USING WOOD PRODUCTS TO MITIGATE CLIMATE CHANGE:

A REVIEW OF EVIDENCE AND KEY ISSUES FOR SUSTAINABLE DEVELOPMENT

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ACRONYMS

ACP	Africa, Caribbean and the Pacific
AIJ	Activities Implemented Jointly
ATFS	American Tree Farm System
BRE	Building Research and Consultancy
CAC	Central America and the Caribbean
CDM	Clean Development Mechanism
CIFOR	Center for International Forestry Research
CIS	Commonwealth of Independent States
CITES	Convention on Illegal Trade in Endangered Species
CSA	Canadian Standards Association System
CSR	Corporate and Social Responsibility
ECCM	The Edinburgh Centre for Carbon Management
EDIP	Environmental Development of Industrial Products
EIA	Environmental Impact Assessment
ESA	East and South Asia
EU	European Union
EWP	Engineered Wood Products
FAO	Food and Agriculture Organisation of the United Nations
FLEGT	Forest Law Enforcement Governance and Trade
FSC	Forest Stewardship Council
GHG	Greenhouse Gases
IEA	International Energy Agency
IIED	International Institute for Environment and Development
ILO	International Labour Organisation
ISO	International Standards Organization
ITTO	International Tropical Timber Organisation
LCA	Life Cycle Assessment
LCI	Life Cycle Inventory
LUCF	Land-use change and forestry
LULUCF	Land use, land-use change and forestry
MTCC	Malaysian Timber Council Certification
NENA	Near East and North Africa
NTC	Nordic Timber Council
NTFP	Non-Timber Forest Products
OECD	Organisation for Economic Co-operation and Development
PEFC	Pan European Certification Scheme
PET	Polyethylene Terephthalate
PFP	Private Forestry Project
PVC	Polyvinyl Chloride
RIL	Reduced Impact Logging
SEA	Strategic Environmental Assessments
SFI	Sustainable Forestry Initiative
SFM	Sustainable Forest Management
SSA	Sub-Saharan Africa
UK	United Kingdom
UNECE	United Nations Economic Commission for Europe
UNFCCC	Framework Convention on Climate Change
USA	United States of America

EXECUTIVE SUMMARY

Human induced climate change is one of the most pressing and complex issues facing society in the 21st century. Increased use of forests and wood products, while not replacing the need to reduce greenhouse gas emissions at source, does make an important contribution towards tackling the problem of climate change. The use of wood products can also provide broader social, economic and environmental benefits. However, these broader developmental benefits are not always recognised, nor do they always materialise in tandem with climate change mitigation initiatives. This report aims to improve understanding of the benefits of, and linkages between, the use of wood products to mitigate climate change and the capacity to deliver broader human development.

Sustainably managed and non-managed forests are both important carbon sinks. Their conversion to other land uses is a significant cause of CO_2 emissions. The three main possibilities for mitigating climate change using forestry and wood products are: activities that reduce greenhouse gas emission from forests (such as reducing biomass burning and deforestation); activities that help maintain the ability of forests to store carbon (such as management techniques including silviculture and low impact logging); and activities that expand the capacity of forests to store carbon (such as afforestation and agroforestry). Some forest management programmes now include carbon sequestration in their management objectives.

Despite increases in global economic activity and population since the mid 1980s, the total consumption of industrial wood has barely changed. However, there have been major changes in the origin and composition of production. This has seen larger areas of economically efficient plantation increasingly substituting for production from natural forest areas with an overall loss of forest cover. The combination of relatively static consumption together with these changes in production patterns has meant that the contribution of forest and wood production systems to climate change mitigation has not fully been captured. Promoting both forests and wood products can help to redress this.

High transport costs in the forest sector mean that the size of domestic markets has traditionally dwarfed the size of international markets. However, sourcing industrial wood through international trade has increased, particularly within regional markets such as Europe. Despite disadvantages in terms of forest growth rates, boreal and temperate regions, such as the EU, have managed to fend off much of the competitive challenge from tropical regions. With a few specific exceptions, tropical production and trade figures for industrial wood show little increase in market share.

Europe (including Eastern European countries and the Russian Federation) contains 27% of the total global forest area. The region is a major producer of wood products and considerable trade occurs within the region, such that most European wood comes from Europe. For example, although hardwood imports in Europe are less Eurocentric than softwoods, almost 91% of hardwood roundwood imports are still from within Europe. While historic deforestation rates in Europe have been high, current European forestry activities are now associated with expanding forest areas and widespread sustainable management. For example, almost 50% of the world's certified forests are found in the EU. Therefore, within the European market, most product categories have strong sustainability credentials. The remaining doubts centre around increasing volumes of softwood sourced from the Russian Federation, some hardwood imports from countries with weak forest controls in Africa, Asia and Latin America, some panel imports from South East Asia and a significant volume of poorly traceable secondary processed wood products.

The extent of forest loss over the last few years has led many to intuitively link forest loss with wood production. In fact the reverse is nearer to the truth, and forest cover is often increasing where sustainable forest production has proved economically viable. Conversely, where market forces have favoured agricultural alternatives to forest production systems, deforestation has happened at pace. Falling demand for forest products (and boycotts or bans on tropical timber) diminish the competitive position of forest management versus agricultural alternatives. Promoting wood products can turn this around.

Promotion of wood products can act as a greener alternative to more fossil-fuel intensive materials. Substituting a cubic metre of wood for other construction materials (concrete, blocks or bricks) results in the significant average of 0.75 to 1 tonne of CO_2 savings. The main opportunities to capitalise on these CO_2 savings include using a greater proportion of wood products (for example exchanging coal for biomass wastes, and increasing the use of wood in the construction and packaging industries), using wood products with a longer useful life, and increasing recycling. This report documents life cycle assessments that show how specific substitutions towards wood products can provide carbon benefits.

Product substitution is driven by changes in consumer preferences. This in turn is influenced by product innovation and promotion, making advertising and technological investment in new wood products important so that they can compete in terms of cost, quality and visibility. Wood industries have often lagged behind competitors such that in Europe and the US there is still increasing substitution away from wood products. The environmental benefits of using wood are perversely and incorrectly attributed to wood substitutes. Other constraints also prevent growth in some wood sector products, for example hygiene requirements limit the use of wood products in food packaging. Emissions reporting under the UNFCCC and the Kyoto Protocol unjustifiably favours non-wood alternatives, a problem which could be tackled with carbon intensity labelling. Pro-timber building standards would also help, as would education in architectural, engineering and planning sectors. Legislation is increasingly supportive of wood products, but still holds some constraints.

Forests provide multiple benefits to society rather that just benefits from income generation. Sustainable forest management attempts to ensure these economic, social and environmental benefits materialise, but this is not easy in diverse natural forests, and many industry stakeholders focus primarily on economic benefits. Good local, national and international forest governance can help maximise the multiple benefits of forestry. In Europe where governance is generally strong, the outcome is a stable or expanding forest estate. In other regions, particularly in the tropics, governance is under-resourced and the forest estate may be unstable or diminishing or pandering to the economic needs of the few.

Sustainable forest management offers the opportunity not only to mitigate climate change but also to contribute simultaneously to sustainable development objectives. However, meeting these objectives in Europe alone will contribute little to sustainable development in other regions, and whilst the science of carbon offsets may be simple, the politics are not.

Development contributions, which the broader adoption of sustainable forest management might facilitate, include economic, social and environmental gains. Economic opportunities include investment under the Clean Development Mechanism, and direct and indirect employment in forest industries. Social opportunities include contributions to local livelihoods, and improved local governance. Environmental benefits include not only climate change mitigation but also conservation of biodiversity, soil and water resources.

While there are many win-win situations for climate change mitigation and development, sustainable forest management may also inhibit the meeting of sustainable development objectives. For example: afforestation or reforestation may remove valuable local agricultural lands, decrease water availability or cause soil acidification; projects may be top-down and erode local decision making structures; and plantations can negatively impact biodiversity and encourage use of genetically modified organisms.

In the light of the opportunities and risks described above, there is a pressing need to promote those situations in which the dual aims of climate change mitigation and broader human development can be met. Voluntary mechanisms such as certification provide a partial solution. Yet critics of certification note that it provides a market advantage to already sustainably managed forests in wealthy northern countries (only 8% of certified forests are in tropical low-income countries), and may disadvantage small producers or managers of complex natural forests.

Further engagement and international cooperation is therefore needed between the north and the south to chart the ways in which wood industries can improve their contribution to climate change mitigation and sustainable development. Parallel efforts are needed to jointly improve the environmental and developmental profile of the wood industries worldwide in the face of market forces, competition and the often wilful distortion of facts. Greater cooperation between the wood industries across different regions would be strategically advantageous, mediated by an appropriate international organisation. The development of robust criteria by which to identify positive win-win solutions and the preparation of guidelines and case studies to that end would be useful first steps along this pathway.

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CHAPTER 1 - INTRODUCTION

Climate change is one of the most pressing and complex issues facing society in the 21st century. Many countries, particularly those that have ratified the Kyoto Protocol, now recognise this and are actively developing measures to mitigate and adapt to climate change. As part of the important role that forests can play in providing wealth and well-being to countries and their citizens, forests can make an important contribution towards tackling the problem of climate change. However, the potential benefits of utilising wood products to reduce carbon dioxide emissions is not well recognised in the decision-making of governments, public purchasing agencies and individual consumers.

It is critical in any assessment of the relative merits of one product type (versus other competing product types) to understand the various competing frames of reference within which the debate takes place. Each set of actors will have their own agenda that will in turn affect their presentation of, or interpretation of the facts. Table 1.1 introduces the main actors whose perspectives shape the debate. The views of these actors are simplified, and reality is likely to demonstrate greater diversity of views within actor groups than shown in this table, but it is clear that different groups of actors take radically different views on the advantages and disadvantages of using forest products – often without adequate reference to body of evidence on forestry and its interaction with human development.

Increased use of forests and wood products can also provide broader social, economic and environmental benefits as well as contributing to climate change mitigation efforts. However, this is very dependent on the types of wood production systems in operation, and consensus on these issues between and amongst stakeholders listed in table 1.1 is lacking. There is therefore a need for better understanding of the benefits and costs for sustainable development of using wood products to mitigate climate change. This report aims to contribute to the understanding and communication of these issues, thus leading to improved policy and purchasing decisions. Particular focus is placed on Europe and European markets, in which, it is assumed the NTC will have most interest. Less attention is given to issues such as the use of wood for energy, and the use of waste wood. Whilst interesting, these issues are less relevant to the main substance of the report, and would need to be dealt with by a larger research project.

Table 1.1: Main actors in the debate about the sustainability of wood in comparison with alternative construction materials

Actors	Agenda	Perspective	Example
Wood products industry	To promote the value of wood products	There are multiple benefits to forests. Wood production increases forests. Buy wood!	(Jerkeman and Remrod 2003)
Competing structural products industries: Steel, plastics, aluminium, concrete	To promote the value of competing structural materials	There are environmental benefits to using products that do not involve cutting trees down. Substitute wood!	(American Plastics Council 2004)
Consumers of wood products and substitutes	To get quality at the minimum price, preferably without damaging the environment	Wood products can be of variable quality. The environmental benefits of using different alternatives are unclear. Buy quality at the cheapest price!	(Eastin *et al*. 1996)
Environmental alliances	To preserve the global environment / biodiversity	Wood production systems can be sustainable but often are not. It all depends!	(Dudley *et al*. 1996; Poore 2003)
Social alliances	To eradicate poverty and reduce inequity	Wood production systems are vital to rural livelihoods, but have abused local communities in some instances. It all depends!	(Madeley 1999; Westoby 1987)
Climate change alliances	To mitigate climate change	Wood production systems can make important contributions to climate change mitigation efforts. It all depends!	(Stuart and Moura Costa 1998)
Government authorities	To maximise human well-being within their voting domain	Economic wealth is primary although food security / agriculture must be secure. It hardly matters – but agriculture is subsidised above forests	(Government of Zimbabwe 1999)

Chapter 1 of this report has introduced the context and challenges, the main issues under discussion and the key stakeholders. Chapter 2 focuses on forests, wood and climate change, describing the role that forests play in the global carbon cycle, and the various options for mitigating climate change using forestry and wood products. Chapter 3 explains important trends in wood markets and links to forest production, both at a global level and with particular focus on Europe. The chapter ends with a section describing perspectives on sustainable management, illegality and sustainability issues relating to the use of other product types in Europe. Chapter 4 compares the greenhouse gas profiles of wood with competing non-wood materials in the construction and packaging markets. It describes the barriers and potential for substituting non-wood products with wood products. Chapter 5 assesses forestry and wood products in the context of broader concerns about sustainable development (which is considered to have economic, social and environmental components). The chapter first focuses on the concept of sustainable forest management (SFM), and then describes the extent to which SFM and sustainable development are served by the climate change mitigation agenda, and situations where SFM and sustainable development can be impeded by the climate change mitigation agenda. The chapter ends with a section describing the ways in which sustainable development can be assessed in the context of SFM and climate change mitigation. Assessment methods include various international organisations and assessment criteria, sustainability impact assessments, and certification. Chapter 6 concludes the report by providing a series of statements (based on evidence in the report) relating to the benefits and costs for sustainable development of using wood products to mitigate climate change.

CHAPTER 2 – FORESTS, WOOD AND CLIMATE CHANGE

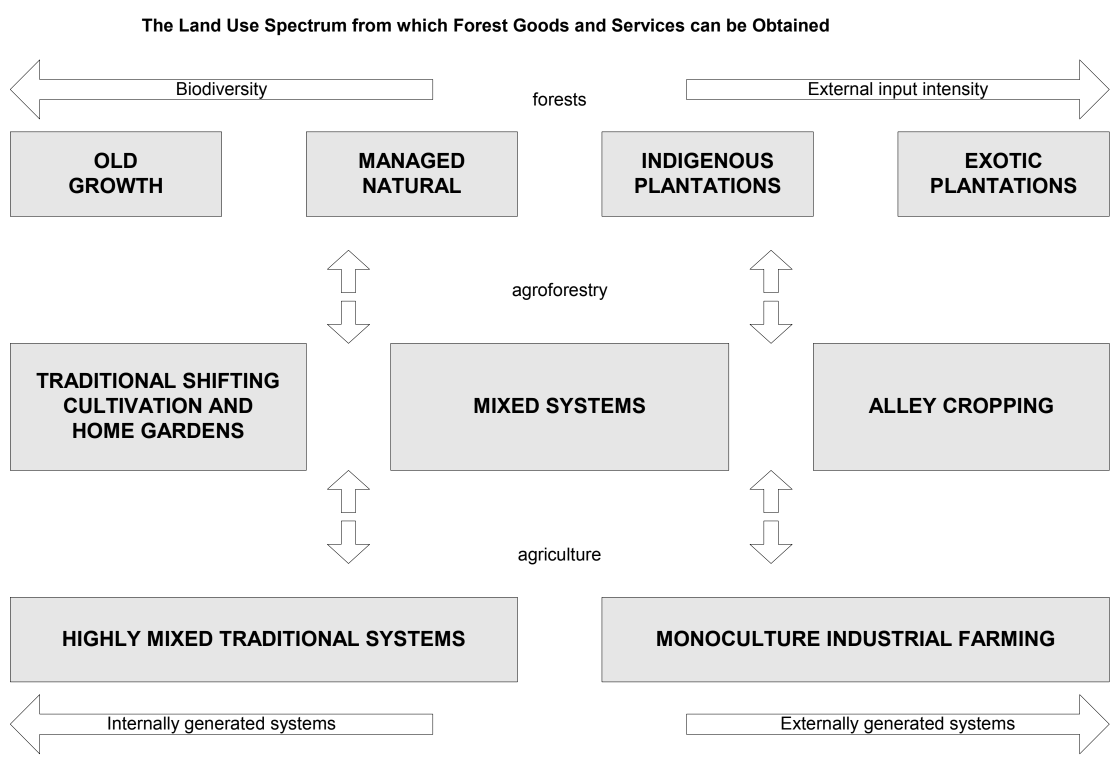
This chapter describes the role that forests play in the global carbon cycle, the significance of wood as a carbon store, and the various options for mitigating climate change using forestry and wood products. These options include reducing GHG emissions from forests, maintaining existing forest or wood carbon sinks, and expanding forest or wood carbon sinks.

2.1 Forests and the global carbon cycle

Human induced changes to the global carbon cycle are thought to be the main driver of climate change that has occurred since the industrial revolution and which is predicted to accelerate over the next century. While the main human influence on global carbon flows is the emission of approximately six billion tons of carbon per year from the combustion of fossil fuels, human impacts on soil and vegetation are also significant (IPCC 2001). This section describes the role of forests within the carbon cycle and how human activities affect forest carbon dynamics.

The world's forests hold a stock of carbon of over 1,200 billion tons; almost double the amount of carbon held as CO_2 in the atmosphere. This stock is shared between a range of different forest types depicted in Figure 2.1. However, the vast majority of CO_2 fluxes are between the atmosphere and non-managed forests such as Amazonia and the boreal forests.

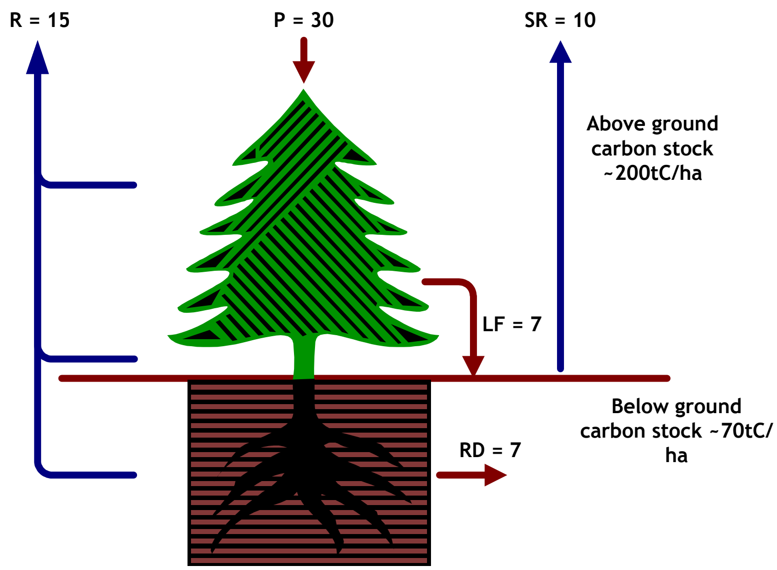
Figure 2.1: The land use options from which forests goods and services can be obtained



Source: Mayers and Bass (1999)

Every year, just under 10% of this carbon (approximately 100 billion tC) is cycled between the forests and the atmosphere, through the natural processes of photosynthesis, respiration and combustion (Steffen *et al*. 1998). This accounts for 80% of the annual flux of carbon between all terrestrial (rather than aquatic) ecosystems and the atmosphere. Figure 2.2 illustrates the main flows of carbon between atmosphere, trees and soil for a hectare of tropical forest.

Figure 2.2: Carbon uptake by photosynthesis, storage in wood and soil releases by respiration and combustion in tC per hectare per year



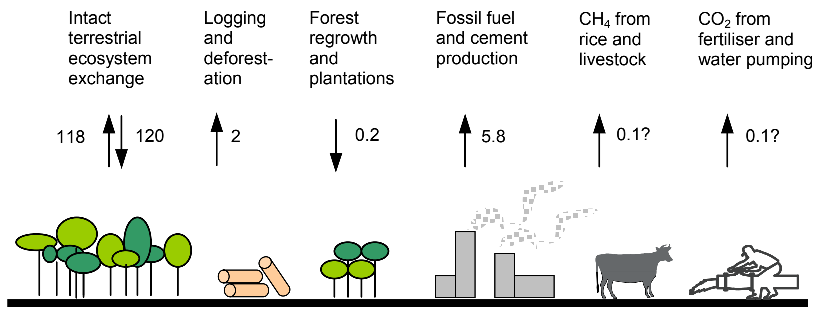
R= plant respiration; P=photosynthesis; SR = soil respiration; LF=leaf fall; RD = root decomposition

Source: Based on results from experimental station near Manaus, Brazil (Grace *et al*. 1995)

While there is considerable uncertainty as to how terrestrial carbon stocks have changed during the 18,000 years since the last glacial maximum, there is clear evidence that human activities over the past 500 years, principally the expansion of agriculture and exploitation of forests for fuel and timber, have led to significant reductions of these stocks. According to Houghton and Hackler (1995), over 100 billion tC were released to the atmosphere between 1850 and 1980 through changes in land use, principally the expansion of agricultural and gazing lands. Historically, deforestation in China and Europe occurred prior to the industrial revolution, with forest conversion in the tropics – Asia, Latin America and Africa – taking place predominantly in the 20th century. Continuing deforestation, mainly in the in tropical regions, is currently thought to be responsible for annual emissions of 1.1 to 1.7 billion tC; approximately 20% of anthropogenic CO_2 emissions (Brown *et al*. 1996b; Melillo *et al*. 1993). However, in many temperate countries the growth of productive forest plantations is a significant sink, of approximately 0.2 billion tC and rising (FAO 2001a).

Figure 2.3 illustrates the current annual flows of carbon between the land and atmosphere.

Figure 2.3: Carbon flows between the land and the atmosphere (billion tC yr^{-1})



While land use change is a significant cause of CO_2 emissions, there is strong evidence that sustainably managed and non-managed natural forests can be important carbon sinks. Evidence from experiments across a range of forests from tropical, temperate and boreal regions show that forests are currently a net sink of CO_2, absorbing up to 25% of global fossil fuel emissions (Malhi *et al*. 1999). This "sink effect" may be occurring as a result of the increase in atmospheric concentrations of CO_2 plus nitrogen deposition, or may be a longer term feature of forest ecology.

As well as being important in the global carbon cycle, forest products have an important role to play in the development of a sustainable low carbon economy, through the production of renewable fuels and products that produce less greenhouse gas (GHG) emissions per unit than most mineral or oil based products.

On their own, the increased use of wood products may only have a limited global impact on carbon sequestration (Dixon *et al*. 1994); however, wood products could possibly reduce fossil fuel emissions when substituted for materials such as steel, concrete, or plastics which emit more GHGs during production. Further benefit can also be achieved if wood residues are recovered in the production chain and used as alternative energy source to fossil fuels (Marland and Schlanmadinger 1997).

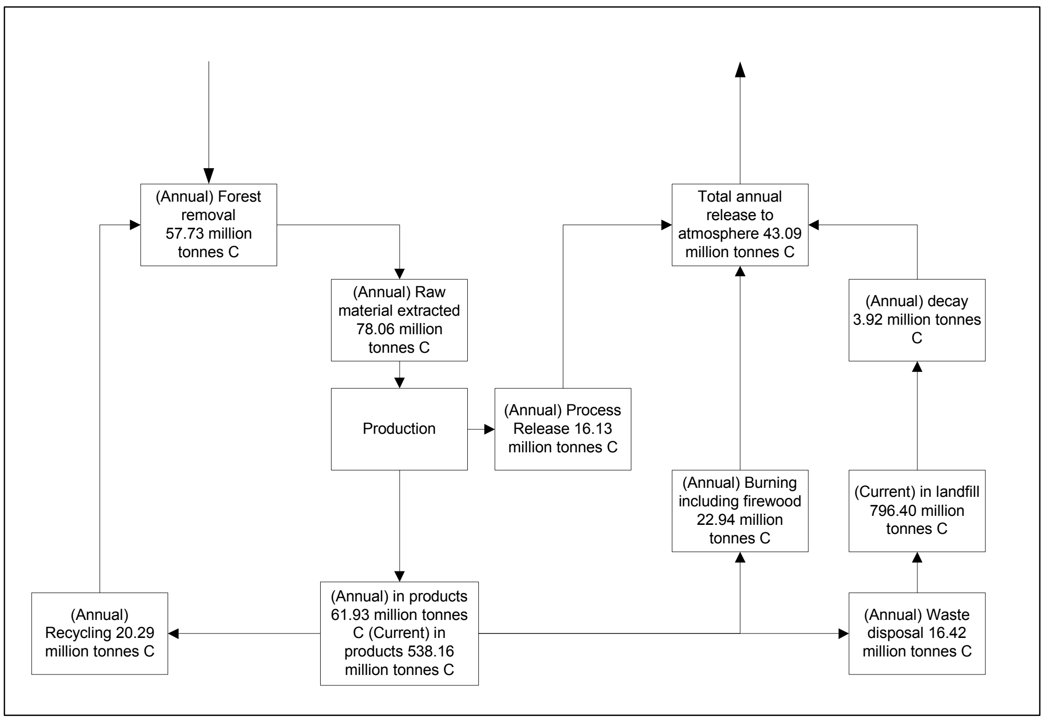
The GHG benefits of forest products relative to fossil fuels and mineral or oil-based products are discussed in more detail in chapter 4.

2.2 The significance of wood as a carbon store

Wood is one of the most important primary materials for construction, furnishing and communication. In Europe, over 50% of total consumption is used for paper, cardboard and other lightweight packaging, 20% is used for construction timber and the remaining fraction is used for a variety of panels and chipboard (UNECE/FAO 2003).

Over the past century the use of wood for building material has decreased due to the introduction of alternative construction materials such as concrete and various composites. Over the past 20 years, the use of wood-derived packaging and furniture has also decreased significantly with the introduction of plastic packaging materials (Robins and Roberts 1996; APME 2001).

Figure 2.4: Carbon stocks and flows in the forest sector in the European Union



Source: Adapted from European Forest Institute data

In the context of international agreements such as the Kyoto Protocol and EU efforts to reduce the impacts of consumption through the amendments to the Packaging Directive and the Energy Performance of Buildings Directive (2001), there is increasing interest in substituting sustainably produced wood-based products for oil or mineral-based products. Not only is wood a biodegradable and renewable resource, it is also an effective store of carbon as long as products remain intact within buildings or other structures. Furthermore, at the end of a wood product’s life it can be used as fuel to substitute for fossil-based energy. Figure 2.4 shows current carbon stocks and flows in the forest sector in the 15 EU countries minus Greece.

2.3 Options for mitigating climate change using forestry and wood products

When considering the management of forested lands to mitigate climate change it should be recalled that forests are often managed for multiple purposes, including industrial wood production, fuelwood production, production of non-timber forest products (NTFP), protection of natural resources (e.g. water and soil), wildlife management, and recreation (Brown 1996). Following international concern about climate change, carbon sequestration has now become an additional objective for certain forest management programmes. There are many forest management strategies which can reduce global CO_2 emissions. For example, preventing deforestation and unsustainable agricultural and land-use practices is "one of the most cost-effective, and environmentally beneficial actions that can be taken now to arrest global climate changes" (Hughes and Benemann 1997).

In the following section, the promotion of wood products will be considered alongside more general forest management strategies to outline the potential forestry options for climate change mitigation. In general, these efforts can be categorized into three general strategies: (1) activities that reduce GHG emissions from forests; (2) activities that help maintain the ability of forests to store carbon; and (3) activities that expand the capacity of forests to store carbon.

2.3.1 Strategy 1: Reducing GHG emissions from forests

Reducing deforestation
Deforestation is an entrenched global environmental problem, causing widespread loss of wildlife habitat and biodiversity, as well as interfering with basic ecosystem functioning. Brown *et al.* (1996a) estimate that "deforestation contributes to 20-25 per cent of the current global anthropogenic CO_2 emissions." In the tropics, there is an accelerated rate of deforestation predominately due to the felling and burning of forests to open up new lands for agriculture and pasture. This type of deforestation is not easily prevented due to the increasing demand for agricultural land as a result of rising human populations. Efforts to reduce deforestation rates must therefore be accompanied by efforts to increase productivity and sustainability of existing agricultural lands, so that production keeps pace with increasing demands.

Pilot land-use change projects designed to avoid emissions by reducing deforestation have produced "marked environmental and socioeconomic co-benefits, including biodiversity conservation, protection of watershed and water resources, improved forest management and local capacity building, and employment in local enterprises" (IPCC 2000). Examples include the Rio Bravo project in northwestern Belize and the AES Barbers Point carbon-offset project in Paraguay (IPCC 2000).

Reducing area and frequency of biomass burning

Another source of GHG emissions is caused by biomass burning which takes place in many parts of the world when forests or savannahs are burned to stimulate regeneration of grasses for livestock. Burning of fuel wood and charcoal, and consumption of agricultural residues, also contribute emissions. In many low income countries, there are no integrated fire management programmes which can help reduce the risk of unintentional wildfires (William Ciesla in Adger *et al*. 1997). Establishing appropriate forest management programmes could reduce the area and frequency of biomass burning and could also provide additional benefits to local communities and the environment.

Increasing efficiency of burning fuel wood and other biofuels

Biofuels such as wood, charcoal, crop residues and animal dung are used for heating, cooking and processing raw materials in many parts of the world. In fact, biofuels are the fourth most important source of energy worldwide. According to the International Energy Agency, biofuels currently provide about 49 EJ (1,170 Mtoe) of energy per year, or ~11% of global primary supply. In developing countries, biofuels account for about 20% of primary energy supply (IEA 2000). In many low income countries the figure is considerably higher. Currently, it is estimated that household biofuels account for 2-7% of global emissions (Adger *et al*. 1997). This figure could be greatly reduced with more efficient technology, for example, with more efficient cook stoves. For such improved technology to have an impact on global GHG emissions they must be relatively inexpensive to ensure wide distribution. Cook stove projects in India, China and Africa demonstrate that low-cost alternatives can be found with significant benefit to local households as well as for the environment. Improved wood stoves can reduce the amount of indoor pollution, thus providing additional human health benefits. They also require less fuel so less time needs to be spent collecting it. For fuel-efficient cook stoves to have real impact they must be cost effective at the level of household economies – often they are not (Arnold *et al*. 2003).

Increased use of wood and other biofuels in place of fossil fuels

Biofuel substitution is also a promising way to reduce GHG emissions by replacing fossil fuels with biofuels (such as forest residues from timber harvesting) that emit less carbon. Exchanging coal for biomass wastes and residues is "one of the lowest-cost, nearest-term options for reducing fossil CO_2 emissions at existing power plants" (Hughes and Benemann 1997), and is a promising mitigation strategy in high-income countries where the appropriate infrastructure is already in place. For example, research on fuel substitution in Sweden found that "the highest cross-price elasticities can be found between wood fuel and non-gaseous fossil fuels (oil and coal), reflecting a relatively large substitution possibility" (Brännlund and Lundgren 2001).

Increasing efficiency of timber-harvesting practices

In many parts of the world, inefficient timber-harvesting operations result in excessive soil disturbance, logging residues and damage to remaining trees.

This increases GHG emissions and reduces the ability of the remaining trees to sequester carbon (Adger *et al*. 1997). It can also reduce the future economic viability of the timber stand. Improvements in timber-harvesting include the development of forest management and harvesting plans; reduction of logging damage by prefelling of vines where trees bind together; directional felling; reduction of yarding damage by restricting bulldozers to skid trails and maximizing log-winching distances; increased utilization of felled trees; and post-harvest practices, such as the removal of steam crossings, proper slash disposal and treatments to promote vegetation growth in logged-over areas. According to one study conducted in several tropical countries, less than 50% of the mainstem of harvested trees is currently utilized, compared with 78% in industrial countries (Dykstra and Heinrich 1992).

Low impact logging is "an attractive forestry offset option because approximately half of the eventual greenhouse gains are realised over the first few years" (Stuart and Moura Costa 1998). Low impact logging also lessens the risk of failure of carbon offset investments. Other environmental benefits include maintaining biodiversity, reduced risk of forest fires, and the promotion of soil integrity. Moreover, low impact logging allows forests to continue "to provide economic potential through continued protection of timber resources in an environmentally sustainable manner" (Stuart and Moura Costa 1998). However, GHG benefits of low impact logging are difficult to quantify. More recent studies have contradicted some of the early estimates. Slower regeneration of valuable timber species can lead to longer rotation times and perversely, can decrease average long term carbon uptake.

2.3.2 Strategy 2: Maintaining existing forest or wood carbon sinks

Management and conservation of natural forests
In addition to timber harvesting, changes in the management of natural forests can also help mitigate climate change. For example, increasing the productivity of existing natural forests can increase carbon sequestration. The carbon sink potential of a forest can be enhanced by changing forest management practices to accelerate tree growth, maintain optimum stocking levels and protect from fire, insects and disease or invasive weeds. This can be achieved through silvicultural treatments such as thinning, liberation treatments, weeding and fertilisation. Since substantial amounts of carbon are also stored in soils, management practices that promote an increase in soil organic matter can also have a positive carbon sequestration effect (Stuart and Moura Costa 1998). Of course, there are cost constraints to all of these approaches.

Long-term use of forests and forests products
From the perspective of carbon storage, the most desirable uses of forests and forest products are those that extend rotation ages, and production of goods that are durable and long-lasting. Although logging reduces the amount of carbon stored on the land, forests will regenerate and accumulate carbon, possibly at a faster rate than that previous to logging, if

they are not severely damaged during harvesting operations and sound management occurs. Currently, temperate and boreal forests are estimated to provide a net carbon sink of about 0.7±0.2 Pg/yr (Brown 1996). This is because such forests are, on average, composed of relatively young classes with high growth rates, and thus high carbon sequestration rates. They also tend to be managed for sustained yield more often than in tropical forests.

2.3.3 Strategy 3: Expanding forest or wood carbon sinks

Forest planting
Afforestation has become another option for mitigating global climate change, especially with the establishment of fast-growing trees in the tropics, which can fix from 12 to 70 tonnes of carbon per hectare over rotation ages ranging from 7 to 20 years (Adger *et al*. 1997). The cost constraints of forest planting may be partially offset by the sale of carbon credits, making afforestation projects, such as plantation forestry, economically feasible (Frumhoff *et al*. 1998; Smith 2002). Of course, the sequestration potential of these projects will vary significantly with location, scale and broader management techniques. For example, conservation of soil carbon in plantations can increase when understory vegetation and leaf litter is not cleared (Chomitz and Kumari 1998). Sequestration levels also depend on the tree species planted and their growth rates.

The Kyoto Protocol includes many provisions for forest carbon sequestration projects, including the joint implementation provision, and the Clean Development Mechanism (CDM), which allow nations to claim credits for carbon sequestration projects undertaken in cooperation with other countries. However, there are many obstacles for implementing such mechanisms, especially measurement challenges. Such obstacles, when combined with the self-interest of certain actors and a lack of information, may prevent the Kyoto Protocol provisions from having significant impacts (Richards and Andersson 2001; Mulongoy *et al*. 1998; Smith 2002). Opposition to the Kyoto Protocol provisions also comes from environmental groups, concerned that any focus on the provision of carbon sinks will reduce the attention given to reducing the source of GHG emissions.

Agroforestry
Agroforestry combines trees and shrubs with crops or livestock in ways that increase farm and forest production. This form of land use can provide goods and services to local people whilst maintaining environmental stewardship, and it can also provide for carbon sequestration to a degree dependent on the scale and ultimate use of the wood products. Examples include the 'Four Around' scheme in China, which was carried out over 6.5 million hectares in the 1980s. Agroforestry projects of this scale can sequester large amounts of carbon as well as provide economic development and environmental benefits such as the prevention of soil and water erosion, increased soil fertility, maintenance of soil organic matter and physical properties, increased nutrient inputs through nitrogen fixation and uptake from deep horizons, and promotion of more closed nutrient cycling (Young

1997; Adger *et al*. 1997). One study of carbon stocks in smallholder agroforestry systems in the tropics noted carbon sequestration rates varying between 1.5 and 3.5 MgC ha^{-1} yr^{-1} and projected a tripling of carbon stocks over a 20 year period to 70 MgC ha^{-1} (Watson *et al*. 2000). The same study estimated the area currently under agroforestry worldwide as 400 million hectares, with an estimated carbon gain of 0.72 t C ha^{-1} yr^{-1}. This could potentially reach 26 MMTC yr^{-1} (MMTC = million metric tons carbon) by 2010, and 45 MMTC yr^{-1} by 2040 (Watson *et al*. 2000). As is the case in the AES Thames Guatemala project (Dixon *et al*. 1993), agroforestry may also provide local economic benefits, providing greater income to farmers from timber, fruits, medicinals, and extractives than would have been achieved through alternative agricultural practices (Cooper *et al*. 1996; Pandey 2003).

CHAPTER 3 - TRENDS IN WOOD MARKETS AND FORESTS

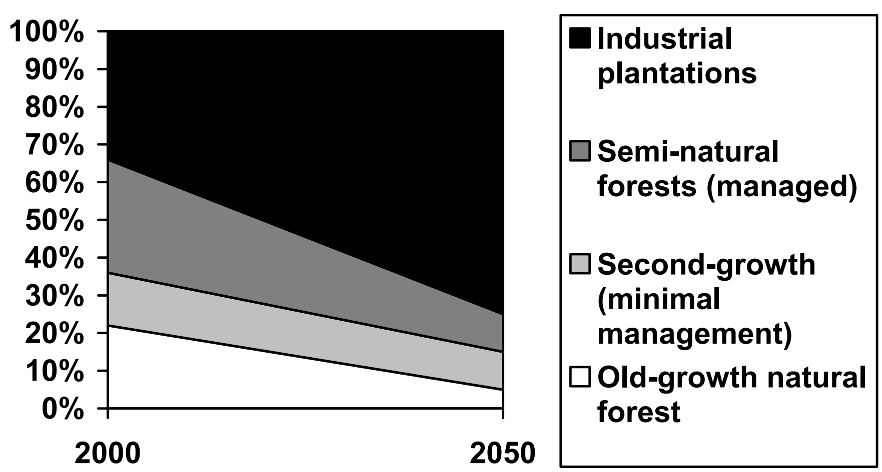
Having previously described the role that forests and wood can play in the mitigation of climate change, this chapter now moves on to characterise market trends in wood products and linkages with forest production systems and management. Particular focus is placed on the European wood industries and wood market, and the chapter finishes with a section describing perspectives on sustainable management, illegality and sustainability issues relating to the use of other product types in Europe.

3.1 Global market for wood products and links to forest production

3.1.1 Underlying global trends in the use of industrial wood

Despite the large increases in global economic activity, wealth and world population since the mid 1980s, the total production of industrial wood has barely changed, hovering at around 1.5 billion cubic metres (Sedjo 2001) (table 3.1). The relatively steady increase between 1960 and 1980 led many to predict continuing global consumption – but these predictions proved unfounded. Reasons for the recent stagnation include the substitution of wood with other materials, the growth in global recycling and the maturation of heavy wood-demanding economies (e.g. the USA, EU and Japan). Yet, while total production has remained relatively constant in recent years, there have been major changes in the origin and composition of that production.

Figure 3.1: Estimated current and forecast industrial roundwood supply by forest management situation (% global harvest)



Source: based on Sedjo (1999)

Historically, most wood has been sourced from natural forests. However, a major continuing trend in forestry is the gradual replacement of timber from natural forests with timber from plantations (figure 3.1). In Europe this trend is already far advanced, although for cost reasons, many plantations are established through natural regeneration rather than planted.

Table 3.1: World and regional distribution of industrial roundwood production, 1961–2000 (m cum)

Region	1961	1971	1981	1991	2000	Average annual change, 1961–2000
Total	1,017	1,296	1,412	1,558	1,587	1.12%
CAC	6	9	11	11	13	1.93%
ESA	26	49	72	87	68	2.38%
Europe	23	273	280	267	325	0.94%
NENA	8	12	13	9	13	1.43%
Oceania	30	49	63	81	83	2.61%
South America	28	41	84	114	153	4.35%
SSA	24	40	50	54	67	2.59%
Former USSR	253	298	277	275	139	-1.48%
Canada	87	116	139	153	183	1.88%
China	35	43	76	90	96	2.53%
Japan	49	45	31	28	18	-2.49%
USA	248	320	317	388	428	1.37%
Tropical	116	183	291	354	367	2.92%
Non-tropical	902	1,114	1,121	1,204	1,219	0.76%

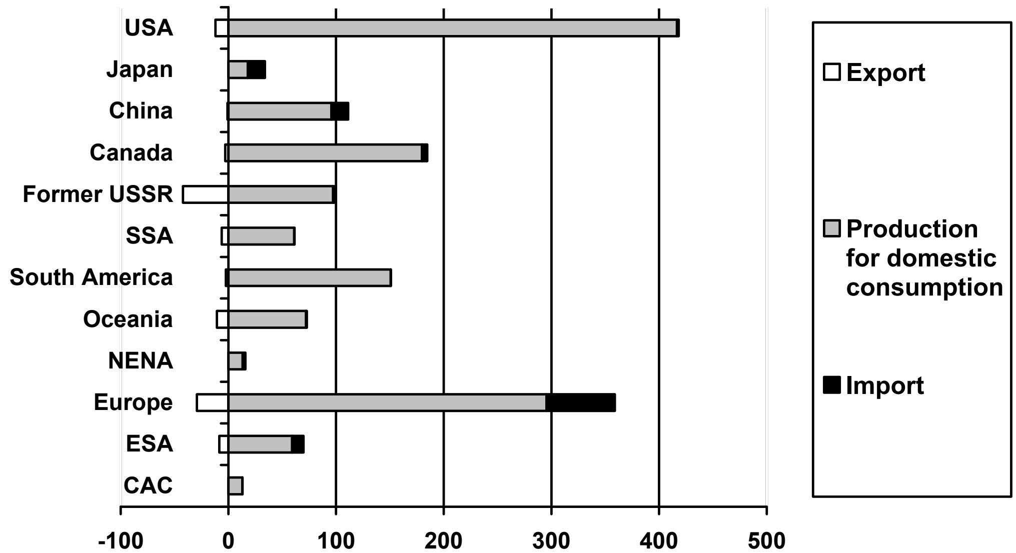
For the purposes of this analysis the world is divided into 12 regions: Central America and the Caribbean (CAC); East and South Asia (ESA); Europe; Former USSR; Near East and North Africa (NENA); Oceania; Sub-Saharan Africa (SSA); South America; China; Canada; Japan; and the USA.

The high transport costs associated with wood products have meant that domestic markets for wood products have dominated international markets. To a considerable degree this is still the case as the example of regional balances for industrial roundwood shows (figure 3.2).

Despite the historic dominance of production for domestic consumption, there has been a steady increase in sourcing industrial wood through international trade (figure 3.3).

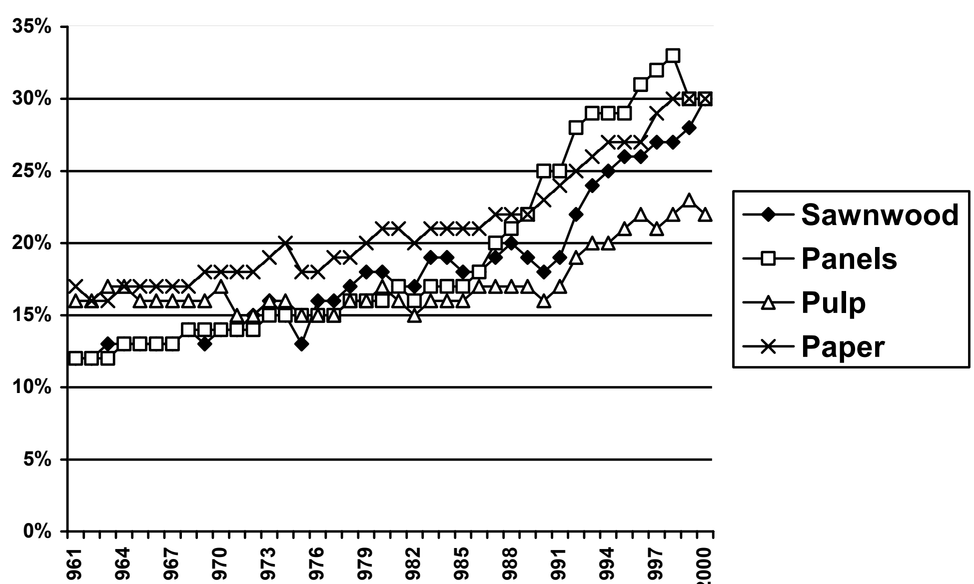
High transport costs have meant that high volumes of international trade have been limited to internal regional markets such as Europe, North America and South East Asia (both in exports and imports). Intra-European trade has dominated global trade figures in many product categories and is explored in more detail in section 3.2. Nevertheless, just as globalisation and market forces are driving changes in forest type (from less efficient natural forests to more efficient plantations) so too market forces drive changes in production location (from less efficient to more efficient locations).

Figure 3.2: Regional balances for industrial roundwood, 2000 (million cum)



Source: FAO Forest Resource Assessment (2000)

Figure 3.3: Percentage of each forest product category that enters international trade, 1961-2000



Source: FAO Forest Resource Assessment (2000)

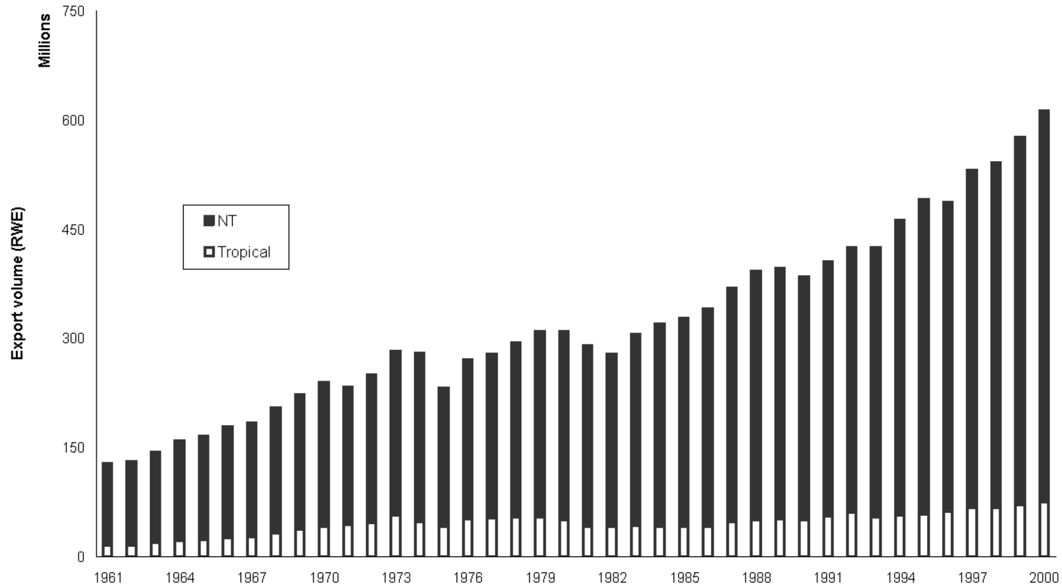
One notable recent shift has been the recent emergence of Russia as a major exporter of softwood. Following the collapse of the centrally controlled market, low production costs, a weak currency and abundant natural resources enabled Russia to increase its roundwood exports by as much as 14% in 2002 (Ekstrom 2003). At 8.6 million cubic metres in 2002, Russian exports of sawn softwood now exceed those of the entire former USSR for the first time. Even with these greatly expanded exports, Russian production is still well below its annual allowable cut and with rapid increases in the productive capacity of Russian business expected, the Russian trade is expected to have a major impact on future European and Asian markets. The existing oversupply of roundwood has already led to falling raw material costs in Europe.

Another major shift has been the recent emergence of China as a major global importer of roundwood and sawnwood and a major exporter, particularly of secondary processed wood products (SPWPs) – a category that includes wooden furniture and parts, builder's woodwork, other SPWPs (including packaging, cooper's products, domestic products etc.) and mouldings (Kunshan *et al*. 2000). China has leapt above Germany and Canada to become the world's second largest producer of SPWPs due to a strong policy encouraging downstream processing, low wages and substantial inward investment from USA, Taiwan, Singapore and other South East Asian neighbours. From a total output value of US$ 157 million in 1978, Chinese furniture production expanded to US$16.9 billion in 2001 involving 50,000 enterprises and nearly five million employees (ITTO 2002). The important link between Russia and China also deserves comment - with trade between the two countries rapidly expanding (e.g. a doubling in sawn softwood trade between 2000 and 2002 (Kosak and Spelter 2003). The low cost supply from Russia coupled with low cost processing capacity in China will present a formidable competitive axis in years to come.

With major shifts towards low-cost production locations, particularly for high-value, low-volume products such as SPWPs, it might have been expected that production and trade would have shifted from temperate and boreal regions towards tropical and subtropical regions. Yet production and trade figures demonstrate little evidence for increasing market share for tropical industrial wood (figure 3.4).

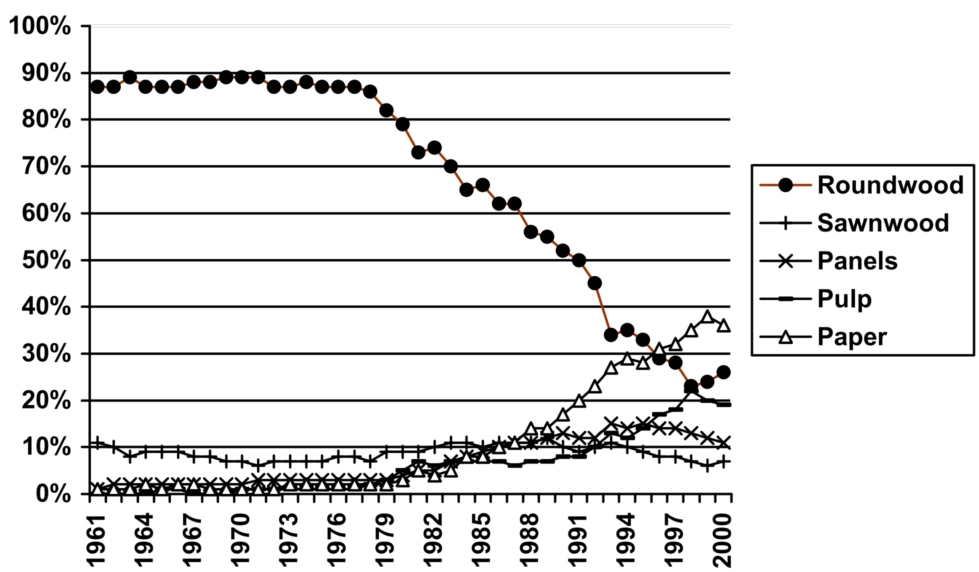
Within tropical regions there has certainly been a shift in the type of production for export (figure 3.5). Often with the help of protectionist measures, some tropical countries have succeeded in shifting their exports into value-added products. For example, the rapid development of the South East Asian panel production developed in response to investment policies coupled with export bans and export taxes on industrial roundwood and sawnwood exports. In one component of panel production, plywood, the trade became dominated by South East Asia and tropical plywood exports managed to capture 70% of the global market in the early 1990s (Rytkonen 2003). Yet, over-capacity in South East Asia has led to the exhaustion of accessible raw material, which is at least partly responsible for the subsequent loss of market share in tropical plywood which currently stands at less than 60%. The implications of distorting trade policies for long term production in Indonesia are detailed in Macqueen *et al.* (2004a).

Figure 3.4: Volume of wood exports from tropical and non-tropical (NT) countries (cubic metres – round wood equivalent), 1961-2000



Source: FAO Forest Resource Assessment (2000)

Figure 3.5: Percentage composition of exports from tropical countries, 1961–2000



Source: FAO Forest Resource Assessment (2000)

Boreal and temperate regions such as the EU have largely managed to fend off the competitive challenge from tropical regions. This has not primarily been achieved through the use of tariff barriers. Tariff levels are already generally low in the forestry sector, having been progressively reduced in preceding decades (Bourke 2001). An important exception to this is the continuing existence of tariff escalation on some processed products[1]. Instead non-tropical countries have managed to maintain market share through qualitative improvements (client-orientated flexible production technologies and design, coupled with superior marketing and delivery) (European Communities 2000). These have in many cases been coupled with non-tariff barriers that alter trade (e.g. subsidizing forest planting in the host country, restricting competitors products that do not meet predefined standards, placing quotas or using licenses to cover competitors products etc). The effect of these may exceed that of tariff barriers (Rice *et al.* 2000).

3.1.2 Changing patterns of forest cover and links to the production of industrial wood

Forest cover is diminishing at an alarming rate around the world with a net loss of 9.4 million hectares annually (FAO 2001a). Although there have been changes in assessment methodology it is safe to say that the rate has diminished slightly from an average forest loss of 13 million hectares per year between 1980-1990. Nevertheless, the massive extent of net forest loss has led many to draw a link intuitively between forest loss and the production of wood. In fact the reverse is nearer to the truth. Where sustainable wood production has been viable, commercial venture forests have flourished – where sustainable forest production has not been economically viable, forests have been replaced.

The explanation for net global forest loss is found in two contrasting stories hidden within the aggregate figures. On the one hand, over the last decade there has been an annual total loss of 14.6 million hectares, primarily in natural tropical forests. On the other hand, there has been an annual total increase of 5.2 million hectares primarily in monoculture timber plantation and forest regeneration. This has translated into net losses of tree cover in 89 countries and net increases in 67 countries (extrapolated from FAO Forest Resource Assessment 2000). Gains were reported in Europe, Near East and North Africa, Former USSR, Canada, Japan, China and the USA, although many of these countries or regions had already depleted much of their forest resource in previous centuries. In the tropical countries some 0.46% of remaining forest has been converted into other land uses annually (much higher than the world average of 0.24%).

In forest-rich tropical countries such as Indonesia, for example, forest cover has fallen from 162 to 98 million ha since 1950 and the rate of forest loss has accelerated from one million ha/year in the 1980s to approximately two million ha/year in natural forests since 1996 – despite an ambitious plantation programme which has established 9.8 million hectares of plantation during its lifetime (FWI/GFW 2002). In the Brazilian Amazon, a 40% increase in annual forest clearance between 2001 and 2002 brought

[1] See for example the Committee on Trade and Environment's Report to the 5th Session of the WTO Ministerial Conference in Cancún, WT/CTE/8, 11 July 2003, page 6.

deforestation primarily in the Amazon to 2.55 million ha per year, its highest annual level since 1995 (Amigos da Terra 2003) - despite a Southern plantation programme which has established 4.9 million hectares during its lifetime.

Market forces intrinsically favour the most financially competitive land uses. This is often to the detriment of sustainably managed natural tropical forests (Macqueen *et al*. 2004a). Contributory factors include:

- *Profitability of other land uses* (often agriculture) such as grain crops in temperate America and Europe, palmoil in South East Asia or soy production in South America. Agricultural subsidies exacerbate the differential between forest and agricultural alternatives.
- *Failure to capture non-market benefits* (e.g. biodiversity and wilderness values) upon which much of the value publicly ascribed to natural forests is based.
- *High sustainable forest management costs* - easily marketable products (e.g. timber / pulp) are much more cheaply produced in plantations and by harvesting operations based on forest clearance. The sheer diversity in natural forests means that locating and extracting valuable timbers is a comparatively costly exercise.
- *Market trends* currently favour uniform product quality and design flexibility - increasingly served by softwood fibre-based and moulded products – rather than a multiplicity of variable hardwood species.
- *High cost of protecting property rights* in remote locations and over the long time frames which sustainable forest management requires.

The prevalence of aggregate forest loss in forest-rich frontier countries particularly in the tropics (e.g. Northern Brazil or Borneo) has been explained by the high relative cost of protecting property rights in such areas – favouring extractive timber mining rather than investment in forest management (Hyde 2003). As markets and infrastructure develop, it is scarce agricultural crops rather than abundant wood products that are most profitable, leading to land conversion around developing markets. Only when timber scarcity raises forest land values above agricultural alternatives, and above the cost of protecting property rights, do the conditions for sustainable management exist. But even under these conditions it is usually intensive plantation timber stands (high value per unit area) rather than extensive natural forests (low value per unit area) that cross the threshold of economic viability soonest. Further out at the forest frontier, studies in South America have shown that sustainable forest management is rarely economically viable at any reasonable profit margin (Landell-Mills 1997). Rational economic alternatives would be to mine the best timber from such forests and then leave them to recover over an extended period or convert the land to some other more profitable use.

In summary, it is the conversion to agricultural land due to the non-competitive nature of commercial forestry which is the most frequent factor associated with forest loss (Angelsen and Kaimowitz 2001). The same pattern of underlying forest loss that affected Europe is now being reenacted in tropical countries. Moreover, land conversion often simultaneously liberates low cost timber supplies which further undermine the prospects for sustainable management in remaining forest areas (Macqueen *et al*. 2004a). It is important to distinguish between the direct (e.g. agricultural land clearance) and indirect factors (e.g. road construction) associated with forest loss and the underlying causes which drive them (Lanly 2003). Underlying causes might include the desire for family security driving population growth, the desire for wealth driving agricultural expansion or logging practices which open forests to fire, the desire for territorial control driving infrastructure development etc. (see Browder 1985; Pfaff 1996; Nepstad *et al*. 1999; Laurance *et al*. 2002).

The prospects for the remaining areas of natural tropical forest are not quite as bleak as they seem, however, for two principal reasons – first many areas of forest are, and will remain for some time, inaccessible to market forces (table 3.2). Second, there are efforts to conserve a significant portion of these remaining areas. For example it is estimated that at least 7.5%-10.4% of forests are set aside for protection (Iremonger *et al*. 1997; WRI 2001; WCMC 2002).

Table 3.2: Economically inaccessible forested land area, 1998

Region	Economically inaccessible forested land area (m ha.)	% of total forest area
Africa	233	35%
Asia	177	45%
Oceania	61	20%
Europe	20	12%
Former USSR	166	18%
North America	238	51%
Central America	49	62%
South America	709	80%
Total	**1,653**	**43%**

Source: Global Fibre Supply Model of FAO (1998)

Outside inaccessible or protected areas, forest cover is linked to the competitive prospects for Sustainable Forest Management (SFM) (see chapter 5). Falling demand for forest products due to fears over forest loss will only diminish still further the competitive position of forest management vis-à-vis agricultural alternatives. Extreme actions such as boycotts and bans on tropical timber have been shown to have negative impacts for forests in those countries in the short and long term (Brown *et al*. 2002). A more cogent response would be to promote greater use of timber, with particular price premiums (or where not possible, subsidies) for timber from natural forests to offset the competitive disadvantages of natural forest production in comparison with plantation systems.

Further trade liberalization for agricultural products (where tariff levels remain much higher) is likely to have a much more significant impact on competitive land use and forest cover than market changes in forestry. There is some debate as to whether agricultural trade liberalization would increase or decrease forest cover – depending largely on the extent to which it was accompanied by intensification (drawing people out of extensive subsistence farming practices).

3.1.3 Changing patterns of forest management linked to the production of industrial wood

We noted in section 3.1.1 the rapid shift in the origin of forest production from natural forests towards plantation and semi-natural forest types. The nature and complexity of sustainable forest management differs quite markedly between these categories. It is much easier to manage plantation and semi-natural forests sustainably (replacing stands after felling) than comparable complex natural forests and especially diverse tropical forests. Reviews of the narrow sense sustainability in plantations suggest that in successive rotations of trees there is, so far, no significant or widespread evidence for decline in yield (other than where poor silvicultural practices and operations appear to be responsible). While pest and disease may cause problems, the risks are containable with vigilance, the maintenance of infra-specific genetic diversity and sound biological research (Evans 1999).

Sustainable forest management in diverse natural forests is much more complex. For example, sustainable management in the Amazon must accommodate prodigious diversity (55,000 species of higher plant, 502 different mammals, 1,677 species of bird, 600 species of amphibian – not to mention the staggering invertebrate numbers – Capobianco 2001). Commercial forestry uses a tiny fraction (10-30) of these species (AIMEX 2000) but must ensure not only their ecological integrity, but also that of the myriad of non-commercial species. It is little wonder that natural forest management operations struggle to demonstrate both economic competitiveness and sustainability.

One industrial strategy to tackle the lack of competitiveness of natural forest management is to step outside laws which are set up to foster sustainable forest management in different countries – inflicting damage to the environment and significantly, to government coffers. There has been considerable recent attention focused on the topic of illegal logging (see Contreras-Hermosilla 2001; Brack *et al*. 2002). This has spawned a number of international meetings such as the inter-ministerial sessions on Forest Law Enforcement, Governance and Trade (FLEGT). It is too early to determine the outcome of such processes, but one might observe that greater enforcement of legal requirements will do little in themselves to make sustainable forest management more profitable in comparison with other land uses.

With the shift in production from natural to plantation forests there is an increasing likelihood that timber will come from a 'sustainable' origin. It has been estimated that an area of less than 10% of the current global forested area could supply all the world's industrial forest requirements if this transition continues (Sedjo and Botkin 1997). However, the much greater intensity and efficiency of forest production in relatively tiny plantation and semi-natural forest areas may leave extensive remaining tracts of natural forest below the minimum threshold for economically viable production (Macqueen 2001). In the absence of other mechanisms to attribute value to those natural forests, forest clearance for alternative land uses and/or the lucrative, unsustainable and possibly illegal creaming of timber resources become rational (although perhaps undesirable) economic alternatives. So greater narrow-sense sustainability (at the forest management level) may occur in parallel with decreasing broad-sense sustainability (of diverse forests at the landscape level). The best available evidence for the dynamics described above is found in a close look at third party certification schemes (section 5.5.3).

3.2 European wood industries and wood market

3.2.1 The scale and extent of European forests and wood markets

Adopting a broad concept of Europe which includes the Eastern European countries and the Russian Federation, forests cover 1,039 million hectares (46%) of a total land area of 2,259 million hectares – this constitutes 27% of the total global forest area. It must be borne in mind that the Russian Federation alone accounts for 851 million hectares of forest in 1,688 million hectares of territory. We return to the important specific case of Russian production and exports in section 3.2.3. If we were to restrict our focus to the EU, forests cover a mere 116 million hectares (37%) of a total land area of 313 million hectares – just 3% of the global forest area - and almost 70% of that forest cover is found in four countries: Sweden, Finland, France and Germany.

Within our broad notion of Europe, just over 32 million hectares of the total forest area is officially classified as plantation forest, although extensive areas of managed semi-natural forest in Northern Europe also function effectively as plantation. Forest cover in Europe is increasing by 0.1% per annum – a figure which hides some divergences, for example the slightly higher rate of increase (0.27%) in the EU.

Table 3.3 shows the extent of production within broader and narrower notions of Europe and compares this with the global total. It is quickly apparent that the EU dominates production figures and trade within the broader European region in everything except exports, where the Commonwealth of Independent States (CIS) and other European states are increasingly strong, especially in roundwood exports. Europe as a whole is a major producer of wood products (accounting for approximately one quarter of the world total in various product categories). Europe’s significance in trade is larger still, accounting for approximately one third and one half of the global trade across various product categories. It should be noted however that much of this trade occurs within the region.

Table 3.3: Production of wood based products

Region	Industrial Round wood (000m³)	Sawnwood (000m³)	Panels (000m³)	Pulp for paper (000 tonnes)	Paper and paper board (000 tonnes)
PRODUCTION					
EU production	225,808	71,708	36,866	33,201	77,598
EU % of world	**15**	**17**	**24**	**19**	**26**
CIS production	100,929	20,358	4,160	3,907	3,932
CIS % of world	**7**	**5**	**3**	**2**	**1**
Other Europe production	84,996	23,977	8,967	4,970	9,416
Other Europe % of world	**5**	**6**	**6**	**3**	**3**
Tot. Europe production	411,733	116,043	49,993	42,078	90,946
Tot. Europe % of world	**27**	**28**	**33**	**24**	**31**
IMPORTS					
EU imports	42,051	36,786	16,086	14,421	37,855
EU % of world	**47**	**31**	**32**	**42**	**43**
CIS imports	582	1,058	434	54	708
CIS % of world	**0.6**	**0.9**	**0.9**	**0.2**	**0.8**
Other Europe imports	6,357	3,254	2,851	1,241	4,624
Other Europe % of world	**7**	**3**	**6**	**4**	**5**
Tot. Europe imports	48,990	41,098	19,371	15,716	43,187
Tot. Europe % of world	**56**	**36**	**39**	**47**	**49**
EXPORTS					
EU exports	13,169	30,021	14,566	7,792	44,348
EU % of world	**16**	**26**	**30**	**23**	**49**
CIS exports	21,042	5,222	1,408	1,007	1,762
CIS % of world	**26**	**5**	**3**	**3**	**2**
Other Europe exports	14,897	11,891	3,890	951	5,181
Other Europe % of world	**18**	**10**	**8**	**3**	**6**
Tot. Europe exports	49,108	47,134	19,864	9,750	51,291
Tot. Europe % of world	**60**	**41**	**41**	**29**	**57**

Source: FAO (2001a)

3.2.2 Use of wood in construction in Europe

The use of wood in construction has a historical distribution in Europe, with something of a north-south divide. Nordic countries and Scotland have a strong and enduring tradition of building with wood with 90% and 60% of small residential house markets respectively, whereas southern European building traditions are based around stone and brickwork, e.g. the French market in small residential houses is dominated by masonry with timber-frames having only 4% market share (Toratti 2001). These percentages only show proportional increase, absolute figures show evidence of an overall downturn in construction in Europe over the past few years (UNECE/FAO 2002).

In Germany, there is currently a trend towards increasing the use of wood in residential buildings. The market share of timber buildings has doubled during the past decade from around 6% in the early '90's to around 12% in 2001 (Blass 2001). An increase has also been apparent in Austria, with overall increases in timber housing and wooden construction elements (Austrian Wood Industries 2001). However, unless underlying barriers are removed these markets may soon have reached saturation.

Table 3.4 summarises the market situation for wood in construction over the past decade in selected European countries. Note that the changes are proportional, rather than absolute.

Table 3.4: market situation for wood in construction over the past decade in selected European countries

Country	Decrease	No Change	Increase	Comment
Germany			✓	Market may be reaching saturation in current legislative and building tradition framework
Austria			✓	Market may be reaching saturation in current legislative and building tradition framework
Netherlands			✓	Government and industry are actively working towards increasing proportion of wood used in construction
UK		✓	✓	Increase in timber frame construction is recent, with growing government backing to encourage increased use of wood in the industry
Finland		✓		Government and industry traditionally, and continue to, support extensive use of wood in construction
France		✓		Wood is not associated with French building traditions, although the government is actively promoting the use of wood in construction

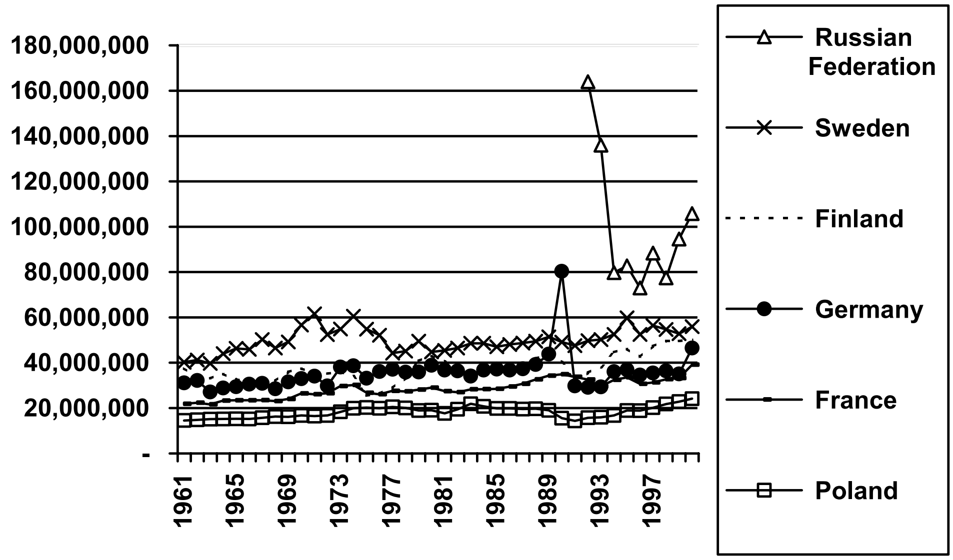
Source: AMAresearch (2003); Enjily (2001); Hartl (2001); Hartl (2002); van de Kuilen (2001); Toratti (2001); TUN (2003); UNECE/FAO (2002)

3.2.3 Significant recent trends in European wood production and trade

Production:

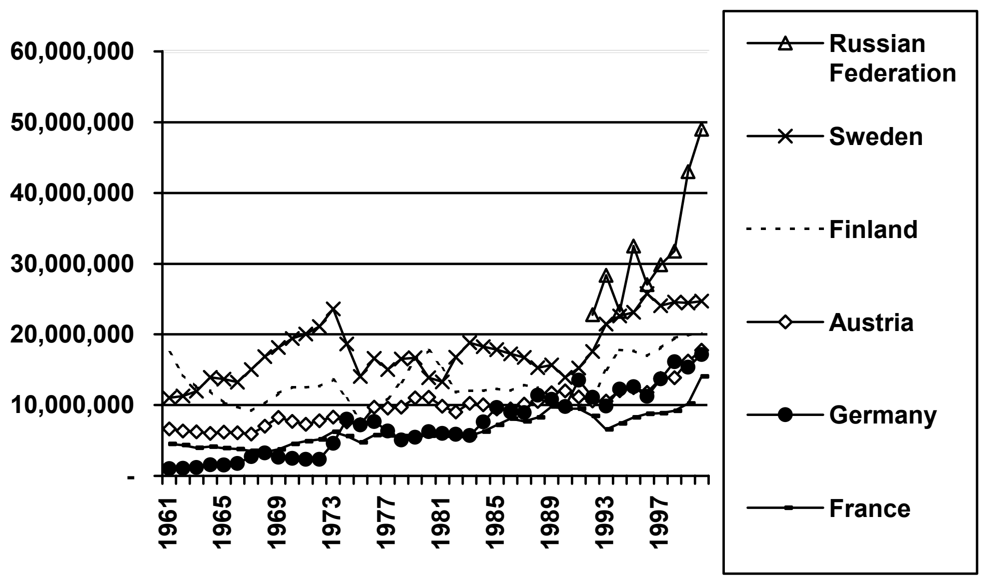
The volume of European roundwood production has more than doubled over the past 40 years with FAO data showing a rise from 223 million m^3 in 1961 to 460 million m^3 in 2000. The former Soviet Union was the major European producer followed by Sweden, Finland, Germany, France and Poland. The collapse of the Soviet Union led to an initial rapid demise in Russian timber production, but this picked up in the late 1990s and Russia now produces approximately one quarter of the total European production totalling 176 million m³ (Ekstrom 2003) (figure 3.6).

Figure 3.6: Top six European roundwood producers (in cubic metres)



Source: FAOSTAT (2003)

Figure 3.7: Top six European exporters of roundwood, sawnwood and panels combined (in cubic metres)



Source: FAOSTAT (2003)

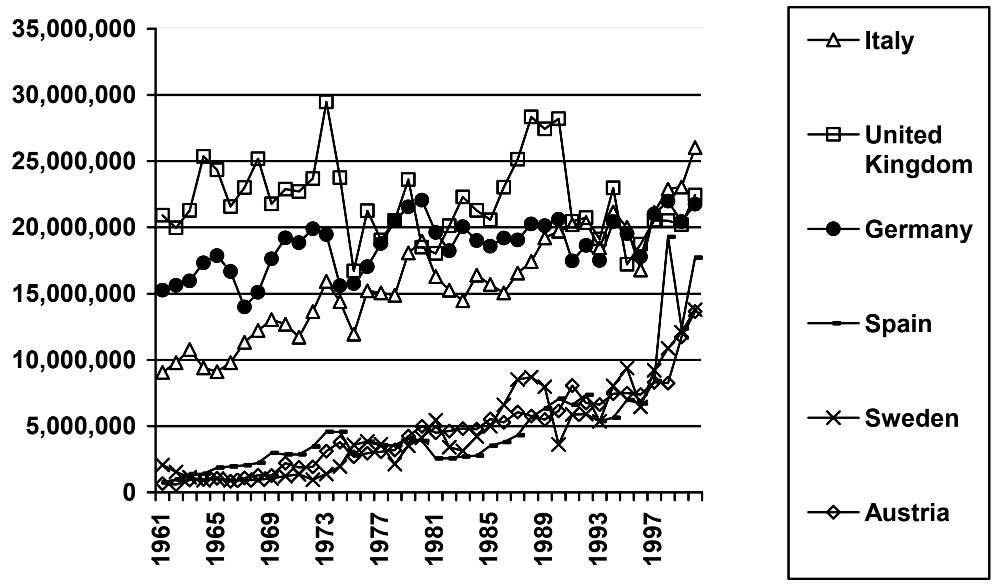
Exports:

In terms of export trade, European countries export figures excluding pulp and paper between 1961 and 2000 show a fourfold increase from 53 million to 228 million m³. The Russian Federation once again displays the biggest recent increase in exports, particularly in roundwood and sawnwood but with rapidly developing capacity in wood based panels (Janssens 2003).

Sweden and Germany also showed notable increases over the last 40 years (figure 3.7). Just outside the top six nations, Latvia has displayed impressive recent export growth due to expanding capacity and greenfields projects financed mainly by foreign capital in the Baltic states (Kosak and Spelter 2003).

Production and exports of woodpulp, paper and paperboard have also increased over the last 40 years and production rose in the EU to near record levels in 2002 following a small downturn in 2001. In Russia the increase in production has been even more dramatic (Ince *et al*. 2003).

Figure 3.8: Top six European importers of roundwood, sawnwood and panels combined (in cubic metres)



Source: FAOSTAT (2003)

Imports:

The main European importing countries for roundwood, sawnwood and panels are Italy, the UK and Germany followed by Spain, Sweden, Austria and France (figure 3.8). The driving force behind imports differs for each country. For example, Italy imports timber primarily because it is the world's largest producer of furniture. The UK on the other hand imports to meet its production deficit.

In terms of imports, intra-European trade vastly surpasses other international trade: over 90% of imports of roundwood and sawnwood into Europe are from other European states. There is a slight distinction here between softwoods (coniferous) and hardwoods (non-coniferous).

Softwood imports are extremely Eurocentric originating almost entirely from countries with strong forest governance and stable forest estates. For example, 98.5% of softwood roundwood imports are from Europe. Of the estimated 38 million m^3 of roundwood imported, only 0.5 million m^3 was sourced from outside Europe. In terms of softwood sawnwood a similar picture is seen, and 97.2% of the coniferous sawnwood imports to Europe are from other European countries. Of an estimated 34.5 million m^3 in 2001, only 931,000 m^3 was sourced from outside Europe (of which 358,000 million m^3 came from Canada, 246,000 m^3 from the USA and 116,000 m^3 from Chile).

Hardwood imports show a somewhat less Eurocentric pattern than softwoods. Nevertheless, almost 91% of hardwood roundwood imports are from Europe (table 3.5); of the 29.5 million m^3 imported in 2001, only 2.5 million m^3 was sourced from outside Europe. There is a downward trend in roundwood imports as producer countries shift towards the export of further processed products. The hardwood flooring market which had grown for the last 15 years driven by consumption in Germany, Spain, Italy, France and the Nordic countries finally levelled off in 2001 and 2002 (Buckley 2003).

Table 3.5: The breakdown of non-coniferous (hardwood) roundwood imports to Europe in cubic metres by exporting region, 2001

Region	Volume (cum)	%
Europe	26,896,454	91%
Africa	1,461,405	5%
Asia	105,852	0%
North America	309,852	1%
South America	675,506	2%
Oceania	1,434	0%

Of the extra-European hardwood imports, a significant proportion come from Africa (1.5 million m^3/yr) or specifically: Gabon (639,000 m^3/yr), Congo-Brazzaville (260,000 m^3/yr), Liberia (258,000 m^3/yr) and Cameroon (200,000 m^3/yr). Outside of Africa notable countries include: Uruguay (445,000 m^3/yr) the USA (287,000 m^3/yr) and Myanmar (83,000 m^3/yr).

More striking is the increased proportion of processed wood products that are sourced from outside Europe. For hardwood sawnwood, more than 40% of imports originate outside of Europe (table 3.6).

Table 3.6: Proportions (est.) of non-coniferous (hardwood) sawnwood imports to Europe in cubic metres by exporting region, 2001

Region	Volume (cum)	%
Europe	4,931,726	59%
Africa	1,168,661	14%
Asia	674,103	8%
North America	886,994	11%
South America	620,264	7%
Oceania	14,512	0%

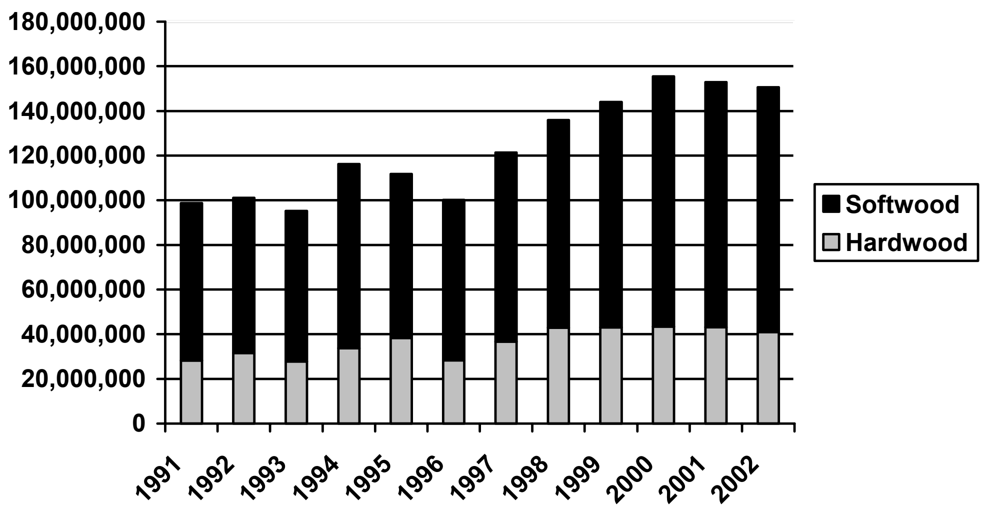
Within Europe, sawnwood hardwood imports from Romania have increased dramatically - in line with 21% increase in Romanian exports as part of a government programme to promote investment and trade. Romanian exports now exceed all other European countries. Hardwood imports from

Russia and Latvia have also increased dramatically over the past five years (Buckley 2003).

Outside of Europe, the main sources of hardwood sawnwood imports from Africa are from Cameroon (458,000 m^3/yr), South Africa (261,000 m^3/yr), Cote d'Ivoire (234,000 m^3/yr) and Ghana (105,000 m^3/yr). North American imports come from the USA (726,000 m^3/yr) and Canada (161,000 m^3/yr) The main sources of hardwood sawnwood imports from Asia are Malaysia (431,000 m^3/yr), the Philippines (107,000 m^3/yr) and Indonesia (83,000 m^3/yr). The main additional player is Brazil from which 590,000 m^3/yr of hardwood sawnwood is imported.

It is worth emphasising however, that while substantial percentages of roundwood and sawnwood hardwood originate outside of Europe, the total volume of hardwood imported is substantially less than comparable softwood figures (figure 3.9).

Figure 3.9: Roundwood and sawnwood imports (cum, RWE) to Europe as softwoods and hardwoods*, 1991–2002



*FAO use coniferous and non-coniferous categories
Source: FAOSTAT (2003)

The proportions have stayed relatively constant over this period, with hardwood timber supply accounting for approximately 30% of total imported volume.

It is noteworthy that many trends in European trade are governed by WTO-notified regional trade agreements - Europe accounts for 60% of the global total in force by 2000 (WTO 2001) of which the EU is one[2]. An example of such an agreement is the preferential treatment given to low-income

[2] Members: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Portugal, Spain, Sweden and the UK.

countries in Africa, the Caribbean and the Pacific region (ACP). The original ACP Lomé Convention has been replaced by the Cotonou Agreement with a commitment from 2002 to negotiate new WTO-compatible trade arrangements that will come into force on 1 January 2008. The poorest ACP countries are guaranteed free access to the EU market by the year 2005 (FAO 2000). The waiver for the Cotonou agreement was extended to 2007 by the WTO Ministerial meeting in Doha, enabling the EU to continue offering preferential tariff treatment for products from ACP states without having to do the same for all other WTO members. The EU has also pursued major framework agreements for reciprocal trade liberalization with Mexico, Chile and the MERCOSUR grouping (Argentina, Brazil, Paraguay and Uruguay).

3.2.4 European perspectives towards sustainable management and illegality

Almost 50% of the world's certified forests are found in the EU (Rametsteiner and Kraxner 2003). This amounts to 40% of the existing forest area within the EU. There is a considerable difference between EU member states and eastern European countries, but this is largely due to the late availability of certifiers in such regions. For example, Russia has less than 0.5% of its forest area certified. Whereas some of the main softwood producing countries such as Finland and Austria have reached 100% certification, the percentages in the hardwood sector are much lower.

Recent calculations have suggested that illegal logging (especially in the tropics) loses governments US$10-15 billion per year (World Bank 2002). Significant international efforts have emerged to combat illegal logging and the European intergovernmental FLEGT process has highlighted some of the issues involved. In May 2003 the EU Action Plan introduced the idea of a voluntary license scheme onto which producer countries can sign on - opening the legal possibility for excluding illegal timber from European markets. The proposal has yet to be approved by the Council of Europe.

3.2.5 Sustainability issues relating to different product types

Previous sections have assessed the magnitude and changing dynamics of wood available in the European market, noting the fact that the origin of timber has important implications for sustainability. This section attempts to categorise the main options available to the European consumer, highlighting the advantages and disadvantages of different sources of wood and the implications for particular purchasing policies (table 3.7).

The main distinctions around which consumer choice on sustainability might be based include:

- Product type (roundwood, sawnwood, panels, pulp and paper, and secondary processed wood products)
- Timber type (hardwood / softwood)
- Forest type (plantation and semi-natural forests / natural)
- Geographical origin (boreal and temperate / tropical and subtropical)
- Degree of assurance (certified / non-certified)

Within each category there will also be significant differences: for example, plantations may have a very different sustainability profile depending on whether they comprise native species or exotics; timber operations in tropical Latin America have a very different profile to those in tropical South East Asia; and there are major differences in the standards imposed by certification schemes.

Nevertheless, our intention here is not to assess the merits of each individual source of timber but to generate broad confidence about the merits and risks of using particular categories of timber. We restrict our comments to the main categories of wood product currently circulating in the EU market and their source of origin.

Table 3.7: General remarks about the likely sustainability of different categories of wood products in the European market

Category	General observations	Question marks
Roundwood softwood	Sustainable - with few question marks. Only 1.5% of the total European imports had their origin outside of the broader European states. Most European states have increasing forest cover, strong governance and widespread certification.	Question marks over sustainability in Russian Federation - alleged illegal logging in Siberian and Russian Far Eastern forests (Forests Monitor 2001a). Most of the allegations have centred on the trade with Japan and China.
Sawnwood softwood	Sustainable - with a few question marks. Only 2.8% of the total European imports had their origin outside of the broader European states and much of this was from Canada the USA and Chile where forest governance is also strong and certified sustainable management commonplace.	As above: Since Russia is by far the biggest exporter to the EU in sawnwood softwoods - there are some concerns over the sustainability of supply- but these must be weighed against the needs of economic development of the country.
Roundwood hardwood	Mostly sustainable - Only 9% of hardwood timber originates from outside of Europe. Although much less of the production is certified this is often due to the smaller scale of hardwood forestry operations.	The imports from Africa and South America often come from certified forests but it is worth specifying this, as many do not and there are extreme stories associated with social and environmental destruction with alleged links to some European owned companies (Forests Monitor 2001b; Global Forest Watch 2000a; 2000b)
Sawnwood hardwood	Mostly sustainable - although almost 60% of the sawnwood hardwoods originate within Europe, there is also a significant trade from Africa, Asia and Latin America. Some of the tropical hardwood originates from certified producers and many more contribute important revenue to the countries involved.	Of the 40% of sawnwood originating outside of Europe and in addition to some alleged irregularities relating to tropical timber from Africa, there have also been strong allegations about the sustainability of supply of some timber from South East Asia and Latin America (Glastra 1999; Lawson 2001; Forest Watch Indonesia 2002; Greenpeace 2002).
Panels	Mostly sustainable - Europe is a net	The main concern is over the imports

	exporter of plywood but still imports just over 20% of its total consumption - including hardwood plywood from South East Asia and China and softwood plywood from Brazil.	of tropical hardwood plywood from South East Asia where overcapacity is a major problem (Macqueen et al 2004a).
Pulp and Paper	Sustainable - with a few question marks. Europe is a net exporter of pulp and paper, but also imports approximately half of its apparent consumption - however almost all its paper originates within Europe or North America. For woodpulp 27% comes from North America and 14% comes from Brazil and Chile with some imports from South Africa and India (Ince *et al*. 2003).	There are few concerns over pulp and paper production as much of this comes from plantation forest systems (even in South America). While plantations have their own sustainability issues, their intensive nature makes them more comparable with agricultural crops.
Secondary Processed Wood Products (SPWPs)	Questionable sustainability in many cases. Highly processed products, which include primarily furniture but also builders' woodwork, mouldings and other products are sourced from Europe (at least 50%) but also from a number of different countries including particularly China, Canada, the USA and Malaysia. Tracing the origin of materials is difficult in this sector unless certified.	The shift in origin towards Asia (particularly in countries such as the UK) and especially towards China, raises questions over the sustainability of furniture supply. Where there is doubt it is preferable to insist on chain of custody certification.

CHAPTER 4 – COMPARING WOOD WITH COMPETING NON-WOOD MATERIALS

Previous chapters have described the current and potential role that forests and wood can play in climate change mitigation, and important trends in wood markets and links to forest production. This chapter moves on to compare the greenhouse gas profiles of wood with competing non-wood materials in the construction and packaging markets. It describes the barriers for substituting non-wood products with wood products and ends with some discussion of the future potential for material substitution.

4.1 Greenhouse gas profiles of competing wood and non-wood based materials

Material substitution by wood products, such as building components and furniture with an estimated life of between 10 to 75 years, is effective in removing carbon from the atmosphere. But even the use of products, such as wood and paper and board packaging, with shorter life spans of two months to two years can have a beneficial impact (Enterprise Europe 11 2003). Substituting a cubic metre of wood for other construction materials (concrete, blocks or bricks) results in an average of 0.8 tonnes of CO_2 savings. The main ways to improve the carbon balance include using a greater proportion of wood products, using wood products with a longer useful life and increasing recycling. The following sections compare the greenhouse gas profiles of some important wood based and non-wood based products in the construction and packaging markets.

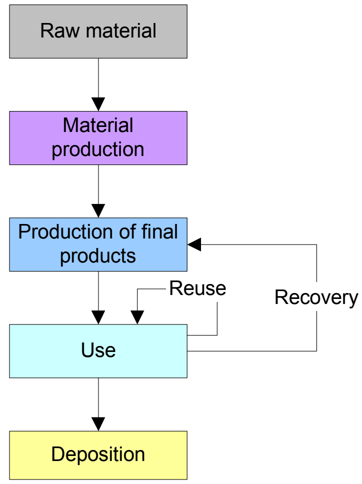
4.1.1 Methodology

Life cycle assessment (LCA) involves the evaluation of some aspects – often the environmental aspects – of a product system through all stages of its life cycle. Sometimes also called 'life cycle analysis', 'life cycle approach', 'cradle to grave analysis' or 'Ecobalance', it represents a rapidly emerging family of tools and techniques designed to help with environmental management and longer term sustainable development. A typical LCA-study consists of the following stages:

1. Goal and scope definition.
2. A detailed life-cycle inventory (LCI) analysis, with compilation of data both about energy and resource use and on emissions throughout the life cycle.
3. An assessment of the potential impacts associated with the identified forms of resource use and emissions.
4. The interpretation of results from the previous phases of the study in relation to the objectives of the study.

Studies generally follow similar LCA methodology – with comparable lifecycle stages and boundaries. These stages are shown in figure 4.2.

Figure 4.2: Basic life cycle assessment stages



Source: Adapted from EEA (1997)

A commonly used framework for doing LCAs is the ISO 14040 series, comprising:

1. ISO 14040: Environmental management – Life Cycle Assessment – Principles and framework.
2. ISO 14041.2: Environmental management – Life Cycle Assessment – Goal and scope definition and inventory analysis.
3. ISO 140432.1: Environmental management – Life Cycle Assessment – Life cycle impact assessment.
4. ISO 14043.1B: Environmental management – Life Cycle Assessment – Life cycle interpretation.

A number of different LCA paths exist for the products under consideration. For example, if the timber frame of a house is sent to landfill on demolition, this will lead to different disposal emissions than if the house burns down. The main disposal options considered here are landfill, recycling and combustion. Only the most common disposal route for building materials is taken into account, whereas different LCA options are taken into account in the packaging materials analysis.

Sources considered are given in table 4.1. This list is not exhaustive, but does highlight the variety of material existing on LCA of consumer and industry products as well as the apparent lack of previous EU-wide in-depth studies on this topic.

Only selected wood products and their alternatives are considered, and only generic products and categories of use are analysed. Selected country data is taken as representative of Europe, acknowledging that a more detailed analysis would represent the issues better. The analysis focuses only on the GHG impacts of different products, rather than taking into consideration the full impacts of product lifecycles.

Table 4.1: Data sources for life cycle assessments

Country	Basis for quoted figures	Original data	Comment
Finland	Actual production, use and disposal figures – based on ISO 14040 standards – for specified materials from named manufacturers	1993-1999	Thorough and transparent, although full lifecycle assumptions are not fully clear
Denmark	LCA based on Danish Environmental Development of Industrial Products (EDIP) methodology, the Danish standard for product LCA analysis	1994-1998	A review of EDIP has not been done, although the report is given credibility from its use in Danish policy formulation
International	LCA methodology following ISO 14040 standards, including energy recycling but excluding service life of three different house construction types, based on assumptions of standard material use within each	1991-2002	Transparent, although lacking in detailed treatment of individual materials
EU	LCA methodology largely following ISO 14040 standards, and actual EU average per capita material consumption from 1999	1991-2000	Transparent and thorough, although average per capita usage figures make results difficult to compare with other studies' results, background data from a large number of sources
UK	Environmental profiles for specified materials from named manufacturers are based on ISO 14041 standards, and approved by BRE	Data collected 2000-2002, valid for four years	Comprehensive results, although methodology is not given and materials assessed are limited
Sweden	Environmental profiles for specified materials from named manufacturers are based on ISO 14041 standards, mainly products from Swedish companies but with some Italian, Polish, Japanese and Finnish input as well	1995-1999	Few materials relevant for building and packaging materials covered, although thorough product and lifecycle descriptions

Sources: RTS (1998-2001); Ministry for Environment (2001); FAO (2002); BIO (2003); BRE (2000-2002); Swedish Environmental Council (2000-2002).

The studies used differ somewhat in methodology. To reduce distortions in the analysis, product comparison in the different categories has therefore been done based on a single source per category. Therefore, while there is little use in comparing products between categories, the methodologies underpinning the data within each category are consistent and provide useful comparisons.

Assumptions on the deposition of products differ between sources; certain sources consider a number of alternative disposal routes, whereas others assume a single option. Where possible, alternative means of disposal have been considered.

4.1.2 Competing materials in the construction market

To assess the GHG impact of wood products in comparison with non-wood alternatives, the following categories of materials and uses are considered:

- Building: walls, roof, insulation
    - Wood-based products: sawn timber, chip-board, cellulose insulation
    - Wood substitutes: concrete, concrete brick, clay brick and tiles, steel, rock and fibre-glass wool insulation

The most comprehensive source of information regarding different building materials was the Finnish RTS set of product environmental reports (RTS 1998-2001). These made the following assumptions:

- Materials produced from virgin raw material
- Emissions from use considered over maximum lifetime of material
- Single end use considered in data, although alternatives suggested
- Materials:
    - Standard concrete: density 2,400kg/m^3
    - Heavy concrete: density 2,500kg/m^3
    - Light concrete block: density 398kg/m^3
    - Calcite brick: density 1,750kg/m^3
    - Red brick: density 1,450kg/m^3
    - Chipboard: density 670kg/m^3
    - Sawn timber: density 366-417kg/m^3
    - Rock wool insulation: density 22kg/m^3
    - Glass fibre insulation: density 16kg/m^3
    - Cellulose wool insulation: density 30kg/m^3

The GHG emissions from selected materials are shown in figures 4.3 and 4.4.

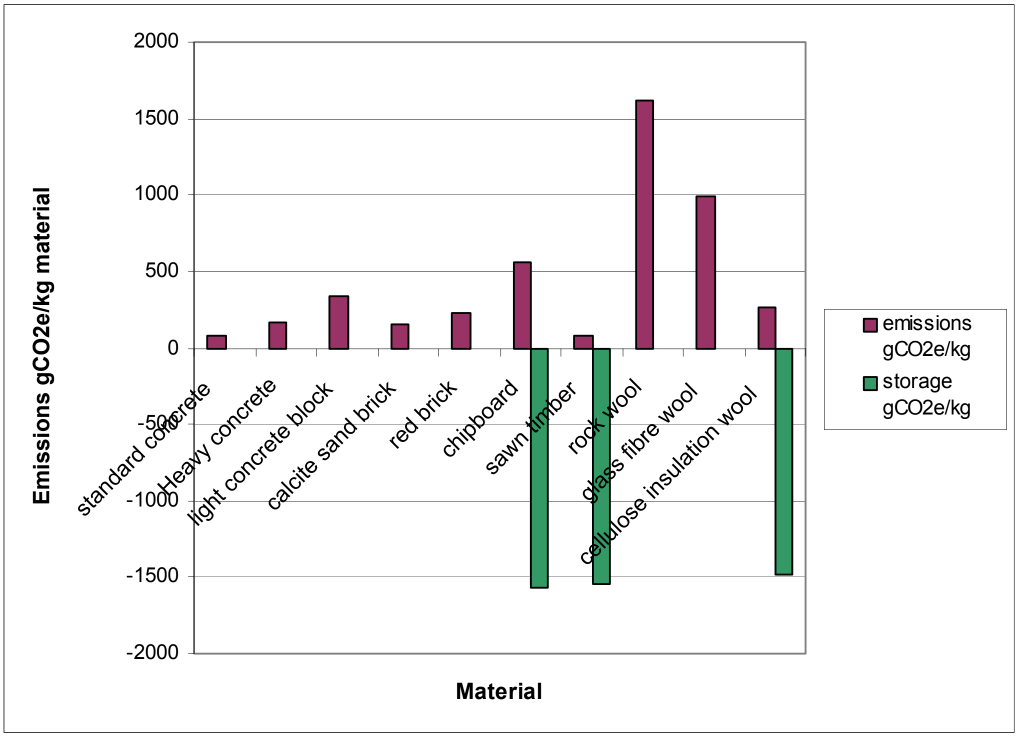
Table 4.2 shows the differences in GHG savings between using a similar volume of sawn timber to selected alternatives.

Table 4.2: CO_2e savings from timber substitution

Sawn timber vs.	Saving kgCO_2e/m^3
standard concrete	792
heavy concrete	1,013
light concrete block	725
red brick	922

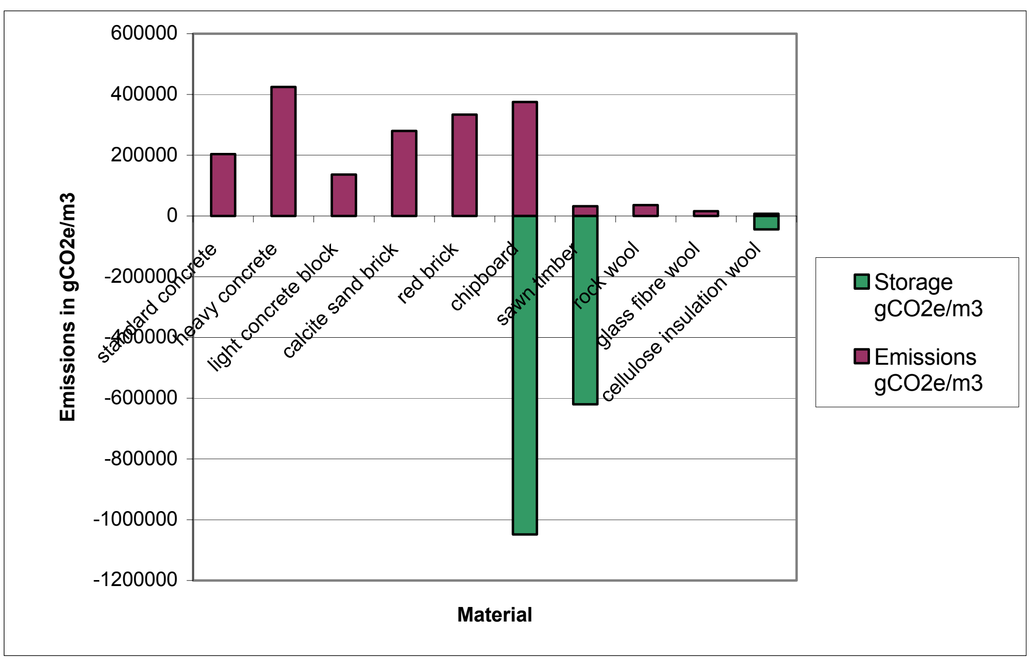
Source: RTS (1998-2001)

Figure 4.3: Emissions from building materials in gCO_2e per kg of material



Source: RTS (1998-2001)

Figure 4.4: Emissions from building materials in gCO_2e per m^3 of material



Source: RTS (1998-2001)

4.1.3 Competing materials in the packaging market

To assess the greenhouse gas impact of wood products in comparison with non-wood alternatives, the following categories of materials and uses are considered:

- Packaging: cartons, cans, tins
    - Wood-based products: cardboard, paper
    - Wood substitutes: glass, Polyvinyl Chloride (PVC), Polyethylene Terephthalate (PET), steel, aluminium

The most comprehensive source of information regarding different packaging materials was the Danish Environmental Ministry's report on the environmental impact of packaging materials (Ministry for Environment 2001). This made the following assumptions:

- Emissions from use considered over maximum lifetime of material
- LCA paths considered:
    - p-f: produced from 100% virgin raw material, disposal 100% incineration
    - s-f: produced from 100% recycled material, disposal 100% incineration
    - p-fg: produced from 100% virgin raw material, disposal 10/90 incineration and recycling
    - s-fg: produced from 100% recycled material, disposal 10/90 incineration and recycling
    - now (for glass): produced from 100% virgin raw material, 30/70 incineration and recycling
    - future (for glass): produced from 100% virgin raw material, 10/90 incineration and recycling
- Materials:
    - Paper
    - Card
    - Glass
    - PET
    - PVC
    - Steel
    - Aluminium

The GHG emissions from selected materials are shown in figures 4.5 and 4.6. Clearly, aluminium for incineration is a major GHG contributor. Cardboard and glass represent the lowest GHG contribution per kilogram of packaging. For cardboard, net GHG emissions are negative due to the recovery of energy contents in the material.

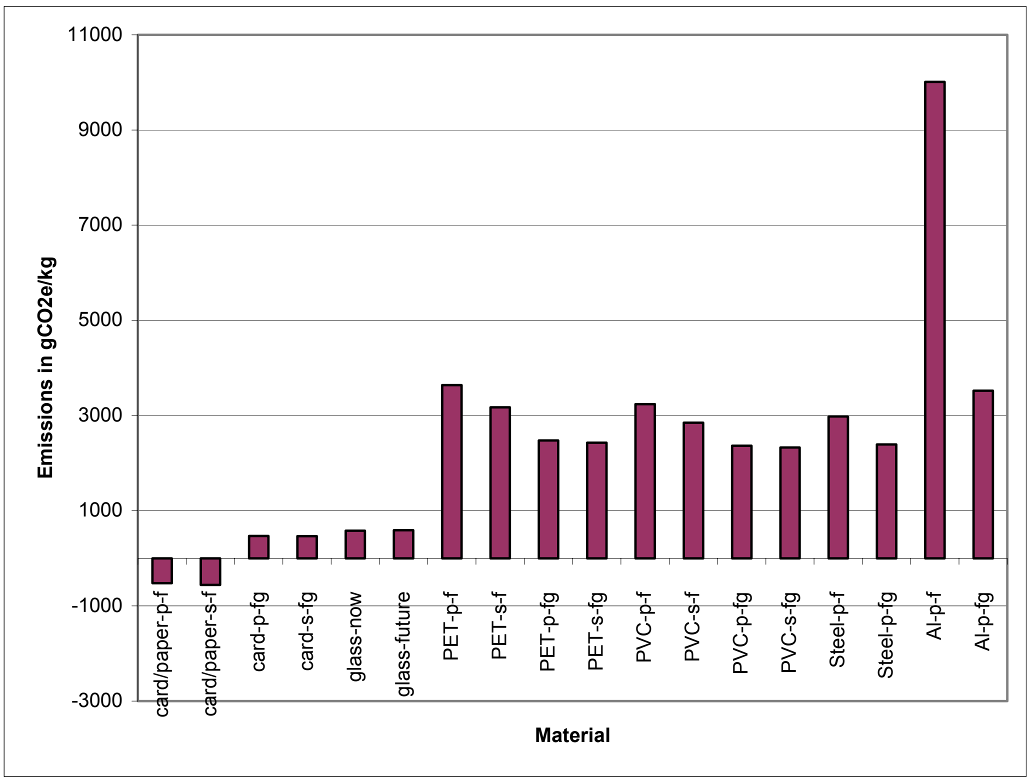
In terms of GHG savings, table 4.3 shows the differences between using a similar weight of card (non-recycled/incinerated, and recycled/recycled) to selected alternatives.

Table 4.3: CO_2 savings from card use

Card vs.	Saving from card p-f gCO_2e/kg	Saving from card s-fg gCO_2e/kg
Glass now	1102.60	114.72
PET s-fg	2954.00	1966.12
PVC s-fg	2852.00	1864.12
Steel p-fg	2916.00	1928.12
Alu p-fg	4045.00	3057.12

Source: Ministry for Environment (2001)

Figure 4.5: Emissions from packaging materials in gCO_2e per kg material



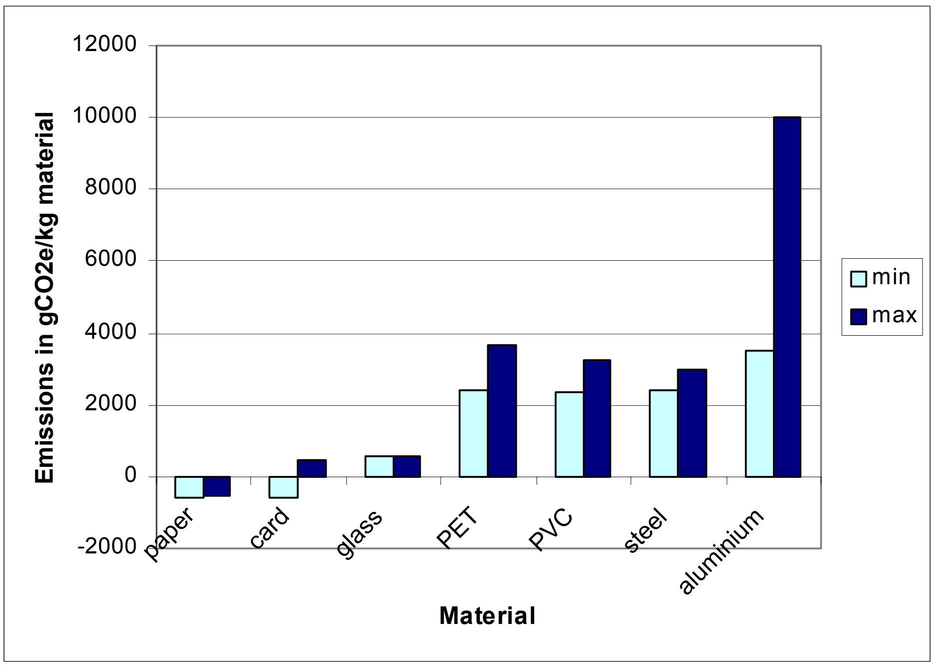
Source: Ministry for Environment (2001)

4.2 Barriers to materials substitution

Product innovation and changing consumer preferences drive changing product preferences and in some cases this leads to product substitution. In a mature market, product substitution at the same unit cost occurs in different waves, first due to perceived practicality, then due to a fashion for technological modernity and finally due to environmental sustainability (Hagstedt 2003).

While all forest industries are subject to substitution, wood substitution is strongest for framing materials, windows and doors, mouldings and casework, cladding, furniture, pallets and packaging (Burrows and Sanness 1999). The same authors list the main sources of competition for forest industries in order of competitive strength as: steel, plastics, aluminium, concrete and gypsum. Steel and concrete have traditionally competed in the construction sector, while plastic and aluminium have competed in the packaging sector. Aluminium industries have been strong competitors in North America and Europe. Steel and concrete have traditionally been strongest in Asia with plastics spread across all three regions.

Figure 4.6: Comparison of packaging materials emissions according to different lifecycle paths



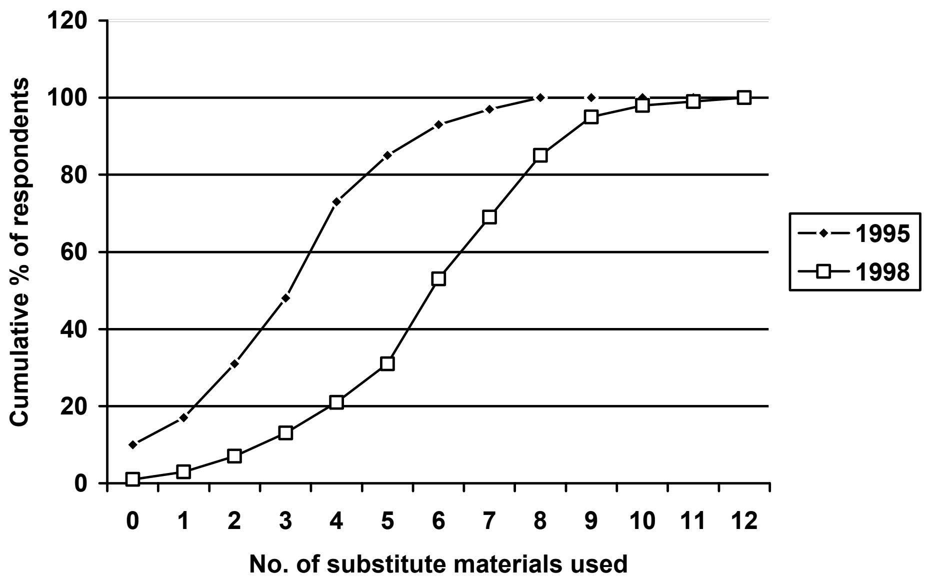
Source: Ministry for Environment (2001)

The fragmented ownership of forest industries in comparison with competing industries have meant that competitors have been better able to lobby – for example, many people are aware of the links between forest harvesting and timber, but fewer are aware of the link between oil drilling and plastics (Burrows and Sanness 1999). Boycotts for timber originating in Ghana have rarely been accompanied by boycotts of plastics originating in the oil wells of, say, Nigeria.

In terms of competing materials, there appear to be different threshold prices at which substitution occurs (Spelter 1998). In an extensive survey of the US residential construction industry it was found that issues of product quality (straightness, strength, lack of defects), product availability, price and price stability, and ease of use featured most highly as drivers of substitution (Eastin *et al*. 1996; Fleischman *et al*. 1999; CINTRAFOR, 2000).

Environmental factors were much less important in defining product preferences (e.g. product wastage, energy efficiency and reduced environmental impact). The same survey highlights two important trends: the significant increase in the number of wood substitutes used over time (figure 4.7) and the increasing belief that substitutes are better for the environment than wood. In a European study a similar pattern exists with plastics becoming very competitive for outdoor products and plastic facades, and also increasing in the window frame market (38% and increasing) in comparison with wooden alternatives (33% and decreasing) (Nilsson 2001).

Figure 4.7: Increasing use of substitute materials by US residential construction industry



Source: after CINTRAFOR (2000)

4.2.1 Construction materials

Although the use of timber and wood for construction purposes is more prevalent in some parts of Europe, the European Wood Construction R&D Network – a partnership between organisations in the timber industry across Europe – has discovered a number of common barriers to the substitution of traditional construction materials with wood across Europe (European Wood Construction R&D Network 2001). The barriers with the highest ranking are as follows:

- Fire safety is questionable
- Wood has the image of poor durability
- There is a lack of knowledge and experience in timber engineering and construction
- Most designers do not consider wood a real structural material

- Traditional building practices (in certain parts of Europe) do not involve extensive use of wood

4.2.2 Waste wood

A major obstacle for the increase recovery and recycling of waste wood in the UK identified by the Waste and Resources Action Programme (WRAP 2003) is the prevailing attitude that waste wood has little economic value. Burning – without useful energy production – and landfill are generally considered easier and cheaper options than recovery and recycling. Where there is interest in recovery and recycling, a number of further barriers exist: no outlets for recycled products; no network for pickup and processing; distance and cost implications of recovery and recycling.

4.2.3 Packaging materials

For food packaging, a number of hygiene and preservation requirements limit the level of material substitution to wood-based packaging products. Food packaging regulations in Europe require that the packaging materials must not cause mass transfer (migration) of harmful substances to the food. For example, any liquid cartons are lined with non-wood materials for impermeability and product protection, and paper packaging is limited to products which are not affected by humidity.

Other sectors also have industry requirements for durability and product protection. Any wood-based packaging product will be at a disadvantage compared to alternative materials such as plastics in terms of permeability and resistance to humidity.

4.3 Potential for material substitution

In theory, substitution of non-wood materials by wood should be a viable option in many sectors. Not only can the use of wood reduce the emissions caused by the production of alternative, non-renewable materials, but also help in the overall efficiency of the end-product, such as houses.

In the UK, a number of timber construction demonstration projects have been initiated, such as Gallions Ecopark in Thamesmead, and Timber Frame 2000 (TF2000), a collaboration between Building Research and Consultancy (BRE), the Government, TRADA Technology Ltd and the timber industry. This particular project aims to demonstrate the safety, benefits and performance potential of timber frame buildings in general, but also in medium-rise construction (four to eight storeys)

The issue of fire safety is currently being addressed through testing and the revision of building standards in many countries. For example, Germany has recently allowed residential buildings of up to four storeys to be timber-framed (Blass 2001).

Material substitution can play a significant role in mitigating climate change, as the amount of carbon fixed in wood rises in line with increasing industrial use of wood, where the forest resources are responsibly managed. EU policy is generally supportive of material substitution in favour of wood products. One key EU report, for example, is of the opinion that '..substitution, whereby fossil fuel based products are replaced by wood, brings a triple gain:

- Carbon emissions are decreased in the production process,
- Recycling rates are high, and
- Wood products' carbon sink increases in the longer term, so more and more carbon is removed from the atmosphere' (Enterprise Europe 11 2003).

Throughout the literature focused on the substitution of construction materials with wood, the consensus is that a pan-European set of timber building standards is required to facilitate maximum substitution. In order for these standards to be implemented appropriately, there is also a need for further education in the sectors of architecture, engineering and planning to fill the knowledge and experience gaps which inhibit greater use of wood in construction.

The significant preference for low cost rather than environmental qualities in wood products versus material substitutes poses a problem for sustainable forest management where environmental gains often have costs associated with them. In competition with alternative materials, sustainable forest management might be said to threaten wood industries' financial bottom line. An alternative way of looking at these issues, however, is to acknowledge that there is also an 'environmental bottom line' and 'social bottom line' defined by international commitments on the environment, labour standards etc. We have noted the fact that competing industries have strongly asserted their environmental and social credentials. The temptation to cut environmental and social corners in order to compete on cost is a short-sighted option. If the wood industries are to remain competitive and serious in their commitment to a minimum threshold of environmental and social sustainability beneath which they will not sink – (the 'environmental bottom line' and 'social bottom line') it is necessary to find more positive solutions. One promising business answer lies in technological investment. Finding new efficiencies in wood use allows competition on cost, while the development of new product designs allows competition on quality.

One example of the pay-offs to be had through investment in technology is the remarkable recent growth of Engineered Wood Products (EWPs) - constituting one of the recent success stories of the wood products industry (de la Roche *et al*. 2003). Tissari *et al*. (2003) note that Engineered Wood Products (EWP) production and consumption has grown phenomenally in North America, especially for glulam, I-beams and laminated veneer lumber (all specialist composite construction materials). The factors driving demand for these products have been the fierce global competition, decreased availability of large-dimension old timber, new conversion technologies, better adhesive technology and the worldwide adoption of performance-based building codes that allow greater heights and areas for wood production. On a cautionary note, further processing is not a cure-all solution and can lead to falling company profitability if it is not based on a thorough assessment of material flows, processes, costs, prices and revenues (Tissari *et al*. 2003).

CHAPTER 5 – WOOD PRODUCTS AND BROADER CONCERNS ABOUT SUSTAINABLE DEVELOPMENT

This chapter presents discussions on forestry, wood, climate change mitigation, competing materials and markets from previous chapters in the context of concerns about sustainable development, which is considered to have economic, social and environmental components in this report. The concept of sustainable forest management (SFM) is introduced, and the extent to which SFM and sustainable development are served by the climate change mitigation agenda described. Situations where SFM and sustainable development can be impeded by the climate change mitigation agenda are also described. The chapter ends with a section describing the ways in which sustainable development can be assessed in the context of SFM and climate change mitigation. Assessment methods include various international organisations and assessment criteria, sustainability impact assessments, and certification.

5.1 The contributions of forestry to sustainable development

So far, the report has argued that wood can be an effective and competitive material for mitigating greenhouse gas emissions. But if more wood was used, what would be the implications for SFM and, more broadly, for sustainable development? In this chapter we explore the contributions that forest production systems make to sustainable development, why these contributions are often undervalued and how this might be addressed.

The most common understanding of sustainable development can be found in the Brundtland report, *Our Common Future*, which defines it as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs." Thus, sustainable development involves the notion of deliberately organising human affairs and using the resources of nature to improve human well-being while simultaneously conserving the planet's natural resources for future use. The mitigation of climate change is therefore one of many potential contributions which the use of wood products has for sustainable development. Subsequent paragraphs draw attention to some other contributions.

Beyond a stable environment in which to exist, human well-being is also contingent on many other factors (Alkire 2002). For example, extensive surveys of poor people illustrate some of the main aspirations which humans have for their well-being (Narayan *et al*. 2000) complementing earlier ethical works which grapple with more generic human motivations for action (Grisez *et al*. 1987). The concept of the 'good life' has been understood for a very long time indeed to comprise different elements of human aspiration (Aristotle circa 322 BC).

Multiple human aspirations are the driving force behind more recent attempts to define sustainable development. These encompass issues such as subsistence, health and vitality; productive work and creative use of its returns; intellectual and aesthetic appreciation; identity, faith and culture; friendship and social fulfilment; and freedom, security and control over one's environment. While often still used to refer solely to economic growth, broader visions of sustainable development are increasingly linked to a much more nuanced understanding of human aspiration towards the freedom to pursue the multiple dimensions of human capability (Sen 1999).

Table 5.1 Contribution of forestry to dimensions of human well-being

Dimension of human well-being	Contribution of forestry
Subsistence, health and vitality	• Water regulation (quantity and quality) in upland watersheds • Energy for 2.4 billion people • Medicines for the primary health of several billion people • Bushmeat – 20% of the protein in 62 least developed countries • Soil fertility through bush fallow • Livestock fodder • Reducing vulnerability in times of rapid change (Kaimowitz 2003; FAO 2001b)
Productive work and creative use of its returns	• Formal employment for 17.4 million people • Informal employment for 29.6 million people • Other sources of income from forests may surpass measured employment by up to 10:1 (ILO 2001; Arnold and Dewees 1997)
Intellectual and aesthetic appreciation	• 85% of the total seven million world species are terrestrial and almost two thirds of all species occur in the tropics, largely in the tropical humid forests • Tourism is the worlds fastest growing business with 663 million tourists per year spending US$ 453 billion – an estimated 7% of which is on nature tourism (Pimm and Raven, 2000; Lindberg *et al*. 1997)
Identity, faith and culture	• Cultural identity, often linked to sacred groves for worship and ritual • Traditional ecological knowledge which provides the basis for local management practices and institutions (Berkes 1999)
Friendship and social fulfilment	• Strengthened rights, capabilities and governance in rural areas through people centred forestry • Providing opportunities for productive partnerships between the private sector and local communities (FAO 2001b)
Security and control over one's environment	• Sustainable forestry could make a substantial contribution to controlling atmospheric CO_2 levels but deforestation currently contributes 1.5-2 Gt carbon per year (compared to 6.5 Gt per year from fossil fuel and cement production) (Bass *et al*. 2000)

Source: Macqueen (2004b) drawing on Alkire (2002)

The purpose of introducing the multiple dimensions of sustainable development is to emphasise the breadth of benefits that forests and forest production systems have to offer. Measuring the contribution of wood product industries by their contribution to climate change mitigation alone does them a disservice. It is important instead to note the other ways in which forest production systems contribute to sustainable development and the international commitment to the Millennium Development Goals (see for example Kaimowitz 2003).

We summarise in table 5.1 some of the key contributions that forest production systems make to six main dimensions of human well-being (Macqueen 2004b).

Not all the contributions that forestry makes to human well-being are reflected in markets for forest land and timber (e.g. biodiversity or watershed values). This often leads to underestimation of the true value of forests in comparison with alternative land uses. Notwithstanding recent attempts to improve the functioning of markets for environmental services, the extent to which such values are routinely incorporated in decision-making is small (Landell-Mills and Porras 2002). In addition to the underestimation of forest value due to market externalities, forest production systems also face three other market valuation problems:

- Forests can take a long time to grow (which increases risks and investments across generations);
- Forests often occupy large areas of land (which increases interactions with multiple stakeholders in any one generation); and
- Forests supply multiple products and services to different stakeholder groups (which makes negotiating their use problematic).

In order to contribute optimally to human well-being (in the interests of sustainable development) it has therefore been necessary for the forest sector both to negotiate a consensus on current and future forest use between multiple competing stakeholders and find ways of including market externalities into decision-making processes. The evolution of our understanding of SFM, described below, reflects the attempt of the forest sector to contribute to sustainable development in this broad sense.

5.2 Evolving notions of SFM – the emergence of a conceptual framework

5.2.1 Economic sustainability

The earliest recognition of the need for SFM related to the need to safeguard the economic sustainability of forest production systems (i.e. keeping the timber flowing). Awareness of the exhaustible nature of the resource is found in Roman documents, although the first surviving Forest Code dates only to the 14th century under Charles V of France (Westoby 1989). Heavy colonial demands for naval timber between 1600 and 1900 led to the occupation of strategic timber reserves. Moreover, the simultaneous expanding production of plantation crops such as sugar required forest clearance and wood as energy for processing, thus exacerbating the demand for timber (Dawkins and Philip 1998).

As management principals were translated from simple temperate forests to complex tropical forests they encountered some difficulties. The quantitative underpinnings that are necessary to match timber harvesting to the regenerative capacity of several thousand woody species in tropical forests are daunting, and the returns comparatively small. While it is possible to manage complex tropical forests sustainably, for example using Reduced Impact Logging (RIL) techniques (Dykstra 2001), this rarely occurs in practice (Putz *et al*. 1999).

As natural forests have been depleted there has been a trend towards industrial monocultures or smaller scale on-farm plantation wood production. Across millions of hectares of humid tropical lands, local farmers (mostly smallholders) have heavily modified natural forest cover on their own land or communal forests, or developed high-value commercial tree products together with subsistence goods (Franzel and Scherr 2002).

5.2.2 Social sustainability

With economic sustainability the main aim of forestry in the colonial era, it seemed quite legitimate to keep people out of the forests. For example, in India with the passing of the Forest Acts of 1865 and 1878 this was achieved by employing gun-toting forest guards in newly created forest reserves. This led in turn to the Indian Congress calling for defiance to forest regulations in 1920-1922 (Dawkins and Philip 1999). The subsequent decades have seen radical changes and more than seven million hectares of Indian forest are now under joint forest management (Khare *et al*. 2000).

Despite earlier indications, it was not until 1962 that the social agenda of forestry became institutionalised with the publication of "The role of forest industries in the attack on economic underdevelopment" (Westoby 1987). The relationship between forests and people changed from one of exclusion to one of inclusion – recognising the vital and multiple roles that forests play in rural livelihoods. The trend towards 'forestry for people' culminated in a 1978 World Forestry Congress in Jakarta under that title.

Social sustainability at the landscape level through such vehicles as 'social forestry' has been complemented by social sustainability measures at the management unit level. For example, social criteria and indicators for sustainable forest management have been included in 'Criteria and Indicators' toolkits (e.g. CIFOR 1999) and in certification standards (e.g. those of Forest Stewardship Council (FSC) – Bass *et al*. 2001). Such approaches draw on various bodies of thinking and international obligation on social issues, including the International Labour Organisation (ILO) conventions to which most countries are signatory (Poschen 2000).

In addition to legislation and consumer pressure for great social sustainability, companies themselves have been assessing the business case for corporate social responsibility (CSR) in the forest sector (see Ward *et al*.

2002). This has often translated into voluntary movement towards certification.

5.2.3 Environmental sustainability

Commitment to environmental sustainability at a global level has been a relatively recent concern. Only in 1972 did nations sign up to the Convention for the Protection of World Cultural and Natural Heritage, followed by the Convention on Illegal Trade in Endangered Species (CITES) in 1973. Where timber extraction threatens endangered wildlife, there were obvious grounds for protective measures. Yet it was not until the 1980s with mass media coverage of forest destruction in Brazil, and satellite images in 1987 of 7,603 fires in the Amazon, that the issue of deforestation and environmental sustainability became an international priority (Humphreys 1996).

Forest losses led some to estimate extinction rates in the rough order of 700 species per year (Pimm and Raven 2000). Conservation work has subsequently attempted to identify "biodiversity hotspots" based on the degree of species endemism and threat to those species – as a basis for protected area management (Myers *et al*. 2000).

Ecotourism is one industry which has been attempting to capitalise on the growing concern for environmental sustainability and impute value to forests through marketing their diversity. Recent estimates suggest that as much as 7% of total financial expenditure in tourism is linked to nature tourism (Lindberg *et al*. 1997). These developing markets for landscape beauty have also been complemented by direct payments for various biodiversity services (Landell-Mills and Porras 2002).

More recently still, growing concern over climate change culminated in the 1993 United Nations Framework Convention on Climate Change (UNFCCC) and the 1997 Kyoto Protocol. Markets for carbon sequestration are another way of imputing value to forests in addition to that of timber alone.

The prevalence of support for markets for environmental services is an indication of dissatisfaction with the way the free market is currently affecting forest cover. Attempts are being made to bundle environmental services such that the combined value of forest products and services is competitive with land use alternatives (Landell-Mills and Porras 2002).

5.2.4 The importance of good governance for SFM

Good governance, creating an enabling framework for the complex demands of economic, social and environmental sustainability, is now accepted as being a vital ingredient for achieving sustainable development more broadly and particularly for SFM. Good forest governance does not necessarily mean ensuring that each area of forest contributes to every potential dimension of human well-being. Some areas of forest might best serve particular human aspirations (e.g. productive work towards material well-being) while others might best be orientated towards quite different areas of human aspiration (e.g. aesthetic appreciation of landscape beauty). Some areas of forest might serve human aspiration best by being converted to an alternative land use altogether.

Since it is problematic to advocate SFM in all circumstances, SFM is logically best considered at a landscape level. Ideally a mosaic of different types of forest and non-forest land uses should provide the products or services best suited to the area. The role of good forest governance is to ensure that this mosaic of forest and other land use types is carefully sustained and adequately attends to all the dimensions of human well-being. A landscape approach to SFM in forest governance does not obviate the need for detailed prescriptions for SFM at the management unit level for each different type of remaining forest. Rather, it adds a level of strategic planning to such detailed management prescriptions.

Figure 5.1: The 'pyramid' of good forest governance

5. Verification of SFM. Audit, certification or participatory review undertaken
4. Extension. Promotion of SFM to consumers and stakeholders undertaken
3. Instruments. Coherent set of 'carrots and sticks' for implementation in place
2. Policies. Forest policies, standards for SFM and legislation in place
1. Roles. Stakeholder roles and institutions in forestry and other land uses negotiated and developed
FOUNDATIONS Property/ tenure rights and constitutional guarantees Market and investment conditions Mechanisms for engagement with extra-sectoral influences Recognition of lead forest institutions (in government, civil society & private sector)

Source: Mayers *et al.* (2002)

Notes on figure 5.1:

- The pyramid describes those elements of good governance which are significantly under the control of forest stakeholders
- The pyramid's 'foundations' are less directly controlled by forest stakeholders – but it is crucial that forest stakeholders understand the constraints and opportunities emanating from beyond the forest sector to enable them to argue their case and influence those with the power to improve the foundations

Framing SFM primarily at the landscape level adds a degree of complexity to good forest governance. Many different sectors and authorities, often far from the forest itself, influence the sustainability of such landscape mosaics (Mayers *et al*. 2002). The policy, legal and institutional conditions affecting forests derive from the local level (e.g. community rules and social norms regarding forest use), the national level (e.g. legal rights to forest land and resources, and policies affecting the relative profitability of different forest uses), and the global level (e.g. multilateral environmental agreements affecting forests, trade rules, and the policies of multinational companies and investors). Mayers *et al*. (2002) attempt to interpret this complexity by portraying these governance elements in 'tiers' (figure 5.1).

5.2.5 Conclusions relating to SFM

We have noted in the preceding sections that what happens in forestry is driven by human aspirations for different dimensions of well-being. We have noted that a mosaic of different types of land use systems may best meet the different aspirations of multiple stakeholder groups. We have drawn attention to the local, national and international dimensions of forest governance. Finally, we have noted that there are numerous hierarchical tiers of governance and management that are required to negotiate and enforce an optimal land use mosaic.

In relation to this study we should note that it is forest governance in the broad sense that defines the degree of forest cover and the sustainability of management in any particular country. In countries where governance is generally strong, and economic, environmental and social concerns relatively balanced, the outcome is a stable or expanding forest estate, which meets the diverse needs of the public. In other regions, particularly in the tropics, governance is under-resourced and the prospects for the forest estate may be determined by the needs of the few, rather than the multiple needs of the many. Constructive measures to strengthen governance and provide affirmative consumer support to SFM products and services from such regions are particularly important.

5.3 The extent to which SFM and sustainable development are served by the climate change mitigation agenda

Many synergies exist between the provisions necessary to mitigate climate change and those necessary for sustainable development. For example, improvements in energy efficiency, renewable energy, transport, and sustainable land-use policies all have positive impacts on both climate change and socio-economic development. Under Article 2 of the Kyoto Protocol, Annex I countries are required to promote sustainable development in the course of reducing GHG emissions. Moreover, Article 2.1(a) of the Protocol provides an impetus for Parties to assess the impacts of land-use change mitigation policies on sustainable development (IPCC 2000). Indeed, all forest-sector actions taken to mitigate climate change are required by the Protocol to be sustainable. The following sections will elaborate some of these possible economic, social and additional environmental opportunities.

5.3.1 Economic opportunities

We have already noted that forestry can contribute to economic development, particularly in low-income countries, by supporting local economies through timber-harvesting, employment, and providing non-wood products for market. Economic benefits can also include reduced risk of flood damage, which could destroy agricultural lands or human settlements, and reduced siltation of rivers, which can protect fisheries and investments in hydroelectric power generation facilities (Chomitz and Kumari 1998).

Large-scale development-orientated forestry projects are often plagued with financial problems due to their size and low return-on-investment. The CDM under the Kyoto Protocol may improve the economic feasibility of these projects. An example of how a climate change mitigation project can be combined with economic development is the Activities Implemented Jointly (AIJ) pilot project in Costa Rica's Private Forestry Project (PFP) (Subak 2000). However, proactive efforts are needed to enable community-based CDM projects to compete effectively in carbon trading markets with projects managed by large scale operators. If suitably targeted, CDM projects can be cost-effective for investors in terms of production costs, but many have high transaction costs, a hurdle which is particularly hard for small projects to overcome (Smith and Scherr 2002; Bass *et al*. 2000).

Large-scale, modern forest industries can provide wage employment for local people, who can thus become less reliant on more arduous and less rewarding forest product and shifting cultivation activities. However, despite these possible benefits, many jobs in the forestry sector are associated with low wages and poor treatment of employees (Poschen 2000) so that any new opportunities need to be weighed carefully against disruption to existing livelihood benefits.

Logging and subsequent wood processing are not the only economic enterprises derived from forests. In much of the world, "most employment in forest industries is in very small enterprises, often composed only of a few family members, rather than in the formal sector" (Byron and Arnold 1999). For instance, a 1991 survey in Zimbabwe estimated that 237,000 people were employed in small woodworking, carving, fuelwood and cane and grass product enterprises, compared with a reported 16,000 employed in forestry and forest industries (Byron and Arnold 1999). The impact of secondary industries in terms of employment provision can therefore be considerably more significant than direct employment in the primary sector. Such employment is often based in cities rather than the rural areas. Forest climate change projects that encourage these smaller enterprises can contribute significantly to local economic development. The Plan Vivo series of projects includes examples of such useful synergies (ECCM 2004).

As it is difficult to monitor effectively what happens in forested areas, many governments have set in place forest and environmental regulations designed to limit rather than encourage production and sale of forest products. Since 1990, the Government of Thailand has attempted to conserve forests by closing them off from the public. This has caused "major changes in the access to food for the villagers, as they used the forest both directly for food collection and indirectly as a source of income" (Kunarattanapruk *et al*. 1995). Poor rice-growing households have suffered the most from such policies since their rice production is insufficient to support income and food needs year round. Therefore, "[c]ritical to shaping project success in meeting carbon mitigation and sustainable development goals is effective participation by local communities affected by project activities" (IPCC 2000). As seen by the RIL project in Sabah, Malaysia, "such projects can combine reduced carbon emissions with reductions in the environmental impacts of commercial logging, as well as socioeconomic development through technical training and employment" (Pinard and Putz 1997).

5.3.2 Social opportunities

There is also significant potential for wood and forest climate change mitigation projects to lead to social development, principally in low-income countries. Carbon offset policies should therefore build in adequate provisions for concerning local environmental and social factors, with relevant local participation and powers of veto (Bass *et al*. 2000). The IPCC (2000) states that carbon mitigation objectives should be "interwoven with traditional economic and social factors that affect land-use decisions, such as the demand for food, fibre, fuel, building materials, and habitable land." Such activities can also generate socio-economic improvements through changes in producer and consumer welfare, employment, poverty, and equity (IPCC 2000). Warner (2000) echoes the central poverty alleviation objective of much development assistance by suggesting that success be "measured not only by the amount of forest products harvested, export figures or revenue generated, but also by the contribution of forests in alleviating poverty" and benefits from the non-tangible services forests offer. Forest management activities that could also support social development include: agroforestry projects that also meet fuel wood needs, the opening up of markets for indigenous forest products, and the promotion of wood waste and paper recycling.

CDM projects can potentially contribute to local livelihoods, and indeed one of the goals of the CDM is to assist developing countries which host CDM projects to achieve sustainable development. Governments hosting CDM projects must define their own sustainable development objectives, and develop policies to ensure enabling conditions for forest carbon projects to contribute on a large scale to local livelihoods exist (Smith and Scherr 2002; Bass *et al*. 2000). However, social impact assessments are currently not mandatory, and some governments may feel that sustainable development criteria provide additional complications, which may chase away potential investors (Reid *at al*. 2003). Bass *et al*. (2000) conclude that "a reliable carbon commodity could assist local rural development, but only if appropriate policies, institutions, community mechanisms and project procedures can be put in place. These must ensure equity as well as competitiveness in relation to larger-scale schemes." In many cases, forests have already proven to be fertile ground for pioneering good local governance (Mayers and Vermeulen 2002b). Lessons in this regard, such as the value of local land rights and equitable benefit distribution, could provide valuable inputs to carbon offset projects.

5.3.3 Additional environmental opportunities

In addition to benefits from carbon sequestration, wood and forestry climate change mitigation policies can provide additional environmental benefits. Mitigation efforts should therefore extend over and above the issue of forests and climate change to include concerns about "the conservation of biodiversity; water and soil resources; ecosystem productivity; wildlife habitat and populations; and forest contributions to global ecological cycles" (Rotherham 1996). The reduction in deforestation and biomass burning, the improved management of natural forests, and the sustainable harvesting of timber and other forest products can all positively enhance the natural ecosystem while preventing carbon emissions and promoting carbon sequestration. For example, plantations of exotic or native species can be designed to enhance biodiversity by jump-starting the process of restoring natural forests (Lugo *et al*. 1993; Johns 1997). It has also been suggested that fuelwood plantations might reduce pressure on natural woodlands in relatively arid regions; thus, helping to stem desertification in some settings (Kanowski *et al*. 1992).

There can also be additional, positive climate impacts, for example the relatively high water use by forests as compared with non-forest lands can, in certain circumstances, allow for more water transfer to the atmosphere, with potential effects on local and regional climate if the forest areas are extensive. "Although the magnitude of these feedbacks is the subject of contention, extensive forestation may increase humidity, lower temperature, and increase rainfall in temperate and tropical regions" (Harding 1992; Blythe *et al*. 1994). Needless to say, the precise environmental benefits derived from climate change mitigation projects will depend on the specifics of the project (e.g. the species and variety of tree species and the location and scale of the project). However, potential environmental benefits do exist and should be fully explored when devising climate change mitigation strategies.

5.4 Situations where SFM and sustainable development can be impeded by the climate change mitigation agenda.

Many synergies exist between climate change mitigation and sustainable development. However, there are cases where there could be "significant trade-offs associated with deeper levels of mitigation in some countries" (Beg *et al*. 2002). Box 5.1 identifies some of these trade-offs in the context of land use, land-use change and forestry (LULUCF) projects under the Kyoto

Protocol. Policymakers responsible for designing climate change mitigation projects should therefore identify and consider such possible tradeoffs in order to ensure sustainable development objectives are met (IPCC 2000). As explained by Dention *et al.* (2002), "though the first priority of developing country policymakers is to reduce poverty and encourage economic growth, climate change mitigation can offer an opportunity to revisit development strategies from a new perspective. The challenge is to ensure that actions to address environmental problems, including climate change will contribute to, rather than obstruct, local and regional economic development."

Box 5.1: Factors Affecting the Sustainable Development Contribution of LULUCF GHG Mitigation Projects

- The consistency of project activities with international principles and criteria of sustainable development, such as those described in multilateral environmental agreements
- The consistency of project activities with nationally defined sustainable development and/or national development goals, objectives, and policies
- The availability of sufficient institutional and technical capacity to develop and implement project guidelines and safeguards
- The extent and effectiveness of local community participation in project development and implementation
- The transfer and local adaptation of technology (including hardware and software)
- The application of sound environmental and social assessment methodologies to assess sustainable development implications
- The degree to which a focus on carbon sinks reduces efforts made to reduce emissions

Source: adapted from IPCC (2000) Section 5.6

Negative impacts can result if the forest projects are situated on land for which communities have alternative priorities or if communities are not effectively engaged in all phases of project design and implementation (Cullet and Kameri-Mbote 1998). For example, reforestation and afforestation projects which hope to increase carbon sinks may remove valuable local agricultural lands. Efforts can be taken to increase the productivity of existing agricultural lands, but demand for land in some regions may be too high to make afforestation and reforestation a viable option.

Forest climate change mitigation projects may also lead to detrimental environmental impacts, as noted by IPCC (2000), which states that afforestation can have "highly varied impacts on groundwater supplies, river flows, and water quality." For example, when forests are planted on former non-forest lands, such as peatlands, soil acidification may occur (Fowler *et al.* 1995). Afforestation can lead to soil and water acidification and may increase aluminium in waters, especially in areas with base-poor soils, which can have a negative effect on fish, invertebrates, vegetation, and perhaps trees themselves (Ormerod *et al.* 1989). Kreiser *et al.* (1990) offer a word of caution by stating that acidification often occurs independently from afforestation, but that afforestation in areas of high acid deposition can lead to increased rates of lake acidification. The IPCC (2000) comments that "the risk of enhanced acidification is a well-known constraint on afforestation in parts of Europe and North America."

Concerns have also been raised over a recent agreement at the 9th Conference of Parties to the UNFCCC held in Milan in December 2003, regarding allowing the use of genetically modified trees in forests planted to offset global warming (IISD 2003).

Plantations may negatively impact biodiversity, particularly when single species stands (typically teak or pine) replace native grassland or woodland habitat. Many grassland ecosystems are rich in endemic species; for example, in the Mpumalanga province of South Africa, the expansion of commercial plantations (eucalyptus and pine) has led to significant declines in several endemic and threatened species of grassland birds (Allan *et al*. 1997). Exotic tree species such as pine and teak may be preferred over native species since they hold a more profitable market price, and they may provide more socio-economic benefits for local owners but they would not necessarily enhance biodiversity. Such tradeoffs need careful consideration.

5.5 Assessing sustainable development in the context of SFM and climate change mitigation

Assessing the potential sustainable development impacts of climate change mitigation strategies is far from straightforward. Many feel there should be a globally accepted set of criteria for evaluating the sustainable development component of climate change mitigation policies, and attempts have been made to this end. This section will briefly outline three methods for assessing sustainable development.

5.5.1 International organisations and assessment criteria

Addressing the growing need to assess sustainable development impacts in a systematic and uniform fashion, many international organisations and agreements have established principles or guidelines. While there are no agreed upon set of criteria and indicators, several sets are being developed for closely related purposes (see, for example table 5.1). Warhurst (2002) argues that tailor made approaches to developing sets of indicators are more effective than 'off the shelf' indicators, but that the latter can inform the former, and that there are merits to combining expert derived top-down approaches, with stakeholder scoped bottom-up approaches.

International efforts to derive criteria and indicators specific to sustainable forest management include the Helsinki Process (covering 39 European countries), the Montreal Process (covering 12 non-European countries in the temperate and boreal zones), the Tarapoto Process (covering the eight countries in the Amazonian Cooperation Treaty), and the International Tropical Timber Organization (covering most forested countries in the tropics). The Center for International Forestry Research (CIFOR) also offers a valuable set of criteria (CIFOR C and I Team 1999; Prabhu *et al*. 1999). The CIFOR criteria are based on research in large-scale natural forests that are managed for commercial timber production in Indonesia, Cote d'Ivoire, Brazil, and Cameroon, with additional sites in Germany, Austria, and the USA. These criteria and indicators provide a useful framework for evaluating policy, environmental, social, and production aspects of sustainable forest management and are designed to be readily adaptable to local conditions. In addition, CIFOR is also planning to formulate a set of criteria for tropical plantations and community-managed forests. Governments seeking to implement forest climate change mitigation programmes may be able to use or adapt the criteria and indicators developed by one of these international bodies. However, it is important to recognize that these international guidelines are often very general.

In the context of the CDM, host countries must create a definition of sustainable development that is nationally appropriate and compatible with internationally accepted principles. They must then develop a set of indicators by which sustainable development objectives can be assessed and measured, and they must determine the relative importance of selected sustainable development indicators for each CDM project, both in comparison to each other and to carbon offset benefits. Many Asian countries have moved some way towards defining national sustainable development objectives in their legislation, and some have made progress regarding developing indicators and establishing systems to monitor and assess whether sustainable development criteria have been met. However, in most countries, considerable institutional capacity strengthening and training of the main participants in the CDM process is required (Reid *et al*. 2003).

5.5.2 Sustainability Impact Assessments

Sustainability Impact Assessments are also a possible means for assessing the sustainability of forest climate change mitigation projects (Smith and Scherr 2002; IPCC 2000). Such methods have already been used in many different countries for site-specific activities, and could be modified to be applicable to climate change mitigation projects.

Impact assessments have the advantage of considering a broad range of environmental and or social effects, and measurement does not necessarily require monetary enumeration of benefits and costs. However, it is not always easy to integrate descriptive analyses of intangible effects with monetary measurements of costs and benefits, and such assessments do not always facilitate effective evaluation of trade-offs. Assessments also tend to be reactive and project focused (Dalal-Clayton and Bass 2002). The most common types of impact assessment are strategic environmental assessments (SEA) and environmental impact assessments (EIA) (table 5.2).

Poorly designed and implemented CDM projects can pose significant risks for local communities, and in this context, Smith and Scherr (2002) recommend mandatory social impact assessments for CDM projects.

Table 5.1: Examples from the UN Commission on Sustainable Development's working list of sustainable development indicators relevant to LUCF policies and measures under the Kyoto Protocol

Program Area	Driving Force Indicators	State Indicators	Response Indicators
Combating Poverty	• Unemployment rate	• Head count index of poverty • Poverty gap index • Squared poverty gap index • Gini index of income inequality • Ratio of average female wage to male wage	• (None listed)
Transfer of Environmentally Sound Technology, Cooperation, and Capacity-Building	• Capital goods imports • Foreign direct investments	• Share of environmentally sound capital goods imports	• Technical cooperation grants
Protection of Quality and Supply of Freshwater Resources	• Annual withdrawals of ground and surface water • Domestic consumption of water per capita	• Groundwater reserves	• Density of hydrological networks
Combating Desertification and Drought	• Population living below poverty line in dryland areas	• National monthly rainfall index • Satellite-derived vegetation index • Land affected by desertification	• (None listed)
Combating Deforestation	• Harvesting intensity	• Forest area change	• Managed forest area ratio • Protected forest area as a percentage of total forest area
Promoting Sustainable Agriculture and Rural Development	• Use of agricultural pesticides and fertilizers • Irrigation percentage of arable land • Energy used in agriculture	• Arable land per capita • Land area affected by salinization or waterlogging	• Agricultural education
Conservation of Biological Diversity		• Threatened species as a percentage of total known native species	• Protected species as a percentage of total known native species

Source: http://www.grida.no/climate/ipcc/land_use/105.htm#table2-8

Table 5.2: Comparing SEA and EIA

Strategic Environmental Assessment (SEA)	Environmental Impact Assessment (EIA)
Is proactive and informs development	Usually reacts to a specific development proposal
Assesses the effects of a proposed policy, programme or plan on the environment; or the effect of the environment on development needs and opportunities	Assesses the effects of a proposed specific development on the environment, and is not well linked to policy decisions
Assesses cumulative impacts and identifies implications for sustainable development	Assesses direct impacts and benefits
Focuses on maintaining a chosen level of environmental quality	Focuses on the mitigation of (negative) impacts
Is a continuing process aimed at providing information at the right time	Has a well defined beginning and end
Creates a framework against which many (negative) impacts can be measured	Focuses on specific project impacts
Has a broad perspective and a low level of detail	Has a narrow perspective and a high level of detail
Driven by the need for vision and overall framework for policy (as in national sustainable development strategies)	Driven by the need for watertight legal process requirements (as in lawsuits)

Source: Dalal-Clayton and Bass (2002)

5.5.3 Certification

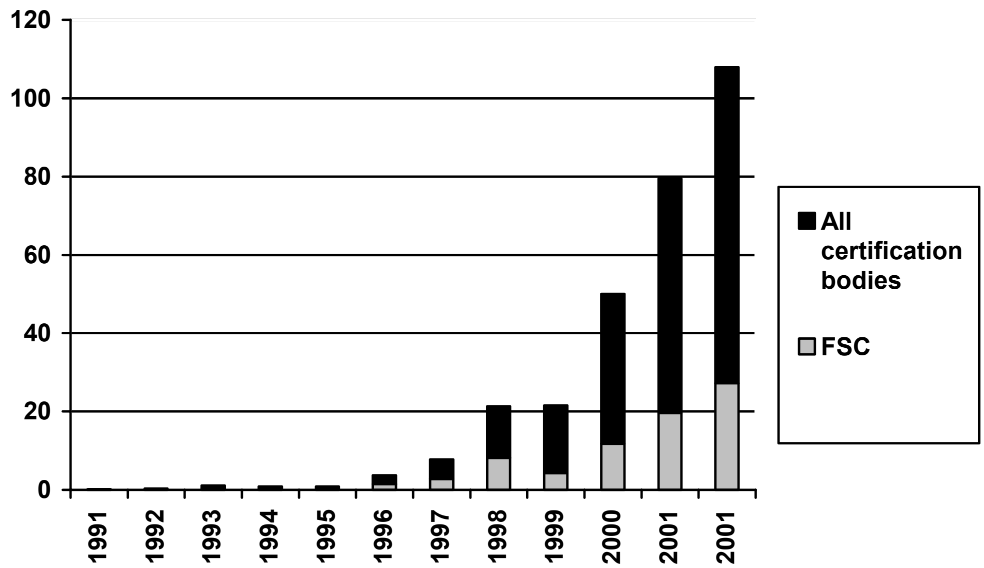
Another method for assessing the impact on sustainable development is through forest product certification. Forest certification involves an outside agency evaluating the environmental and social effects of a wood producer's operations, and then providing a rating for consumers (Bass *et al.* 2001). Such a method would "reward the performance of companies that adopt sound forestry practices by enabling them to maintain or improve the marketability of wood or other forest products" (IPCC 2000).

As of mid-2003, certified forests account for something approaching 150 million hectares worldwide (figure 5.1) dominated by the Pan European Certification Scheme (PEFC) with 32%, the Sustainable Forestry Initiative (SFI) with 26%, and the FSC with 24% (Rametsteiner and Kraxner 2003). The FSC is one of the largest and most credible because it has the support of major environmental groups such as World Wildlife Fund, Greenpeace, and the Rainforest Action Network (Bass *et al.* 2001). It is commonly used by major retailers and home builders, particularly in the US. Other major schemes include the American Tree Farm System (ATFS) and the Canadian Standards Association system (CSA) and the Malaysian Timber Council Certification (MTCC) (Pepke 2002; MTCC 2001).

The total area certified equates to just over 3% of total forest area.
More than 90% of certified forests occur in temperate and boreal high-income countries (Eba'a Atyi and Simula 2002). Approximately 50% of certified forest areas are located in Europe and 40% in North America. Only

8% of certified forests are in the tropical low-income countries (Thang 2003). This striking imbalance between high and low-income countries is a recent development, since in 1996, low-income countries' share of certified forest was 70% (Rametsteiner and Kraxner 2003). This in itself is relatively meaningless because of the tiny initial areas. The more important point is that certification is clearly now being used for a purpose for which it was not originally designed – i.e. it is being used to give market advantage to already sustainably managed forests rather than to encourage a move towards sustainability particularly in tropical areas (Bass *et al*. 2001).

Figure 5.1: The extent of certified forest land cover (est.), 1991–2002 in million hectares



Source: FAOSTAT on-line database (2002); Earthtrends (2003); Jenkins (2000); FSC data; United Nations Environment Program-Global Resource Information Database; Global Land Cover Characteristics Database.

As might be expected from the relative complexity of sustainable management in natural forests, the majority of certified forest is plantation or semi-natural forest. Many of the largest certification schemes (e.g. SFI, ATFS) have a strong regional base in the north. The FSC certification scheme, and to a lesser extent PEFC, are exceptions with global ambitions. The latest data from the FSC (table 5.3) shows that industrial plantations and semi-natural forests account for 56% of the certified forest area in tropical countries and 62% in non-tropical countries with a marked trend towards plantations in the former and semi-natural forests in the latter.

While statistics on certification provide one proxy for the extent of sustainable forest management, there is less evidence to suggest that certification has actually significantly changed forest management practices. While a certain tightening up of environmental, social and economic practices was found, a recent review of certification impacts suggests that certification has mostly been used by participating industries to endorse and legitimise already good management practice, rather than facilitating wholesale shifts from 'bad' to 'good' practice (Bass *et al*. 2001).

Table 5.3: FSC certified forested land area, 2002

Region	%	Land area (ha)	Natural	Semi-natural	Plantation
CAC	3.39%	986,042	775,742	161,624	48,676
ESA	0.83%	240,454	155,048	10,000	75,406
Europe	56.44%	16,401,517	4,800,073	10,331,471	1,269,973
NENA	0.00%	0	0	0	0
Oceania	2.27%	658,735	29,808	44,167	584,760
S. America	9.03%	2,623,443	1,418,976	13,206	1,191,261
SSA	3.86%	1,121,934	85,980	35,000	1,000,954
Former USSR	7.75%	2,251,189	32,712	2,218,477	0
Canada	3.44%	1,000,920	971,441	29,479	0
China	0.00%	940	0	940	0
Japan	0.02%	6,390	0	902	5,488
USA	12.96%	3,766,379	3,127,121	632,257	7,001
Tropical	19.4%	5,637,938	2,465,554	265,839	2,906,545
Non-tropical	80.6%	23,420,005	8,931,347	13,211,684	1,276,974
Total		**29,057,394**	**11,396,901**	**13,477,523**	**4,183,519**

For the purposes of this analysis the world is divided into 12 regions: Central America and the Caribbean (CAC); East and South Asia (ESA); Europe; Former USSR; Near East and North Africa (NENA); Oceania; Sub-Saharan Africa (SSA); South America; China; Canada; Japan; and the USA.

Source: FSC (2002)

Certification is not without other problems (Asia-Pacific Forestry Commission 2000). In general, it favours large producers who spread the costs of certification audits against large production volumes. The initial evaluation costs are relatively high, at about US$30,000 to US$50,000 (Waner 1993), which is too expensive for smaller forestry operations, principally in low-income countries (box 5.2). However, FSC has recently surveyed the problems associated with small-scale producers (Weben-Smith *et al*. 2002) and introduced new simplified and stepwise procedures to redress this scale inequality (FSC 2003; Higman and Nussbaum 2002).

There is also debate over the exact criteria used in current forest certification practices, which are of principle concern if certification is to be used to evaluate the sustainability of proposed forest climate change mitigation projects. In a paper published by the OECD and IEA, it is argued that relying on existing certification such as the FSC would be difficult. "Although there are some overlaps, there are also important differences between criteria for FSC certification and criteria for eligibility of [afforestation/reforestation] activities under the CDM" (OECD Environmental Directorate and International Energy Agency 2003). For instance, forest certification can be granted to monoculture plantations, although the FSC does favour biodiversity in its evaluations. In fact, some of the proposed project activities under the CDM, such as Plantar (reforestation with monoculture plantations in Brazil), and PROFAFOR (reforestation of grasslands to create 'natural forests' in Ecuador) already have FSC certification. This is despite the fact that 98% of the Plantar project afforestation/reforestation area involves monoculture plantations (OECD Environmental Directorate and International Energy Agency 2003).

Box 5.2: Challenges faced by community forest enterprises regarding certification

- The high costs of certification for community groups
- The inaccessibility of both market information and certified forest product markets
- The inability of forest standards to recognise many (complex) local land use systems, and locally-relevant social issues
- The lack of links between certification and the (development of) policies to promote community forestry
- The social and cultural burdens, and the technical challenges, entailed when undertaking the necessary business improvements to support certified forest operations

Source: Bass et al. (2001)

The International Standards Organization (ISO) aims to promote the development of standardisation in many sectors. The ISO 14000 process standards for environmental management systems can be implemented by any type of enterprise in any sector, including forestry, and could be used as a means for assessing the social and environmental impacts of forest climate change mitigation projects. The standards set specific environmental and sustainable development criteria for operations, and then allow projects to be managed on an ongoing basis to attain those goals with independent auditors verifying whether the management system was consistent with the standard (IPCC 2000). ISO has been around longer than forest certification, and many large forestry companies and some governments originally saw it as an alternative to FCS. In current practice, however, many companies see the performance focus of FSC and process focus of ISO 14001 as complementary, and implement both (Bass *et al.* 2001).

CHAPTER 6 – CONCLUSIONS

Tackling climate change is a key imperative of our time. Commitment to the cause is steadily growing – amongst governments and citizens – yet huge challenges remain. Wood is vital to society worldwide, and the potential for this natural resource to play a part in tackling climate change is immense. But tackling climate change is not sufficient unless it is done in a way which furthers the prospects for sustainable development – the development of all nations and peoples in a way that meets the needs of the present without compromising the ability of future generations to meet their own needs. Could the production and use of wood be organised in such a way as to mitigate the negative effects of climate change and to foster sustainable development? On this question we conclude the following:

Forests act as carbon sinks

Forests are currently a net sink of CO_2, absorbing up to 25% of global fossil fuel emissions of this greenhouse gas. The science is simple enough: trees convert CO_2 into solid carbon, in the form of wood, and they do so particularly effectively when they grow rapidly.

Plantation growth constitutes an expanding sink in many temperate countries – of approximately 0.2 billion tC per year and rising.

Natural forests do not actively sequester as much carbon per unit area because they grow at a slower rate than plantations. Nevertheless, there is strong evidence that sustainably managed and non-managed natural forests can be important carbon sinks. However, continuing deforestation, mainly in tropical regions, is currently thought to be responsible for annual emissions of 1.1 to 1.7 billion tC per year, or approximately one fifth of anthropogenic CO_2 emissions.

Forestry can play a part in mitigating climate change

Three main possibilities for mitigating climate change using forestry and wood products are apparent: (1) activities that reduce GHG emissions from forests; (2) activities that help maintain the ability of forests to store carbon; and (3) activities that expand the capacity of forests to store carbon.

Pilot land-use change projects designed to avoid emissions by reducing deforestation have shown their worth in producing environmental and socio-economic benefits, including biodiversity conservation, protection of watershed and water resources, improved forest management, local capacity building, and employment in local enterprises. However these initiatives are also controversial (see below).

Low impact logging is a potentially attractive forestry offset option because approximately half of the eventual greenhouse gains are realised over the first few years. However, GHG benefits of low impact logging are difficult to quantify.

Changing forest management practices can enhance the carbon sink potential of a forest by taking silvicultural measures to accelerate tree growth, maintain optimum stocking levels and protect from fire, insects and disease or invasive weeds. Since substantial amounts of carbon are also stored in soils, management practices that promote an increase in soil organic matter can also have a positive carbon sequestration effect.

But forestry can only play a small part. There is no substitute for reducing GHG emissions at source – some 90% of the cuts required will have to come from introducing cleaner fuels and improving energy efficiency. One estimate suggests that if 100 million hectares of additional plantations were to be established (the likely maximum over the next 50 years – the annual carbon fix would amount to about 0.4 billion tonnes, or approximately 7% of the annual anthropogenic carbon loading into the atmosphere.

Wood is better for the climate than a range of alternatives

Wood can provide renewable fuels, construction materials and a range of household products with lower production of greenhouse gas emissions per unit than most mineral or oil-based products.

Exchanging coal for biomass wastes and residues is one of the lowest-cost, nearest-term options for reducing fossil CO_2 emissions at existing power plants – and is a promising mitigation strategy in high-income countries. The theory is that biomass plantations will promptly sequester the amount of carbon released by burning biomass fuels.

Wood is an effective store of carbon as long as products remain intact within buildings or other structures. Substituting a cubic metre of wood for other construction materials (concrete, blocks or bricks) results in an average of 0.8 tonnes of CO_2 savings. Strategies to improve the effectiveness of wood as a carbon store would need to aim to achieve a greater proportion of wood products, a longer useful life, and increased recycling.

Technological investment is a key business strategy. One example of the pay-offs to be had through investment in technology is the remarkable recent growth of engineered wood products such as glulam, I-beams and laminated veneer lumber.

However, trends are towards non-wood alternatives. The use of wood substitutes, and the belief that these substitutes are better for the environment than wood, are both increasing. Other limits prevent growth in some wood product sectors. In food packaging for example, a number of hygiene and preservation requirements limit the level of material substitution by wood-based products that is possible, whilst for waste wood the challenge in many countries is to establish even a basic economic value.

Emissions reporting perversely favours non-wood alternatives. The current method for constructing national reports of greenhouse gas emissions under the Kyoto Protocol and UNFCCC requires countries to consider any harvested forest products as emissions as soon as they leave the forest site. The reason for this decision was the difficulty in agreeing how to track carbon stored in products between countries and then assess subsequent release upon combustion. Nevertheless, this has the perverse effect of favouring more carbon intensive materials such as cement, steel and bricks, and reduces the opportunities for the forest industries to contribute to a lower carbon economy through product substitution.

Carbon intensity labelling would be one way forward. It is suggested that the above tracking and monitoring problem, could be addressed by the introduction of a forest-industry led programme of carbon labelling of forest products. Forest products (perhaps from forests that are certified as sustainable) would be labelled with a carbon intensity figure (like a product label) that could be used by construction companies and other product users when compiling company reports of emissions. A similar scheme is being developed in the oil industry for blends of biofuels and mineral fuels.

Timber building standards would also help. To facilitate substantially greater use of timber over alternatives in construction, it is widely noted that a pan-European set of timber building standards is needed, along with further education in architectural, engineering and planning sectors.

Legislation is increasingly supportive of wood – but still holds some constraints. Driven by environmental considerations, legislation across Europe is becoming increasingly supportive of wood-based products. However, a number of barriers still exist to a broad substitution of construction and packaging material by wood-based products, such as food hygiene restrictions and structural strength requirements.

European wood has strong sustainability credentials

Most European wood comes from Europe! Europe as a whole is a major producer of wood products - accounting for approximately one quarter of the world total in various product categories. Trade in Europe's wood products accounts for approximately one third to one half of the global trade across various product categories. Much of this trade, however, occurs within the region - over 90% of imports of roundwood and sawnwood into Europe are from other European states.

European wood product sustainability credentials can be characterised as follows:

- *Softwood - roundwood and sawn – is mostly sustainable* (and only 2% of imports in Europe are from outside Europe) - with a few question marks over sources in the Russian Federation.
- *Hardwood – roundwood – is mostly sustainable* (only 9% of hardwood timber originates from outside of Europe), with some imports from Africa

and South America from certified forests but others from countries with very weak forest governance such as Congo-Brazzaville, Liberia and Burma.

- *Hardwood – sawn – is mostly sustainable*, but although almost 60% of the sawn hardwoods originate within Europe, claims of sustainability of supply from a number of sources in Africa, South East Asia and Latin America are strongly questioned.
- *Panels are mostly sustainable* - Europe imports just over 20% of its total consumption, and the main concern is over tropical hardwood plywood from South East Asia where overcapacity is a major problem.
- *Pulp and paper can be considered sustainable* – although the concept of sustainability applied to intensive plantations, from which most pulp and paper production are sourced, is much-debated. Europe is a net exporter of pulp and paper, but also imports approximately half of its apparent consumption, mostly from North and South America.
- *Secondary processed wood products are of questionable sustainability* – furniture and builders' woodwork, mouldings and other products are sourced from Europe (at least 50%), North America and, increasingly, Asia especially China. Many Asian sources are of dubious sustainability, for which chain of custody certification will be increasingly important.

But sustainable forest management is an elusive goal in much of the world (not helped by greater use of wood to store carbon in Europe)

Conversion of forest to agricultural land due to the non-competitive nature of commercial forestry is the most frequent factor associated with forest loss. Falling demand for forest products due to fears over forest loss will only diminish still further the competitive position of forest management vis-à-vis agricultural alternatives. Promotion of greater use of timber can play a part in redressing this, with particular price premiums, or subsidies where premiums are not possible, for timber from natural forests.

Sustainable forest management in diverse natural forests is a complex affair – and fraught with differences of perception and opinion. In plantations, the whole idea of sustainable forest management is questioned by many, yet plantations are the subject of most effort to date from certification schemes. With the steady shift of production to plantation forests, there is an increasing likelihood that the timber will come from a source certified as 'sustainable'.

The 'triple bottom line' is only recognised by a few. Whilst the 'extra burden' of sustainable forest management is perceived by many in the wood industry as threatening the financial bottom line, in many temperate contexts and a few tropical contexts, the industry is recognising that to remain competitive it must pay attention to the 'environmental bottom line' and the 'social bottom line' too.

Box 6.1: Myths about the non-sustainability of wood

It is testimony to the value which people place on forests that claims about the sustainable use of wood are regarded with such scepticism by the general public. Perhaps debunking some myths surrounding the sustainability of wood production systems will help the general public find greater expression of support for forests through an appreciation of wood as a structural and artistic material.

Myth 1 - Wood harvesting is the same the world over and involves cutting down the forest

In temperate / boreal plantations and semi-natural forests, trees are normally cut in contiguous blocks – 'clearcut' – leaving a large area of denuded land which is then often replanted. In most European countries replanting is obligatory and enforced. For most plantation companies, replanting is a commercial imperative. In diverse natural tropical forests, companies generally log only 10-15 species that are of medium or high commercial value and ignore hundreds of other species (the Amazon forest has approximately 2,500 woody species in the forest). Logging is therefore 'selective' – and the extent to which the remaining forest is able to recover depends on the extent to which operators reduce impact during logging (and leave the forest undisturbed after logging). Where commercial logging is done well this variation may leave anything between 50-70% of the large trees untouched and 90-95% of the soils unaffected. While logging does increase the likelihood of fire damage, it is what happens outside the forest sector that is critical to the long term fate of the forest (e.g. settlement, ranching, conversion to cash cropping etc.)

Myth 2 - Wood consumption drives deforestation

Poor quality forest operations may degrade the quality of the forest resource but rarely do they remove it altogether (it is not in their interests so to do – although some operators do put short term gains above long term sustainability). What drives deforestation is the fact that forest production systems cannot generate as much profit as land use alternatives (such as oil palm, soybean, ranching etc.) Market forces replace inefficient production systems with systems that produce more profit – a simple competitive model of survival of the fittest. The consumption of wood is the main reason why forest production systems can exist and compete at all – not the cause of their demise.

Myth 3 - International consumption is the main driver of tropical deforestation

International trade comprises a small fraction of the total wood production. Almost 50% of wood is used as fuel which is rarely traded over international borders. For the main other product categories displayed in figure 3.3 only 20-30% of production enters international trade. In part because of the high unit transport costs for wood products, the main trade flows are intra-regional (e.g. within the EU itself or within South East Asia). The extent to which the EU consumer affects forest trends in a country such as Brazil is marginal – almost 86% of Brazil's production is destined for the domestic market. It is domestic consumption that is the most powerful determinant of the competitiveness of forest land use in comparison with land use alternatives in tropical countries.

Myth 4 - Wood boycotts decrease demand for wood which means less trees are cut down

Wood boycotts to save the forest have almost entirely the opposite effect. As consumers refrain from buying timber, timber prices fall and the value of forest land falls in comparison with land use alternatives. Since producers are no longer able to make a competitive income from forestry, the obvious alternative is to deforest the land and use it for something else. The only other alternative would be to increase production per unit forest area in order to compensate for the reduced price of timber products. For example, between 1980 and 1993 dozens of European and American organisations actively promoted a ban on tropical timber as a means of decreasing tropical deforestation. In Brazil, production increased from 16 to 23 million m^3 per year and the participation of Amazon timber in international markets doubled. The other effect of bans in one place is displacement of the problem to another place – see for example the current predation of forests in Russia and south-east Asia to feed the Chinese market following a logging ban in that country.

Quality of forest governance determines whether forests are run for the specific needs of the few or the multiple needs of the many. What happens in forestry is driven by human aspirations for different dimensions of well-being. A mosaic of different types of land use systems may best meet the different aspirations of multiple stakeholder groups. In countries where forest governance is generally strong, and economic, environmental and social concerns relatively balanced, the outcome is a stable or expanding forest estate, which meets the diverse needs of the public. In other regions, particularly in the tropics, governance is under-resourced and the prospects for the forest estate may be determined by the needs of the few, rather than the multiple needs of the many. Constructive measures to strengthen governance in, and provide affirmative consumer support to SFM products and services from, such regions are particularly important.

Climate change mitigation through forestry initiatives could further the cause of sustainable development

Many synergies exist between climate change mitigation and sustainable development – for instance, improvements in energy efficiency, renewable energy, transport, and sustainable land-use policies all have positive impacts on both. However, as for the main challenges of sustainable forest management, climate change mitigation through forestry activities in Europe will contribute little to sustainable development in other regions.

Significant trade-offs are associated with deeper levels of mitigation in some countries. For example, there are cases where plantations have replaced habitats rich in biodiversity (and others where plantations may help enrich biodiversity when established on derelict or abandoned agricultural land). Plantations often bring far fewer benefits in terms of employment than is generally claimed by companies within the industry, and in some cases have sparked off serious conflicts with local people where they have deprived them of the land on which their livelihoods are based. To date, some of the investment companies involved in carbon deals have no forestry experience, whilst many local people involved have little understanding of how the deals they sign up to will work.

Carbon offset forestry faces the same challenges as good forestry in general. Critical to shaping project success in meeting carbon mitigation and sustainable development goals is effective participation by local communities affected by project activities. In assessing use of land for forestry, greater attention should be given to the environmental and social costs, to make sure that damaging schemes are ruled out. Subsidies for commercial plantations should be phased out, or at least dramatically reduced, since they create economic distortions making plantations viable in situations where other land uses might make better social, economic and environmental sense.

Whilst the science of carbon offsets may be simple, the politics are not. Much of the debate focuses on the CDM – with many opposed on the grounds that any focus on sinks diminishes the focus on sources. At the ninth

Conference of the Parties to the UNFCCC in December 2003, rules adopted for carbon sink projects, which have added fuel to the fire by potentially allowing plantations which displace local inhabitants, require impact assessments only if the host country considers them necessary. This potentially opens the door to the use of genetically modified trees in forests planted to offset global warming. The debate will be long and fractious.

Many feel there should be a globally accepted set of criteria for evaluating the sustainable development component of climate change mitigation policies. The UNFCCC remains a vital forum, and over the next few years opportunities should be seized to further explore the potential benefits of using wood products both for GHG sequestration and enhancing prospects for sustainable development.

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