCN and Vietnamese red lists of threatened species combined) were detected in the three zones. Sixteen red-listed tree species were found in the core zone, ten in the buffer zone and five in the restoration zone (Table 1). Most red-listed species, such as Fujian cypress (*Fokienia hodginsii*), reached their highest densities in the core zone, but one species (*Quercus platycalyx*) was quite abundant in the restoration zone. For some red-listed tree species, canonical correspondence analysis suggested relationships among the presence of footpaths, canopy closure and basal area, implying reduced abundance caused by human activities.

The forests in the core and buffer zones are rich in tree species (249 observed), many of which provide NTFPs (48%) and valuable timber (22%). Seventy-nine tree species (32%) were rare in at least one of the two zones. Overall tree density was not different in the two zones, but tree diameter and species richness were lower in the buffer zone. At the tree level, logistic regression analysis indicated that presence on one or both of the red lists, tree diameter, density of species and NTFP use (in order of reducing importance) were significantly associated with the probability of tree absence from the buffer zone (Table 2). However, most NTFP species had different densities in the core and buffer zones, and this correlated with signs of human interference.

At the species level, the density of species was the most important variable, and low density strongly increased the probability of species absence (Figure 2). Our results also indicate that rare and red-listed trees were depleted in the buffer zone.

Finally, the status of populations of highly valued timber species *Fokienia hodginsii* and two other threatened tree species (*Aglaia spectabilis* and *Quercus platycalyx*) was assessed across the three zones. In the core zone, the three target species were moderately rare: they were not among the 10% most common species or the 50% rarest species (Figure 3). *F. hodginsii* and *A. spectabilis* were most abundant

Table 1: Number of trees with dbh ≥ 6 cm in the core zone, buffer zone and restoration zone of the Ta Xua Nature Reserve for 18 tree species, and their conservation status in the Vietnamese and IUCN red lists of threatened species

Scientific name	Vietnamese name	No. of trees			Conservation status[a]	
		C.z.	B.z	R.z	Viet Nam	IUCN
Aglaia spectabilis (Miq.) S.S. Jain & S.S.R. Bennet	Gội nếp	12	1	1	VU	LC
Canarium pimela K.D. Koenig	Trám đen	0	1	0	VU	nl
Castanopsis cerebrina (Hickel & A. Camus) Barnett	Sồi phảng	4	13	9	EN	nl
Castanopsis lecomtei Hickel & A. Camus	Cà ổi Sapa	3	10	0	VU	nl
Castanopsis purpurella subsp. Purpurella	Dẻ gai đỏ	3	0	0	VU	nl
Castanopsis tessellata Hickel & A .Camus	Cà ổi lá đa	2	0	0	VU	nl
Cinnadenia paniculata (Hooker f.) Kostermans	Kháo xanh	12	0	1	VU	nl
Cinnamomum balansae Lecomte	Vù hương	0	1	0	VU	EN
Dacrycarpus imbricatus (Blume) de Laub.	Thông nàng	2	2	0	nl	LC
Fokienia hodginsii (Dunn) A. Henry & H.H. Thomas	Pơ mu	11	4	1	EN	VU
Goniothalamus macrocalyx Bân	Màu cau trắng	1	0	0	VU	VU
Lithocarpus vestitus (Hickel & A. Camus) A.Camus	Sồi lông nhung	3	0	0	EN	nl
Madhuca pasquieri (Dubard) H.J. Lam	Sến mật	35	2	0	EN	VU
Magnolia baillonii Pierre	Giổi găng	1	0	0	VU	LC
Magnolia balansae A.DC.	Giổi lông	1	2	0	VU	DD
Magnolia braianensis (Gagnep.) Figlar	Giổi nhung	1	0	0	EN	DD
Podocarpus neriifolius D.Don	Thông tre lá dài	1	0	0	nl	LC
Quercus platycalyx Hickel & A. Camus	Dẻ cau	7	7	29	VU	nl

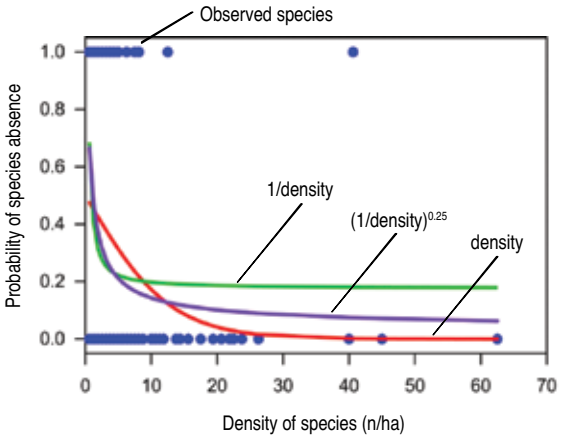
[a] Based on the IUCN and Vietnamese red lists of threatened species (IUCN 2014; Nguyen et al. 2007). VU = vulnerable; EN = endangered; LC = least concern; DD = data deficient; nl = not listed. Notes: C.z. = conservation zone; B.z = buffer zone; R.z. = restoration zone. 40 plots were assessed per zone.

Table 2: Probability of tree absence in the buffer zone by a multiple logistic regression model

Predictor variable	Parameter estimate	Standard error	p (z test)	Odds ratio	95% confidence interval	Type of variable
Red-listed	1.078	0.2477	<0.0001	2.94	1.81–4.78	0/1
dbh (cm)	0.011	0.0035	0.0017	1.01	1.00–1.02	Continuous
Density of species (n/ha)	-0.0096	0.0032	0.0025	0.99	0.98–1.0	Continuous
NTFP	-0.483	0.109	<0.0001	0.62	0.49–0.76	0/1

Note: The multiple logistic regression model logit (p) = 1.078 × red-listed + 0.011 × dbh - 0.0096 × density - 0.483 × NTFP; Akaike Information Criterion = 1984.1; likelihood ratio test: $p < 0.001$. In the regression model, "red-listed" and "NTFP" are dichotomous variables—that is, they have only two values (yes = 1 and no = 0). For example, if a tree is red-listed, the value of "red-listed" in the model is 1. If a tree is not red-listed, the value is 0.

Figure 2: Probability of species absence based on three logistic regression models of species density



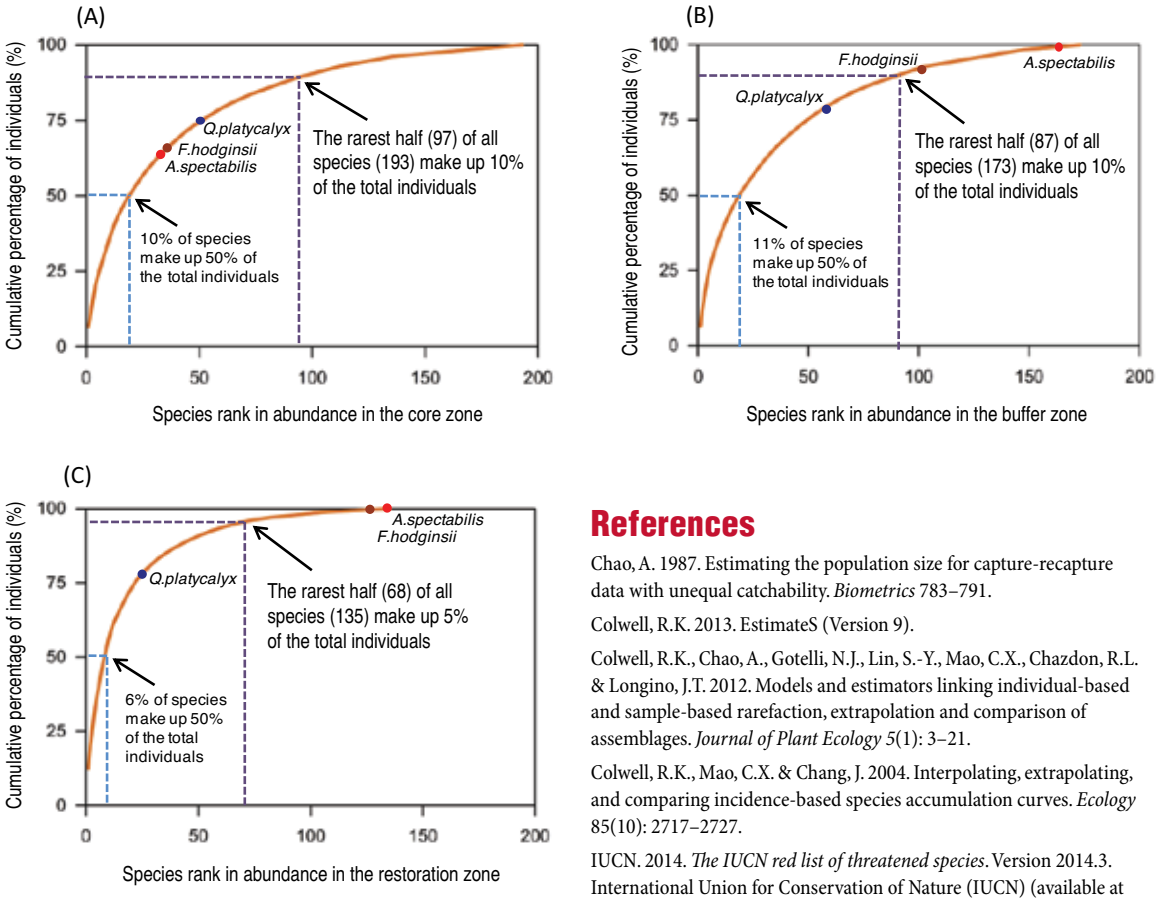
Note: The three logistic regression models are: density of species per hectare; 1/density of species; and (1/density of species)$^{0.25}$. The (1/density of species)$^{0.25}$ model (purple line) had the lowest Akaike Information Criterion value, indicating the best prediction accuracy.

in the core zone and much less abundant in the buffer and restoration zones. In contrast, the highest density of *Q. platycalyx* was in the restoration zone. There was regeneration of all three target species in the core zone but little or no regeneration of *F. hodginsii* and *A. spectabilis* in the buffer and regeneration zones. Regeneration of *F. hodginsii* and *A. spectabilis* was found mostly in the vicinity of conspecific adult trees.

Conclusion

The study indicates that conservation effectiveness is related to the level of statutory protection afforded to a particular area, with full protection ensuring more robust conservation outcomes. The use of logistic regression models enables the evaluation of conservation effectiveness in a given nature reserve over time and among nature reserves and national parks, and it also facilitates the development of conservation strategies by quantifying the effects of different forest management measures on the presence or absence of trees

Figure 3: Cumulative abundance of tree species with dbh ≥ 6 cm in the core zone (A), buffer zone (B) and restoration zone (C)



Note: The y axis represents the cumulative percentage of individuals, and the x axis represents the abundance rank of species, from most abundant (left) to rarest (right). The rank abundance of the three target species is indicated.

and species. Monitoring forest resources with a focus on rare and red-listed species at the Ta Xua Nature Reserve and other protected areas is needed, and conservation measures probably need to be improved.

Timber harvesting likely changed forest structure and species composition in the Ta Xua Nature Reserve, whereas the use of NTFPs by local people generally raises less concern. The integration of local people in forest management, coupled with regulations governing logging intensity, represents a suitable policy for reconciling conservation and socioeconomic development goals because it most likely serves local demands while conferring a certain level of conservation.

Acknowledgements

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China's domestic furniture market is growing rapidly

American style: High-end Chinese consumers are proving partial to expensive Western-style furniture as well as to classical Chinese-style and avant-garde furniture. *Photo: Tan Xiufeng*

As living standards continue to improve in China, people are becoming increasingly willing to invest in home decoration, and their growing purchasing power has driven the rapid development of the country's furniture market. This article takes a close look at China's dynamic domestic furniture market and its implications for the timber trade, based on a report published in 2017 by the Hong Kong Trade Development Council (HKTDC).[1]

China's domestic furniture market has vast room for expansion. According to the Chinese Family Development Report 2014, there were about 430 million households in all provinces, autonomous regions and municipalities on the Chinese mainland in 2014. On average, people replace their home furniture every ten years; therefore, around 43 million Chinese households replace their furniture each year. Assuming that each household spends RMB 1000 on furniture replacement, the furniture replacement market is worth RMB 43 billion annually.

The number of Chinese households is expected to reach 500 million by 2040. Moreover, urbanization—which is China's leading policy for stimulating domestic demand—is bound to further bolster the development of the furniture market.

1 This article was compiled, with permission, from a survey published by the HKTDC, with contributions by Mike Adams (ITTO) and Tan Xiufeng (Chinese Academy of Forestry). The HKTDC publication can be found at: http://china-trade-research.hktdc.com/business-news/article/China-Consumer-Market/China-s-Furniture-Market/ccm/en/1/1X000000/1X002L63.htm. For more information on the HKTDC see: www.hktdc.com

Different strokes for different folks—categories of consumers

Mainland furniture consumers can be divided into three broad groups:

1) **Avid consumers**: this is a very rich group, with little concern for prices. Avid consumers are usually partial to expensive Western-style, classical Chinese-style and avant-garde furniture.

2) **Consumers of luxury/branded goods**: these want their furniture to reflect their tastes and personalities, and aesthetic and cultural elements are also important. This group is at the forefront of trends when it comes to aesthetic pleasure, lifestyle and price.

3) **Average wage-earning consumers**: this group constitutes the majority of consumers. Average wage-earners will often shop around before making a purchase, and price and quality are dominant factors in their consumption behaviour.

According to the Industrial Classification and Codes for National Economic Activities issued by the National Bureau of Statistics of China, the furniture-manufacturing industry is divided by product type into wooden furniture manufacturing, bamboo/rattan furniture manufacturing, metal furniture manufacturing, plastic furniture manufacturing and miscellaneous furniture manufacturing. Wooden furniture is the main component of the industry, accounting for more than 60% of the players.

An increasing number of consumers, particularly mid-to-high-end consumers and children's furniture consumers, choose to embrace new lifestyle concepts, such as the "eco

Two-child bunk: Demand for children's furniture is on the rise in China. *Photo: Tan Xiufeng*

home". Such consumers have a strong preference for "eco" and "environment-friendly" furniture, such as odour-free and formaldehyde-free products, even though the price of most such furniture is higher than other like products.

In HKTDC's consumer survey, over 90% of respondents were interested in green, eco-friendly materials and were willing to pay a premium of 14% (on average) in purchasing products made of green materials. In view of this, many brands of furniture and building materials have added the idea of eco-friendliness to their brand concepts. Examples in the mainland market include "smart" furniture incorporating an indoor air purification function, and lightweight honeycomb board furniture.

Mainland China furniture market

The mainstream design of furniture has been embracing elements of culture, nature, environmental protection and trendiness for many years. With respect to personalized designs, consideration has been given to ergonomics in terms of colour, shape, silhouette and size. Personalized design is winning the hearts of many people.

In the choice of furniture materials, there is a "back-to-basics" trend among consumers towards solid-wood furniture with minimalistic designs and wood veneer furniture showing wood grains. Plywood furniture is the mainstay of wooden furniture, but solid-wood furniture is gaining in popularity among consumers with a certain level of economic strength; meanwhile, plywood furniture is moving towards imitation solid wood.

Classical Western-style furniture comes in "rich and exuberant", "fresh and bright" and "quaint and nostalgic" colours, as well as a great variety of styles and designs. As more people buy luxury villas in China, the demand for large furniture pieces is rising. The pursuit by Chinese consumers of Western-style homes benefits a number of foreign chain brands.

Modern classical furniture combining Chinese and Western elements is emerging as new hot picks in the furniture market, a trend that could be attributed to the prevailing social culture. An increasing number of international and domestic home brands are incorporating Chinese elements in their designs. This type of furniture uses a wide diversity of materials, such as Manchurian ash wood, elm and paulownia, as well as the more expensive pheasant wood, pine, catalpa and cherry. Some furniture items are even decorated with details such as rattan webbing and hand carving to give them a touch of trendiness.

Demand for children's furniture is on the rise. As living conditions improve, parents are increasingly willing to buy furniture that helps create a good environment for the development of their children. With full implementation of the "two-child policy" now underway as part of the 13th Five-Year Plan, pundits believe that this market has further room for growth. According to preliminary data from the National Bureau of Statistics, the number of children aged below 15 reached 240 million in 2015, including 16.55 million new-borns, a growth rate of 12%. Surveys show that beds, tables and chairs take up the biggest share of the children's furniture market. In this market, the ratio of plywood furniture to solid-wood furniture is approximately 7:3; as incomes rise, however, and people become more health-conscious and environmentally aware, the share of solid wood in children's furniture may rise.

Outdoor furniture is increasingly popular in the Chinese market. Available in increasing variety, this segment mainly comprises the following categories: beach beds; rattan chairs; leisure chairs; bamboo chairs; and other outdoor furniture items. Of these, rattan and leisure chairs account for the biggest shares.

Demand in the outdoor furniture market has been extending from specialized sectors such as exclusive clubs, leisure venues, residential communities and star-graded hotels and restaurants to the home sector, including private gardens, rooftops and terraces. Momentum is increasing in the home sector.

Rosewood is a high-quality hardwood, and furniture made of this wood is generally regarded as exquisite. The rosewood furniture industry is expanding beyond traditional markets such as Beijing, Jiangsu and Guangdong, with growing consumption in Dongyang (Zhejiang province), Xianyou (Fujian province), Shanxi and Shanghai. The rosewood furniture industries are growing quickly in Pingxiang in Guangxi and Guangfeng in Jiangxi.

Custom-made furniture is becoming popular in tandem with growing demand for personalized home products. Furniture makers are increasingly treating each customer as a unique market and tailor-making products according to individual needs.

A number of large bespoke furniture manufacturers (i.e. companies making furniture to order) are developing rapidly. Companies such as Shangpin Home Decoration, Shoufeiya Home Collection and Oppe in Home are offering bespoke manufacturing for various types of furniture and even for entire houses. In addition, the trend towards elegant refurbishing is bringing opportunities for custom-made furniture.

In demand: Rosewood in traditional designs is still popular in China, and rosewood furniture industries are growing quickly. *Photo: Tan Xiufeng*

Star-graded hotels: a major source of demand

Data from the China National Tourism Administration show that the number of five-star hotels on the mainland increased from 492 in 2010 to 807 in 2015, an average annual growth rate of 10.4%; the number of four-star hotels increased from 1817 in 2010 to 2398 in 2015 at an average annual growth rate of 5.7%. The demand for new furniture in these hotels has been worth an average of about RMB 3.6 billion per year. It is estimated that demand for replacement furniture in hotels will be worth almost RMB 13 billion in 2017 (based on the standard of replacement at least once every five years).

Market competition

After more than 20 years of rapid growth in its furniture industry, China has become the world's largest furniture production base and exporter. According to information released by the China National Furniture Association (CNFA), of all Chinese regions, the Pearl River delta has the highest concentration of the furniture industry, including the highest production output and the strongest integrated support capability. Next come Fujian, Zhejiang, Jiangsu, Shandong and Shanghai, which have an edge in product quality and operations management. The furniture industry is developing fast in the Yangtze River delta region (led by Shanghai), which has the highest average growth rate in the country.

The northern and northeastern regions—with Beijing at the centre—have a sound furniture industry base and rich wood resources. The furniture industry in the central and western regions is capitalizing on the opportunities arising from urbanization and the Belt and Road Initiative.

Planned and completed furniture (home furnishing) industrial parks (bases) are mainly in the following eight central and western provinces: Anhui, Hebei, Henan, Hubei, Jiangsu, Shaanxi, Sichuan and Yunnan. The development of these industrial parks can help consolidate and improve the industry chain; shorten distances between production and markets; reduce logistical costs; change employment distribution patterns; and promote industrial restructuring, specialized division and industrial cooperation between regions. In 2014, the CNFA chose Dayong in Guangdong and Anji in Zhejiang as experimental towns to lead breakthroughs in the upgrading and transformation of China's furniture-industry clusters.

Branding is the next step

Furniture producers in China are much less concentrated than in other industries, and most are small and medium-sized. As a result of low industry concentration, few brands have a strong influence in the market. After years of competition, however, a number of branded enterprises of a certain scale have emerged with considerable marketing strength, such as QuanU, Qumei (QM) and Red Apple.

Competition among industry players in China's furniture market shows that rivalry in this market has come of age. Today, furniture brands are no longer fighting for first-tier cities but are gradually shifting their focus to markets in second- and third-tier cities.

Rapid urbanization has also spurred the growth of home marts in second- and third-tier cities. The market for furniture marts and brands is almost saturated in first-tier cities. Although the scale of economies and consumption is lower in second- and third-tier cities, such markets offer more room for development. Thus, tapping into medium- and low-end markets will become a key marketing strategy.

Applying technology to drive innovation

China's furniture industry has started its upgrading process, mainly towards advanced manufacturing and the application of information technology in production. Furniture enterprises need to upgrade their products and add value to them through technological innovation with the aim of achieving "low cost, high quality and high efficiency".

The future development trend will be green manufacturing—that is, product life cycles must be conducive to environmental protection and the reduction of energy consumption. For example, greater attention will need to be paid in production processes to ecological protection, human health and home safety as a way of sustaining the development of the furniture industry.

Foreign furniture industry players have stepped up the pace at which they are entering the Chinese market. In recent years, for example, Airland, a mattress and bedding manufacturer from Hong Kong, has snapped up the distributorship of foreign brands such as Serta for the greater China region. Ashley Home Furnishing, a major American brand, has been expanding into the Chinese market on a large scale. As of the third quarter of 2015, Swedish global furniture retail giant IKEA had opened 18 stores in China; it intends to expedite the pace of expansion in China with the aim of increasing the number of stores in the country to 34 by 2020.

Traditional and emerging sales channels

Traditional furniture enterprises in China mainly market their products in three ways: consignment through distributors in various places; renting outlets in various places and selling products themselves; and displaying and selling products in large furniture malls or marts. Some specialized stores and chain stores with financial clout have emerged, however. According to HKTDC's consumer survey, large home centres are the major channel through which consumers obtain information on furniture products.

Furniture hypermarkets have developed rapidly in various places across China in recent years, many in the form of chain operations offering single brands. There are also hypermarket clusters, which are high concentrations of different types of furniture hypermarket, as well as general merchandise stores, which not only sell furniture but also other household supplies and even building materials; many chain-operated hypermarkets are also general merchandise stores. Red Star Macalline is the leading home-mart operator on the mainland.

The operational focus of different sales channels varies. For example, large furniture marts mainly offer home furniture but also sell office furniture. Specialized stores generally sell their own brands; the majority of such stores are either larger domestic production enterprises or famous foreign brands. IKEA was the earliest foreign brand to set up specialized stores on the mainland, but many other foreign furniture companies have adopted similar sales formats.

With a view to making furniture part of the everyday life of consumers, some branded mart chains have created shopping-district effects by bringing in famous foreign brands, setting up home-experience stores, building commercial complexes, and establishing furniture villages. In this way they obtain the double benefit of raising brand awareness and achieving a several-fold increase in sales.

The "O2O" e-commerce model is gaining popularity in China's furniture market. "O2O" refers to the linkage of online sales and marketing with offline business operations and consumption. Various types of O2O operators now exist on the mainland, and the model takes various forms in practice. QM is a typical example of a furniture-manufacturing enterprise and e-commerce operator: it uses its website as its sales platform, showcasing images of various products and accepting online orders from consumers. Consumers may also opt for an offline experience by visiting physical stores and placing orders there at online prices. This not only allows furniture brands to carry out sales and marketing but also helps them boost product sales over short periods, thereby speeding up cash flows and reducing inventory pressure.

Some traditional furniture sellers are conducting another type of furniture e-commerce. Easyhome, for example, has developed the Juran.cn website to "move" its offline-experience stores online. It targets consumers who like the brand but want to select products online.

Some O2O e-commerce operators start as pure online brands and open offline-experience stores later. In other words, they build up their e-commerce platform by extending their coverage from online to offline channels. Meilele.com is an example of such an operation.

Tropical and topical

Indigenous groups win land rights victory in Brazil

Brazil's Supreme Court has made two key decisions strongly favouring the country's indigenous communities, according to a report published on the Mongabay website in August 2017. The court ruled that two civil actions brought by the Mato Grosso state government against the indigenous agency, Funai, were inadmissible. In both cases, the Mato Grosso government had claimed that federally established indigenous reserves had been set up on land that belonged to Mato Grosso state and which had not been traditionally occupied by the indigenous people living there today. Indigenous people both in and outside the courtroom greeted the decisions enthusiastically, according to the article.

Source: https://news.mongabay.com/2017/08/indians-win-key-land-rights-victory-in-brazils-supreme-court

How effective are tropical forest conservation policies?

Numerous types of forest conservation policies are implemented in the tropics, such as protected areas; development programmes; certification; and payment schemes for environmental services. Rigorously quantified knowledge on the effectiveness of such policies is highly fragmented, however, especially for incentive-based tools. Papers published recently compile new evidence and insights from 13 evaluation studies of forest conservation initiatives covering eight countries on four continents. An overview paper by Jan Börner and numerous co-authors systematically compares the conservation effects estimated by these studies using forest-cover change as a proxy for conservation effectiveness. Nine studies estimated that annual conservation impacts on forest cover were less than 1% (with two exceptions in Mexico and Indonesia). According to the authors, a key lesson from the studies is the need to move beyond estimates of the average effects of undifferentiated conservation programmes because specific elements of programme design and the implementation context are equally important for understanding conservation effectiveness. Particularly crucial, they say, will be a better understanding of the causal mechanisms through which conservation programmes have impacts.

Source: http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0159152

Does forest certification work?

An article published on the Mongabay website in September 2017 reported that, based on a review of 40 studies, certified tropical forests are overall better for the environment than forests managed conventionally. According to the article there is insufficient evidence, however, to say whether certified tropical forests are better for people than conventionally managed tropical forests. The article, which was part of a special series on conservation effectiveness, also found that profits and other economic benefits are "hard to come by" for certified logging companies working in tropical forests.

Source: https://news.mongabay.com/2017/09/does-forest-certification-really-work

Carbon emissions from tropical forests quantified

Research published in *Science* in September 2017 used 12 years of pantropical satellite data (2003–2014) to quantify net annual changes in the aboveground carbon density of tropical woody live vegetation. It provides "direct, measurement-based evidence" that the world's tropical forests are a net carbon source of 425.2 ± 92.0 teragrams of carbon per year (Tg C yr^{-1}), with annual losses of 861.7 ± 80.2 Tg C yr^{-1} and gains of 436.5 ± 31.0 Tg C yr^{-1}. The authors say that carbon gains arise from forest growth and losses are due to deforestation and reductions in carbon density in standing forests due to degradation or disturbance, with the latter accounting for 68.9% of overall losses.

Source: http://science.sciencemag.org/content/early/2017/09/27/science.aam5962

Norway supports International Land and Tenure Facility

The Norwegian Minister of Climate and Environment, Vidar Helgesen, announced on 3 October 2017 that the Norwegian Climate and Forest Initiative intends to support the International Land Tenure Facility with US$20 million over the next few years. According to a press release, the contribution will build further momentum for Norway's strong commitment to support indigenous peoples in their efforts to secure rights to their customary lands. The International Land and Tenure Facility is a new institution that provides grants to advance land and forest-tenure security and the rights and livelihoods of indigenous peoples and local communities, in close collaboration with governments.

Source: www.regjeringen.no/en/aktuelt/local-communities/id2573457

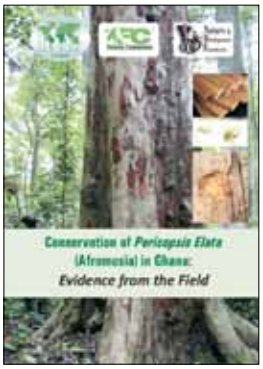
Reforms to Australian illegal logging regulations

The Australian government announced changes to its illegal logging laws and published the *Reforming Australia's Illegal Logging Regulations—Regulation Impact Statement* (RIS) in October 2017. The aim of the RIS is to remove unnecessary costs on the regulated community from the due-diligence requirements of the Illegal Logging Prohibition Regulation 2012. Among other things, the reform establishes a new "deemed to comply" arrangement for products certified under the Forest Stewardship Council or the Programme for the Endorsement of Forest Certification. According to the Australian government, this will streamline due-diligence requirements for importers and processors dealing with such products, providing an estimated annual regulatory saving of AUD 4.2 million.

Source: www.agriculture.gov.au/forestry/policies/illegal-logging/consultation-engagement

Recent editions

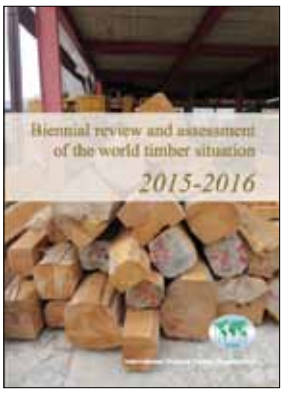
Compiled by Ken Sato



Nature and Development Foundation 2017. *Conservation of* Pericopsis elata *(afromosia) in Ghana: evidence from the field*. Nature and Development Foundation, Accra, Ghana.

ISBN: 978-4-86507-038-5
Available at: https://goo.gl/pXfvhc

This publication, an output of ITTO project TMT-SPD 017/15 Rev.2 (M): "Improving sustainable *Pericopsis elata* conservation and trade regulation in Ghana", presents data on the distribution, conservation and trade of *Pericopsis elata* – better known by its trade name, afrormosia – in Ghana. The publication serves as a wake-up call for natural resource managers, environmental organizations and all non-state actors in Ghana's forest sector on existing approaches to the protection, conservation and trade of *P. elata* and the forest management system in general.



ITTO 2017. *Biennial review and assessment of the world timber situation 2015–2016*. Yokohama, Japan.

ISBN: 978-4-86507-035-4
Available at: www.itto.int/annual_review

ITTO's *Biennial Review and Assessment of the World Timber Situation* compiles the most up-to-date and reliable international statistics available on the global production and trade of timber, with an emphasis on the tropics. It also provides information on trends in forest area, forest management and the economies of ITTO member countries. It is based on information submitted by ITTO member countries through the Joint Forest Sector Questionnaire, supplemented by other sources as necessary.

IUFRO. 2017. *The global teak study: analysis, evaluation and future potential of teak resources*. IUFRO World Series Volume 36. International Union of Forest Research Organizations (IUFRO), Vienna.

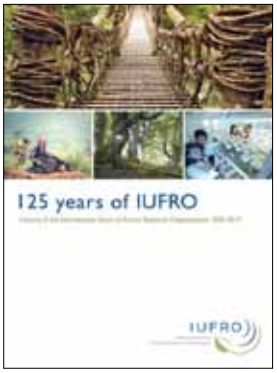
ISBN: 978-3-902762-77-1
Available at: https://goo.gl/Dw7ssE

This report presents the findings of a recent ex-post evaluation of an ITTO project on teak conservation in Myanmar and a comprehensive review of other teak-related ITTO projects in Côte d'Ivoire, Ecuador, Ghana, Indonesia and Panama. Guided by these evaluation results, a team of experts synthesized globally available, state-of-the-art scientific information and empirical knowledge on teak to compile this global teak study.

ITTO. 2017. *Report of International Conference on Sustainable Mangrove Ecosystems: managing a vital resource for achieving the Sustainable Development Goals and the Paris Agreement*. Yokohama, Japan.

ISBN: 978-4-86507-042-2
Available at: https://goo.gl/2EK8pu

This conference report is an output of the International Conference on Sustainable Mangrove Ecosystems, which was convened to promote the conservation, restoration and sustainable management of mangrove forest resources in the tropics. An important objective was to identify ways in which mangrove restoration and sustainable management could contribute to the achievement of Sustainable Development Goals 13, 14 and 15 and the Paris Agreement on climate change. At its conclusion, the conference adopted the Bali Call to Action for Sustainable Mangrove Ecosystems, in which participants urge policymakers, land-use planners, mangrove practitioners and scientists, international organizations, the private sector, donors and coastal communities to redouble their work to ensure the conservation, restoration, protection and sustainable management and use of the world's remaining mangrove forest ecosystems.



Johann, E., Buck, A., Burger, B., Kleine, M., Prüller, R. & Wolfrum, G. 2017. *125 years of IUFRO: history of the International Union of Forest Research Organizations 1892–2017*. International Union of Forest Research Organizations, Vienna.

ISBN: 978-3-902762-86-3
Available at: www.iufro.org/download/file/27496/6534/iufro2017-125-years_pdf

This book, which marks the 125th anniversary of the International Union of Forest Research Organizations (IUFRO), is a contribution to maintaining the record of IUFRO's history. It presents an overview of the organization's work since its foundation in 1892, placing particular emphasis on significant historical developments since the centennial celebrations in 1992. It especially serves, therefore, as a guide to IUFRO's work and strategies over the past 25 years.

Meetings

27 November–2 December 2017
53rd Session of the International Tropical Timber Council and Sessions of the Associated Committees
Lima, Peru
Contact: www.itto.int/workshop_detail/id=4991

4–6 December 2017
3rd Meeting of the UN Environment Assembly
Nairobi, Kenya
Contact: www.unep.org/about/sgb

5–7 December 2017
53rd Global Environment Facility Council Meeting
Washington, DC, USA
Contact: www.thegef.org/events/53rd-gef-council-metting

8–11 December 2017
Cairo Wood Show
Cairo, Egypt
Contact: www.cairowoodshow.com

11–15 December 2017
23rd Session of the Near East Forestry and Range Commission
Beirut, Lebanon
Contact: abdelhamied.hamid@fao.org

14–15 December 2017
Bioeconomy Investment Summit 2017
Helsinki, Finland
Contact: www.2017bioecosummit.eu

12–15 January 2018
DOMOTEX 2018: The World of Flooring
Hannover, Germany
Contact: www.domotex.de

25 January 2018
Timberlands, Forest Products and Wood Fiber Issues in Western North America 2018
Vancouver, USA
Contact: richard@westernforestry.org

7–8 February 2018
Lignofuels 2018
Amsterdam, the Netherlands
Contact: www.wplgroup.com/aci/event/lignocellulosic-fuel-conference-europe

28 February–1 March 2018
10th Carbon Dioxide Utilization Summit
Tampa, USA
Contact: www.wplgroup.com/aci/event/co2-us

1–3 March 2018
IUFRO Working Party 7.02.13: Improving Forest Health on Commercial Plantations
Punta del Este, Uruguay
Contact: www.iufro.org/download/file/26442/5712/puntadeleste18-1st-announcement_doc

6–8 March 2018
Asia-Pacific Regional Workshop on Trans-boundary Biodiversity Conservation: Empowering Forestry Communities and Women in Sustainable Livelihood Development
Pontianak, Indonesia
Contact: ma@itto.int

3–4 April 2018
Changing Dynamics of the Asia-Pacific Wood Trade
Portland, USA
Contact: www.worldforestry.org/event/changing-dynamics-asia-pacific-wood-trade

10–12 April 2018
Biomass and Bioenergy Conference
Sorocaba, Brazil
Contact: www.bbcbrazil.com.br

16–19 April 2018
6th International Forest Engineering Conference (FEC2018): Quenching our Thirst for New Knowledge
Rotorua, New Zealand
Contact: www.foresteng.canterbury.ac.nz/FEC2018.shtml

1–2 May 2018
5th Annual Forest Investment Conference
New York, USA
Contact: https://events.risiinfo.com/investment-conference/program

8–10 May 2018
Fifth Session of the Intergovernmental Technical Working Group on Forest Genetic Resources
Rome, Italy
Contact: www.fao.org/forestry/86904/en

8–10 May 2018
Intergovernmental Technical Working Group on Forest Genetic Resources (ITWG-FGR) – 5th Session
Rome, Italy
Contact: FO-ITWG-FGR@fao.org

21–25 May 2018
International Conference on Ozone and Plant Ecosystem
Florence, Italy
Contact: https://conference2018.wixsite.com/ozoneandplants

3–9 June 2018
China Wood Industry Tour
Chongqing and Chengdu, China
Contact: https://danaevents.co.nz/2018china

10–16 June 2018
North American Forest Soils Conference: International Symposium on Forest Soils
Quebec City, Canada
Contact: www.cef-cfr.ca/index.php?n=Colloque.NAFSC-ISFS2018

15–17 July 2018
41st Council on Forest Engineering Annual Meeting: Revolutionary Traditions, Innovative Industries
Williamsburg, USA
Contact: www.regonline.com/builder/site/Default.aspx?EventID=2030985

16–20 July 2018
COFO 23: World Forest Week
Rome, Italy
Contact: www.fao.org/about/meetings/cofo

5–9 August 2018
Workshop on Tree Resistance to Insects and Diseases: Putting Promise into Practice
Mt. Sterling, USA
Contact: https://treeresistance2018.ca.uky.edu

7–25 August 2018
XXX International Intensive Course on Diversified Management of Natural Tropical Forests: Management in the face of climate change and forest landscape restoration challenges
Turrialba, Costa Rica
Contact: capacitacion@catie.ac.cr

14–18 August 2018
11th World Bamboo Congress
Xalapa, Mexico
Contact: http://worldbamboocongress.org

4–6 September 2018
12th World Congress on Biofuels and Bioenergy
Zurich, Switzerland
Contact: https://biofuels-bioenergy.conferenceseries.com/europe

9–14 September 2018
The Importance of Engaging Local Communities and Stakeholders to Increase Successful Adoption of New Technologies
Christchurch, New Zealand
Contact: http://mailchi.mp/7282aea54a70/eke-new-zealand?e=47765f11e6

17–19 September 2018
Woodfiber Resource and Trade Conference
Durban, South Africa
Contact: https://events.risiinfo.com/wood-fiber

24-27 September 2018
African Forest-related Policy and Politics
Yaoundé, Cameroon
Contact: http://pfbc-cbfp.org/Joboffers/items/forest-related.html

25–28 September 2018
New Frontiers in Forecasting Forests 2018
Stellenbosch, South Africa
Contact: http://conferences.sun.ac.za/ff2018/NFFF2018

5–8 November 2018
5th International Conference on Forests and Water in a Changing Environment
Valdivia, Chile
Contact: www.cabi.org/forestscience/calendar/9895

5–10 November 2018
54th Session of the International Tropical Timber Council and Sessions of the Associated Committees
Yokohama, Japan
Contact: www.itto.int

7–22 November 2018
14th Meeting of the Conference of the Parties to the Convention on Biological Diversity
Sharm El-Sheikh, Egypt
Contact: secretariat@cbd.int; www.cbd.int

ITTO provides this list of international meetings as a public service but is not responsible for changes in date or venue or for other errors.