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Timber Trade, Trade Policies and Environmental Degradation

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London Environmental Economics Centre

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Abbreviations

Names:

ECE = European Commission for Europe
FAO = The United Nations Food and Agricultural Organization
GDP = Gross Domestic Product
GNP = Gross National Product
ITTO = The International Tropical Timber Organization
NPV = Net Present Value
OECD = The Organisation for Economic Co-operation and Development
US = The United States
WRI = The World Resources Institute

Units:

cum or m^3 = cubic meters
mt = metric tonnes
ha = hectares
000 = thousand
mn = million
yr = year
na = not available

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1. Introduction

Concerns about the state of the world's forests have led to increased interest in the role of the international timber[1] trade in promoting forest depletion and degradation. The following paper examines the extent to which the timber trade and policies, compared to other factors, cause environmental damage and inefficient resource use in the forestry sector. The paper also addresses the potential role that interventions in the timber trade may have in promoting efficient and sustainable resource use in the forestry sector.

Section 2 overviews the current timber trade flows and their relationship to the regional distribution of global forests and deforestation. Section 3 examines in more detail the specific role of the timber trade, compared to other causal factors, in global deforestation and the environmental impacts of forest use. Both of these Sections raise a number of key policy issues concerning the environmental effects of the timber trade, forestry policy and wider economic policies. Section 4 summarizes the main issues, which are then further explored in subsequent sections. Section 5 discusses domestic market and policy failures, both within the forestry sector and economy-wide, that impact on timber forest management and its environmental effects. The environmental effects of timber trade policies are explored in Section 6, which examines the implications of timber trade import barriers for developing countries, timber trade export restrictions within these countries and the possible links between trade liberalization and deforestation. Section 7 in turn looks at some evidence of the timber trade impacts of domestic environmental policies and at the scope for unilateral and multilateral trade interventions to achieve efficient and sustainable resource use in the forestry sector. The conclusions of the paper are summarized in Section 8.

2. Global Forest Resources and the Trade in Forest Products: An Overview

In mid-1992 FAO plans on completing its *1990 Forest Assessment* which will update the world's most comprehensive database on the world's forest resources. The FAO studies are an amalgamation of various primary sources ranging from case studies and national statistics to satellite data. The data on developed countries is being amassed by the FAO/ECE in Geneva while FAO in Rome compiles the developing country data. Although some preliminary, summary results on deforestation rates in developing regions have been released, the overview of global forest resources and forest land use that follows is necessarily based on past FAO assessments as well as other secondary sources. While a number of these secondary sources, such as the World Resources Institute (WRI 1990) and Sedjo and Lyon (1990), have pieced together regional or global reviews from more up-to-date primary sources they often end up relying heavily on the older FAO and ECE/FAO figures.

Data on the production and trade of forest products is generally more accessible and reliable than that concerning forest resources and changes in land use. FAO maintains an extensive database of information that chronicles the yearly turnover in internationally traded forest

[1] 'Timber trade' is used in its broadest sense to include trade in all forest products: industrial roundwood, sawnwood, wood based panels, wood pulp and paper products.

products as well as figures on domestic production. An additional source of information on tropical timber is the International Tropical Timber Organization (ITTO) which compiles statistics reported by its producer and consumer country members.

2.1 Global Forest Resources

WRI (1992) concludes that in the mid-1980s approximately 27% of the world's land area - or 3565 million hectares (mn ha) - was covered by forests and woodlands. Closed forest accounted for almost 80 % - 2822 mn ha of natural forests. Other woodlands accounted for an additional 13% of the world's land area - or 1695 mn ha. [2] Figure 2.1 gives a regional breakdown of closed and open forest lands along with an indication of the percentage of total land area covered by closed and open woodlands in each region. No discernible pattern in percentage of total natural forest cover between the tropical or temperate cover emerges from the data. Around 40% of the USSR and the Americas are forested while Europe (34%), Africa (23%), Oceania (20%) and Asia (18%) are relatively less forested. Asia, Europe and the ex-USSR countries maintain large tracts of closed forest relative to open forests. The only region with more open than closed forest - by a factor of two - is Africa.

Commercial harvesting of forest resources may occur in both open and closed forest. Open woodlands, as in Africa for example, lend themselves more to use as sources of fuelwood and other local uses. Closed forests, on the other hand, are more likely to be subject to more intensive commercial exploitation for industrial wood products. As this study examines the environmental effects of the international trade in forest sector commodities, closed forests are of particular importance (see Figure 2.2). The USSR and Latin America hold just over one-half of the world's closed forests between them. North America follows with 21% and Asia with 13%. The remaining closed forests are situated within Africa (6%), Europe (6%) and Oceania (3%) completing the regional distribution. Interestingly enough - as shown later on - despite their large areas of closed forest, neither the large USSR or Latin American forests are currently a major factor in the international trade in timber.

Natural forests are also classified according to whether they are bamboo, broadleaved or coniferous with the latter two being by far the more prevalent closed forest formations. Figure 2.2 illustrates that softwoods (coniferous) stands predominate in temperate, 'developed' regions (90% according to Sedjo and Lyon (1990)) and hardwoods (broadleaved) are found in the largest quantities in tropical 'developing' regions. However, there are substantial hardwood resources in the 'developed' North, particularly in the USSR, the US

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[2]Definitions of closed and open vary. For *temperate closed forests* WRI uses the ECE definition of areas with greater than 20% of area covered by tree crowns and the area's primary use is forestry. For *tropical closed forests* FAO's definition of areas with a large proportion covered by trees and without a continuous grass layer on the forest floor is used by WRI. FAO's definition of areas with more than 10% tree cover and a continuous grass cover is taken by WRI as the criteria for *open forests*. WRI classifies temperate areas that are not used for agricultural purposes, have between 5-20 percent of their area covered by tree crowns, or have shrubs and stunted trees covering over 20% of their area as *other woodlands*. This is essentially ECE's definition of open forest minus the restriction that such areas be less than half a hectare in area. Finally, forest fallows and shrubs in tropical countries are also classified as *other woodlands* by WRI.

and Canada (466 mn ha). The reverse is not the case. Developing countries have little in the way of softwood resources. The extent of Africa and Latin America softwood resources comes to just 32 mn ha. Figure 2.2 lists the Asian softwoods at 65 mn ha, but this number reflects the influence of developed, temperate zone countries. In particular, it includes Japan which has 25 mn ha of forest resources of which roughly two-thirds are coniferous species (Ward Associates 1991). FAO (1981b) reports that the 16 tropical Asian countries surveyed in 1980 had only 8 mn ha of conifers. The bulk of the remaining Asian forest resources - including softwoods - resides in China, Turkey and Mongolia.

Sedjo and Lyon (1990) report that 70% of world demand for industrial uses of wood is based on softwoods and that softwood supplies from temperate plantations and secondary growth forests are on the rise. Although the Asia and Oceania region makes the largest tropical contribution to industrial wood production - mostly in the form of hardwoods - its share of world production is still less than 5%. These figures indicate that the sustained future supply of industrial wood is not necessarily tied to the future of tropical, closed, broadleaf forests. This does not preclude the possibility - explored throughout the remaining sections of this paper - that the trade in timber has a deleterious effect on tropical rain forests, old-growth temperate stocks or environmental quality in general.

2.2 Changes in Forest Land Use - Deforestation and Reafforestation

In recent years certain global patterns in forest land use changes have appeared. While in the temperate region forested area has remained broadly stable - Sedjo and Lyon (1990) actually report a 2% gain in temperate forest area since World War II - the deforestation of tropical rain forests has generated an increasing amount of publicity.

Table 2.1 reviews the evidence gathered over the last decade on the extent of deforestation in closed tropical forests. The debate centers over the extent to which the deforestation rate has accelerated, and if so to what degree. FAO figures for 1976-80 and estimates for 1981-1985 indicated that deforestation rates were approximately 0.6% in all three tropical regions. More recent reports by WRI and FAO reveal a marked increase in deforestation in the 1980s. In particular, the annual rate of closed forest deforestation - according to WRI (1990) - has accelerated to 1.4% in tropical Asia and to 1.6% in Latin America for an average of 1.2% for the 68 countries surveyed. Preliminary results from the *FAO 1990 Forest Assessment* (covering both open and closed forests) also strike a pessimistic tone. When comparing the results for 52 countries covered in both the 1980 and the 1990 assessment, the overall deforestation rate appears to have risen from 0.6% to 1.2%.

As shown in the bottom half of Table 2.1 the alarming nature of the rise in deforestation reported by WRI (1990) depends in large part on its rather controversial deforestation estimates for Brazil and India. The 1990 FAO assessment should provide further information relevant to the debate over the validity of these figures. FAO currently suspects that it underestimated the deforestation rates in its earlier studies (Dembner 1991). Thus, the outcry over rising rates of tropical deforestation may be misplaced - they may have been a chronic condition. However, Schneider *et al* (1990) suggests that Amazonian deforestation is actually much lower than FAO's estimates. The really alarming factor is the general uncertainty over

the real magnitude of deforestation and the seeming inability to definitively monitor changes in land use.

Forests, of course, are not only destroyed, but are regenerated by human intervention or renewed naturally or by human management. Reafforestation refers to three separate processes: (1) the restoration of a previously existing forests (artificial regeneration), (2) the artificial establishment of a new forest on previously forested ground (reforestation), and (3) the artificial establishment of forests in previously unforested areas (afforestation). Table 2.2 presents data estimating the global rate of reforestation (and afforestation) - calculated by WRI (1990) to total roughly 15 mn ha per year in the 1980s. The bulk of the reforestation occurs in China (4.6 mn ha), the U.S. (1.8 mn ha), Brazil (0.5 mn ha) and Europe (1.0 mn ha). An FAO estimate from the late 1970s placed the stock of plantation forest at 90 mn ha of which only some 12 mn ha were located in the tropics. While the degree to which a planted forest is an effective substitute for the values produced by virgin forest varies with the type of forest, Sedjo and Lyon (1990) point out that in the years to come an increasing proportion of world timber supply will come from plantation forests. Given the potential explosiveness of plantation supplies and their rapid growth rates, Sedjo and Lyon (1990) warn against drawing conclusions about future supplies of timber by simply comparing small increases in plantations with large changes in area deforested.

2.3 Ownership and Management of Global Forest Resources

A variety of ownership and management systems for forest resources are practiced around the world. While the data on managed and protected areas shown in Table 2.2 is necessarily incomplete due to the difficulty of actually determining the exact uses of closed forest and implementing a clear definition of forest management, it does indicate that the world's closed forests are far from being under comprehensive management and that only a small proportion have protected status. Poore *et al* (1989) provide one of the most comprehensive overviews of tropical forest management in the book *No Timber Without Trees*, while FAO has undertaken several regional studies of forest management (FAO 1989a, 1989b, FAO 1987).

Forest ownership in the more prominent OECD countries is summarized in Table 2.3. No clear pattern between public and private ownership is apparent - for example Canada's forests are almost exclusively in public hands while three-quarters of US forest resources are privately owned. As of 1980, FAO reported that over 80% of forest land is state property in Guyana, Peru, Bolivia, Brazil, Colombia, Venezuela and ex-British colonies such as Belize (FAO 1982). Private ownership of forest lands is more prevalent in Central America and communal ownership a factor in roughly half of Mexican forest lands. In anglophone Africa, customary rights recognized by colonial administrations in countries such as Ghana, Nigeria and Malawi have meant that although the forests are often nominally nationalized they are in fact treated as communal property. In francophone Africa, on the other hand, forests were traditionally considered property of the state - although local use was not expressly forbidden - and post-independence attempts to communalize forest lands have largely failed. Finally, as of 1980 forest lands in tropical Asia were 80-90% owned, controlled and managed by the state. An important exception is Papua New Guinea where a majority of the forest rights were owned by the local clans and tribes.

2.4 Production and Trade in the Forest Sector

FAO segregates forest products into 5 general categories: roundwood, sawnwood, wood-based panels, wood pulp and paper products. Roundwood is composed of both industrial roundwood and fuelwood (including charcoal). While the production of charcoal and fuelwood is significant in terms of volume of production, only a very small percentage (less than 0.3%) of total fuelwood and charcoal production enters the international trade (Table 2.4a). What is more, Table 2.4b shows that the value of imports of fuelwood and charcoal compared to the value of imports of all forest products is very small - less than 0.5% between 1961-1990. As fuelwood rarely qualifies as a traded good due to its low value per unit of volume and weight it is excluded from further consideration in this study and the industrial category of roundwood is used to capture log volumes and values.

Table 2.4a demonstrates that the volume of industrial roundwood produced and traded throughout the world has been growing steadily since 1961, to reach a level of production of 1,654 million cum and imports of 124 million cum in 1990. This has meant that a constant level of industrial roundwood production (7-8%) has been traded internationally from 1970 to date. The volume of production of all higher processed forest products have been rising even more rapidly over time, and approximately 20% of these other forest products are traded internationally. Table 2.4b shows that while the value of industrial roundwood imports has been rising steadily over time, its share of trade in all forest products has fallen from a peak of around 20% in the 1970-80s to 10% in 1990. This reflects the increasing importance of the higher processed forest products in the international trade. In particular, sawnwood and sleepers have increased their share of the forest product market (in value terms) from 22% to 28% between 1980 to 1990, and paper and paperboards from 33% to 39% during the same period.

An overview of current regional trade flows in industrial forest products in value and volume terms is provided in Tables 2.5 and 2.6. These tables provide evidence that the global market is largely dominated by developed countries. For example, on the export side (Table 2.5), developing countries account for just 13% of global industrial forest products export revenues. The principal exporters of forest products are North America and Western Europe who export 31% and 49% of the world industrial forest products respectively (in value terms). On average, the volume export figures shows a similar pattern, but a more detailed analysis by forest product category shows that the export share of developing countries varies considerably across commodity groups. For example, developing countries account for 28% of industrial roundwood exports, 11% of sawnwood and sleeper exports, 42% of wood based panels, 8% of wood pulp and 6% of paper products. The developing country export figures are heavily influence by Far East Asia - in particular, this region is responsible for exporting 66% of roundwood exports and 91% of woodbased panels from all developing countries.

Paper products make up approximately 47% of global export revenues (in value terms) from the industrial forest sector. However, as noted above this is a segment of the market in which developing countries have only a minor market share. The next largest markets are those for sawnwood (17%) and wood pulp (16%), followed by wood-based panels (10%) and industrial roundwood (9%). North America and Western Europe dominate the paper products, sawnwood and wood pulp markets whilst Eastern Europe and the ex-Soviet Union have not played much of a role in the market despite their sizeable forest resources. Of the

developing regions only the Far East Asian countries make a significant contribution in the global market, supplying almost 40% of world's trade in wood-based panels and 20% of the world's trade in industrial roundwood and sawnwood (in value terms).

Table 2.6 demonstrates that, as with exports, the developing countries share of the total world trade in imports of industrial forest products is relatively minor (only 27% in value terms). However, it is interesting to note that the developing countries have a larger share in the value of world imports (27%) than in the value of world exports (13%). Europe is the dominant player in the demand for forest products, importing over a quarter of the value of total industrial forest products. This is followed by the Near East with 15% (mainly consisting of sawnwood and sleepers), then North America with 14%. North America proves to be largely self-sufficient in roundwood, and but imports close to one-fifth of the global totals for wood pulp and paper products.[3] Japan is included in the 'Other developed countries' category, which explains its 13% share of the overall import value.

Although a number of tropical[4] developing countries export forest products only a select few actually maintain a positive trade balance in forest products. Table 2.7 summarizes (in value terms) the trade balance for tropical countries that currently export forest products. On average, the value of net exports has increased by 20% across all the tropical forest product exporting countries between 1980 and 1990. However, this increase is evenly distributed across all regions. For example, the value of net exports has actually fallen in tropical Africa from US$818 million to US$635 million over the same period. Tropical Central and South America has shifted from having a negative to a positive trade balance, and has been strongly influenced by the doubling of Brazil's exports between 1980-1990. Braxil currently accounts for approximately 90% of total exports from tropical Central and South America. In contrast, net exports from tropical Asia and Oceania have remained stable between 1980 and 1990, with the increase in exports from Indonesia and Malaysia being offset by the increase in imports by Hong Kong and decline in exports from the Philippines. The forest sector generates a net earning in foreign exchange in only ten of the eighteen African countries, five of the nineteen Central and Southern American countries, and eight of the seventeen countries from Asia and Oceania that are listed in Table 2.7. Thus, despite the furor over the issue of tropical deforestation a large number of developing countries are potentially more concerned about the future of world timber prices and supplies - both softwoods and hardwoods - than tropical deforestation.

Estimates (in volume terms) of the proportion of forest products that enter world trade from tropical countries and their apparent domestic consumption (ADC) of these products are presented in Table 2.8. As noted above, tropical Asia and Oceania is clearly the most important region in terms of production and exports of tropical forest products. It accounts for half of the industrial roundwood, sawnwood and wood-based panels produced by tropical countries and its exports represent over 85% of total exports of these products from tropical countries. Tropical Central and South America produce 36% of forest products from tropical countries, but few of these products are exported as the large figure for apparent domestic

[3] However, North American imports include a large amount of 'internal' US - Canada trade.

[4] Throughout this report tropical countries are taken to be countries with the majority of their land mass lying between the tropics.

consumption in Table 2.8a indicates. Africa produces a minor share of forest products from tropical countries (14%) and exports roughly 10% of its domestic production. Whilst Africa accounts for around 15% of the ADC of roundwood in all tropical countries, its proportionate ADC of sawnwood (9%) and wood-based panels (12%) is much lower. The remaining ADC of all tropical countries is split fairly evenly between tropical Central and South America and tropical Asia and Oceania.

Table 2.8b shows forest product exports as a percentage of domestic production in tropical regions between 1961 and 1990. On average in 1990, tropical regions exported 11% of industrial roundwood, 12% of sawnwood, and 69% of wood-based panels, with the rest consumed locally. The proportion of industrial roundwood and sawnwood exported relative to production has decreased from the peak around 1970, whilst in contrast the proportion of wood-based panels exported relative to production has doubled. However, this pattern is dominated by the Asian block - in particular the effect of their dramatic increase in percentage of wood-based panels exported relative to production rising from 40% in 1960-70s to 90% in 1990 - and is therefore not applicable to all regions. For example in Africa, while exports of industrial roundwood and sawnwood as a percentage of production have fallen over time, exports of wood based-panels have also fallen from 34% in 1961 to 22% in 1990. This is mainly due to the increased domestic consumption of processed wood in Africa. Similarly, in Central and South America, exports of all forest products compared to production have decreased since 1961.

A number of studies have attempted to forecast future trends in supply and demand in the forest sector (ECE/FAO 1986, ECE/FAO 1989, ECE/FAO 1990, FAO 1991, Sedjo and Lyon 1990). In a recent paper Arnold (1991) critically reviews some of these efforts and concludes that there is little basis for making firm forecasts of future wood supplies. Arnold (1991) does, however, feel that it is reasonable to make a number of broad statements concerning general long-term trends. These statements are generally supported by recent work by Vincent (1991). A number of the trends that are pertinent to these studies are highlighted below.

- Demand for industrial wood is projected to grow at a rate of from 15 to 40% over the next 15 years. Developing countries will take an increasing share of this growth, although developed countries will continue to dominate the market.

- Changes in technology and preferences will favour the growth in consumption of reconstituted products as opposed to that of solid products such as sawnwood.

- Hardwood consumption will grow faster than softwood consumption.

- Tropical resources will decline, but expanding temperate resources will be more than sufficient to lead to stable real prices for wood products.

- Projected growth in demand will be met by plantations; 'unexpected' increased in demand could be met by additional resources in central Canada, northern Europe and eastern Russia.

- The shift to consumption of planted and second growth forests as versus old growth stands will continue. The focus will shift from the Pacific Northwest and the tropics to forests in the southern and northeastern U.S. and newly planted southern temperate resources.

- Japan and western Europe could become increasingly self-sufficient, while parts of the developing world may need to increase their imports.

In his synopsis, Arnold (1991) suggests the tropics are expected to be increasingly less important in the overall trade picture. As temperate countries look more to temperate resources to meet their needs and domestic consumption in tropical producer countries grows the trade in tropical timber is itself likely to decline. Nevertheless, to the extent that producer countries succeed in exporting a much higher volume of value-added goods in place of logs, total volume of the tropical timber trade may fall but the drop in value of the trade will not be proportionate. In addition, an increase in South-South trade - particularly in sawnwood - will act as a counteracting force (Arnold 1991). Asia will continue to be the dominant producer and exporter of tropical timber with an increasing quantity of value-added goods, and consequently decreasing log exports. As a result of Asian producers moving into downstream markets, Africa and Latin America may become relatively more important sources of log and sawnwood exports respectively.

3. Contribution of the Timber Trade to Forest Degradation

Unsustainable extraction of timber from forests to supply the international trade in forest products can lead not only to a decline in standing timber stocks, but wider environmental effects. These external effects include the loss of other consumptive uses (e.g. harvesting and hunting other forest resources and recreational uses), of ecological functions (e.g. watershed protection, carbon storage and microclimatic role) and of other non-consumptive values (e.g ecotourism, genetic resource and existence values) of the forest. The production of timber for the international trade can effect the environment both:

- *directly* through the removal of trees and other damage incurred to surrounding forest during timber extraction; and

- *indirectly* through opening up and improving access to the forests which then impacts on other socio-economic factors which may degrade the environment.

3.1 Direct Environmental Impacts of Timber Production

Although the international trade in forest products is well documented, it is difficult to extrapolate from such data to the direct impact of the international trade on the environment for a number of reasons, including:

- uncertainty over the magnitude of forest degradation, conversion and regeneration in many countries and regions;

- the difficulty in gathering reliable data on the amount of timber extracted for domestic use as opposed to that entering international markets;

- uncertainty over the extent of plantation forests and their relative importance in reducing demand for old-growth forest resources; and

- methodological problems in assessing the wider environmental implications of timber extraction practices.

If the volume of timber extracted each year exceeds the amount of timber regenerated, then the *stock of timber resources* will decline over time. Although recent efforts by FAO and other organizations are constantly improving our ability to monitor the state of forests, hard data is still relatively scarce, especially in developing countries. The debate over the deforestation rates of Brazil and India - highlighted in Section 2.2 - provides a salient example of the large discrepancies that often exist between estimates of deforestation in developing countries. Thus, it comes as no surprise - as noted by Pearce (1990) - that monitoring agencies often present widely differing estimates of the extent of conversion of tropical forests to alternative uses such as agricultural cultivation or cattle ranching. Even less attention has been paid to measuring the extent to which the forest cover has been degraded by timber extraction - though the implications of such degradation are also important for the state of the environment.

Although the data is far from complete, the results of tabulations such as those conducted by the World Resources Institute (1990) and summarized in Tables 2.1 and 2.2 suggests that current levels of timber extraction in *tropical forests* - both open and closed - exceeds the rate of reforestation. Poore et al. (1989) noted that less than 1 million hectares, out of an estimated total area of 828 million hectares of productive tropical forest remaining in 1985, in all tropical forest countries, was demonstrably under sustained-yield management for timber production.[6] Improved data on deforestation and all modes of *reafforestation* would, however, greatly improve the reliability of such assessments.

Data in developed countries is generally more widely available. Table 3.1 gives some indication of the efficiency of use of *temperate forest* resources in OECD countries. The efficient use indicator is based on the ratio between annual increments and annual harvests, i.e. when the ratio is greater than one it shows that these resources have not been over-utilized, when it is less than one the resources have been over-utilized.[7] If over-utilization of timber resources continues over a period of time then the sustained development of these

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[6] This is based on the 'tight' definition of sustained yield management employed by Poore *et al* (1989) where a maximum volume of harvesting is maintained so that there is no deterioration in the prospects for future sustainable harvests.

[7] However, the 'efficient use indicator' is somewhat misleading. According to Vincent (*pers. comm.*), harvests equaling growth is an indication of economically efficient timber utilization only after a country has made the transition from the economically optimal mining of old-growth to the economically optimal sustained-yield management of second-growth forests. Even then, harvest would still exceed growth for certain intervals if the country pulse harvests its forests in a sustainable way. For example, it might follow a cycle of not harvesting any timber for 40 years, then harvesting all its forests during the subsequent 20-year period.

resources may be threatened. The data in Table 3.1 suggest that whilst timber resources in some OECD countries were over-utilized in the 1950s, since the 1970s they have been used more sustainably. However, this index must be treated with caution as it only gives a broad indication of aggregate trends. The aggregate data will not necessarily reflect changes in the mix of species utilized or local degradation. For example, in the early 1980s sustained yield logging was exceeded by over 60% in twelve national forests in the western United States (Dudley 1991b). However, the data in Table 3.1 indicates that the US as a whole had constant, or increasing, stocks of timber.

As discussed in Section 2.4, rough data on the extent of domestic use (i.e. subsistence use and domestic commercial use) and commercial exports (i.e. international trade) is available in volume terms from FAO sources. Unfortunately, while value estimates for exports and imports are provided by the FAO, estimates of the value of domestic consumption are difficult to obtain. Nevertheless, it is apparent from the data on volume of production, exports, imports and apparent domestic consumption given in Table 2.8 that *tropical countries* consume far more of their production than is exported. In addition, as noted earlier, although quite a few tropical forest countries export forest products only a small proportion are actually net exporters of forest products (Table 2.7).

Palo (1988) observed that in a number of developing countries the ratio of forest product exports to total merchandise exports parallels and even exceeds that found in the Nordic countries, Canada and other developed countries that have traditionally relied on the forest sector to spur export-led growth. From 1950 up to 1980 expansion and rapid industrialisation of the forest based sector proved a driving force in these developing economies, but in more recent years the rapid growth of domestic population and internal demand for timber has absorbed much of the potential for expanding timber and timber related exports (Palo 1988). Thus the growth of domestic consumption in developing countries that export forest products will generally serve to limit the growth of timber exports.

As indicated in Section 2.4, Arnold (1991) believes that demand for hardwoods will increase (mainly due to low prices brought about by the high availability and relatively low cost of hardwood production) and will outstrip demand for softwood in coming years. As the more accessible old-growth tropical forests are logged and developing countries follow the examples of Indonesia, the Philippines and others by placing export restrictions on logs and sawnwood, logging of *temperate hardwood forests* is likely to increase. Sedjo and Lyon (1990) are confident that the temperate zones plantation forests, secondary growth forests and remaining old-growth forests are sufficient to meet this demand. Meanwhile, the continued demand for softwood products implies that plantations in the southern US, Chile, New Zealand, Brazil and other areas will increasingly be put into production. The extent to which such areas will contribute to global production may depend on events in the Soviet Union.

The USSR contains the single largest concentration of temperate forests with over 40% of the world total temperate forest area and roughly one-half of the world's softwood supplies. FAO (1989) reports that annual roundwood production in the USSR was nearly 400 million cubic meters and exports were roughly 19 million cubic meters in the late 1980s. However, the impact of this offtake on the environment is unknown due to the lack of reliable information (ECE/FAO, 1989). For example, recent concerns have been raised over the

extensive timber extraction activities that are reported to be taking place in Siberia. One thing, however, is certain - should the USSR begin to draw down its stock of softwoods it would have a dampening effect on the world market for timber (Sedjo and Lyon 1990).

Although total temperate forest cover in North America is less than that in the USSR, roundwood production and exports are much higher. The USA sends the majority of its timber exports to Japan, and the remainder to Europe (FAO 1989). While Europe as a whole is a net timber importer, various European countries are net timber exporters, such as Denmark and France. Europe has a long history of forest management, and extraction of timber for the trade is not thought to lead to excessive declines in timber stocks due to extensive reforestation programmes.

In addition to the direct depletion of stocks, timber extraction can incur *external environmental costs* by degrading other forest resources and functions which are of value to people. Much of the criticism of tropical deforestation stems from scientist's claims that closed tropical forests are estimated to hold between 50-90% of the worlds biodiversity (Reid and Miller 1989). Evidence of the importance of the sustainable uses of this biodiversity for subsistence forest products, pharmaceutical and crop breeding research, ecotourism and as a key component in global warming, local watershed protection, microclimatic functioning and other environmental functions dictate that timber extraction imposes significant external costs in the tropics. While the concentration of biodiversity - and its use for subsistence - is not as pronounced in temperate forests, the wider environmental effects of logging activities remain a concern in developed countries. For example, Sedjo (1990) suggests that maintaining the biodiversity and recreational uses of old growth temperate forests has been a major environmental issue in the United States since the 1950s.

The extent of these external environment impacts from timber extraction depends largely on the type, and success, of forest management practices. Poore et al. (1989) notes that successful forest management depends on certain conditions being met, including the long-term security of operation, operational control, a suitable financial environment and adequate information. Although there are a few cases of successful sustained-yield management of forests for timber - for example in some regions in India, Malaysia and the Philippines (FAO 1989) - these tend to be the exception.

Poorly designed and implemented management regimes for selective logging of natural forests are likely to have serious implications for the environment. For example, on average only about 5 to 35 cubic meters (m^3) of merchantable wood are extracted per hectare of tropical closed broadleaved forests (FAO/UNEP 1981). However, these small commercial volumes relative to total standing timber can lead to disproportionate damage to the forest due to careless use of equipment and inefficient logging practices. Typically, at least half of the remaining stock, including immature trees of commercial value and harvestable stocks of less desirable varieties, are damaged beyond recovery (Repetto 1990). Clear cutting the forest for the timber may have even more significant environmental effects. For example, in Canada almost 90% of the total logging activities is by clear-cutting, which has led to serious landslides in parts of Vancouver Island (Dudley 1991b). Measuring the wider environmental impacts and costs of forest management practices is complicated, and few empirical studies have been undertaken.

The impact of timber production on the environment may be offset to some extent by investments in *reafforestation*. However, if investments to offset the degradation of natural forest are channelled into plantation forests then only part of the full environmental costs of timber extraction may be compensated. That is, investments in plantations may counteract the decline in stocks of timber, but may not always compensate for the wider environmental costs of natural forest degradation. For example, in Chile, ancient temperate Southern Beech forests are being clear cut and replaced with non-native timber plantations. Similiarly, in many tropical countries, natural forests have been clearer and replaced with plantation forests, with the loss of wider environmental values, such as biodiversity. Even if the compensatory investment is in management of a natural forest area, some of the environmental benefits of the degraded natural forest may still have been irreversibly lost, e.g biodiversity or non-timber forest products.

3.2 Indirect Environmental Impacts of Timber Production

In addition to the direct impacts of timber extraction on the environment, timber production can influence environmental degradation indirectly. This indirect impact may occur through the opening up and improvement of access to the forests, which may then interact with other socioeconomic factors encouraging activities that degrade the environment. However, due to the intricately interconnected relationship of the various causes of deforestation, it is extremely difficult to identify how much of the deforestation process is due to timber production.

In many developing countries where there are still areas of previously unexploited forest, and there exist no formal property rights for this land, timber production may encourage open access exploitation at the forest frontier and rapid forest conversion. In most industrialized countries, where there are fewer areas of unexploited forests, and ownership of the land is usually already established, open access exploitation is less of a problem. Timber extraction usually involves extensive road building which benefits other activities, such as agriculture and hunting, by improving access to the forest and reducing costs of transporting produce to market. In Northern Brazilian Amazon, the total road network (paved and unpaved) increased from 6,357 to 28,431 kilometers over the 1975-88 period. Although the road expansion programme cannot be specifically attributed to timber extraction in this case, a simple correlation between road density and the rate of deforestation demonstrates that as road density increases, the rate of deforestation increases in larger proportions (Reis and Marguilis 1991).

Timber extraction is often the first step towards opening up the tropical forest and clearing the land for agricultural production. What is more, in many developing countries, property law establishes deforestation as a prerequisite of formal claim over the land for those settling in forested areas (Mahar 1989; Pearce, Barbier and Markandya 1990). Table 3.2 suggests around half of the area logged in African countries is subsequently deforested, whilst there is little, if any, deforestation of previously unlogged forest land. The environmental impact of forest conversion to agriculture has grown as logging has progressively opened up more remote, hilly and ecologically vulnerable areas.

Paris and Ruzicka (1991) provide a bold 'guesstimate' of the private and social costs of logging of old-growth forest in the Philippines. As shown in Table 3.3, selective logging yields positive private returns when the revenues from selling logs (i.e. the value of the log harvest) are set against the costs of road building, harvesting and transportation. In their 'Model 1' Paris and Ruzicka examine what the net economic gain would be if the selective timber production were sustainable, and the downstream environmental impacts taken into account. After accounting for the costs of protection, timber stand improvement and enrichment planting to ensure the sustainability of production the private returns are reduced, but still positive. When the additional offsite damage to downstream activities are taken into account, the net economic gain is negative. 'Model 2' examines the case where the timber production is not made sustainable. After taking into account the costs of depleting the stock of timber and the high downstream damages the net economic loss is extremely high, and this use of the forest resources socially unattractive.

A similar economic valuation of the net benefits from harvesting wood in Malawi is summarized in Table 3.4. The private net benefits from unsustainable harvesting are positive. However, after accounting for the additional costs of reforestation to enable the level of harvesting to continue sustainably and the additional costs of soil erosion on land converted to agriculture, the net social benefits are negative. Discounted over time at 5%, 10% and 50%, the present value of the total net loss to Malawi between 1990 and the year 2000 represent 3.3%, 2.8% and 1.2% of GDP respectively.

3.3 Statistical Evidence on the Causes of Forest Degradation

A number of studies have attempted to assess the relative importance of various economic activities, including timber extraction, in causing *tropical deforestation*. However, most of the work is extremely tentative because of the problems outlined in Section 3.1. For example, Binswanger (1989) and Mahar (1989) highlight the role of subsidies and tax breaks, particularly for cattle ranching, in encouraging land clearing in the Brazilian Amazon. However, more recent analysis by Schneider et al. (1990) and Reis and Marguilis (1991) emphasize the role of agricultural rents, population pressures and road building in encouraging small-scale frontier settlement in this region. The study by Schneider et al. (1990) identifies the importance of the role of logging in the current pattern of Amazon exploitation, primarily through opening access to previously inaccessible lands. The role of timber extraction has been encouraged by both a range of public policies, increasing domestic demand and a strong international demand for tropical hardwoods. Log production from the Amazon region has increased rapidly throughout from 4.5 million cubic meters (m^3) in 1975 to over 24.5 million m^3 in 1987.

Although there have been several case studies examining the role of the timber production and the timber trade in tropical deforestation, there have been few attempts to explore these linkages through statistical analysis. However, the studies that do exist provide some interesting results. A recent study by Amelung (1991) identified the major shifts in land use changes and the causes of deforestation in tropical countries. Table 3.5 shows the percentage share of the various activities which cause deforestation[8]. The agricultural sector accounted

[8] Deforestation here is taken to be a reduction in the crown cover to less than 10%.

for the largest share at over 80% on average of total deforestation in all tropical forest countries. The direct impact of forest activities on deforestation is minimal (i.e. less than 10% of total deforestation). This is partly because timber which is harvested by selective logging is not considered to contribute to deforestation given the definition of deforestation used in this study.

Table 3.6 shows two alternative measures of forest degradation, biomass reduction and forest modification (Amelung 1991). The role of the forestry sector in *biomass reduction* is much more significant than its role in deforestation as a whole, especially in Indonesia. However, agriculture continues to play the dominant role in forest degradation. In contrast, the forestry sector is almost completely responsible for converting virgin forests into productive closed forests or other forms of land use through *forest modification*. In short, Tables 3.5 and 3.6 show that timber extraction is largely responsible for opening up previously unexploited forest, which then enables other economic uses of the forest resources, such as agricultural cultivation, which lead to forest degradation and deforestation.

A statistical analysis by Burgess (1991) examined the causes of deforestation in 54 tropical forest countries. Although this study confirmed a significant and positive relationship between the total level of *non-coniferous roundwood production and deforestation*, it did not explicitly examine the role of the timber trade. However, a study by Capistrano (1990) and Capistrano and Kiker (1990) explored the influences of international and domestic macroeconomic factors on tropical deforestation.[9] They revealed that the *export value of tropical wood* was a major factor explaining depletion of closed broadleaved forests between 1967-71, although this variable was not significant after the early 1970s. A series of cross-sectional statistical tests of various factors influencing deforestation in 72 tropical forest countries (Palo, Mery and Salmi 1987) identified a weak, but positive, statistical relationship between *forest coverage and forest products exports per forest area*. This latter study appears to contradict the previous studies by suggesting that the higher the level of exports from a given area of forest, the higher the aggregate forest cover.

There have been few, if any, attempts to conduct statistical analysis of the causes of *temperate deforestation* and little attention has been paid to the role of the timber production and the timber trade. Air pollution is considered a major cause of forest degradation, and can impact on forests through local or transboundary air pollutants and through climate change. The demand for fuelwood in Latin America and northern Asia is also a major cause of temperate deforestation. Other contributory factors contributing include the conversion of forests to farmland, urban expansion, fires and the impact of tourism (Dudley 1991b).

[9] The authors take changes in timber production forest area as a proxy for total deforestation. Although they argue that there is close correlation between average area of closed broadleaved forest and timber production forest area, there are many tropical forest countries where industrial logging is not a significant source of overall deforestation. Thus their analytical results are more relevant to deforestation of tropical timber production forests than to overall tropical deforestation.

3.4 Conclusion

It is extremely difficult to distinguish the impact on the environment of timber harvested for the international trade from total domestic timber harvests. The *direct impact* of timber extraction on the state of the forests in many tropical and temperate countries appears to be relatively insignificant. However, there are many countries where the stock of timber resources are being harvested in excess of their incremental growth and timber extraction incurs wider environmental costs.

The *indirect impact* of the timber extraction - through road building and opening up the forests - is considered to have more significant implications for forest conversion and environmental degradation. In particular, in many developing countries the improved access to previously inaccessible areas resulting from timber extraction activities, combined with a lack of well defined property rights for forest land, leads to rapid forest conversion at the agricultural frontier. In most industrialized countries where there are few remaining unexploited and unallocated forests, open access forest conversion is less of a problem.

A serious concern in both developed and developing countries is the conversion of natural forests to *plantation forest*. Although this may maintain the supply of timber, wider environmental costs such as the loss of biodiversity and habitat for wildlife, soil erosion and the long term loss of soil fertility, effects on the water table and water quality and so on may not be taken into account.

4. Forestry Sector Policy and the Environment: An Overview

The previous section looked at both the direct and indirect impacts of timber production and trade on forest degradation and its resulting environmental effects. Although these impacts may be significant, particularly in specific regions and countries, commercial logging is generally not the predominant cause of global deforestation. Other factors, such as agricultural land conversion, are much more important. Moreover, as much timber extraction is for domestic consumption, it is difficult to apportion blame for *all* the environmental impacts associated with commercial logging onto the *international trade* in timber products.

Nevertheless, to the extent that the public policies influencing forest sector trade encourage inappropriate production forest management and harvesting, then the resulting forest degradation and environmental impacts will be 'excessive'. That is, the level of timber extraction and forest depletion arising from commercial logging and trade is greater than what is deemed optimal from a social, and indeed perhaps even a global, point of view. This situation essentially results from the failure of individuals in the market place and by governments not fully recognizing and integrating environmental values into timber management, production and trade decisions.

Some of the environmental values lost through timber exploitation and depletion, such as watershed protection, non-timber forest products, recreational values, etc., may affect only populations in the countries producing the timber. Concerned domestic policymakers should

therefore determine whether the benefits of incorporating these environmental values into decisions affecting timber exploitation balance the costs of reduced timber production and trade, as well as the costs of implementing such policies. The socially 'optimal' level of timber exploitation and trade is one where the additional domestic environmental costs of logging the forests are 'internalized' in production decisions, where feasible.

Increasingly the world's forests, including its remaining timber reserves, are also considered to provide important 'global' values, such as a major 'store' of carbon and as a depository of a large share of the world's biological diversity. Similarly, even some 'regional' environmental functions of forests, such as protection of major watersheds, may have transboundary 'spillover' effects into more than one country. But precisely because such transboundary and global environmental benefits accrue to individuals outside of the countries exploiting forests for timber, it is unlikely that such countries will have the incentive to incur the additional costs of incorporating the more 'global' environmental values in forest management decisions. Not surprisingly, sanctions and other interventions in the timber trade are one means by which other countries may seek to coerce timber producing countries into reducing forest exploitation and the subsequent loss of environmental values. In addition, trade measures are increasingly being explored as part of multilateral negotiations and agreements to control excessive forest depletion, to encourage 'sustainable' timber management and to raise compensatory financing for timber producing countries that lose substantial revenues and incur additional costs in changing their forest policy.

However well-intentioned they may be, both domestic and international environmental regulations and policies that attempt to 'correct' forest management decisions may have high economic, and even 'second order' environmental, costs associated with them. There is increasing concern that the potential trade impacts of environmental policies that affect forestry and forest-based industries may increase inefficiencies and reduce international competitiveness. Moreover, the trade impacts of domestic environmental regulations may affect industries in other countries and lead to substantial distortions in the international timber trade. The overall effect on the profitability and efficiency of forest industries may be to encourage forest management practices that are far from 'sustainable'. Careful analysis of both domestic and international environmental policies affecting forest sector production and trade is therefore necessary to determine what the full economic and environmental effects of such policies might be.

Finally, current import and export policies influencing timber trade flows can themselves be a source of major environmental impacts in the forest sector. Protection of forestry and forest-based industries, whether explicit or implicit, can encourage inefficient expansion of domestic industries that leads to excessive forest depletion. Producer countries that are unable to penetrate protected international markets may be discouraged from developing value-added processing, even though a cost, and possibly a comparative, advantage may exist in these countries for such industries. It is conceivable that the loss in value added leads to a higher rate of timber exploitation in order to increase earnings from raw log and semi-processed exports; on the other hand, over-expansion processing capacity and inefficient operations could result in greater deforestation. The long-term price implications of existing and proposed global timber trade policies, including any barriers to trade in certain timber products, may affect the incentives for some producer countries to change their forest policy

and management practices, and may even encourage an expansion of activities that are environmentally detrimental.

The above concerns over the links between timber exploitation and trade, forest depletion and measures to protect the environment can be grouped into three key policy issues:

- the environmental effects of domestic market and policy failures through their impacts on timber forest management;
- the environmental effects of current timber trade policies pursued in both producer and consumer countries; and,
- the impacts of domestic and international environmental regulations, policies and agreements on the timber trade.

These issues need to be addressed in order to design appropriate policies to manage the trade and to control excessive forest degradation. The following three sections will briefly outline each of these major issues, drawing on selective examples as illustrations.

5. Domestic Market and Policy Failures and Timber Forest Management

The previous section noted that the prevalence of domestic market failures and distortionary domestic government policies may drive a wedge between the private and socially optimal rates of environmental degradation associated with timber extraction and trade. Removal or correction of these failures may make the timber trade more sustainable.

Market failures can lead to excessive environmental degradation when markets do not operate efficiently or fail to reflect fully environmental values. The presence of open access resource exploitation and public environmental goods, externalities, incomplete information and markets and imperfect competition can all contribute to this type of market failure. Usually some form of public or collective action, involving regulation, market-based (economic) incentives or institutional measures, is required - provided that the costs of correcting market imperfections do not outweigh the benefits.

Policy failures can also exacerbate environmental degradation when the policy interventions necessary to correct market failures are not taken, or over-correct or under-correct for the problem. They also occur when government decisions or policies are themselves responsible for excessive environmental degradation.

5.1 Domestic Market Failures and Incentives

The result of domestic market failure is a distortion of economic incentives. Forest management and forest-based industries may be affected in several ways. For example, the market prices of most widely traded timber products typically do not reflect the environmental costs of their production. Market prices fail to account for indirect use values

(e.g. watershed protection or nutrient cycling), as well as future and non-use values (e.g. option value or existence value), which may be lost or degraded by the production or consumption of forest products. All these environmental benefits are typically public goods, and thus have no market price.

Where forest users lack the means to appropriate such value, they will tend to ignore it. Logging companies, for example, may neglect the impact of their activities on wildlife, and the resulting loss of value for hunting or tourism. Any such loss falls outside the private cost and benefit calculations of the timber firm (hence the name 'externality'). When external costs are consistently ignored throughout an industry, prevailing market prices will tend to fall below the socially optimal level, leading to excessive exploitation.

In the absence of a system of formal property rights and tenure, forested land becomes essentially an open access resource from which no one can be excluded. Therefore, even if an individual wanted to conserve the forest, or set it aside for future use, another individual may decide to intervene, and extract timber from the plot for his own personal gain. The risk and uncertainty associated with abstaining from current use creates an incentive to maximize short term returns by extracting timber immediately. Thus, the individual fails to account for the 'user cost' of resource use. With the exception of more remote 'frontier' areas of tropical forests, very little forested land exploited for timber is subject to 'pure' open access conditions. However, as will be discussed below, the failure to design appropriate concession arrangements for public forest lands and insecurity of ownership of plantations can create similar conditions as the 'open access' situation. That is, private individuals and concerns will make harvesting decisions based on short-term profit-maximising decisions and have little regard for the potential for greater future returns from the timber stand.

Imperfect competition in the forestry industry can also have important environmental effects. Barriers to entry and exit can prevent the most efficient firms from operating in the industry, thus leading the industry as a whole to extract more timber than necessary to provide a given supply of products. Inefficiencies in the processing sector are particularly damaging in this respect, as they directly impact on the scale of timber exploitation through poor log conversion rates and overexpanded capacity. Imperfect competition and information may also have implications in terms of failure to improve or adopt technologies and forest management practices that minimize forest depletion and environmental degradation.

The market prices of traded forest products and services may also be distorted by domestic public policies, including economic policy, public investment and institutional arrangements. It is often difficult to disentangle the linkages between domestic macroeconomic, sectoral and trade policies as they affect forestry (see Figure 5.1). Economic policy interventions at various levels can alter the profitability of forest-based activities vis-a-vis other domestic sectors, and their competitiveness relative to foreign producers.

As the links between domestic public policies and forestry may be significant, it is worth reviewing some of the mechanisms involved.

5.2 Public Policies and the Forestry Sector

Domestic macro-economic policies, such as exchange rate devaluations and the level of debt servicing ratios, may impact on the timber trade and deforestation (Figure 5.1). An overvalued exchange rate acts as a subsidy to urban consumers on imported goods, whilst implicitly taxing timber exports produced domestically. Real currency devaluations, as frequently required by structural adjustment programmes for indebted developing countries, remove existing distortions and provide incentives for greater domestic production of exportables, including timber products. This is due to increasing international price competitiveness and increased domestic demand for home produced goods as imported substitutes become relatively more expensive. Both impacts can directly encourage deforestation through the expansion of wood production for the international and domestic markets. Increasing pressure to meet debt servicing payments may also contribute to deforestation if countries pursue short term policies at the expense of long term sustainable development. More generally, macroeconomic policies (e.g. fiscal and monetary policy) can affect underlying demand and supply conditions, with knock-on effects in the forestry industry.

The impacts of macroeconomic policies on the forestry sector, and subsequently on deforestation, are difficult to analyze. As noted in Section 3, there have been few, if any, economic studies of the causes of temperate deforestation, and the studies of tropical deforestation often produce conflicting conclusions regarding macroeconomic influences on deforestation. For example, in a study of these linkages in tropical forest countries, Capistrano and Kiker (1990) found a negative correlation between debt-service ratios and deforestation. In contrast, Kahn and McDonald (1990) discovered a positive relationships between tropical deforestation and public external debt and annual percentage changes in that debt. On the other hand, the results by Capistrano and Kiker (1990) do show that the high availability of external funds in the early 1970s in tropical forest countries may have reduced the pressure on the use of domestic forest resources (e.g., through the need for increased investments and production in forest extraction). Their study also indicates a high correlation between exchange rate devaluation and tropical deforestation. Thus the indirect impact of debt on increased tropical timber extraction and deforestation, through the policy responses to correct or service the debt problem as implemented through structural adjustment programmes, may be significant.

Forest exploitation is directly affected by economic policies aimed specifically at the forestry sector, including domestic and trade instruments (e.g. tax credits or subsidies for forest conversion, afforestation or for wood product exports). Forestry is also indirectly affected by economic policies which alter incentives and returns in downstream industries or related sectors, such as wood processing, construction and agriculture (Figure 5.1).

Public investment often has very direct effects on forest-based activities, particularly where transport infrastructure and public services are extended to previously inaccessible forested areas. Such investment may be considered an important subsidy to the logging and wood processing industry, by reducing the costs of gaining access to forest resources, and of bringing forest products to market. Public investment in remote forested areas also acts as an impetus to human population migration and agricultural expansion, frequently associated with forest clearing. The result may be conflicts over land use, or a misallocation of forest

resources, as areas designated for timber exploitation are encroached upon by migrant farmers, ranchers, miners and others.

Institutional and legal arrangements governing land tenure and transactions can also have significant effects on forest land use. Formal property law and titling regulations in many developing countries, for example, often ensure that land clearing is the only means of securing claims to frontier forest landholdings. Important areas of old growth forest that could be exploited for commercial timber on a sustainable basis may be lost in this way.

Short concession periods for logging operations on public lands can reduce incentives for reforestation, while stumpage fees and licenses are frequently set at very low rates that fail to reflect the scarcity value of standing timber. Moreover, many governments are unable to manage effectively the public forest estate, resulting in illegal encroachment or logging. All of these factors reduce incentives for sustainable management of timber resources by private firms.

The following examples in both temperate and tropical forest countries illustrate the effects of domestic policy failures on timber forest management and the environment.

5.3 Domestic Policies, Timber Management and Environmental Impacts

As outlined by Hyde and Sedjo (1990), public policies influence the environmental effects of timber forest management through their impacts on:

- the level of *privately efficient* harvests;
- the level of *socially efficient* harvests when accounting for environmental externalities;
- alternative *royalty, contract and concessional* arrangements and their implications for trespass, high-grading and other environmental losses;[10] and,
- the level of *rent distribution*.

The implications are illustrated in Figure 5.2.[11] If p is the competitive price for delivered logs, V is the harvest volume and MC_1 is the short-run private marginal cost curve of the concessionaire for delivered logs, then V_1 is the optimal short-run and private harvest level. That is, the private concessionaire is concerned only with short-run financial returns from harvesting and not with the potential long-run returns from the stand or with any of the 'external' environmental effects of logging. However, this level of extraction, V_1, is not optimal from a social point of view because it excludes a) the 'user costs' of short-run

[10] *Trespass* is a forestry term that refers to losses due to logging theft, which could also be extended to included losses due to graft. *High-grading* refers to the removal of high-valued timber and leaving a degraded timber stand (Hyde and Sedjo 1990).

[11] This example concerns a concessionaire contracting with a forestry ministry to extract timber from public forest land. With modification, the example could easily be extended to describe a forest operation on private land.

harvesting, i.e. the discounted future returns from leaving the residual stand undamaged and growing or through avoidance of high-grading and other practices that degrade the stand, and b) any 'external' environmental costs of timber extraction (e.g. watershed degradation, downstream sedimentation, disruptions to nutrient cycling, loss of natural habitats, loss of non-timber products, etc.).

Improved contractual arrangements between the forest ministry and the concessionaire could ensure that the latter 'internalizes' any additional user costs. Long term contracts that coincide with optimal harvesting/regrowth rotations could ensure that the concessionaire has an incentive to take account of these user costs, denoted by MC_2 in Figure 5.2. Other arrangements, such as imposing provisions for continuation of short-term contracts on condition of 'sustainable' practices or even outright sale of the land, could also be applied. If successful, such contractual arrangements would ensure that the concessionaire would attain the optimal long-run harvest level, V_2, and deplete less timber. Finally, if MC_3 is the additional off-site environmental costs of timber harvesting, then these costs can also be 'internalized' by imposing a tax equal to *bd* on the concessionaire.[12] The result is that the concessionaire now harvests at the socially optimal level, V_3, which is lower than the private short or long-term level.

As indicated in Figure 5.2, the concessionaire is making an economic rent equal to pap_1, or pbp_1 if all social costs are accounted for. The forestry ministry can 'capture' all or part of this rent through harvest taxes. However, an *ad valorem* (flat rate) tax or royalty that is a percentage charge on net revenues does not affect the harvest level (i.e., will not 'move' the concessionaire from V_1 to V_3) but will increase the incentive to high-grade, trespass and ignore off-site environmental costs. A uniform fixed royalty, which is a flat fee per unit of harvest, does alter the marginal harvest decision, but also increases the incentive to high-grade, trespass and ignore off-site environmental costs on the infra-marginal land. Moreover, increasing this royalty may actually *decrease* tax revenues if the elasticity of the marginal cost curve is greater than one, and could reduce harvests below the socially optimal level, V_3. To 'internalize' user and environmental costs *and* capture a greater share of rents would require a more sophisticated combination of policies of, first, sorting out long-run contractual arrangements and an environmental 'tax' equal to *bd* as outlined above, and second, charge a competitively bid lump sum fee for the right to harvest the stand, equal to pbp_1, in order to capture the economic rent generated at V_3.

In sum, the above discussion provides a useful background for understanding how public policies can affect the incentives for timber forest management and its environmental impacts. Designing policies to reduce these impacts and control excessive forest degradation is clearly complex and requires careful attention to harvesting incentives. As the following examples illustrate, many domestic policies do not even begin to approximate the appropriate incentives required to achieve a socially optimal level of timber harvesting. More often than

[12] It is possible that the forestry ministry might want to impose a single tax to cover both user and environmental costs, in which case the optimal tax would be *bc* in Figure 5.2; however, Hyde and Sedjo (1990) correctly argue that such a tax does nothing to 'extend' the horizon of an operator after short-run gains, and would actually encourage high-grading, trespassing and tax avoidance, especially for infra-marginal stems and stands.

not, pricing, investment and institutional policies for forestry actually work to *create* the conditions for short-term harvesting by private concessionaires, and in some instances, even *subsidize* private harvesting at inefficient levels.[13]

For example, in Malaysia and Indonesia, government policies to encourage the switching from the export of raw logs to processed timber products have led to substantial economic losses, the establishment of inefficient processing operations and accelerated deforestation (Repetto and Gillis 1988). Throughout Southeast Asia the allocation of timber concession rights and leasing agreements on a short time scale, coupled with the lack of incentives for reforestation, have contributed to excessive and rapid depletion of timber forests. In the Philippines, the social gain from logging old-growth forest was found to be negative (around - US$130 to - US$1175 per hectare), once the social costs of timber stand replanting, the costs of depletion and the costs of off-site damages were included (Paris and Ruzicka 1991; see also Table 3.3).

Short-term concessions and poor regulatory frameworks coupled with inappropriate pricing policies often contribute to excessive rent-seeking behaviour in tropical timber production (Gillis 1990). That is, concessionaires have an incentive to open up additional stands for harvesting in order to 'mine' timber for high short-term profits. Table 5.1 indicates government rent capture from tropical timber in five countries. By not charging sufficient stumpage fees and taxes or by selling harvesting rights too cheaply, by and large most governments have allowed the resource rents to flow as excess profits to timber concessionaires and speculators, often through short-term harvesting operations.

For example, in the Philippines, if the government had been able to collect the full value of actual rents, its timber revenues would have exceeded US$250 million - nearly 6 times the US$39 million actually collected. Instead, excess profits of at least US$4500 per ha went to timber concessionaires, mill owners and timber traders (Repetto 1990a).[14] Although the total area of production forest in the Philippines is 4.4 million ha, the total area under timber concessions exceeds this at nearly 5.7 million ha - almost 90 per cent of the entire forest area. Concessions are awarded for 25 years but some for as little as five, even though the minimum realistic felling cycle is 30 years and the rotation 60 years. Almost all the large logging companies have senior politicians on their boards, and it is generally the politicians, not forestry officials, that ultimately determine concession policy and allocation (Poore *et al.* 1989, ch. 5).

Hyde and Sedjo (1990) point out the difficulty experienced by forestry departments, particularly in developing countries, in administrating and collecting various timber fees and taxes. For example, in Malawi the Forestry Ministry collects less than 50 percent of the

[13] For further examples and discussion, see Barbier, Burgess and Markandya (1991); Gillis (1990); Pearce (1990); Repetto (1990) and Repetto and Gillis (1988).

[14] As noted above, rent capture *per se* may not be as fundamental to an efficient outcome as ensuring proper 'internalizing' of the user costs of timber exploitation through appropriate contractual and concession terms. That is, even if government rent capture is low, it can still ensure through proper concession arrangements that the stand is harvested at the private long-run efficient level. However, in many countries poor rent capture and poor concession policies go hand in hand, combining to produce short-term and rent-seeking behaviour in concessionaires.

receipts due from timber harvests. Much of the problem may have to do with the complexity of fees and concession arrangements, which makes enforcement and supervision of revenue collection difficult. In a review of forest pricing and concession policies in West and Central Africa, Grut, Gray and Egli (1991) suggest replacing the multiplicity of forest fees with an annual concession rent, set by competitive bidding, and replacing logging concessions with forest management concessions that should be regularly inspected.

Public policies also have an important influence on the pattern of forest-based industrialization and its implications for long-term economic development and deforestation. Vincent and Binkley (1991) note that stumpage prices (e.g., the prices of harvested logs at the stand) have a crucial role to play in the interrelated dynamics of timber reserve depletion and processing expansion, particularly in facilitating the transition of the forest sector from dependence on old-growth to secondary-growth forests and in coordinating processing capacity with timber stocks. Unfortunately, in most developing countries, stumpage prices tend to be administratively determined rather than set by the forces of supply and demand, thus understating stumpage values and failing to reflect increasing scarcity as old growth forests are depleted. A number of economic and environmental distortions result:

- Old-growth forests are depleted too rapidly;
- Forest land is inappropriately cleared for agriculture or other uses;
- Inadequate and inappropriate investment is made in second-growth forests;
- Inefficient processing facilities are installed;
- Decisions on log and lumber trade policies are inefficient and encourage unsustainable management practices;
- Elaborate and counter-productive capital-export controls are needed to ensure that resource rents are not repatriated.

Binkley and Vincent (1991) explore three case studies of long-term forestry policy and development: logging in Peninsular Malaysia which is mainly of old-growth tropical forests, in Ghana which logged over most of its old-growth tropical forest but has poorly developed its secondary forest and in Chile which produces timber mainly from second-growth (e.g. plantation) temperate forests. In Malaysia, wood prices - timber charges, log prices and sawnwood prices - have been kept artificially low at every stage of forestry development, from log exporter to exporter of primary products to embryonic exporter of downstream products. The result has been the development of processing capacity that exceeds the forests' sustained yield capacity. Like Malaysia, Ghana has shown little success in establishing plantations as an alternative source of timber to the natural forest. Artificially low royalty rates for natural forest timber mean that concessionaires' incentives to invest in plantations is limited, and at the same time, through its impacts on delivered log prices has helped encouraged the overexpansion of domestic processing capacity. In contrast, in Chile the crucial policy issue has been how to build up an efficient industry based on the nation's increasing supply of timber from privately owned plantations (mainly of *Pinus radiata*). Initial success seems to have come from providing private investors with secure, long-term

tenure for plantations and additional planting incentives. Another key policy has been to permit the export of logs, which forces domestic mills to pay world prices for sawlogs, pulpwood and woodchips and to be more efficient.

Improper policies also have an impact on timber forest management and its environmental effects in industrialized (OECD) countries. Logging fees or royalties for timber harvested from public lands are also based on administrative pricing. The standard calculation is to take the short-run derived demand lumber price at the mill minus harvest, extraction and (log to lumber) conversion costs in order to determine the royalty (Hyde and Sedjo 1990). Such pricing methods are not related to long-run 'user' costs or environmental values, and in many instances do not even approximate market and economic scarcity values for timber.
For example, in Australia state forest agencies generally set timber harvesting royalties by administrative means, which are then negotiated with individual buyers as part of a package that includes processing commitments. The royalties are usually adjusted in the short term in line with changes in inflation, and in the long term in line with changing market conditions. A recent study compared the resulting administrative royalty pricing in the 1980s with market-derived prices. The study indicated that processors were prepared to pay 49 to 74 percent above royalty levels for low-grade logs, 34 to 48 percent extra for medium grade logs and 27 to 40 percent extra for higher quality logs. Old-growth forest hardwood sawlogs and softwood sawlogs were generally priced below market price; pulplog royalties were found to be both above and below market price (Resource Assessment Commission 1991).

As outlined by Wibe (1991), other problems also exist with regard to ensuring that private investors and concessionaires in OECD countries produce timber at a long-run privately efficient level. First, markets for forest land in these countries are far from perfect and free, preventing any investment in forestry from being fully capitalized through selling the standing timber or planted stand. For example, in the Nordic countries, Germany and France restrictive regulations exist on the market for forest lands. In addition, regulations on the buying and selling of forest land usually imply large transaction costs, especially when holdings are small, which is normally the case. The result is that private forest owners tend to invest too little in regeneration and/or reforestation. Secondly, concerning publicly owned forest lands in OECD countries, the major problem is in securing efficient contracts with private forestry activities. For example, in Canada, where 11 percent of forest land is owned by the federal government and 80 percent by the provinces, provincial governments sell licenses to private concessionaires for 20-50 year periods. They usually have the right to harvest the area once, with some restrictions on maximum annual cuts. Concessionaires can also obtain volume licenses that allow them the right to harvest a certain volume of timber in an area. However, such contracts often exclude any regulations of long-term damage and degradation of the stand or of any environmental impacts. Nor are these values incorporated in the license fee, which is usually set very low, and in some areas, close to zero.

Subsidies in OECD countries, particularly for plantation establishment, are now recognized to have direct and indirect environmental impacts, as several case studies have revealed (Jones and Wibe 1992; Wibe 1991). For example, in Sweden subsidization of forest land drainage to increase timber production has led to the loss of over 30,000 ha of wetlands annually. In the United Kingdom in the 1980s, tax concessions on afforestation were increased but not for the purchase of land. Investors therefore had an incentive to minimize land purchases and increase their tax shelters by locating coniferous plantations on land of

poor or negligible agricultural value, such as wetlands, heath, moorland, but which have high environmental value as natural wildlife habitat and for other amenities. The tax concessions were repealed in 1990, although they have been replaced by direct afforestation grants to farmers.

The long-run economic effects of subsidizing forest plantations may also have indirect environmental impacts (Jones and Wibe 1992; Wibe 1991). If such subsidies lead to more afforestation on agricultural or wild lands, then the expansion in supply could reduce prices and profitability. In Italy, this has caused skilled owners of established plantations to be replaced by less skilled 'new' (and subsidized) owners, with implications for productive efficiency and timber stand management over the long term. In the United States and Germany, state intervention has facilitated below-cost sales by public forest companies, reduced profitability for the whole sector and discouraged private investment. The result is inefficient forest management and sub-optimal levels of exploitation. In Spain, the non-priced environmental benefits of traditional forestry systems of holm and cork oak woodlands in the Dehesa regions have led to underinvestment in private holdings; however, public intervention has been to plant conifers, poplars and eucalyptus, which have altered the characteristics of plantations in these regions and actually increased local environmental degradation.

5.4 Conclusion

This section has argued that domestic market and policy failures have important implications for the forestry sector and its environmental impacts. Obviously, forest production for both international markets and domestic consumption is affected. However, as many timber products are essentially *tradeable*, in that they are either exportable goods or essentially serve as import substitutes,[15] then the impact of the domestic market and policy failures on the timber trade and its environmental effects may be more extensive than first appearances suggest.

If public policies are to be re-directed to achieve efficient and sustainable management of timber reserves, then major changes are required. Economic valuation of the impacts of current policies on timber management and the environment is essential for determining the appropriate policy responses. Often, however, insufficient economic data and information exist to allow precise estimation of the economic costs arising from domestic market and policy failures. Although in most cases cost estimates as orders of magnitude and indicators of the direction of change are sufficient for policy analysis, in many cases we are not even at this state of 'optimal ignorance' to begin designing appropriate policy responses (Barbier 1991).

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[15] Strictly defined, a *traded* commodity is a good whose production or consumption will affect a country's level of imports or exports at the margins. In addition, a *potentially tradeable* commodity is a good that may not be currently traded but which ought to be if the country adopted optimal trade policies (Squire and van der Tak 1975). This latter category would include domestically consumed timber products that benefit from prohibitive tariffs or quotas and for which the marginal cost (at full opportunity cost) of increasing domestic production exceeds the cost of importing.

Some general observations are worth noting, however. First, as Section 3 indicated, domestic market and policy failures also have a major influence on the conversion of forest land to agriculture and other uses. As this is the single largest cause of deforestation in the world, addressing only the domestic market and policy failures that directly affect the forestry sector will by no means be sufficient to halt deforestation and forest degradation in most countries. Second, as discussed in Section 4, the incentives for sub-optimal use of timber resources may not be linked to domestic and market policy failures alone, but may also stem from distortions in the international timber trade itself, which arise either through trade restrictions and policies imposed by importing and exporting countries or through the failure of the international timber market to account for the 'global' externalities related to timber production. Finally, other countries involved in the timber trade - mainly importing countries - may increasingly pursue 'active' trade intervention policies as a means of coercing producer countries to 'correct' domestic market and policy failures that the importers feel are exacerbating the environmental impacts of timber production and trade.

The following sections examine in more detail the last two policy issues concerning the timber trade.

6. Environmental Effects of Timber Trade Policies

Global timber trade policies, such as protectionism or export subsidization, may affect forest resource use and related forest degradation. Protection of forestry or forest-based industries may be explicit or implicit. Tariffs and quotas on imported forest products, or manipulation of nominal exchange rates, may provide direct protection of domestic forest industries, leading to higher and possibly unsustainable levels of exploitation than would occur under a more liberal trade regime. Implicit protection may also be afforded via subsidies or product standards that discriminate against imported products, with similar effect on the management of forest resources. 'Liberalization' of the timber trade, either by a single country or a group of countries, may in some cases reduce excessive environmental degradation associated with timber exploitation, but in others, may exacerbate the problem.

The following section explores some of these issues with regard to barriers to the trade in timber products faced by developing countries, the use of timber export taxes and bans as a means of encouraging forest-based industrialization and the potential impacts of trade liberalization.

6.1 Timber Trade Import Barriers and Developing Countries

Bourke (1988) has conducted a study of the implications of timber trade barriers for developing countries. Average trade weighted tariff rates for all wood and wood product imports into developed market economies are around zero for wood in the rough, and since the post-Tokyo Round (i.e., after 1979) of GATT negotiations have declined from 2.4% to 1.7% for primary wood products and from 7.8% to 5.7% for secondary wood products. However, tariff rates for the major developed country markets clearly differentiate between imports from developing countries and other producers (see Table 6.1). Developing

countries on average face the lowest level of duties, due to the range of special preferences they are eligible for, particularly special rates under the UNCTAD Generalized System of Preferences (GSP) scheme. There is also the tendency for tariffs and the rates of protection to escalate; that is, they are lowest on unprocessed products and rise with increased processing. On the other hand, import tariff levels for wood products appear to be even higher in developing countries, and are also subject to escalation.

Nevertheless, the degree of tariff escalation between raw log and processed timber products has considerable implications for developing countries. The higher relative tariffs for processed products clearly restrict the ability of these countries to develop their own value-added processing capabilities. The traded products particularly affected by tariffs in developed country markets are plywood, some size and species of sawnwood, reconstituted panels and some wood manufactures. Some paper and paper products also display high tariff rates. For example, the cost advantage of plain plywood processing in Indonesia, Sabah, West Malaysia, the Philippines and Singapore over that in Japan ranged from 9 to 39% in 1980; however, when the Japanese 20% import duty was included, this cost advantage dropped significantly and was actually negative for Indonesia and Singapore. Another study estimated that in 1975 African timber producing countries had a cost advantage over European producers of plywood which ranged from 7 to 33% (Bourke 1988).[16] Many of these tariff barriers for timber products faced by developing countries are reinforced by additional non-tariff barriers, such as health, safety and technical standards, anti-dumping and countervailing duty investigations, and import licensing schemes.

Unfortunately, it is extremely difficult to determine what the environmental effects of such trade barriers might be in developing countries. One argument is that, by deterring value-added processing by timber-producing countries, trade barriers are preventing efficient forest-based industrialization. World prices for raw logs are kept artificially low, further exacerbating the disparity between stumpage prices and the real economic scarcity value of logs. The result is that old growth forests are logged excessively, and the transition of the sector from dependence on old-growth to second-growth forests and in coordinating processing capacity with timber stocks is not made.[17]

However, there are complications with such an argument. As pointed out by Bourke (1988), although developing countries as a group have comparative advantage in simply worked wood and wood manufactures, and possibly veneer and plywood, it is not certain that the timber-producing developing countries within this group would necessarily have the comparative advantage in producing all these products. For example, newly industrialized countries (NICs) that have no or negligible production forests, such as Taiwan, South Korea and Singapore, currently have a greater comparative advantage in more advanced processed

[16] Bourke (1988) also points out that cost advantage in these cases does not necessarily imply comparative advantage. For example, in the comparison of plywood processing in the Asian developing countries as opposed to Japan, the primary cost advantage appears to be in the costs of logs, which were clearly affected by export controls and taxes in the developing countries that discriminate against the export of raw logs in order to encourage domestic processing. However, as discussed below, one reason why developing countries implement such restrictions may be to compensate their domestic processors for these import barriers they face in exporting to foreign markets.

[17] For further discussion on this point see Section 5, and Binkley and Vincent (1991).

products, such as plywood and veneer. Thus current import barriers may be discriminating more against the NICs rather than the timber-producing countries. There may be a knock-on effect of discrimination against the NICs onto the timber-producing countries, but the magnitude of this impact is difficult to determine. The ultimate impacts on forest management and its environmental impacts of both the first-order and second-order effects of timber trade import barriers are therefore hard to discern. The situation is further complicated by the extensive use of non-tariff barriers to processed timber imports from timber developing countries. Bourke (1988) found substantial evidence that such barriers are restricting trade from the log producing countries. However, the effects of non-tariff barriers on trade flows is difficult enough to analyze, let alone the impacts on forest degradation.

In addition, the timber trade has been subject to severe distortions by export restrictions imposed by log producing countries. One justification cited by timber-producing countries for imposing such export restrictions is that they compensate for the import barriers in developed economy markets by making the price of raw logs higher to the processors in the importing country while reducing the cost disadvantage faced by domestic processors within the timber producing countries. Whatever the reasons for the export restrictions, they are an additional source of distortion in the timber trade, which make isolating the impacts of import barriers on trade flows and forest degradation more difficult. It is worth exploring the implications of these export policies in developing countries in more detail.

6.2 Timber Trade Export Restrictions and Developing Countries

Timber export taxes, controls and policies are currently being used by some log-exporting developing countries to encourage forest-based industrialization and, as discussed above, to 'compensate' domestic processors for discrimination faced in developed country markets. In the past, export taxes were used primarily as a means to raise revenue from the export of wood in rough. Although there have always been difficulties in administrating and collecting export taxes on logs, they were generally higher than stumpage fees and generated more government revenue (Gillis 1990; Repetto and Gillis 1988; Grut, Gray and Egli 1990).

Gillis (1990) has reviewed the role of export taxes and bans in encouraging forest-based industrialization. Initially, the preference seems to have been for export taxes, through employing escalating rates. For most tropical forest countries, export tax rates on logs generally ranged between 10 and 20%. Export taxes on sawn timber, veneer and plywood have been negligible. Where sawn timber exports were taxed, rates were typically half that of logs. This strategy proved only moderately successful in achieving the desired results; for example, although expanded processing capacity was established in Malaysia, the Philippines and Indonesia, it was achieved at high economic costs, both in terms of the direct costs of subsidization as well as the additional costs of wasteful and inefficient processing operations. In addition, as a long-term forest industrialization strategy, it may prove difficult to ensure export sales of processed products through denying processors in other countries access to logs (Bourke 1988). Importers have been known to substitute other raw materials (e.g., cement, steel, plastics, fibreboard, etc.) for timber, and alternative sources of supply, such as softwoods from temperate regions or from other log-producing developing countries, can become available. For example, the effect of log bans in most South American countries was reduced by Chile abandoning its controls in 1975 and expanding log export; and in

response to greater restrictions from Asian log producers, Japan has partly compensated by finding other hardwood suppliers and substituting softwood logs.

In Indonesia, the *ad valorem* export tax on logs was doubled from 10 to 20% in 1978, while most sawnwood and all plywood were exempted. Beginning in 1980 controls on the export of logs were progressively enforced, until an outright ban was introduced in 1985 (Gillis 1988). The export tax structure created effective rates of protection of 222% for plywood manufacture, and the drop in export revenue to the government from diverting log exports was not compensated by any gain in value-added in sawmilling, resulting in a loss of US $15 per m^3 at world prices. The consequence has been the creation of inefficient processing operations and expanded capacity, with consequences for the rate of timber extraction and forest management.[18] Gillis (1988) has estimated that over 1979-82, due to the inefficient processing operations resulting from this policy, over US $545 million in potential rents was lost to the Indonesian economy, or an average cost of US $136 million annually. Moreover, as the switch from log to processed exports occurred at a time when forest product prices were falling sharply in real terms, the cost to the economy in export earnings was high. Over 1981-84, the net loss in export earnings amounted to US $2.9-3.4 billion, or approximately US $725-850 million annually. Additional losses were also incurred through selling plywood below production cost, which amounted to US $956 million in 1981-84, or US $239 million annually (Fitzgerald 1986).

Although the switch to value-added processing of timber initially slowed down the rate of timber extraction, the inefficiencies and rapidly expanding capacity of domestic processing may actually increase the rate of deforestation over the medium and long term.[19] With favourable export trends predicted, Indonesian log production is now constrained solely by the capacity of domestic processing. Existing installed capacity of the sawmill industry is 15.3 million m^3, and of the plywood industry 6 million m^3. With a 54% conversion rate for sawn logs and a 43% rate for plywood, this suggests a maximum annual demand for logs of 42 million m^3. If as predicted, plywood production expands to 8 million m^3 by 1995, total log demand could reach almost 47 million m^3 per year. In comparison, official statistics suggest that total log production had peaked, before the ban, at around 25.3 million m^3 - although some estimates put this figure closer to 31 million m^3. Although current capacity utilization of sawmills is only 60% and of plymills 70%, this implies that current log demand is already close to 27 million m^3, and will rise - assuming no change in utilization - to almost 32 million m^3 in 1995 (Barbier 1987). In addition, the high rates of effective protection to domestic processing has led to major operational inefficiencies and thus the lowest conversion rates in Asia. As a result, for every cubic meter of Indonesian plywood, 15% more stems must be cut relative to plymills elsewhere in Asia that process Indonesian log exports (Gillis 1988). Thus the protection given to Indonesian mills not only may increase rather than reduce total log demand but the gross operational inefficiencies may ensure that millions more logs may be harvested than by a more efficient policy to boost domestic processing capabilities than forced industrialization through export taxes and bans.

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[18] See Section 5 for more details on this relationship.

[19] Barbier (1987) points out that much of the reported decline in log production over the initial period can be attributed to depressed world prices for all timber products, and therefore, is not necessarily attributable to less exploitation because of increased processing activities. There is also a discrepancy between officially reported harvesting levels and rates based on processing industry output.

Gillis (1990) has observed that the use of export tax structures to promote forest-based industrialization has become largely replaced by export bans in tropical forest countries, although export taxes are still being used in certain regions and for specific timber products. Table 6.2 summarizes some of these policies in developing countries. In Indonesia, not only does the export log ban still remain in place, but in October 1989 export taxes on sawn timber were increased to prohibit exports and shift processing activities to plywood.

As discussed above, many log-producing countries see the use of export taxes and bans as the means to compensate domestic processing industries for import barriers faced in developed economy markets. Bourke (1988) has argued that in the face of such barriers, log-producing countries can maintain some degree of cost-competitiveness by either a) continuing with existing discriminatory policies against log exports in order to subsidize delivered log prices to domestic processors, or b) improving the efficiency of processing operations, especially in plant capacity and conversion rates, in order to reduce costs. However, it is clear from the Indonesian case cited above that the use of export taxes and restrictions to encourage processing activities can undermine the efficiency of these activities, with counter-productive consequences for forest management and depletion. Such export trade policy distortions only serve to magnify the negative environmental impacts of domestic market and policy failures in producing countries, as discussed in Section 5.

6.3 Trade Liberalization and Deforestation

Very little evidence exists on the environmental effects of timber trade liberalization - i.e. the removal of either import and/or export restrictions. Anderson (1991) provides a theoretical analysis of the general environmental effects of trade liberalization. Some of the results may be relevant to the timber trade. According to Anderson, a small country exporting a good whose production is relatively 'pollutive', would only gain unambiguously from trade liberalization if it simultaneously ensured that something close to the optimal environmental policy was in place, despite the fact that its environment may be more 'polluted' under a liberal trade regime. On the other hand, in the absence of an environmental policy, trade liberalization can actually worsen a small country's environment, and the gains in trade from liberalization may not necessarily compensate for this welfare loss. In other words, a timber-exporting country that has high environmental costs associated with its timber exploitation would actually gain from trade liberalization (e.g., removal of either export and/or import barriers) only if, as discussed in Section 5, it instigated some of the appropriate timber management and other policies necessary to 'internalize' the environmental costs of its forestry operations. The failure to do so will certainly reduce the welfare gains from trade liberalization, and may mean that additional environmental costs from increased timber product exports through poor management and domestic policies, will not be compensated sufficiently by the increase in export earnings.

A study by Boyd, Hyde and Krutilla (1991) investigates some of the possible connections between broad trade liberalization, i.e. the removal of export restrictions, across the major economic sectors, and tropical deforestation in the Philippines. Preliminary findings indicate that trade liberalization in the Philippines would increase deforestation, and that the effects through industrial logging would be particularly significant. Output and exports in the logging sector increase by 6.5% and 28.5% respectively, while investment and employment

in logging increase by 2.8% and 13.0% respectively. The authors cite as the main reason that the wood-based manufacturing sector, as distinct from the rest of manufacturing, is highly export-oriented and receives no nominal tariff protection. However, as discussed in Section 5, the Philippines has a poor record of *domestic* policy failures affecting timber management and deforestation, including short-term concessions, poor regulatory frameworks and inappropriate pricing policies. For example, Boyd, Hyde and Krutilla (1991) note the production restrictions and log export bans in the Philippines cited in Table 6.2, which are ostensibly to control deforestation, but believe these to be ineffectual. The authors believe that well-enforced restrictions would mitigate some of the logging impacts on deforestation associated with trade liberalization. Improvement in all aspects of forestry policy and timber management to control inefficiencies and environmental costs would clearly reduce these impacts further.

No comparable analysis has been made of the effects of removing timber trade import barriers on deforestation or forest degradation. However, an analysis of the estimated trade effects from a removal of the post-Tokyo round tariffs on wood and wood products in ten major developed market economies has been conducted (Bourke 1988 and NEI 1989). The effects on the imports from developing and developed market economies are indicated in Table 6.3. Two effects are shown. Tariff reduction can lead to *trade creation* through boosting demand through a lower import price. Tariff reduction can also produce *trade diversion*, if the price change causes the relative attractiveness of different timber imports to change, causing importers to switch part of their purchases to other suppliers. The analysis shows that tariff removals may create as much as US$ 150.6 million new exports for developing countries - a 3.3 percent increase - with trade diversion amounting to around US$ 1-3 million. Thus the additional trade created far outweighs any trade diversion. Almost all new trade that would be created for developing countries would involve the EEC, Japan and the United States. For developed market economies, trade creation totals about US$ 731.4 million, or an 8 percent increase. Around US$ 11.8 million would be diverted, mainly in the EEC. Although for developed market economies as a whole the gains from additional trade creation exceed any diversion, Austria, Canada and Switzerland would benefit the most (Bourke 1988).

Similar effects also result from the removal of non-tariff barriers in wood and paper products. For example, imports of these products from developing countries have been estimated to increase over 1980 levels by US$ 638 million into the EEC, by US$ 40 million into USA and Canada, and by US$ 10 million into Japan (Bourke 1988).

In sum, although substantial trade creation could result from the removal of import trading barriers for timber products in developed market economies, it is unlikely that such a complete removal of tariffs would occur. The effects of a more gradual reduction are more difficult to predict. However, the impacts on forest resources and the environment are not easy to determine, and as discussed above, will involve important first and second-order impacts.

6.4 Conclusion

This section has demonstrated that the environmental effects of current timber trade policies can be significant. However, evidence of these effects is extremely scarce. The examples cited in this chapter concern mainly the timber trade of developing countries. Although import barriers in developed market economies are clearly reducing trade flows from developing countries, the environmental implications are more difficult to determine. More significant, perhaps, are the export restrictions imposed by developing countries themselves, which are used both to compensate their own processing industries for the protectionist policies of importing economies, and to stimulate forest-based industrialization. However, in combination with domestic market and policy failures (see Section 5), such export policies are achieving their goals at high economic and environmental costs. Given the pervasiveness of the domestic market and policy failures, 'liberalizing' export regimes in the forest sector of developing countries may not be sufficient to reduce unnecessary deforestation. Removal of import barriers in developed market economies may or may not reduce rates of deforestation in timber exporting developing countries, although the incentives to develop efficient domestic processing in these countries may help to discourage 'over-mining' of old growth forests.

7. Environmental Policies and the Timber Trade

One important and difficult policy question is whether, and under what circumstances, is trade intervention an appropriate instrument of environmental policy. Forests are increasingly being seen as unique global assets, particularly in terms of their role in climate regulation and maintenance of biological diversity. As global concern about the impact of the timber trade on deforestation mounts, there will be increasing calls for international cooperation to preserve these values of the forests and action to control the trade through bilateral and multilateral environmental agreements, as well as unilateral trade regulations and restrictions. Such interventions will clearly have an economic cost. They will only be justified if the benefits of environmental improvement they produce are even greater. In addition to trade policies, domestic environmental regulations can have important implications for industrial competitiveness and trade balances. This issue is becoming increasingly relevant to the timber trade, where the potential trade impacts of environmental policies affecting forestry and forest-based industries can be significant. Already there is talk of compensating timber producing countries, both for abstaining from the trade and for maintaining their forests.

The following section examines in more detail the impacts of domestic and international environmental regulations, policies and agreements on the timber trade, focusing in particular on the trade impacts of domestic environmental regulations, the use of unilateral and multilateral trade policy measures to achieve environmental regulation and the increasing interest in international environmental agreements and compensatory financing for tropical forest management.

7.1 Timber Trade Impacts of Domestic Environmental Policy

The timber industry is directly affected by concession terms which require reforestation or rehabilitation of logged areas. When such conditions are strictly enforced, they can add significantly to the costs of timber extraction. As argued in Section 5, such measures may be necessary to 'internalize' the user and environmental costs associated with timber harvesting. In addition, the forestry sector may be constrained by the creation or expansion of public parks and reserves; by legal protection afforded to certain endangered species of forest plants or animals; or by reservation of forested areas for the exclusive use of indigenous populations. All of these public initiatives can effectively reduce both the scale and the profitability of forestry activities, with obvious implications for trade.

As discussed in Section 5, from a social perspective, the loss of additional timber trade earnings in the short run can be justified, provided that the gains in terms of achieving long-run 'sustainably' managed timber production and improved environmental benefits exceed these costs. Similarly, different forest land use options - whether for timber production, conversion to an alternative use or preservation as a protected area - must be analyzed to determine the relative costs and benefits incurred with each option.[20] In practice, it is rare for any such analysis to be conducted, either *ex ante* or *ex post*, to determine whether a particular environmental regulation or land use option is appropriate. The failure to do so can lead to underestimation of the full production and trade impacts of environmental policies, and can even undermine the objectives of such policies. We illustrate the issues involved by two examples: the establishment of a national park in Cameroon and the trade impacts of environmental regulations on logging in the Pacific Northwest of the United States.

The Korup Project is an on-going programme to promote conservation of the rain forest in Korup National Park in Southwest Province, Cameroon. The area which includes Korup National Park and the neighbouring Oban Park in Nigeria contains one of the oldest and most unique rain forests in the world. The conservation efforts of the Korup Project are seen to be necessary to forestall the wholesale destruction of the natural habitat in the area in the face of persistent land-use pressures, including timber extraction, within both Cameroon and Nigeria. A social cost-benefits analysis (CBA) of the Project was undertaken on behalf of the Government of Cameroon and World Wide Fund for Nature - UK to determine whether establishment of the Park was a viable economic option compared to other uses of the forest, in particular commercial logging (Ruitenbeek 1989).

The results of the analysis are depicted in Table 7.1. The CBA includes not only the *direct* operating and capital costs of the Project but also the *opportunity costs* of lost timber trade earnings (calculated as lost stumpage value) and lost production from the six resettled villages (lost forest use). Against this must be weighed the *direct benefits* of the Project in the form of sustained forest use beyond the year 2010 when the forest would otherwise have disappeared, replacement subsistence production of the resettled villagers, tourism, minimum expected genetic value of the forest resources in terms of pharmaceuticals, chemicals, agricultural crop improvements, etc., and environmental functions - watershed protection of

[20] See Barbier (1990) for further discussion of the methodology employed for such approaches.

fisheries, control of flooding and soil fertility maintenance. Also included are *induced benefits*, agricultural and forestry benefits of the Project's development initiatives in the buffer zone. The external trade credit shows a positive benefit to Cameroon of direct external funding of the project. 'Uncaptured genetic value' is a negative adjustment reflecting the fact that Cameroon will be able to capture only 10% of the genetic value through the licensing structures and institutions which it has in place, and 'uncaptured watershed benefits' indicates that some of the watershed protection benefits will flow to Nigeria and not Cameroon.

Thus the analysis indicates that the Korup Project offers substantial net economic benefits as a land-use option at the project level and to Cameroon as a whole. Although the loss of short-run timber earnings is a cost, they are more than exceeded by the overall benefits of the Project.

In the United States, recent studies have suggested that the combination of environmental and trade restrictions on logging in the Pacific Northwest may have significant impacts on timber flows and prices both domestically and abroad (Flora and McGinnis 1991; Perez-Garcia 1991). Three harvesting restrictions in the region (mainly affecting Douglas-fir) are being implemented almost simultaneously:

- **State-log export ban:** The 1990 Forest Resources Conservation and Shortage Relief Act passed by the US Congress banned the exports of most State-sold logs, with the exception of Alaska and 25% of State-owned timber in Washington).

- **Replanning:** Coinciding with a revised outlook for harvests on private lands, replanning of timber harvests on National Forest lands will cause a substantial reduction in regional harvests.

- **Spotted owl reservations:** Specific geographic zones in the region, mostly on public old-growth forest lands, have been proposed as reserved habitat for the spotted owl. In addition, revised harvest scheduling has been proposed for all forest lands, private and public, considered essential to restoring owl populations.

The spotted owl reservations are clearly an example of an environmental restriction on timber operations in the region; replanning has elements of both a timber and environmental restriction; whereas the log export ban is unambiguously a trade restriction. Flora and McGinnis (1991) have analyzed the incremental and cumulative impacts of these restrictions on domestic and export timber flows and prices for both logs and milled lumber from the Pacific Northwest. Their results are shown in Table 7.2 and indicate substantial impacts on domestic and export trade from environmental restrictions both on their own and in combination with trade restrictions.

In the short run, the decline in domestic harvesting, lumber (sawnwood) shipments and log and lumber exports will be significant, with the addition of spotted owl reservations at least doubling the impacts. The greatest impact of the reservations will be on sawnwood export volumes. Even greater effects will occur on domestic log prices and export log and lumber prices. Replanning and the export embargo are expected to raise these prices by around 25-50%, whereas the addition of the spotted owl reservations on public lands further raises

prices by around one half, and imposing them on all lands effectively doubles these prices. Domestic sawnwood prices are affected similarly, but the impact are less severe. The result could be an export premium for Pacific Northwest logs, increased revenues for log sellers in the region, but a cost-price squeeze on US, and to some extent foreign lumber producers. Moreover, as timber harvests decline, both log and sawnwood exports fall, with a disproportionately greater drop in log exports. Although the export premium will mean that more logs and lumber are exported, foreign importers will respond to higher prices and lower supplies by purchasing both logs and lumber from elsewhere. Thus, over the longer term, the price effects are projected to subside somewhat as both domestic and foreign timber users find ways to substitute for Pacific Northwest supplies. As a consequence, the long-run volume effects on harvesting, domestic supplies and exports will also be less severe.

The wider domestic and global impacts of the trade and environmental restrictions on logging in the Pacific Northwest have been examined by Perez-Garcia (1991). This study considered the effects of environmental legislation in terms of reductions of the volume of timber sold on public and possibly private lands, which may amount to a 44 percent initial loss in timber volume sold. It also examined as a trade restriction the 75% log export ban for Washington State lands, which will increase the domestic supply of logs. The results of the study indicate significant global impacts of the environmental restrictions, both on their own and in conjunction with the trade restriction.

The projected impacts of the environmental restrictions on their own are:

- An increase in sawlog prices around the globe both in the short and long term, led by large increases in the Pacific Northwest region.

- Global sawlog production decreases by 0.4 million m^3 in the short run and 1.2 million m^3 in the long run; however, large falls in the Pacific Northwest and neighbouring regions are somewhat offset by increased production in other US regions, Canada, Japan, Sweden, Finland, Western Europe, Chilie and New Zealand.

- The net short and long term effects of a decline in sawlog production on log consumption by mills is to decrease consumption in both the US West and Inland regions, as well as in major importing countries such as Japan and South Korea. In contrast, more logs are consumed in the US South and Canada.

- In the sawnwood and plywood markets, prices also increase as a result of reduced global supplies in the short and long term. Over the long term, production of sawnwood and plywood decreases in the US West, whereas Canada increases sawnwood exports and the US South increases both sawnwood and plywood exports. Japan is forced to increase imports to replace falls in domestic lumber production.

The effects of combining the environmental restrictions with the 75% export ban for Washington State forests offsets some of the above impacts in the short run for the US West but has cumulative effects on other markets. In the long run (e.g., the year 2000), many of the effects of the trade restriction are overshadowed by the impacts of the environmental restrictions. However, if other log producers such as the Soviet Union or tropical forest countries substantially increase their production and exports to counterbalance the restrictions

in the Pacific Northwest, the impact of the log shortfall on international markets, prices and timber harvesting is reduced. However, the market share of the Pacific Northwest will not only fall as log costs for sawmills and plywood mills increase, but log importing countries will also experience an increase in their log costs. Increased substitution from other timber sources and of non-wood products is expected, as is a general increase in consumer costs globally (Perez-Garcia 1991). On a global scale, the environmental implications of increasing timber harvests in other regions of the world may offset the environmental gains associated with the environmental restrictions in the Pacific Northwest. This will particularly be the case if the expansion of harvesting in the Soviet East and tropical countries proceeds without correction of the domestic policy and market failures and trade distortions outlined in Sections 5 and 6.

7.2 Unilateral Timber Trade Interventions and Environmental Objectives

Stevens (1991) categorizes trade instruments into four main types:

- **Complementary measures** - import and export restrictions implemented in conjunction with domestic environmental regulations and legislation; for example, if domestic timber producers are required to harvest trees sustainably, then restrictions may be imposed on timber imports that are 'unsustainably' produced.

- **Coercive measures** - trade measures used to coerce other countries into adopting good environmental practices, particularly to promote extra-territorial environmental objectives; for example, some countries are considering bans on imports of tropical timber to discourage producer countries from over-exploiting tropical forests.

- **Countervailing measures** - trade measures used to counteract foreign environmental practices that are directly harmful to domestic interests; for example, compensatory subsidies may be extended to domestic forest industries that are 'internalizing' the environmental costs of production but face competition from foreign exporters who do not.

- **Multilateral measures** - trade interventions incorporated into international environmental agreements to achieve environmental objectives, regulate commerce in environmentally sensitive goods, raise compensatory financing and for broader environmental purposes; for example, the International Tropical Timber Organization (ITTO) may urge member countries to place a levy on tropical timber imports to raise funds for producer countries to adopt sustainable forest management practices and policies, and to restrict imports from those countries that do not provide evidence of 'sustainable management' of their timber production.

With the exception of multilateral measures, the trade interventions described above are essentially unilateral, imposed either by one trading nation or a trading bloc. Here, we will discuss mainly the relevance of these latter interventions to the timber trade. Multilateral measures will be discussed in more detail below.

When applied to the timber trade, complementary, coercive and countervailing measures all run the risk of being in violation of GATT rules. However, article XX of GATT does allow some scope for the use of trade interventions for environmental objectives provided that such interventions do not "constitute a means of arbitrary or unjustified discrimination between countries where the same conditions prevail or a disguised restriction on international trade". More specifically, three sub-articles can be invoked on behalf of this exception:

- **Sub-article XX(b)**: allows for trade measures undertaken "to protect human, animal or plant life or health".

- **Sub-article XX(g)**: allows for trade measures necessary to the "conservation of exhaustible natural resources if such measures are made effective in conjunction with restrictions on domestic production or consumption".

- **Sub-article XX(h)**: allow for trade measures undertaken "in pursuance of obligations under any intergovernmental commodity agreement".

The last sub-article clearly allows for multilateral measures, particularly those under the auspices of ITTO on behalf of the International Tropical Timber Agreement (ITTA). Unilateral measures could only be justified on the basis of Sub-articles XX(b) and (g). Obviously, interpretation of these rules for specific case is required. Essentially, where a country needs to treat timber imports differently than it does domestic goods in support of a regulatory scheme, these two sub-articles may be invoked, provided the measure is not unjustifiably discriminatory nor intended to inhibit trade.

Sub-article XX(g) does allow some latitude for unilateral trade restrictions in support of "conservation of exhaustible natural resources", which may be increasingly invoked for intervention in the timber trade. So far, rulings by GATT panels have involved fairly narrow interpretations of this sub-article. For example, attempts by the United States to impose a ban on tuna imports from Canada in 1979 and on imports of yellowfin tuna and tuna products from Mexico in 1990 were both invoked with reference to sub-article XX(g). In its case against Canada, the US argued that tuna was an exhaustible and over-exploited resource; the prohibition was not discriminatory in that similar measures had been taken for similar reasons against imports from other countries; the action was taken in conjunction with measures aimed at restricting domestic production or consumption although not specifically against albacore tuna; and the measure was related to conservation of tuna in that it was taken to prevent threats to the international management approach that the US viewed as essential to the conservation of tuna stocks. However, the GATT panel ruled that the ban could not be justified under Article XX(g) because the United States had imposed the ban against imports of all tuna and tuna products, whereas restrictions on domestic catch had to dat been applied only to specific tuna species (Grimmett 1991). Similarly, the US embargo of all yellowfin tuna and tuna products harvested with purse seine nets in the eastern Pacific Ocean by tropical foreign nations was justified in terms of the need to protect Pacific dolphins. However, the GATT panel recently upheld Mexico's complaint that such an action was discriminatory.

There is considerable debate as to whether similar environmental controls, such as a ban on tropical timber imports, are compatible with GATT sub-article XX(g). Hewett, Rietbergen

and Baldock (1991) argue that a Dutch policy to ban imports of non-sustainably produced tropical timber could comply with the sub-article if a) restrictions on domestic consumption of tropical timber were introduced (e.g., in construction or furniture); b) the controls were applied strictly in line with the criteria of sustainable management of production, and avoided discrimination between countries on other grounds; c) the reasons for the ban were made explicit, allowing sustainably produced timber unrestricted entry; and d) if the ban can be justified and explained in terms of conserving tropical forests. However, others are more pessimistic, and expect any import ban or other environmental control on the timber trade not only to be unacceptable under recent GATT rulings, but in the case of the Netherlands or the United Kingdom adopting a unilateral policy, also to contravene EEC legislation (Arden-Clarke 1991; Dudley 1991a).

Recent calls for broadening the objectives of the GATT to further the use of trade interventions for environmental policies will, if successful, open the door to a whole host of unilateral timber trade measures. For example, Arden-Clarke (1991) has argued that the GATT should be amended to allow any of the 'external' environmental costs of production to be considered essentially an environmental 'subsidy' for any output that is subsequently exported. Thus GATT should be amended to allow contracting states to:

- discriminate between like products that vary in the degree to which the environmental and resource costs of their production are incorporated in their price;
- protect domestic industries that internalize more of their costs than foreign competitors, with import tariffs or export subsidies; and,
- provide subsidies to maintain the competitiveness in international markets of exported products with greater cost internalization than competing products.

Such an approach would clearly allow nations to invoke the full range of complementary, coercive and even countervailing measures available to them for intervention in the timber trade. For example, in the case of the US environmental restrictions imposed on Pacific Northwest logging discussed above, the US government would be able to limit timber imports from other countries that did not maintain similar environmental standards for their timber operations. Alternatively, the US could choose to subsidize plywood and lumber mills in the region and elsewhere in the country for their loss of 'international competitiveness' as a result of the environmental restrictions. In addition, any importing country or trading bloc could impose trade sanctions on producer countries that appeared to be producing timber or timber products 'unsustainably', particularly as the result of the type of policy failures described in Sections 5 and 6.

Whether a broadening of the GATT rules is achieved or not, some countries and trading blocs are adopting stringent interventions in the international timber trade on environmental grounds. The most likely measure is a ban on imports of tropical timber that is not 'sustainably' produced. For example, the Netherlands has recently declared a policy whereby from 1995 (or earlier if the 1993 evaluation shows this to be feasible) all tropical hardwood imports must originate from countries where logging is subject to national/regional long-term forest management plans, and where adequate provision has been made for the protection of largely virgin rainforests, and for the conservation and sustainable management of other

forests (Government of the Netherlands 1991). In bilateral consultations and international fora (e.g., the EEC, ITTO and the FAO Tropical Forest Action Plan), the Netherlands will also seek agreement to adopt the same approach and assistance in achieving this objective through, for example, an international labelling system to distinguish 'sustainably' produced timber commodities; protection for species threatened with imminent extinction; financial support to tropical forest countries for the development and implementation of long-term timber production and management plans, and their monitoring and evaluation; and generally accepted guidelines on the granting of and conditions governing timber concessions, and on appropriate monitoring. The Dutch advocate raising the necessary financing for this policy internationally, through an import levy on tropical timber, supplemented by compulsory government contributions in proportion to commercial interest.

The main thrust of the Netherlands' policy is clearly to stimulate complementary actions at the international level, e.g. through the EEC and ITTO. For example, in considering a similar policy for the UK, Dudley (1991a) has suggested that its most important impact would be to send "a clear message both to exporters and to other importing countries regarding the urgency of developing sustainable forestry in the tropics." Nevertheless, there are some important obstacles to such unilateral bans.

First, such bans could be interpreted as *discriminatory*, in the sense that only tropical, and not temperate, timber producing countries would be affected. As discussed in Section 5, there is little evidence to suggest that temperate production of timber is necessarily 'sustainable', yet a ban on tropical timber alone would exclude temperate wood products. This seems particularly misplaced, given that the largest hardwood reserves are in the temperate regions of the United States, Canada and the Soviet Union (see Section 2). On the other hand extension of the ban to all timber products would most likely invite retaliatory action from those developed market economies that produce temperate timber. Developing countries would argue, with some justification, that their ability to retaliate in response to a tropical timber ban is much more limited, which only highlights the discriminatory nature of such a ban.[21]

Second, imposition of a tropical timber ban on the grounds of 'sustainable management' may prove to be *arbitrary* and possibly *unworkable*. As argued by Poore *et al.* (1989), "it is questionable whether one universal definition of 'sustainable management' is useful, because it will lend itself to different interpretations by different interests". Yet, unless there is an international consensus on what is meant by 'sustainable management', it will be left to each nation or trading bloc to determine its own criteria, which may differ markedly. On the other hand, attempts by ITTO to develop guidelines on sustainable management suggest a total of 41 principles and 36 recommended actions covering forest policy, management, and socio-economic and financial aspects (ITTO 1990). Much more work is required on such guidelines by the ITTO and other institutions before they can become operational. Similar problems exist for labelling 'sustainably' versus 'unsustainably' produced products.

[21] The Dutch ban may in particular be accused of protectionism, as at the same time the Netherlands also "seeks to increase domestic timber production . . . The policy may have an indirect impact on the rainforests, since the more self-sufficient the country becomes, the less tropical timber it will need to import. The plan is to increase forest acreage in the Netherlands by 38,000 ha from 1977 to 2000" (Government of the Netherlands 1991, p. 22).

Certification would have to be carried out by an independent body with sufficient standing to win the trust of importers and consumers, and with a reputation of its own which is important enough to guard against corruption. A network of qualified inspectors would be needed to make site inspections and keep careful accounts of the amount of timber coming out of certified forests and plantations, and there would have to be penalties for fraud and negligence (Dudley 1991a). Such an operation clearly requires cooperation on an international scale, which may not be forthcoming if bans are imposed unilaterally.

Third, a unilateral ban may also be *ineffective* in reducing either tropical deforestation or the trade in 'unsustainable' timber. As discussed in Sections 2 and 3, timber production is not the major cause of tropical deforestation, not all (and a declining share) of the tropical timber produced is for export and an increasing share of tropical timber exports is being absorbed in South-South trade. This would suggest that, in response to a unilateral ban imposed by importers, major tropical timber exporters (e.g. in Southeast Asia) may be able to divert some timber supplies to domestic consumption, or to other export markets, fairly easily. For those tropical forest countries where timber exports are not significant, and are not a major factor in deforestation (e.g. Latin America), a unilateral ban - even if imposed by a major trading bloc - would have little impact on timber management or overall deforestation. In fact, a tropical timber ban may encourage acceleration of the kind of distortionary export policies discussed in Section 6. Tropical forest countries could justify this policy by the need to 'compensate' domestic processors for the distortionary impacts of the ban and to 'squeeze' more value added out of their remaining exports. In addition, processed timber products would be more difficult to 'certify' as to whether they have been produced 'sustainably' or unsustainably', facilitating the evasion of the ban.

Finally, a unilateral ban might have little impact on the economic *incentives* for sustainable management at the concession level, and may actually encourage poor management practices. As discussed in Section 5, a host of domestic and market policy failures in tropical forest countries affect the 'internalization' of the user and environmental costs of timber harvesting by concessionaires. Major policy changes in the forestry sector will be required to address these issues, yet by imposing a unilateral ban, an importing country may reduce any political leverage it could have to influence policymakers in producing nations. Thus Hewett, Rietbergen and Baldock (1991) argue that any unilateral ban must be accompanied by 'positive incentives' to producer countries, such as financial aid to facilitate the changes needed to progress towards more sustainable timber management and compensation for short-term losses in export earnings. However, such bilateral transactions do not guarantee that improvements in incentives at the concession level will be forthcoming, unless monitoring, certification and penalties can be strictly and efficiently enforced. Moreover, as an extension of the 'rent capture' argument outlined in Section 5, a bilateral transfer of funds at the *government* level may do little to alter incentives perceived by the *concessionaire* to improve timber management practices; on the contrary, as the concessionaire has to bear the costs of altering behaviour but receives no financial gain, the incentives for high-grading, trespassing

and avoiding taxes and regulations are increased, especially for infra-marginal stems and stands.[22]

It is also conceivable that some 'unilateral' option is also taken at the producer end of the trade. For example, Rauscher (1990) examines in a theoretical framework the arguments put forward by Gillis (1988) and others that, by forming a cartel, tropical timber-exporting countries could both profit from higher prices, as well as have a considerable resource-conserving effect. This view essentially follows from theoretical propositions showing that, under some general conditions, the rate of resource extraction is lower under monopoly conditions (e.g. a cartel) than under perfect competition. However, Rauscher (1990) shows that in the long run the monopolistic solution does not actually differ from the competitive one; only if international compensation payments for forgoing timber exploitation and trade were made would a cartel have a resource-conserving effect in the long run.

7.3 Multilateral Timber Trade Interventions and Environmental Objectives

Mounting scientific evidence suggests that forests may play an important role in global climate regulation. Accelerated deforestation over the past century has been implicated in global warming, changing weather patterns and the rise in mean sea levels. It has also become clear that tropical forests, in particular, harbour a disproportionate share of the world's natural wealth of genetic resources (biodiversity). These resources are of uncertain but possibly significant economic value, not only in terms of their potential uses in agriculture, industry and medicine, but also simply in terms of the value placed on their continued existence by the general public (existence value). Increasing publicity and education about the intricate and fragile ecology of tropical forest areas has led to growing concern for their preservation.

These phenomena imply that standing timber has an important global economic value, which is not captured by producers of forest products and is therefore not reflected in the market prices of these products or their derivatives. Any significant deforestation inevitably results in some destruction of this global value. This *global externality* has been identified as a possible justification for new and/or increased international financial transfers, in favour of nations harbouring large tracts of forest land. The idea is that all nations would benefit from increased efforts to preserve the world's remaining major forested areas. All nations, it is argued, should therefore contribute to *compensate* producing nations for the loss of potential income that they would incur by reducing deforestation, timber sales and conversion of forest land to other uses.

As discussed above, these concerns, as well as the desire to see traded timber produced more sustainably, are the main motivation behind increased multilateral interventions in the timber trade. Perhaps the most important international forum for implementing such measures may

[22] Essentially, in exchange for the financial aid, the tropical forest government would impose additional 'sustainable management' regulations or taxes, which would increase the marginal costs, and decrease rents, to the concessionaire as indicated in Figure 5.2. However, on inframarginal stands and stems, the concessionaire would have an incentive (equal to *bc* in Figure 5.2) to highgrade, trespass and otherwise avoid these regulations.

be the International Tropical Timber Agreement (ITTA), and its executive body the ITTO. The agreement is unique, in that parties to it include representatives of major consumer countries, producer countries, timber traders and NGOs.

The ITTA was negotiated in 1983 and entered into force on 1 April 1985. Its main aims are:

- to promote growth and diversification of international trade in tropical timber and, in so doing, to improve the structure of the international market;
- to increase the transparency of the international market in tropical timber;
- to encourage reafforestation and forest management where tropical timber is used for industrial purposes; and
- to promote the formulation of national policies geared to the continuing use and conservation of tropical forests and their genetic resources.

At the Tenth Session in May 1991, the International Tropical Timber Council (ITTC) unanimously adopted a 'Year 2000 Target' that encourages 'ITTO members to progress towards achieving sustainable management of tropical forests and trade in tropical forest timber from sustainably managed sources by the year 2000' (Decision 3(X) ITTC 1991). Guidelines for sustainable management (see ITTO 1990) were also adopted at the Session, although ongoing work to make these guidelines operational is required. Further analysis is also required of the various policy options available to ITTO in achieving its Year 2000 Target of achieving trade in 'sustainably managed' timber. By adopting this Target ITTO is clearly within GATT rules, as indicated by sub-article XX(h). In addition, similar national initiatives, such as the Dutch policy of requiring all tropical timber imports to be 'sustainably' produced by 1995, may no longer be dismissed as unilateral initiatives, although action could still be taken against the Netherlands for 'jumping the gun' by five years. The Target has major political significance as under the auspices of the ITTA, producer countries, consumer countries and international timber traders have to cooperate in taking practical steps towards sustainable timber management and production.

Strong leadership by the ITTO will be required to meet the Year 2000 Target and avoid the pitfalls of unilateral bans and controls on the timber trade discussed above. However, problems of *workability* (e.g. operationalizing sustainability and labelling), *effectiveness* and *incentives* still remain. A crucial issue may be the role of raising additional revenue both to finance international monitoring and implementation of the Target and to provide compensatory financing to developing countries.

International compensation may be a particularly difficult policy on which to obtain consensus. One study has indicated that a 1-3% surcharge on the tropical timber imports of the EEC, Japan and USA would raise approximately US$ 31.4 to 94.1 million with little additional distortionary effects (NEI 1989). If endorsed by the ITTO, the import surcharge would be within GATT rules, again through sub-article XX(h). A differentiated surcharge could also be imposed so that imports of processed tropical hardwood products face less discrimination than logs, thus reducing existing distortions from escalating tariffs. The funds raised would most likely be transferred to the ITTO for distribution, possibly through specific

projects and programmes. Other forms of collecting additional funds were found by the study to be less desirable.

For example, imposition of an export levy by producing countries themselves has the advantage of directly addressing the forest management systems of those countries, but presents obvious problems of monitoring and evaluating success in achieving sustainable management. If the funds were transferred to ITTO, transaction costs could be high, the same rate would need to be implemented in all producer countries simultaneously, and less funds would be raised than through an import surcharge. A parafiscal tax on all timber sold in consumer countries has the advantages of taxing all kinds of timber equally, including non-tropical products, and of generating large revenues at a low rate of taxation. However, such a tax has complications for external trade policies (e.g., temperate forest countries could claim unfair discrimination) and 'harmonization' of internal tax rates within trading blocs (e.g., the EEC's 1992 Internal Market Strategy). Finally, a voluntary surcharge collected by the tropical timber trade itself could raise funds transferrable to ITTO without requiring additional national legislation. Unfortunately, compliance and effectiveness may be diminished because of the current overcapacity and low net profit margins faced by many international traders and woodprocessing industries; the lack of effective control measures to ensure collection with equal efficiency in all consumer countries; and, the possibility of entry and exit by traders in the industry to avoid payment (NEI 1989).

Amelung (1991) has further explored some of the conditions necessary to ensure efficient international compensation payments, arguing that payments are a better solution to controlling tropical deforestation than trade barriers as they offer the chance to 'internalize' global externalities and improve incentives for management. Moreover, rather than focus exclusively on interventions in the timber trade to finance compensation, Amelung (1991) opts for the establishment of an international rain forest fund, as proposed by UNEP, in order to avoid free-riding among non-tropical countries. To be effective, compensation payments should meet the following criteria:

- To avoid principle-agent problems, i.e. contract default and cheating by tropical forest countries, payments should be made periodically rather than once-and-for-all lump sum transfers. Periodic payments would also facilitate renegotiations, if required.

- Payments should be tied to conditionalities with respect to protecting tropical forest reserves, reform of domestic market and policy failures affecting tropical forests and generally "foster economic activities that do not destroy the regenerative capacity of this ecosystem and the development of the necessary technologies" , which presumably includes sustainably managed timber production.

- Contributions by non-tropical countries should be tied to the per capita GNP of these countries. As all people are affected more or less equally by the global externalities of forest clearing, countries with a larger population are made less well off. In addition, countries with higher per capita GNP tend to have lower marginal utilities of consumption and thus lower discount rates. Since the preservation of tropical forests provides long-term benefits, wealthier nations should have a higher consumer preference for their protection.

Similar arguments are put forward by Sedjo, Bowes and Wiseman (1991), although their preference is for the establishment of a global system of marketable forest protection and management obligations (FPMOs). Under a voluntary global forestry agreement, FPMOS would be distributed to all signatories, probably through criteria based on a mix of GNP levels and forest area. Holders of FPMOs must either a) fulfill the obligation 'on the ground' or b) induce another agent to assume the obligation, presumably in exchange for a payment. Thus countries with large obligations and small forests would have 'excess' obligations and hence be forced to meet these externally. Countries with large forests and small obligations could meet them internally but would then have an 'excess' of forests. They could then be the object of negotiations with countries that had 'excess' obligations. The advantages of such a system are that, while not requiring compliance, it provides incentives for nations to comply out of their own self-interests, as well as achieving the objectives of international compensation; it would ensure that non-tropical forest countries (e.g., mainly industrialized countries) would bear a substantial portion of the costs; and it would not excessively limit production of traditional and commercial forest products. The disadvantages would be the high degree of monitoring required, the need for a 'clearing house' for international trade in permits and the difficulties of negotiating a comprehensive international agreement to establish the system. On the last point, the authors argue for the establishment of a 'transition' system with only a few major industrialized and tropical forest countries involved, and initially limited to mainly bilateral agreements with little trading.

7.4 Conclusion

Domestic environmental restrictions need to be carefully analyzed and monitored to determine their potential impacts on international trade and 'second order' effects on the global environment. It is possible that these latter effects coupled with any additional economic costs may outweigh the intended environmental benefits, thus reducing the net gains from such policies. Similarly, increased calls for both unilateral and multilateral interventions in the timber trade to encourage more sustainably produced timber run the risk of being self-defeating if such policies prove to be discriminatory, unworkable, ineffective and produce perverse incentives. International cooperation under the auspices of the ITTO and other international fora offers a greater likelihood of achieving this objective. As outlined in Section 5, to be successful, new policies must first create the incentives to manage timber stands as long term income-generating assets followed by the correction of environmental externalities by regulation or taxation.

Comprehensive international agreements and compensation mechanisms to deal with the overall problem of tropical (and possibly temperate) deforestation may ultimately eliminate the need to consider intervention in the timber trade. Given that commercial logging is not the primary cause of global deforestation, such approaches would avoid unnecessary, and possibly inappropriate, discrimination against the timber trade. On the other hand, a comprehensive tropical forest agreement would be more difficult to negotiate and raises its own problems of workability and effectiveness.[23]

[23] For a discussion of the inherent problems of negotiating international environmental agreements, see Barrett (1990).

In sum, there are no easy ways forward on these issues. Given that sustainable timber management and tropical forest management are perceived to be 'global' problems, then global, cooperative solutions are required. Multilateral measures, whether involving timber trade interventions or international forest agreements, are the most promising avenues for progress.

8. Conclusion

This paper has examined a number of issues pertaining to the environmental effects of the international trade in tropical timber. We have examined the role of the timber trade and trade policies, compared to other factors, in causing deforestation and environmental degradation, and consequently, the scope of using policy interventions in the timber trade to achieve environmental objectives.

Our findings suggest that the timber trade is not the major source of global deforestation and environmental impacts; not only is the conversion of forests to other uses such as agriculture a more significant factor, but much of timber harvested from the world's forests is for domestic consumption and does not even enter international trade. Nevertheless, there is genuine cause for concern over (1) the 'mining' of old growth forests in some regions of the world to service the trade, (2) the impacts of market, policy and trade distortions on the incentives for timber management and trade, and (3) the consequent failure of many countries to make an efficient and sustainable transition from dependence on old-growth to second-growth forests and to match domestic processing capacity with the economic availability of timber stocks. The crucial relationship - for all countries - is the impact of forestry and wider economic policies on the *incentives* for timber management at the stand, concession and plantation level. Efficient and sustainable timber management requires that proper economic signals be transmitted to timber operators, whether harvesting from private, public, plantation or old growth forest stands, so that they may maximize the *long-run* income generating potential of these forest assets and 'internalize' any environmental externalities associated with timber harvesting.

We also suggest that trade measures may be an extremely 'blunt', and in many instances an inappropriate, tool for eliciting the proper incentives for sustainable timber management. First, substantial distortions already exist at both the import and export end of the timber trade, the environmental effects of which are not very well known. Further interventions to achieve environmental objectives may both compound these uncertainties and prove to have unintended - even counter-productive - effects. Second, domestic market and policy failures have a significant impact on forest management and its environmental implications. Thus, domestic environmental regulations can have substantial effects on timber trade flows and prices. Trade interventions, on the other hand, at best only address these problems indirectly, through attaching 'conditionalities' and providing compensatory financing. Unilaterally imposed trade measures by importing countries would in particular have difficulty in influencing domestic policies within producer countries. Finally, trade measures have their most direct impact on cross-border product flows and prices. As noted above, changes in these international flows may have very little influence on the main proximate causes of deforestation and forest degradation in producer countries. Even for forestry

operations, there may be little effective control on how these 'trickle down' effects influence economic incentives at the timber stand level.

We are therefore extremely cautious over the use of timber trade interventions to achieve environmental objectives. Such interventions could have their role to play in encouraging more efficient and sustainable timber management, but in order to maximize their effectiveness, such policy options should be pursued and endorsed through multilateral cooperation between importing and exporting countries. If combatting global deforestation is the goal, then multilateral measures should focus less on trade interventions and more on designing appropriate international environmental agreements to deal with this problem directly.

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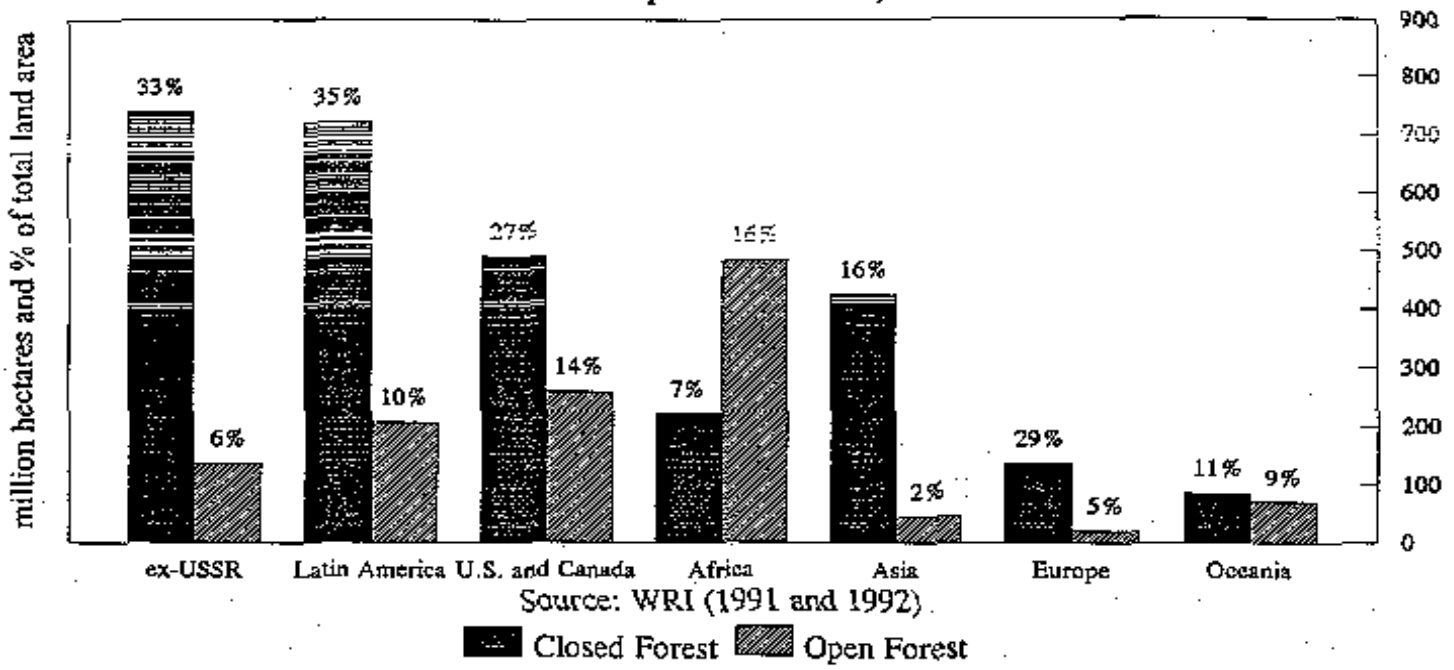
FIGURE 2.1: WORLD NATURAL FOREST RESOURCES

Closed and Open Forest Areas, 1980s

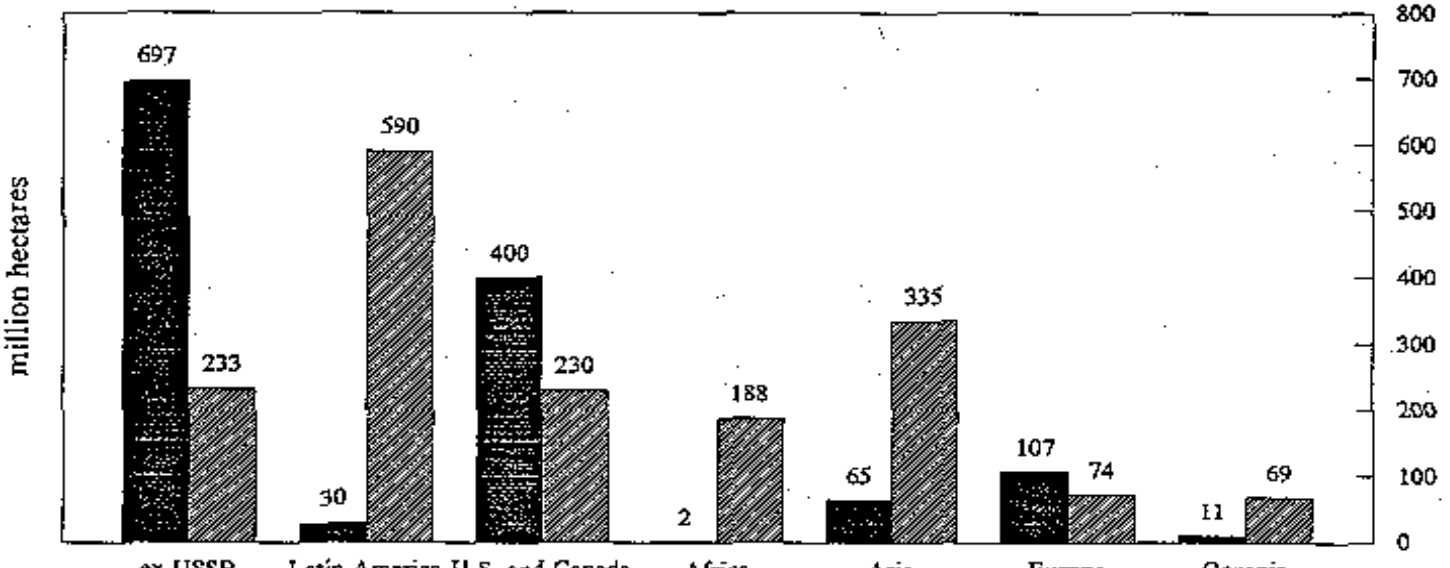


Source: WRI (1991 and 1992)

Closed Forest Open Forest

FIGURE 2.2: WORLD CLOSED FOREST RESOURCES

Land Area by Forest Formation, 1970s-80s



Source: ECE/FAO (1985), Persson (1974)

Softwood Hardwood

Table 2.1: Estimates of Annual Tropical Deforestation

	Closed Forests						All Forests	
Period:	1976-1980		1981-1985		1970-1980s		1981-1990	
Source:	FAO (1981)		FAO (1988a)		WRI (1990)		FAO 1990 b/ (preliminary)	
	000 ha	% a/	000 ha	%	000 ha	%	000 ha	%
Region								
Africa	1327	0.6	1333	0.5	1359	0.6	4800	1.7
Tropical Asia	1802	0.6	1791	0.7	3860	1.4	4700	0.9
Latin America	4119	0.6	4005	0.6	10909	1.6	7300	1.4
Oceania			32	0.6				
Total	7248	0.6	7160	0.6	16128	1.2	16800	1.2
# of Countries covered		76		107		68		62
Selected Countries			As above				As noted below	
Brazil	1480	0.4	1480	0.4	8000	2.2	c/ 1700	0.5
Cameroon	80	0.4	80	0.4	100	0.6	d/ 200	1.1
Madagascar	165	1.6	150	1.5	150	1.5	d/ 200	1.9
Nigeria	285	4.8	0	5.0	300	5.0	d/ 400	6.7
Zaire	165	0.2	180	0.2	182	0.2	d/ 400	0.4
Costa Rica	0		0		124	7.6	e/	
India	143	0.3	143	0.3	1500	4.1	f/ 48	0.1
Indonesia	550	0.5	600	0.5	900	0.8	d/ 1200	1.1
Myanmar	92	0.3	102	0.3	677	2.1	d/ 800	2.6
Philippines	100	1.1	92	1.0	143	1.5	d/ 270	2.8
Thailand /g	325	3.9	245	2.9	397	2.5	d/ 600	7.2
Viet Nam	+D120	0.9	65	0.9	173	2.0	d/ 350	4.6

Notes:

a/ Sources include FAO (1981a), FAO (1981b) and FAO (1981c).

b/ Preliminary estimates for CLOSED AND OPEN forests from the FAO 1990 Assessment (Dember, 1991).

c/ Results of a ten year survey using satellite data by Robert Pereira da Cunha, INPE, Brazil and cited in Agarwal (1991). The range between 1700 and 8000 mn ha for Brazil represents the low and high ranges of recent deforestation estimates. (Note that WRI data for Brazil is for one year - 1987).

d/ Estimates by Myers from Yo (1991) - these estimates are generally regarded as on the high side.

e/ Over one-quarter of Costa Rican land surface is protected. It is generally expected that the remainder of the country will be denuded of forest in the next decade.

f/ Again this is a lower bound value - from a study conducted by the Indian Forest Service on satellite data from 1981-3 and 1985-7. It contrasts strongly with the 1500 mn ha figure from 1975-82.

g/ WRI (1990) figure for Thailand is for CLOSED and OPEN forests.

Table 2.2: Reforestation and Forest Management

Region	All Forests		Closed Forest Area		
	Total Area	Reforested Per year	Total Area	Managed	Protected
	000 hectares				
USSR	928,600	4,540	791,600	791,600	20,000
Latin America	928,021	817	720,941	484	22,375
U.S. and Canada	732,389	2,495	473,673	102,400	31,198
Africa	684,402	355	219,811	2,327	9,434
Asia	491,565	5,708	409,418	48,705	19,417
Europe	158,892	1,031	137,005	74,628	1,732
Oceania	157,669	117	86,322	0	55
World	4,081,538	15,063	2,838,770	1,020,144	104,211

Note: a/ According to WRI reforestation refers to the areas of plantations dedicated to industrial or non-industrial uses, but does not include natural or managed regeneration of old tree crops - although some countries may report such regeneration or reforestation.
b/ Data was unavailable for a large number of countries on the extent of reforestation, managed and protected areas. Thus the total is not representative of the world total per se.

Source: WRI (1990)

Table 2.3: Forest Ownership in Selected OECD Countries

Country	Total Forest Area mn ha	Public			Private		
		National	Other	Total	Farms	Industry	Total
		% of total forest area					
Canada	436	26%	68%	94%	6%	-	6%
US	296	26%	2%	28%	57%	15%	72%
Australia	107	74%	-	74%	26%	-	26%
Sweden	28	19%	8%	26%	49%	25%	74%
Japan	25	31%	11%	42%	58%	-	58%
Finland	23	24%	2%	26%	66%	9%	74%
Turkey	20	100%	-	100%	-	-	0%
France	15	12%	17%	30%	70%	-	70%
Spain	11	6%	29%	35%	34%	31%	65%
Yugoslavia	10	-	70%	70%	30%	-	30%
New Zealand	10	75%	-	75%	19%	6%	25%

Note: Countries selected have over 10 mn ha of forest and woodland.

Source: OECD Environment Committee (1991) and WRI (1990)

Table 2.4a: Volume of World Production and Trade in Forest Products (million cum) 1/

	1961	1970	1980	1990
Fuelwood + charcoal				
Production	1041	1186	1480	1796
Imports	4	3	3	4
Imports as a % of Production	0.3	0.2	0.2	0.2
Industrial roundwood				
Production	1018	1278	1452	1654
Imports	38	93	118	124
Imports as a % of Production	3.8	7.3	8.1	7.5
Sawnwood+sleepers				
Production	346	415	451	486
Imports	41	56	78	95
Imports as a % of Production	11.8	13.6	17.2	19.5
Wood based panels				
Production	26	70	101	125
Imports	3	10	16	29
Imports as a % of Production	12.0	14.4	15.5	23.4
Wood pulp 1/				
Production	62	102	126	155
Imports	10	17	21	25
Imports as a % of Production	16.0	16.3	16.4	16.3
Paper+paperboards 1/				
Production	77	126	170	238
Imports	13	23	34	55
Imports as a % of Production	16.5	18.0	19.9	22.9

Note: 1/ Wood pulp and paper and paperboards in million mt.

Table 2.4b: Value of World Trade in Forest Products (million US$)

	1961	1970	1980	1990
All Forest Products (AFP)				
Imports	6778	14170	62377	123360
Fuelwood+charcoal				
Imports	31	29	122	187
as % of AFP	0.5	0.2	0.2	0.2
Industrial roundwood				
Imports	908	2693	12316	12523
as % of AFP	13.4	19.0	19.7	10.2
Sawnwood+sleepers				
Imports	1841	3020	13952	34395
as % of AFP	27.2	21.3	22.4	27.9
Wood based panels				
Imports	437	1184	5236	10391
as % of AFP	6.4	8.4	8.4	8.4
Wood pulp				
Imports	1316	2650	9777	17341
as % of AFP	19.4	18.7	15.7	14.1
Paper+paperboards				
Imports	2244	4567	20845	48252
as % of AFP	33.1	32.2	33.4	39.1

Source: FAO (1992)

Table 2.5: Exports of Industrial Forest Products, 1990

	Industrial Roundwood	Sawnwood & Sleepers	Wood Based Panels	Wood Pulp /1	Paper Products 1/	Total
All Developed and Developing Countries						
1000 CUM	118154	88406	31179	25027	55218	
US$ million	8964	16920	10135	15817	45268	97104
All Developed Countries						
1000 CUM	84178	78146	17840	22931	51694	
US$ million	6378	14521	5779	14609	42887	84174
N. America						
1000 CUM	31255	46991	5791	13230	17263	
US$ million	3161	6938	1280	8380	10707	30467
Europe						
1000 CUM	26699	24138	10396	7922	31582	
US$ million	1833	6378	4050	5338	29687	47286
Oceania						
1000 CUM	10520	633	379	652	499	
US$ million	502	130	101	256	274	1264
Other developed countries						
1000 CUM	686	55	199	528	1335	
US$ million	36	27	77	267	1675	2082
All Developing Countries						
1000 CUM	33976	10260	13339	2096	3524	
US$ million	2586	2399	4356	1208	2380	12930
Africa						
1000 CUM	4183	909	248	240	7	
US$ million	493	231	104	120	5	953
Latin America						
1000 CUM	5084	2084	987	1630	1323	
US$ million	209	426	317	962	830	2743
Near East						
1000 CUM	117	106	23	0	49	
US$ million	14	20	10	0	30	74
Far East						
1000 CUM	22618	7116	12074	227	2145	
US$ million	1727	1711	3921	126	1516	9001
Other developing countries						
1000 CUM	1975	45	7	0	0	
US$ million	142	12	4	0	0	159

Notes: 1/ Wood pulp and paper products in 1000 MT

Source: FAO (1992)

Table 2.6: Imports of Industrial Forest Products, 1990

	Industrial Roundwood	Sawnwood & Sleepers	Wood Based Panels	Wood Pulp 1/	Paper Products 1/	Total
All Developed and Developing Countries						
1000 CUM	123975	94618	29282	25332	54552	
US$ million	12523	34395	10391	17341	48252	122903
All Developed Countries						
1000 CUM	98428	82653	23360	21342	45446	
US$ million	9639	17242	8246	15067	39705	89898
N. America						
1000 CUM	6898	33961	4838	4499	12647	
US$ million	293	3314	1306	3054	8824	16791
Europe						
1000 CUM	44053	37431	14173	13380	29514	
US$ million	3510	10511	5515	9681	27867	57084
Oceania						
1000 CUM	18	1430	127	279	977	
US$ million	7	372	66	193	949	1587
Other developed countries						
1000 CUM	47316	9636	4114	3034	1598	
US$ million	5802	2992	1274	1999	1350	13418
All Developing Countries						
1000 CUM	25547	11955	5922	3991	9206	
US$ million	2884	17154	2145	2274	8548	33005
Africa						
1000 CUM	897	1802	105	139	584	
US$ million	114	386	53	75	467	1095
Latin America						
1000 CUM	112	2049	335	879	1958	
US$ million	20	300	118	429	1504	2372
Near East						
1000 CUM	1111	3400	1235	139	1052	
US$ million	256	15490	683	93	1737	18258
Far East						
1000 CUM	23425	4588	4221	2833	5588	
US$ million	2493	953	1280	1677	4820	11223
Other developing countries						
1000 CUM	2	116	26	0	24	
US$ million	0	26	11	0	20	57

Notes: 1/ Wood pulp and paper products in 1000 MT.

Source: FAO (1992)

Table 2.7: Forest Products Trade Balance in Tropical Countries (thousand US$) 1/

	Imports 1980	Imports 1990	Exports 1980	Exports 1990	Net Exports 1980	Net Exports 1990
All Tropical Countries 1/						
TOTAL	4194595	6733551	7578144	10801979	3383549	4068428
Tropical Africa						
TOTAL	413330	180062	1231249	815545	817919	635483
Cameroon	11464	35412	167628	99833	156164	64421
Cent Afr Rep	700	468	38036	29994	37336	29526
Congo	1541	4500	84439	106087	82898	101587
Côte d'Ivoire	12155	27200	585996	236147	573841	208947
Eq Guinea	0	0	2248	18700	2248	18700
Gabon	3599	3655	162560	136774	158961	133119
Ghana	3029	5129	38940	76526	35911	71397
Guinea	0	1056	0	800	0	-256
Guinea-Bissau	98	310	130	350	32	40
Kenya	26622	23594	13392	4054	-13230	-19540
Liberia	5809	1942	96187	78264	90378	76322
Madagascar	8716	8546	138	534	-8578	-8012
Malawi	27038	8058	0	1993	-27038	-6065
Mozambique	10900	950	8672	923	-2228	-27
Nigeria	248332	33083	1020	1680	-247312	-31403
Sierra Leone	1130	1028	0	146	-1130	-882
Tanzania	16600	15700	1166	1539	-15434	-14161
Zaire	5648	3666	22162	17032	16514	13366
Zimbabwe	29949	5765	8535	4169	-21414	-1596
Tropical C. and S. America						
TOTAL	1742339	1707796	1122119	1950004	-620220	242208
Belize	3281	3253	1737	2445	-1544	-808
Costa Rica	59545	40020	20901	21895	-38644	-18125
Cuba	204026	193411	0	1847	-204026	-191564
El Salvador	29851	21800	1414	2725	-28437	-19075
Guatemala	99932	69410	22454	18326	-71478	-51084
Honduras	28312	137921	31339	31061	3027	-106860
Mexico	609382	403605	17034	13884	-592348	-389721
Nicaragua	13321	10566	4270	2569	-9051	-7997
Panama	34264	76979	1038	3988	-33226	-72991
Trinidad & Tob	98889	54396	776	458	-98113	-53938
Bolivia	11805	4060	20450	22160	8645	18100
Brazil	274856	299402	864664	1750981	589808	1451579
Colombia	119100	104056	13924	20060	-105176	-83996
Ecuador	93956	157834	27334	24373	-66622	-133461
Fr Guiana	1177	1087	3510	2169	2333	1082
Guyana	6469	7356	6260	2694	-209	338
Paraguay	11524	13055	66451	24971	54927	11916
Peru	37829	104914	6830	2558	-30999	-102356
Suriname	10820	9671	11733	840	913	-8831
Tropical Asia and Oceania						
TOTAL	2038926	4845693	5224776	8036430	3185850	3190737
Brunei Darus	3745	6775	14	30	-3731	-6745
Cambodia	1885	100	173	94	-1712	-6
Hong Kong	564560	1752273	63749	705535	-500811	-1046738
India	204965	290967	26258	16337	-178707	-274630
Indonesia	155288	330157	1879402	3069199	1724114	2739042
Laos	816	200	10900	10251	10084	10051
Malaysia	191627	483372	1987252	3040884	1795625	2557512
Myanmar	9770	4721	119335	148084	109565	143363
Philippines	85309	173662	482286	123119	396977	-50543
Singapore	545109	747548	526980	663302	-18129	-84246
Sri Lanka	37742	28771	6464	600	-31278	-28171
Thailand	199553	1002371	27963	101551	-171590	-900820
Yemen	19903	10499	29	29	-19874	-10470
Fiji	8824	7804	5968	22775	-2856	14971
Papua N Guinea	8600	5504	70857	115500	62257	109996
Solomon Is	979	767	16538	17240	15559	16473
Vanuatu	251	202	608	1900	357	1698

Notes: 1/ Tropical countries are taken here to be countries with the majority of their land mass lying between the tropics. The term forest products includes industrial and non-industrial wood products and is based on the FAO definition given in the front of the FAO Yearbook (1992). Only those tropical countries that exported forest products in 1990 are included in this table.

Source: FAO (1992)

Table 2.8a: Production and Trade in Forest Products by Tropical Forest Countries (thousand cum) 1/

	Production 1990	Exports 1990	Imports 1990	ADC 1990
All Tropical Countries				
Industrial Roundwood	257587	28705	4318	233200
Sawnwood	72584	8719	4841	68705
Wood-based Panels	18483	12818	1891	7556
Tropical Africa				
Industrial Roundwood	41687	3959	40	37768
Sawnwood	6598	814	235	6019
Wood-based Panels	1108	243	66	931
Tropical C. and S. America				
Industrial Roundwood	95697	172	95	95620
Sawnwood	26641	1032	1557	27166
Wood-based Panels	4289	833	296	3752
Tropical Asia and Oceania				
Industrial Roundwood	120203	24574	4183	99812
Sawnwood	39345	6873	3049	35521
Wood-based Panels	13086	11742	1825	3169

Table 2.8b: Forest Product Exports as a Percentage of Production in Tropical Countries (%) 1/

	1961	1970	1980	1990
All Tropical Countries				
Industrial Roundwood	15.6	27.1	18.2	11.1
Sawnwood	15.3	17.3	16.2	12.0
Wood-based Panels	34.0	33.0	32.5	69.4
Tropical Africa				
Industrial Roundwood	23.8	23.3	16.3	9.5
Sawnwood	32.1	28.5	12.7	12.3
Wood-based Panels	34.0	33.0	28.6	21.9
Tropical C. and S. America				
Industrial Roundwood	1.6	1.0	0.2	0.2
Sawnwood	14.7	13.6	6.9	3.9
Wood-based Panels	34.0	33.0	15.3	19.4
Tropical Asia and Oceania				
Industrial Roundwood	22.2	44.2	33.4	20.4
Sawnwood	11.9	18.5	24.5	17.5
Wood-based Panels	40.5	39.9	49.4	89.7

Notes: 1/ Tropical countries are taken here to be countries with the majority of their land mass lying between the tropics.

Source: FAO (1992)

Table 3.1: Commercial Forests: Growing Stock and Efficient Use of Timber Resources

	Growing Stock	Annual Net Increment	Efficiency in Usage:		
	1980-85 average	1980-85 average	1950s	1970s	1980-85 average
	cum/ha	cum/ha/yr	annual growth/total harvest		
Countries					
Canada	74	2	na	na	2.1
USA	109	4	1.7	1.8	1.7
Japan	106	3	na	na	1.9
Australia	64	1	na	na	2.6
New Zealand	151	15	na	na	1.2
Austria	274	6	0.7	1.2	1.3
Belgium	148	8	0.9	0.8	1.6
Denmark	141	5	1.1	0.9	1.3
Finland	86	3	1.1	1.0	1.2
France	120	4	0.9	1.3	1.6
Germany a/	224	6	0.7	1.0	1.0
Greece	73	2	1.0	1.1	1.4
Ireland	102	7	1.5	4.5	3.2
Italy	154	3	1.0	1.2	1.3
Luxembourg	249	4	0.8	1.6	1.5
Netherlands	103	4	0.8	1.0	1.1
Norway	83	3	1.2	1.6	1.6
Portugal	90	4	1.0	1.1	1.1
Spain	68	4	na	1.5	2.1
Sweden	101	3	1.3	1.0	1.4
Switzerland	364	6	1.1	1.1	1.1
Turkey	58	3	na	1.0	1.0
United Kingdom	108	6	0.7	1.5	2.3
Yugoslavia	138	4	0.4	0.9	1.4
Totals					
North America	89	3	na	na	2.0
OECD Europe	114	4	na	na	1.4
OECD	93	3	na	na	1.9

Notes: a/ includes western Germany only

Source: OECD (1991)

Table 3.2: Timber Harvesting and Deforestation in African ITTO Producer Countries, 1981-85

Country	Area Logged a/	Area Logged Deforested b/	Unlogged Area Deforested c/
		000 ha	
Cameroon	272.0	75.0	3.0
Congo	57.0	20.5	1.5
Cote d'Ivoire	330.0	290.0	d/
Gabon	150.0	15.0	d/
Ghana	na	22.0	na
Liberia	104.0	44.0	d/
Total	> 913	466.5	> 4.5

Notes: a/ total average area selectively logged per annum
b/ estimated area of a/ subsequently logged
c/ unlogged area deforested per annum
d/ unknown but small

Source: E.B. Barbier et al. (forthcoming)

Table 3.3: Financial versus Social Profitability: Logging in the Philippines

	Financial Gain a/	Social Gain Model 1 b/	Social Gain Model 2 c/
Volume extracted (cum) d/	2.86	2.86	2.86
Market price of logs (per cum)	2000	2200 f/	2200 f/
		Pesos/ha/yr	
Value of log harvest	5720	6292	6292
Road building, harvesting and transportation costs	-2369	-1895 g/	-1895 g/
Financial Returns e/		3351	
Cost of protection, timber stand improvement and enrichment planting		-1000 h/	-
Cost of depletion		-	-19592 j/
Cost of marginal offsite damage to downstream activities		-6245 i/	-12741 k/
Value of subsistence farming crops		-	2100
Net Economic Gain		-2848	-25836

Notes: a/ Legal operations using existing selective logging systems assumed. Private profits of illegal operators will be higher. Different combinations of yield and price are possible to capture the variations in the quality of standing forest.
b/ Model 1: old growth forest selectively logged and subsequently protected.
c/ Model 2: old growth forest selectively logged and subsequently not protected.
d/ One hectare of old growth forest of 30-50% slope sustainably yielding 100 cum every 35 years or 2.86 cum per year.
e/ be shared by the government through forest charges and environmental fees under existing regulations. Does not contain the cost of mandatory reforestation (P10,000/ha every 35 years).
f/ equal to market price adjusted upwards by 10% to account for low cost illegal supplies.
g/ standard conversion factor 0.8 applied.
h/ P1,000/ha for one year to ensure sustainability of production on the one hectare in question.
i/ P2,600 for 3 years discounted at 12%. Off-site damage assumed to be limited in duration instead of being sustained in perpetuity.
j/ loss of the gain from timber production on one hectare in perpetuity in the absence of protection, i.e. P2,351 (P3351 - P1000) discounted at 12%.
k/ P3,100 for 6 years discounted at 12%.

Source: Paris and Ruzicka (1991)

Table 3.4: Cost-Benefit Analysis of Logging in Malawi

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
	in thousands of Malawi Kwacha										
Total Benefits	30672	34674	38815	43116	48372	51093	54301	57613	60811	64525	68153
Wood harvest	27786	28804	29864	30967	32421	33113	34235	35402	36397	37848	39156
Crop value	2886	5870	8951	12149	15951	17980	20066	22211	24414	26677	28997
Total Costs	64021	64418	64830	65256	65763	66033	66311	66597	66891	67193	67502
Wood replacement	63636	63636	63636	63636	63636	63636	63636	63636	63636	63636	63636
Environment cost	385	782	1194	1620	2127	2397	2675	2961	3255	3557	3866
Net Benefits	-33349	-29744	-26015	-22140	-17391	-14940	-12010	-8984	-6080	-2668	651

Net present value at 5% = -143994 % of GDP at 5% discount rate = 3.3%
Net present value at 10% = -122531 % of GDP at 10% discount rate = 2.8%
Net present value at 50% = -52385.8 % of GDP at 50% discount rate = 1.2%

Note: Data for the southern and central regions of Malawi.

Source: World Bank (1991)

Table 3.5: Sources of Deforestation in Tropical Countries, 1981-1988 a/

	Brazil	Indonesia b/	Cameroon	All Major Tropical Countries
Forestry	2 d/	9	0	2 (10) e/
Agriculture	89	80	100	(83) f/
shifting cultivators c/	13	59	92	na
	(23)	(67)	(95)	(47)
permanent agriculture:	76	21	8	36
-pastures	40	0	0	17
-permanent crops	4	2	5	3
-arable land	32	19	3	16
Mining including related industries	<3	<0.3	0	na
Hydroelectricity production	4 b/	0	0	1 b/
Residual g/	2	11	0	(13) h/

Notes: a/ Percentage shares in deforestation refer to averages for the respective period.
b/ Data refer to the 1980-1990 period.
c/ Figures in parentheses show the results of the FAO for 1980. These data include also market oriented farmers who produce cash and export crops and engage only partly in shifting cultivation.
d/ Deforestation due to logging is due to charcoal production.
e/ The figure in parentheses refers to the estimation of EK (1990). The calculation includes only Indonesia and Brazil, since these countries account for the largest share in clear cutting by the forestry sector.
f/ This percentage rate is based on the assumption that the percentage share calculated for shifting cultivators can be taken as an average for the 1981-1988 period.
g/ This includes other industries, housing, infrastructure services and fire loss.
h/ The residual has been calculated from the data in this column which includes data from different periods.

Source: Amelung (1991)

Table 3.6: Sectoral Share in Forest Degradation and Forest Modification, 1981-85 a/

	Percentage Share in Biomass Reduction (Degradation)				Percentage Share in Forest Modification			
Sector	Brazil	Indonesia	Cameroon	Total b/	Brazil	Indonesia	Cameroon	Total b/
Forestry	6	44	10	10	(100) c/	(100) c/	98	71
Agriculture d/	85	49	90	76	0	0	2	26
Others d/	9	7	0	13	0	0	0	4

Notes: a/ For the definition of modification and biomass reduction (degradation) see FAO (1982)
b/ Total refers to all major rain forest countries.
c/ Following FAO statistics, deforestation in virgin forests is 0, since clearing by agriculture and other sectors concentrates on disturbed forests. Even though some clearing occurs in virgin forests, there is reason to assume that the bulk of deforestation is due to forests that have been logged over prior to the clearing of the respective areas.
d/ These figures have been derived from Table 3.5 and reflect averages for the 1981-1988 period or, in the case of Indonesia, the 1980-1990 period.

Source: Amelung (1991)

Table 5.1 Tropical Timber Rent Capture

	Potential Rent from Log Harvest (1)	Actual Rent from Log Harvest (2)	Official Government Rent Capture (3)	3/2 (%)	3/1 (%)
Indonesia (1979-82)	4,954	4,409	1,644	37.3	33.2
Sabah, Malaysia (1979-82)	2,198	2,094	1,703	81.3	77.5
Philippines (1979-82)	1,505	1,033	171	16.5	11.4
Philippines (1987)	256	68	39	57.1	15.3
Ivory Coast	204	188	59	31.5	28.9
Ghana	–	80	30	38.0	–

Notes: All figures in US$ millions

Source: Repetto (1990b) and Repetto and Gillis (1988)

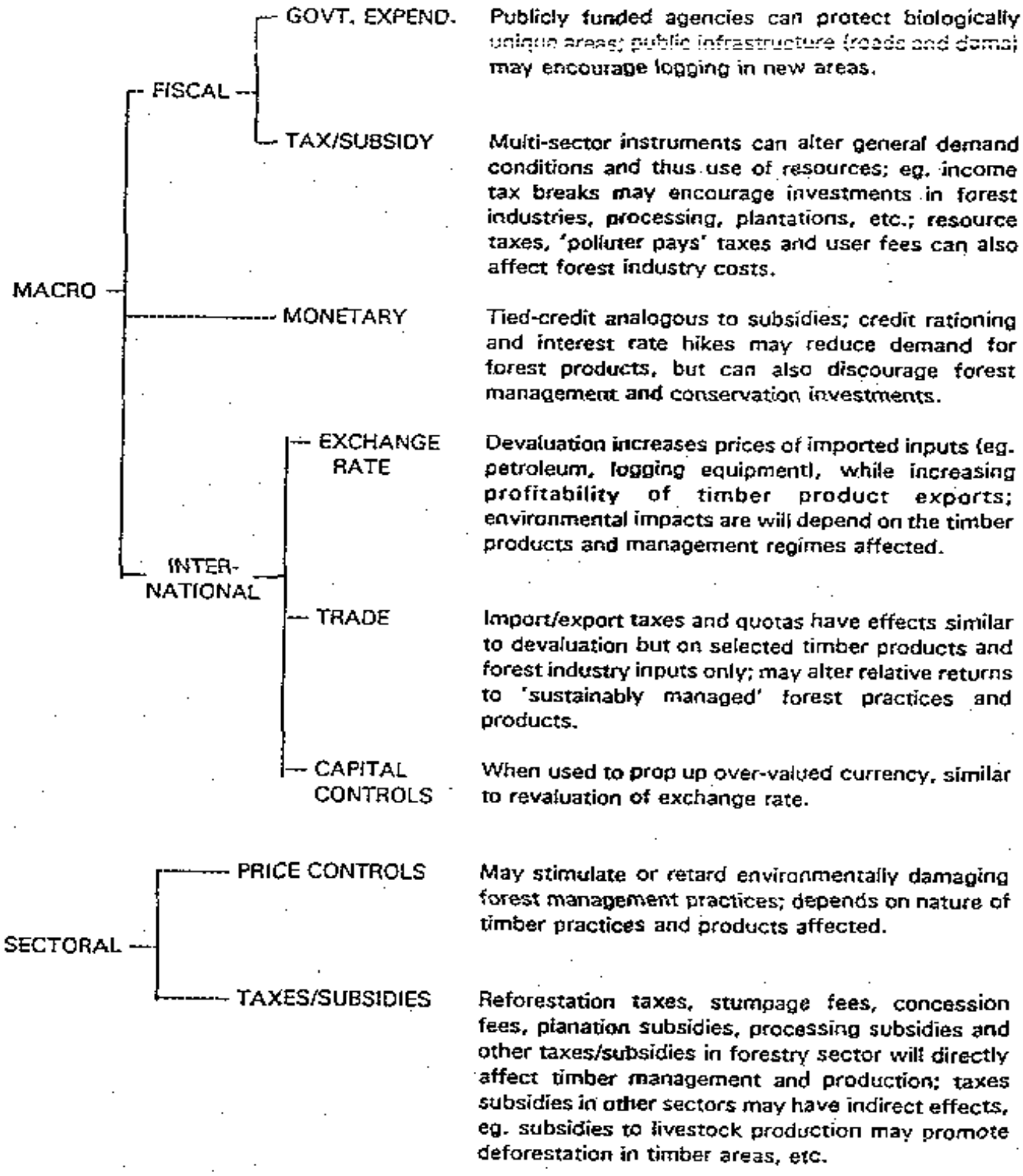
Table 6.1 Tariff Rates for Wood and Wood Products in Major Importing Markets

1. Industrialized Markets	Imports from Developing Countries		Imports from Other Developed Market Economies		Nominal Protection Rate	Effective Protection Rate
	pre Tokyo	post Tokyo	pre Tokyo	post Tokyo	post Tokyo	
EEC						
Wood in rough	0.0	0.0	0.1	0.0	1.0	1.1
Primary products	2.5	1.9	1.0	0.8	1.6	4.0
Secondary products	2.5	1.5	2.2	1.7	10.5	17.9
USA						
Wood in rough	0.0	0.0	0.0	0.0	0.0	0.0
Primary products	11.0	5.6	0.8	0.4	0.3	0.0
Secondary products	3.5	1.7	4.7	2.4	7.6	13.7
Japan						
Wood in rough	0.0	0.0	0.0	0.0	2.3	2.3
Primary products	8.2	7.4	0.3	0.2	2.9	8.5
Secondary products	11.1	4.8	9.6	4.3	12.8	24.3

2. Developing Markets	All Imports post Tokyo
Africa	
Wood in rough	14.4
Primary products	16.2
Secondary products	24.1
Latin America	
Wood in rough	26.2
Primary products	37.6
Secondary products	52.5
Asia	
Wood in rough	34.1
Primary products	57.8
Secondary products	73.1

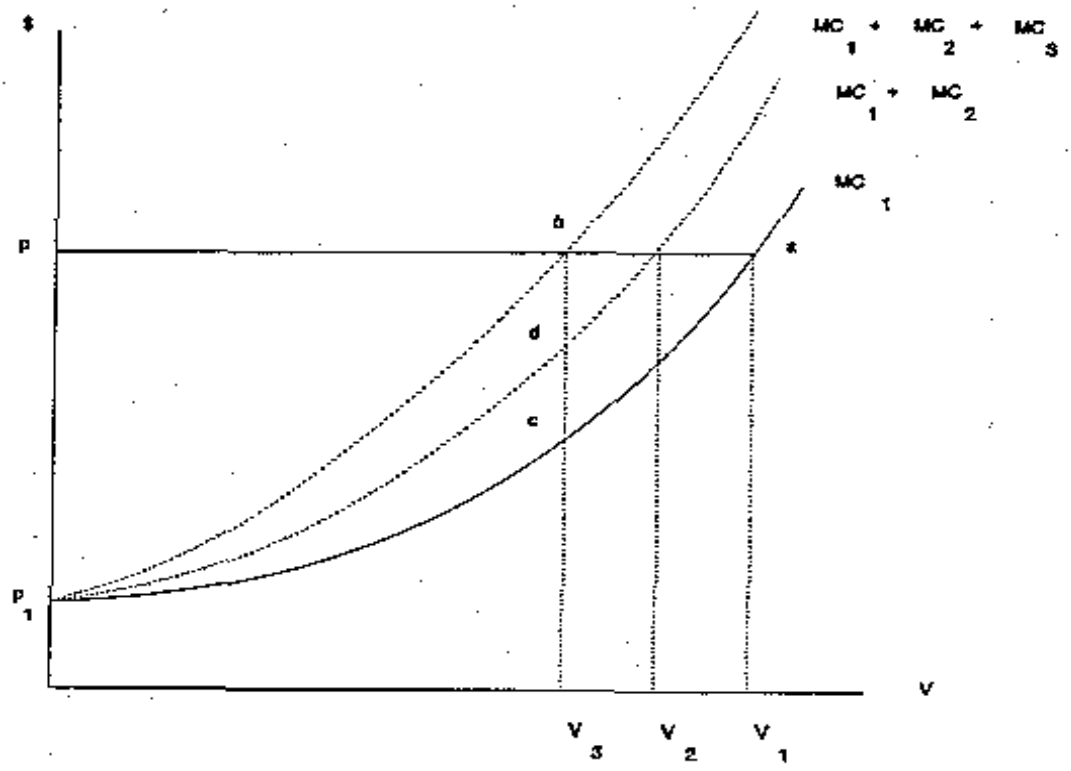
Source: Bourke (1988)

Figure 5.1 Economic Policy and Potential Impacts on Timber Management



Source: Adapted from Bishop et al. (1991).

Figure 5.2 Social and Private Harvesting Decisions



p = competitive price for delivered logs

V = harvest volume

MC = timber concessionaire's marginal cost curve for delivered logs

Source: Hyde and Sedjo (1991)

Table 6.3 Estimated Trade Effects from the Removal of Post-Tokyo Round Tariffs in the Main Developed Market Economy Markets a/

	Imports from Developing Economies			Imports from Developed Market Economies		
	Trade Creation	Trade Diversion	Total Effects	Trade Creation	Trade Diversion	Total Effects
Importers	(US$ Million)		(%)	(US$ Million)		(%)
EEC	45.2	20.35	4.0	78.4	-38.6	1.25
Japan	49.2	-0.15	2.7	15.4	0.45	0.8
USA	46.1	-4.5	6.15	56.2	4.45	2.95
All b/	150.6	-2.0	3.35	731.4	-5.6	8.05

Notes: a/ Increase over 1976 trade levels. Trade Diversion and Total Effects are averages of low and high estimates.
b/ Total of all ten developed market economies; others not shown are Austria, Canada, Finland, New Zealand, Norway, Sweden and Switzerland.

Source: Bourke (1988)

Table 6.2 Export Taxes and Bans on Tropical Timber, 1989

Country	Tax Rate/Export Policy	Remarks
Cameroon	2% of valuer mercurial	However, export taxes are also reported to be 11% of average f.o.b prices.
Central African Republic	*Logs:* US $11.45 per m^3 for red woods, US $11.07 for white woods. *Sawn timber:* US $250 per m^3. *Veneer:* US $2.90 per m^3.	Tax is imposed on processed wood export; roundwood equivalents are much lower.
Cote d'Ivoire	Specific rates variable by species	*Sapelli:* US $57.49 per m^3 *Sipo:* US $89.20 per m^3 *Assamela:* US $138.27 per m^3.
Ghana	Log export ban enforced since 1979	
Indonesia	20% *ad valorem* on logs	Tax imposed only on some logs in inaccessible regions. Log export ban since 1985 has made the tax irrelevant for other regions.
	Specific export taxes on sawn timber, ranging from US $250-2400 per m^3.	Specific export taxes on sawn timber introduced in 1989; plywood exempt from all export taxes.
Liberia	Ranges from US $1.44/$m^3$ for low valued species to US $58.57 for high valued species (*Sipo*).	Tax is called the Industrialization Incentive Fee and is imposed on logs only.
Malaysia:		
Pennisular	Log export ban since 1971.	
Sabah	No specific export tax or ban but see remarks.	The Sabah timber royalty has a strong export tax feature: the royalty rate for log exports is almost 10 times the rate for logs used domestically.
Saraswak	15% *ad valorem* of f.o.b. log values	Tax applies to one hardwood species only.
Papua New Guinea	10% of f.o.b. log values	Tax reported to have been widely evaded through transfer pricing. Log export ban proposed.
Philippines	Log exports restricted to 25% of annual allowable cut since 1979.	Ostensibly to control deforestation.

Source: Gillis (1990)

Table 7.1 Cost-Benefit Analysis of Land Use: Korup Project, Cameroon

		Base Case Result (NPV £'000, 8% Discount Rate)
Direct Costs of Conservation		- 11,913
Opportunity Costs		- 3,326
- Lost stumpage value	- 706	
- Lost forest use	- 2,620	
Direct Benefits		11,995
- Sustained forest use	3,291	
- Replaced subsistence production	977	
- Tourism	1,360	
- Genetic value	481	
- Watershed protection of fisheries	3,776	
- Control of flood risk	1,578	
- Soil fertility maintenance	532	
Induced Benefits		4,328
- Agricultural productivity gain	905	
- Induced forestry	207	
- Induced cash crops	3,216	
Net Benefit - Project		**1,084**
Adjustments		6,462
- External trade credit	7,246	
- Uncaptured genetic value	- 433	
- Uncaptured watershed benefits	- 351	
Net Benefit - Cameroon		**7,545**

Source: Ruitenbeek (1989)

Table 7.2 Domestic and Export Effect of Timber and Environmental Restrictions, US Pacific Northwest a/

A. Short Run	Base (1990) Level	Replanning (All Lands) and Embargo	Owl (Public Lands), Replanning (All Lands), and Embargo	Owl (All Lands), Replanning (All Lands) and Embargo
		(Percentage Change from Base Level)		
All-owner harvest	11.54 b/	- 5	- 8	- 16
Log export volume	2.92 b	- 12	- 16	- 25
Lumber shipments	7.76 b/	- 2	- 3	- 5
Lumber export volume	1.76 b/	- 3	- 7	- 16
Domestic log prices c/	293 d/	+ 30	+ 52	+135
Export log prices	450 d/	+ 48	+ 66	+137
Domestic lumber prices	309 d/	+ 9	+ 14	+ 31
Export lumber prices	336 d/	+ 24	+ 43	+116

B. Long Run	Base (1990) Level	Replanning (All Lands) and Embargo	Owl (Public Lands), Replanning (All Lands), and Embargo	Owl (All Lands), Replanning (All Lands) and Embargo
		(Percentage Change from Base Level)		
All-owner harvest	11.54 b/	- 4	- 6	- 12
Log export volume	2.92 b/	- 11	- 14	- 23
Lumber shipments	7.76 b/	- 1	- 2	- 3
Lumber export volume	1.76 b/	- 3	- 8	- 21
Domestic log prices c/	293 d/	+ 16	+ 26	+ 60
Export log prices	450 d/	+ 27	+ 37	+ 68
Domestic lumber prices	309 d/	+ 5	+ 8	+ 17
Export lumber prices	336 d/	+ 19	+ 36	+101

Notes: a/ Short run: all policy changes occur in 1990 and their impacts experienced in that year; long run: three-year lagged impacts.
b/ Billions of board feet (Scribner for logs, lumber tally otherwise).
c/ Average price of number 2 softwood logs.
d/ US $ per thousand board feet.

Source: Flora and McGinnis (1991)

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