WWF

REPORT

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WWF LIVING FORESTS REPORT: CHAPTER 4

FORESTS AND WOOD PRODUCTS

FORESTS AND WOOD PRODUCTS

"WE ARE LIVING AS IF WE HAVE AN EXTRA PLANET AT OUR DISPOSAL. WE ARE USING 50 PER CENT MORE RESOURCES THAN THE EARTH CAN PROVIDE, AND UNLESS WE CHANGE COURSE THAT NUMBER WILL GROW VERY FAST – BY 2030, EVEN TWO PLANETS WILL NOT BE ENOUGH[3]"

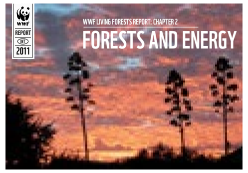
Jim Leape, Director-General, WWF International

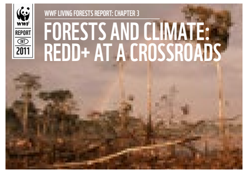
This chapter of the Living Forests Report explores how we can meet future demand for **wood products** within the finite resources of one planet.

The *Living Forests Report* aims to catalyse debate on the future role and value of forests in a world where humanity is living within the Earth's ecological limits and sharing its resources equitably. The report presents **Zero Net Deforestation and Degradation** (ZNDD) by 2020 as a target that reflects the scale and urgency with which threats to the world's forest biodiversity and climate need to be tackled. We use the **Living Forests Model**[1], developed by WWF in collaboration with the International Institute for Applied Systems Analysis (IIASA), to look at the land-use implications of ZNDD under a range of scenarios that consider different conservation, dietary and energy-use options.

The first three chapters of the report were published in 2011:

- Chapter 1 – ***Forests for a Living Planet*** examines the drivers of deforestation and the need to shift to a new model of sustainable forestry, farming and consumption with ZNDD.
- Chapter 2 – ***Forests and Energy*** examines the safeguards needed to ensure expanding use of **bioenergy** helps to provide energy security, rural development and greenhouse gas (**GHG**) reductions without destroying valuable ecosystems or undermining food and water security.
- Chapter 3 – ***Forests and Climate – REDD+ at a Crossroads*** highlights REDD+ as a unique opportunity to cut GHG emissions from forests in time to prevent runaway climate change, but only if investments are made now.





This 4th chapter examines current and future demand for wood products and how this can best be met. We explore the many values and uses of **wood** and its footprint relative to alternative materials (**pages 2-7**); the current and future demand for wood products (**pages 8-17**); the relationship between wood production and the conservation of other forest values (**pages 19-21**) and various options for producing wood (**pages 22-31**). The chapter concludes with broad solutions that will enable humanity to optimize the use and benefits of wood without diminishing the natural capital in the world's forests.

While this chapter focuses on wood as the major commodity extracted from forests, it is important to note that forests also produce **non-timber forest products** (NTFPs). The global value NTFPs is hard to assess but was estimated at US$18.5 billion in 2005[2]. The economic, cultural and ecological value of NTFPs makes them an important component of sustainable forest management and the conservation of biological and cultural diversity.

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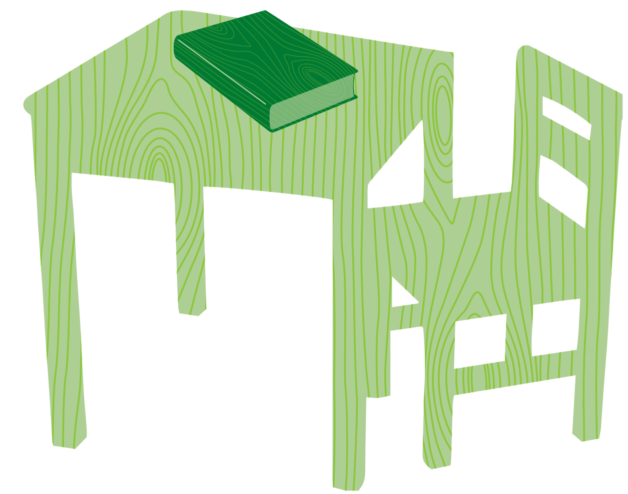
WOOD PRODUCTS: TODAY AND TOMORROW

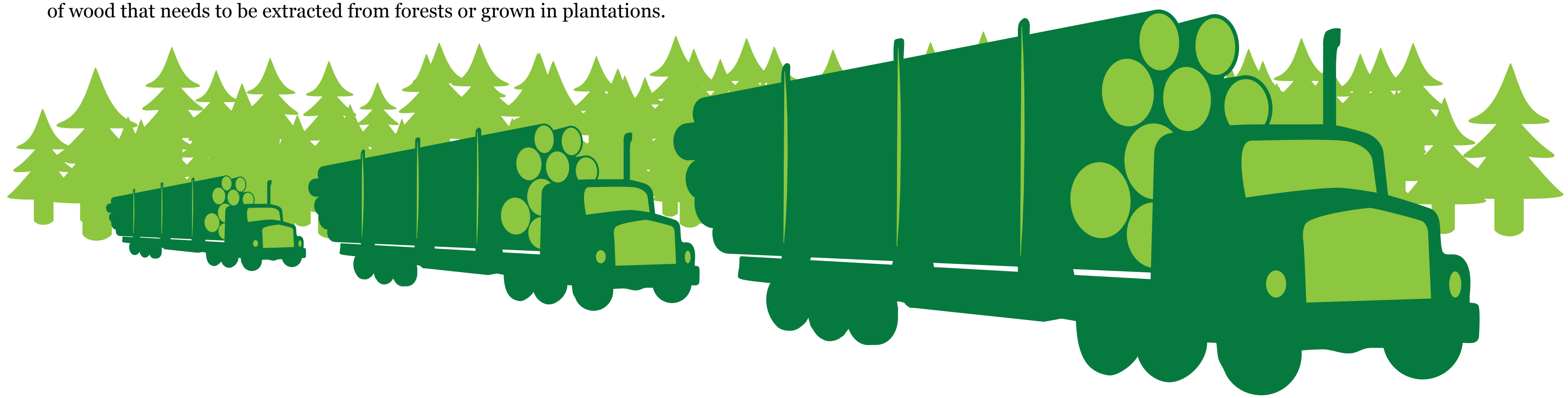
Humanity will likely use more wood in more ways as the future unfolds. If **production forests** are managed sustainably and wood products are used efficiently or replace others with a heavier footprint, this should be good for the planet.

WWF advocates reducing wasteful consumption of wood and **paper**. But even with more frugal use and greater efficiencies, net demand is likely to grow with rising population and incomes in developing countries. So how can we produce more wood without destroying or degrading forests, in a world where competition for land and water is increasing? This challenge spans the whole supply chain, from where and how wood is grown and harvested to how wisely and efficiently it is processed, used and reused. It also involves changes to consumption patterns – such as eliminating excessive and wasteful use of paper in rich societies, while improving access for the poor to paper products that can improve education, hygiene and food safety.

Advancing technology is enabling new uses of wood and its core chemical components in composites, films and chemically processed speciality **cellulose**. In the future such uses could add significantly to the volume of wood that needs to be extracted from forests or grown in plantations.



EVEN WITH MORE FRUGAL USE AND GREATER EFFICIENCIES, NET DEMAND IS LIKELY TO GROW

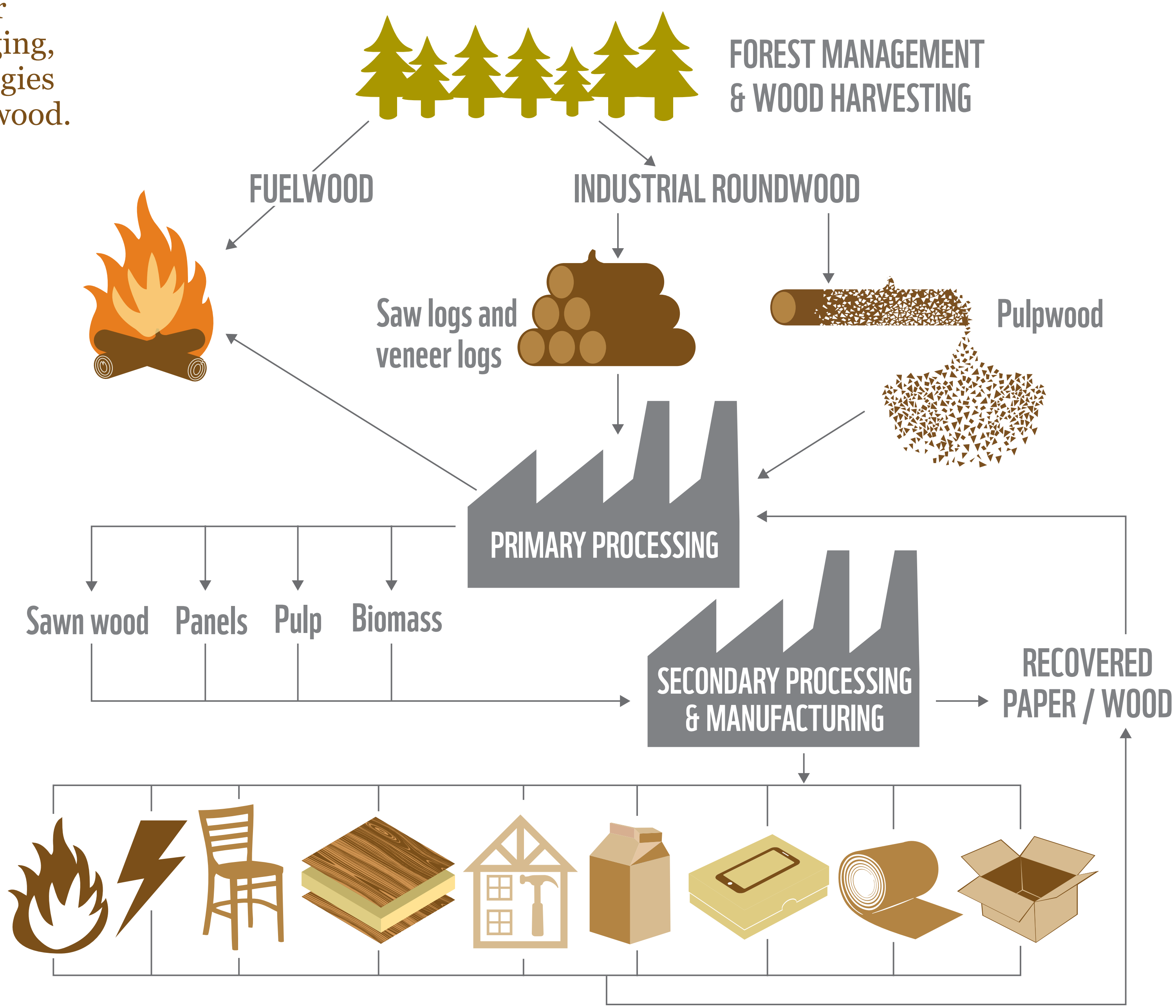


THE MANY USES OF WOOD

Wood is used to construct and furnish buildings, to make paper products for hygiene, writing, printing and packaging, and to produce energy. New technologies are creating many more ways to use wood.

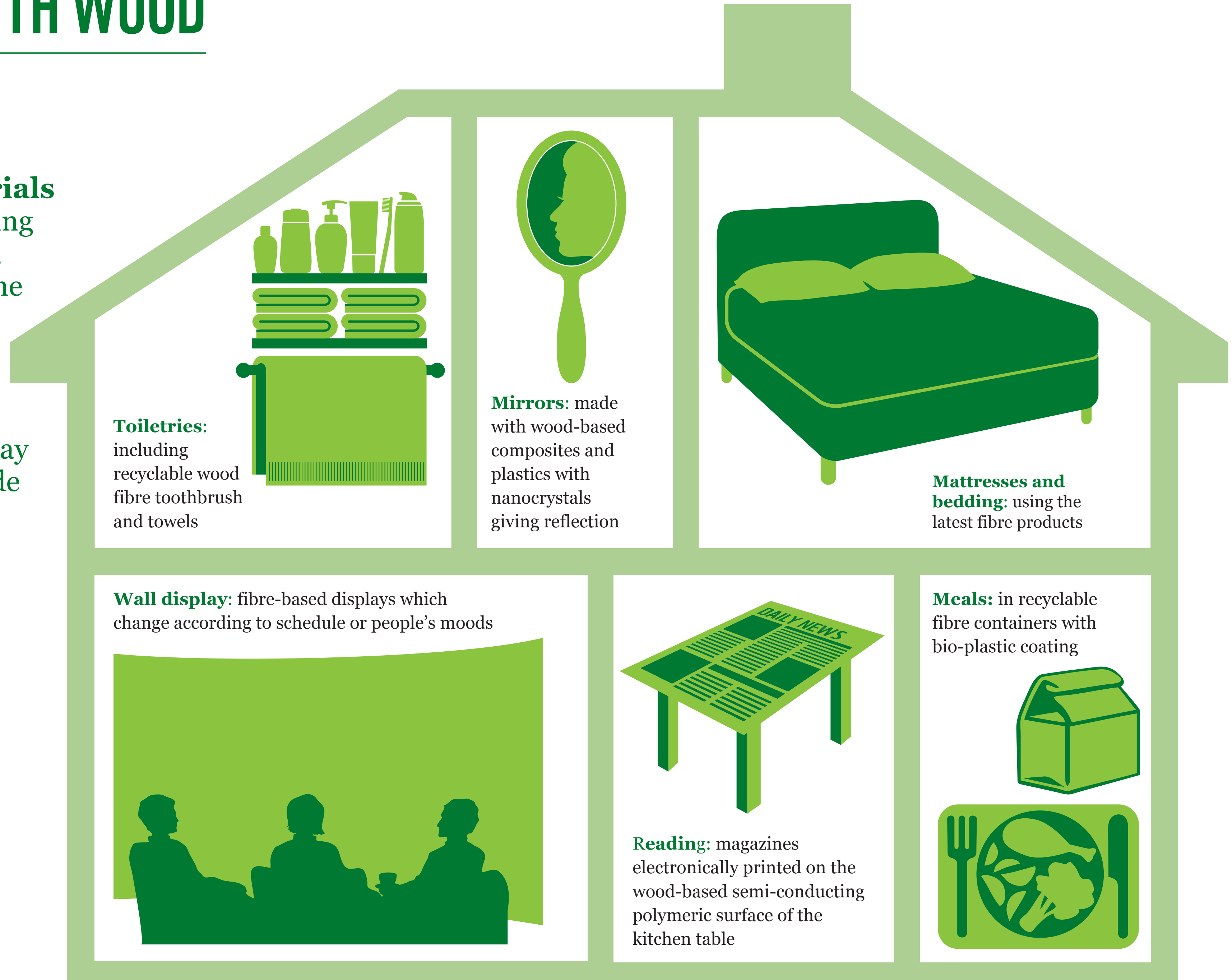
Many terms used to describe wood materials mean different things in different regions and contexts. For the purposes of this chapter we use the terminology set out in the graphic of the forest products value chain, which is defined more fully in the glossary.

The forest products value chain



THE FUTURE WITH WOOD

Wood-based biomaterials will be used in an increasing range of pharmaceuticals, plastics, cosmetics, hygiene products, consumer electronics, chemicals, textiles and construction materials[4]. By the middle of the 21st century everyday uses of wood might include those shown here.



WOOD'S NATURAL ADVANTAGE

Wood is engineered and synthesized by nature, biodegradable and, if forests are managed well, renewable.

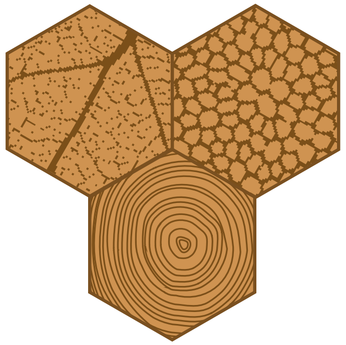
Wood is a strong, pliable and aesthetically appealing raw material that can be produced with less energy and pollution than artificial materials such as steel and plastic. But many things can undermine this natural advantage – unsustainable forestry practices harm forests and deplete carbon stores; huge logs can be lost or wasted; indiscriminate plantation expansion can displace communities and take away their livelihoods; dirty pulp mills pollute air and water; and paper fit for recycling is dumped in landfills or burned.

Solid wood items, such as furniture or wood used in construction, can have extremely long working lives. With suitable design, care and maintenance wooden furniture can last 100 years or more, and wooden structural components in buildings can endure for centuries. Even in extreme environments, such as in the sea, wooden pilings can last much longer than other materials such as steel or concrete.

Technological advances are enabling many innovative uses of wood: composites for construction, bio-foam for car interiors, bio-plastic coating for food packaging, bio-based polymer paints in consumer electronics, and pharmaceutical uses such as pills bound with **wood pulp** derivatives for slow release in the body. Wood-based chemicals and new wood-based biomaterials currently use a small portion of total wood supply. They tend to be by-products (e.g., of pulp mills) and not viable if produced in standalone plants[5]. However, longer term, new technologies, prices and energy policies could mean that these products absorb a much greater portion of the wood supply.

Key benefits of wood-based materials over other materials

Nature does much of the engineering and synthesis



Wood is renewable, recyclable and biodegradable

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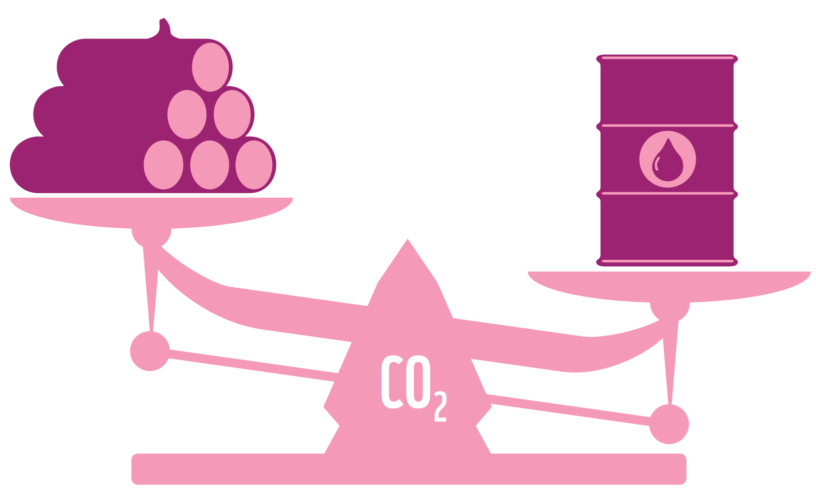
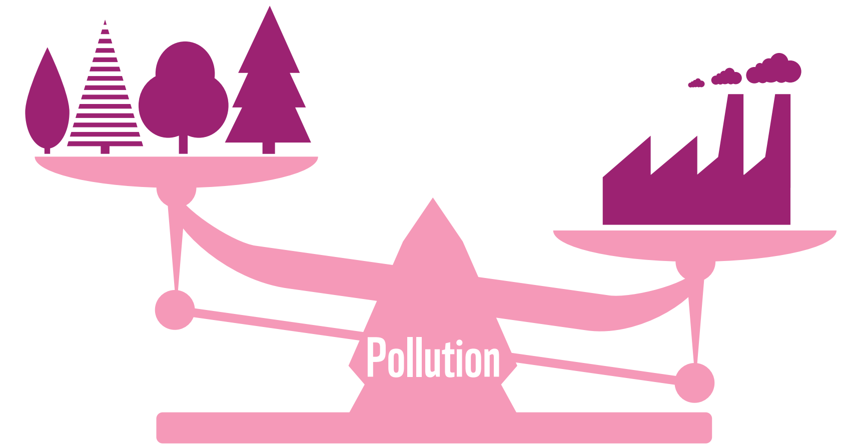
THE FOOTPRINT OF WOOD COMPARED TO OTHER MATERIALS

More demand for renewable materials, whether driven by legislation, policy or personal choice, could lead to more use of wood-based products.

The potential for more innovative uses of wood heightens the need for accurate life-cycle comparisons of wood products with alternatives derived from fossil fuels, mines or quarries. Results could have major implications on policies and consumer preferences.

The complexity of evaluating the overall footprint of different products has prompted a plethora of life-cycle assessment (LCA) methodologies and much subjectivity in their application. This means LCA studies are difficult to compare and often reach opposing conclusions. Causes of inconsistency include varied approaches to quantifying impacts, especially on biodiversity, of raw-material extraction across sectors and contexts, and uncertainties due to the lack of representative and up-to-date inventory data on inputs. The ISO guidelines on LCA (ISO 14040:2006 and revisions) stress the need for transparency in LCA reporting and provide guidance tailored to specific product categories.





We need to understand how the environmental costs and benefits of wood-based products compare with similar products made from other materials. More robust studies on product footprints could help us make important everyday choices:

- **Wood, concrete or steel in buildings?**
  Wood-frame houses create space in the walls for easy insulation, while innovative engineered wood beams can bear the loads needed to structure a multi-storey building with less mass than steel and concrete alternatives. A recent study[6] of energy "embodied" in building materials found that wood outperformed cement and steel by more than a factor of 10 on energy and GHG savings in the supply chain per cubic metre constructed. But comparing the full environmental impact of materials is not simple: design variables, for example, affect the efficiency of heating, ventilation and air conditioning over the life of the building.
- **Wood, oil or cane to make plastic packaging?**
  The use of fossil-based plastic packaging has a range of well-documented environmental problems[7].Polylactic acid, a compostable bio-polymer substitute for fossil-based plastic packaging, can be made from sugars extracted from the cellulose (C6 sugars) and hemicellulose (C5 sugars) of wood[8]. But how does this compare with another substitute – high-density polyethylene made from sugarcane?
- **Paper, fossil-based plastic or glass for beverage containers?**
  A meta-analysis of LCA studies on the environmental impact of beverage packaging found most studies ranked the environmental performance of wood-based cartons ahead of other forms[9].
- **Plastic, aluminium or cork[10] for wine bottle stoppers?**
  One study found that the cork stopper out-performs aluminium and oil-based plastic alternatives in reducing GHG emissions, atmospheric acidification, ozone depletion, eutrophication of surface water and solid waste[11]. Using cork supports biodiversity-rich forests in the Mediterranean and elsewhere. Producers also claim new treatments have dramatically reduced the risk of wine being wasted after becoming tainted by chemical compounds sometimes found in cork[12].

THE MANY LIVES OF WOOD

A single piece of wood or wood fibre can be recycled through a succession of different products.

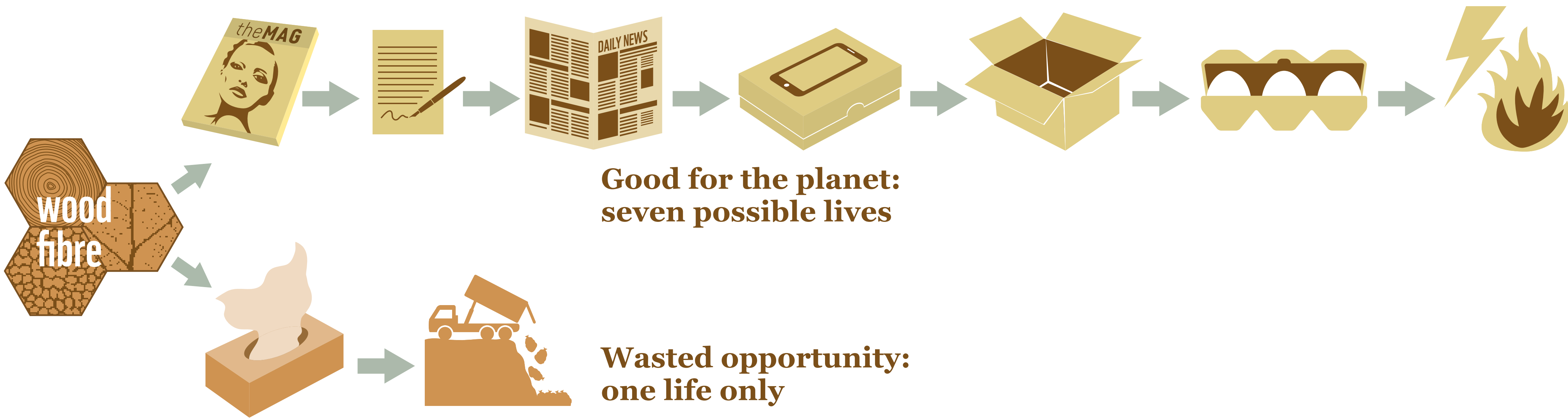
Nearly all types of solid wood can be reused if recovered and separated from other waste. Wood can be salvaged from old buildings, bridges and wharfs and used again in modern décor, from furniture to flooring. Smaller, less valuable wood scraps can be collected and used to make particle board and other modern composite products. In the UK, more than half of the wood previously sent to landfill is now recycled[13].

Paper can be recycled and reused many times, thus reducing the volume of **virgin wood fibre** needed to produce paper products.

This recycling flow can be shortened if paper is prematurely burned or dumped in landfills. In 2010, 28.5 per cent of the 227 million tonnes of municipal waste generated in the US was paper and **paperboard**[14].

The proportion of virgin wood fibre that needs to be added at each recycling stage depends on the product quality requirements, for example, virgin wood fibres tend to be stronger, longer and produce whiter paper than those that have been recycled several times. Technologies are under development for a very short wood fibre that can be used even beyond the seven uses shown below.

The many lives of a wood fibre



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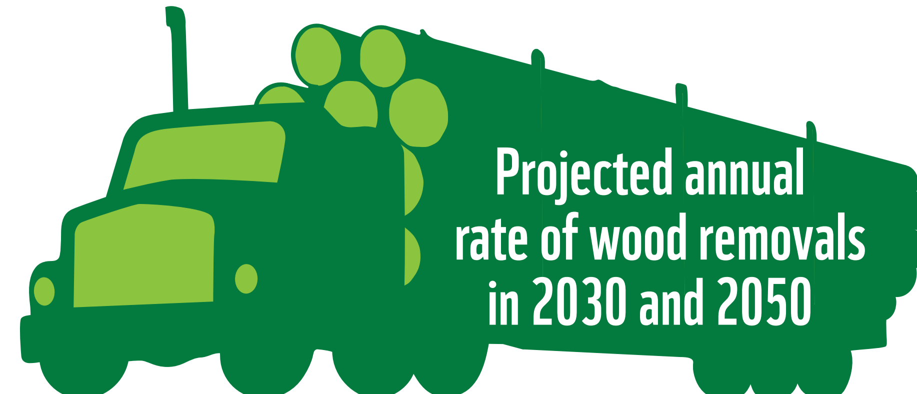
THE DEMAND FOR WOOD PRODUCTS

The Living Forests Model projects significant growth in wood removals to meet rising demand for wood products.

In 2010, global reported wood removals[15] amounted to 3.4 billion m^3. Total removals were undoubtedly higher due to illegal or unreported wood harvesting, especially fuelwood. Of the reported harvest, 1.5 billion m^3 was used as industrial roundwood and the rest for fuelwood[16].

The Living Forests Model (see figure) projects annual wood removals in 2050 will be three times the volume reported for 2010. The projection includes steadily growing demand for solid wood and paper products between now and 2050 in emerging markets. However, a projected massive escalation in use of wood as a feedstock for bioenergy is the main driver of rising demand. The Living Forests Model projects that by 2050, annual demand for **energy wood** (woody biomass that is not used for household fuelwood or the production of wood-based products) alone will exceed 6 billion m^3 under the **Do Nothing scenario** and 8 billion m^3 under the **Bioenergy Plus scenario** (the latter projection is more than double the total reported wood removals in 2010)[17].

The Living Forests Model projections are based on certain assumptions, and should not be read as an attempt to forecast the future, given the many uncertainties that will affect future demand and supply. For example, the model does not attempt to factor in potential, but currently unknown, uses of wood spurred by future technological innovation, nor does it assume dramatic shifts in consumption patterns or recycling rates. However, the model does highlight the likelihood of steady growth in overall volume of virgin wood for products and the potential for dramatic growth in the volume of wood harvested for use as energy “and to reach ambitious carbon mitigation targets under the Bioenergy Plus scenario [18].



	FAO 2010	LIVING FORESTS MODEL 2030 Do Nothing	2030 Bioenergy Plus	2050 Do Nothing	2050 Bioenergy Plus
Saw logs & veneer logs	853	1,444	1,444	1,763	1,773
Pulpwood*	527	754	754	905	893
Other industrial roundwood[19]	153	153	153	153	153
Energy wood	1,868	2,753	3,138	6,317	8,209
Household fuelwood		2,064	2,064	2,218	2,054
Total wood supply	**3,401**	**7,168**	**7,553**	**11,356**	**13,082**

Units: millions of cubic metres (roundwood equivalent)

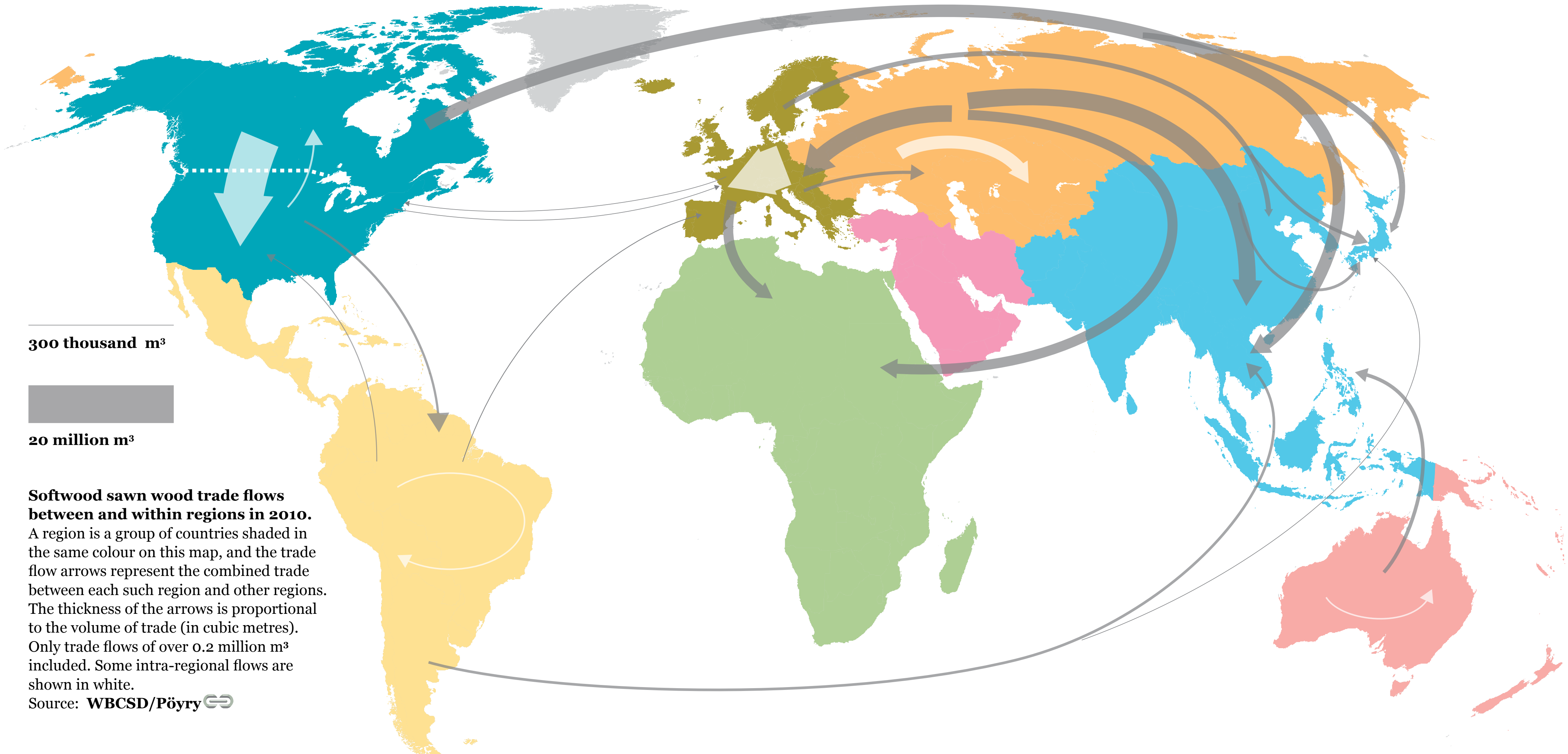
Projected annual rate of wood removals in 2030 and 2050 under the Living Forests Model’s Do Nothing and Bioenergy Plus scenarios compared to FAO statistics on reported wood removals in 2010. Source: FAO (2010 figures20) and IIASA (2030 and 2050 projections)

* Pulpwood does not include offcuts and sawdust from saw logs that are used in significant amounts in pulp production.

TRADE IN SAWN WOOD AND PANEL PRODUCTS

The major regions importing sawn wood and panels are Asia, North America and Western Europe, although Africa and the Middle East are fast emerging as major destinations.

The increased demand for sawn wood and panels could compound the pressure on forests in WWF priority places such as the Amazon and Guianas, Chocó-Darién, Sumatra, Atlantic Forests, Altai-Sayan Montane Forests, Borneo, Mekong Complex, Southwest Australia, Congo Basin, Amur-Heilong, Yangtze Basin, Southern Chile, Coastal East Africa and the Mediterranean.



Softwood sawn wood trade flows between and within regions in 2010.
A region is a group of countries shaded in the same colour on this map, and the trade flow arrows represent the combined trade between each such region and other regions. The thickness of the arrows is proportional to the volume of trade (in cubic metres). Only trade flows of over 0.2 million m³ included. Some intra-regional flows are shown in white.
Source: **WBCSD/Pöyry**

WHERE IS PAPER MADE AND CONSUMED?

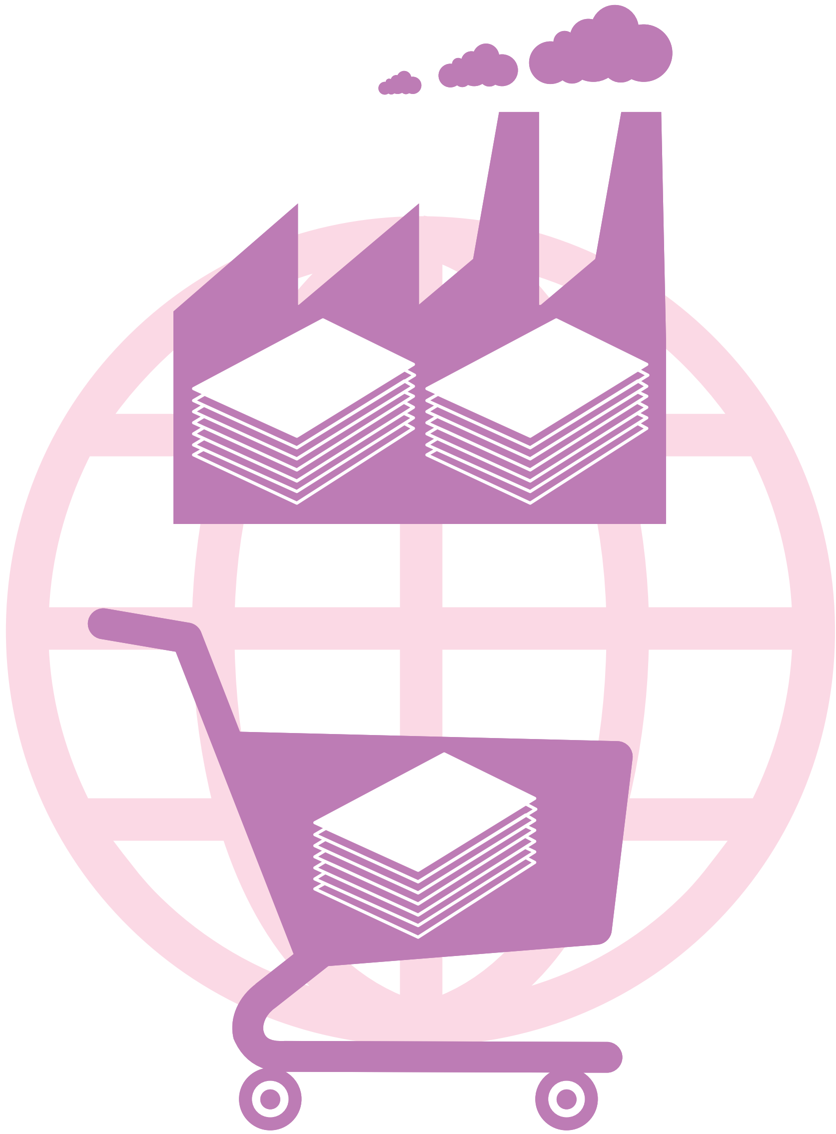
Around 40 per cent of the annual industrial wood harvest is processed to make paper and paperboard.

The volume of wood used in this production has doubled since the 1960s. Paper and paperboard production has increased fourfold in the same period, through increased wood harvest and use of **recovered paper**[21].

As shown in Figure A, Page 12, the main paper consuming countries/regions are China, the US, Japan and Europe (mainly Germany, Italy, UK, France)[22]. While China appears to be consuming most of its paper production, this statistic masks that as much as a quarter is exported as packaging for manufactured goods and in finished products that use paper (e.g., in instruction manuals)[23]. Most analysts anticipate a continuing shift in trade patterns due to faster-growing demand in emerging markets. The highest long-term demand growth for paper is expected in packaging (wrapping paper, containers and cartons) and tissue[24]. Demand for printing and writing papers has lower expected growth – even declining in some regions, leading to a lower net demand for wood pulp in North America, Japan and Western Europe.

Trade in **market pulp** is growing steadily as more paper products are produced away from the wood supply. This is associated with a trend to locate paper mills closer to the end customer (for example, to supply specialized products tailored to the buyer's needs) or in countries with comparative advantage in manufacturing (e.g., China).

The increased demand for virgin wood fibre for pulp and paper and the related wood pulp trade (see map on next page) could compound the pressure on forests in WWF priority places such as Sumatra, New Guinea, Southern Chile, Amur-Heilong, Altai-Sayan, Chocó-Darién, Atlantic Forests and Borneo.



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GLOBAL WOOD PULP TRADE FLOW

Wood pulp trade flows between regions in 2010.
A region is a group of countries shaded in the same colour on this map, and the trade flow arrows represent the combined trade between each such region and other regions. The thickness of the arrows is proportional to the volume of trade (in tonnes). Intra-regional flows and flows below 100,000 tonnes are excluded.
Source: **WBCSD/Pöyry**

PAPER CONSUMPTION AND PRODUCTION

In 2009, China (24 per cent) and the US (19 per cent) were the world's biggest paper and paperboard producers[25]. North America and the Nordic countries have built very few new production lines in the past 15-20 years and will decrease production in the future, while Asia's production is expected to increase (see figure A). According to WBCSD/Pöyry estimates[26], the main paper-producing region in 2025 (see figure B) will be Asia ahead of North America and Western Europe. Increased demand for wood pulp and recovered paper is projected in China, the rest of Asia, Eastern Europe and Latin America.

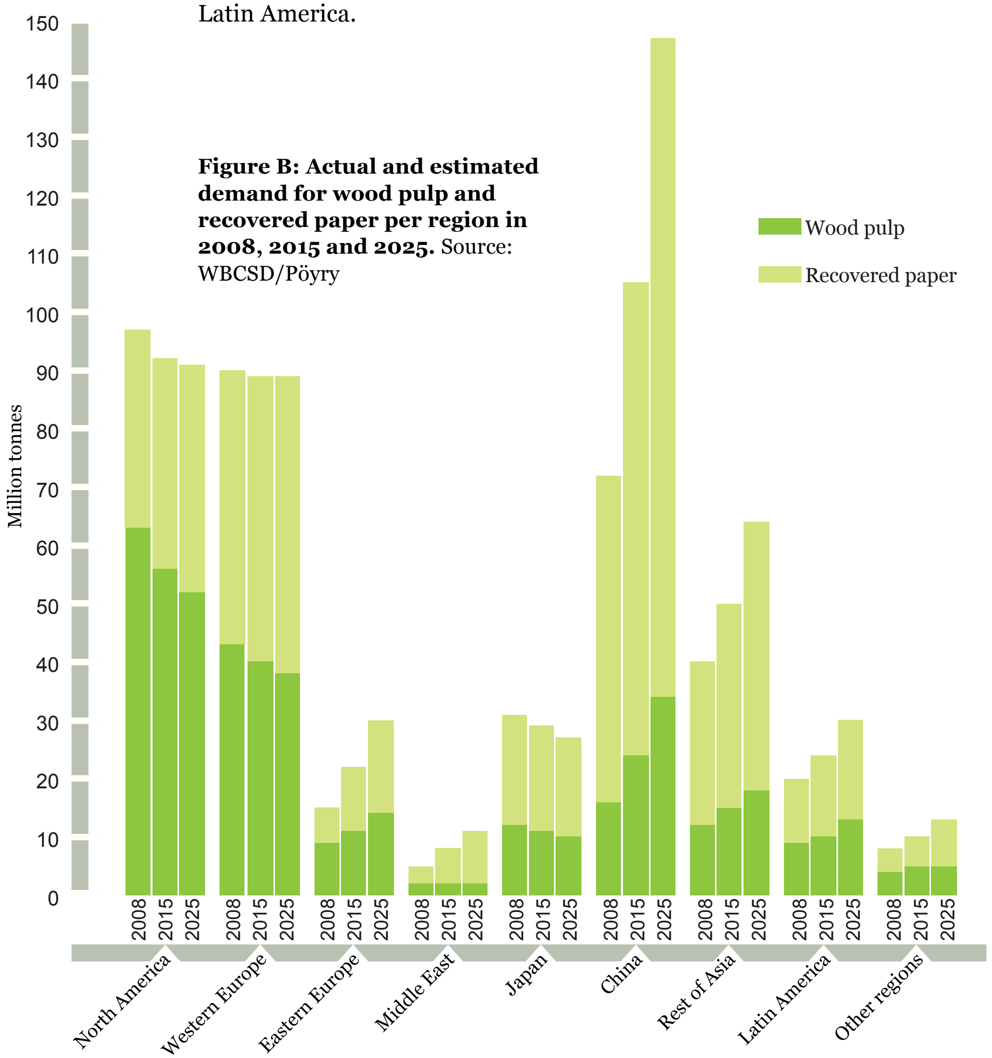

Figure B: Actual and estimated demand for wood pulp and recovered paper per region in 2008, 2015 and 2025. Source: WBCSD/Pöyry

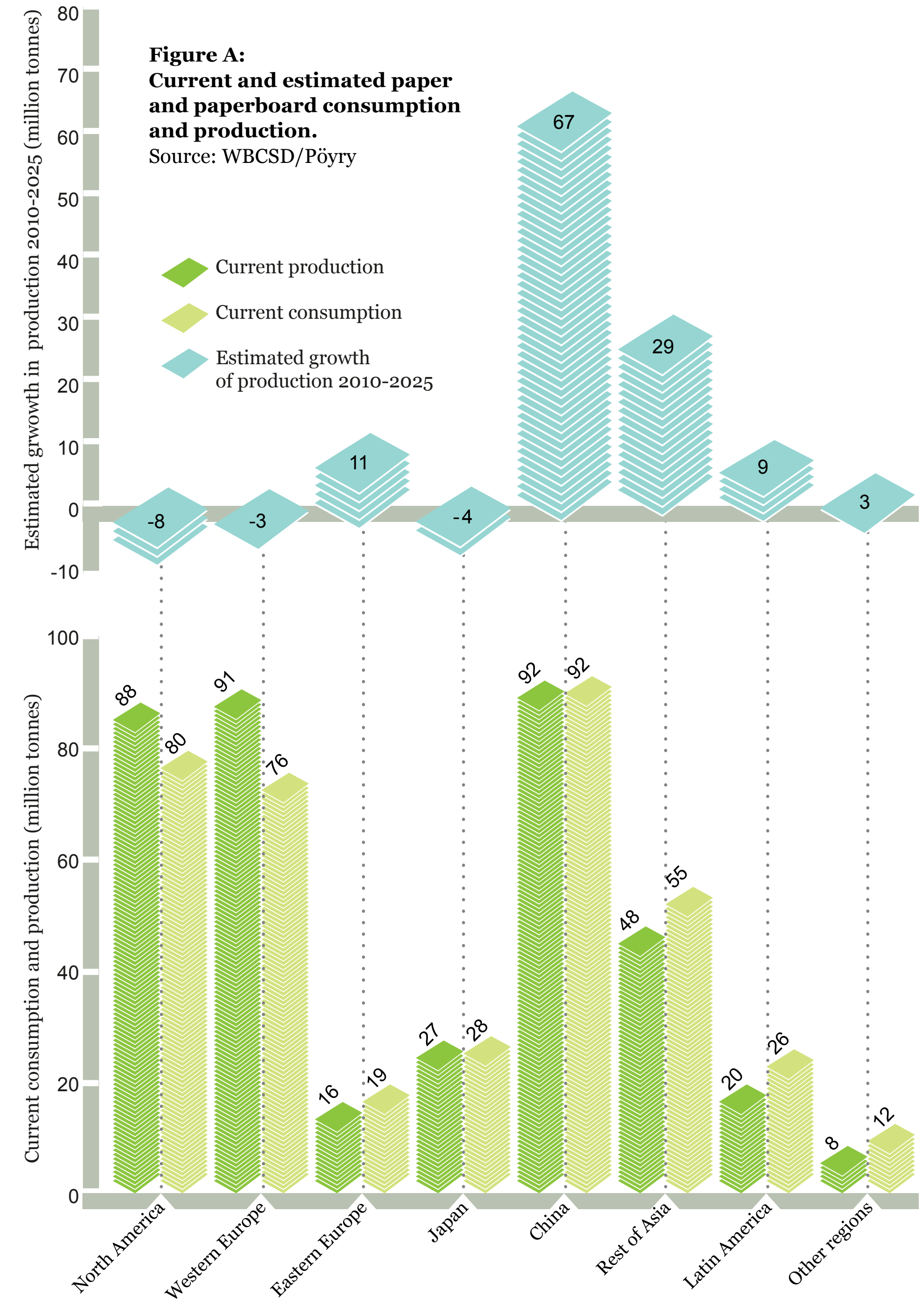

Figure A: Current and estimated paper and paperboard consumption and production. Source: WBCSD/Pöyry

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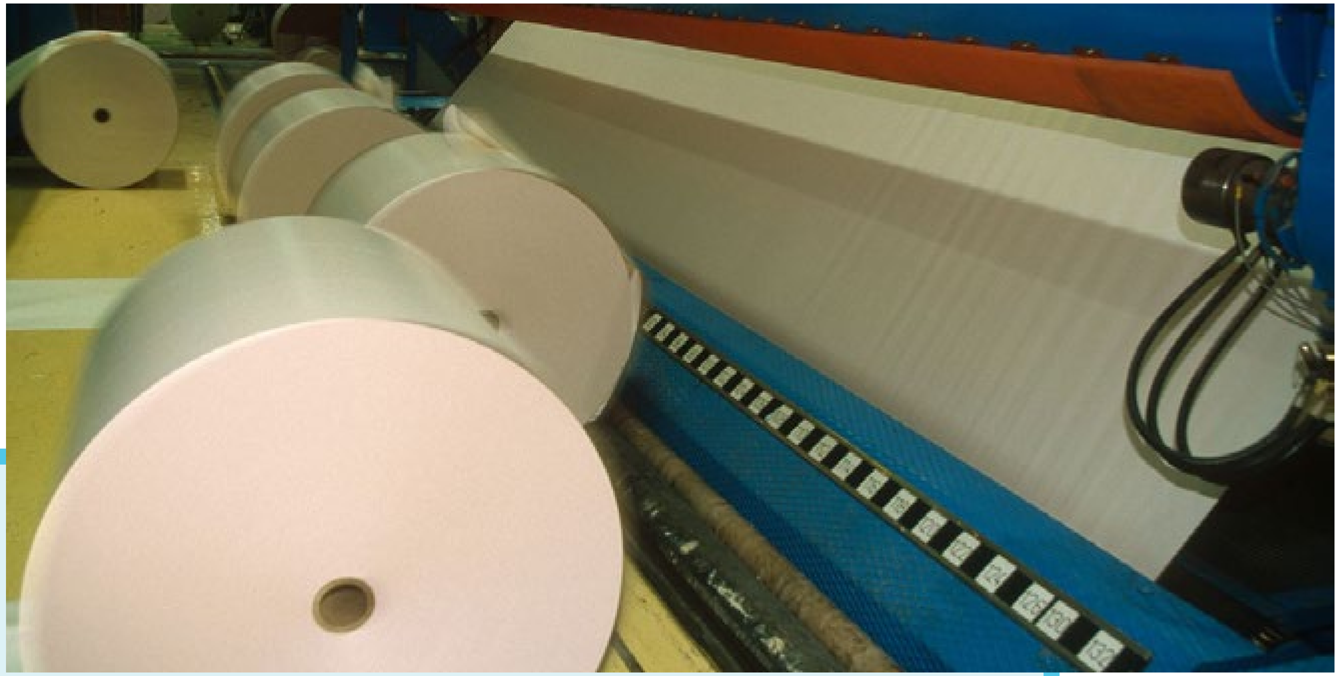
TALKING POINT: AN INDUSTRY VIEW


© EDWARD PARKER / WWF-CANON

Paper produced from a certified forest in Sweden.

The forest industry has a long history of change and expansion, from papyrus to Gutenberg and modern paper machines and bio-refineries. It now stands before another period of change and transition. There are three main foundations for the success of this change: sustainable management of a renewable raw material in natural forests and plantations; new processes and technologies; and, finally, new types of bio-based products for the consumer.

In sustainable forest management, consistent work in developing methods, equipment and certification for forests in all corners of the world is bearing fruit. The integration of new harvesting technology, new models for plantation forestry, new programmes to extend the use of environmental best practices, new ways of addressing social issues and the assurance, education and technology transfer benefits of independent certification are bringing results with accelerating speed – in conserving biodiversity, for instance.
New technologies are being developed by the industry and equipment manufacturers, including more material- and energy-efficient processes and advances such as nanotech coating, new pulping methods, and engineered wood building systems. This increasingly happens in cooperation with the end product part of the chain. The new high-tech wood-based solutions will leave a significantly lower ecological footprint than alternative materials.

In new products, the industry enters even deeper into the consumer's day-to-day with bio-based materials, biofuels and bio-based chemicals, leading to new alliances. Among others, the automotive, pharmaceutical, cosmetics, textiles, electronics and food sectors are becoming a closer part of the forest industry's network.

The forest-based industry is central to a new low-carbon economy. Wood-based products can substitute for many less sustainable, non-renewable alternatives. Forests represent the best investment option for large-scale carbon storage.

Sustainable forest management is the key strategy for producing more fibre. Innovation, including through biotechnology, will also be essential for expanding the sustainable supply of biomass in a resource-limited world. Using this fibre wisely as a foundation of a bio-based economy is a significant sustainable development opportunity.

All in all, the forest industry is embracing this change as an opportunity. In an age of resource scarcity, its sustainable, renewable, material-efficient products are ideally placed to satisfy the needs at the heart of the consumer's daily life.

José Luciano Penido, Chairman, Fibria and Riikka Joukio, Senior Vice President, Metsä Group; Co-chairs, WBCSD Forest Solutions Group

IMPACT OF RECYCLING ON OVERALL DEMAND FOR WOOD

Increasing the proportion of recycled material in wood products can reduce demand for virgin wood fibre and increase the net value of wood.

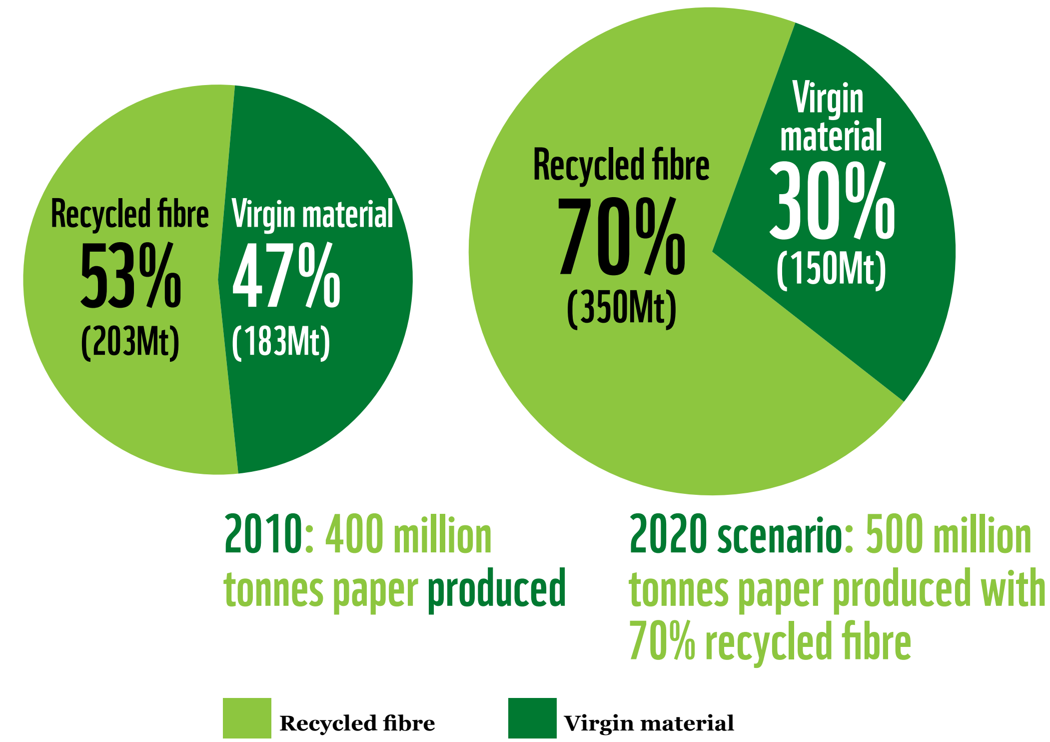
Use of material other than virgin wood fibre for the production of sawn wood, panels and paper increased from 21 per cent of total fibre use in 1990 to 37 per cent in 2010 and is projected to reach almost 45 per cent in 2030[27]. Recovered paper is the largest source, then **non-wood fibre**, but collection of waste wood products (demolition waste, used furniture, etc.) is increasing rapidly, as is use of recycled wood in board production.

In 2010, recovered paper comprised 53 per cent of the fibre used in global paper production, increasing from 43 per cent in 2000[28]. Virgin fibres make up the other 47 per cent, including 4.7 per cent from non-wood sources (e.g., bamboo, agricultural residues, etc.)[29]. Non-wood fibres are used extensively in India, for example, and if sourced from sustainably managed areas could help reduce the footprint on forests.

Paper recovery and use vary greatly between countries. China alone imported 50 per cent of the recovered paper that was internationally traded in 2009[30]. Recovered paper use will further grow in the future. A scenario developed by Voith[31] (see figure) indicates that even with higher global paper consumption, demand for virgin material (both wood and non-wood) would drop if global use of recovered paper increased. In theory, this would reduce the share of the world's forests and land that needs to be allocated to fibre production for the paper industry.

Increased recycling involves sorting and separating paper products from other waste. A **recovery rate** of 90 per cent was reached by South Korea in 2009. Efforts to increase recycling are likely to have the greatest impact on the overall footprint of the paper industry if targeted at countries with low recovery rates and increasing consumption; reducing the distance that recovered paper is transported for recycling would also have a significant effect.

Producing more paper with less virgin material



Increased paper recycling and improved paper-making technologies could reduce the demand for virgin material by 2020. The ratio of different fibre sources (in % and volume) for worldwide production in 2010 (source: FAO[33]) and under a scenario for the year 2020 (source: Voith[34]).

Trends in the mix of paper products consumed will affect the prospects for increased recycling. **Recycled fibres** make up almost 80 per cent of fibre in **container boards**, but barely 10 per cent of fine printing paper, for instance. Consumer preferences are another key factor. For example, increased consumer demand for recycled content could erode the market for pure-white tissues, motivating the makers of these throwaway products to use more recycled fibre – today's global average for recycled fibre in tissue products is 50 per cent[32].

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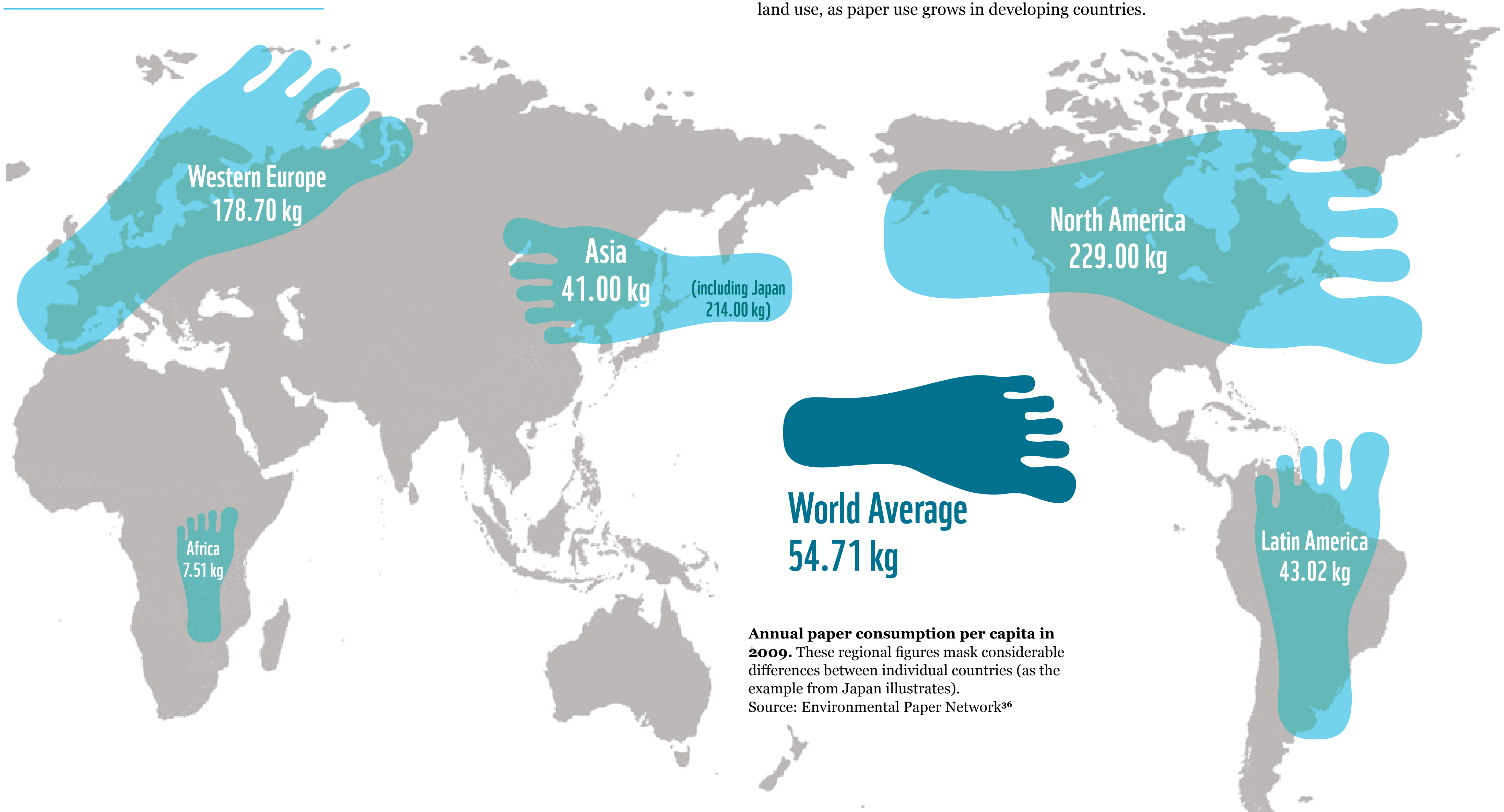
PAPER CONSUMPTION PATTERNS

Rich societies can reduce wasteful paper use, while the poor need more paper for education, hygiene and food safety.

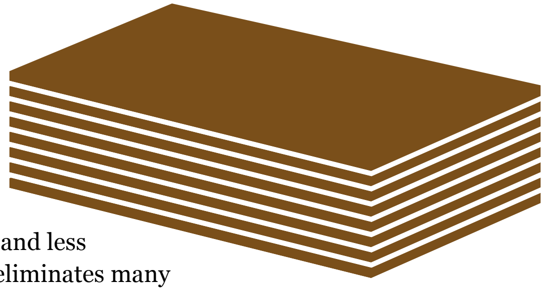
Today, 10 per cent of the world's population consumes over 50 per cent of the paper[35]. This is hardly fair – paper is an important means to share knowledge and express ideas, improve sanitation and keep food safe. A 10 per cent reduction in paper and paperboard consumption in North America and Europe would match one year's consumption in Africa and South America combined. Reducing wasteful consumption, like over-printing or over-packaging, would also ease the pressure on forests and land use, as paper use grows in developing countries.



Annual paper consumption per capita in 2009. These regional figures mask considerable differences between individual countries (as the example from Japan illustrates).
Source: Environmental Paper Network[36]

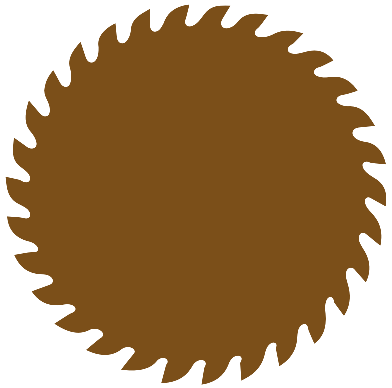
MORE PRODUCTS FROM LESS WOOD

In addition to increased recycling, more efficient processing and manufacturing can help reduce pressure to extract more wood from forests.



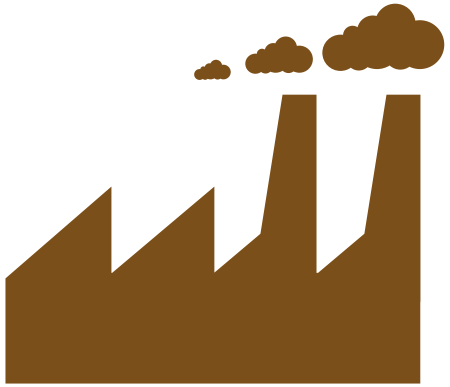
Changing technologies

Engineered wood products make very efficient use of a given volume of wood and can be manufactured from fast-growing, underutilized and less expensive wood species. Engineered wood also eliminates many defects found naturally in wood, improving the material's inherent structural advantages. By-products from other production processes – small chips or unusable pieces of wood – can increasingly be used in composites and pulp. In the paper industry, new product designs and advances in engineering offer the prospect of near limitless reuse of short, recycled fibres.



Sawmills

On average sawmills operate at around 50 per cent efficiency[37]: in other words, only half the saw log is converted to sawn wood. In Europe and North America some mills reach above 70 per cent efficiency. Many mills are able to send their sawdust and off-cuts for further processing, such as the manufacture of panel products, but this is not always the case. While challenges vary regionally (tropical sawmills, for example, deal with a larger variety of log sizes and species), greater efficiency is possible through better logging and log grading systems, infrastructure and sawing technology. A 10 per cent increase in milling efficiency for tropical sawn wood could reduce global demand for saw logs by 100-200 million m^3 per year[38]. Increased efficiencies in small sawmills will increase profitability, benefiting local communities.



Pulp and paper mills

Ongoing innovation is enabling more efficiency in pulp and paper mills. New processing technologies mean more cellulose fibres can be extracted from a given volume of wood and less left to be burned. Smart use of mineral additives in paper, and better-engineered packaging (thinner but stronger), allow more units to be produced from the same volume of pulp. Increasingly mills can be seen as "bio-refineries" with by-products used to substitute oil from fossil fuels in materials such as polylactic acid.

Use of non-wood fibre

Other plant-based materials can supplement the use of wood fibre in many product lines: these include paper made from bamboo fibre or residues from food crops and furniture made from rattan. The relative efficiency and environmental impact of these other plant fibres will vary with the circumstances in which they are grown, sourced and processed and the fibre properties they bring to the end product.

OPTIONS FOR INCREASING WOOD PRODUCTION

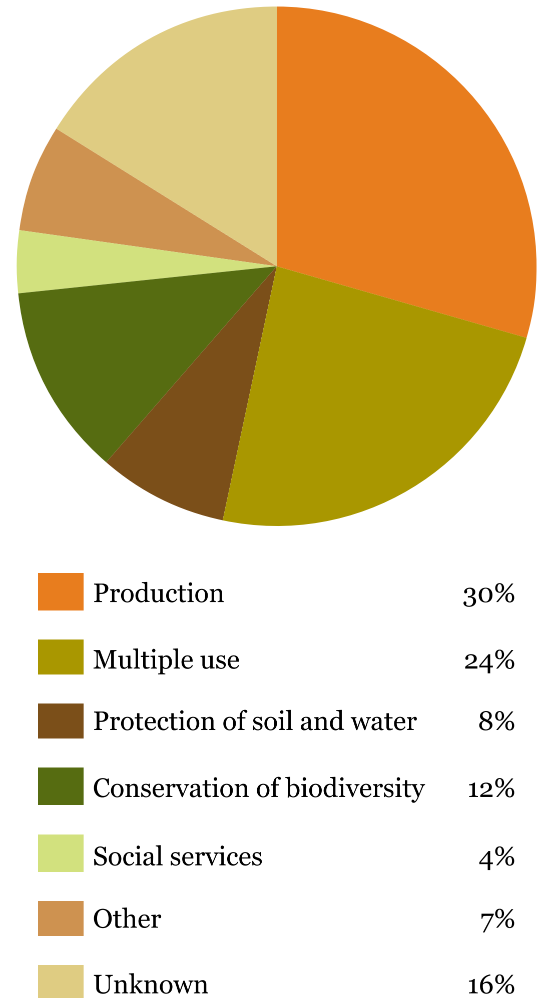
Higher demand for wood could be supplied from new plantations and by extracting more from natural forests.

The Living Forests Model projects a significant increase in wood demand (including as a feedstock for bioenergy) over the coming decades, even with increased recycling, reuse and efficiency. According to the model, this demand can be met by a combination of enlarging the portion of the world's natural forests that is managed for production, and establishing new tree plantations.

According to statistics collected by the FAO, almost 1.2 billion hectares of forest (or 30 per cent of the total forested area) are currently designated primarily for the production of wood and NTFPs with an additional 949 million hectares (24 per cent) designated for multiple uses – usually including some extraction of wood and NTFPs (see pie chart). Worldwide over 60 per cent of the growing stock in the production forest area consists of commercial species (ranging from over 90 per cent in Europe to just 20 per cent in Africa), though not all are of harvestable size or in areas available for wood supply[39].

In 2010, the world's estimated **growing stock** of wood totalled 527 billion m^3 in all forests and plantations and 15 billion m^3 in other wooded land[40]. This has decreased slightly in the last 20 years due to net forest loss, but growing stock per hectare has increased[41]. Over 165 billion m^3 of growing stock (nearly one third of the global total) is in areas zoned for production (natural forests and plantations) or multiple use[42].

Reported global wood removals in 2010 amounted to 3.4 billion m^3, of which about half were industrial roundwood (1.533 billion m^3) and half fuelwood[43]. That means total wood removals were less than 1 per cent of the world's growing stock, and industrial roundwood removals comprised about 1 per cent of the growing stock in production and multiple-use forests. This suggests there is no shortage of wood in the world's forests; however, the sustainability of extracting more depends on many local variables in community aspirations, ecology and forest management practices. Already, high-value species (such as mahogany, merbau, Chinese oak and ramin) and large saw logs are in short supply in some regions[44].



Global forest functions in 2010. Source: FAO

Figures do not add to 100% due to rounding

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SHOULD MORE NATURAL FOREST BE OPENED UP TO COMMERCIAL HARVESTING?

To supply more wood, natural forests can either be logged more heavily or logged lightly over a larger area.

Depending on the scenario, the Living Forests Model projects that between 242 million and 304 million additional hectares of natural forest outside protected areas would need to be managed for commercial harvesting by 2050[46]. The scenarios assume that demand for wood beyond the volumes sourced from plantations will come from well-managed natural forests, and project an expansion of up to 25 per cent above the current area of natural forest used for commercial wood production.

The environmental and social impact of any new logging concession or tree plantation will vary according to local context, management practices, safeguards applied and how revenues are distributed. This makes it difficult to draw blanket conclusions about the respective merits of expanding production in natural forests or more plantations as a means of increasing the global supply of wood.

Similarly, there is no simple verdict on whether it is better to log natural forests more heavily in a smaller area or conduct a lighter form of logging over a larger area. The options will be defined by restrictions under local laws or voluntary sustainability standards, and by what is economically viable. The optimal balance between protection and exploitation of forests is hotly contested from ideological and scientific standpoints. Debates rage over the impacts of logging on forest carbon[47] and studies have reached sharply differing conclusions on the biodiversity impacts of logging in tropical forests[48,49]. One recent study concluded that the economic forces behind industrial logging regimes are several hundred years out of synchronization with the natural cycles of forests[50]. In addition, increased harvesting, particularly of previously undisturbed boreal forests, would likely lead to a major release of carbon, largely from peat deposits[51].

Not all the natural forests currently designated for production are commercially viable, while others are being "mined" by over-harvesting or destructive logging. Optimizing yield from the total area designated as production forest will require some changes in the location and configuration of this area and assumes robust land-use planning. For example, heavily degraded production forests that are no longer commercially viable could be rezoned for other uses that would enable their restoration and regeneration.

SUSTAINABLE WOOD EXTRACTION AS A FOREST CONSERVATION STRATEGY

Forest stewardship, motivated by a commercial interest in maintaining wood supply, can help protect vulnerable forests from illegal logging, encroachment or conversion to farmland.

The market for wood can motivate good forest stewardship that safeguards a critical resource and protects forest values; or it can destroy the very places where wood grows.

Production forests play a crucial role in maintaining global climate, economic development and biodiversity conservation. They provide vital buffers for, and links between, protected areas. However, the capacity of production forests to provide ecosystem services and sustain timber yields varies greatly depending on how well they are managed and the values protected in the surrounding land-use mosaic. For example, poorly planned selective logging results in waste of harvested wood, unnecessary damage to residual trees and soil, and large canopy gaps that disrupt forest ecology and increase the risk of fire. The Tropical Forest Foundation suggests that 50 per cent less damage to remaining trees during logging operations would increase productivity on a given land base by 20 per cent[52].

The pursuit of conservation objectives in a forest managed for timber production may mean less wood is removed in each harvesting cycle, reducing revenues in the short term. Yet less intensive forms of logging and the creation of "set-asides" can also help maintain the longer-term productivity of the forest by sustaining ecological, carbon, nutrient and water cycles and decreasing vulnerability of tree species to disease and fire.

However, a forest manager may need to achieve a certain threshold of wood extraction per hectare to make the implementation of environmental and social safeguards viable or to compete with a possible alternative land-use that would require the forest to be cleared. For this reason, conservationists are often supportive of efforts to develop new markets for lesser-known tropical timber species. Cameroon, for instance, has an estimated 630 tree species of actual or potential commercial value, of which over 500 are scarcely used at all[53]. In such circumstances, improved markets for lesser-known species might help make responsible forest management viable. This is a double-edged strategy though, as more commercial species may make illegal logging more alluring in regions where governance is weak or encourage the expansion of logging into pristine forest areas.

Another way of making sound forest stewardship more viable is the creation of new market mechanisms (e.g., REDD+) to pay forest managers for environmental services provided. This may motivate management practices that are more sustainable than an operation seeking to maximize timber yields as its only revenue stream. Some stakeholders, however, oppose use of such funds for commercial forestry[27].

Management plans with environmental safeguards – an essential stepping stone?
The area of tropical natural forest currently used for wood production that is covered by management plans increased by about 35 million hectares between 2005 and 2010, to an estimated 131 million hectares[55]. The gap between forests with no management plan and those under responsible management is huge. While the growth in areas with a plan is a promising sign, the areas without management plans (roughly two-thirds of the 400 million or so hectares of production forest in the tropics) remain vulnerable to degradation or deforestation.

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TALKING POINT: A RIGHTS AND RESOURCES VIEW

Forest communities, indigenous peoples and smallholders manage a growing share of the world's forests, and an important share of forest products, services and employment. New rigorous research by the Rights and Resources Initiative analysing the world's most-forested developing countries makes clear that recognizing the rights of these stakeholders has strong social, economic and environmental benefits. It also shows that, globally, the area of forest recognized as owned or controlled by indigenous peoples and communities has increased from 10 per cent in 2002 to 15 per cent today; in the forests of developing countries it has increased from 21 per cent to 31 per cent (around 680 million hectares of forest lands). The 27 countries studied are home to 2.2 billion rural people and include 75 per cent of the developing world's forests. Secure local land rights are key to sustainable development – a global target set at the 1992 Earth Summit[56]. Legislation recognizing or strengthening land rights has also increased dramatically – with, for example, over 50 laws enacted since 1992. Adoption of the UN Declaration on the Rights of Indigenous Peoples (UNDRIP) in 2007 provided a new impetus, but major progress is still needed: 97 per cent of forest lands in Africa and 60 per cent in Latin America are still being contested.

Given secure tenure rights, many communities and smallholders become highly effective managers, reforesters and producers for high-quality export tropical timber, wood products for fast-growing domestic markets, NTFPs, and key environmental services including water and biodiversity conservation. Chhatre and Agarwal,[57] for example, link participation in community-owned forests to significantly lower carbon emissions in a sample of 80 forests in East Africa, South Asia and Latin America.

The developed world dynamics between private ownership and wood supply are also changing with demographics, reducing wood supply from some, and increasing it in others. Private forests in the USA contribute much more per hectare to GDP then public forests, and private forest owners in Europe have associated (e.g., through the International Family Forest Alliance (IFFA)) to supply changing wood markets, promote a next generation of owners and diversify the range of products and services their forests could provide.

Augusta Molnar, Rights and Resources Initiative

© KATE HOLT / WWF-UK

A child sitting in front of a recently felled tree on the edge of Virunga National Park, near the provincial capital of Goma in the Democratic Republic of Congo. Communities that depend on forest resources can be important allies in sustainable forest management.

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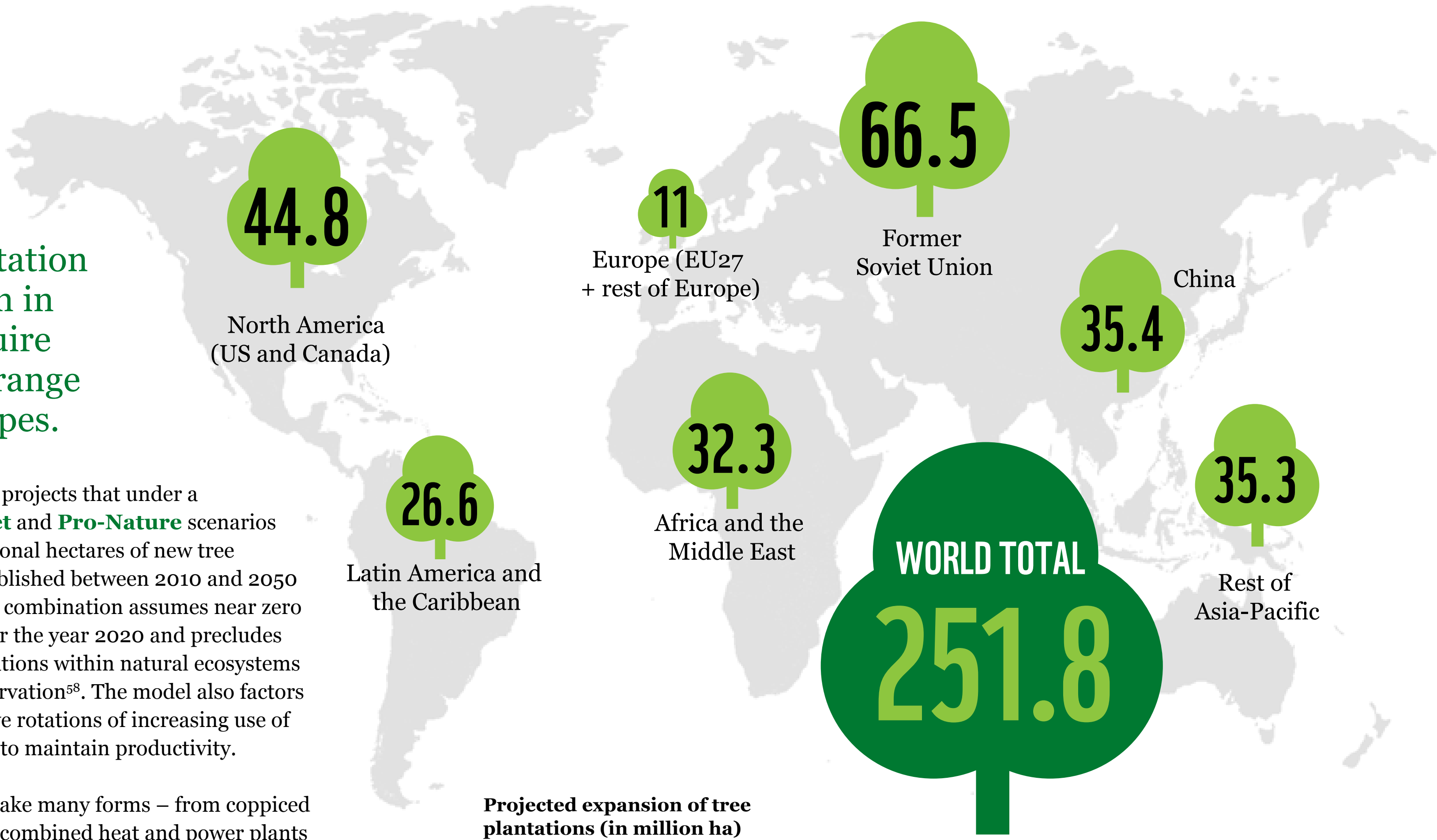
THE ROLE OF TREE PLANTATIONS: 1

Ending deforestation and degradation in forests will require expansion of a range of plantation types.

The Living Forests Model projects that under a combination of the **Target** and **Pro-Nature** scenarios around 250 million additional hectares of new tree plantations would be established between 2010 and 2050 (see figure). This scenario combination assumes near zero loss of natural forests after the year 2020 and precludes the creation of new plantations within natural ecosystems in priority areas for conservation[58]. The model also factors in the costs over successive rotations of increasing use of fertilizer and pest control to maintain productivity.

These plantations would take many forms – from coppiced willow and poplar to feed combined heat and power plants in cooler northern regions, mixed plantations of native species for high quality timber products, or "fastwood" acacia and eucalyptus plantations nearer to the equator.



Projected expansion of tree plantations (in million ha) under the Living Forests Model's Target and Pro-Nature scenarios combined, by region between 2010 and 2050. Source: IIASA

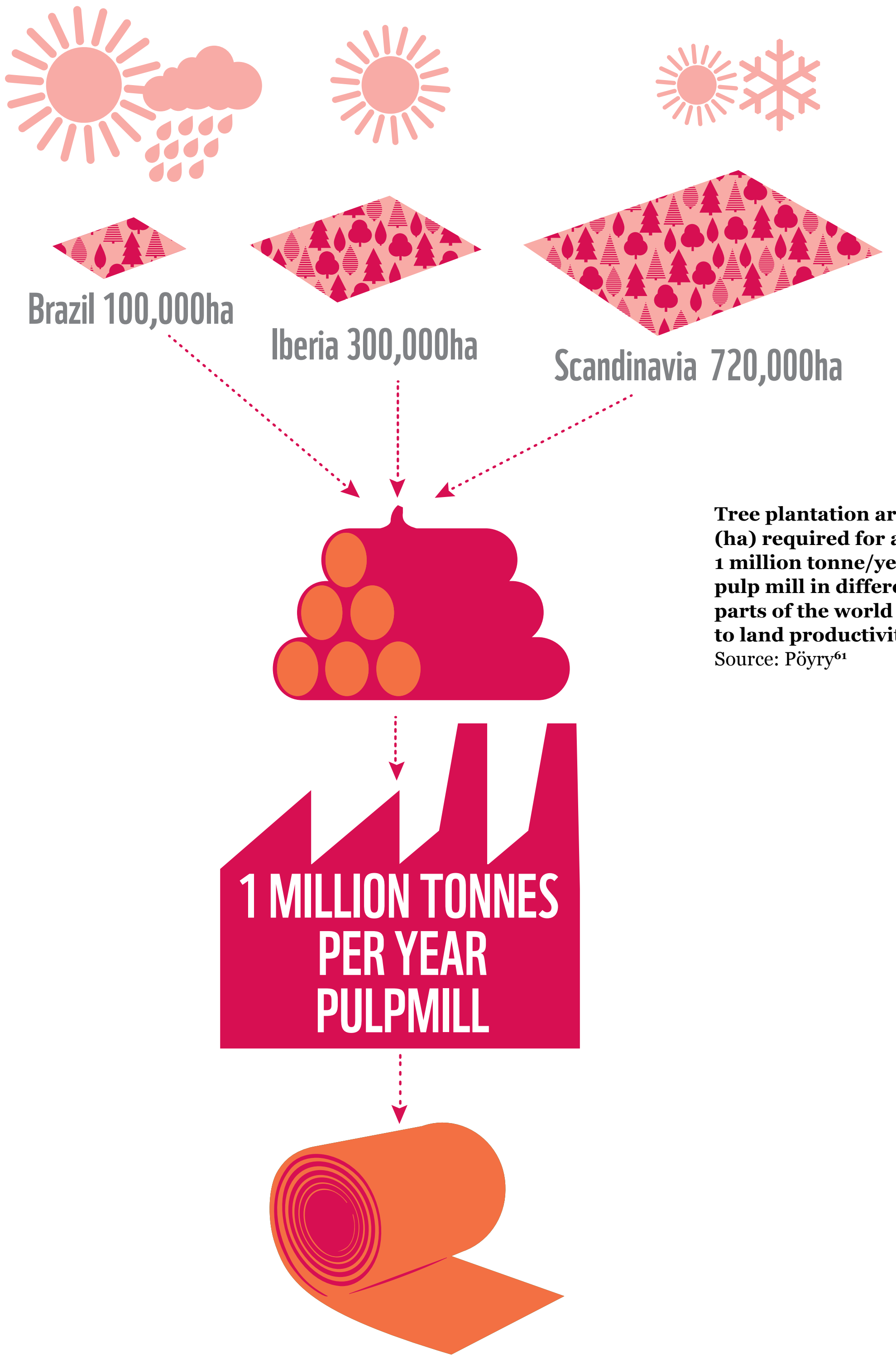
THE ROLE OF TREE PLANTATIONS: 2

In the right place and managed sustainably, tree plantations can reduce the pressure to bring natural forest areas into production.

Tree plantations made up only 7 per cent of total forest cover in 2006, but provided 50 per cent of industrial roundwood[59]. A growing proportion can be described as **intensively managed plantations**, with a rotation of 5 to 25 years. These supply around 40 per cent of plantation wood and their area has increased by 2 per cent per year since 2000, mostly in Asia, Oceania and South America[60]. They yield far more wood per hectare than natural forests, with the highest yields achieved close to the equator (see figure). Improvements in landscape planning and planting techniques could boost productivity even more.

Uncertainties remain, however, about the long-term impacts of tree plantations. Most intensively managed plantations are in their first or second rotation and are so new that long-term environmental impact studies are unavailable.

To realize the productivity benefits of plantations with positive rather than negative social and environmental impacts, further expansion of tree plantations should be focused on degraded land, while maintaining or restoring natural ecosystems in the surrounding landscape, safeguarding the rights and livelihoods of indigenous peoples and local communities, and promoting greater benefit-sharing.



Tree plantation area (ha) required for a 1 million tonne/year pulp mill in different parts of the world due to land productivity.
Source: Pöyry[61]

THE ROLE OF TREE PLANTATIONS: 3

Along with improved practices, advances in biotechnology could further boost plantation yields. But the precautionary principle[62] must be applied in deciding if and how they are deployed and such advances must first gain social acceptance.

The Living Forests Model assumes that future tree plantation yields will match the best yields achieved today for a given combination of climate variables and soil type[63]. However, in theory biotechnology, whether through conventional plant breeding or genetic modification, could improve plantation yields and reduce globally the portion of land that needs to be dedicated to wood production.

So far there has been very limited commercial deployment of genetically modified (GM) trees and no international consensus exists on the potential risks, benefits and ethics of GM technology (see box). Wherever GM organisms are proposed to be released into the environment, WWF advocates a strong precautionary approach with respect to environmental and social impacts and transparent monitoring for such impacts. National regulatory frameworks for environmental use and release of GM organisms (including field trials and commercialization) should support and implement the Cartagena Protocol on Biosafety.

GM trees

An extract from The Forests Dialogue Scoping Paper on GM Trees[67]

Gamborg and Sandøe[64] note "that if modern biotechnology is to stand a chance, three main conditions for public acceptance must be met: utility, low risk, and an assurance that the biotechnology is used in a decent way". But they also note that surveys suggest these are necessary but not sufficient conditions, and that "moral acceptability is a better predictor … than risk or usefulness". Thus, a fundamental challenge for proponents of GM trees is to build public trust[65], in part by finding ways of demonstrating to members of civil society that GM trees satisfy these conditions and tests. Societies will continue to rely on technological advances, such as those offered by genetic modification[66]; conversely, as aspects of the agbiotech debate (amongst many others) illustrate, scientific advances do not necessarily or inherently confer legitimacy or gain social acceptance. More profound social processes are necessary to engender legitimacy and acceptance of scientific innovation for which the balance of potential benefits and risks is uncertain, and this applies to GM trees as to other such technologies.

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WHERE IS NON-FOREST LAND POTENTIALLY AVAILABLE FOR NEW TREE PLANTATIONS OR RESTORATION OF NATURAL FORESTS?

In many regions there is potential to regain lost forest cover through mosaics of new plantations, natural forest restoration and responsible farming.

Map A (see next page) represents the maximum forest area the Earth could naturally support. Areas of existing tree cover are in dark green and currently non-forested areas, with the biophysical characteristics needed to make restoration of tree cover a possibility, are in light green. These are mainly areas where forests have been cleared since the last ice age, and currently comprise croplands, grasslands and degraded lands. Within these areas restoration of tree cover could take many forms – from ecological restoration for biodiversity objectives to **agroforestry** or intensively managed plantations.

Map B (see page 26) excludes current tree cover and shows the potential forest and tree plantation productivity in terms of expected mean annual increment of above-ground carbon in the potential areas for restoration of tree cover (light green areas in Map A) . The darker green areas are where restoration of tree cover would have greatest productivity. Depending on the purpose of the restoration, this would determine the speed at which carbon is sequestered, commercial timber is grown or habitat is restored.

WWF does not advocate the restoration of tree cover in all or most of the areas in Map B, which simply identifies areas with biophysical characteristics capable of supporting forests. A decision to restore tree cover in a specific place, for whatever purpose, must involve local stakeholders, respect the aspirations of local communities and recognize the right of indigenous peoples to give or withhold their free, prior and informed consent to activities that will affect their rights to their lands, territories and other resources[68]. The type of restoration is critical – restored natural forests, for example, will have higher biodiversity conservation value than single-species tree plantations.

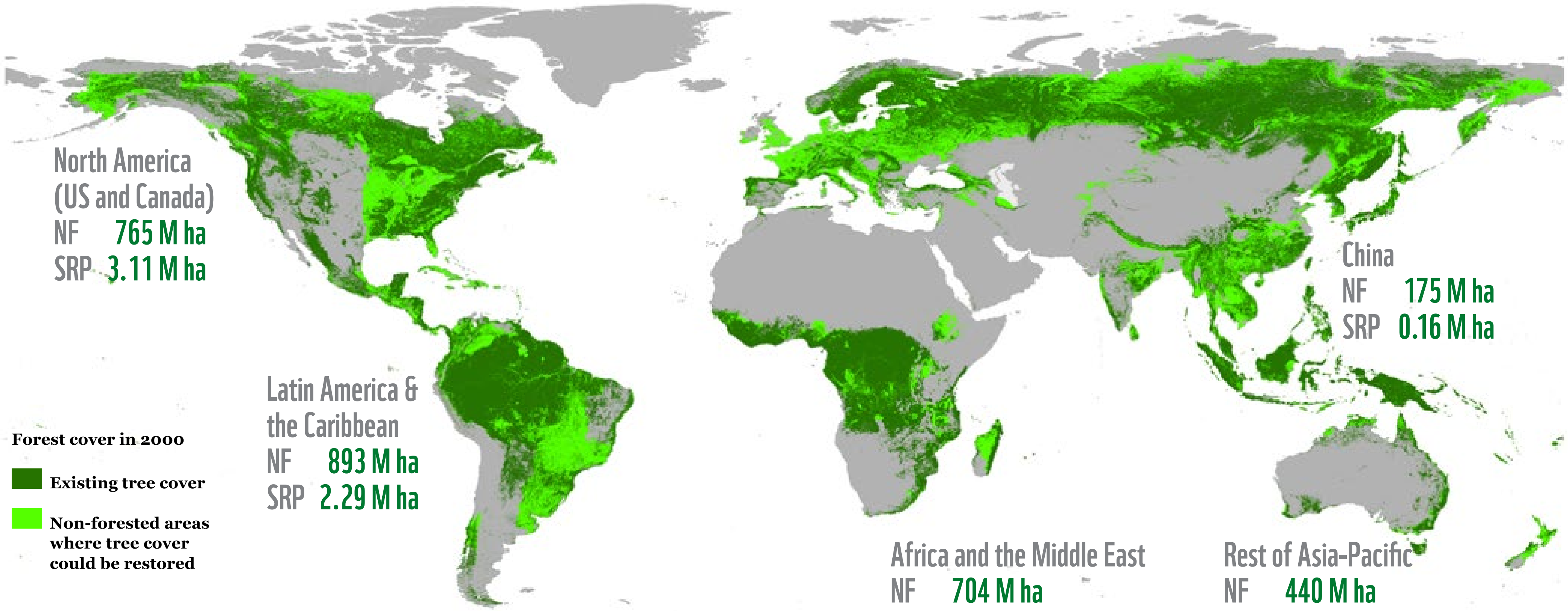
Depending on the circumstances, restoration of tree cover could enhance or conflict with food production. Allocation of land and water between crops, pastures, forests or tree plantations will ultimately depend on global consumption patterns and public sector policies around food, water and energy security. Changes in food consumption patterns (such as those outlined in the **Diet Shift scenario**[69]) will determine how much land with potential for restoration of tree cover could be taken out of food production without creating food shortages.

Many of the potential restoration areas overlap WWF's Global 200 ecoregions, a representative sample of biomes and habitat types where conservation would achieve the goal of saving most life on Earth. Sustainable land-use mosaics and restoration of forest cover are critical components of strategies to enhance ecological integrity and conserve biodiversity in many of these ecoregions.

GLOBAL POTENTIAL TREE COVER

World Totals

Natural Forest (NF) 4,347 M ha (million hectares)
Short rotation plantations (SRP) 7.29 M ha

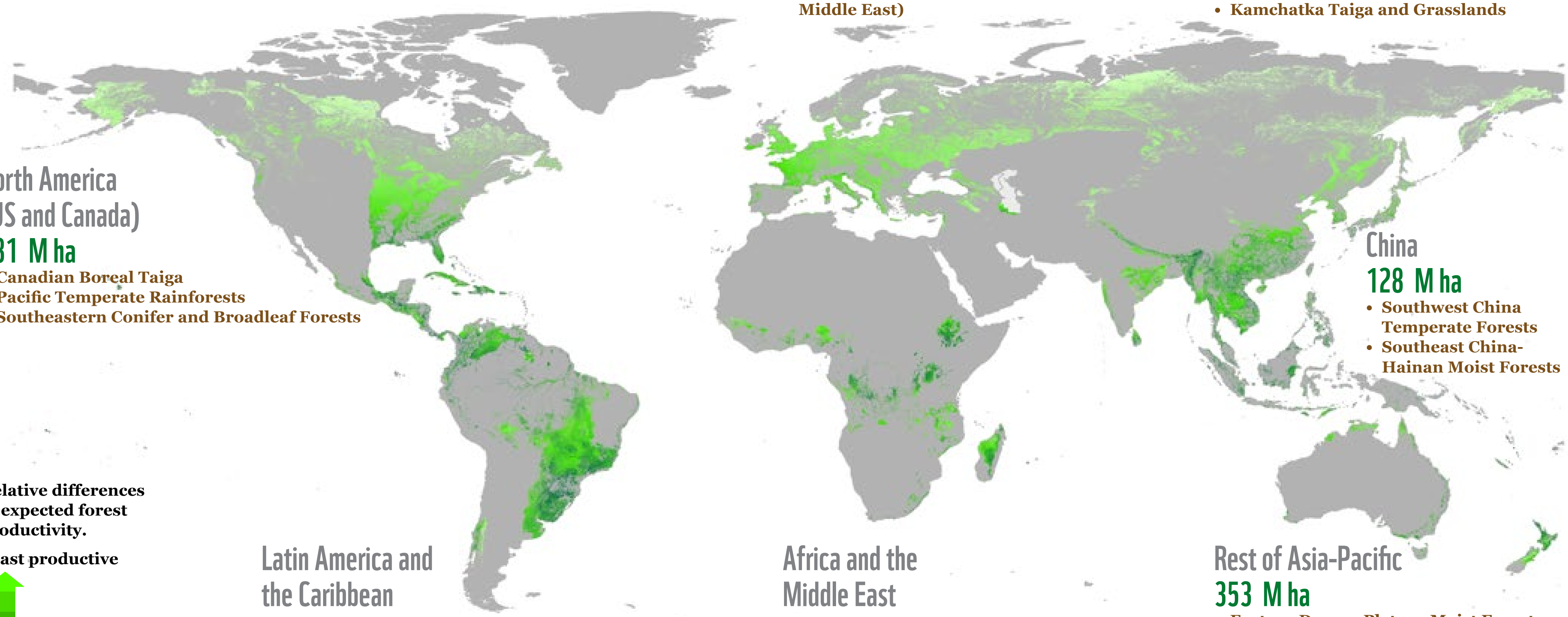


Map A: Global potential tree cover map. The Global Land Cover 2000 map was used to identify existing tree cover (dark green). The IIASA G4M biophysical model was used to identify areas where forests could occur (light green). The latter are non-forested areas with the biophysical characteristics needed to make restoration of tree cover a possibility)[70]. This is based on climate variables (temperature and precipitation) and soil characteristics from the Harmonized World Soil database.

POTENTIAL AREAS FOR RESTORATION OF TREE COVER

Map B: Potential areas for restoration of tree cover. This builds from Map A by excluding existing tree cover. Within the potential areas for restoration of forest tree cover, the map shows potential forest productivity, in terms of expected mean annual increment (MAI) of above-ground carbon. The green shading indicates relative differences in expected productivity. Areas named in brown are examples of WWF Global 200 ecoregions with strong potential for restoration of tree cover.

World 2,155 Million Hectares (M ha)



Europe (EU 27 + rest of Europe)
183 M ha
- European-Mediterranean Montane Forests
- Mediterranean Forests, Woodlands and Scrub (extends into Africa and the Middle East)

Former Soviet Union
401 M ha
- Altai-Sayan Montane Forests (extends into China and Mongolia)
- Central and Eastern Siberian Taiga
- Kamchatka Taiga and Grasslands

North America (US and Canada)
281 M ha
- Canadian Boreal Taiga
- Pacific Temperate Rainforests
- Southeastern Conifer and Broadleaf Forests

China
128 M ha
- Southwest China Temperate Forests
- Southeast China-Hainan Moist Forests

Relative differences in expected forest productivity.

Least productive

Most productive

Latin America and the Caribbean
561 M ha
- Atlantic Forests
- Cerrado Woodlands and Savannas
- Northern Andean Montane Forests

Africa and the Middle East
248 M ha
- Ethiopian Highlands
- Madagascar Dry Forests
- Madagascar Forests and Shrublands

Rest of Asia-Pacific
353 M ha
- Eastern Deccan Plateau Moist Forests
- Indochina Dry Forests
- Naga-Manapuri-Chin Hills Moist Forests
- Northern Indochina Subtropical Moist Forests (extends into China)

TALKING POINT: THE FAO'S VIEW ON PLANTED FORESTS

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This pine nursery is part of a timber cooperative in Oaxaca, Mexico.

Planted forests can be environmentally sound sources of renewable energy and industrial raw material. Covering 264 million hectares worldwide they can support rural livelihoods, help communities raise their standard of living, and advance sustainable development. Planted forests contribute to maintaining ecological processes, to mitigating climate change, and to restoring degraded lands. In many countries they have emerged as a substantial component of natural resource use and will continue to become an increasingly important part of the landscape, given their critical significance for local economies, forest industry and products, energy and the environment.

FAO will continue to support developing countries in their efforts towards sustainable management of planted forests as documented in the Voluntary Guidelines for Responsible Management of Planted Forests. FAO further adopts an important role in facilitating an informed public debate about the controversy of planted forests and in supporting major stakeholder groups, including the public, to better understand the role of planted forests in integrated ecosystem management and sustainable development.

Dr Walter Kollert, FAO Forestry Department

HALTING ILLEGAL LOGGING

Although the illegal trade remains on a massive scale, solutions to this problem are emerging.

Improved enforcement of forest laws and increasing regulation of trade in wood products is helping reduce illegal logging. Research carried out by Chatham House estimates that illegal logging has fallen 50 per cent in Cameroon, 50-75 per cent in the Brazilian Amazon and 75 per cent in Indonesia since 2000[71].

New trade regulations targeting illegal logging

Governments in consumer countries are introducing prohibitions on trade in products containing illegally sourced wood and other policy measures linked to the Forest Law Enforcement, Governance and Trade (FLEGT) initiatives[72]. The 2008 amendment of the US Lacey Act makes it an offence to import, handle or sell illegally sourced wood products[73]. The EU Timber Regulation[74] will enter into force in 2013, requiring those placing wood products on the EU market to exercise due diligence to ensure the wood was legally sourced. The Australian government is also developing an Illegal Logging Prohibition Bill, which, if passed, will regulate due diligence requirements for importers and processors. However, other growing markets for wood products have yet to take firm action. China, for example, has commissioned a study into the country's role as an importer of illegally sourced wood, but has no official plans to develop legislation to tackle the issue[75].

Traceability

One critical step in reducing illegal logging and associated trade is accurate tracing of wood along the supply chain. Without traceability a business cannot be sure that the wood or fibre in products it sells, uses or manufactures originates from a legal source. Technology is making full traceability more feasible. Better labelling devices (such as bar-coded tags or radio-frequency identification chips that can be scanned electronically) on logs or processed material enable efficient and accurate data capture at critical points along the supply chain. Internet-related data management systems are harder to forge or falsify than paper-based manual-entry systems. DNA and isotopic[76] testing as well as fibre analysis can be used to check suspicious claims about the source or species of wood in a product. However, in regions where the trade in logs or processed wood is fragmented (involving numerous intermediaries) and opaque (e.g., characterized by cash transactions and poor official record keeping), full traceability may only be feasible if governance and government-led tracking is strengthened and if buyers simplify their supply chains and use the emerging tracking and tracing systems.

However, legality is only a step towards sustainability. Elements of sustainability, such as good governance, inclusiveness and maintaining forest ecosystems, usually require actions that go beyond mere legal compliance.

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WHAT QUALIFIES AS SOUND MANAGEMENT OF PRODUCTION FORESTS?

"Sustainable forest management" is a much-contested term and no simple consensus definition exists. However, the Forest Stewardship Council (FSC) principles provide a useful benchmark to assess the sustainability of production forestry.

There have been many attempts to define sustainable forest management, by bodies such as Forests Europe[77] and the International Tropical Timber Organization[78]. All have their merits, but no global definition has been agreed. WWF believes that the FSC principles serve as a useful checklist of critical aspects of forest management that is environmentally sound, socially just and economically viable.

FSC's 10 Principles of Forest Stewardship

1. Compliance with laws and FSC principles
The Organization shall comply with all applicable laws, regulations and nationally ratified international treaties, conventions and agreements.

2. Workers' rights and employment conditions
The Organization shall maintain or enhance the social and economic wellbeing of workers.

3. Indigenous peoples' rights
The Organization shall identify and uphold indigenous peoples' legal and customary rights of ownership, use and management of land, territories and resources affected by management activities.

4. Community relations
The Organization shall contribute to maintaining or enhancing the social and economic wellbeing of local communities.

5. Benefits from the forest
The Organization shall efficiently manage the range of multiple products and services of the Management Unit to maintain or enhance long-term economic viability and the range of environmental and social benefits.

6. Environmental values and impacts
The Organization shall maintain, conserve and/or restore ecosystem services and environmental values of the Management Unit, and shall avoid, repair or mitigate negative environmental impacts.

7. Management planning
The Organization shall have a management plan consistent with its policies and objectives and proportionate to scale, intensity and risks of its management activities. The management plan shall be implemented and kept up to date based on monitoring information in order to promote adaptive management. The associated planning and procedural documentation shall be sufficient to guide staff, inform affected stakeholders and interested stakeholders and to justify management decisions.

8. Monitoring and assessment
The Organization shall demonstrate that progress towards achieving the management objectives, the impacts of management activities and the condition of the Management Unit are monitored and evaluated proportionate to the scale, intensity and risk of management activities, in order to implement adaptive management.

9. Maintenance of High Conservation Value Forests
The Organization shall maintain and/or enhance the High Conservation Values in the Management Unit through applying the precautionary approach.

10. Implementation of management activities
Management activities conducted by or for The Organization for the Management Unit shall be selected and implemented consistent with The Organization's economic, environmental and social policies and objectives and in compliance with the Principles and Criteria collectively.

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FOREST CERTIFICATION TO IMPROVE FOREST MANAGEMENT

Forest certification enables the buyers of wood products to seek assurances that the wood was legally harvested and came from a well-managed forest.

Forest certification is a voluntary process, usually market driven, where an accredited body verifies the legality and social and environmental qualities of forest management against an agreed standard[79]. Increasingly, such standards are set at a national level with equitable participation of all relevant stakeholders. The link from the forest floor to final point of sale as a certified forest product is achieved through an audited chain of custody.

Perhaps 30 per cent of the world's production forest is certified, and around 13 per cent of this under FSC[80]. To have the greatest impact, certification will need to expand significantly in those regions, particularly the tropics, where forests suffer most from destructive forestry, and do so while maintaining quality standards and systems. Longer term, voluntary certification has the ability to generally raise standards of forest management, certified or not, by for instance highlighting outmoded forestry practices[81].

What does WWF regard as credible forest certification?
Certification of good forest management by a third party under a system requiring:

- Alignment with globally applicable principles that balance economic, ecological and equity interests;
- Participation of all major stakeholders in the governance of the system and in the development of broadly accepted standards for responsible forest management;
- Respect for legal and traditional rights and maintenance of High Conservation Values;
- Independent, robust mechanisms for verifying and communicating the performance of certified forest managers.

WWF considers that FSC is currently the only credible forest certification system, while other major schemes have significant shortcomings[82].

Certification facts
As of 28th October 2012:

- 405 million hectares of forest and plantations were certified under the two major international schemes (FSC and **PEFC**), this figure includes some forests certified under both schemes[83];
- 164 million hectares were FSC certified (about 106 million hectares of natural forest, 13 million hectares of plantations and 45 million hectares of semi-natural and mixed plantation and natural forest)[84];
- 241 million hectares were PEFC certified[85];
- Only 4 per cent of tropical production forests have been certified under any scheme[86].

The potential supply of industrial roundwood from all certified forests and plantations (under all schemes) was estimated as 447 million m3 roundwood equivalent in mid-2011, about 25 per cent of global production[87].

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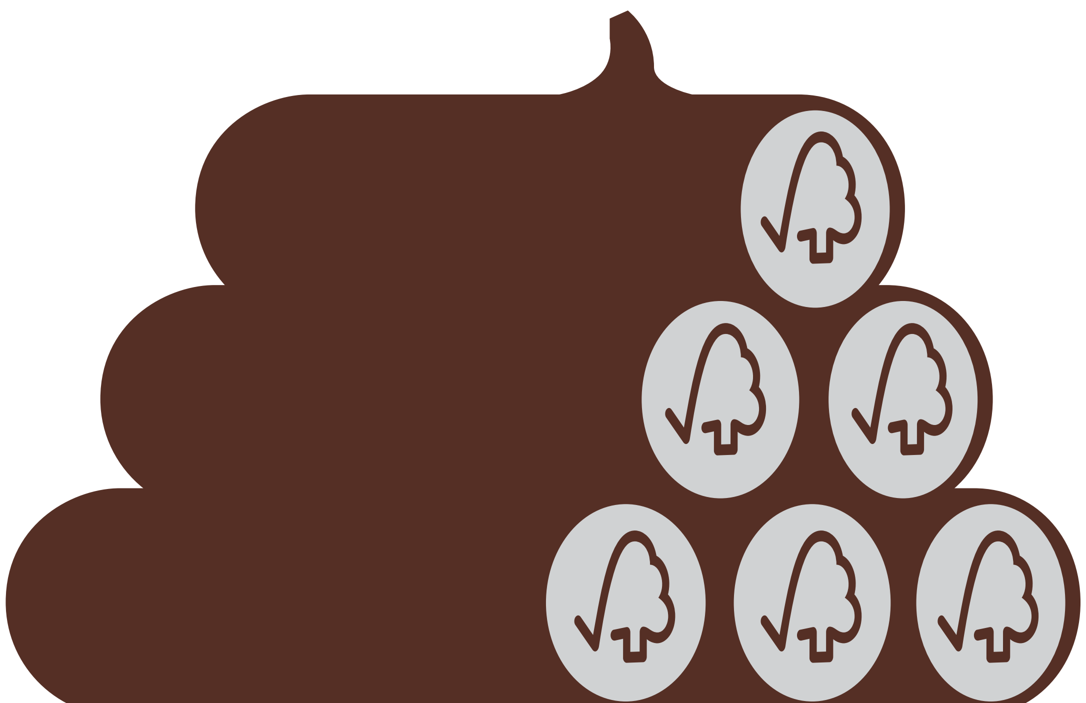
DOES FOREST CERTIFICATION MAKE A DIFFERENCE?

Studies indicate that FSC certification has a positive impact on economic, ecological and social aspects of forest management, but more research is needed.

While many studies describe benefits of forest certification (see box for some examples), measuring the impacts of forest certification presents many challenges. The majority of the studies are based on indirect approaches – not field-based assessments – and the few with primary data have faced challenges in attributing observed impacts to the certification intervention[88]. More well-structured studies are needed to fully evaluate the impact of FSC and other forest certification schemes.



Tropical forests in general
An extensive study of Corrective Action Requests (CARs)[89] looking at FSC-certified operations in natural tropical forests concludes that FSC certification has a positive impact particularly in the fields of: health and safety of employees and their families; management plans; monitoring; use of reduced-impact logging; and protection of rare, threatened species. The study found that the number of CARs given in certification assessments was decreasing over time, suggesting that companies have incorporated management activities that are in line with FSC requirements as standard best practice.

Borneo
The Deramakot Forest Reserve (DFR) in Sabah, Borneo covers 55,000 hectares and was originally licensed for logging in 1956. In 1989, it was designated as a model site to develop sustainable forest management and all logging activities were suspended. A new management system with reduced-impact logging was implemented in 1995 and DFR was FSC certified in 1997. Studies comparing DFR with similar conventionally logged forests have shown DFR to be more effective in sustaining biodiversity[90]; it is one of the few areas in Sabah containing all five Bornean wild cat species, including the bay cat (Pardofelis badia) – one of the world's rarest wild cats[91]. DFR is also estimated to have 54 tonnes more carbon per hectare stocked in the above-ground vegetation than the Tangkulap Forest Reserve (a conventional logging site)[92].

Gabon
A study from Gabon[93] looking at the quality of wildlife management of forest concessionaires concluded that FSC-certified operations comply significantly better with national legislation and IUCN recommended best practices compared to non-certified companies.

Brazil
In plantation forestry in Brazil, FSC-certified operations performed substantially better on social and environmental aspects than non-certified companies[94].

BIG CHALLENGES, POTENTIAL SOLUTIONS

WWF has three key platforms for engaging the forest products industry in the uptake of responsible practices.

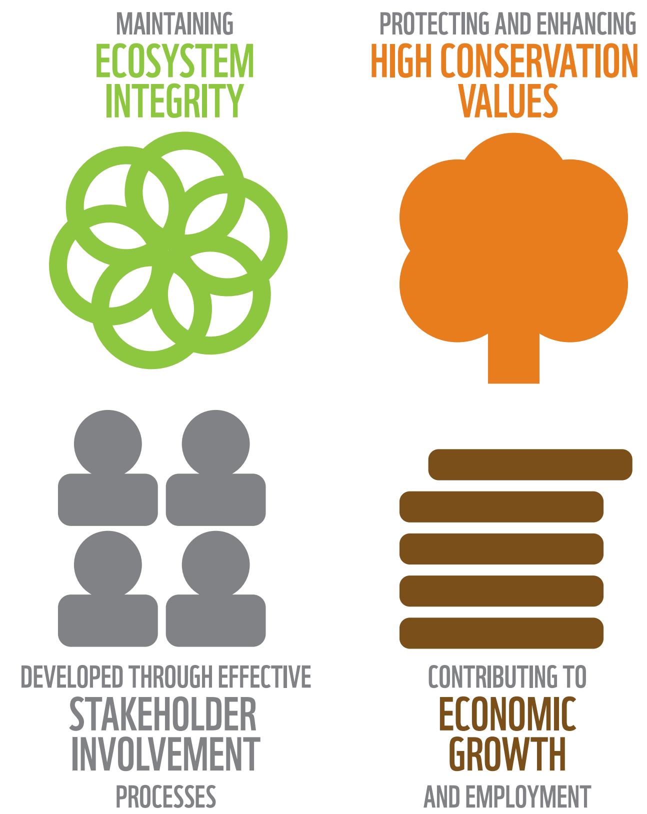
Global Forest & Trade Network (GFTN)

GFTN is the world's longest-running and largest forest and trade programme, involving nearly 300 companies, ranging from small operations supplying local markets to large, fully integrated multinational companies, in over 30 producing and consuming countries. Companies participating in GFTN commit to responsible purchasing of forest products or to achieving credible forest certification in the forests they manage. Participation is based upon annual performance towards long-term targets. Participants have been a key force in generating market demand for legal and certified products and achieving certification in some of the world's most valuable and threatened forests.

New Generation Plantations project (NGP)

The NGP project is a platform bringing companies and governments together with WWF to develop and promote better plantation management. The NGP concept describes an ideal form of plantation that:

- maintains ecosystem integrity – including biological, carbon, nutrient and water cycles;
- protects and enhances High Conservation Values – biodiversity, ecosystem services and social and cultural values;
- is developed through effective stakeholder involvement – local communities, governments and NGOs;
- contributes to economic development – creating jobs and helping businesses and economies.

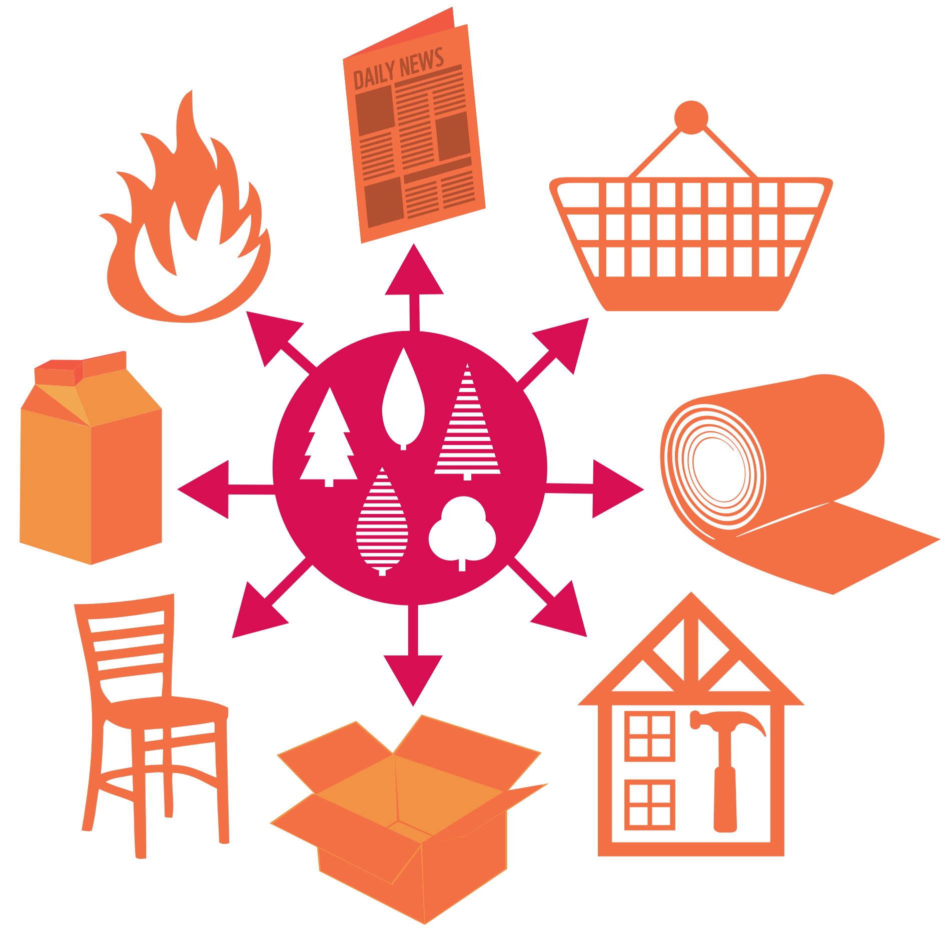


Paper Sector Transparency Tools

WWF has created a range of tools to reduce the ecological footprint of paper:

- Best measures for a paper efficient office;
- A guide explaining the potential environmental costs of paper and how to minimize these, including practical tips for buyers and producers;
- Check Your Paper, an online database of brands transparent about their environmental footprint, to assist responsible buyers; it scores how well a paper performs on responsible fibre sourcing, clean production and climate impacts.
- An Environmental Paper Company Index, showcasing paper producers' global environmental footprint in different product categories. In 2012, these were fine paper, tissue and packaging.

RISING TO THE CHALLENGE – WOOD PRODUCTS AND FORESTS IN PERPETUITY



The key challenge for the wood products industry in a future with zero net deforestation and forest degradation is how to supply more wood products with less impact on forests.

"WE ALL FACE UNCOMFORTABLE CHOICES AND TRADE-OFFS, BUT ONLY BY TAKING BRAVE, INFORMED DECISIONS CAN HEALTHY, SUSTAINABLE AND EQUITABLE HUMAN SOCIETIES BE ENSURED, NOW AND INTO THE FUTURE."[68].

The future looks bright for responsible producers of wood products. Demand should continue to grow as emerging and developing nations use more paper for hygiene, education and packaging and more wood to construct and furnish better houses and buildings. Wood should increasingly substitute for many alternative materials that are less sustainable, more energy intensive and bring a heavier pollution load. New technologies are likely to enable greater use of wood to make biofuels, pharmaceuticals, plastics, cosmetics and textiles. This growing demand should be tempered by less profligate consumption in richer societies, new efficiencies and more recycling.

Critical enablers of a forest products sector that contributes positively to the health of the planet include:

- **Better forestry:** e.g., ensuring legality and sustainable forest management; more sustainable plantations; rationalized and inclusive landscape-scale forest zoning; responsible procurement practices.
- **Better technologies:** e.g., increased mill and recycling efficiencies; new low-footprint wood products.
- **Better governance:** e.g., stronger social safeguards; effective enforcement of regulations.
- **Better policies:** e.g., incentives to reduce the rate of forest conversion and destructive logging, such as public policy measures to reward forest stewardship that delivers carbon storage, biodiversity conservation or water regulation services.
- **Better information:** e.g., long-term ecological impacts of various forms of natural forest management and intensive plantations.
- **Wise consumption:** e.g., more repeat use of individual wood fibres; new consumption patterns that meet the needs of the poor while eliminating waste and over-consumption by the affluent. This includes wood products as well as food and energy, as all commodities are competing for land and water.

There is no fundamental reason why ZNDD cannot be achieved while sustaining a vibrant wood products industry and meeting people's needs. However, this assumes that the forest industry adopts sympathetic approaches to ecosystems, local communities and small forest owners. The forest products industry has the potential to be either a friend or an enemy of a living planet.

In this chapter, we have assumed that wood production can be managed to address social and environmental concerns. The next chapter of the report will focus on projected areas of future loss ("deforestation fronts") and the implications for biodiversity conservation.

GLOSSARY, NOTES AND ACRONYMS

Agroforestry: ecologically-based natural resources management system that, through the integration of trees on farms and in the agricultural landscape, diversifies and sustains production for increased social, economic and environmental benefits for land users at all levels .

Bioenergy: energy derived from biomass, which can be used to generate electricity, supply heat and as a liquid biofuel.

Bioenergy Plus scenario: a scenario of the Living Forests Model where bioenergy feedstock demand is based on the "global 2ºC scenario" derived from the POLES (Prospective Outlook for the Long-term Energy System) model .

Biomass: biological material derived from living or recently living organisms, such as wood and other crops. Biomass may also include biodegradable wastes that can be burnt as fuel. It excludes fossilized organic material which has been transformed by geological processes into substances such as coal or petroleum.

Cellulose: the basic structural component of plant cell walls, cellulose comprises about 33 per cent of all vegetable matter and is the most abundant of all naturally occurring organic compounds. Not digestible by humans, cellulose is a food for herbivorous animals (e.g., cows, horses), is processed to produce papers and fibres, and is chemically modified to yield substances used in the manufacture of such items as plastics, photographic films, etc.

Container board: container board is a type of light-weight paperboard specially manufactured for the production of corrugated board (formed by gluing one or more fluted sheets of paperboard to one or more flat sheet). It is typically used in the packaging of large materials.

Diet Shift scenario: a scenario of the Living Forests Model where the total global consumption of animal calories is maintained at the 2010 global average with convergence in per capita consumption across regions (i.e., those now below the global average consume more in the future, while those now above the global average consume less).

Do Nothing Scenario: A Living Forests Model projection of what the world could look like if our behaviour continues in line with historical trends. The Do Nothing Scenario anticipates land-use change due to: (a) demands for land to supply a growing global human population with food, fibre and fuel; and (b) continuation of historical patterns of poorly planned and governed exploitation of forest resources. Key assumptions in this scenario are:

- By 2050, world population reaches 9.1 billion and per-capita GDP almost triples.
- Demand for commodities is driven by changes in affluence (measured by GDP) and human population growth.
- Aggregate historical trends in agricultural productivity gains continue.
- The average human diet in a country changes according to historically observed relationships with per-capita GDP.
- Forestry and agricultural production does not expand into protected areas, but unprotected natural habitats can be managed for production of timber or converted to timber plantations, cropland and pasture.
- Total primary energy use from land-based biomass feedstocks doubles between 2010 and 2050 due to projected energy demand and the competitiveness of bioenergy technologies and supply chains.

Energy wood: woody biomass that is not used for household fuelwood or the production of wood-based products.

FAO: Food and Agriculture Organization of the United Nations

Fibre: cellulose-filled cells that are extracted from biological material (e.g., wood, bamboo, agricultural residues) and used to manufacture a variety of products, including paper.

Fuelwood: roundwood that will be used as fuel for purposes such as cooking, heating or power production. It includes wood harvested for fuel from main stems, branches and other parts of trees and wood that will be used for charcoal production (e.g., in pit kilns and portable ovens). It also includes wood chips to be used for fuel that are made directly (i.e. in the forest) from roundwood.

GHG: greenhouse gas

Growing stock: volume of wood in all living trees in a given area that have more than a specified diameter at breast height (or above buttress if these are higher). Includes the stem from ground level or stump height up to a specified top diameter, and may also include branches above a specified minimum diameter .

High Conservation Value (HCV): an exceptional or critical ecological attribute, ecosystem service or social function of forests and other biomes, defined by the FSC as follows:
HCV1 – Species diversity: Concentrations of biological diversity including endemic species, and rare, threatened or endangered species, that are significant at global, regional or national levels.

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GLOSSARY, NOTES AND ACRONYMS

HCV 2 – Landscape-level ecosystems and mosaics: Large landscape-level ecosystems and ecosystem mosaics that are significant at global, regional or national levels, and that contain viable populations of the great majority of the naturally occurring species in natural patterns of distribution and abundance.
HCV 3 – Ecosystems and habitats: Rare, threatened or endangered ecosystems, habitats or refugia.
HCV 4 – Critical ecosystem services: Basic ecosystem services in critical situations, including protection of water catchments and control of erosion of vulnerable soils and slopes.
HCV 5 – Community needs: Sites and resources fundamental for satisfying the basic necessities of local communities or indigenous peoples (for example for livelihoods, health, nutrition, water), identified through engagement with these communities or indigenous peoples.
HCV 6 - Cultural values: Sites, resources, habitats and landscapes of global or national cultural, archaeological or historical significance, and/or of critical cultural, ecological, economic or religious/sacred importance for the traditional cultures of local communities or indigenous peoples, identified through engagement with these local communities or indigenous peoples .

Industrial roundwood: all harvested wood (saw logs, veneer logs and pulpwood) suitable for processing into wood products, and excluding wood used directly as fuelwood.

Intensively managed plantations: plantations of introduced and/or native tree species established through planting or seeding for rapid production of biomass (5 to 25 years).

Living Forests Model: developed for WWF by the International Institute for Applied Systems Analysis (IIASA) the model draws on G4M and GLOBIOM models to show geographically explicit land-use change under different scenarios. The G4M model projects future deforestation and land-use change by extrapolating from historical trends and taking into account future projections for population, GDP and infrastructure. GLOBIOM is an economic model that allocates land and resources optimally based on projected commodity and ecosystem service demands under future GDP, population and policy scenarios.

Market pulp: pulp that is produced in one location, from virgin or recycled fibre, dried and shipped to another location for further processing to make paper and paperboard.

Non-timber forest product (NTFP): a product of biological origin other than wood derived from forests, other wooded land and trees outside forests . NTFP refers to all the resources/products (other than industrial roundwood and derived sawn timber, wood chips, wood-based panels and pulp) that may be extracted from forest ecosystems and are used within the household or are marketed or have social, cultural or religious significance. These include plants and plant materials used for food, fuel, storage and fodder, medicine, wrapping materials and bio-chemicals, as well as animals .

Non-wood fibre: cellulose-filled cells that are extracted from biological material other than wood (e.g., bamboo, agricultural residues) and used to manufacture a variety of products including paper.

Panels and panel product: a range of materials (e.g., plywood, particleboard or fibreboard) typically formed into sheets from particles, fibres or veneers, made from industrial roundwood or recovered fibre/wood.

Paper: material mainly used for writing or printing upon or for packaging, as well as for tissue products, that is produced by pressing together moist fibres, typically derived from pulpwood, fibre crops or recovered paper, and drying them into flexible sheets.

Paperboard: a relatively stiff, heavy material, thicker than paper, that is produced by pressing together moist fibres, typically derived from pulpwood, fibre crops or recovered paper, and drying them into thick sheets.

PEFC: Programme for the Endorsement of Forest Certification, a major certification organization.

Production forest: forest area designated primarily for production of wood, fibre, bioenergy and/or non-timber forest products .

Pro-Nature scenarios: scenarios (Pro-Nature and Pro-Nature Plus) of the Living Forests Model which project that the remaining natural ecosystems are conserved (i.e., no further conversion of these ecosystems to cropland, grazing land, plantations or urban settlement) in areas identified as important for biodiversity by three separate conservation mapping processes using a UNEP World Conservation Monitoring Centre (UNEP-WCMC) dataset. These scenarios assume that current land uses (e.g., cropland or forestry) in these areas remain constant and continue to produce food or wood .

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GLOSSARY, NOTES AND ACRONYMS

Protected area: a clearly defined geographical space that is recognized, dedicated and managed through legal or other effective means in order to achieve the long-term conservation of nature with associated ecosystem services and cultural values .

Pulp: a material prepared by chemically or mechanically extracting cellulose fibres from pulpwood, fibre crops or recovered paper.

Pulpwood: industrial roundwood that will be used for the production of pulp, particleboard or fibreboard. It includes roundwood (with or without bark) that will be used for these purposes in its round form or as split wood or wood chips made directly (i.e. in the forest) from roundwood. It does not include by-products from the sawmill.

Recovered paper/wood: fibre, paper and wood from unused material, collected waste and manufacturing waste. It can be divided into pre-consumer and post-consumer recovered paper/wood.

Recovery rate: percentage of usable recycled materials that have been removed from waste generated in a specific area or by a specific industry.

Recycled fibre: fibre made from processing recovered paper or wood.

REDD+: A package of actions aimed at (1) reducing emissions from deforestation and forest degradation (REDD) in developing countries; (2) conservation and sustainable management of forests; and (3) enhancement of forest carbon stocks.

Roundwood: All wood felled or otherwise harvested and removed.

Saw logs: Roundwood that will be sawn (or chipped) lengthways for the manufacture of sawn wood.

Sawn wood: planks or boards mechanically sawn from saw logs.

Target scenario: a scenario of the Living Forests Model where ZNDD (with near zero gross rate of loss of natural and semi-natural forest) is achieved by 2020 and maintained at that level indefinitely .

Veneer logs: roundwood that will be used for the production of veneer (a thin facing layer of wood) mainly by peeling or slicing.

Virgin wood fibres: wood fibre used for the first time in the manufacture of paper or other products.

WBCSD: the World Business Council for Sustainable Development .

Well-managed natural forests: natural and semi-natural forests managed in an economically viable, socially equitable and environmentally sustainable way that maintains biodiversity and ecosystem services. The FSC elaborates this further with 10 principles .

Wood: the hard fibrous material that forms the main substance of the trunk or branches of a tree or shrub.

Wood-based biomaterials: materials synthesized from wood fibre.

Wood fibre: cellulose-filled cells that are extracted from wood and used to manufacture a variety of products including paper. It covers both virgin wood fibre and fibre from recovered paper or wood.

Wood pulp: pulp made from virgin wood fibres.

Wood products: the wide range of products that are manufactured from industrial roundwood.

Zero Net Deforestation and Forest Degradation (ZNDD): WWF defines ZNDD as no net forest loss through deforestation and no net decline in forest quality through degradation. ZNDD provides some flexibility: it is not quite the same as no forest clearing anywhere, under any circumstances. For instance, it recognizes people's right to clear some forests for agriculture, or the value in occasionally "trading off" degraded forests to free up other land to restore important biological corridors, provided that biodiversity values and net quantity and quality of forests are maintained. In advocating ZNDD by 2020, WWF stresses that: (a) most natural forest should be retained — the annual rate of loss of natural or semi-natural forests should be reduced to near zero; and (b) any gross loss or degradation of pristine natural forests would need to be offset by an equivalent area of socially and environmentally sound forest restoration. In this accounting, plantations are not equated with natural forests as many values are diminished when a plantation replaces a natural forest.

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