Wood *for* Good

SOLUTIONS FOR DEFORESTATION-FREE WOOD PRODUCTS

Union of Concerned Scientists
Citizens and Scientists for Environmental Solutions

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This report was produced by the Union of Concerned Scientists Tropical Forest & Climate Initiative. **Pipa Elias** is a consultant to the Tropical Forest & Climate Initiative. **Doug Boucher**, **Lael Goodman**, and **Calen May-Tobin** are Union of Concerned Scientists staff members working on the Tropical Forest & Climate Initiative. **Kranti Mulik** is an economist in the Union of Concerned Scientists Food and Environment Program. **Cara Cummings** is a consultant to the Union of Concerned Scientists.

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Executive Summary

Tropical forests should be filled with the sounds of howling monkeys and chirping birds. But all too often you hear the buzzing of chain saws and chugging of bulldozers instead. These lush forests are being cleared for agricultural expansion, which puts biodiversity, local communities, and the global climate at risk. This often occurs after logging trucks create in-roads to haul out wood for global markets. Unmanaged tropical wood extraction will continue to increase over the next decades unless businesses and governments begin enacting sustainable production requirements now.

Like other natural resources, tropical wood is often "mined" for products we use every day in the United States, such as furniture, paper, and kitchen cabinets. But while wood is a renewable resource, many logging activities in the tropics are done without regard to the forest ecosystem, and over time this truncates tropical forests' potential to regrow again and again.

There are many paths to sustainable wood production from the tropics—and right now, the greatest limitation is political will.

Governments and businesses must recognize that tropical forest conservation and wood production are not mutually exclusive. This report explores how sustainably managed tree plantations (areas where foresters grow trees specifically for wood products), wood certification programs, and government policies can help achieve these seemingly discordant goals.

Plantations are a good solution for growing wood used commercially as they can provide a higher yield than natural forests (i.e., forests that self-regenerate to regrow naturally). However, as this report details, plantations are only sustainable if they are established on previously disturbed lands, rather than replacing primary (virgin) forests. Producers and businesses should promote sustainable forestry approaches including the use of mixed native species in tropical plantations, and the management of secondary forests (forests from which trees have been harvested in the past) to rejuvenate their potential to provide high-quality wood for decades to come. Governments can make these sustainable approaches more attractive for businesses and local communities, and support their implementation, by improving land tenure systems and placing a value on ecosystem services (benefits provided to humankind by trees, such as air and water purification, food, protection against soil erosion, etc.).

Certification programs, most notably the Forest Stewardship Council and the Programme for the Endorsement of Forest Certification, promote sustainable wood production globally. While these certifications do not definitively prohibit logging from primary forests, they are the best option available for ensuring that wood production does not come at the expense of forest ecosystem function.

There are many paths to sustainable wood production from the tropics—and right now, the greatest limitation is political will. Governments need to change forest production policies, promote certification programs, generate markets for sustainably produced wood, and promote legal production systems. These efforts can ensure that everyone—from forest owners and producers to wood product retailers and consumers—has the opportunity to protect our world's forests for generations to come.

CHAPTER ONE

Introduction

Tropical forests are home to hundreds of thousands of plant, mammal, bird, and insect species. Forests purify air and water, and provide food and medicine for millions of people. But these forests are disappearing around the world, threatening the well-being of people who depend on them. And nearly all deforestation in the twenty-first century is occurring in the tropics, especially in Southeast Asia and Latin America. Approximately 40 million hectares (ha) of tropical forest areas were cleared between 2000 and 2005 (Hansen, Stehman, and Potapov 2010)—an area larger than Montana.

Beyond its damage to biodiversity, ecosystem services, and the livelihoods of many indigenous peoples who rely on the forests for their food and shelter, tropical forest loss is a major contributor to climate change. About 15 percent of annual anthropogenic (human-caused) carbon emissions come from tropical deforestation (Boucher et al. 2011). Further, while the two largest producers of global warming pollution, the United States and China, are mostly temperate and their emissions come mostly from the burning of fossil fuels, the third and fourth largest emitters, Indonesia and Brazil, are tropical; the majority of their emissions come from land use sectors, primarily due to deforestation and forest degradation.


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The durability, versatility, and beauty of wood make it ideal for many products in our everyday lives.

Approximately 40 million hectares of tropical forest areas were cleared between 2000 and 2005—an area larger than Montana.

While the chief driving forces of tropical forest loss are related to large-scale commercial agriculture (e.g., raising cattle, palm oil production), the cutting of forests for wood products has an important role too (Boucher et al. 2011). Some forests are clear-cut for their timber value and/or to prepare the land for agricultural use, while others are converted into plantations of fast-growing trees for pulp and paper. Many forests are selectively logged, in which only a few trees are removed; this can lead to degradation—a condition in which there is still some forest cover but many of the benefits of the forest (including carbon storage, biodiversity habitat, and species diversity) are reduced. This, in turn, can sometimes later cause complete forest loss. International trade in tropical wood products is also increasing, and tropical countries are expected to continue to expand their role in wood trade over the next decade.

Fortunately, trees can grow back, and forests can be managed as renewable resources. Both natural forests and plantations can be regenerated after wood is harvested from them, and if sustainably managed, can continue to be harvested indefinitely. This report looks at wood products from tropical forests such as timber and paper, and how all of those involved in the supply chain, from the logger who cuts the trees to the consumer who buys the table made from those trees, can help stop overall deforestation—that is to say, the loss of primary tropical forests due to the global demand for wood. The industry should aim for zero overall deforestation while supplying the need for wood products and contributing to the economic development of tropical countries.

WHAT DO WE MAKE FROM WOOD?

Although modern society has developed steel, plastic, polymers, and other industrial materials for our buildings, retail goods, packaging, and communications systems, wood is still a very important part of our lives. "Wood products" include not only solid wood used for constructing houses or making furniture but also a variety of processed products. The modern forest industry has found a variety of ways to cut up and use trees, such as veneer (thin slices produced by cutting around the log's circumference rather than sawing through it) and chips, and then put them back together into secondary processed wood products (SPWPs) like plywood and particleboard.

Another major use of wood is for "pulp and paper"—products like newsprint, books, tissue paper, printer paper, and cardboard. Though estimates vary, experts have calculated that as much as 42 percent of the worldwide timber harvested for industrial purposes is used to make paper products (Abramovitz 1999). North Americans consume large amounts of these paper products; in 2009, the average North American consumed more than 225 kilograms (500 pounds) of paper products—equivalent to approximately 100 reams of letter-sized copy paper, and more than five times the global average consumption (Environmental Paper Network 2011). While much of the pulp used to make paper products comes from managed forests outside of the tropics, wood from tropical forests does make its way into paper products and Brazil and Indonesia are the sixth and eighth top producers, respectively, of wood pulp for paper (Bowyer, Shmulsky, and Haygreen 2007). One analysis of children's books in Germany found that 19 out of 51 books had significant traces of tropical wood species not generally found on plantations (Hirschberger et al. 2010).

Fibers from protected tropical trees have been found in children's books.

Different kinds of trees can produce different products. Hardwoods—broad-leaved flowering trees—are structurally complex, giving them unique and distinct appearances. Thus they are more commonly used for furniture, panels, and other decorative items that show off the wood grain (Bowyer, Shmulsky, and Haygreen 2007). Since most tropical trees are hardwoods, historically most of the tropical timber trade was in luxury hardwoods such as mahogany and teak for high-value furniture. Softwoods, most of which are needle-leaved conifers like pines and firs, have wood that is relatively homogeneous; they are composed of just a few cell types and have long fibers. This makes them ideal for construction materials, such as lumber and plywood, and for many kinds of paper. Historically there has been little export of softwood products from the tropics, though the recent increase in plantations is changing this trend (ITTO 2009).

There are many biological characteristics that affect how the wood can be used, such as density, growth uniformity, fiber length, and strength. Some of these characteristics depend on the species, while others depend more on the climate and where the individual tree grew (Bowyer, Shmulsky, and Haygreen 2007). For many uses, however, hardwood species can substitute for each other, and similarly for softwoods. For example, besides aesthetics there is little structural difference between a kitchen cabinet made from maple from the United States or teak from Southeast Asia. Table 1 (p. 4) describes some of the major wood products on the market and the types of trees and forests from which they typically originate.

Although wood products play a major role in our everyday lives, some of them, like shipping pallets, generally escape notice. With globalization comes an increase in the movement of goods around the world, and for the sake of efficiency, these loads are moved almost exclusively on pallets, which are frameworks of flat wooden boards that can carry heavy loads and easily be lifted and moved by forklift. In the United States alone there are nearly 2 billion pallets in daily use, with more than 700 million new pallets produced every year, and that number is on the rise (Mazeika Bilbao 2011). In 2006 the amount of wood used to make new pallets for the United States required between 14 million and 17 million trees.[1]

1 Calculated assuming a 33.3 cubic foot (ft^3) loblolly pine or a 41.6 ft^3 red maple.

Table 1. COMMON WOOD PRODUCTS AND THEIR SOURCES

BASE PRODUCT	EXAMPLES OF TREE SPECIES		FOREST ORIGINS		END PRODUCTS
	Temperate	Tropical	Temperate	Tropical	
Hardwood lumber	Black cherry Oak	Mahogany Teak	Eastern and southeastern United States	Almost all tropical regions	Furniture, flooring, millwork, cabinets, pallets
Softwood lumber	Southern pines Douglas fir Hemlock	Tropical pines Radiata pine	Eastern, southeastern, and western United States	Uncommon, but in some high-elevation or otherwise cooler regions	Building construction (house framing, interior wall paneling, exterior siding), decking, exterior trim, windows, doors
Pulp and paper	Southern pines (softwood) Birch (hardwood)	Radiata pine (softwood) *Acacia mangium* (hardwood) Eucalyptus (in this case used as a hardwood)	Southern and western United States	Tropical lowlands	Paper, cardboard, tissue
BASE PRODUCT	**EXAMPLES OF SPECIES (MOSTLY MIXED AND USUALLY FROM TEMPERATE FORESTS)**				**END PRODUCTS**
Structural panels	Mixes of both softwoods and hardwoods; usually uses lower-value species				Construction (plywood siding, forms for pouring concrete)
Nonstructural panels	With the exception of the decorative veneer on these panels (which uses hardwoods), most can be made from "waste" during the processing of wood into other products				Paneling, furniture (cabinet shelves, backing), decor, minor uses in construction
Composite lumber products[2]	Mostly softwoods, but a few hardwoods like gum and yellow poplar				Construction (house framing, bridge framing/support), engineered beams

2 Lumber made from chipped wood bound and strengthened with resins or other substances

More than 30 percent of the total hardwood produced in the United States is used to build pallets and wood containers, which makes the pallet industry the largest single user of hardwoods in the country (Buehlmann, Bumgardner, and Fluharty 2009). Pallets, however, have a relatively short life span; the entire stock is replenished every four years. Even though technologies exist for recycling and reuse (while being careful that reusing pallets can spread non-native insects), pallets still make up 2 to 3 percent of all waste in U.S. landfills (Buehlmann, Bumgardner, and Fluharty 2009). Currently, only about 8 percent of U.S. pallet materials are imported from other countries (Argentina, Brazil, Chile, and Uruguay), but as pallet production grows, it is likely that manufacturers will turn to other countries where wood is readily available and less expensive (Sanchez 2011).

Other forest products include fuelwood (including charcoal) and non-wood products such as fruits and medicinal plants (Onyekwelu, Stimm, and Evans 2010). These will not be a focus of this report since they are not major drivers of deforestation (Boucher et al. 2011).

NATURAL FORESTS IN DIFFERENT REGIONS OF THE TROPICS

The three main tropical forest regions—Amazonia (in South America), the Congo Basin (in central Africa), and Southeast Asia—vary quite a bit in their forest industries, based on important biological differences among their forests. While nearly all tropical forests have a very high diversity of tree species, Southeast Asia is distinctive in that many of its forests are dominated by a single family of trees, the Dipterocarpaceae. These "dipterocarp forests" (pronounced dip-teh-roh-karp) are unusual in that almost all the trees are excellent for timber: they are tall, fast-growing, with few lower branches, and with wood that is strong but not overly heavy. Dipterocarp dominance of Southeast Asian forests means that often half or more of the timber in these forests is commercially valuable. This is in strong contrast to Amazonian and Congo Basin forests, where generally only a few species—well under 10 percent of the volume of wood—can be sold on the timber market (Corlett and Primack 2011).

Dipterocarp dominance of Southeast Asian forests means that often half or more of the timber in these forests is commercially valuable. As a consequence, logging in Southeast Asian forests can be highly profitable.

As a consequence, logging in Southeast Asian forests can be highly profitable. Economic estimates indicate that the net timber value of dipterocarp forests, though quite variable, averages many thousands of dollars per hectare, versus hundreds of dollars or less in Amazonia and the Congo Basin (Edwards et al. 2011; Fisher et al. 2011; Ruslandi and Putz 2011). And this is just the value of the timber; it does not include profits from the land cleared by the logging.

Southeast Asia is not only the most profitable region for tropical logging, but also the dominant region for production. As Table 2 shows, although Indonesia and Malaysia have relatively little forest, they have the world's highest annual log production, generating more logs than Brazil (which has the largest forest area in the world) and dwarfing the output of the Democratic Republic of Congo. Indonesia is also quickly cutting its tropical forests to replace them with oil palm plantations.

The three main tropical forest regions also differ in what happens to forests after they are logged. In both the Amazon and Congo Basin, where forests tend to be selectively logged, it is possible for them to grow back if left alone. This seems to happen often in the Congo Basin because there is relatively little pressure for conversion of the land to use for commercial crop production and pasture (Fisher 2010; Houghton and Hackler 2006). In the Amazon, on the other hand, selectively logged forests are often completely cleared after logging (sometimes immediately, sometimes with a lag of several years) and turned into cattle pastures or soybean fields (Boucher et al. 2012). In the Brazilian Amazon, for example, selectively logged forests are four times more likely to be cleared than those that have not been logged at all (Asner et al. 2009a), and more than three-fourths of the land that has been cleared is used for cattle pasture (May and Millikan 2010; Bustamante, Nobre, and Smeraldi 2009).

Table 2. FOREST AREA AND ANNUAL LOG PRODUCTION OF THE LEADING TROPICAL FOREST NATIONS

Southeast Asia dominates tropical wood production even though it has much less forest than Amazonia or central Africa.
Source: Corlett 2009.

	FOREST AREA (1,000 SQUARE KILOMETERS)	ANNUAL LOG PRODUCTION (MILLION CUBIC METERS)
Malaysia	209	27.0
Indonesia	885	26.0
Brazil	4,777	22.9
Democratic Republic of Congo	1,336	0.1

In Southeast Asia, the pressure for complete conversion to non-forest is even greater, since a larger proportion of the timber has already been removed and because the alternative uses are very profitable. One of the leading alternatives in recent years has been oil palm plantations, which have expanded rapidly (May-Tobin et al. 2012; Boucher et al. 2011); recent analysis has shown that, like logging, palm oil production is a very lucrative business in Malaysia (Fisher et al. 2011; see also Edwards et al. 2011; Ruslandi and Putz 2011). When a company (or subsidiary companies of the same conglomerate) can capture the value of both the timber and the subsequent land use for palm oil production, there is a very strong incentive to clear forests. Pulp and paper plantations have also expanded rapidly in Southeast Asia (Koh et al. 2011). Though these plantations can be useful for meeting the global demand for these wood products, careful planning is needed to ensure the most diverse, carbon-rich, and ecologically important forests are not being replaced with plantations (see Chapter 4).

CHAPTER TWO

Wood Production and Its Impacts on Tropical Forests

Increased global demand for wood products like timber and paper is causing changes to tropical forests in a few ways: some forests are clear-cut solely for their wood, some are replaced with fast-growing plantations, and some are selectively logged. When unmanaged or unplanned, each of these situations can lead to negative outcomes—either degradation of the forestland or, worse, total loss of the diverse forest ecosystem.

DEFORESTATION CAUSES CARBON EMISSIONS

Trees absorb and store carbon as they grow, and clearing forests causes the carbon to be released back to the atmosphere. As noted earlier, tropical deforestation is responsible for about 15 percent of global warming pollution worldwide. Agricultural uses such as pastures and crops clear the whole area of forest, generating most of these emissions. Selective logging in the tropics is also a source of emissions—between 2000 and 2005 more than 20 percent of the area was selectively logged (Asner et al. 2009b). However, not all of the forest biomass is removed from selectively logged forests so the emissions of global warming pollution are lower than in areas where all the trees are removed (Putz et al. 2012).

A recent study comparing sources of deforestation-related emissions since 1850 shows that, globally, the total net emissions from wood production have been relatively small compared with those from agriculture (croplands, including shifting cultivation, and pastures) (Houghton 2012): about 17 billion tons of carbon compared with 124 billion tons. This was the case even though an estimated 1.5 billion ha of forestland had been harvested for wood (sometimes repeatedly), compared with 2.4 billion ha cleared for agriculture.

LOGGED FORESTS CAN BE LOST FORESTS

There are several ways the demand for wood can permanently change tropical forests. First, there is clearing for conversion to pulp and paper plantations. This is when forests are cleared not so much for the value of the timber (though a few valuable trees may be picked out and used) but for the value of the land,


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Large-scale oil palm production and other forms of agriculture are the major cause of deforestation in the tropics.

so that high-value timber or pulp plantations can be planted. Although this conversion does replace the old trees with new trees, it leads to a loss in carbon and biodiversity, since plantations rarely accumulate as much biomass or provide the same habitat as the natural forest they replaced (Liao et al. 2010).

Selective logging can also indirectly lead to forest clearing. While the actual number of valuable trees removed is usually quite small (except in dipterocarp forests in Southeast Asia, as explained previously), many more trees can be killed in the process through damage, accidental felling, or clearing for roads (Elias 2012; Gerwing 2002). Furthermore, the roads built for this selective logging then allow others users or industries to come in and completely clear the remaining trees. In Africa it has been shown that selective logging can open the forest for further harvesting for charcoal production (Ahrends et al. 2010) and other unmanaged activities (Boucher et al. 2011); in Southeast Asia selectively logged forests are often replaced by oil palm plantations.

Complete conversion to agriculture is especially damaging because it leads to long-term land use change (Foley et al. 2007). A degraded, or even completely cleared, forest can naturally regenerate if left alone. One study of selectively logged forests in Indonesia found that logged forests can regain a comparable number of trees to primary forests in 5 to 15 years, and comparable species numbers in 10 to 20 years (Slik, Verburg, and Keßler 2002). Though this process can be slow and is not guaranteed, it is an opportunity for the forest to regain some of the carbon and biodiversity that was lost (Rice, Gullison, and Reid 1997).

Selective logging increases fragmentation and the edge area of a forest, drying it out and making it more susceptible to fire. Tropical forests are often not adapted to fires, so this burning can lead to destruction of the entire forest.

Even without total deforestation occurring, logging can degrade forests and cause significant emissions and a loss of biodiversity. A review of 19 studies of carbon loss after tropical logging found that, on average, tropical forests lost 26 percent of the carbon they had before (Putz et al. 2012). Furthermore, after a certain point, degradation can start to change the structure and functioning of the forest in significant ways. For instance, selective logging increases fragmentation and the edge area of a forest, drying it out and making it more susceptible to fire (Broadbent et al. 2008). Tropical forests are often not adapted to fires, so this burning can lead to destruction of the entire forest.

The removal of even just a few trees can lead to complete deforestation by creating roads into the forest and increasing the likelihood of devastating forest fires.

ILLEGAL LOGGING

A further problem with tropical logging is that it is often done illegally (Lawson and Macfaul 2010). These illegal activities include removing trees from protected areas, failing to pay taxes and fees for timber, cutting protected species, stealing wood from the rightful owners, and/or removing more timber than allowed from a given area. Some industries also falsely use timber harvesting permits to clear land for agricultural crops (Lawson and Macfaul 2010; Contreras-Hermosilla, Doornbosch, and Lodge 2007). In the tropics, illegal logging can cause forest damage and ecosystem impoverishment, loss of biodiversity and carbon, changes in soil nutrients, and increased susceptibility to clearing (Elias 2012).

Illegal logging also undercuts economic development in the forestry sector. Very little of the profit from these activities remains in the local community. In one example, experts estimated that only 2.2 percent of the total product value was held locally by those who illegally logged the forest; the rest went to

In the tropics, illegal logging can cause forest damage and ecosystem impoverishment, loss of biodiversity and carbon, changes in soil nutrients, and increased susceptibility to clearing

middlemen such as brokers, buyers, manufacturers, and exporters (Kishor and Damania 2007). These communities are also threatened by the black market created by these illicit activities, which erodes social norms and can lead to violence (Chimeli and Soares 2011). Finally, illegal logging depresses world timber prices by 16 percent (Snow 2009), threatening the economic viability of legitimate forest producers worldwide by creating unfair competition.

For all these reasons, illegal activity makes logging less sustainable. Illegal harvesting is likely to lead to forest degradation, increasing the probability that sooner or later the area will be completely deforested (Elias 2012). Recent evidence indicates that efforts by developing- and developed-country governments to curb illegal logging, such as the United States' Lacey Act, have slightly reduced the rates of illegal logging in the tropics (Elias 2012; Lawson and Macfaul 2010). A strong, continued effort is needed to end illegal logging and move toward sustainable management.

THE ROLE OF TROPICAL WOOD IN A GLOBAL MARKET

The wood products market has become global, but the tropics are still a relatively small part of it. As Table 3 shows, tropical forests accounted for about 8 to 20 percent of global production in the major wood product sectors in 2009. International trade and market globalization is steadily increasing the ease with which tropical wood enters northern markets, and cheap processing in growing economies are making these products even more accessible.

However, the market is changing, and tropical countries are becoming increasingly important as both producers and processors of wood. Recent trends show that the countries losing their forests at the fastest rate (mainly tropical countries) are also quickly becoming more significant exporters in the global wood market (Kastner, Erb, and Nonhebel 2011).

Consumption and Trade

Global wood consumption over the past couple of decades has increased (FAO 2006), albeit minimally. In 2005 consumption of "industrial" wood (i.e., wood processed into other forms versus unprocessed firewood) was about 1.55 Bm^3 (Figure 1), one-third of which was pulp and paper and two-thirds of which was sawlogs (i.e., logs to be sawn in the mill) and veneer. Despite the increasing use of electronics in society, which could replace paper use, it is still the pulp and paper sector that has grown the most over recent years—pulpwood log consumption increased almost three times more rapidly than sawlog and veneer log consumption (1.7 percent per year versus 0.6 percent per year) (FAO 2007a).

As with consumption, globalization and economic growth have led to increases in the international trade of wood and

Table 3. ANNUAL PRODUCTION OF THE MOST COMMON WOOD PRODUCTS, 2009

Tropical wood's share of the global market is expected to increase over the next decade. Wood is measured in cubic meters. A cubic meter is about 35 cubic feet-a volume that would make a very comfortable doghouse for a large dog like a Saint Bernard. Paper products, on the other hand, are measured by weight (FAO 2012). Note: FAO data are self-reported by countries, and therefore subject to error and non-compatibility.

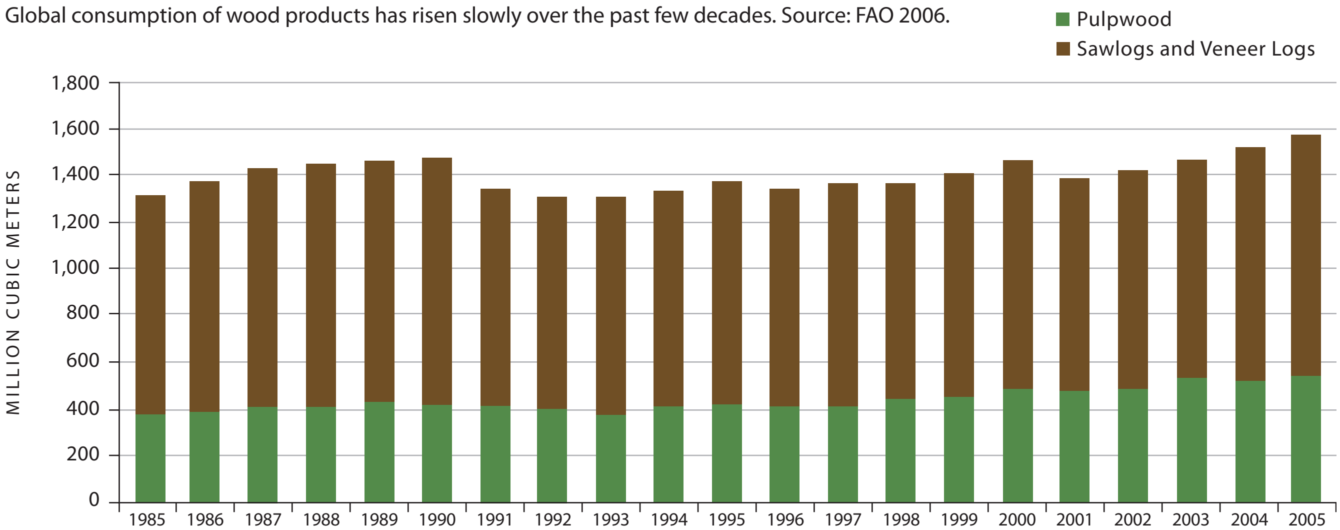
PRODUCT	GLOBAL PRODUCTION	TROPICAL PRODUCTION[3]
Newsprint	32.6 Mmt	2.6 Mmt
Printing and writing paper	105 Mmt	15.3 Mmt
Plywood	80.3 Mm^3	13.3 Mm^3
Sawn wood (wood cut into boards, lumber, planks, etc.)	362 Bm^3	72.8 Mm^3

Mmt: million metric tons Mm^3: million cubic meters Bm^3: billion cubic meters

3 Tropical production values compiled from available data for those countries included as tropical production countries in ITTO 2009.

Figure 1. TOTAL GLOBAL "INDUSTRIAL" WOOD CONSUMPTION, 1985–2005

Global consumption of wood products has risen slowly over the past few decades. Source: FAO 2006.



wood products, though trade rates have grown much faster than consumption rates. From 1985 to 2005 international trade of forest products (including pulp and paper, wood products, and SPWPs) increased from $60 billion to $257 billion with an average annual growth rate of 6.6 percent, and wood products and SPWPs registering the fastest growth (Figure 2, p. 10). By 2020, the global trade in wood and wood products is expected to reach around $450 billion (U.S.), with 40 percent of it being in SPWPs (FAO 2007a).

Traditionally, European and North American countries have dominated both the production and trade of wood and wood products, but this is changing. Since 1990, China has increased its share in the global wood market from 1.5 to 7.2 percent, predominantly due to exports of SPWPs. China is expected to continue its expansion of market share, as is Brazil and Russia, and they will be key players in the global trade market by 2020. Changes are also happening in production. Globally more than 50 percent of industrial wood products come from 7 percent of the world's forests, but very few of these are in the tropics (FAO 2010a). Despite the increase in timber and pulp production in tropical regions, predominantly in Asia and Latin America, tropical countries still account for only a small share of world exports. However, increasing demand in emerging countries such as Brazil,

From 1985 to 2005 international trade of forest products increased from $60 billion to $257 billion; by 2020, it is expected to reach around $450 billion.

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A processing facility turns pulp and wood chips into paper.

China, and India is expected to drive further growth in international trade (Whiteman 2005), and could lead to increased production in developing countries also.

Processing

Already, developing countries are important in processing wood to produce SPWPs, such as particleboard used in furniture. Of the 15 major exporters of furniture, six are now tropical developing countries: Brazil, China, Indonesia, Malaysia, Mexico, and Thailand (Kaplinsky et al. 2003). China has overtaken Italy's position as the largest exporter of furniture. Australia, Canada, Europe, Japan, New Zealand, and the United States are the largest importers of furniture, so there is now a considerable flow of wood from tropical forests to developing-country processing facilities and then on to developed-country consumers. Furthermore, developing countries have increased their own demand for wood products (Figure 3).

Pulp and paper products are the part of the market that has seen the largest increase in demand over the past decade. In Asia demand is fast outpacing supply, but despite increases in production, the region is still a net importer (Aulisi, Sauer, and Wellington 2008).

© Flickr/Chi King

Tropical forests provide habitat for many mammals, birds, and insects.

Figure 2. TOTAL ANNUAL VALUE OF INTERNATIONAL WOOD PRODUCT TRADE, 1985–2005

International trade in forest products has increased over the past couple of decades. The quickest growth has occurred in wood products and SPWPs. Source: FAO 2006.

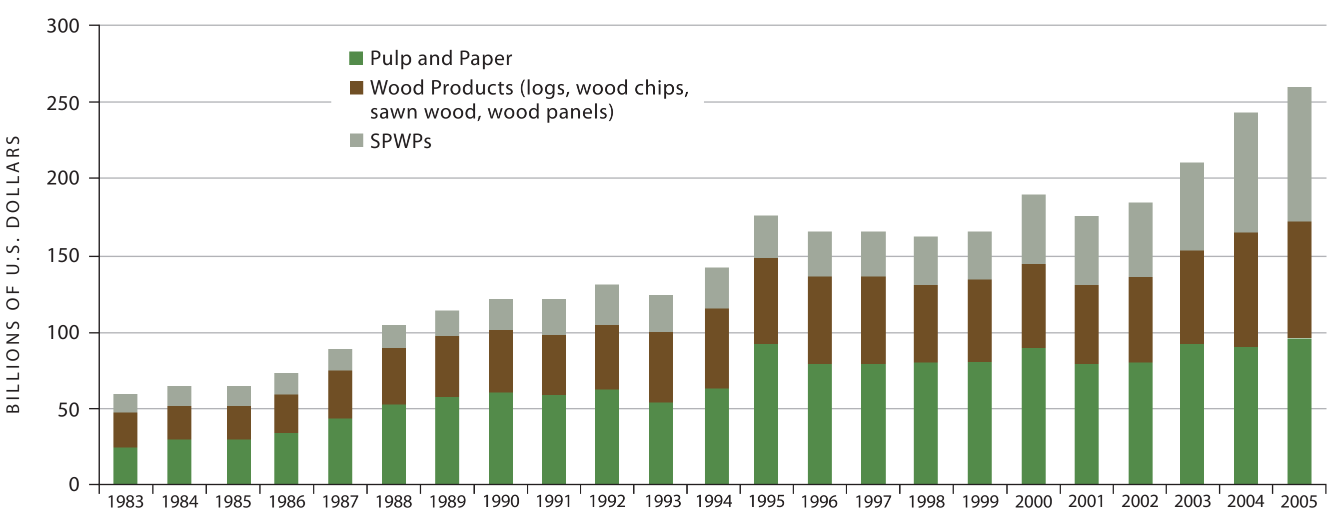
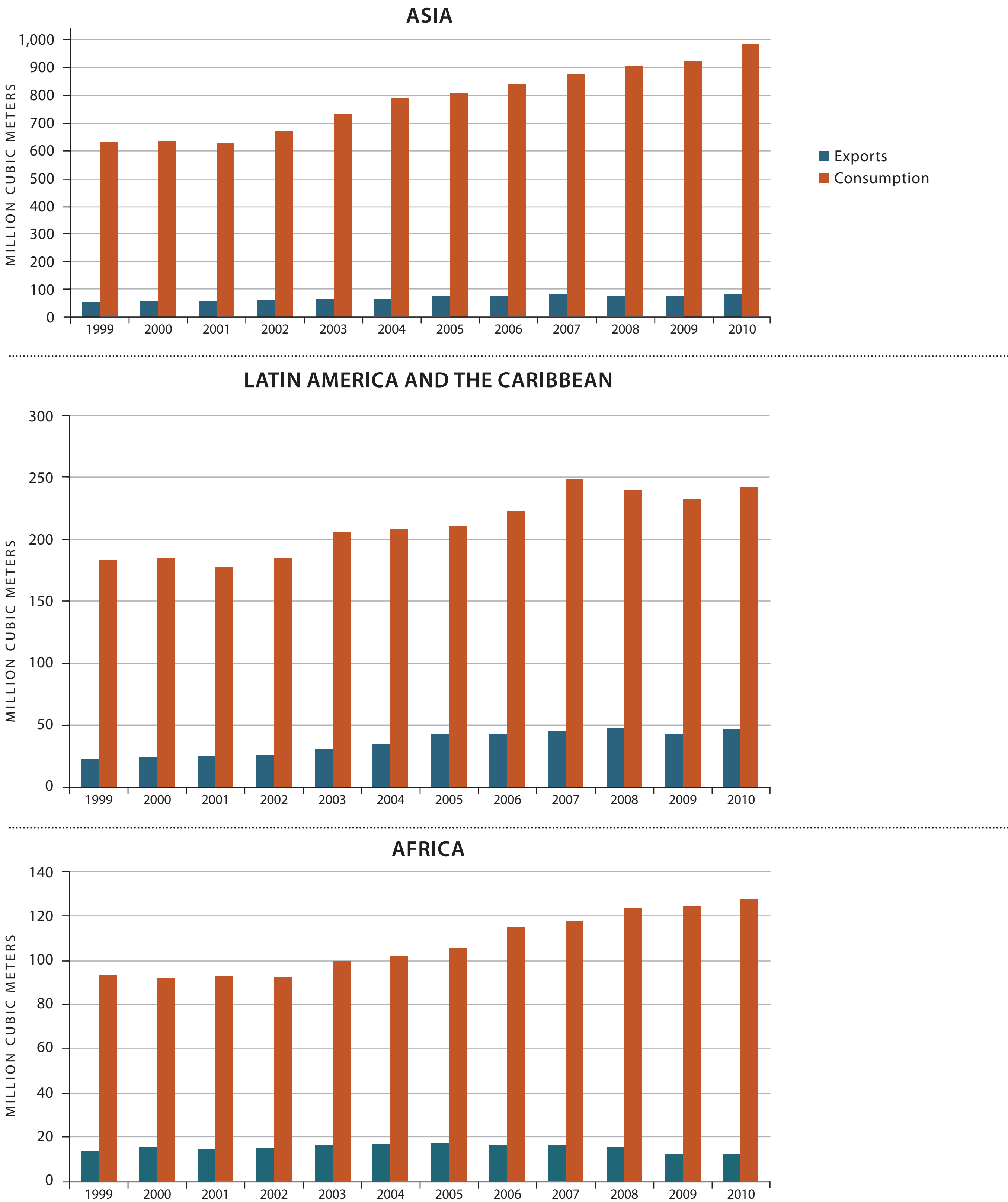


Figure 3. **CONSUMPTION AND EXPORT GROWTH BY REGION, 1999–2010**

Since 1999 consumption has grown in tropical regions. Exports have increased from Asia and Latin America and the Caribbean. Note the difference in scale between Asia and the other regions. Source: FAO 2012.



CHAPTER THREE

Where Should We Harvest Our Wood?

The forests that occupy about 30 percent of the total land area worldwide include both natural forests and plantations (FAO 2007a). Natural forests differ from plantation forests in terms of their structure and purpose. Natural forests are home to a diverse range of species and can produce a wide range of timber and non-timber forest products. Plantation forests, also known as planted forests, are cultivated systems established by manual planting and/or seeding, with the primary purpose of wood production.[4] Plantations tend to be lower in biodiversity than natural forests in the same regions, but their much higher growth rates allow them to yield large amounts of wood products over many harvests from small areas compared with natural forests. This comparison is particularly stark when compared with primary natural forests, in which subsequent harvests yield little more than half as much wood as the first (Putz et al. 2012). Given the loss of biodiversity and carbon and the danger of complete deforestation when natural forests are harvested in the tropics, it is not necessarily less environmentally damaging to produce wood products by harvesting natural forests rather than by establishing plantations on cleared areas (e.g., degraded pastures). The pros and cons of these two alternatives have given rise to sharp debates among scientists in recent years (Putz et al. 2012; Shearman, Bryan, and Laurance 2012).

While plantations account for only 5 percent of global forest cover, they are becoming increasingly prominent as countries aim to develop new sources of sustainable wood production to meet growing market demand. This trend is particularly evident in Asia, which is home to 62 percent of the world's plantations (FAO 2007a) (Figure 4).

Not surprisingly, the increase in forest plantations in the tropics has led to an increase in market share for plantation-

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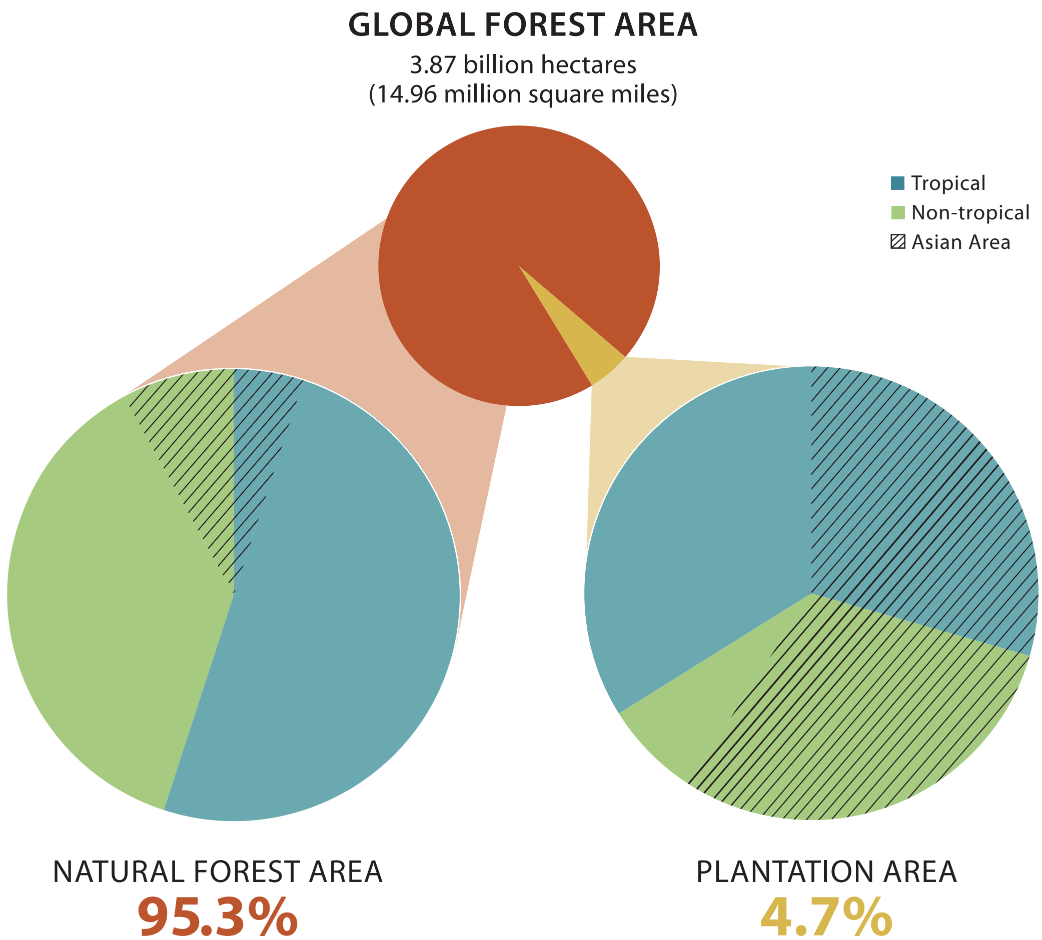
Plantations are becoming increasingly prominent as solutions to meet the growing market demand for wood products.

Plantations tend to be lower in biodiversity than natural forests in the same regions, but their much higher growth rates allow them to yield large amounts of wood products over many harvests from small areas compared with natural forests.

4 Some forests are also planted for the purpose of soil or water conservation, wind breaks, or other environmental services. Those forests are not assessed in this report.

Figure 4. **NATURAL FORESTS AND PLANTATIONS AS A PERCENT OF WORLD'S LAND AREA, BY REGION**

More than 60 percent of the world's plantations are in non-tropical regions, and Asia, in particular, has established a greater portion of plantations compared with other regions. Tropical regions are also those with the most rapid forest loss, and plantations are expected to expand greatly in the tropics in the future. Thus, it is important that any expansion of plantations in tropical regions does not replace natural forests. Data sources: FAO 2003; ITTO 2006a.

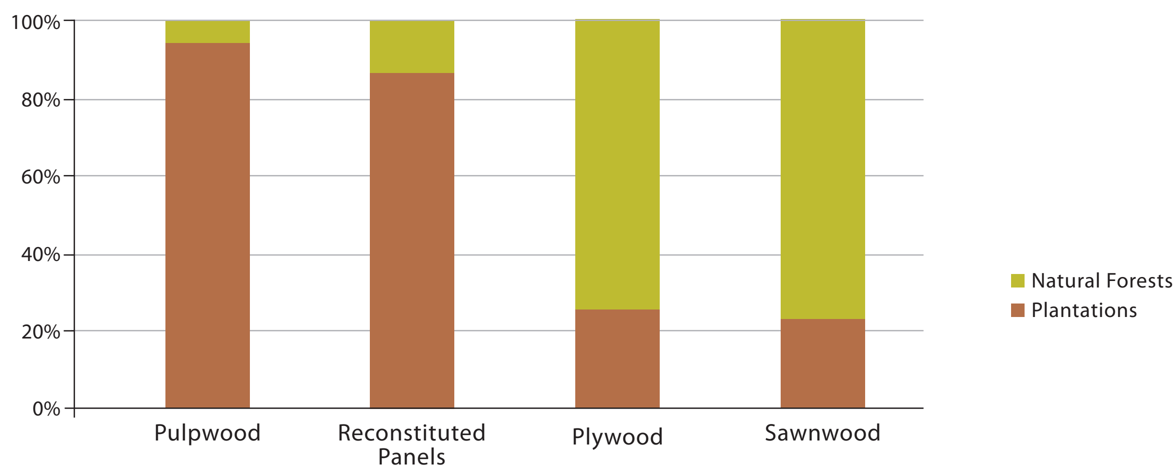


based wood products. Figure 5 (p. 14) shows that the majority of wood pulp production (over 95 percent) and reconstituted wood panel production (over 85 percent) in the tropics (Asia Pacific, Africa, Latin America, and the Caribbean) is from plantation timber. The share of plywood and sawn wood coming from tropical plantations is under 30 percent, but is growing. In the Latin American and Caribbean regions, almost all of the pulpwood and reconstituted panel wood are derived from plantations, with the majority of the pulp coming from eucalyptus (FAO 2007a). Currently 50 percent of all short-fiber pulp traded in the global market is from eucalyptus, and this is projected to reach 60 percent in the future (BRACELPA 2007).

If these trends continue, the annual potential production capacity of plantations will reach around 1.8 Bm^3 per year by 2020, with more than 80 percent of this situated in the tropics and other countries in the Southern Hemisphere. This volume would be adequate to meet most of the industry's global wood demand in that year (FAO 2007a).

Figure 5. **PLANTATIONS' CONTRIBUTION TO THE MARKET FOR COMMON TROPICAL WOOD PRODUCTS IN 2006**

Plantations in the tropics already provide most of the wood that goes into paper and panels, and are expected to meet a greater proportion of market demand for other wood products in the years ahead. Source: ITTO 2006b.



ADVANTAGES OF FOREST PLANTATIONS

Forest plantations are poor in biodiversity and carbon, but for wood production they offer a number of advantages. By concentrating productivity on a few fast-growing, commercially valuable species and using the latest technology and genetic varieties, forest plantations can result in much larger yields than natural forests. In the tropics plantations can produce 3 to 10 times more commercially usable wood than natural forests (Onyekwelu, Stimm, and Evans 2010). When plantation trees are young, they grow most quickly; some species in the tropics can grow from 2.5 to 6 meters in height per year. Plantation-based wood products tend to get better prices, since the trees are grown to be the ideal shape and size for processing. This uniformity also increases processing and manufacturing efficiency. In contrast, the production of wood from natural forests, even if environmentally sustainable, may not be economically viable (Shearman, Bryan, and Laurance 2012; FAO 2007b; Bowyer 2006; Nair 2001).

It is often said that there is no "good" source for wood—the choice is either establishing "industrial" plantations or cutting down trees in natural forests. But industrial plantations (see Table 4 on p.16 for examples) need not have a negative connotation.

It is often said that there is no "good" source for wood—the choice is either establishing "industrial" plantations or cutting down trees in natural forests. But industrial plantations need not have a negative connotation.

For example, "industrial" could simply refer to the end use of the wood produced (i.e., wood products rather than fuel). By this definition, industrial plantations represent 48 percent of global plantation area. Non-industrial plantations established for fuelwood, soil and water conservation, and wind protection, account for 26 percent; the remaining 26 percent are established for other or unspecified purposes (FAO 2001).

"Industrial" could also refer to the use of industrial machinery—chain saws, bulldozers, trucks, etc.—to cut and haul away the trees. The most common reason industrial plantations are viewed as negative is when the term is used as a description of the spatial and temporal pattern of plantations, with rows of trees uniformly spaced apart and short harvest rotation lengths (i.e., with only a few decades between planting and harvest/replanting).

Exotic Species

Exotic species are those that grow in an environment different from their natural habitat. According to the U.S. Environmental Protection Agency, the term exotic refers to species "that are not only able to survive but also able to reproduce outside their habitats where they evolved or spread naturally" (EPA 2012). Exotic trees are generally planted because they are fast-growing, including species of *Eucalyptus, Acacia,* and some pines, so their growth rates are often much higher than those of the native species of the region. For example, exotics can sometimes produce 5 to 10 times more wood than native species in parts of the tropics (Espinoza and Gonzalez Ronalds 2007). The planting of exotic species is criticized on the grounds that they displace native plant and animal species and reduce biodiversity.

In the tropics, eucalyptus and pine are the most commonly planted exotics, and in Latin America they are the norm for plantations and meet the majority of the fiber demand of the pulp and paper industry. In Brazil growth rates of eucalyptus (originally from Australia) can reach 40 to 55 cubic meters per hectare per year for a seven-year rotation (FAO 2001). Brazil has 5 million ha of forest plantations, of which 60 percent is eucalyptus and the majority of the rest is pine (BRACELPA 2007). *Pinus radiata* (native to California) is also grown as an exotic species in south-temperate countries such as Australia, Chile, and New Zealand.

Monoculture plantations are often criticized for their negative impacts on the local environment such as reduced biodiversity, soil nutrient degradation and groundwater depletion.

Monocultures

Monoculture refers to plantings of just one species. Globally, the majority of forest plantations are monocultures, with a limited number of tree species in common use (FAO 2001). Monoculture offers some benefits over mixed-species plantations: it focuses resources like water and soil nutrients on just the fastest-growing tree types, makes nursery practice and stand management easier, and produces uniform wood (Evans and Turnbull 2004).

However, monoculture plantations are often criticized for their negative impacts on the local environment (Erskine, Lamb, and Bristow 2006; Lamb, Erskine, and Parrotta 2005), such as reduced biodiversity, soil nutrient degradation (Cossalter and Pye-Smith 2003), and groundwater depletion. Monocultures are considered to be more susceptible to pest outbreaks (Lugo 1997), though inconsistencies exist and there is little experimental evidence (Keenan, Lamb, and Sexton 1995; Watt 1992). Finally, monoculture plantations generally do not produce many traditional forest goods used by local people such as fruits, seeds, and medicinal plants (Evans 1999), and

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New plantations should be established on degraded land (like this grassland covered by invasive species in Indonesia).

Table 4. INDUSTRIAL PLANTATION TYPES IN THE TROPICS

For more information on these types of plantations, see Chapter 4. Source: Adapted from Pokorny, Hoch, and Maturana 2010.

PLANTATION TYPE	AVERAGE SIZE	SPECIES TYPES	EXAMPLES	END USES
Softwood industrial monoculture	Up to tens of thousands of ha	Exotic fast-growing	Some species of eucalyptus, pine, acacia	Fiber (mainly pulp for paper)
Hardwood industrial monoculture	Up to hundreds of ha	Exotic or native, with preference for high-value	Some species of eucalyptus, teak	Timber for construction, wood for home decor
Hardwood mixed species	Up to hundreds of ha	Mixed, with preference for high-value	Teak	Timber for construction, wood for home decor
Agroforesty	Up to tens of ha	Mixed	Legumes, fruit trees	Timber, wood, non-wood products (e.g., fruit, crops, livestock)
Outgrower schemes[5]	Up to tens of ha	Exotic fast-growing	Eucalyptus, pine	Fiber
Non-industrial fuelwood plantations	Up to hundreds of ha	Mixed	Regionally dependent mix of species	Fuelwood
Afforestation and reforestation	Up to hundreds of thousands of ha	Mixed, with preference for natives	Regionally dependent mix of species	Ecosystem protection or rehabilitation
Food and oilseeds	Up to hundreds of ha	Monocultures, often non-native	Palm, banana, coffee	Food or oil products

5 In outgrower schemes, processing companies do not own the forests from which trees are harvested, but rather work with a number of forest owners in the area who provide wood for processing.

commercial plantations have been associated with social conflicts (Onyekwelu, Stimm, and Evans 2010).

MIXED-SPECIES PLANTATIONS

Mixed-species plantations can combine species with somewhat different but complementary physiological requirements. For example, planting deep-rooted species with shallow-rooted species improves water use efficiency, while nitrogen-fixing leguminous trees can enhance soil nutrients for other nearby trees.

Mixed-species plantations provide a number of advantages over monoculture plantations, such as protection from pests, improved biodiversity habitat, and restoration of degraded areas that closely mimics natural regeneration (Parrotta and Knowles 1999; Guariguata, Rheingans, and Montagnini 1995; Keenan, Lamb, and Sexton 1995; Montagnini et al. 1995). Compared with monocultures they may produce more biomass per unit of area due to limited competition between species and optimal use of land area (Montagnini et al. 1995). For example, mixed species can reduce competition for sunlight and can optimize soil nutrients, reducing the need for chemical fertilizer inputs (Guariguata, Rheingans, and Montagnini 1995; Lamb and Lawrence 1993). Though there are a number of studies that highlight the benefits of mixed-species plantations (Forrester et al. 2006; Kelty 2006; Wood and Vanclay 1995), including higher yields,[6] these plantations are still rare in practice (Nichols, Bristow, and Vanclay 2006).

6 Erskine, Lamb, and Bristow 2006; Menalled, Kelty, and Ewel 1998; Khanna 1997; Cannell, Malcolm, and Robertson 1992; FAO 1992; Kerr, Nixon, and Matthews 1992; Morgan, Campbell, and Malcolm 1992.

CHAPTER FOUR

Solutions and Recommendations

All forests provide multiple benefits to society. All members of society—producers that grow and harvest trees, businesses that manufacture and sell wood products, consumers who buy wood and wood-based products, and governments of both producing and consuming countries—can play a role in supporting sustainable forest management practices. This chapter provides recommendations for practices and approaches that can move the wood products industry away from deforestation in the tropics.

RECOMMENDATIONS FOR PRODUCERS

Establish Long-term Forest Management

- Identify which native species can be grown in plantations, identify degraded lands where they can be planted, then appropriately manage them to meet demand
- Take steps to manage and restore secondary forests, using reduced-impact logging
- Improve livelihoods for local communities
- Become a certified producer of sustainable wood

Follow Best Management Practices

- Protect water and reduce soil erosion
- Reduce chemical inputs
- Protect biodiversity
- Protect genetic resources
- Plant on degraded land

PRODUCERS IN THE TROPICS

Wood producers in the tropics should move toward a paradigm of sustainable management through careful planning, increasing productivity to meet demand with less land, establishing efficient systems, and following best management practices that reduce the environmental impact of harvest and wood production. In the tropics well-managed plantations that don't endanger or replace primary forests can be used to meet demand; ideally, these plantations are established on degraded lands instead of replacing natural forest, and utilize a mix of native species chosen to optimize output. Some careful removal of trees from secondary forests pre-identified for production may also be useful in meeting wood demand. In this case, these forests should be designated as "working forests," clearly distinguishing them from other secondary forests in which harvest will not happen.

Establishing a Forest Management Paradigm

Without planned management it is difficult to predict the future of a forest after harvest. Trees may grow back, but they may not be the desired species. Or, the forest may be so damaged that it never regains its original level of biodiversity and wood volume. In the worst cases there are no plans for the forest and it is cleared for other purposes. Without planning for sustainability, wood is simply "mined" from the forest like a limited amount of gold can be mined from the earth, and it will not be a renewable resource. Forest management can help achieve pre-determined goals, whether they are to grow a second generation of harvestable trees or to reduce the environmental impact of wood extraction.

The International Tropical Timber Organization (ITTO) defines sustainable forest management (SFM) as "the process of managing permanent forest land to achieve one or more clearly specified objectives of management with regard to the production of a continuous flow of desired forest products and services without undue reduction in its inherent values and future productivity and without undue undesirable effects on the physical and social environment" (Blaser et al. 2011). Therefore an SFM plan requires actions to address the establishment, care, reproduction, and harvesting of a working forest.


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Silvopasture systems provide a way to raise cattle while maintaining some forest cover.

Without planning for sustainability, wood is simply "mined" from the forest like a limited amount of gold can be mined from the earth, and it will not be a renewable resource.

Meeting Demand with Less Land

Plantations that follow best management practices can be useful in meeting wood product demand from the same piece of land over long periods. There are many options for growing production trees in the tropics, some of which are described below (and summarized in Table 4).

Monoculture Plantations

Many factors should be considered when deciding to establish a plantation in the tropics. First, species should be selected to match the location where they will be grown. Ideally, native species are used as they are naturally adapted to the local climate; plantation producers that plan to use exotic species should choose those that are suited to the climate to minimize supplemental inputs.

Then, during the main years of tree growth, managers need to determine how to provide sufficient nutrients to the trees, as soil nutrients are lost at a greater rate in plantations than natural forests given the speed of growth and short harvest rotation. Fertilizer use in tropical plantations is not very common, but has recently increased, and should be done sparingly to reduce costs and the possibility of leakage into the surrounding ecosystem (Onyekwelu, Stimm, and Evans 2010).

Once the trees have grown, forest managers need to determine when to harvest them. Usually, this is dependent on the ultimate use of the wood, with pulp rotations being much shorter than timber or veneer rotations. Increasing rotation length can sequester more carbon from the atmosphere but, depending on the product the wood will be used for, it may reduce the value added during those years. For example, if a tree is going to be used for pulp to make paper, it will not grow as quickly in later years and will therefore be gaining less value every year. On the other hand, increasing the rotation length of some trees, like eucalyptus, can transform a plantation from being used for low-value pulp into higher-value solid wood products.

Mixed-Species Plantations

In the tropics, mixed-species plantations are most commonly used to grow a diverse range of hardwoods. Producer benefits from mixed-species plantations include creating a diverse income stream (including some non-timber products like fruit or nuts), diversifying production risk, creating a seed source for the next generation of trees, and improving yield (Onyekwelu, Stimm, and Evans 2010). See Box 1 for an example of a successful mixed-species plantation management plan.

The management choices that go into mixed plantations are similar to those in monoculture species plantations; however, species selection and nutrient management warrant additional considerations. Often, native species are used in mixed plantations, helping increase the ecological "connectivity" between the plantations and surrounding native forests. Nutrient management can be improved on mixed plantations by using species of trees that increase nitrogen in the soil and therefore reduce the need to use fertilizer (Onyekwelu, Stimm, and Evans 2010).

Agroforestry

Agroforestry is the practice of combining agricultural land and trees on the same plot. Crop or animal production is usually the main purpose, so farmers typically plant a few widely spaced trees to reduce interference with agricultural practices. The most famous example of agroforestry is planting cacao or coffee under shade trees. Agroforestry systems can provide

Box 1

The Atlantic Forest Restoration Compact

Most of the diverse Mata Atlântica forest along Brazil's South Atlantic coast was cleared centuries ago and only small remnants remain. A large-scale effort has begun in this region to restore forests and biodiversity by planting combinations of fast-growing timber species, both exotics and natives, with a wide diversity of native species destined to become the core of future natural forests.

This project, known as the Atlantic Forest Restoration Compact, is the result of input from hundreds of nongovernmental organizations (NGOs), government and business organizations, and thousands of landowners. It is based on the realization that protection alone will be insufficient, and that planting forests for restoration, mostly on low-value pastures, will have to be an important feature of the region's conservation strategy (Calmon et al. 2011; Rodrigues et al. 2009).

The Compact is based on the realization that protection alone will be insufficient, and that planting forests for restoration, mostly on low-value pastures, will have to be an important feature of the region's conservation strategy.

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Brazil's Mata Atlântica forest

The Compact sets a goal of restoring 15 million ha of forest by 2050, thus increasing the region's forest cover from 17 percent to at least 30 percent. Its guidelines are intentionally flexible to adapt to local environmental, socioeconomic, and political conditions.

The most common approach in this restoration effort is to plant a combination of a few valuable fast-growing species, which may be natives or exotics such as eucalyptus, together with a large number of slower-growing native trees whose purpose is long-term ecosystem protection and biodiversity restoration. The fast-growing species will be cut out in a few decades, providing income for landowners and thus giving them an economic incentive to participate. The remaining native species will then be the foundation of the new, restored Atlantic forest (Calmon et al. 2011).

multiple environmental benefits. Trees grow roots deep into the soil, creating a system that cycles water and nutrients much deeper than most other plants, and sequestering more carbon than, for example, a cattle pasture alone (Haile, Nair, and Nair 2010). Trees grown along creeks and rivers also protect waterways by preventing soil erosion and nutrient pollution. Furthermore, agroforestry can provide wildlife habitats and corridors (Murgueitio et al. 2011) and improve farm aesthetics.

These mixed-use, multispecies systems can provide farms with diversified income streams. However, up-front costs may prevent these practices from being economically viable on a small scale or for lower-value crops (Balderas Torres et al. 2010). National and international programs that reimburse the initial costs of agroforestry may spur more small landholders to practice it.

Sustainable Production from Natural Forests

Primary forests should not be used for commercial wood production, either through first-entry logging or conversion to plantations, as both cause a large carbon loss (Putz et al. 2012; Liao et al. 2010). Logging of primary forests also causes a long-term loss of potential timber volume and affects biodiversity (Putz et al. 2012). However, secondary forests identified for long-term wood production can be useful for obtaining species not grown in plantations.

In highly degraded forests, significant management efforts like protection from further degradation, fire risk reduction, and soil conservation may be needed to regenerate the forest and achieve a sustainable production system (Akindele and Onyekwelu 2010; Elias and Lininger 2010). In some cases degradation is so severe that trees can no longer grow and the areas are invaded by grasses. These too can be restored to create production forests, but usually require significant planting efforts—thus making these areas possible candidates for establishing plantations.

© NFMA, FAO

Measuring and monitoring forests over time is critical for understanding the effects of logging on the ecosystem.

Primary forests should not be used for commercial wood production, either through first-entry logging or conversion to plantations, as both cause a large carbon loss.

When logging secondary forests, the damage normally associated with unmanaged harvest can be mitigated through reduced-impact logging (RIL). RIL is the implementation of multiple science-based practices to reduce the environmental impact of selective logging (Lentini, Zweede, and Holmes 2009; Putz et al. 2008). These practices include modifying the number of trees left in the forest, leaving trees of certain sizes to grow into a mature forest, harvesting during seasons that will not damage the soil, establishing no-cut zones in steep terrain or close to water, and avoiding damage to the trees left in the forest.

RIL can significantly reduce disturbance from logging. In Indonesia, for example, over the next few decades an RIL plan established in the late 1990s is expected to reduce disturbance to soil and residual vegetation by 50 percent and cut costs by 15 percent compared with conventional logging (Sist, Dykstra, and Fimbel 1998). In the Amazon, RIL experiments show that this practice can help reduce the impact of logging on wildlife (Presley et al. 2008; Wunderle, Henriques, and Willig 2006).

Research results vary as to the cost-effectiveness of RIL. What is clear is that these practices often require investments in logger education and long-term planning, and therefore it is often necessary for governments to provide policies and incentives to promote these more sustainable practices (Medjibe and Putz 2012). Furthermore, there is no generally accepted definition of RIL. While the specific RIL activities necessary for reducing environmental damage will differ among forests, a generally accepted standardization may help with certification efforts and broaden participation (Ezzine De Blas and Ruiz Perez 2008).

Best Practices for Sustainable Forest Management

Regardless of forest or plantation type, a management plan should include the following ecological and societal goals:

Protecting water and soil. Forest management choices can affect water and soil resources. Tree corridors along waterways should not be harvested, as they help protect water quality and reduce soil erosion (Keenan et al. 1999). Plantations also require a lot of water (Jackson et al. 2005), so they should not be planted in regions or areas where water is already scarce. Finally, short-rotation forests remove a lot of soil nutrients (Onyekwelu, Stimm, and Evans 2010), so soil fertility considerations should be included in determining rotation length.

Plantations require a lot of water, so they should not be planted in regions or areas where water is already scarce.

Reducing or avoiding chemical inputs. Fertilizer use in tropical forests is on the rise (Onyekwelu, Stimm, and Evans 2010), although it is expensive and its utility is still not generally accepted (Bigelow, Ewel, and Haggar 2004). In any ecosystem, overuse of fertilizer can affect water quality; conventional fertilizers are also energy-intensive to create, contributing to higher global warming emissions. To minimize or eliminate the need for fertilizers, plantations should include species that add nitrogen to the soil naturally; if fertilizers are used, they should be applied sparingly to avoid runoff into local waterways.

Providing plant and animal habitat. Creating diverse forests can help restore biodiversity on degraded landscapes (Lamb, Erskine, and Parrotta 2005). Monoculture plantations should use native species as often as possible to help improve biodiversity (Lamb, Erskine, and Parrotta 2005)—a shift from current practice in which 50 percent of tropical plantations use exotic species such as acacia, pine, or eucalyptus (Onyekwelu, Stimm, and Evans 2010). Furthermore, when establishing plantations, areas of high biodiversity should be avoided and plantations should not be so large that they significantly interrupt biodiversity corridors.

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Following best practices for forest management can reduce the negative impacts of wood production on wildlife.

Monoculture plantations should use native species as often as possible to help improve biodiversity.

Protecting genetic resources. Genetic selection—picking the best trees from the forest and harvesting their seeds for replanting—is a common technique among foresters. In the tropics, forest managers should increase the number of native species on which they focus genetic improvement efforts, and ensure there is variability among and within native species used for production.

Planting on degraded lands. Degraded lands vary a great deal in terms of how much forest cover, biodiversity, and ecosystem function has been lost (Lamb, Erskine, and Parrotta 2005). A good forest management plan can speed up recovery and help create forests that provide desirable species and growth rates, as well as restore ecosystem services. Avoiding primary forests or high-carbon-storage areas like peatlands will also avoid significant heat-trapping emissions (Jauhiainen, Hooijer, and Page 2012; Liao et al. 2010).

Box 2

A young Honduran prepares to plant a mango tree.

Community Forestry

Community forestry systems are those that provide local communities with formal responsibility of managing forests (Charnley and Poe 2007). Community forestry has many benefits, including integrating local knowledge and goals into efforts to conserve forests and implementing sound principles of forest management. It may also aim to spur local land ownership, though it can occur under various forms of land tenure including privately owned land, government-owned land, forests held as common capital, and land owned or controlled by indigenous peoples.

Often, community forestry aims to promote local economic development while protecting forests for the long term. For example, in Mexico structures promoting community forestry have enabled communities to sell timber and non-timber products while also protecting forests and local ecology (Bray, Antinori, and Torres-Rojo 2006). Other countries such as Bolivia, India, Nepal, and the Philippines have also successfully implemented community forestry (Charnley and Poe 2007). These systems can be more effective in reducing deforestation than setting aside "no-touch" forest areas (Elias and Lininger 2010). Community-managed forests can also provide income through agroforestry or non-timber forest products (Kotru and Sharma 2011).

Photo: © Sustainable Harvest International (sustainableharvest.org)

Improving livelihoods for local communities. Historically, local communities received little benefit from establishment of traditional monoculture plantations in the tropics, not only because they do not provide the fruit, seeds, and medicines that natural forests and mixed-species plantations can provide, but also because many plantations are owned by outside corporations rather than local residents. Limitations including insecure land tenure, high up-front costs, or competing demands for land can exclude local communities from establishing their own plantations and benefitting from the market (Lamb, Erskine, and Parrotta 2005). Institutional, legal, and policy changes are needed to make forest management more attractive to local communities (as described in Box 2). These changes include providing secure land tenure, eliminating policies that promote deforestation, providing loans or other financial incentives for sustainable plantations, providing technical assistance and information, creating markets for native species, and developing systems to pay for ecosystem services (i.e., putting a value on services that forests provide, such as water purification and erosion prevention, and paying landowners for keeping forests intact in order to maintain these services).

MANUFACTURERS AND RETAILERS

In the middle of the supply chain, between producers and consumers and between trees and tables, are the vast number of businesses that buy and sell tropical wood products. Most of them do not think of themselves as part of the forest products industry, but the range of enterprises that use wood products is extremely wide. Wood not only goes into houses and furniture, but also into office buildings, trucking, and textiles. Shipping goods uses cardboard and pallets in large quantities. And paperwork is a fundamental part of every business. Thus, many businesses can play a part in moving tropical wood production toward zero deforestation.

Businesses selling tropical wood products should look for certified sources of wood as a reasonable standard for ensuring their products are not causing deforestation and forest degradation.

Certification

Businesses selling tropical wood products should look for certified sources of wood as a reasonable standard for ensuring their products are not causing deforestation and forest degradation.

RECOMMENDATIONS FOR MANUFACTURERS AND RETAILERS

Identify Opportunities to Improve Sustainability

- Identify the supply chain and determine producer practices
  - Determine which products are coming from countries with high deforestation rates
- Support efforts by producers' and consumers' governments to improve legal production
  - Determine which products are coming from countries where illegal logging is a problem

Certify Products as Sustainable

- Demand certified wood (even for lower-end products)
- Send sustainably produced goods across the entire sales network
- Work with consumers and stakeholders to support local and global efforts to increase certification
- Become members of certification programs and get involved in the certification process to strengthen and improve those programs
- Support certification in countries where deforestation is the highest

Identify Alternative Species that Can Help Reduce Demand and Pressure on Natural Tropical Forests

Invest in Sustainable Forestry Operations

- Plan to use certified producers for all business growth and new investments
- Support "impact investing" to bridge the divide between philanthropy and profit

Nongovernmental, voluntary certification programs have been in place since the early 1990s, developed as a response to the lack of political will for government-level management requirements (Auld, Gulbrandsen, and McDermott 2008).

Table 5 (p. 24) outlines the guiding principles of two of the largest and most well-respected wood certification programs. The **Forest Stewardship Council (FSC)** has a global standard comprising 10 principles and more than 50 criteria, each of which is tailored at national or local levels to meet different ecological, economic, and social conditions (Auld, Gulbrandsen, and McDermott 2008). To determine if a forest is meeting FSC standards an auditor conducts a field inspection. All the applicable principles and criteria must be met—they are not a menu for land managers to select from but rather an entire package (FSC 1996). The FSC logo is common among a wide array of wood products in the United States, though not all products containing certified wood bear a logo since they may be made from wood from multiple sources. In fact, only a small percentage of the world's certified wood ends up being sold with the logo (Auld, Gulbrandsen, and McDermott 2008).

Many producers have also developed their own certification schemes, usually on a national level. Many of these, including the U.S. Sustainable Forestry Initiative and programs implemented in Brazil, Chile, Gabon, Malaysia, and Uruguay, are under the **Programme for the Endorsement of Forest Certification (PEFC)**, which creates mutual recognition of national-level programs and allows for common labeling (PEFC 2012; Auld, Gulbrandsen, and McDermott 2008). Another major tropical producing country, Indonesia, has created the Indonesian Ecolabeling Institute (LEI) (which has opted to participate in a "memorandum of understanding" with the FSC rather than become part of the PEFC).

At a global scale, it is difficult to compare the ecological impacts of FSC or PEFC programs, since their implementation on the ground varies both between and within the programs. The flexibility of standards to fit local needs is important, but makes comparison difficult. However, research shows that by and large producers that have had their wood certified have changed at least some aspects of their management practices (Auld, Gulbrandsen, and McDermott 2008).

Certification systems like those of the FSC and PEFC require products to be legally produced and procured; therefore, businesses certifying their entire product stream are supporting efforts to ensure legal production from the tropics. Some businesses have supported government efforts to address illegal logging, and others should join the effort. Canfor Pulp, The Forest Products Alliance of Canada, the National Wood Flooring Association, Taylor Guitars, and the UK Timber Trade Federation, among others, are members of the Forest Legality Alliance—a group designed to achieve better forest governance, sustainable management of forests, and biodiver-

Table 5. CERTIFICATION PROGRAM CRITERIA

A list of the guiding principles for the Forest Stewardship Council and the Programme for the Endorsement of Forest Certification; each provides sustainability certification for forest growers globally and certifies wood products sold in the United States and elsewhere. Sources: FSC 2012a, PEFC 2010.

Forest Stewardship Council

- Compliance with laws
- Workers' rights and employment conditions
- Indigenous peoples' rights
- Community relations
- Benefits from the forest
- Environmental values and impacts
- Management planning
- Monitoring and assessment
- High conservation values
- Implementation of management activities

Programme for the Endorsement of Forest Certification

- Maintenance and appropriate enhancement of forest resources and their contribution to the global carbon cycle
- Maintenance of forest ecosystem health and vitality
- Maintenance and encouragement of productive functions of forests (wood and non-wood)
- Maintenance, conservation, and appropriate enhancement of biological diversity in forest ecosystems
- Maintenance and appropriate enhancement of protective functions in forest management (notably soil and water)
- Maintenance of other socioeconomic functions and conditions

(Note: There are additional criteria if a group of forest managers are applying for certification together.)

sity conservation by reducing the demand for illegally harvested forest products (Forest Legality Alliance 2012; Forest Legality Alliance n.d.).

Gaps in Certification Programs

Primary forests. Currently neither the FSC nor PEFC have an outright ban on first-entry logging of tropical forests. The FSC's requirements to protect biodiversity and the PEFC's requirements to protect ecosystem function implicitly prohibit this action, but certification of wood removed from primary forests is still possible. Certification programs should consider the implications of primary forest logging on biological diversity and carbon dioxide emissions, and reevaluate the sustainability of programs that do not explicitly stop this action.

Adoption. Lack of adoption is a serious concern in the tropics. Of the area certified by the FSC, less than 12 percent is in the tropics; for the PEFC it is less than 3 percent (FSC 2012b; PEFC 2012). Tropical forests have proportionally less area certified for sustainable production than those in temperate areas (Purbawiyatna and Simula 2008). Lack of adoption is problematic for a few reasons. First, since certification only occurs on a property-by-property basis, "bad" forest management practices by non-certified owners could continue nearby while those managers that were already close to meeting the certification requirements opt into the programs. As long as non-certified products are still purchased, good practices may not spread to those "bad actors" and simply support the status quo. Second, participation is low in those countries that are losing forest cover and exporting wood, such as the Democratic Republic of Congo, Myanmar (Burma), the Philippines, and others (Table 6).

Lack of adoption is a serious concern in the tropics. Of the area certified by the FSC, less than 12 percent is in the tropics; for the PEFC it is less than 3 percent.

Project-level standards. As certification programs continue to grow and adapt with increased scientific knowledge and experience, some countries are behind in creating national-level standards and use only project-level standards (Table 6). These are the most general possible standards, since they can be adapted to any forest ecosystem in the world, and are therefore the most flexible and easy to meet. The FSC is currently working to improve these generic standards, but at the current time they are insufficient compared with national-level certification standards.

Overall limitations. There is a risk to overselling certification as the solution to all bad forest management practices (Dauvergne

Table 6. DEGREE OF CERTIFICATION IN TROPICAL COUNTRIES WITH THE HIGHEST DEFORESTATION RATES

Sources: Annual deforestation data from FAO 2010b, FSC area certified from FSC 2012b, LEI area certified from LEI 2012, CERFLOR area certified from INMETRO 2012.

COUNTRY	TOTAL WOOD PRODUCT EXPORT VALUE, 2011	CERTIFIED AREA IN COUNTRY, AS OF 2012	PERCENT OF FOREST AREA CERTIFIED[7]
Indonesia	$6.1 billion	1,407,542 ha in LEI standards 985,333 ha in FSC project-level standards	2.5%
Brazil	$5.7 billion	1,537,997 ha in Brazilian National Forest Certification Program (CERFLOR) (PEFC-endorsed) 6,515,179 ha in FSC project-level standards	1.5%
Cameroon	$409 million	820,630 ha in FSC national standards	4.1%
Mexico	$405 million	340,447 ha in FSC project-level standards	Less than 1%
Myanmar (Burma)	$385 million	No PEFC or FSC standard	—
Philippines	$194 million	No PEFC or FSC standard	—
Ecuador	$176 million	38,367 ha in FSC project-level standards	Less than 1%
Papua New Guinea	$165 million	32,610 ha in FSC national standards	Less than 1%
Ghana	$160 million	1,566 ha in FSC project-level standards	Less than 1%
Solomon Islands	$114 million	64,412 ha in FSC project-level standards	2.9%
Democratic Republic of Congo	$91 million	FSC Congo Basin regional standards[8]	—
Bolivia	$63 million	1,106,052 ha in national FSC standard	1.9%
Guatemala	$48 million	499,020 ha in FSC project-level standards	13.6%
Nigeria	$45 million	No PEFC or FSC standard	—
Angola	$43 million	No PEFC or FSC standard	—

7 Calculated using third column and FAO 2010b.
8 These standards were released in April 2012 and are still being rolled out; therefore the values are still listed as non-applicable in the "certified area in country" column.

and Lister 2010). Currently the unequal distribution of certification means that many of the places where deforestation is happening most quickly are not the same places were certification is expanding rapidly. Therefore, businesses sourcing wood from those countries need to be especially vigilant and work to promote certification there. Finally, certification is meant to be a standard for how forests are grown and harvested, not a standard for how forests are conserved. Therefore, certification must go hand in hand with forest conservation efforts (see Government Recommendations section).

Businesses can take action to spread the adoption of certification (as exemplified in Box 3, p. 26). This can include asking for certification of even low-end products (currently higher-end products are more likely to be certified), using certified products in their entire sales network (currently it is more likely that retailers intending to sell to North America or Europe will certify), and working with NGOs and stakeholders to support local and global efforts to increase certification (Auld, Gulbrandsen, and McDermott 2008). Furthermore, businesses should prioritize engaging in those countries where deforestation is happening at the largest scales to help target the problem.

Certification programs can be part of a solution to meeting tropical wood demand without deforestation and forest degradation, but they should be supplemented with additional efforts to create landscape-level change that goes beyond just

Box 3

Businesses and NGOs Working Together: IKEA and WWF

Between September 1, 2010, and August 21, 2011, Swedish home-goods retailer IKEA used 14.5 Mm^3 of wood, 16.2 percent of which was FSC-certified (IKEA Group 2011). Acknowledging that a huge amount of wood goes into its products, the company has been working with the World Wildlife Federation (WWF) since 2002 to promote sustainable forests. The WWF's efforts, now in more than 15 countries, focus on combating illegal logging, supporting forest certification, promoting a responsible timber trade, mapping and protecting high-conservation-value forests, and supporting responsible forest management (WWF 2012). IKEA's long-term goal is to use only recycled or certified wood (IKEA Group 2011).

One of the benefits of IKEA's approach to sustainability is that its sustainability goals extend across its entire market, which is important for broad adoption of good forest management practices. Recently, however, IKEA has opposed improvements to the U.S. Lacey Act that require imported wood products to be legal (see page 34) (Laskow 2012). With such strong sustainability standards, IKEA should support policies that bring *all* businesses up to a higher level of responsibility.

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An IKEA store in Japan. IKEA's forest sustainability pledge covers its global sales network.

the area of the certified forest. Planning at a level beyond just what one producer owns is required to avoid bad practices on uncertified land. Though landscape planning requires government commitment to sustainable development, businesses can also play a role in this process by making commitments to legal procurement, reducing waste, and investing in sustainable production systems that will reduce emissions and the negative ecological impacts of their business practices.

Sustainable, plantation-grown wood can be used to substitute for species that are normally harvested from primary forests. For example, the Urufor Company in Uruguay is growing FSC-certified eucalyptus to replace hardwoods that would have been harvested from primary forests for furniture, flooring, cabinets, and other high-end products.

Bamboo, Composites, and Other Alternatives

Bamboo can substitute for both softwoods and hardwoods, and its popularity as such has increased due to its rapid growth rate, adaptability to various climatic and environmental conditions, and easy regeneration by sprouting. Bamboo plantations can be harvested within five years and are seen as a cheap alternative to wood. Considerations of whether this substitution is environmentally beneficial include emissions from transportation and the chemicals used to process bamboo (Vogtländer, van der Lugt, and Brezet 2010).

Wood-plastic composites are composed of small wood fibers mixed with plastic; composite boards are often used for decks given their durability and resistance to mold and pests (Caufield, Clemons, and Rowell 2010). This can be a sustainable option when the product is created from waste material (from both wood and plastic industries) or uses recycled materials.

Sustainable, plantation-grown wood can also be used to substitute for species that are normally harvested from primary forests. For example, the Urufor Company in Uruguay is growing FSC-certified eucalyptus to replace hardwoods that would have been harvested from primary forests for furniture, flooring, cabinets, and other high-end products (Urufor 2012).

Investing in Land and Forests

The Global Impact Investing Network defines impact investments as "investments made into companies, organizations, and funds with the intention to generate measurable social and environmental impact alongside a financial return" (GIIN 2012). Impact investing seeks to bridge the divide between philanthropy and profit. And interest in impact investments is growing quickly: in 2006 the Social Investment Forum estimated that one of every eight dollars were invested using some kind of social, environmental, or ethical criteria (SIF 2006).

The countries that boast thriving investment in forests typically tend to be developed nations with temperate forests such as the United States. Some investment options include real estate investment trusts, which specialize in timber and can be traded on the stock market like any other stock, and timberland investment management organizations, which are usually used by large institutions or organizations. While neither of these financial mechanisms is inherently guaranteed to follow good management practices, conventional wisdom has it that if the investments are long-term, sustainably managing forests will have the greatest return on investment.

However, there have been barriers to the growth of investments in tropical forests. Many sustainable management investments have not succeeded in the past for a number of reasons including the high cost of management, pressure to invest in good forestry with poor financial prospects, the prevalence of small companies rather than large companies practicing sustainable forestry, business risks in developing countries, poor access to commercial finance, and lack of payment for ecosystem services (Canby and Raditz 2005).

There are many small and medium enterprises offering investments through plantations, reforestation projects on degraded land, non-timber forest products, wood products, and ecosystem services.

In recent years, the financial industry has made attempts to create impact investment opportunities in tropical forests. There are many small and medium enterprises offering investments through plantations, reforestation projects on degraded land, non-timber forest products, wood products, and ecosystem services, to name a few. However, many such enterprises require long-term investment (often 20 to 25 years for trees to reach a harvestable size) and have payback only at the end of each cycle, making it a poor short- or medium-term investment (Scholtens and Spierdijk 2007). There have been limited successes to date, and as some of the barriers to investment listed above are minimized, it may become easier for impact investing in tropical forests to fulfill its promise.

RECOMMENDATIONS FOR BUSINESS AND INDIVIDUAL CONSUMERS

Reduce Paper Use

- Reduce packaging
- Manage paper mail
- Reduce kitchen paper waste

Reduce the Need for New Products

- Use repurposed and recycled building material
- Donate building material and furniture for reuse
- Reduce the wood used in materials packaging and reuse shipping pallets
- Purchase recycled products

Promote Certification

- Purchase from certified producers and sellers, especially those that certify their entire supply chain
- Take part in influencing the certification process

BUSINESS AND INDIVIDUAL CONSUMERS

Consumers—both individuals and businesses—largely dictate the market for wood products worldwide; high-end products (like furniture and décor) can drive the harvesting of exotic, and sometimes endangered, woods from tropical forests, while demand for ever-cheaper products helps fuel the expansion of plantations to grow wood for SPWPs like plywood and particleboard. Fortunately, the right consumer choices can address these concerns. Educating consumers about the impact of wood product purchases and increasing the availability of forest-friendly products can not only help reduce demand but also help move the forestry industry toward zero deforestation.

Reducing Paper Demand

To relieve pressure on tropical forests, it is important that consumers—both businesses and individuals—reduce their consumption of paper products. Globalization has increasingly meant that paper products are being produced with wood grown outside North America. In 2006 15 percent of the pulp used in China's processing facilities came from Indonesia and another 15 percent came from Brazil (Hirschberger et al. 2010). One of the world's largest pulp and paper companies, Asia Pulp and Paper, is a significant producer in Indonesia, and in 2006, an estimated 70 percent of its pulp came from natural forests rather than plantations (Box 4), according to the World Wildlife Fund (WWF Indonesia 2006).

Educating consumers about the impact of wood product purchases and increasing the availability of forest-friendly products can not only help reduce demand but also help move the forestry industry toward zero deforestation.

In North America, packaging accounts for around 40 percent of paper consumption (Environmental Paper Network 2011). Businesses should certify their packaging products and let individual consumers know this through their websites and/or product labeling, since the final purchaser often does not see the packaging and shipping materials that were used to transport the product they bought. At home, individual consumers can buy household items in bulk to reduce packaging and, when given the option, choose goods with less packaging. Actively managing mail by canceling unused or unwanted subscriptions, reading books and magazines electronically (Box 5, p. 30), and requesting to be taken off mailing lists can also reduce the amount of paper that enters a consumer's home. Consumers can also reduce the amount of paper used in the kitchen by using washcloths for cleaning surfaces and cloth napkins at meals, or smaller-sized paper towels.

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Being removed from mailing lists and paying bills electronically is one way for consumers to reduce paper consumption.

Wood that does not go through the pulping process is often used to make solid wood products. Much of this wood goes to new construction, remodeling, furniture, and manufacturing (Box 6, p. 31). In 2005, prior to the economic downturn, Americans consumed 221 Mm^3 of solid wood (McKeever and Howard 2010). Construction accounts for the largest share of timber product use in the United States—around 60 percent of use in 2009 (McKeever and Howard 2010)—and the average North American residential structure is 40 percent wood (Winandy 2006). However, large amounts of solid wood become waste every year. In 2002, 8.2 Mmt of solid wood entered the waste stream, 5.5 Mmt of which could have been repurposed (Falk and McKeever 2004).

To most efficiently use the wood that has already been cut, all salvageable solid wood should be reused and repurposed. Rather than demolishing a building, for example, it should be disassembled to recover the usable wood (and other materials); disassembly can yield recovery rates of between 50 and 90 percent (Falk and McKeever 2004). If possible, reuse is the most efficient, as it takes the least amount of reprocessing. When remodeling or building a new structure, using repurposed wood keeps new trees from being used. More and more places are beginning to recognize the value in used goods. The Habitat for Humanity ReStore is just one example of a place where used building materials and furniture can be donated for use in others' building projects.

Rather than demolishing a building, it should be disassembled to recover the usable wood; disassembly can yield recovery rates of between 50 and 90 percent.

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Box 4

The Asia Pulp and Paper Campaign

As one of the largest pulp and paper companies in the world, Indonesia-based Asia Pulp and Paper (APP) markets its products to companies and organizations in more than 120 countries (APP 2012). However, APP also has a long history with the international community of failing to follow through on conservation measures, and recent publicity has caused a number of its customers to sever ties with the company.

In 2005, the Rainforest Alliance entered into an agreement with APP to allow the Rainforest Alliance to monitor high-conservation-value forest (HCVF) areas. In February 2007, after APP failed to act to ensure forest protection and conservation based on the Rainforest Alliance's recommendations, the Rainforest Alliance terminated its contract with APP, stating that the company's efforts were "insufficient to manage and protect these HCVFs" (Rainforest Alliance 2007). Just months later, in October 2007, the FSC announced that it was "disassociating" itself from APP (FSC 2007). This coincided with reports by a coalition of NGOs that APP had continued to construct a logging road and cut trees (even after the company had agreed to a moratorium on natural forest clearance), a move that was both destructive to the habitat of the endangered Sumatran tiger and potentially illegal (Eyes on the Forest 2008).

However, the most public campaign against APP was Greenpeace's efforts to target companies that purchase supplies from APP. The campaign notably targeted toymaker Mattel with a campaign called "Barbie, It's Over," which included giant banners, a Twitter campaign, and thousands of messages from the public. The campaign eventually led Mattel to promise to use packaging made only from sustainably managed wood. A report issued in March 2012 indicated that Greenpeace investigations found evidence of Ramin (a genus of trees consisting of about 30 different species) in APP mill yards, a clear violation of the law as Indonesia banned the logging of Ramin in 2001 (Greenpeace 2012). Recently, a number of companies including Danone, Hasbro, Lego, Mondi, and Xerox have all pledged to stop sourcing products from APP. APP responded in May 2012 by announcing new sustainability initiatives to preserve HCVF, a promise that has been made many times before. It remains to be seen whether this time is any different.

What Can You Do?

It would be extremely difficult for the average person to completely eliminate their use of paper. Instead, recycling paper goods can reduce the number of trees needed to produce paper. It is estimated that paper can be recycled anywhere between four and eight times (each time paper is recycled, its fibers are shortened until they are no longer adequate for use). In addition to reducing the need for virgin wood, recycling paper saves energy, water, and landfill space (EPA 2009).

Americans are increasing their paper recycling, and today more than 60 percent of paper is now recycled (AF&PA 2010). However, around 26 million tons are still added to landfills every year, comprising around 16 percent of landfill waste (EPA 2009). And production of recycled goods requires consumer demand for these products. Consumers can look and ask for "post-consumer" recycled goods (i.e., goods made from paper products that have already been used, discarded, and recycled at least once before).

Box 5

Books vs. E-readers

An increasingly popular question among avid readers is whether cutting down trees to make paper for books justifies the purchase of electronic readers (or e-readers) like the Amazon Kindle or Barnes & Noble Nook. Both paper and electronics have environmental impacts. These include the chemicals used in paper processing, printing, and electronics production, resource use (mining precious metals versus cutting down trees), and manufacturing-related energy use. From a global warming standpoint, cutting down trees to make paper releases heat-trapping carbon into the atmosphere, but so does charging an e-reader's battery using electricity from a fossil-fuel-fired power plant. Lastly, the heavy metals in many electronic gadgets can pollute the air and water if disposed in landfills or incinerators instead of being recycled.

Taking all these factors into account, e-readers generally make environmental sense for those who purchase many new books a year and who will also use it to read magazines and newspapers (Ritch 2009). However, it is important to note that, from a global warming perspective, the decision between paper books and e-readers is minor compared with other consumer choices like transportation or home energy use, which account for 28 and 32 percent of the average household's total carbon emissions, respectively (Shulman et al. 2012).

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E-readers may make environmental sense for avid readers of books and magazines.

Buying a new book or an e-reader are not the only options available to readers. Libraries, book swaps, and other lending/sharing programs spread the environmental impact per item over multiple uses and reduce demand for new items. Consumers who wish to own their own items can buy used books or refurbished e-readers to minimize the environmental impact.

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Buying used books spreads the environmental impact per item over multiple uses.

E-readers generally make environmental sense for those who purchase many new books a year and who will also use it to read magazines and newspapers.

Box 6

(concrete) © iStockphoto.com/ollo; (wood) © Flickr/BoneDaddy.P7

(left) Concrete is used in many construction projects, but can have a larger environmental impact than wood.
(right) If harvested from a sustainably grown forest wood can be a climate-friendly alternative to concrete, metal, and other building materials.

Construction Materials: Wood vs. Cement vs. Metal

Wood is just one of many materials used in construction; cement, steel, plastic, and aluminum are also common. There are many environmental factors against which these materials can be compared. For example, the wood processing industry is not heavily dependent on outside energy inputs for operating machinery. Wood production generates waste materials like bark and sawdust, which are then burned to provide the energy needed to run the sawmill; therefore, wood generates 60 to 70 percent of its own processing energy (Bowyer, Shmulsky, and Haygreen 2007). Furthermore, unlike mines or quarries, the forests from which these wood products originate provide at least some ecosystem services. Concrete has about three times more global warming potential than wood, while aluminum has about 300 times more global warming potential (Asif 2009). Therefore, there are many environmental benefits of using wood over other durable materials, particularly if it is legal and from a responsibly managed source.

Concrete has about three times more global warming potential than wood; aluminum has about 300 times more potential.

However, all of these durable products have different characteristics. For example, while cement and metal are sturdy regardless of how their components are arranged, wood's strength depends on how its fibers are oriented and whether it has any biological defects that affect its strength (Bowyer, Shmulsky, and Haygreen 2007).

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Pallets

Although environmental certification is an important topic in the wood industry, an interview with U.S. pallet manufacturers showed that certification was a low priority for them, as they cited consumers' unwillingness to pay more for certified products (Sanchez 2011). If this changes it would affect a significant proportion of tropical wood production.

Plastic pallets proved an alternative to wood pallets, but they are considerably more expensive and difficult to repair. The benefits of plastic pallets are that they are often made of recycled materials, more durable, weather-resistant, exempt from biosafety concerns, and easily sanitized.

GOVERNMENTS

While there are many ways in which businesses and individuals can modify their production and/or consumption habits to help ensure deforestation-free supply chains, government policies are necessary as support systems to secure the large-scale change needed to dramatically shift the wood products industry toward sustainable practices. These policies can be broadly grouped into those affecting production and those affecting consumption.

Production Policies

At a very basic level the fate of tropical forests depends on who controls the rights to the forests. In many countries this is either the government (national or subnational) or private entities (people or corporations)—or some combination of both. While some policies are applicable to all ownership types (e.g., strong enforcement to control illegal logging), many policies governments use to promote sustainable management differ based on who owns the land. For instance, a government has more say over land that it owns but leases to a timber company than it does over land that is privately held.

Without permanent claim to the land, individuals or companies that wish to extract timber products have no incentive to properly manage the land.

Concession systems in which governments own the forest and lease the logging rights to companies theoretically offer the most options for governments to promote sustainable forestry. The government can negotiate the terms of the logging concession and include a mandate that companies harvest in a sustainable manner. Indonesia, for example, has had a legal requirement for sustainable management since the 1970s (Cashore et al. 2006). However, these mandates are rarely enforced. As of 2002, more than 17 million ha of concession forests that were supposed to be sustainably managed in Indonesia were considered degraded and another 4 million have been reclassified as non-forest land due to clearing (Cashore et al. 2006). This lack of enforcement is due to a number of factors including the recent political history of the country and changes to the administration of lease rights. However, it is important for governments to enforce strict control over the leases they administer and hold bad actors accountable.

Even in countries where the government owns most of the forests, there has been increasing recognition of traditional or indigenous rights. National governments have been devolving rights back to indigenous groups, which allows for community management of forests and has the potential for sustainable

RECOMMENDATIONS FOR GOVERNMENTS

Change Forest Production Policies

- Establish clear land tenure
- Create incentives and value for standing forests, including payments for ecosystem services
- Remove subsidies for poor management and deforestation

Promote Certification

- Align national forestry policies with sustainability and certification
- Provide financial incentives for sustainable plantations
- Provide technical assistance and information

Generate and/or Promote Markets for Native, Sustainably Grown Species

- Increase government purchases (procurement) of certified products

Promote Legal Production Systems

- Provide sufficient enforcement
- Conduct necessary reforms to remove corruption

Doug Boucher

International efforts to reduce illegal logging can help avoid problems such as the edge effect (shown above), which increases forests' vulnerability to wildfires and biodiversity loss.

use of forests (Box 2). But in some countries, such as Indonesia, there is still a lack of clarity between national government rights and traditional rights (Obidzinski and Chaudhury 2009). This lack of clarity can lead to mismanagement of lands.

It is therefore fundamental to sustainable forest management that land rights and ownership be clearly identified. Without permanent claim to the land, individuals or companies that wish to extract timber products have no incentive to properly manage the land; they can simply take what they need and move on (Dubé and Schmithüsen 2007). Even if they wish to stay and manage the land properly there is no guarantee that the government will not take away their land and give it to someone else. With clear ownership and use rights associated with forestlands, the land owner has an investment in the land and a strong incentive to maintain its productivity. However, strong land tenure rights can actually *increase* deforestation if non-forestry uses of the land (e.g., cattle ranching, farming) afford clearer ownership rights than forestry (Dubé and Schmithüsen 2007). Thus strong land tenure policies should be coupled with other policies that help ensure permanence of forests. For instance, in Brazil, where much of the forestland is privately owned, the Forest Code amended in 2012 requires that between 50 and 80 percent of an owner's land be maintained as forest. While this does allow for a certain amount of deforestation, it also ensures a high degree of conservation.

Governments should also remove inadvertent technicalities that lead to deforestation. For instance, the Indonesian government has a long-running initiative to increase plantation area. However, there is nothing that prohibits converting natural

Governments in producing nations can play a role in promoting certification efforts by aligning their forestry policies with existing certification criteria.

forest to plantations, which has long-term negative effects on the environment and economy (Obidzinski and Chaudhury 2009). Plantation owners are allowed to use forests as collateral for obtaining bank loans, which gives them the money to clear the rest of their land. Additionally, the Indonesian government has long encouraged the wood processing industry by inflating demand above a sustainable supply. Likewise, in many countries the clearest way to establish land tenure has been to clear the forest and demonstrate "use."

Governments in producing nations can also play a role in promoting certification efforts by aligning their forestry policies with existing certification criteria. In Latin America, for example, Bolivia has developed its forestry laws to complement certification; as a result, it has a greater proportional area of forests under certification than Ecuador, a country that has much weaker governance in general (Ebeling and Yasué 2008). While the "good actors" in the market might naturally be pulled toward certification, government policies can help push others to improve their practices as well. Furthermore, by valuing the services forests provide beyond timber, such as clean water and biodiversity habitat, the apparently higher cost of certified products may disappear, since these forests provide a lot of service value beyond timber (Dauvergne and Lister 2010).

Overall, it is important for governments to strike a balance between strength and simplicity in their forest management laws. Evidence suggests that complex and unclear forest policies are cumbersome to many loggers and community forestry groups and have the potential to drive them toward illegal practices (Nasi et al. 2011). Finally, no matter how strong policies are, in the end they are just pieces of paper in the absence of strong enforcement. As noted above, while some illegality can be attributed to the complexity of forest policies, it is also due to lack of enforcement (Obidzinski, Andrianto, and Wijaya 2007).

Consumption Policies

The most direct way that governments can encourage deforestation-free markets is through the goods and services they purchase, known as procurement. It has been estimated that 18 percent of the global wood trade fulfills government procurement for the G8 countries (Canada, France, Germany, Italy, Japan, Russia, the United Kingdom, and the United States)

If a government establishes a deforestation-free policy for all its procurement, this can go a long way toward shifting the market as a whole toward zero deforestation.

(Toyne, O'Brien, and Nelson 2002). In terms of wood products this can be anything from the printer and toilet paper used in government offices to the timber used to build outdoor viewing platforms in national parks. Procurement essentially makes governments a large consumer in markets. If a government establishes a deforestation-free policy for all its procurement, this can go a long way toward shifting the market as a whole toward zero deforestation.

Governments in consuming countries can also affect markets in a less direct way by banning imports of illegally produced goods. Given the links between illegality and deforestation (see the Illegal Logging section), limiting the market for illegally produced goods takes pressure off forests. As an example, the United States' 100-year-old Lacey Act, which has long regulated illegal trade in plant products, was amended in 2008 to make it illegal to import or own illegally harvested and produced wood products. The European Union also took steps to limit the importation of illegally harvested timber products with its Forest Law Enforcement Governance and Trade (FLEGT) program.

Policies such at the U.S. Lacey Act and the E.U. FLEGT program make it illegal for businesses and consumers in those countries to import wood or paper products made from illegally harvested timber. An additional advantage of these policies is that by cracking down on the bad actors they level the playing field and thereby make it easier for legal producers to compete in the global market.

Providing a Sustainability Framework

Across the globe, government policies are a major factor in determining forest management and land use decisions. Adjusting government policies to improve sustainability provides the framework for everyone—from forest owners and producers to wood product retailers and consumers—to protect our world's forests for generations to come.

Sustainable production from the tropics *is* possible. Political hurdles must be overcome to make this a reality today.

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Wood *for* Good

SOLUTIONS FOR DEFORESTATION-FREE WOOD PRODUCTS

Wood plays a major role in our everyday lives. It is used to make the furniture and paper we use at home and in the office, as well as the pallets and shipping boxes used to transport goods around the world. The rapid growth of the wood products market has led to increased deforestation in the tropics, which destroys biodiversity, reduces ecosystem services like erosion protection and water purification, and contributes to global warming.

However, it is possible to maintain an economically viable wood industry while protecting tropical forests. Producers can establish high-yield plantations of native species on degraded land. Businesses can support certification programs and invest in sustainable producers. Consumers can reduce demand for new wood by choosing recycled products. And governments can change implement policies that generate markets for legal, sustainable wood products. All of these sectors play an important role in supporting sustainable forestry practices and must work together to maximize their success.

This report is one of a series that examines the vegetable oil, meat, and wood products markets and details how businesses and governments can ensure their products and policies are deforestation-free.

This report is available on the UCS website at *www.ucsusa.org/deforestationfree.*

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