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Promoting the conservation and sustainable development of tropical forests

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Looking for the money tree

Sustainable forestry has always struggled to remunerate forest owners and managers as liberally as various forms of agriculture on the same land might do. Growing trees is a relatively slow business, and managing natural forests sustainably for their many values, including timber, is complex. Nevertheless, the wider benefits of forests, especially natural forests, for local people, nations and the planet are so vast that we must do our best to retain them in a world in which money talks loudly. In this edition of the TFU, we feature recent studies looking at ways to increase the income that tropical forests generate.

In the lead article on page 3, Christian Held and co-authors summarize a report prepared for ITTO that uses modelling to project the supply of and demand for tropical timber to 2050. Using a "middle of the road" socioeconomic development pathway, the study finds that the production of industrial roundwood in natural tropical forests will be fairly steady from now until mid-century. Maintaining market share for this timber, say the authors, will require that sustainable forest management (SFM) in the tropics becomes more competitive by expanding the range of commercially viable timber species and generating revenue streams from carbon sequestration and other ecosystem services. But this, in turn, will need massive investment, and many tropical enterprises are neither sufficiently profitable nor able to meet compliance requirements to borrow the money they need to modernize. "Business development support is urgently required to enable forest-based companies to obtain access to capital," write the authors.

In his article on page 8, Alain Karsenty summarizes the main conclusions and recommendations of an analysis he undertook for ITTO on incentives

Timber demand in 2050 · incentives · lesser-used species · non-timber products · more

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Cover image: Local collectors in the Bolivian Amazon hold recently harvested wild cacao fruit. *Photo: © Helvetas/Simon Opladen*

Above: Yokohama's Redbrick Warehouse Park, which celebrates its 110th anniversary this year. *Photo: R. Carrillo/ITTO*

… Editorial continued

for SFM, drawing on his own expertise as well as case studies in eight tropical countries. He makes 22 recommendations for governments and stakeholders that, if implemented, would greatly encourage the uptake of SFM. As a starting point, says Karsenty, "theories of change" are needed to indicate the changes that would occur as a consequence of a given incentive or set of policy measures and which would also point out existing disincentives and hurdles that might limit the effectiveness of a new scheme. Such theories would help in bringing a systemic approach to policy reforms.

Miguel Roberto Mendieta (page 12) explores one of the factors limiting the profitability of SFM in natural tropical forests, as mentioned by Held et al., which is the large number of tree species not valued in timber markets. Mendieta says there is an abundance of underused timber species in the Caribbean region of Honduras, even though such species have wood properties comparable with other more valued species. He reports on an ITTO project that has helped collate information on these species and worked with community forestry organizations and companies to increase their marketability. This is crucial if local communities are to continue protecting the forests and using them sustainably.

Another means for increasing the revenue earned from natural forests is to make greater use of non-timber forest products (NTFPs), which is the subject of a detailed literature review by Jürgen Blaser and co-authors co-published by ITTO and the Precious Forests Foundation and summarized on page 16. Some NTFPs can generate considerable annual income for local people, who can use it to supplement other earnings from timber production and farming. A focus of the research by Blaser et al. was on multiple-use approaches, and they found evidence that it is possible to accommodate both timber and NTFPs in the same forest "where long-term commitment exists".

Other stories in this edition include an article by Ken Hickson on ITTO-assisted efforts to create a DNA-based test-and-trace system to reduce illegal trade of African cherry bark (page 21); an ITTO Fellowship report by Atté Cyrille Bi Tiesse on work he carried out with colleagues to map erosion-sensitive landscapes in a mountainous area of Côte d'Ivoire; and, in the Market Trends feature, an article by Zhu Guangqian and an ITTO Market Information Service correspondent on China's fluctuating imports of logs and sawnwood during the pandemic.

It is a huge oversimplification to say that the only way to save many tropical forests is to use them profitably, but nevertheless there's truth in it. Money earned from sustainable forestry helps convince landholders and policymakers that the forests are worth keeping, and some of it can also be put back into managing the resource. Many of the values of forests might never be properly monetized, although a great deal of work is underway, including by ITTO, to develop payment schemes for services related to carbon, water and biodiversity. But the monetary value of others can be increased. Perhaps one day we will all be willing to pay more for maintaining these precious forests because of the benefits we receive.

What lies ahead for the tropical timber sector?

A new ITTO report analyzes the supply of and demand for tropical timber to 2050 and its contributions to a sustainable economy

by Christian Held, Eva Meier-Landsberg and Verónica Alonso

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Pushing ahead: An engineered wood product is processed in a community-owned factory in Ixtlan, Mexico. The tropical forest sector could grow substantially by 2050, given necessary investment and an emphasis on compliance with market and regulatory standards. *Photo: T. Yanuariadi/ITTO*

This article summarizes selected results from the study, *Tropical Timber 2050*, which was published by ITTO in May 2021. Drawing on outputs of the Global Forest Product Model (GFPM)[1] and publicly available data, the study projects the supply of and demand for tropical timber in 2050. In making its projections, the study assumes a "middle of the road" shared socioeconomic pathway (SSP).[2]

To ensure a full picture of future timber supply and demand, the study compares the situation in the tropical timber producer regions with other regions,[3] especially China, Europe and North America. The full study, available on the ITTO website (see details at the end of the article), also examines challenges for future timber production systems and wood-processing industries and the potential for increasing the use of tropical timber in a sustainable economy.

Tropical timber supply and demand to 2050

Global production of all roundwood will grow by 13% by 2050, to 4.3 billion m^3 (Figure 1). Global industrial roundwood (IRW) production will increase by 45%, to 2.9 billion m^3. Tropical IRW production will grow by 24%, from 429 million m^3 in 2015 to 534 million m^3 in 2050. Global woodfuel production will decline by 21%, from 1.8 billion m^3 in 2015 to 1.5 billion m^3 in 2050, due mainly to a decline in consumption in sub-Saharan Africa. Nevertheless, woodfuel production will still exceed the volume of IRW production in the tropics.

The rate of growth in IRW production in tropical producer regions to 2050 will be relatively low compared with global growth in IRW production. Tropical producer regions will contribute only 19% of global IRW production in 2050 and 16% of global IRW consumption, even though 38% of the global population will be living in those regions in 2050, with growing income per capita. By 2050, all tropical producer regions will be net exporters of IRW (Figure 2), meaning that substantial volumes of IRW will be exported without meaningful value-added in the producer regions.

Plantation forestry will be the main source of timber in tropical producer regions in 2050 (Figure 3). With limited expansion possibilities for large-scale plantations, smallholders and agroforestry systems will become important IRW production systems. All systems will need improvements in productivity and timber quality.

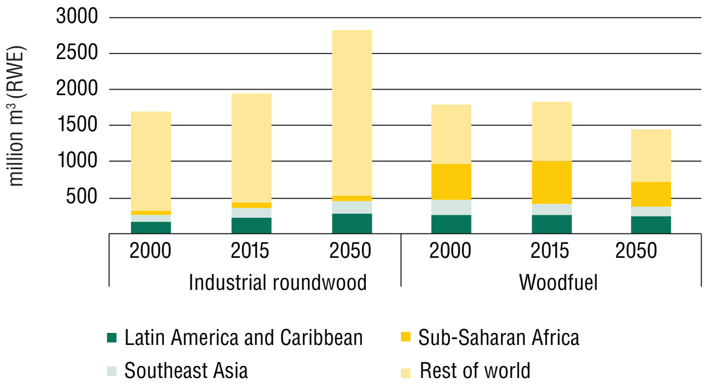
IRW production levels in natural forests will remain fairly stable. To maintain market share for tropical timber derived from natural forests, sustainable forest management (SFM)

1 The 2010 configuration of The Global Forest Products Model (GFPM) links the forest sector to scenarios of the Intergovernmental Panel on Climate Change (IPCC). The scenarios examined were a subset of the "story lines" prepared by the IPCC. Each scenario has projections of population and gross domestic product. These projections were used as input in the GFPM simulations. The IPCC also makes projections of forest area, which were integrated in the timber supply submodel of the GFPM (Buongiorno et al. 2012). However, it does not specify production systems (e.g. plantations or natural forest).

2 The Sixth Assessment Report on climate change by the IPCC uses SSPs to derive scenarios of greenhouse-gas emissions. In SSP 2, "The world follows a path in which social, economic, and technological trends do not shift markedly from historical patterns. Development and income growth proceeds unevenly, with some countries making relatively good progress while others fall short of expectations. Global and national institutions work toward but make slow progress in achieving sustainable development goals. Environmental systems experience degradation, although there are some improvements and overall the intensity of resource and energy use declines. Global population growth is moderate and levels off in the second half of the century. Income inequality persists or improves only slowly and challenges to reducing vulnerability to societal and environmental changes remain" (Riahi et al. 2017).

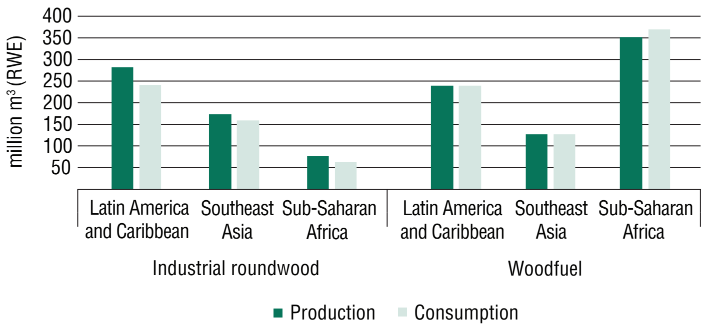
3 For the purposes of the study, tropical timber-producing regions (tropical producer regions) comprise the countries in sub-Saharan Africa, Latin America and the Caribbean, and Southeast Asia.

Figure 1: Industrial roundwood and woodfuel production, 2000, 2015 and 2050



Source: FAO (2020); GPFM, corrected/adjusted by the authors.

Figure 2: Projected production and consumption of industrial roundwood and woodfuel in tropical producer regions, 2050



Sources: FAO (2020); GPFM, corrected/adjusted by the authors.

will need to become more competitive by expanding the range of commercial species and including revenue streams from carbon sequestration and other ecosystem services. Industrial concessions and communities will need to improve their silviculture and obtain third-party certification to demonstrate legality and sustainability.

Key actions to support tropical timber production

Multilevel efforts will be required to maintain and enhance long-term sustainable tropical timber production in both plantations and natural forests. These will include developing enabling forest governance systems; supporting the development of new business models for natural forest management and plantations; mobilizing capital and incentives for smallholder tree-planting and communities; resolving market constraints for smallholders and communities; and ensuring adaptability to climate change, which will be crucial for maintaining forest productivity.

Wood-processing and employment

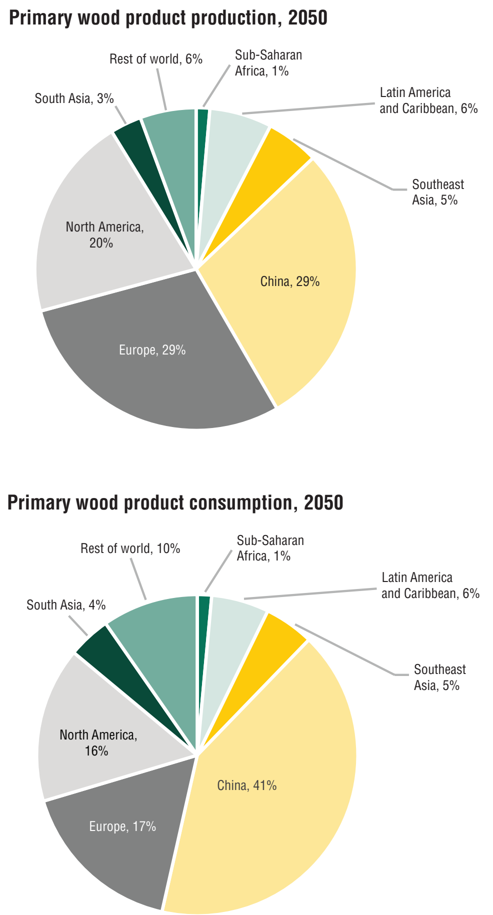
The projected global production volume of primary-processed wood products will increase by 61% between 2015 and 2050, to 3.7 billion m^3 roundwood equivalent (RWE). The tropical producer regions will contribute 12% (476 million m^3 RWE) of this, growing by only 36% over the same period. The domestic consumption of primary wood products will also be relatively low in tropical producer regions in 2050, at 12% of global consumption (Figure 4).

Even with this moderate increase, future IRW processing capacities in tropical producer regions will need to grow by more than 160 million m^3 to meet regional increases in demand. Forest industries in many tropical countries are in dire straits, however. Predominantly, machinery is configured for large-dimension timber from natural forests, but increasingly the supply comprises small-dimension timber from plantations and agroforestry. Ultimately, this leads to low efficiencies and low margins.

As a result, domestic industries are often neither profitable enough to access capital nor capable of meeting the increasing compliance requirements to obtain formal credit. Business development support is urgently required to enable forest-based companies to obtain access to capital. Establishing the required capacity in forest industries in the tropics by 2050 will take capital expenditures estimated at USD 40 billion, in addition to significant investment in modernizing outdated operations.

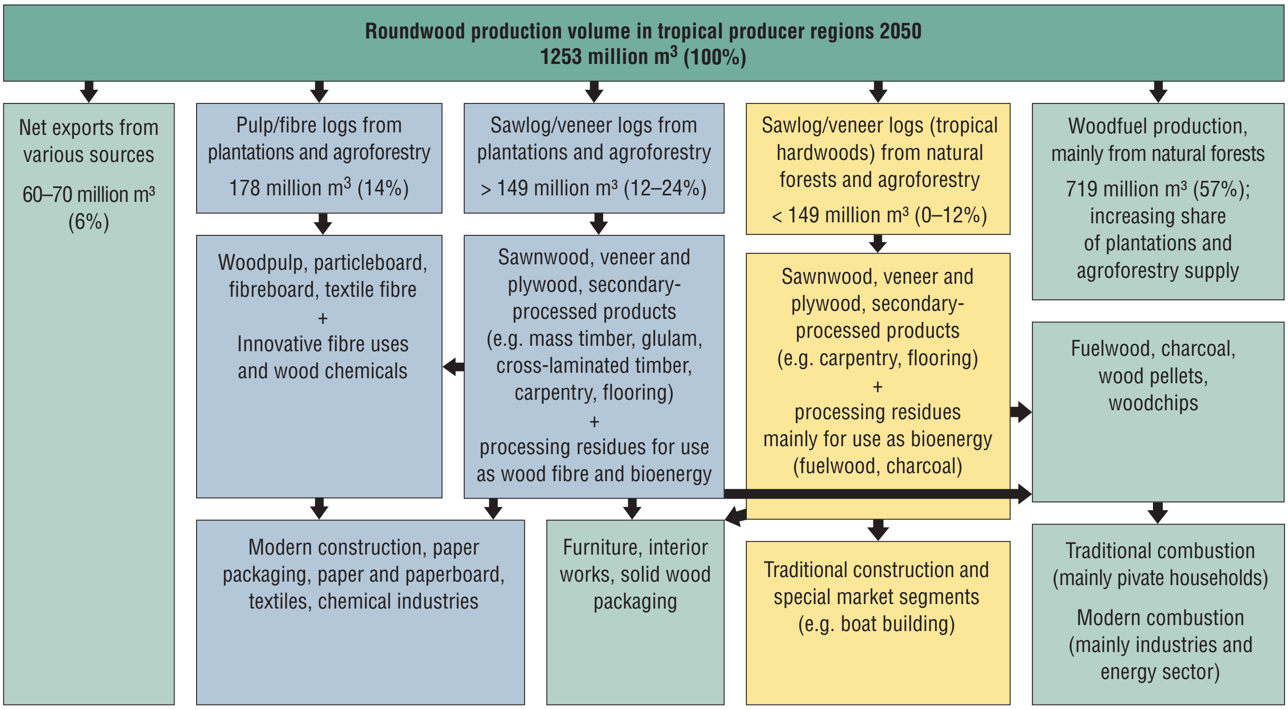
The modernization of, and investment in, tropical forest industries will create 1.3 million jobs by 2050 (to a total of 7 million full-time equivalent positions) (Figure 5). Meeting the future employment needs of the sector will require a well-trained workforce, which still needs to be developed. Forest enterprises face several challenges in enhancing productivity and value-adding, especially informality,

Figure 4: Participation of selected world regions in the production and consumption of primary wood products, 2050



Source: GFPM, corrected/adjusted by the authors.

Figure 3: Indicative flow of roundwood in tropical producer regions in 2050

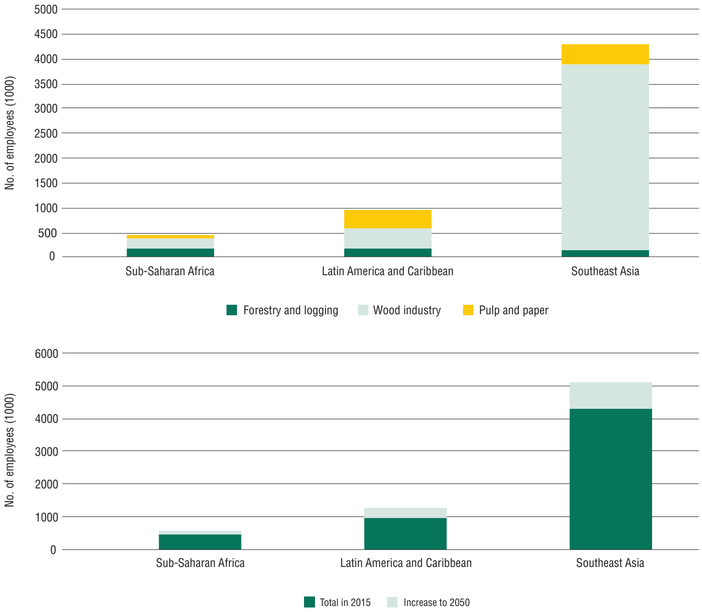


Notes: Dark-green boxes present the roundwood mix from various sources; blue boxes present roundwood flows from planted sources; yellow boxes present natural forest roundwood flows; and light-green boxes present roundwood flows that include planted and natural sources.
Source: Authors' own elaboration based on GFPM projections.

Table 1: Future activity fields in the transition and modernization of the tropical forest sector

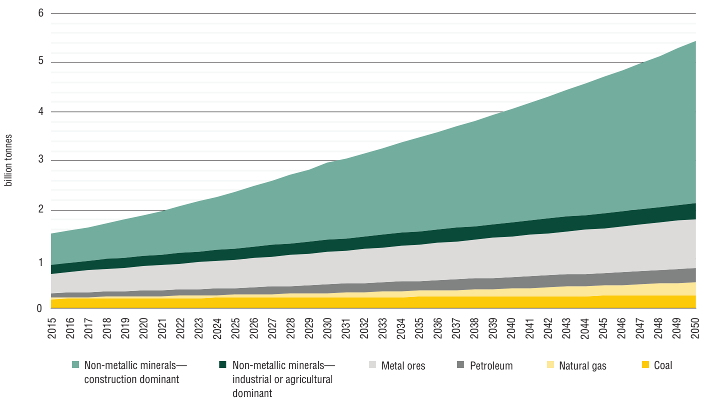
Focus area	Field of future activities
1. SFM: managing and conserving tropical forests	Develop concepts to provide the raw materials of the future: high-quality raw materials for modern industries from productive plantations that are resilient to climate change
	Develop innovative business models and multiple revenue streams for natural forest management, including "concessions 2.0"
2. Economics, statistics and markets: improving the transparency of—and expanding international markets for—tropical timber	Support international initiatives that promote timber trade, legality and transparency through data analytics and impact monitoring
	Analyse current and future market requirements and understand the transitions required for tropical timber supply and value chains
3. Sustainable forest industries: developing efficient and value-adding tropical forest-based industries	Promote innovation and digitalization in tropical timber sectors, from forest information systems and timber production to wood-product processing and consumer requirements
	Develop incentive and capitalization schemes for small and medium-sized enterprises
4. Climate-change mitigation and adaptation: addressing climate change	Promote the substitution of non-renewable materials with sustainable timber to mitigate greenhouse-gas emissions and other negative externalities associated with the use of non-renewable materials
	Cooperate with initiatives that address deforestation and degradation and promote reforestation for commercial purposes
5. Capacity building: raising the capacity of forest stakeholders to manage and benefit from their resources	Promote diversity in tropical timber production to enable broad participation, ownership and benefit-sharing in SFM, including in small to large enterprises, private and public actors, gender and generations
	Facilitate knowledge transfer and provide training and education to meet future silvicultural and industry labour requirements

Figure 5: Formal employment in wood-processing industries in tropical producer regions, and increase in employment to 2050



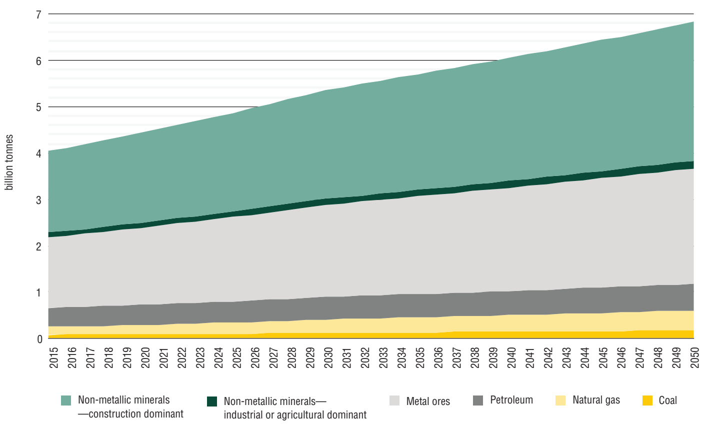
Sources: GFPM; UNIQUE forestry and land-use forest industry benchmarks database.

Figure 6: Non-renewable material consumption in sub-Saharan Africa, 2015–2050



Sources: Projections based on UN (2020a) and UN (2020b).

Figure 7: Non-renewable material consumption in Latin America and the Caribbean, 2015–2050



Sources: Projections based on UN (2020a) and UN (2020b).

restricted access to capital and a lack of business development support. These challenges need to be overcome to ensure global competitiveness and an adequate timber supply for future employment and sustainable growth in producer countries.

The tropical timber industry needs transformative public and private investments to overcome its challenges. Public investment would facilitate the raising of private investments at scale and help stimulate sustainable growth. Any effort to increase investment in tropical timber industries will need to be harmonized with action to encourage the widespread adoption of SFM in timber production. The following key actions would have catalytic power:

- **Capitalize start-ups and small and medium-sized enterprises (SMEs).** Obtaining the required investment in modern industries will only be possible by capitalizing domestic enterprises. A critical mass of technology-driven start-ups and SMEs is required to build future modern companies that can attract larger equity investments.
- **Develop knowledge and skills in the wood industry.** In the future, the labour requirements for modern wood industries will be more sophisticated, and ensuring sufficient well-trained personnel will require solid education and training.
- **Standardize tropical timber products to make them competitive in a global commodity market.** To be competitive, tropical timber products will need to comply with international product standards. Only standardized products will enable mass markets in construction and fibre to expand timber use and compete with non-wood products.
- **Encourage traceability-of-origin and sustainability certification to gain access to new markets for wood products in substituting for non-renewable materials.**

Tropical timber in a sustainable economy

According to projections, an economic-growth scenario will lead to a near net doubling of global materials use by 2050. The vast majority of these materials will be non-renewable, and their use is closely linked to externalities, triggering negative impacts on biodiversity, climate, ecosystems and human wellbeing. If they follow the pathways of today's industrialized economies, tropical producer regions will become major drivers of greenhouse-gas emissions and ecosystem degradation (figures 6–8). As tropical low- and middle-income countries rapidly grow their economies, building a sustainable and resilient future will require strategies to mitigate the negative effects of materials use and resource extraction.

Tropical timber could take a leading role in substituting non-renewable materials and achieving carbon-neutral production. The increasing demand for goods in the construction sector and other sectors like plastics and textiles can partly be met by wood-based products.

The demand for concrete and metals in tropical producer regions will rise rapidly alongside population and economic growth. Urbanization will be a main driver of increased materials use due to high demand for housing and other buildings. Strategies for coping with such future demand should prioritize resource-use efficiency and encourage societies to strive to achieve carbon-neutral production based on renewable and sustainably produced materials such as wood.

Enhancing the use of sustainably produced timber in rural and urban construction will require standardized modern wood products (e.g. cross-laminated timber, laminated veneer lumber and other engineered wood products). On the demand side, architects and construction companies will need to increase their adoption of timber-based construction techniques. On the supply side, domestic primary processing industries will need to invest and modernize.

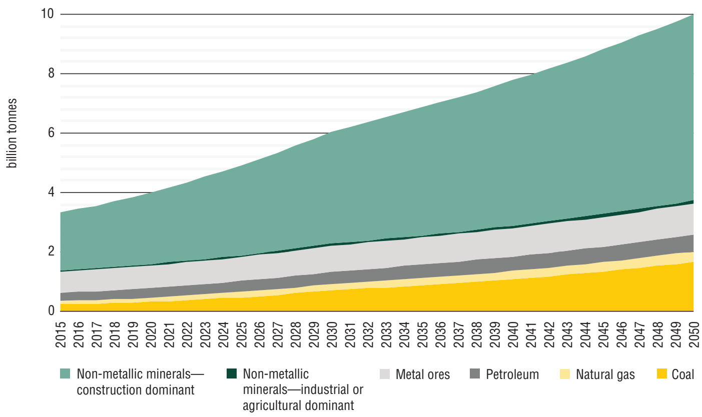
In the textiles industry, raw materials for viscose and other wood-based fibres can be produced with low-water-using processes, making the water footprint significantly smaller than that for cotton and polyester. Cellulose textile fibres can also be used as an alternative for cotton in regions where climate-change-induced temperature increases and water shortages restrict cotton-growing capability.

Substitutes for plastics made from wood (bioplastics) are technologically available and some are already in mass production, but production costs are higher than for conventional plastics. Wood-based products are biodegradable and reusable (although, as for conventional plastics, the single use of bioplastics should be avoided). The global pulp-and-paper industry is investing in research and prototype production lines to increase product versatility and cost-efficiency.

Tropical timber can play a major role in slowing biodiversity loss, ecosystem degradation, social inequality and other negative externalities related to the extraction of natural resources in tropical regions. The enhanced use of tropical timber should be based on the following complementary strategies and key actions:

- Increasing resource efficiency, such as reducing waste through technical improvements in production processes and the digitization of value chains, using side-streams and byproducts and, where feasible, applying cascade use.
- Changing consumption patterns, such as those projected for the declining use of woodfuel, and allocating freed resources to new processing pathways.
- Developing regional processing industries to reduce export volumes and increase domestic value-added.
- Improving forest management, for example by expanding certification and improving management planning. Production systems will need to be modified to enable higher harvesting rates, improve forest health and produce higher-value assortments.

Figure 8: Non-renewable material consumption in Southeast Asia, 2015–2050



Sources: Projections based on UN (2020a) and UN (2020b).

- Exploring opportunities and striving for timber-focused investments in natural capital. Green investments, investments in nature-based solutions such as tropical rainforest conservation and landscape restoration, and subsidies or tax reductions for green products will be incentives for increasing natural capital and economic efficiency.

ITTO's role in the transition and modernization of the tropical forest sector

In light of the opportunities and challenges identified in this study, ITTO could take a leading role in guiding the development of the tropical forest sector in the decades to come. The Organization's work programme deals with specific aspects of the development of the tropical forest sector. Table 1 provides an indicative list of potential future activities (some of which ITTO is already engaged in).

The full report by Christian Held et al., *Tropical Timber 2050* (ITTO Technical Series No. 49), was published as part of an ongoing activity in ITTO's Biennial Work Programme, with funding from the Government of Germany. The report is available at www.itto.int/technical_report

ITTO also undertook a related study, *Fiscal and Non-fiscal Incentives for Sustainable Forest Management*, published as ITTO Technical Series No. 48. This is featured in a separate article in this edition and is available at www.itto.int/technical_report

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Incentivizing sustainable forest management

Ecological taxation and other incentives could greatly increase the uptake of sustainable forest management in the tropics

by Alain Karsenty

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Looking for a sign: Forest workers discuss the management of a community forest in Ucayali, Peru. The innovative use of taxation can incentivize the uptake of SFM. *Photo: P. Recavarren/AIDER*

Traditionally, tropical forestry has relied mainly on prescriptions and coercive regulations to enforce rules. Growing awareness of the depletion of the main commercial species in natural tropical forests due to insufficient regulation has led to the development of a new generation of management plans that are more constraining than in the past, increasing costs and (therefore) reducing profits for compliant operations. The budgets of many government forest services have declined in recent decades as a result of financial crises that have induced severe cuts in public expenditure. Corruption in extractive activities, and widespread informality, weaken the effectiveness of field control and favour illegal logging, which exerts downward pressure on timber prices and thus reduces the profitability of legal and sustainable timber. At the same time, a lack of sustainable harvesting practices has meant that large areas of natural tropical forests have become degraded, helping to justify land-use change.

Land-related fiscal policies also have an impact on the viability of forestry. Weak or absent rural property taxation creates incentives for the extensification of agricultural and pastoral systems, to the detriment of forests. Gaps in land taxation are linked directly to difficulties in developing cadastral systems, and this situation is unfavourable to the stated desire of intensifying agricultural production to ensure food security and conserve forest resources.

Finally, an increase in informal forest harvesting (i.e. forest harvesting that takes place outside governmental regulatory and reporting systems) in many countries has hindered the development of domestic markets for sustainably produced industrial timber. This phenomenon is not specific to the forest sector—entire sections of many economies (especially in very poor countries) are experiencing informalization processes—but it has a significant impact on operations striving to ensure forest sustainability.

As part of ITTO's work to assist its member countries, I undertook an analysis of existing—and the potential impact of new—incentives for promoting investment in productive forests to achieve deforestation-free landscapes and value chains for green growth in the tropics. A synthesis of this study, with case studies in Brazil, Cambodia, the Congo, Côte d'Ivoire, Myanmar, Peru, Thailand and Viet Nam, was published in April 2021 (see below). This article summarizes the main conclusions and recommendations.

What are incentives?

Before the development of incentive regulation, economists derived and recommended optimal pricing formulas. In contrast, incentive regulation acknowledges regulatory imperfections and moves the aim from optimal regulation in the direction of practical regulation with desirable properties. Incentive regulation derives from the conviction that conventional regulation to achieve social and environmental objectives has worked poorly in the past and that approaches based on differences in relative prices (i.e. the price of an item compared with the price of other items) could do better by changing people's behaviour and thereby help align private and collective interests.

This is the purpose of ecological taxation, which aims to change behaviour by encouraging producers and consumers to adopt environmentally friendly practices. The emblematic example of this is taxation of greenhouse-gas emissions. Because the goal is to reduce emissions, ecological taxation will bring in considerable funds at the beginning, but its yield will decline as emissions decrease. A "perfect" green tax is one for which the revenues gradually fade away. But producers and consumers will only be able to change their practices if alternatives are available to them (e.g. more efficient public transport). Revenues from ecological taxes should be used to support public and private investment in building these alternatives. The more alternatives that are available, the more that ecological taxes can be used to accelerate change.

This issue is well known in the fields of energy and transport, but ecological taxation has rarely been used to date to incentivize sustainable forest management (SFM).

Direct and indirect incentives

Sectoral and macroeconomic policies help provide the general investment climate and heavily influence the economic behaviour of individuals and corporations. Creating a sound, long-term investment climate for forests requires, among other things, clarity on property rights for land and forests; the effective rule of law; dissuasive sanctions for illegal activities; access to credit; good-quality infrastructure; and the availability of research findings. Nevertheless, such "indirect incentives", which are not specific to forestry, do not target the adoption of SFM.

Some indirect incentives, such as clarity on property rights, may be considered as direct incentives, notably for forest plantations. The performance of public-sector plantations has generally been disappointing, and the challenge is to encourage private owners and communities to plant trees and manage them sustainably. Tenure security is also essential for SFM in natural tropical forests, but the initial investment might be lower compared with plantations.

The following 22 recommendations for governments and stakeholders on fiscal and non-fiscal incentives, if implemented, would greatly encourage the uptake of SFM.

Fiscal incentives

As a general rule, fiscal and other incentives in the forest sector should be granted only when there is a direct and demonstrable link to SFM. In most of the case-study countries, fiscal incentives are available for timber operations in marginal or remote areas, for downstream wood processing, and for locating processing facilities in special economic zones. They are linked only rarely to the quality of forest management (e.g. in the case of tax rebates for certified companies in Brazil and Peru).

Recommendation 1: Develop theories of change indicating the changes that would occur as a consequence of a given measure or combination of measures. Ideally, such theories would be prepared before deciding on changes to the forest tax regime. Robust theories of change would also point out existing disincentives and structural hurdles that might prevent a proposed incentive from yielding its expected results. This would help in embracing systemic approaches to change and pursuing appropriate policy reforms.

Recommendation 2: Link fiscal incentives to independent third-party certification. Forest tax rates should be differentiated according to whether certification has been achieved by a company or other forest manager and the type of such certification. Several countries, including Brazil and Peru, already have this type of incentive. Of considerable interest is the policy adopted in Gabon in mid-2020 that identifies three rates for the area-based tax: 1) the most favourable, being for concessions with forest management certification; 2) an intermediate rate, for concessions with a legality certificate; and 3) the highest rate, for concessions without certification. The weighting of the area tax in the overall fiscal burden is not high, however, and a further step would be to also adjust the harvest and export taxes using the same approach.

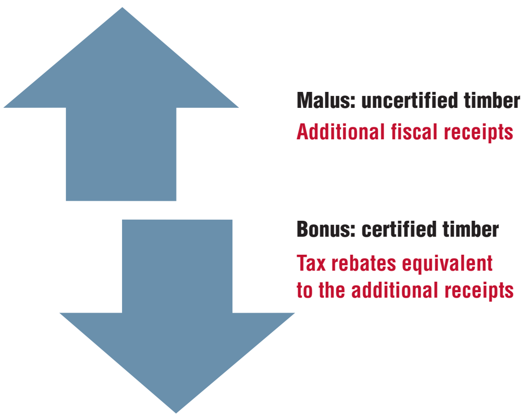
Feebates, also known as bonus–malus mechanisms, constitute an instrument of ecological taxation that combines an increase in taxes on unsustainably produced products with a decrease in taxes on products deemed sustainable (e.g. certified; Figure 1). The aim is to achieve budget neutrality by balancing (on an annual basis) tax increases and decreases.

Recommendation 3: Contemplate three levels of forest tax applicable to the main components of forest-related taxes (i.e. forest area under concession, harvest volume and export-related): 1) malus (if no certification is applied); 2) bonus (if legality certification is applied); and 3) "super bonus" (if forest management certification is applied). Such a system would provide concessionaires with a strong incentive to improve their management practices.

Recommendation 4: Differentiate tax rates among tree species to promote the harvesting of lesser-used timber species (LUTS). Any encouragement to increase the harvesting of specific LUTS should be preceded by sound assessments of the sustainability of such measures.

Recommendation 5: Differentiate tax rates according to location and transport costs to provide an incentive for reducing high-grading in remote areas. To be effective, however, this measure should be combined with differentiated tax rates for species to encourage the greater use of LUTS.

Figure 1: The bonus–malus system for certified and uncertified timber



How big an incentive? A forest worker measures the diameter of a large tree in the Kabaung Reserved Forest, Myanmar. A "perfect" green tax is one for which the revenues gradually fade away as poor environmental practice declines due (at least in part) to the effect of the tax. *Photo: Myanmar Forest Department*

Recommendation 6: Exempt trees harvested in private plantations from forest taxes, with such taxes replaced by existing corporate taxes based on profits.

Non-fiscal incentives

Many countries use bidding procedures to allocate forest concessions and lease public plantations. These procedures often comprise both a technical criteria assessment and a financial offer.

Recommendation 7: Give more points in bidding procedures to certified companies applying for new permits.

Recommendation 8: Adjust financial offers involving annual payments according to timber price trends, and provide incentives (through the payment of rebates) for certified concessionaires. Public marketing incentives for legal and sustainable timber should be considered.

Recommendation 9: In public timber procurement policies, target suppliers that can prove timber legality and, ideally, sustainability through third-party certification.

Recommendation 10: Establish "green lanes" in export procedures to facilitate and speed up the export of certified timber.

Recommendation 11: Where log export bans exist, relax them for plantation trees to increase prices and thereby provide financial incentives for plantation operators and growers.

Recommendation 12: Design and establish in law a permanent forest estate (PFE) through appropriate legal procedures (e.g. gazetting) and the free, prior and informed consent of local communities. The first purpose of a PFE is to prevent the allocation of classified forest lands to agriculture and grazing. Forest concessions should be gazetted and local people consulted. A legally established PFE will generally be insufficient to prevent the allocation of mining or oil permits, but it would raise the expected level of environmental or financial compensation (e.g. through biodiversity offsetting).

Recommendation 13: Recognize the ownership of trees outside forests by landholders based on simplified and inexpensive procedures conducted with the agreement of neighbours and helped by geolocation. Local governments (e.g. municipalities and districts) should be enabled to grant land titles that provide farmers with sufficient tenure security.

Recommendation 14: Outside the legally established private and public forest estates, prioritize the recognition of forest property rights for communities, households and families to support small-scale private forestry. This would encourage farmers to keep and take care of trees and increase opportunities for the development of legal small-scale forest-based enterprises.

Recommendation 15: Enable small-scale informal loggers to enter the formal economy and recognize tree ownership for communities and households to provide a framework for legal relationships between landholders and forest operations. Forest officers should be incentivized, through financial rewards, to facilitate legal permits for small-scale loggers.

Recommendation 16: Encourage supply contracts that allow small-scale wood processors to use industrial sawmill wastes. The use of rubberwood and oil-palm trunks by both large-scale and small-scale sawmillers and other wood processors should be allowed.

Many forest concessions and plantations are encroached by illegal loggers, farmers and poachers. When concessions are large, inevitably there are overlapping rights with customary landholders. Some concessionaires have started mapping customary areas that overlap with their concessions and are using such maps as a management tool and for benefit-sharing.

Recommendation 17: Require the more-equitable sharing of benefits arising from timber harvesting between concessionaires and local communities, potentially based on the participatory mapping of overlapping rights. Part of such shared benefits could be conditional on contractual agreements on hunting and the prevention of illegal logging and poaching.

Recommendation 18: Strive to make the governance of forest concessions more inclusive, and consider local communities as stakeholders with voices in management decisions that affect them. Combined with conditional benefit-sharing measures, this will encourage cooperation against illegal logging and poaching.

Farmers should be incentivized to conserve forests, plant trees and restore natural ecosystems on lands they own or control. Some countries, including India, obtain large shares of their national timber production from agroforestry and trees outside forests.

Recommendation 19: Make financial and non-financial incentives available to farmers for conserving trees, enabling natural regeneration and planting trees on their own lands, in preference to investing large amounts of public money in state-owned plantations, especially when tenure is unclear and disputed. Payments for environmental services (PES) have been introduced and are in use in a growing number of countries, including Brazil and Viet Nam, and these conditional payments can be powerful instruments for encouraging attitudinal change among farmers towards forest resources.

Recommendation 20: Consider national PES schemes targeting forest conservation and restoration as a key element for successful REDD+ and other environmental policies, including climate-change adaptation strategies. Financing initiatives such as national PES schemes need to look beyond regular national budgets for financing.[1]

Some countries (e.g. Costa Rica) have succeeded in ensuring sustainable financing for national PES schemes through earmarked levies on, for example, fuel and water consumption, supplemented by international financial assistance.

Recommendation 21: Consider various levies as a basis for funding national PES schemes, understanding that the larger the levy base, the lower its rate and greater its social acceptability. Financing initiatives such as national PES schemes need to look beyond regular national budgets for financing. Levies on mass-consumption products and services could raise significant funding, but there is a need to also obtain private investment. National and international carbon markets might, in the future, provide financial inputs for the forest sector, but a great deal of uncertainty exists about the parameters of such markets and the level of financial incentives they can provide. Another way of attracting private investments, especially from extractive and agribusiness industries, could be through national schemes for ecological offsetting (particularly biodiversity offsetting).

Recommendation 22: Consider schemes for biodiversity offsetting, especially as a legal obligation framed by clear regulations, as a means to help fund forest restoration and to remunerate forest holders (including concessionaires) for conservation and restoration measures. If a portion of such offsetting is in monetary form, it could supplement national PES schemes.

Moving forward

There is growing interest among policymakers in the design of incentive schemes and green fiscal policies for forests and other sustainable land uses in a revenue-neutral or even revenue-raising manner. ITTO and other partners should continue working to encourage countries to implement appropriate incentives (and remove disincentives) for SFM in their forest-related policies. Because these topics are rarely addressed in traditional forest policies and are largely overlooked in the creation of incentives (and disincentives) beyond the forest sector, there is a need for continued training, advice and capacity building in many tropical countries. ITTO and partners are committed to providing such training and capacity building in coming months and years.

The full report by Alain Karsenty, *Fiscal and Non-fiscal Incentives for Sustainable Forest Management* (ITTO Technical Series No. 48), was published as part of an ongoing activity in ITTO's Biennial Work Programme, with funding from the Government of Germany. The report's annex, prepared by Alain Karsenty and national consultants, comprises comprehensive case studies in Brazil, Cambodia, the Congo, Côte d'Ivoire, Myanmar, Peru, Thailand and Viet Nam. The main report and annex are both available at www.itto.int/technical_report

ITTO undertook a related study in 2020 on trends in tropical timber supply and demand to 2050 (and implications for SFM incentives); the report of this study, *Tropical Timber 2050*, has been published as ITTO Technical Series No. 49 and is featured in a separate article in this edition. It is also available at www.itto.int/technical_report

[1] REDD+ = reducing emissions from deforestation and forest degradation and the role of conservation, sustainable management of forests and enhancement of forest carbon stocks in developing countries.

Helping lesser-used species go mainstream

Promoting the greater use of lesser-used timber species could help achieve sustainability in the moist forests of Honduras

by Miguel Roberto Mendieta

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Resting the laurels: Pieces of black laurel (*Cordia megalantha*) are laid out to airdry with the aim of producing components for the manufacture of cigar boxes. *Photo: Miguel Mendieta/ICF*

The lowland and midland moist broadleaved forests of Honduras are characterized by an enormous wealth of flora, a highly diverse mix of species, and the presence of timber species of significant commercial value distributed across various ecological associations. These forests, therefore, have considerable potential for the production of timber and non-timber forest products. Only four species dominate hardwood markets, however, and the low density of valuable tree species in the forest increases pressure on the resource base in the face of competition from other land uses.

In Honduras, raw materials for the primary industry are harvested mainly from pine forests (471 000 m^3 per year), mostly in the departments of Olancho and Comayagua. Another 13 000 m^3 of hardwood is harvested in the department of Atlántida and the Río Plátano watershed. The annual national roundwood harvest was around 567 000 m^3 in 2016, with a value of about USD 14 million. From this volume, the primary timber industry produced 359 000 m^3 of timber products, valued at USD 97 million. The secondary timber industry processed about 114 000 m^3 of timber as furniture, doors and other manufactured products worth USD 101 million.

Underused species present an opportunity

There is an abundance of timber species in the Honduran Caribbean region that are still undervalued and underused. These timber species—known collectively as lesser-used timber species (LUTS)—have properties comparable with species of currently high commercial value and could logically form the basis of an ecologically and economically sustainable forest industry. The diversification and integrated use of LUTS in the timber sector would help increase the income of forest owners and producers, forestry and agroforestry organizations, and indigenous and local communities in the Honduran Caribbean region. In turn, the sustainable use of LUTS would support sustainable forest management by increasing the attractiveness of forestry as a land-use option.

The ITTO project

With the help of an ITTO project,[1] the Honduran National Institute for Forest Conservation and Development, Protected Areas and Wildlife (ICF) is promoting the marketing and sustainable management of 12 LUTS. Actions by the project have included providing information to stakeholders on industrial feasibility, and market viability studies on potential tropical timber species and community development at the national and subnational levels. The project has pursued a strategy of ensuring that timber products produced, industrialized and marketed from LUTS are legally sourced and managed by forestry and agroforestry organizations that are adherents to the Social Forestry System (*Sistema Social Forestal*—SSF).[2] Under the SSF, tropical timber owners and producers are fully involved in the administration, management and protection of national public forests through community forest management agreements, with technical assistance from the ICF.

The 12 LUTS are piojo rojo (*Tapirira guianensis*), rosita (*Hieronyma alchorneoides*), marapolán (*Guarea grandiflora*), Santa María (*Calophyllum brasiliense*), San Juan areno

1 Project PD 770/15 Rev.1 (I): "Promotion and sustainable management of lesser-used timber species (LUTS) in the moist forests of the departments of Atlantida, Colon and North Olancho in Honduras".

2 The aim of the Honduran Social Forestry System is to incorporate rural, indigenous and tribal communities into the management, integrated use, industrialization and marketing of forest resources in order to improve their living conditions in rural areas.

Table 1: Potential uses of 12 lesser-used timber species in Honduras

Species	Density	Potential uses of timber
Varillo (*Symphonia globulifera*)	Medium to high hardness 0.65–0.75 g/cm^3	Yellow-greenish wood used in interior and exterior carpentry, furnishings, timber decking, woodwork, plywood, general construction, installations and barrels, sleepers, joinery and furniture, agricultural tools, sporting equipment, poles and lathe work, marine constructions on water, packaging, ship bridges, freshwater pilings, pulp and paper. Its latex is used to fill cracks in boats and for torches
Piojo, caobina (*Tapirira guianensis*)	Medium basic hardness 0.48–052 g/cm^3	Reddish wood used in light construction, joinery, plywood, boxes, interior mouldings, general carpentry, particleboard and lathe work; fast, easy drying process
San Juan rojo (*Vochysia guianensis*)	Average basic hardness 0.35–0.47 g/cm^3	Reddish to pinkish wood used in interior carpentry, boxes, plywood, inexpensive furniture, cladding, sawing, veneer, railroad sleepers, canoes, packaging, drawer bottoms of fine furniture, boats, planking, posts, panels, children's furniture, modular and kitchen furniture, toys, and lathed and decorative items; good for pulp and paper
Huesito (*Macrohasseltia macroterantha*)	Medium to heavy hardness 0.58–0.77 g/cm^3 Smooth grain	Whitish wood suitable for cabinetmaking, fine furniture, general construction, flooring and tool handles. It is recommended for ships, boats, veneer and plywood, vehicle platforms and sleepers, carpentry, paving, agricultural works, and machining and lathe work
Rosita (*Hieronyma alchorneoides*)	Semi-hard to hard 0.50–0.61 g/cm^3	Reddish to reddish-brown wood used in the construction of structural frames for dwellings (components such as walls, roofs, floors, columns, beams and fences), heavy construction, piling and marine construction, decorative veneer, interior carpentry, wagon bottoms, bridges, canoes, boats and railroad sleepers, joinery, turnery, poles, tannins, boxes and crates, pallets and pulp and paper
San Juan areno (*Ilex tectonica*)	Heavy 0.57–0.80 g/cm^3	Whitish to off-white wood used in rural construction, veneer and plywood, furniture, boxes and packaging, sawnwood, match sticks, wheels and axles for carts, oars, sills and crossbeams, sidings for roof trusses, carpentry, joinery and lathe work
Santa María (*Calophyllum brasiliense*)	Moderately heavy 0.55–0.65 g/cm^3	Reddish wood used in construction, joinery, cabinetmaking, fine furniture and furniture in general, boats and luxury construction, plywood and structural wood, internal and external construction, carpentry in general, doors, windows, floors, tool handles, linings, ornaments, posts, stakes, turned articles, musical instruments or parts, floors for platforms and truck bodies, ladder steps and handrails, toys, handicrafts, railroad sleepers, boat masts and poles; good for pulp and paper
Marapolán (*Guarea grandiflora*)	Medium-hardness wood 0.50–0.57 g/cm^3	Reddish wood used in construction that supports medium to heavy loads, joinery, door frames, windows and mouldings, decorative veneers, fine furniture, packing boxes, sawmilling, lathed items, interior decoration, shipbuilding, joinery and general carpentry
Selillón (*Pouteria izabalensis*)	Hard to extremely hard wood 0.77 g/cm^3 Fine to smooth grain	Reddish-brown wood with a milky latex used as raw material in the manufacture of adhesives, paints and varnishes, and as insulation for electrical wires; the fruit is edible; and the wood is used for the handles of agricultural tools and implements, and as sleepers
Paleto (*Dialium guianense*)	Hard and heavy wood 0.78–0.85 g/cm^3	Dark brown to reddish-brown wood, used in heavy construction, beams, posts, docks, piles, agricultural implements, bridges and attachments for carts or carriages; recommended for marine construction, frames, doors and windows
Bellota (*Quercus skinneri*)	Medium to hard wood 0.72–0.96 g/cm^3	Dark brown wood with yellowish streaks used in farming tools such as ploughs and carts, other tools and handles, small hydraulic construction, floors, pallets, beams and shipbuilding; because of its high calorific value, it has been used in many localities for charcoal and firewood; the wood is highly valued for its firmness, weight and durability and is used in the manufacture of boats, buildings, furniture, joinery and general carpentry
Black laurel (*Cordia megalantha*)	Light to moderately heavy wood 0.36–0.63 g/cm^3	Brown wood with whitish and yellow streaks used in construction, load-bearing beams and boards for houses, fences, doors, slam bolts, tool handles and furniture; its branches and trunk tips are used for firewood

Table 2: Timber stocks for the 12 selected lesser-used timber species in the tropical moist forests held under community forest management agreements, Caribbean region, Honduras

Species	Total volume (m^3)	Average volume (m^3) per ha	Annual increment (m^3)
Varillo	142 410	7.71	4747
Piojo	134 640	7.29	4488
Red San Juan	121 080	6.56	4036
Huesito	99 720	5.40	3324
Rosita	70 320	3.81	2344
San Juan Areno	54 990	2.98	1833
Santa María	45 990	2.49	1533
Marapolán	41 760	2.26	1392
Selillón	30 270	1.64	1009
Paleto	29 940	1.62	998
Bellota	23 010	1.25	766
Black laurel	1170	0.06	39
Total	**795 300**	**43.1**	**26 510**

Source: Situational diagnosis and estimation of volume stocks of lesser-used timber species in Honduran tropical moist forests in the departments of Atlántida, Colón and North Olancho, ITTO/ICF LUTS Project.

(*Ilex tectonica*), huesito (*Macrohasseltia macroterantha*), paleto (*Dialium guianense*), selillón (*Pouteria izabalensis*), San Juan rojo (*Vochysia guianensis*), varillo (*Symphonia globulifera*), bellota (*Quercus skinneri*) and black laurel (*Cordia megalantha*). Table 1 shows their potential uses.

Promoting the use and management of these species requires the development of skills and capacity in the following areas:

- knowledge of the species' physical and mechanical properties;
- techniques for furniture-making, wood finishing, airdrying, drying in non-industrial and industrial kilns, and saw/blade doctoring and maintenance; and
- the silvicultural management of LUTS.

Potential volume stocks and production value

Under the project, surveys and situational diagnostic studies were carried out to determine and estimate volume stocks of LUTS in Honduran moist forests based on legal sources under forest management. Local studies were implemented on LUTS management and harvesting measures and actions by producers and SSF beneficiary organizations. Guidelines on best management and silvicultural practices were reviewed and updated for the 12 selected LUTS in the departments of Atlántida, Colón and North Olancho.

There are 23 active community forestry organizations in the Caribbean region, comprising cooperatives, producer associations, community enterprises and farmer associations.

Despite the support and national-level cooperation deployed in the Caribbean region in the last 12 years, timber production by community forestry and agroforestry organizations has decreased significantly. The main reasons for this are low domestic demand; the high production and transaction costs associated with products from legal sources; unfair competition from the illegal harvesting and trade of timber products; and the expiration of forest management plans and yearly plans of operation in the forest sector.

The 23 community forestry organizations in the region hold community forest management agreements over 38 214 hectares of national public tropical moist forests, with an allowable cut of 51 155 m^3 per year and annual volume stocks amounting to about 26 500 m^3 per year for the 12 selected LUTS (Table 2) over a 30–40-year rotation. Currently, only nine of the 12 species are being harvested and sold by community organizations.

The species with the highest acceptance in local markets are (in order of diminishing importance) huesito, rosita, piojo, San Juan rojo, varillo, Santa María, San Juan Areno and marapolán; those with the lowest acceptance are bellota, black laurel, selillón and paleto. Low-impact logging techniques with directional felling are used in the harvesting and management of these species, with on-site milling carried out using chainsaws and, in some cases, frames. Boards are transported from the harvesting sites to timber yards by mules, horses and, often, on the shoulders of the producers 6 inches) in lengths of 6–12 feet (about 1.83–3.66 m). All these LUTS are promoted locally and internationally by the cooperatives and organizations involved in their harvesting through, for example, exhibition sales, the internet, telemarketing, radio, newspapers, direct field visits, field tours, lectures, television programmes, newsletters and business meetings.

Timber and furniture production chains

The forest, timber and furniture production chains comprise timber production (in natural forests or plantations), logging (the felling and cutting of the trees, and roundwood processing), the transportation of sawnwood and processed

A time to dry: Boards of lesser-used species from Honduran moist forests are stacked for airdrying. *Photo: © Miguel Mendieta/ICF*

forest products, and the manufacture of furniture and accessories.[3] Industrial roundwood can be used in various ways, such as processed into sawnwood, which is used as an input for the manufacture of other products; processed into squared logs and dimensioned pieces for various uses; as poles for communication and construction uses; and in other forms of industrial wood for multiple purposes.

The structure of the timber and furniture production chain in northern Honduras (the departments of Atlántida, Colón, Cortes, Yoro and El Paraíso), particularly Atlántida and Colón, is characterized by a conglomerate of rural and periurban microenterprises and family-run businesses. These include activities such as sawmilling, timber sales and marketing, the preparation of parts and mouldings, and carpentry and joinery workshops that produce wood furniture and other accessories for household and industrial purposes.

Management and silviculture prospects

In recent decades, Honduran forests have contributed 1% or less to the country's gross domestic product. The limited use of a wide range of LUTS, many of which could potentially obtain good prices if well marketed, has not only caused an imbalance in the harvesting of moist forests, it has also reduced the interest of local communities in protecting these forests. There is an urgent need to put these species to commercial use as a way of increasing the value of the forest; to do so requires appropriate research and development.

Moist forests are one of the country's most valuable resources. Traditionally, however, they have been considered an obstacle to development, and a wide range of policies has been promulgated to support deforestation and the replacement of trees with pastures and crops, as well as the highly selective logging of traditional and commercially valuable timber species. The moist forests and their LUTS offer a wide range of tangible and intangible products and services, but many of these do not have developed markets, and some have not yet even been valued.

Project outputs can be found by inserting the project code PD 770/15 Rev.1 (I) into the ITTO project search function at www.itto.int/project_search. This ITTO project was made possible by funding from the Government of Japan.

[3] The forest-based products industry is not the only element in the manufacture of timber products, with many companies and organizations potentially involved in forest product value chains (from the origin in the forest to the sale of the product), adding value to a given wood product as it passes through each stage. The organization of the forest products industry into clusters has been a powerful tool for the integration of forest organizations and companies. A cluster is constituted by the grouping of strongly interrelated companies in a specific geographic space, where these companies develop their activities as sole producers or in a complementary manner, based on a raw material, product or service. Thus, forest clusters may include forestry operations; primary processing activities such as sawmilling and the production of veneer, boards and cellulose pulp; secondary processing activities such as carpentry, furniture, paper and cardboard; and marketing, supportive supply activities, equipment, goods and services.

The case for multiple-use forest management that includes non-timber products

A literature review published recently by ITTO and the Precious Forests Foundation examines the benefits and challenges of managing for non-timber forest products in tropical production forests

by Jürgen Blaser, Juliana Frizzo and Lindsey Norgrove

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No cheap knockoff: A woman harvests wild cocoa in tropical Bolivia. *Photo: © S. Opladen/Helvetas*

Since the development of the first scientific forest practices, all approaches to long-term forest management have focused on timber (and occasionally woodfuel). The concept of sustained timber yield implies that no more timber should be removed from a forest than will grow back in a given time, but it gives no consideration to other forest products.

A new term—"non-timber forest product" (NTFP)—emerged globally several decades ago for grouping forest products and commodities that are "not timber". Similar terms had been used previously, such as "minor forest products", "byproducts of forests", "other forest products", "secondary forest products" and "special forest products", but "NTFP" implied a new way of looking at these products.

What is an NTFP? According to De Beer and McDermott (1989), NTFPs comprise "all biological materials other than timber, which are extracted from forests for human use". Thus, NTFPs are goods originating in forests that are not directly related to timber production. The term encompasses any product harvested—formally or informally—in the forest other than timber (CIFOR 2008). It considers plant products such as resins, fruits and medicinal plants as well as animal products such as honey and wild meat (also known as bushmeat) (Belcher 2003).

NTFPs are potentially valuable commodities and important elements of sustainable, multiple-use forest management that serves broader conservation and local development goals. The development of NTFPs has been advanced as a mechanism for adding value—in addition to timber—to the management of forest stands. If they are managed sustainably and actively to generate income, NTFPs can help offset the opportunity costs of retaining forest as forest rather than converting it to other, potentially more profitable land uses. The sustainable production of NTFPs, which might include management practices such as assisted natural regeneration, plant breeding and enrichment planting, can support both local livelihoods and nature conservation (Uprety et al. 2016); it can be a valuable addition to the income generated by timber production.

Here, we draw on our recently published report[1] to explore the case for multiple-use forest management in natural tropical production forests, including through the supply of timber and NTFPs. We present two case studies of promising NTFPs in tropical forests in Africa and South America (Box 1 and Box 2) that have not yet reached their full potential but for which large global market expansion may be expected in the next decade.[2]

What we know about managing non-timber forest products in tropical forests

There is a vast literature on the management and potential of NTFPs in accessible forests, including wide-ranging studies by various international scientific and development organizations.

NTFP management is often considered an alternative to timber management, and the focus of many projects and studies has been at the scale of small forest management units (FMUs) managed by communities and producer associations. Many hundreds of NTFP species and their commercialization are described in the literature; most are

1 Blaser, J., Frizzo, J. & Norgrove, L. 2021. *Not only timber: the potential for managing non-timber forest products in tropical production forests—a comprehensive literature review.* ITTO Technical Series No. 50. International Tropical Timber Organization (ITTO), Yokohama, Japan, and Precious Forests Foundation, Zürich, Switzerland; the full report can be downloaded at the link provided at the end of the article.

2 The full report includes case studies of six such NTFPs, three other case studies of highly successful NTFPs, and a catalogue of 28 important NTFPs in tropical forests.

High value: Two large Brazil-nut trees (back centre) in the Antimary State Forest, Acre, Brazil. *Photo: © J. Blaser*

only locally important, but some have significant national and international markets—gutta-percha and rattan, for example, have been traded internationally for more than 100 years, and others have been globally significant for at least 20 years. A well-documented case of a locally used NTFP that has become an internationally traded product is açaí, a product obtained from *Euterpe oleracea* (an Amazonian palm tree, which also produces palm hearts). The Brazilian–American company Sambazon began exporting açaí pulp from the Brazilian Amazon in 2000 to produce "lifestyle" juices, smoothies and energy drinks (Prado 2012). Today, Sambazon is an established multimillion-dollar business, the products of which are distributed worldwide.

Although general information is available on the occurrence, collection, use and marketing of many NTFPs, research and experience is scarce on the management of lesser-known NTFPs in tropical production forests. A case in point is the Swiss–Brazilian, FSC-certified forest enterprise, Precious Woods Amazon (PWA), which manages nearly 0.5 million hectares of natural forest in the Brazilian state of Amazonas, producing hardwood timber for export and the Brazilian market. On its land, which is 98% forested, the company combines timber production with the management of logging debris[3] to produce woodfuel. PWA also manages a small area of enrichment planting of Brazil nut (*Bertholletia excelsa*) and runs trials of enrichment planting involving other NTFPs. The concept of enrichment planting with NTFP species is relatively new; PWA is working with local communities and enterprises to pave the way for multiple-use forest management.

[3] When a tree is felled in a timber harvesting operation, the bole is removed (in the form of logs), but other wood—especially that in the branches and crown—remains on the forest floor. Forests tend to regenerate better if such woody debris is also removed.

The commercialization and harvesting of NTFPs have been encouraged since the late 1980s as an alternative way to protect forests and biodiversity by generating incomes and subsistence for local people (Weinstein and Moegenburg 2004). It was assumed that, as markets grew for NTFPs, forests providing these products would gain in value and therefore be less prone to deforestation. Additionally, the trade in NTFPs was considered a tool for alleviating poverty because nearly 25% of the world's poor depend on forest resources (Fortini 2019). Even though reports of NTFP overharvesting are common in the literature, including with significant impacts on forest structure, a systematic review of the sustainability of NTFP harvesting concluded that, in nearly two-thirds of studies, NTFP extraction was sustainable (Stanley et al. 2012).

Taking the issues described above into account, multiple-use management in tropical production forests can have various forms, including the following:

- managing commercial timber species that also produce valuable NTFPs;
- managing species that produce timber and species that produce NTFPs in the same area;
- combining the harvest of commercial timber and palm species; and
- increasing NTFP production in timber production forests through enrichment planting.

Potential of and constraints on multiple-use forestry that combines timber and non-timber forest products

Literature is limited on conflicts between timber and livelihood-based non-timber uses. There is some evidence, however, that it is possible to develop management approaches that accommodate both uses in timber production forests where long-term commitment exists.

In their literature review of NTFPs in logged-over tropical forests, Rist et al. (2011) found that 82% of reviewed articles addressed negative impacts on the availability of livelihood-relevant NTFPs, most commonly due to conflicts over use and the indirect impacts of logging. Positive impacts were also identified: for example, the removal of canopy trees can provide conducive growing conditions for light-demanding plant species, including some that produce NTFPs. Despite the considerable impacts of existing logging practice on livelihoods, the authors concluded that there was evidence to support enhanced compatibility between timber extraction and the subsistence use of NTFPs.

The majority of the existing literature involves economic appraisal of the role of NTFPs in rural livelihoods, and only limited research exists on the function of NTFPs in local trade and subsistence. This is an important gap: documenting and building on the often-elusive land-use practices of local people can provide an effective foundation for broader multiple-use forest management.

Responsible forest management that includes low-impact logging based on adequate planning (e.g. ecologically sensitive timber harvesting) can contribute to local livelihoods. Logging can also degrade valuable NTFP resources, however, thereby jeopardizing the livelihoods of forest-dependent communities. The impacts of management decisions on NTFPs in production forests and thereby the economic, social and cultural well-being of forest-dependent and forest-adjacent communities must be taken into account.

Accommodating the needs of forest-dependent people is a crucial issue in tropical production forests in the Amazon, the Congo Basin and Southeast Asia. Developing management approaches that ensure the sustainable production of timber and NTFPs has considerable potential to address both livelihood needs at the local level and the long-term security of forest stands.

Case study 1: Safou

Common names: African plum, native pear, bush butter tree, African pear, safou, safoutier, prunier, atanga, nsafu

Scientific name: *Dacryodes edulis*

Present in: West and Central Africa

Harvesting season: May–October

Harvesting yields: 223–335 kg per tree per year

Main uses: edible fruits and oil; the bark, leaves and resin are used to treat malaria, fever and skin diseases

Substitutability: *Dacryodes buettneri* and *Dacryodes klaineana*

Tree density in the forest: 0.2–0.4 trees per ha

Harvesting practice: climbing the tree and/or knocking the fruit down with a long pole

Handling: seeds are removed and the fruit boiled and dried

Dacryodes edulis is a dioecious evergreen tree that grows in non-flooded forest in the humid tropics of Africa in a range encompassing the Atlantic coast from Sierra Leone to Angola as well as Central Africa. This shade-tolerant tree grows in a wide range of soils but prefers ferralitic and volcanic soils. Trees grow to a height of up to 40 m in the forest but to only 10–12 m in plantations. The fruit (safou) is large and cylindrical, and it turns from pink-red when unripe to blue-black when ripe. Safou is 4–12 cm long and 3–6 cm in diameter and has a high content of protein, fat and vitamins.

In summary:

- Safou is very popular among local people in the Congo Basin because of its high oil content. It is one of the most consumed fruits in the Congo Basin and is particularly important in the "hungry season".
- *Dacryodes edulis* is cultivated mainly in homegardens and as a shade tree in cocoa plantations. In Nigeria, only 5% of safou is harvested in forests, where the fruit is smaller than in plantations and tree density is low.
- *Dacryodes buettneri*, in contrast, is still mainly harvested in forests. In Gabon, its fruit is one of the most commonly collected NTFPs. It provides important complementary household income, especially for the very poor.

Plum product: Safou fruits with plantain, Cameroon.
Photo: © S. Hauser/IITA, Ibadan, Nigeria

- Even though the timber of *Dacryodes edulis* is of high quality, comparable with African mahogany, it is used mainly for axe handles and carpentry and is not widely traded commercially. The timber of *D. buettneri* is more commonly traded, mainly for construction and furniture; it was ranked the ninth-most important timber for export in Gabon in 2005.
- The volume of traded safou in Cameroon was estimated at 11 000 tonnes in 2015, making it the third-most popular fruit crop after banana and kola.
- The value of safou production is in the range of USD 9–160 per farmer per year. On average, producers sell 41% of their production and use the rest for self-consumption; on average, they receive 75% of the market price paid to the traders.
- The main export markets for safou are Belgium, France and the United Kingdom, where immigrants from West and Central Africa are the main consumers.

Conclusion

Given growing demands on tropical forests for the many goods and ecosystem services they provide, multiple-use management approaches are essential. As Sabogal et al. (2013) concluded, multiple-use forest management in tropical production forests remains a barely operational concept, however, due to various economic, technical and administrative constraints. Timber is still the only forest commodity with major lucrative markets, and the tropical timber sector is based on a reliable body of technical knowledge and makes a significant contribution to the economies of many tropical countries. The dominant model of timber harvesting is being undermined in some regions by the ever-increasing number of investors interested in agro-industrial and mining projects, for which the financial benefits can be much higher than those associated with sustainable timber harvesting. Multiple-use forest management could increase the economic benefits of SFM, and forest certification and timber legality schemes could help support its implementation.

It needs to be underlined, however, that the compatible management of timber and NTFPs is complex, multifactorial and context-dependent. Compatibility is possible in some situations but may be difficult to achieve in others. Note that this conclusion, also drawn by others (e.g. Guariguata et al. 2010; Rist et al. 2011; Sabogal et al. 2013), is speculative given the scarcity of studies on economically and socially proven multiple-use approaches to timber and NTFP management in the tropics.

Ideally, the process to develop multiple-use forest management approaches in tropical production forests should begin with land-use planning because it implies a thorough assessment of biophysical, social, regulatory and institutional aspects. Overall, two broad approaches could be taken:

1) Improve existing situations on a case-by-case basis, particularly where forest management is entrusted to long-term concession contracts (either community-based or private). Inventories, management planning, harvesting

Box 2: Wild cocoa

Common names: cocoa, cacao, food of the gods

Scientific name: *Theobroma cacao*

Present in: South America, Central America, Mexico

Harvesting season: year-round, but the main seasons are November–January and May–July

Harvesting yields: 50–60 fruits per tree per year and 7–9 kg of dried beans per tree per year

Main use: cocoa solids and butter are used for chocolate production and in the cosmetics industry

Substitutability: no substitutability

Tree density in the forest: high (forming part of the lower forest stratum)

Harvesting practices: involves knocking the fruit to the ground by climbing or by using long poles

Handling: the beans are removed from the cocoa fruit, fermented in wooden boxes and dried in the sun

Theobroma cacao, a tree species in the Malvaceae family, is native to the Amazon Basin, with the centre of origin in the upper Amazon. It is a small, shade-grown tree that grows in humid, high-rainfall climates and can attain a height of 25 m in the wild. Cocoa beans develop in ovoid pods, with each pod containing 25–75 beans; they are white in colour but turn violet-brown when fermented and dried. Cocoa beans are the source of cocoa solids and butter (the main ingredients for chocolate) and also used in the cosmetics industry.

In summary:

- Cocoa solids and cocoa butter are the main ingredients of chocolate, which has become immensely popular worldwide in the last 100 years. More than 4.5 million tonnes of cocoa beans is traded annually, and demand is increasing by 3% per year.
- The three most important diseases affecting cocoa are witch's broom, blackpod and frosty pod, which are all fungal infections of the bean pods or other parts of the tree and often lead to the loss of a significant part of the harvest.
- Various approaches for the prevention and treatment of the diseases exist. Quarantine measures are designed to prevent the spread of disease to unaffected areas; breeding aims to favour varieties with less susceptibility to disease; and integrated management and chemical and biological treatments aim to control the pathogens. Various studies have shown that these approaches can be effective, but further research is warranted.
- Re-agroforestation is being attempted in degraded areas in Brazil involving cocoa cultivation. In Bahia, cocoa is traditionally cultivated in agroforestry systems called *cabrucas* involving a canopy of native forest trees. Located near to natural forests, these shady plantations have a higher richness in bat species than observed in natural forests and could serve as biological corridors.

Hot chocolate: Wild cocoa is a valuable commodity, with the potential to develop niche markets in collaboration with producers of high-quality chocolate. *Photo: © S. Obladen/Helvetas*

- Several examples exist in Bolivia and Brazil of successful wild harvesting of cocoa. In most cases, niche markets could be developed in collaboration with producers of high-quality chocolate.
- Ninety percent of cocoa production globally comes from small-scale farmers, who often earn less than USD 1.25 per day, the threshold of absolute poverty. In Ghana, the average daily income of cocoa farmers was USD 0.40–0.50 in 2017. Even though the market for certified sustainable cocoa is growing, it still represents a small share of the total world market. In the case of wild harvesting, the cooperative of the Tacana indigenous people in Bolivia, which harvests cocoa in the wild, can sell its cocoa beans for a price of USD 4.4 per kg.
- Little experience exists in introducing shade-tolerant varieties of cocoa to tropical timber production forests, but there is clear potential for co-management. There is interest in integrating wild cocoa in multiple-use management, such as through enrichment planting with wild cocoa in timber production forests. In the Brazilian Amazon, PWA is proposing to take a pioneering role in the management of forest plots enriched with wild cocoa.

and marketing would address both timber and NTFPs within an overall concept of managing forests and their products and services sustainably.

2) Develop new management regimes that explicitly encourage the sustainable production of timber and NTFPs, and the delivery of ecosystem services, over long timeframes.

The core idea is to explicitly enhance both timber and NTFP values. Approaches for optimizing compatibility between management for timber and for NTFPs must be developed, scaled to the size of the forest area to be managed (i.e. the FMU), including the silvicultural system to be applied, harvest planning and intensity, and organizational aspects of managing (in the same area) a range of forest products and services. The dynamics of multi-actor partnerships—for example between a forest concession-holder

Incense incentive: Women extract agarwood from pieces of wood after tree harvest, Assam, India. *Photo: © Assam Agarwood Association*

and a local community—must be clearly defined, and the necessary technical, organizational and financial capacities for multiple-use management must be incorporated into tropical forestry curricula (Guariguata et al. 2008).

The full report, *Not only timber: the potential for managing non-timber forest products in tropical production forests—a comprehensive literature review,* by J. Blaser, J. Frizzo and L. Norgrove, published as ITTO Technical Series No. 50, is available at www.itto.int/technical_report. Publication of the report was made possible by funding from the Precious Forests Foundation.

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Getting DNA tracking cherry-ripe for forests

A new phase has commenced of an ITTO project that has helped create a test-and-trace system to cut illegal exports of African cherry bark

by Ken Hickson

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On track for sustainability: Project workers visit a private farm in the Congo that has planted African cherry trees with the aim of producing bark and high-value timber. *Photo: Oumar*

The science of DNA testing used to combat crimes such as murder and assault is being increasingly used against the illegal wildlife trade. A recent focus of attention is the endangered African cherry (*Prunus africana*), the bark of which is used by pharmaceutical companies in the treatment of prostate disorders.

This valuable species was listed in Appendix II of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) in 1995. The aim of CITES is to ensure that international trade in wild animals and plants (or products derived from them) does not threaten the survival of those species in the wild. Species listed in CITES Appendix II, and products derived from them, may be traded internationally, provided that specimens are accompanied by export permits. Such permits, in turn, may only be granted when the appropriate scientific authority of the country of export has advised that such export will not be detrimental to the survival of that species (this is called a "non-detriment finding", or NDF) (CITES undated).

CITES and ITTO have worked together for more than a decade to assist tropical countries in implementing CITES provisions for CITES-listed tree species. The collaborative effort is helping countries across the tropics to design forest management plans, conduct forest inventories, create guidelines for making NDFs, and develop and disseminate tools for timber identification (Sosa Schmidt and Johnson 2016).

The main conservation concern with African cherry is the harvesting of its bark. Although the species is resilient to some bark removal, poor practices and excessive bark-stripping can kill trees. Such practices have led the International Union for Conservation of Nature to classify the African cherry as "vulnerable" on its Red List of Threatened Species.

Although the extent of threat to the species has been contested, the CITES Plants Committee expressed heightened concern in 2006 over the decline of African cherry populations in Burundi, Cameroon, the Democratic Republic of the Congo, Equatorial Guinea, Kenya, Madagascar and the United Republic of Tanzania. The European Union imposed an import ban in 2007 (UNEP-WCMC 2008).

In Cameroon, an ITTO–CITES project began in 2009 to assist with the sustainable management of African cherry, starting with an inventory of the species and an effort to document the level of harvesting.

The project helped establish controlled sustainable harvesting in production areas in Cameroon and other African countries, including the Democratic Republic of the Congo. This work enabled Cameroon to produce an NDF, after which CITES approved a conservative export quota to allow international trade to recommence. The project also tackled the practice of removing bark from trees in uncontrolled areas and mixing it with product from controlled areas to increase the volume of bark apparently obtained under approved management plans.

The ITTO–CITES work was overseen by the programme's regional coordinator in Africa, Professor Jean Lagarde Betti, who tapped into a large network of stakeholders—government officials, the private sector and local communities—that had been working on CITES-listed tree species in the region since 2008.

The work was undertaken in two phases. Phase 1 (2008–2012) involved building inventories, developing simple management plans, setting annual quotas and developing NDFs. Phase 2 (2012–2015) involved the implementation of management plans and the recommendations of the NDFs.

Also in the second phase, the ITTO–CITES programme needed help to set up a DNA verification system for African cherry. Double Helix Tracking Technologies was called on to coordinate exploratory work on genetic variation in the species, studying trees scattered across the mountain ranges of tropical Africa and Madagascar (Degen and Bouda 2015; Thomas 2016).

In partnership with the Advanced DNA Identification and Forensics Facility at the University of Adelaide, Australia, Double Helix set out to understand whether it was possible to use DNA techniques to differentiate between bark from controlled and uncontrolled areas and so identify and exclude uncontrolled, unsustainable supply from the market.

Professor Andrew Lowe, Director of the DNA Identification and Forensics Facility, said, "We used the latest genomics methods to develop and apply a simple DNA test for African cherry. The initial scientific results showed significant genetic variation between populations—even those less than 10 km apart. These results are tremendously promising and warrant further investigation, particularly to establish if differences can be identified at the annual plot level. It's also particularly important that this DNA work supports the implementation of simple management plans and that local staff are trained in sampling and analysis procedures".

Double Helix's regional coordinator for Africa, Germain Yene, worked on the ground in phase 2 to collecting a large quantity of useful information. Did he encounter resistance to his work in helping manage the African cherry bark according to CITES rules?

"We took samples at different points in the supply chain, from batches of bark in the field to products prepared for sale or export," he said. "Interestingly, the sampling teams collecting bark did not encounter any resistance from the local people, only curiosity."

But it can be risky work. According to Mr Yene, the sampling team working in the Lake Kivu region of the Democratic Republic of the Congo once came face to face with armed rebels, who confiscated their samples and working equipment. No one was harmed in the encounter.

A new phase of the project, a partnership funded by ITTO and involving the University of Adelaide, the Ministry of Forestry in Cameroon, the Faculty of Sciences of the University of Douala and Double Helix (Singapore), started in Cameroon in May 2021. It has four key objectives:

1) Implement an effective DNA traceability system to control trade in *Prunus Africana* and *Pericopsis elata* (commonly known as African teak).
2) Collect samples of *P. africana* and *P. elata* from different populations in Cameroon.
3) Develop new genetic markers for *P. africana* suitable for differentiating between populations in neighbouring areas.
4) Analyze all samples with genetic markers to determine the most appropriate level of discrimination for each species, such as *Prunus* allocation units or annual harvesting plots.

Working under the supervision of Cameroon's Ministry of Forestry and the Faculty of Sciences at the University of Douala in Cameroon, Mr Yene is again coordinating the collection of samples across Cameroon. He is also checking that the samples are of sufficient quality to be sent to the laboratory at the University of Adelaide. It has been more than five years since the second phase was completed, so local teams require training.

"Among other selection criteria [for the collection teams], it will be necessary to have a good knowledge of the species—its ecology and distribution," said Mr Yene. "When it comes to implementation of a DNA verification system, it is also a question of identifying the different handling points for samples and products along the supply chain, from the forest to the port of embarkation. We will take a random assortment of bark and product samples, which will be compared to the genetic reference database to verify that they are from the claimed harvest area or not."

According to Mr Yene, the system should be thought of as a quality-control system that checks the validity of environmental claims for a product rather than its physical quality.

Professor Betti said that the advanced DNA traceability project is essential for stopping the depletion of endangered tree species and for controlling the trade of *Prunus africana* and *Pericopsis elata*.

"While we accept that the African cherry has important international value as a medicine, we must find a way to stop the illegal harvesting of its bark," he said. "Of course, the tree is resilient to some bark removal, but poor and excessive bark-stripping leads to death of the tree. This must stop."

The project is the latest in a series supported by ITTO that focuses on the development of DNA techniques for tree product traceability.

ITTO's Steve Johnson, who oversees the Organization's work with CITES, noted that the reliable tracking of products from CITES-listed species, such as African cherry, is essential for assuring the global community, importers and other stakeholders that trade is sustainable and not detrimental to the long-term survival of the species.

"We are pleased to be working, once again, with the Government of Cameroon, as well as with our experienced colleagues from the University of Adelaide and Double Helix, to help ensure that the trade in sustainably produced *Prunus* bark continues, so that the medicines produced from it continue to alleviate the suffering of prostate patients around the world," said Dr Johnson.

DNA traceability systems were first introduced by Double Helix in the Indonesian forest sector in 2007 in work that was also supported by ITTO. That system was designed to verify the chain-of-custody documentation of processed merbau wood for export to Australia, New Zealand and Europe.

This is an edited version of an article published online on 7 May 2021 at www.doublehelixtracking.com/news. Full details of the work carried out on *Prunus africana* through the ITTO–CITES Programme can be found at www.itto.int/cites_programme/outputs/id=2086

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Fellowship report

An ITTO Fellow and his colleagues used remote sensing and a geographic information system to map water-erosion sensitivity in the mountainous Tonkpi region in Côte d'Ivoire

by Atté Cyrille Bi Tiesse,[1] Eboua Narcisse Wandan[2] and Zamblé Armand Bi Tra[3]

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Holding it together? An example of a conventional reforestation approach in the Tonkpi region, Côte d'Ivoire, with no attention to erosion control. *Photo: M. Tiesse*

The mountainous Tonkpi region is susceptible to flooding, landslides and especially soil erosion (Boyossoro et al. 2007). Anthropogenic activities such as deforestation, agriculture and small-scale gravel-crushing have stripped vegetation from many mountain slopes, exacerbating erosion (N'Guessan 1989; Bakayoko et al. 2013) and causing rock outcrops to become exposed and break away. This has resulted in material damage to crops and creates risks in terms of civic protection. In addition, erosion leads to the loss of soil fertility and thereby reduces productivity (Raphiou 2013). The aim of our study, which was undertaken with the assistance of an ITTO Fellowship (Box 1), was to assess the region's sensitivity to water erosion and to identify priority areas for anti-erosion management focused on restoring forest cover on mountain slopes.

Study zone

The Tonkpi region is in the far west of the Montagnes District in Côte d'Ivoire and is part of the mountainous area of the Guinean region (Guillaumet and Adjanohoun 1971). It extends over an area of 12 284 km^2 between longitudes 5°24' and 7°3' west and latitudes 8°4' and 6°34' north (Figure 1). The region has an estimated population of 435 000 (RGPH 2014). The average population density is 85 people per km^2, with a maximum of 150 people per km^2 in the Department of Man, where the regional capital is located.

The Tonkpi region is one of the wettest in the country, with rainfall ranging between 1300 mm and 2400 mm per year. Temperatures are high, with an average of 24 °C, and humidity fluctuates between 80% and 85% (CNRA 2009). Topography is marked by a series of low-level plateaus (Bakayoko et al. 2013). These basic forms are interspersed in places by very precipitous areas, the contours of which alternate between average and concave gradients at an altitude that at times exceeds 1000 m. The highest peaks are Mount Tonkpi (1189 m), Mount Glas (1175 m) and Mount Mia (1077 m).

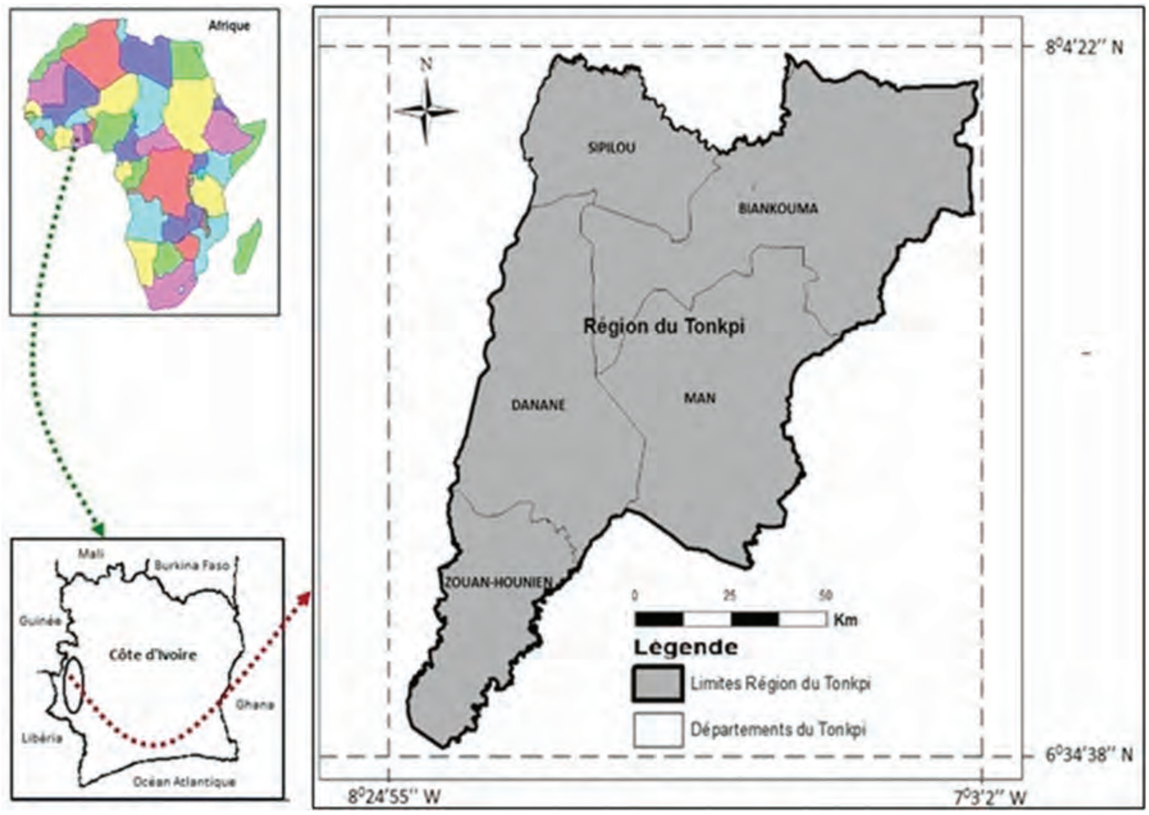
Box 1: The role of the ITTO Fellowship

The ITTO Fellowship awarded in the spring 2015 Fellowship cycle enabled me to acquire the skills and expertise needed to obtain the Certificate of Proficiency in Professional Consulting (*Certificat d'Aptitude au Métier de Consultant*), leading to work as a consultant and membership in the Ivorian network of consultants (*Réseau Ivoirien de Consultants*). The Fellowship also enabled me to obtain my doctorate, with a view to pursuing further research and education at the Graduate School of Agronomics in the Félix Houphouët-Boigny National Polytechnic Institute and elsewhere. I plan to organize a workshop in the Tonkpi region with its Regional Council, Ministry of Environment officials and local elected officials to present the results of my doctoral thesis with a view to raising awareness of good practices for the participatory management of this region.

I express my sincere thanks and gratitude to ITTO for the financial support provided through its Fellowship Programme, and to the Graduate School of Agronomics. I am immensely grateful to my thesis supervisor, Eboua Narcisse Wandan, for his supervision, valuable suggestions and encouragement, and to the Mountain Slope Reforestation Project (*Projet de Reboisement des Flancs de Montagnes*) for the support and friendliness I enjoyed while carrying out this research.

Atté Cyrille Bi Tiesse

Figure 1: Location of the Tonkpi region



Information sources

Three types of data were used in the study: satellite images, and cartographic and demographic data.

1) The satellite images consisted of Enhance Vegetation Index images from the MODIS satellite on 1–15 December between 2001 and 2017, four Landsat 8 images of scene 198-55 from 11 February 2016, Shuttle Radar Topography Mission images, and rainfall simulation images from the Tropical Rainfall Measuring Mission.
2) Cartographic data consisted of the soil map of Côte d'Ivoire produced by Dabin et al. (1960) and georeferenced map layers of the boundaries of the Tonkpi region, its road network, the administrative breakdown of subprefectures, and housing (villages).
3) Population-related alphanumeric data for the Tonkpi region were obtained from the 2014 General Population and Housing Census.

Methodology

The methodology used in the study involved the Mediterranean Desertification and Land Use (MEDALUS) model, which calculates an erosion sensitivity index (ESI) using the geometric mean of quality indexes derived from the environment and human action (Tra 2013). This assessment of erosion sensitivity is based on a combination of four main factors (see equation in next column), each of which is represented by an index: 1) the soil quality index—SQI; 2) the anthropic quality index—AQI; 3) the vegetation quality index—VQI; and 4) the climate quality index—CQI. The indexes were calculated by the matrix product of the parameter maps in a geographic information system.

$$ESI = (SQI \times AQI \times VQI \times CQI)1/4$$

These parameters are all likely to affect soil degradation, as described by various authors (e.g. Escadafal 2002; Salamani and Hirche 2006; Hirche et al. 2007).

Figure 2 summarizes the general procedure for mapping the multifactorial vulnerability to water erosion of soils in the Tonkpi region. The MEDALUS model identifies environmentally sensitive areas (Kosmas et al. 1999), encompassing soil, vegetation, climate and management factors (Benabderrahmane and Chenchouni 2010). The output card corresponds to zones of erosion susceptibility.

Results

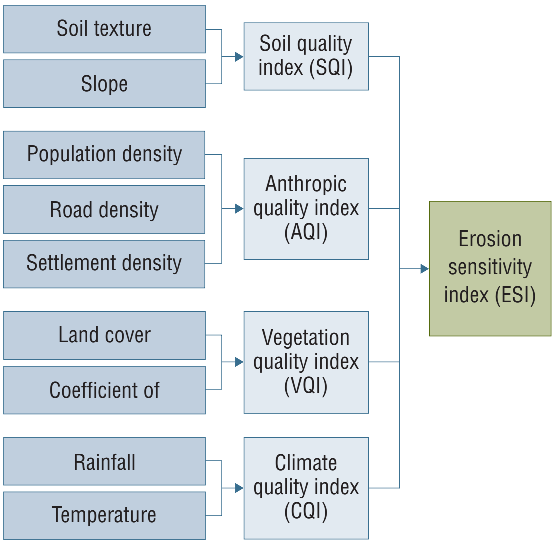
The ESI map (Figure 3) shows the susceptibility of the area to water erosion as a percentage. The higher the value of the index, the more sensitive the area is to water erosion. An analysis of the map identifies three areas of susceptibility, according to ESI value: 1) critical (high ESI value); 2) fragile (moderate ESI value); and 3) potentially resistant (low ESI value). Each of these is described below.

Critical areas

Critical areas (high ESI values) occupy about 43% of the Tonkpi region; they are located in the department of Zouan-Hounien and the central Man–Biankouma axis. Their high vulnerability to water erosion is due to anthropogenic

Mountain-crushing: ITTO Fellow Atté Cyrille Bi Tiesse visits an artisanal gravel-crushing venture in Côte d'Ivoire. This activity has stripped vegetation from many mountain slopes. *Photo: M. Digbi*

Figure 2: Methodological steps for mapping erosion susceptibility using an erosion sensitivity index



pressures associated with high population densities, especially in the departments of Biankouma (100–200 inhabitants per km^2) and Man (200 inhabitants per km^2), the high density of settlements (> 10 settlements per km^2) and the high density of roads (16 roads per km^2), most of which are not asphalted. According to Walter (1977), roads are a major cause of erosion in developing countries. Population pressure has led to the clearing of forests to plant crops, with successive tillage and weeding exposing soils and weakening their structures. Food crops are much less effective at covering the soil than the forest formations they replace after clearing.

Note that these departments are characterized by poor soil quality and steep to very steep (>25%) gradients and an average precipitation of 1200–1500 mm per year. Gradients above 15% endow the runoff with sufficient kinetic energy to make it abrasive. In addition, the soils have a coarse texture, with a low proportion of clay (less than 30%) and a high proportion of sandy particles. According to Mrabet et al. (2001), soils with more than 30% clay have strong cohesion and therefore greater structural stability.

In the Zouan-Hounien zone, the high vulnerability to soil erosion is due to very high rainfall (>1500 mm per year) and a lack of forest cover (canopy, root systems and litter). Dense forests provide better protection against erosion due to their hydrologic regulation. According to Handel et al. (1997), this is because the impenetrable networks of tree roots in dense forests protect soils against erosion by facilitating the infiltration of runoff and ensuring strong cohesion among soil particles, resulting in excellent structural stability. Moreover, the dense tree canopies intercept rainwater and reduce the splash effect of raindrops, and the thick litter on the forest floor reduces the kinetic energy of runoff. The destruction of forest cover in favour of crops inevitably leads to greater vulnerability to soil erosion. Plant cover in the form of agricultural crops is insufficient to protect the region from water erosion.

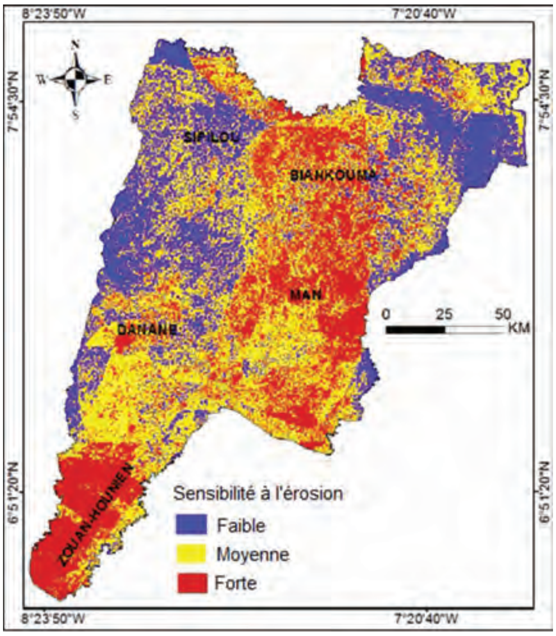
Fragile areas

Areas with moderate ESI values occupy about 35% of the region in the south of the departments of Danané and Man. These areas are fragile because, although characterized by soils with a clay content of more than 30%, which ensures strong soil cohesion and structural stability, they are steep (with gradients of 15–25%) and receive an average annual rainfall of 1200–1500 mm.

Potentially resistant areas

Areas with low ESI values cover about 22% of the region; they occur in zones extending along the western edge of the region, in the north of the departments of Danané and Sipilou, and in the northeast of Biankouma. These areas are not very vulnerable to erosion because of their low population density (0–40 inhabitants per km^2), low road density (<8 km per km^2) and sparsely populated settlements (8 settlements per km^2). Although some of these areas are

Figure 3: Map of the erosion sensitivity index in the Tonkpi region



steep, they generally have soils with clay content exceeding 30% and therefore strong structural stability. Vegetation cover comprises degraded patches of forest and wooded savannas, which, according to Roose (1977), provides more protection against erosion than denuded areas and areas planted with crops. Moreover, average annual rainfall is less than 1200 mm per year in these areas.

Rocky peril: ITTO Fellow Atté Cyrille Bi Tiesse points to an outcrop of boulders in the "Man in the Mountains" district of Côte d'Ivoire. *Photo: M. Digbi*

Recent donors to the ITTO Fellowship Programme have been the governments of Japan, the Netherlands and the USA. For more information see www.itto.int/fellowship

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Market trends

There was considerable fluctuation in China's log and sawnwood imports in 2020

by Zhu Guangqian,[1] with additional text and data from an ITTO Market Information Service correspondent

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New arrivals: Logs from Cameroon at a log yard in Shanghai. China's imports of tropical logs declined in 2020 and the first half of 2021. *Photo: L. Qiang/ITTO*

China's National Bureau of Statistics reported that the country's economy grew overall by 2.3% in 2020, despite contracting by almost 7% in the first quarter of 2020 as authorities shut down transportation, factories and shops to contain the spread of the COVID-19 virus. The positive annual growth was due to an especially strong export performance in the fourth quarter of the year.

Growth could have been even higher if it were not for the ongoing reluctance of Chinese consumers to spend. Job losses, lower incomes, greater savings and continued fears over COVID-19 accounted for much of the sluggishness in consumption. Retail sales contracted in China in 2020, and the savings rate of households jumped to 34% of disposable income, up from around 30% in 2019, due to rising precautionary saving. China's domestic home decoration, furniture, flooring and wooden door markets experienced a downturn in 2020 due to the pandemic. This, combined with disruptions in international wood product markets serviced by Chinese manufacturers, meant a decline in timber imports in 2020.

Domestic consumption accounted for 54% of China's gross domestic product (GDP) in 2020, down from 58% in 2019. Increasing the contribution of domestic consumption to GDP is a government aim, and policy changes to encourage consumer spending are anticipated.

China's imports of logs and sawnwood totalled 108 million m^3 (roundwood equivalent—RWE) in 2020, a drop of 5.2% from 2019. Import values reached USD 16 billion, a year-on-year decline of around 12%. Except for Europe and Asia, imports from all other regions declined or remained flat. There was an increase in imports of European timber due to the large amount of timber harvested from forests damaged by storms and insects. Timber imports from Asia increased in 2020, due mainly to growth in imports of Japanese cedar logs. Landed prices of imports were stable for most of 2020 but rose rapidly in the last few months of the year.

Coniferous log imports

China's imports of coniferous logs reached 46.9 million m^3 in 2020, an increase of 2.9%, year-on-year (Table 1). The average unit price was USD 117 per m^3, a 6.5% drop compared with 2019. Imports of coniferous logs dropped from all countries except Czechia, Germany and Japan (Japan not shown in Table 1).

Table 1: China's main sources of coniferous logs, 2019 and 2020

Country	Volume (1000 m^3)		% change, 2019–2020
	2019	2020	
New Zealand	17 640	16 150	–8.45
Russian Federation	5 800	4 430	–23.6
Australia	4 270	4 200	–1.74
Germany	3 800	9 980	162
USA	3 030	2 620	–13.5
Canada	2 360	1 200	–49.2
Czechia	2 290	3 380	47.4
Other European countries	2 050	1 800	–12.1
Others	4 310	3 110	–27.8
Total	**45 540**	**46 860**	**2.88**

Note: Totals may not tally due to rounding.
Source: China Customs.

For the last five years, the forest sector and wood -processing companies in central European countries have been struggling to contain damage to their forests caused by drought, storms and infestations of bark beetles. It is estimated that a standing volume of about 250 million m^3 has been damaged in Austria, Czechia and Germany.

Table 2: China's main sources of imported coniferous sawnwood, 2019 and 2020

Country	Volume (1000 m^3 RWE)		% change, 2019–2020
	2019	2020	
Russian Federation	1 702	1 479	–13.1
Canada	439.1	276.8	–37.0
Ukraine	83.92	103.5	23.3
Finland	124.0	96.98	–21.8
Germany	69.14	94.51	36.7
Sweden	72.77	91.46	25.7
Other European countries	47.65	77.67	63.0
Belarus	29.52	70.82	139.9
Chile	65.51	56.41	–13.9
USA	31.36	30.5	–2.7
Other countries	101.0	104.25	3.2
Total	**2 766**	**2 482**	**–10.3**

Note: Totals may not tally due to rounding.
Source: China Customs.

Table 3: China's main sources of hardwood logs, 2019 and 2020

Country	Volume (1000 m^3)		% change, 2019–2020
	2019	2020	
PNG	3 265	2 607	–20.2
Solomon Islands	2 296	2 009	–12.5
Russian Federation	1 752	1 912	9.1
US	666.9	722.9	8.4
Equatorial Guinea	660.9	245.1	–62.9
Congo	645.1	582.3	–9.7
Australia	544.5	366.9	–32.6
Cameroon	51.36	43.5	–15.3
France	414.4	386.1	–6.8
Germany	433.6	311.8	–28.1
Others	3 998	3 061	–23.4
Total	**15 190**	**12 640**	**–16.8**

Note: Totals may not tally due to rounding.
Source: China Customs.

European exports of coniferous logs to China increased significantly in 2020. The largest volume was from Germany, at nearly 10 million m^3, up by 162%, year-on-year, and accounting for over 60% of European coniferous logs imported into China. Wood supply patterns to China have changed with the increased use of the China–Europe Railway Express and the large volumes of coniferous logs available in Europe at competitive prices.

Chinese coniferous log imports from New Zealand, North America and the Russian Federation have been affected by the influx of European logs. Imports declined in 2020 by 49.2% from Canada, by 24% from the Russian Federation (partly affected by Russian policy), by 13.5% from the United States of America (US) and by 8.4% from New Zealand.

Imports of coniferous logs from New Zealand accounted for 35% of total Chinese imports in 2020, a drop of 4%, year-on-year. European imports exceeded those from New Zealand in the second half of the year. China's imports of radiata pine from Australia have been suspended since November 2020, and it is expected that volumes from this source will remain low in the medium term.

Coniferous sawnwood imports

China's imports of coniferous sawnwood dropped by more than 10% in 2020. Supplies dropped sharply from the Russian Federation (–13%) and Canada (–37%), the two main sources of this product in China (Table 2). Nevertheless, Russian coniferous sawnwood still accounted for 60% of China's imports, as it has done for the last six years. The proportion of imports from Canada declined in 2020 due to resource problems, increased demand in the North American market, increased shipping costs, the impact of low-priced European storm- and pest-damaged wood, and problems in sourcing from Canada.

Hardwood log imports

China imported 12.6 million m^3 of non-coniferous (hardwood) logs in 2020 at an average unit price of USD 232 per m^3, a year-on-year decline of 17% in volume and almost 10% in value. Tropical hardwood logs accounted for 68% of the total, at 8.58 million m^3, a year-on-year drop of 13.4%.

China imported 4.06 million m^3 of temperate hardwood logs in 2020, mainly from the Russian Federation, Europe, the US and Canada. Tropical hardwood logs came mainly came from Papua New Guinea (PNG) and the Solomon Islands (54% of the total, collectively) and Africa (25%) (Table 3).

Sawn hardwood imports

China's imports of hardwood sawnwood reached 9.04 million m^3 in 2020, at an average unit price of USD 364 per m^3, a year-on-year drop of 4.8% in volume and 5.9% in value (Table 4). The decline in imports was caused by a COVID-19-precipitated recession in the furniture industry in 2020. The volume of tropical sawn hardwood imports in 2020 amounted to 6.59 million m^3.

Rubberwood from Thailand amounted to nearly 3.6 million m^3 in 2020, which was almost 40% of total sawn hardwood imports. Gabon is also a major sawn hardwood exporter: its exports to China in 2020 totalled 571 000 m^3, a year-on-year increase of 4.4%; on the other hand, the unit price dropped by 12%. Gabon's sawn hardwood exports accounted for 61% of China's imports of this product from Africa, and the volume has been increasing in recent years. Generally, the price of imported sawn hardwood was stable in 2020.

Trends in first half of 2021

Substantial rise in log imports—but not tropical logs

According to China Customs, China's total log imports in the first half of 2021 amounted to 31.3 million m^3 (Table 5), valued at USD 5.26 billion (CIF), up by 29% in volume and by 48% in value, year-on-year. The price of imported logs averaged USD 167 (CIF) per m^3, up by 15% over the same period in 2020.

Softwood log imports surged by 41% (year-on-year) in the first half of 2021, to 24.8 million m^3, accounting for 78% of the national total. The average price of imported softwood logs was USD 142 (CIF) per m^3, up by 24% over the same period in 2020. There were big increases in log imports from New Zealand, Germany, Uruguay, Brazil and others but declines from Czechia, PNG and the Solomon Islands (Table 6).

Table 4: China's main sources of sawn hardwood imports, 2019 and 2020

Country	Volume (1000 m³ RWE)		% change, 2019–2020
	2019	2020	
Thailand	3 592	3 548	–1.2
US	1 318	1 338	1.5
Russian Federation	1 318	1 103	–16.3
Gabon	546.5	570.8	4.4
Philippines	378.6	321.6	–15.1
Romania	236.5	200.3	–15.3
Malaysia	206.8	144.5	–30.1
Indonesia	187.9	174.5	–7.1
Germany	165.9	136.9	–17.5
Viet Nam	129.4	108.9	–15.8
Others	1 416	1 389	–1.9
Total	**9 496**	**9 036**	**–4.8**

Table 5: China's log imports, January–June 2021

	Volume (million m³)	% change, year-on-year
Total	31.62	29
Softwood	24.81	41
All hardwood	6.81	–1
Tropical	3.77	–8

Source: China Customs

Table 6: Major log suppliers to China, January–June 2021

Country	Volume (million m³)	% change, year-on-year
New Zealand	10.02	58
Germany	6.43	95
Russian Federation	3.40	3
US	1.64	36
Uruguay	1.10	467
PNG	1.04	–26
Solomon Islands	0.96	6
Brazil	0.94	176
Canada	0.81	44
Czechia	0.73	–48

Data source: China Customs.

Table 7: Tropical hardwood log sources, January–June 2021

Country	Volume (1000 m³)	% change, year-on-year
PNG	1 037	–26
Solomon Islands	958	–6
Brazil	480	–41
Congo	248	2
Cameroon	208	0.50
Mozambique	199	–52
Equatorial Guinea	88	–55
Sierra Leone	78	–18
Democratic Republic of the Congo	76	–62
Suriname	69	–45

Data source: China Customs.

According to local experts, one reason for the increase in softwood log imports in the first half of 2021 was the availability of large quantities of storm- and insect-damaged European spruce from Germany. It has been estimated that about 500 million m^3 of such logs will be harvested by 2024, and much of this volume will be exported to China on the China–Europe Railway Express.

Slight decline in hardwood log imports

China's hardwood log imports fell by 1% in the first half of 2021, to 6.81 million m^3 (22% of total national log imports). The average price of imported hardwood logs in the first half of 2021 was USD 256 CIF per m^3, up by 14% over the same period of 2020.

Tropical log imports amounted to 3.77 million m^3 in the first half of 2021 (12% of China's total log imports in the period), down by 8% compared with the same period in 2020. The average price for imported tropical logs was USD 265 CIF per m^3, up by 14% over the same period in 2020. Thus, the total value of tropical log imports increased over the period by 4%, to USD 9.98 billion CIF, despite the decline in volume.

Before its log export ban, Myanmar was a major—albeit declining—source of tropical logs for China. This trend reversed in the first half of 2021, however, when China's log imports from Myanmar soared by 391% to 6410 m^3, at a value of USD 8.1 million. The average price for imported logs from Myanmar rose by 14%, year-on-year, to USD 1264 CIF per m^3.

Decline in tropical log imports in the first half of 2021

Just ten countries supplied 91% (3.44 million m^3) of China's tropical log demand in the first half of 2021, led by PNG (27%), the Solomon Islands (25%), Brazil (13%), the Congo (7%) and Cameroon (6%). China's tropical log imports from its top and second-top suppliers, PNG and Solomon Islands, fell by 26% (to 1.037 million) and 6% (to 958 000 m^3), respectively. It was this decline that drove down total tropical log imports in the first half of 2021. In the same period, China's tropical log imports from Equatorial Guinea and Suriname dropped by 55% (to 88 000 m^3) and 45% (to 69 000 m^3), respectively. China's tropical log imports from the Democratic Republic of the Congo, Mozambique, Brazil and Sierra Leone also declined over the period (Table 7).

New focus on the domestic economy

The Chinese government adopted its fourteenth Five Year Plan (2021–2025) in March 2021. This plan prioritizes what it calls the "internal cycle" by which it aims to strengthen the domestic economy. The goal is to reduce reliance on foreign technology and imported resources as quickly as possible and to focus on existing plans for industrial modernization and home-grown technological innovation.

The plan suggests that, while supporting employment is important, reforms are needed in the short run to raise ordinary people's incomes, boost domestic consumption and reduce dependence on exports. Given the currently low per-capita consumption of wood products, continued rapid economic development coupled with increased disposable income has the potential to substantially increase Chinese demand for wood products.

Translating this into an expanded market for tropical timber may require a focused effort, however. Commenting on opportunities for tropical timber in the Chinese market, Dr Luo Xinjian, Secretary General of the Global Green Supply Chain Promotion Committee, said, "US and EU [European Union] hardwood exporters have well-developed promotion strategies for the Chinese market but not tropical exporters. For a long time, tropical timber has had a bad image in China, which would have to be addressed before it was possible to expand the market share of tropical timber".

Tropical and topical

Compiled by Ken Sato

One-third of world's trees under threat

A report published in September by Botanic Gardens Conservation International estimates that 30% (17 500) of the world's 60 000 tree species are at risk of extinction. The *State of the World's Trees* is the culmination of five years of research to identify major gaps in tree conservation efforts and one of the first assessments of the world's threatened trees. According to the report, over 440 tree species around the world are on the brink of extinction, meaning that fewer than 50 individuals remain in the wild. The greatest threats facing trees are habitat loss from agriculture and grazing, overexploitation by logging and harvesting, and climate change.

Read more: www.bgci.org/news-events/bgci-launches-the-state-of-the-worlds-trees-report

Climate change threatens Indonesia's medicinal plants

A study by Ria Cahyaningsih and coauthors published in *Global Ecology and Conservation* this October used climate-change projections to 2050 and 2080 to model the impacts of climate change on the distribution of 139 native medicinal plant species in Indonesia. It found that, under two greenhouse-gas emissions scenarios—RCP4.5 (intermediate) and RCP8.5 (worst-case)—more than half the species' populations could lose up to 80% of their distribution area. The most affected species would be those in Java, Papua and Sulawesi. In addition, two-thirds of the species would lose rather than gain areas of suitable climate under future climate-change scenarios. Medicinal plants have immense value for Indonesian people, both for treating illnesses and as economic resources, and urgent, targeted conservation programmes are needed, say the authors.

Read the Mongabay *article at https://news.mongabay.com/2021/08/climate-change-threatens-to-squeeze-out-indonesias-medicinal-plants*

Read the paper at www.sciencedirect.com/science/article/pii/S2351989421003024?dgcid=raven_sd_aip_email#!

African mountain forests high in carbon

In an article published in *Nature* in August, Aida Cuni-Sanchez and about 100 coauthors estimated that structurally intact old-growth mountain forests in Africa contain much more carbon per unit area than previously thought—comparable with lowland African rainforests and considerably more than montane and lowland forests in the neotropics. Using data obtained from more than 72 000 trees in 226 montane forest plots in 12 countries, the authors used allometric models to estimate tree volume and therefore aboveground biomass and carbon. In an article published in *Science Daily*, Dr Cuni-Sanchez speculated on the reason why African mountain forests were so high in aboveground carbon. "It is possible that in Africa, the presence of large herbivores such as elephants plays an important role in mountain forest ecology as these large animals disperse seeds and nutrients and eat small trees, creating space for others to grow larger, but this requires further investigation," she is quoted as saying.

Read the paper in Nature *at www.nature.com/articles/d41586-021-02266-3*

Read the article in Science Daily *at www.sciencedaily.com/releases/2021/08/210825113706.htm*

Secondary forests warrant primary attention

In an essay published in the June edition of *Human Ecology*, Pain et al. debate the distinction between primary and secondary tropical forests, which conventionally is based on ecological criteria. They propose a conceptual model focusing on the disturbances that have altered the forest ecology, the forms of regeneration that follow, and the governance context within which this process takes place.

Read the essay at https://link.springer.com/article/10.1007/s10745-020-00203-y

Strengthening community forest rights the key to forest protection

In the same edition of *Human Ecology*, Liz Alden Wiley contends that although state-owned protected areas have made important contributions to forest survival, they have been insufficiently successful to justify the mass dispossession of customary land-owning communities they have often entailed. Dr Alden Wiley argues that rural communities on all continents have ably demonstrated the will and capacity to conserve forests when their customary ownership is legally recognized. She expects that, despite many roadblocks to greater community control, "Cost-efficiency, experienced decline in conflict around forest tenure, the empowerment and connectedness of rural communities, and sustained pressure for fair governance should persuade policy makers and legislators that a community-based route to forest protection is long overdue".

Read the paper at https://link.springer.com/article/10.1007/s10745-021-00231-2

ITTO releases latest biennial review of world timber situation

Tropical log production declined by 3% in 2020, due largely to the COVID-19 pandemic, and imports plummeted by 11%, according to ITTO's *Biennial Review and Assessment of the World Timber Situation 2019–2020*, which was released in August. The flagship report provides data on the production and trade of primary and secondary processed wood products in 73 countries worldwide. Overall, the impacts of the COVID-19 pandemic on tropical wood product production, consumption and trade varied in 2020, depending on the severity of the pandemic in individual countries and the steps taken to control and mitigate the spread of the virus.

Read the full report at www.itto.int/annual_review

G7 ministers pledge to work with ITTO on sustainable supply chains

In a joint communiqué issued on 21 May 2021, the G7 Ministers responsible for Climate and Environment committed to working with ITTO to increase support for sustainable supply chains that decouple agriculture from deforestation and forest degradation. The G7, or Group of Seven, is a high-level intergovernmental political forum consisting of Canada, France, Germany, Italy, Japan, the United Kingdom of Great Britain and Northern Ireland, and the United States of America. The Climate and Environment ministers of these countries, and the Climate and Environment commissioners of the European Union, issued the communiqué after meeting virtually.

Read more at www.itto.int/news/2021/07/27/g7_ministers_pledge_to_work_with_itto_on_sustainable_supply_chains

Read the G7 Climate and Environment Ministers' Communiqué at www.gov.uk/government/publications/g7-climate-and-environment-ministers-meeting-may-2021-communique/g7-climate-and-environment-ministers-communique-london-21-may-2021

Recent editions

Compiled by Ken Sato

Karsenty, A. 2021. *Fiscal and non-fiscal incentives for sustainable forest management*, with an annex containing country case studies published separately. ITTO Technical Series No. 48. ITTO, Yokohama, Japan.

ISBN: 978-4-86507-067-5

Available at www.itto.int/technical_report

The economic viability of sustainable tropical forestry is often marginal at best, with returns from sustainable timber production and other marketable goods and services comparing poorly to those of alternative land uses. This report, which includes case studies in Brazil, Cambodia, the Congo, Côte d'Ivoire, Myanmar, Peru, Thailand and Viet Nam, analyzes incentives and disincentives for sustainable forest management in the tropics with a view to assisting ITTO producer member countries to put effective incentives in place. It makes 22 recommendations for designing incentives that can make a difference in the adoption of sustainable practices in the tropical forest sector. The annex to the report, published separately, comprises eight comprehensive country case studies.

Held, C., Meier-Landsberg, E. & Alonso, V. 2021. *Tropical timber 2050*. ITTO Technical Series No. 49. Yokohama, Japan.

ISBN 978-4-86507-071-2

Available at www.itto.int/technical_report

This report describes a model developed to forecast trends in tropical timber supply and trade to 2050. It analyzes potential scenarios and examines previous economic and non-economic shocks to estimate the likely time required for the sector to recover to pre-pandemic levels. The report also considers longer-term factors. With global resource use set to more than double by 2050, it is essential to strive for carbon-neutral production based on renewable and sustainably produced materials such as wood. Sustainably produced tropical timber could take a leading role in this quest as a substitute for non-environmentally friendly materials; the report sets out five complementary strategies that could help drive sustainable growth in the sector.

ITTO 2021. *ITTO annual report 2020*. Yokohama, Japan.

ISBN 978-4-86507-077-4

Available at www.itto.int/annual_report

2020 was a challenging year worldwide. By working collaboratively, however, ITTO achieved a great deal, as reflected in the Organization's latest annual report.

J. Blaser, Frizzo, J. & Norgrove, L. 2021. *Not only timber*. ITTO Technical Series No. 50. ITTO, Yokohama, Japan.

ISBN: 978-4-86507-070-5

Available at www.itto.int/technical_report

Tropical forests contain much more value, commercially and for communities, than just timber. For centuries, forest-dependent peoples have known and used numerous edible nuts, fruits and other plant and animal products for food and medicine—what today we call non-timber forest products (NTFPs). This report, which was co-published by ITTO and the Precious Forests Foundation, explores multiple-use forest management approaches in which NTFPs help make the economic case for natural forests. It presents three examples of well-established NTFPs in humid tropical forests—Brazil nut, rattan and rubber. For each, it examines the factors and strategies that have enabled the sustainable harvesting of the NTFP, as well as the challenges in maintaining a sustainable NTFP management regime. The report also describes six promising NTFPs that grow in tropical forests—two each from tropical Africa, Southeast Asia and the Amazon—for which the potential is yet to be fully realized. And it uses a five-star system to rate the potential of 28 individual NTFPs to yield positive economic, social and environmental outcomes.

Maplesden, F. & Pearson, H. 2021. *Forest product conversion factors: tropical logs and sawnwood*. ITTO, Yokohama, Japan.

Available at www.itto.int/other_technical_reports

This report estimates conversion factors for a wide range of tropical timber species based on weight, using data on wood and bark density and wood moisture content. The derived factors can be used to convert the dry weight of a tropical timber consignment to volume, and vice versa.

World Bank 2021. *Designing fiscal instruments for sustainable forests*. Washington, DC.

Available at www.itto.int/other_technical_reports

This report identifies fiscal reforms that can positively influence forest conservation and management while freeing up resources for national development. ITTO supported the development of this publication, including by funding a workshop that brought together academics and practitioners across disciplines to present and discuss potential fiscal mechanisms.

Meetings

ITTO meetings

29 November–3 December 2021
57th Session of the International Tropical Timber Council and Sessions of the Associated Committees
Online
More: www.itto.int
The International Tropical Timber Council is ITTO's governing body. It meets once a year to discuss wide-ranging issues of interest to members, including those related to the trade of tropical timber and the sustainable management of tropical forests. Council sessions are open to official delegates and accredited observers. To access Council documents and registration, visit: www.itto.int/council_committees/documents

6–12 November 2022 (To be confirmed)
58th Session of the International Tropical Timber Council and Sessions of the Associated Committees
Yokohama, Japan
More: www.itto.int

ITTO Fellowship Programme now open for 2021 applications

The next round of applications for ITTO Fellowships is now open! The deadline is Thursday 21 October 2021 at 5pm (Japan Standard Time) for activities commencing after 1 January 2022.

Since its establishment in 1989, the ITTO Fellowship Programme has enabled more than 1400 young and midcareer professionals from 50 countries to strengthen their expertise in tropical forestry and improve their career prospects.

Read more and check your eligibility at www.itto.int/fellowship.

Apply for fellowships at www.itto.int/fellowship/register.

11–24 October 2021
15th Meeting of the Conference of the Parties to the Convention on Biological Diversity
Kunming, China
More: www.cbd.int/meetings/COP-15

26–28 October 2021
10th Asia Smart City Conference
Virtual
https://yport.city.yokohama.lg.jp/en/city-promotion/asia-smart-city-conference-ascc-2

1–12 November 2021
2021 UN Climate Change Conference
Glasgow, UK
More: https://ukcop26.org

5–7 November 2021
GLF Glasgow: Forest, Food, Finance—A New Deal for Earth
Online
More: https://events.globallandscapesforum.org/glasgow-2021

10–13 November 2021
AUSTIMBER 2020/2021
Victoria, Australia
More: www.austimber.org.au

18 November 2021
European Sustainable Tropical Timber Coalition and Fair&Precious Conference
Online
More: www.europeansttc.com/18-november-2021-conference-sustainably-managed-forests-as-part-of-the-solution-to-climate-change/#tab-id-1

23–25 November 2021
Sustainable Woodfuel Value Chains in Africa: Governance, Social, Economic and Ecological Dimensions
Online
More: www.cifor.org/event/sustainable-woodfuel-value-chains-in-africa-governance-social-economic-and-ecological-dimensions

9–12 December 2021
Think Wood, Think Global
Nasr City, Egypt
More: www.woodshowglobal.com/cairo

15–17 March 2022
Dubai Woodshow
Dubai, UAE
www.woodshowglobal.com/dubai

29 March–1 April 2022
International Materials Fair, Technology and Components for Furniture and Interior Projects—FIMMA Maderalia 2022
Valencia, Spain
More: https://fimma-maderalia.feriavalencia.com

25 April–8 May 2022
15th Meeting of the Conference of the Parties to the Convention on Biological Diversity
Kunming, China
More: www.cbd.int/meetings/COP-15

2–6 May 2022
XV World Forestry Congress
Seoul, Republic of Korea
More: www.wfc2021korea.org

9–13 May 2022
17th Session of the United Nations Forum on Forests
New York, USA
More: www.un.org/esa/forests/forum/index.html

May 2022 (second and third week, dates to be confirmed)
15th Meeting of the Conference of the Parties to the UN Convention to Combat Desertification
Côte d'Ivoire
More: www.unccd.int/news-events/unccd-cop15-message-parties-and-observers

June 2022 (dates pending)
Socio-ecological Conflicts in Forest Management: Risks of (not) Adapting?
Nancy, France
More: https://workshop.inrae.fr/iufro-risk-analysis-nancy

1–3 June 2022
Carrefour International du Bois
Nantes, France
More: www.timbershow.com

26 June–1 July 2022
Foliar, Shoot, Stem and Rust Diseases of Trees
Durham, USA
More: www.iufro.org/science/divisions/division-7/70000/70200 /70202

17–20 July 2022
5th World Congress on Agroforestry
Quebec, Canada
www.agroforestry2022.org

September 2022
(dates pending)
ForestSAT 2022
Krakow, Poland
http://forestsat2020.forestsat.com

7–18 November 2022
2022 UN Climate Change Conference
More: https://unfccc.int/calendar/events-list

14–25 November 2022
19th Meeting of the Conference of the Parties to the Convention on International Trade in Endangered Species of Wild Fauna and Flora
Panama City, Panama
More: https://cites.org/eng/meetings/cop

Note that all meetings are subject to change or cancellation in light of the COVID-19 pandemic. Please check the contact addresses for the latest information.

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

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