CHAPTER 2
GLOBAL SUSTAINABLE TIMBER SUPPLY AND DEMAND

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INTRODUCTION

Industrial timber use has provided timber revenue that has helped make timber supply and demand more sustainable in the leading timber producing regions of the world. Sustainable development implies not consuming more resources today than we can replace tomorrow, but sustainable forest management implies more than merely a non-declining supply of timber. Forests as a whole provide vital ecosystem services, as important atmospheric carbon sinks for example. According to the Intergovernmental Panel on Climate Change, global deforestation is a major contributor to global atmospheric carbon emissions and greenhouse gases, while forest growth is a major factor in removals of carbon dioxide from the atmosphere, and thus forest management and forest growth count among the largest available offsets of atmospheric carbon emissions (Nabuurs et al., 2007) conomical industrial timber utilization is a vital element in sustaining forests and avoiding large-scale deforestation, not by avoiding timber harvest but by making forestry more economical and sustainable.

Sustainable forest management depends also on economical development and establishment of more productive silviculture and agriculture to help conserve and restore native forests. Most commercially important species of trees can be planted and cultivated in tree plantations, and growth rates of selected trees are often higher than average growth rates of trees in native forests Yet tree plantations and improved silviculture become economical only when there is sufficient demand for wood fiber and adequate timber revenues. Currently plantations occupy only about four percent of global forest land area (FAO 2006). As explained by Victor and Ausubel (2000), the twentieth century witnessed the start of a "Great Restoration" of the world's forests, particularly in Europe and North America, a restoration that occurred even though timber harvest generally increased, as farmers and foresters learned to grow more food and fiber on smaller areas and eased the need for timber removals from native forests.

Forest ecosystems are nevertheless still threatened in other global regions by systematic land conversion or deforestation. Karl-Henrik Robèrt (*The Natural Step* 1989) is one of many who recognized that natural ecosystems cannot survive systematic destruction of their capacity for renewal. If we want natural forest ecosystems to continue to exist on this planet then we must avoid large-scale deforestation. Thus, from a forestry standpoint, sustainable timber supply and demand is a concept that encompasses sustainable wood supply but seeks also to ensure that intact forest ecosystems will be sustained in the balance of human development, and that forests will continue to provide vital ecosystem services such as atmospheric carbon capture and storage.

GLOBAL DEFORESTATION

Despite resource conservation, improved timber productivity, and technological change, deforestation continues to be a global concern, even in the twenty-first century. Figure 1 illustrates global regions with more than 0.5% change per year in forest area, according to the recent United Nations Global Forest Resources Assessment, FRA 2005 (FAO 2006).

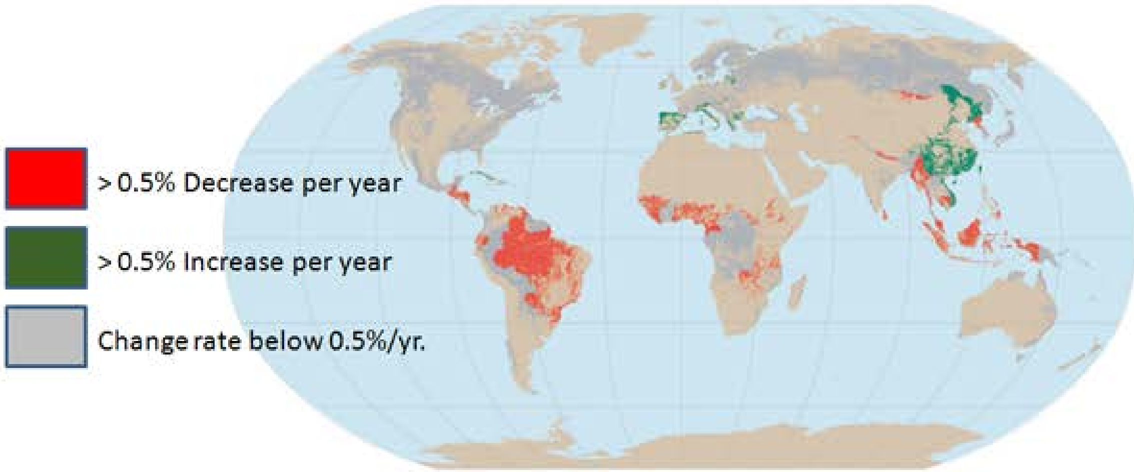

FIGURE 1 – Global changes in forest area per year (FAO 2006).

According to FRA 2005, reduction in forest area happens through either of two processes, deforestation or natural disasters. Deforestation is by far the most significant factor in modern times. Deforestation implies that forests are cleared by people and the land is converted to other uses, such as agriculture or infrastructure. Natural disasters can also destroy forests if the land area is incapable of regenerating naturally and no efforts are made to replant the forest, and it then reverts to non-forested land area.

An increase in forest area can also happen in two ways, either through afforestation (planting of trees on land that was not previously forested), or through natural expansion of forests (such as on abandoned agricultural land). Where part of a forest is cut down and replanted (called reforestation) or where the forest grows back naturally within a relatively short period (called natural regeneration), there is no net change in forest area.

Figure2 (also from FRA2005) summarizes the estimated annual net changes in forest land area by region from 1990 to 2005. An important observation is that rates of deforestation are inconsistent among global regions. Deforestation is currently concentrated mostly in the continental regions of South America and Africa, and also parts of Asia, and notably in tropical forest regions, while generally much lower rates of deforestation and some afforestation is found in temperate forested regions of North America, Northern Europe, and also parts of East Asia (notably in China and Viet Nam).

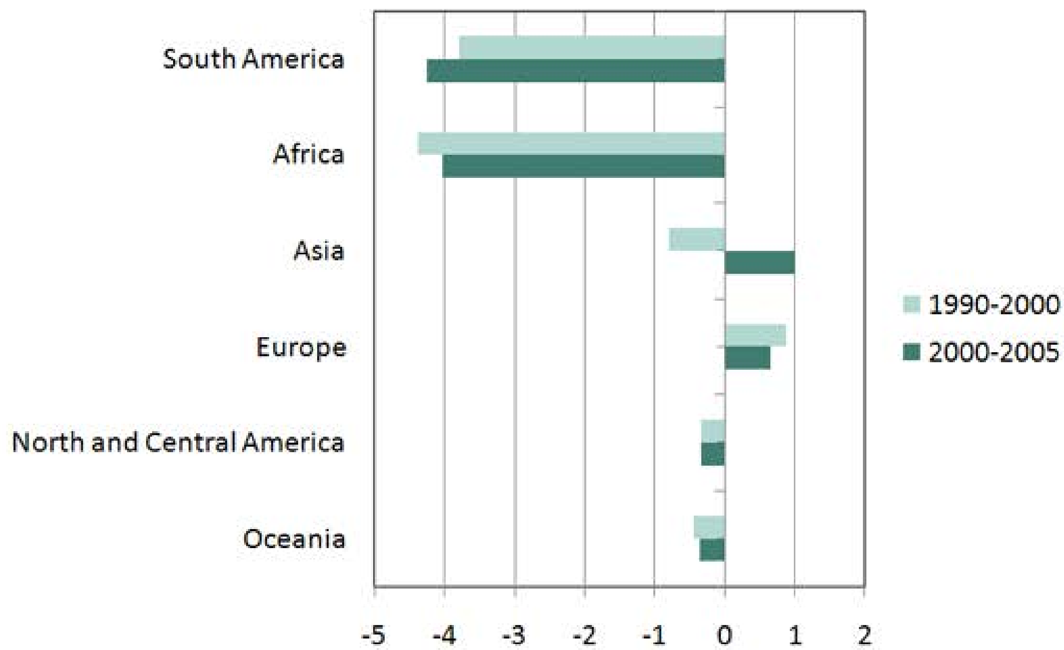

FIGURE 2 – Annual net change in forest area by region 1990–2005, million hectares per year (FAO 2006).

As shown in Figure 2, annual rates of change in forest area and rates of deforestation are not constant over time. Asia for example experienced a net gain in forest area from 2000 to 2005, after Asia had experienced a net loss in forest area from 1990 to 2000.

Over longer spans of time more significant shifts may occur in the density of forest cover and tree volumes. This is reflected, for example, by the estimated historical U.S. forest carbon balance since the 1700s (Figure 3). The forest carbon balance refers to the estimated annual gain or loss of carbon in forest biomass and soil carbon. It is estimated that U.S. forests had large net losses of carbon from the 1700s to early 1900s, as large areas of native forests were cleared and agricultural land use expanded. It is estimated that net emissions of carbon from U.S. forests peaked around the year 1915, at about 750 million tons of carbon per year.

However, after 1915 net emissions of carbon from U.S. forests declined significantly as the rate of deforestation subsided along with much less expansion of agricultural land use in the 20th century. By the latter half of the 20th century improved forest management and conservation. had achieved stable and expanding forest inventory volumes in the United States. The result was negative net carbon emissions in U.S. forests, also known as carbon sequestration (Figure 3).

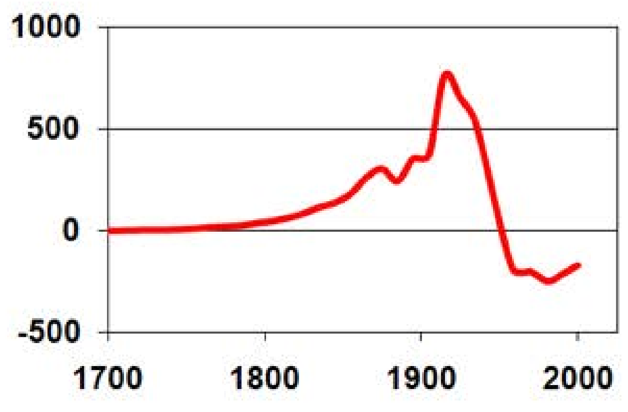

FIGURE 3 - U.S. forest carbon balance since 1700, million tons of carbon per year (Birdsey et al. 2006).

Trends in the global forest carbon balance have become the subject of much attention in the area of climate change. For example, Figure 4 was developed for the 4th Assessment report of the Intergovernmental Panel on Climate Change (IPCC), showing the estimated historical forest carbon balance by global region from 1855 to 2000 (Nabuurs et al. 2007). Although North America and Europe have transitioned to net annual sequestration of carbon in forests, globally forests remain net emitters of carbon, primarily because of continued deforestation in South Asia, South America and Africa.

DEFORESTATION HYPOTHESES

A common but simple hypothesis about global deforestation is that industrial timber harvesting and forest product demands are correlated with global deforestation. This hypothesis can be examined simply by comparing global data on timber harvest by region with data on changes in forest area and net carbon balance of forests. Comparing the distribution of global deforestation and timber harvest actually reveals significant inconsistencies that lead to rejection of the simple hypothesis. In general, the data show that global regions with the highest levels of industrial timber harvest and forest product output are also regions with the lowest rates of deforestation.

Thus, a more appropriate economic hypothesis is that global loss of forest cover and carbon emissions from deforestation are driven primarily by systematic conversion of economically marginal forest land to other land uses, including land clearing for grazing and agriculture, or other forms of land development. The alternative economic hypothesis suggests that forest products and industrial roundwood demands provide revenue and policy incentives to support sustainable forest management, and in turn industrial timber revenues and economical forest management have helped avoid large-scale systematic deforestation in those regions with the highest levels of industrial timber harvest.

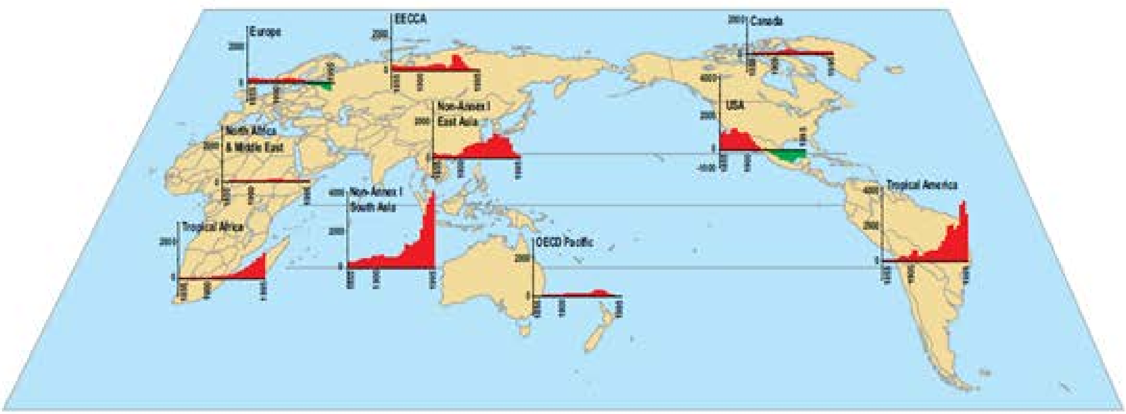

FIGURE 4 – Global forest carbon balance by region from 1855 to 2000, million tons of carbon dioxide equivalent per year (Nabuurs et al. 2007).

GLOBAL TIMBER HARVEST

Data on global industrial roundwood harvest actually reveal striking regional inconsistencies and lack of correlation with global deforestation trends. Figure 5 illustrates recent levels of wood removals from forests by global region for 1990, 2000 and 2005, including both industrial roundwood harvest and fuelwood harvest, as reported in FRA 2005 (FAO 2006). Industrial roundwood harvest levels in North America and Europe are by far the highest among all global regions (Figure 5), which is entirely inconsistent with deforestation trends given the fact that North America and Europe are the only global regions experiencing net sequestration of carbon in forests (Figure 4) and in aggregate the net change in forest area for Europe and North America is positive (Figure 2). High levels of industrial timber harvest are actually coincident with fairly stable forest cover trends as shown by the data for Europe and North America.

By contrast, industrial roundwood harvest levels in Africa, South America and Asia are much lower than in Europe and North America (Figure 5), yet by far the largest losses in forest area have occurred in those regions (Figure 2), and those regions also have largely negative forest carbon balances as well (Figure 4). It can be noted however that Asia has experienced recent gains in forest area (Figure 2) and the forest carbon balance in East Asia has improved substantially in recent years (Figure 4), partly as a result of prodigious expansion of forest plantations in Asia.

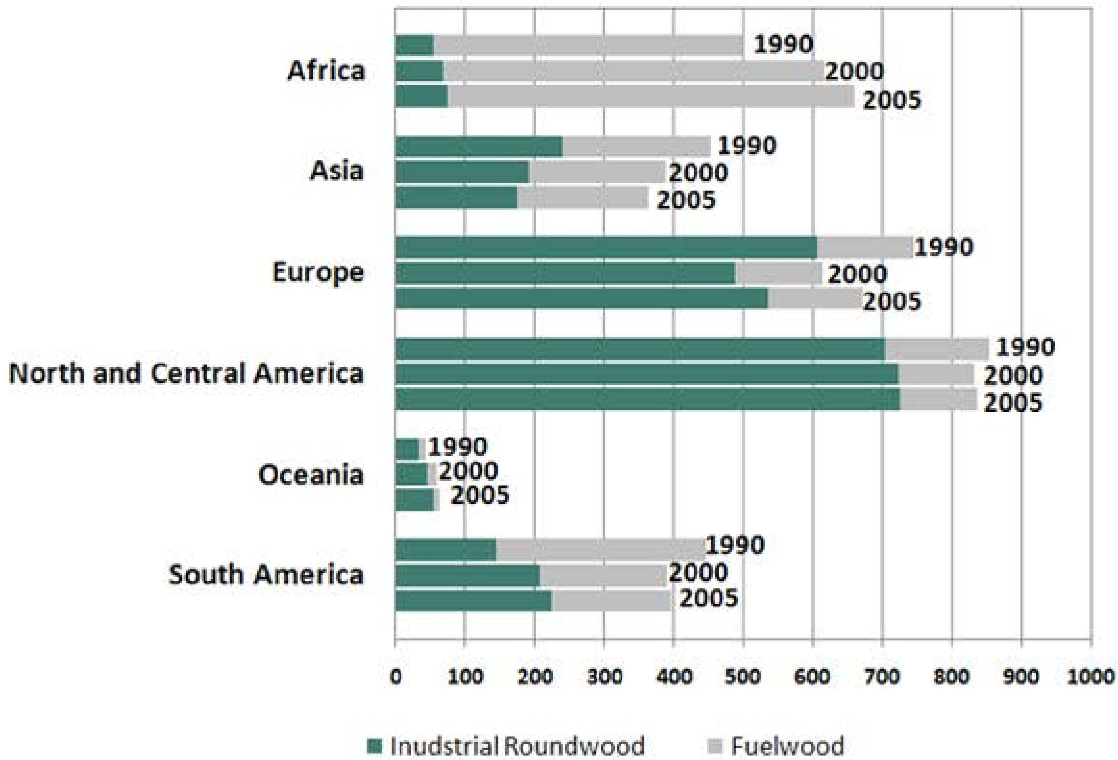

FIGURE 5 –Globalwood removals from forests, 1990,2000, and 2005, million cubic meters per year (FAO 2006).

The global data support rejection of the simple hypothesis that industrial timber harvesting and forest product demands are correlated with global deforestation. It can be noted however that fuelwood harvest levels in Africa and South America are quite large (Figure 5), and much of that fuelwood harvest is for subsistence needs (cooking, heating and charcoal production). Thus, although fuelwood harvest volume is substantial in those regions, the timber revenues from fuelwood harvest are generally low relative to industrial timber harvest, yielding relatively meager returns for forestry and forest management in those regions.

The deforestation data indicate that forests in Africa, South America and parts of South Asia have been largely marginalized or exploited rather than sustained by economical management for timber. On the other hand, high levels of industrial timber utilization and forest product output in North America and Europe have helped sustain timber supply and demand, averting systematic deforestation in those leading industrial timber producing regions of the world. There are of course local exceptions to these general observations, but the global forest data clearly support an alternative hypothesis, that forest products and industrial roundwood demands provide the revenue and policy incentives to support sustainable forest management, and in turn industrial timber harvest and economical forest management help avoid large-scale systematic deforestation.

GLOBAL FOREST INVENTORY TRENDS

Global forest stock or forest inventory trends are another important key to understanding sustainability of timber supply and demand. In effect, forest inventory is the available physical supply of timber on the stump in forests, and in forest economics it is generally recognized that large or abundant inventories of standing timber imply abundant economic supply, while smaller or reduced inventories of standing timber imply less abundant supplies.

One way to measure forest inventory is in terms of estimated carbon stocks in live biomass (trees) in forests. Figure 6 illustrates estimated carbon stocks in live forest biomass for the years 1990, 2000, and 2005, excluding litter, dead wood, and soil carbon. The deforestation that has occurred in Africa, South America and Asia is evident in the declining forest carbon stocks of those regions. Furthermore, the relatively large (mostly native) forest inventories of Africa and South America indicate that wood still remains relatively abundant and cheap in those regions (another reason why economical forest management has yet to reverse the deforestation trends in those regions).

Forest stock in Asia is smaller than in Africa or South America, and Asia has experienced substantial recent declines in forest stocks (Figure 6). South Asia in particular has experienced decreases in forest area (Figure 1) and significant losses of forest carbon (Figure 4). Thus, in contrast to Africa and South America, Asia has relatively less abundant forest inventories, yet Asia has large and growing demands for forest products, which has led to expansion of wood imports and timber plantations in Asia.

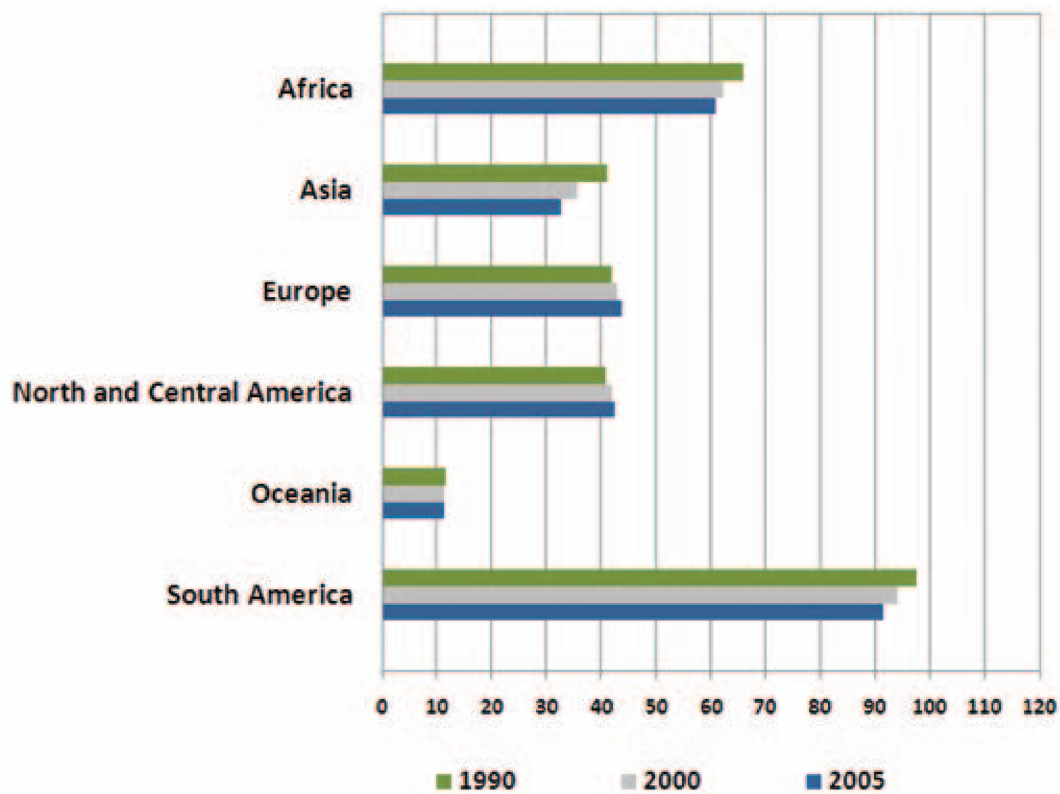

FIGURE 6 – Global carbon stocks in forest biomass 1990, 2000, and 2005, Giga-tons (FAO 2006).

GLOBAL PLANTATION TRENDS BOOST TIMBER SUPPLY

Although some global regions are experiencing losses of forest cover and forest carbon, a positive trend impacting global wood supply has been the relatively rapid expansion of forest plantation area, particularly in Asia. Figure 7 illustrates forest plantation area by global region in 1990, 2000, and 2005. Among global regions, Asia has been expanding forest plantation area most rapidly since 1990. Forest plantation area expanded in other regions including Europe, South America, Oceania, and North America (particularly in the 1990s), but Asia (and China in particular) now has the lead in global forest plantation area. Expansion of industrial wood fiber plantations has boosted wood supply and enabled increased forest product output. Forest plantations worldwide make up an estimated 4 percent of total forest area (FAO 2006), but provide a proportionately higher and increasing fraction of total industrial wood output.

Most industrial plantations have been established to serve industrial wood fiber needs, supported by revenues from wood pulp and other products. Continued expansion of forest plantation area in Asia, Latin America and Europe reflects continued expansion in output of wood pulp well into the current decade in those regions, while the notable slowdown in expansion of plantation area in North America reflects the fact that wood pulp production in North America has declined since peaking in the 1990s (FAOSTAT).

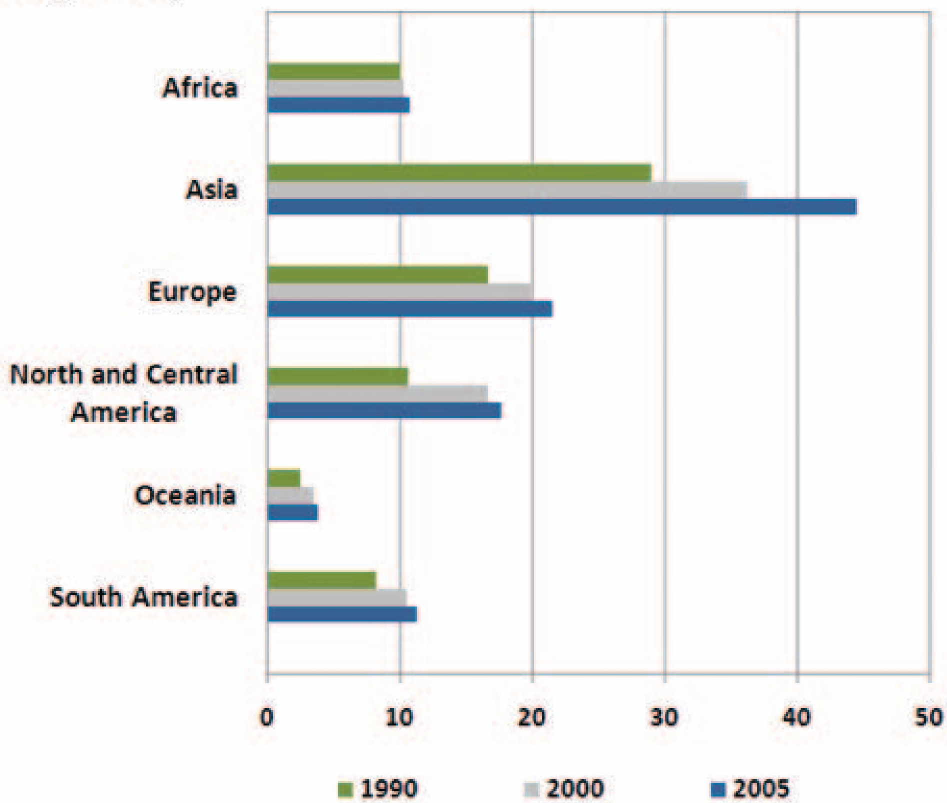

FIGURE 7-Productive forest plantation area by global region 1990, 2000, and 2005, millions of hectares (FAO 2006).

TIMBER DEMAND TRENDS

Timber demand trends can be illustrated by trends in production of sawnwood (lumber and sawn solid wood products) and wood pulp. Sawtimber and pulpwood represent the largest global demands for industrial roundwood. Their overall demand trends differ, and a150 vary by global region.

Shifts of growth in pulpwood demands from North America to Asia, Europe and South America are evident in wood pulp production trends by global region (Figure 8) from the FAOSTAT forestry database. Output of wood pulp has declined in North America after peaking in the 1990s, while wood pulpoutput has continued to expand in Europe, Asia, and South America. The declining trend for wood pulp output in North America reflects a shift in the locus of growth in consumer goods manufacturing from North America to other global regions, particularly to Asia and Europe. Corresponding shifts in demands have occurred for paper and paperboard in print advertising and packaging (correlated with consumer goods manufacturing activity).

Although paper and paperboard production is now actually higher in both Europe and Asia than in North America, higher rates of paper recycling and use of non-wood pulp fiber in Europe and Asia tend to limit wood pulp production in those regions relative to North America,. The recent global economic recession (since 2008) has also resulted in a generalized global downturn in paper and paperboard demands, particularly in Europe and North America, while demand has continued to grow in Asia but at a slower pace.

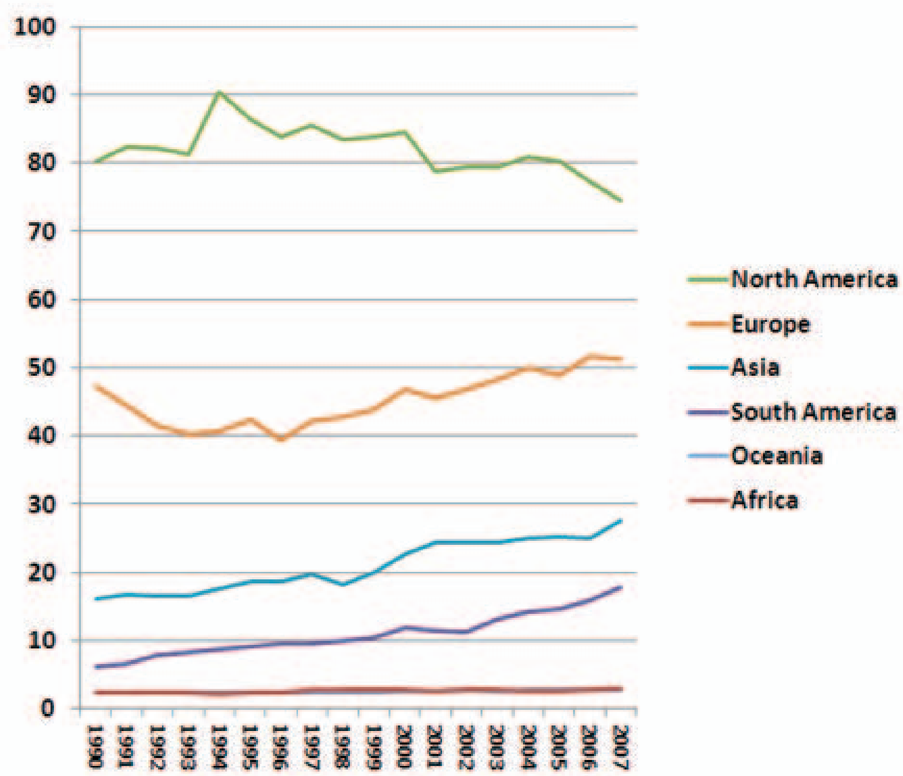

FIGURE 8 –Wood pulp production by global region 1990-2007, millions of metric tons (FAOSTAT).

Global trends in timber demands for lumber production are illustrated by trends in sawnwood production by global region (Figure 9). Europe has regained the lead in sawnwood output over North America in recent years, largely due to a downturn in North American housing construction and related lumber demands. Europe (which includes Russia) had previously held the lead in sawnwood output but production declined significantly in Russia during the early 1990s immediately following the collapse of the Soviet Union. However, Europe (and Russia) has been generally increasing sawnwood production since the late 1990s.

Sawnwood production in Asia and South America has also been increasing in recent years, partly based on plantation grown timber. In fact, sawnwood production in South America has been steadily increasing since the early 1990s as output of lumber from plantation grown timber has steadily increased. Sawnwood production in Asia has been recovering in recent years, but still remains below historical peak levels (Figure 9). Sawnwood production in Africa is comparatively small, and has not increased significantly in recent decades. Sawnwood production in Oceania is also comparatively small on a global scale, but production in Australia and New Zealand has been increasing on the basis of plantation grown timber.

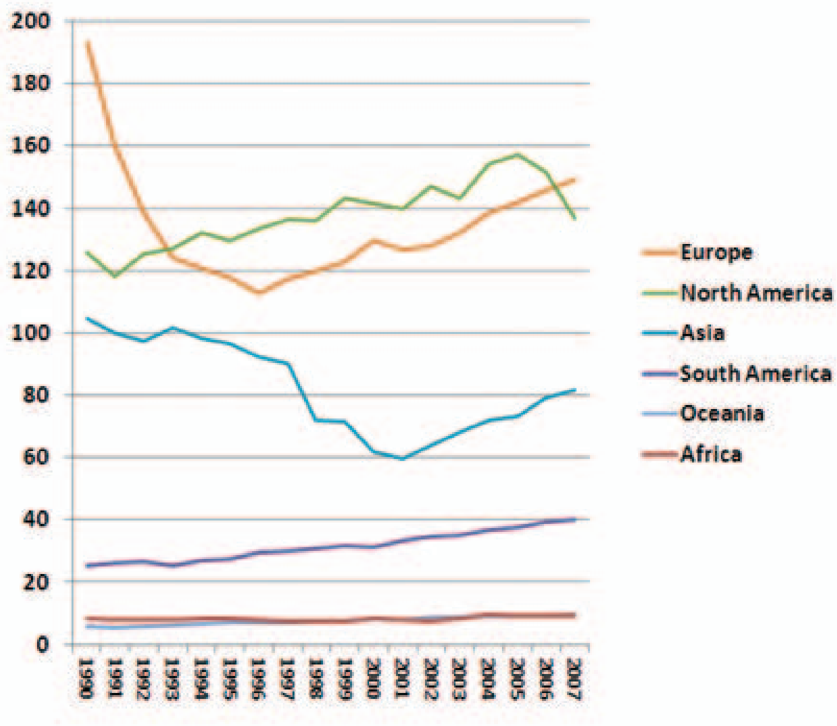

FIGURE 9 - Sawnwood production by global region 1990-2007, millions of cubic meters (FAOSTAT).

In terms of global production, the third largest category of industrial wood products beyond wood pulp and sawnwood is composite wood products (including primarily fiberboards and particleboards). Total global output of fiberboard and particleboard in 2007 reached 162 million cubic meters (including medium density fiberboard or MDF, industrial particleboard, and oriented strand-board or OSB), equivalent to 38 percent of global sawnwood production (FAOSTAT). Global output of plywood, the fourth largest category of industrial wood product, was 76 million cubic meters, equivalent to 18 percent of global sawnwood production in 2007 (FAOSTAT). Global output of composite products has rapidly expanded, more than doubling from 1990 to 2007, while global plywood production has also expanded by just over 50 percent in the same period. However, much of the input for MDF and particleboard products consist of wood residues from sawmills or plywood mills, so roundwood demands for composite wood products are generally much lower than roundwood demands for sawnwood or plywood.

STEADY STATE OR SUSTAINABLE FUTURE IN WOOD PRODUCTS?

Considering future sustainability of timber supply, wood products are likely to experience a steady state or sustainable future provided that forestry policies and practices respond to needs for timber with sustainable forest management, as has been largely the case in Europe, North America, and other regions with stable resource trends. However, the effectiveness of forest policies and forest management appear to vary substantially among global regions (based on trends in deforestation and forest stocks as discussed previously). Some regions are, in fact, experiencing significant rates of deforestation such as Africa and South America, although existing forest stocks are still quite large in those regions (Figure 6). The economic viability of forestry versus other competing land uses (agriculture, livestock grazing, and urbanization) is an important factor influencing the sustainable development of forests in those regions, and high rates of fuelwood removal probably also contribute to deforestation in those regions (particularly in Africa).

High rates of economic growth and population density in Asia favor intensification of land use, and hence more rapid expansion of forest plantations is occurring in Asia than in other global regions (Figure 7). Industrial forest plantations have expanded globally but such plantations still represent only about 4 percent of global forest area. Worldwide expansion of tree plantations and improved forest productivity could substantially increase the world output of timber in the future, but doing so will require sustained high levels of demand and revenues for timber. In regions where wood fiber demands have waned, such as North America, the rate of expansion in forest plantations has diminished.

Although existing global timber resources, improved forest management and forest plantations are capable of meeting industrial roundwood needs for decades to come, the prospect of substantial expansion in global wood energy demand is a wild card (see Chapter 4). As reported by the Intergovernmental Panel on Climate Change in their Special Report on Emissions Scenarios, future energy scenarios vary widely in their projections of future biomass energy demands, depending on future assumptions about petroleum resources and future alternative energy technologies (Nakicenovic et al. 2000). In many scenarios biomass energy production is projected to increase prodigiously after global oil production peaks around 2020 to 2030. However, variations in assumptions about future energy resources, economic growth, and technology development result in a wide range for projected global biomass energy output. In any case, from a forestry and forest products standpoint an appropriate concern is the potential impact of expanded biomass energy demand on sustainability of forests and forest products.

As explained previously, historical data show that the highest global levels of industrial roundwood harvest, in North America and Europe, are consistent with the lowest rates of deforestation globally, supporting the hypothesis that an economically vibrant industrial forest products sector has been key to forest policies and forestry practices that support sustainable timber supply and demand. On the other hand, the historical data show that high levels of fuelwood harvest (wood use for energy) are actually correlated with relatively high rates of deforestation in regions such as Africa, Asia and South America. This observation suggests that future impacts of wood energy demands on sustainable forest management are somewhat uncertain.

Historically, fuelwood has been the timber commodity with the lowest commercial value, generally less than the value of pulpwood and considerably less than the value of higher quality sawlogs or veneer logs. Consequently, adequate flows of timber revenues that can sustain forestry activities and effective forest management are much more likely to be associated with high levels of industrial roundwood harvest rather than high levels of fuelwood harvest (at least that has been the case historically as noted previously). Simply using wood as a low cost energy feedstock (as in conventional fuelwood) is unlikely to generate the kind of timber revenues that will sustain improved forestry practices unless fuelwood prices increase substantially in the future. However, the situation could change if timber prices higher than historical fuelwood prices can be afforded by future wood energy technologies or perhaps future biorefining technologies (for conversion of wood into more valuable liquid fuel or chemical feedstock).

These observations lead toward a conclusion that the future direction of forest product technology (including wood energy and biorefining technology) and supportive forest policies will largely determine economic sustainability of forests and forest management. If future technology and wood demands generate sufficiently high values for timber as a raw material, as has been the case historically with industrial roundwood demands in some regions, then historical experience suggests that forests and forest management will thrive in the future. If on the other hand the average value of timber is marginalized or cheapened by demands for only low-cost wood energy or by insufficient forest product technology development, then historical experience suggests that forests and forest management may face significant challenges regarding their future sustainability.

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