By Zhu Chunquan Rodney Taylor Feng Guoqiang

China's Wood Market, Trade and the Environment

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FOREWORD

As a member of the China Council for International Cooperation on Environment and Development, I have been privileged to participate in many discussions with fellow Council members, in our attempts to make proposals on sustainable development in China. I am often overwhelmed by the scale and complexity of the challenges confronting China's leaders, as they try to balance the economic aspirations of the world's most populous country, with the imperatives of maintaining natural capital.

The challenges in the forest sector are as daunting as those in any other. The people of China are relatively modest users of timber and paper. The average person in the United States of America consumes seventeen times as much wood as a person from China. Yet with a fifth of the world's population and rapid economic growth, China as a nation, has an inevitably large and growing impact on the world's forest resources.

According to this report, China's own forests and plantations produced around 79 million cubic metres of wood for industrial use in 2003 — less than half of the 173 cubic metres required for domestic use and export. China's domestic needs required the harvesting of a log volume of 138 million cubic metres and China's factories absorbed an additional 35 million cubic metres for the manufacture of products for export to other countries. Thus a growing portion of the wood processed in China, ends up being used by consumers in other countries.

China is a relatively forest poor country — most of its original forests were cleared centuries ago, and over-harvesting in recent decades has depleted many of the remaining forests of mature timber trees. In 1998, China responded to disastrous floods in the Yangtze and other rivers, worsening sand-storms in Beijing and declining productivity in timber forests, by initiating ambitious policy reforms. The reforms included logging bans and incentives to restore tree cover in erosion-prone areas. Now that the implementation of these reforms is well underway, it is an opportune time to ask whether the reforms are succeeding, and what China could do to boost its domestic wood production, without further degrading its forest resources.

This report also explores the environmental impact of logging in the countries that supply wood to China. In many of these countries, timber harvesting is poorly regulated and imposes a high cost on the environment. The report suggests measures that could be taken by the Governments of China and its trading partners, along with companies using China as a manufacturing base, to discourage imports to China of wood sourced from illegal or destructive logging operations.

Chinese Vice-Premier Zeng Peiyan, remarked to the China Council in November 2003 that "as a big country with a strong sense of responsibility" China would take care, internationally, to avoid environmental harm to other countries in meeting its resource

needs. This report highlights the need for such an international approach by China and its trading partners to reduce their impacts on the world's forest resources. Decisive actions are needed to ensure that supply chains leading to or through China, do not start with logs from illegal or destructive operations. This is an international problem calling for rapid and concerted action by governments and the private sector.

Claude Martin
Director General
WWF International

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EXECUTIVE SUMMARY

China is a major player in the global forest products market, both as a producer and consumer. China's market for industrial timber, pulp, and paper is the second largest in the world, outranked only by the massive US market. It has relatively limited forest resources and a great potential for increases in consumption of wood and paper products.

China's domestic wood production rates have been in decline since 1995. In many regions, decades of over exploitation of natural forests have depleted standing wood volumes. Logging bans and restrictions, introduced in the wake of the devastating 1998 Yangtze River floods, have cut production further, particularly in the few regions where forests remain relatively well-stocked with timber. Although the maturation of domestic forest plantations will help to bridge the gap between domestic supply and demand, China is likely to continue to face a severe shortage of wood in the coming decades. Imports have expanded dramatically, and may continue to expand, to meet demand.

Section I of this report presents an overview of the diverse policies that shape China's forest products market. Policies to promote economic development, such as the *Construction and Residential Housing Reforms* and *Western Development Programme*, are likely to promote the consumption of wood and wood products. China's economic "Opening-Up" has introduced market forces to the domestic timber market, allowed more liberal trade with other countries and encouraged foreign investment in processing and manufacturing in China. At the same time the *Natural Forest Protection Programme* is restricting domestic wood harvesting, at least in the short term. This programme imposes bans on logging in the forests of the upper and middle reaches of the Yellow River and the upper reaches of the Yangtze and reduced logging in state-owned forests in Hainan, northwest China and northeast China. Overall, China's domestic policies have limited domestic wood production while encouraging imports of wood and wood products.

Section II provides an analysis of China's forest products market, including estimates of future wood supply and demand. Consumption in China has increased slowly over the last decade, lagging behind much higher growth rates for Gross Domestic Product. This is due primarily to stagnation in the volume of wood used in the construction sector where decreasing demand for wood in infrastructure projects has been balanced by an increasing demand for wood in housing. China's exports, though relatively small by comparison, have grown rapidly since 1998 and now account for a substantial proportion of China's imports. In 2003, a quantity of wood-based products[1] equivalent to around 138 million cubic metres

[1] Wood for industrial uses such as building and infrastructure construction, furniture, flooring, panels, packaging, and pulp and paper and excluding fuelwood.

(RWE)[1] were consumed within China, while an additional 35 million cubic metres (RWE) were exported as value-added products, such as paper and furniture. It is likely that Chinese exports will continue to increase. China also has a great potential for increases in domestic consumption in response to a growing economy and rising living standards.

In 2003, China produced an estimated 79 million cubic metres of industrial roundwood and imported an additional 94 million cubic metres (RWE).

A likely effect of the logging bans and depleted stocks of standing timber is that logging in China's natural forests will provide an increasingly small proportion of the wood needed to satisfy both domestic consumption and the growing export market. Maturing plantations will help fill the gap in some product types. However, China faces a severe shortage of wood, particularly large-diameter logs. We estimate that China will need to import a massive 125 million cubic metres (RWE) in the year 2010 to fill its wood and fibre supply gap.

Section III examines the "ecological footprint" of China's industrial wood consumption. Per capita consumption of industrial wood in China is small compared to industrialised countries — the average citizen of the United States and Japan consumes 17 and 6 times more industrial wood, respectively, than the typical resident of mainland China. Yet in aggregate, China's wood market has a relatively large footprint both at home and abroad and the size of the market is expected to grow.

China's expanding demand for wood is stimulating forest enterprise in many diverse regions outside China. In regions with sound governance and a well-managed permanent forest estate, revenues from forest product exports to China may come without significant environmental cost. If China transfers its timber sourcing to such regions, and away from unsustainable and erosion-causing domestic production, it may reduce its net footprint. However, in frontier regions with poor forest governance, increased exports to China may result in a larger ecological footprint in the form of migratory logging and indiscriminate forest clearing.

Russia, Indonesia and Malaysia were the three largest suppliers of timber to China in 2003. China's combined timber imports from these countries totalled around 24 million cubic metres (RWE), which is more than half of the total amount of import of 42 million cubic metres (RWE). New Zealand, Gabon, Germany, Papua New Guinea, Thailand, the United States, Canada and Myanmar make-up a second tier of countries that each supplied more than 800,000 cubic metres (RWE) of timber to China in 2003. China's pulp and paper imports (totalling 52 million cubic metres in RWE in 2003 excluding recycled paper) derive from a larger volume of wood harvested in other countries or regions than China's imports of timber; Indonesia, Russia, Canada, Chile, South Korea, the United States, Taiwan, and Brazil were the major suppliers of pulp and paper to China in 2003.

Section III also explores whether China's forest policies may have taken the pressure off China's own environment, yet increased pressure on the forests of the countries that export timber, pulp and paper to China. It is neither possible, nor useful, to offer a simple composite verdict on this question, and the impacts within China and abroad are variable, multi-faceted and, in the future, will depend on the pattern of the global trade in wood products. However, much of the wood imported by China is sourced from countries that lack sound forest management and controls. Trade statistics and various reports suggest that

[1] Roundwood equivalent (RWE) is the volume of round wood (wood in log form) that is required to produce a given volume of processed timber or manufactured product. The difference between this and the output volume of processed wood comprises residual material and waste, some of which can be used in other timber products.

China is one of the major destinations for wood that may be illegally harvested or traded.

China is increasingly exporting wood in value-added products. Thus, a growing share of China's wood imports represents the ecological footprint of end-consumers in other countries. This also means Chinese manufacturers need to respond to emerging environmental sensitivities in their export markets. For example, a Chinese factory supplying furniture to a retailer in the USA may need to provide assurance that the wood in its products was not harvested illegally. A Chinese paper manufacturer supplying copy paper to Japan may need to ensure the paper does not contain fibre sourced by clear-cutting rainforests.

Section IV describes potential policy changes and actions that could reduce the negative impacts of China's wood products market on the environment. These measures involve many different actors, both in and outside of China. Four broad strategies are presented.

First, China can strengthen environmental protection initiatives in China, such as the *Natural Forest Protection Programme* and the *Grain for Green programme*, to optimise their positive impacts. Possible actions to achieve this include:

- Preparing exit strategies and incentives to maintain momentum beyond the life of the current programmes;
- Broadening their environmental objectives beyond flood control; and
- Strengthening outcome-based monitoring.

Second, China's demand for wood from other countries, and in particular from regions where forest management is poor, could be reduced through environmentally responsible wood production in resource-rich areas in China where logging is currently banned. Possible measures to achieve this include:

- Lifting the logging bans in forests zoned as suitable for production, subject to sustainability safeguards;
- Relaxing the logging bans in collectively-owned forests to motivate community-based forest stewardship;
- Designation of fuel wood harvesting areas to meet local demand through supervised rather than unregulated harvesting;
- Rural credit schemes with longer payback periods matched to timber harvesting cycles; and
- Securing of future harvesting and sale rights for households and collectives that plant trees and manage forests for wood production.

Third, the report suggests possible reforms to improve the efficiency of wood production, distribution and use in China, so as to make forestry a more viable land-use as well as reduce waste so that less wood can be harvested to produce the same output of manufactured products. Recommendations include:

- Further rationalising local administrative procedures for the sale and transport of timber to avoid unjustified constraints on producers' ability to adjust harvesting schedules, prices, product types and delivery destinations to match market demand;
- Reforming the taxation and fees system for timber production to remove disincentives for tree planting and wood production, while ensuring that new incentives for over-logging are not created;
- Better integration of transport infrastructure planning with location of wood harvesting areas, plantation developments and processing mills;
- Recycling of formwork plywood and other materials;

- Full use of thinned logs, small logs, and harvesting and processing residues;
- Promotion of environmentally friendly resource-saving consumption;
- Research and technology transfer to develop cleaner, more efficient, technologies for small-scale, mills using non-wood fibres; and
- Use of wood substitutes and composites where they are viable and cause less net environmental harm.

Finally, the report suggests measures to encourage imports or purchases of wood produced legally and from well-managed forests. The environmental impact associated with supplying wood to China's growing market will be lessened to the extent that China can reduce its reliance on imports of wood sourced at high cost to the environment. Possible actions include:

- Retailers, government agencies, architects, building companies, and manufacturers sourcing or manufacturing wood or paper products in China could adopt responsible procurement policies, including refusal to purchase products containing illegally sourced timber, and a preference for wood and fibre sourced from well-managed forests or recycled sources;
- Use of systems to trace wood from its source to final use;
- Forest certification to verify the quality of forest management from a particular source;
- Government policies and regulations to prevent the import of products containing illegally-sourced wood;
- Bilateral and/or multilateral cooperation to combat illegal forest products trade; and
- A review of the merit of China's "temporary" half tax policy on border trade that has helped fuel massive imports of timber from Russia and other neighboring countries.

SECTION I
THE POLICY ENVIRONMENT FOR CHINA'S FOREST SECTOR

China has instituted significant forest sector reforms in recent years. While a market economy for forest products is developing, the priority for China's forest sector has shifted away from a narrow emphasis on industrial development to include ecological protection measures. This change in policy direction is broadly described by the Six National Key Forest Programmes approved by China's State Council in the year 2000. These six programmes, intended to span the period from 2001 to 2015, are —

1. Natural Forest Protection Programme (NFPP);
2. Shelterbelt Development Programme;
3. Sloping Land Conversion Programme (Grain for Green);
4. Sand Control Programme for Area in the Vicinity of Beijing;
5. Wildlife Conservation and Nature Reserve Development Programme; and
6. Forest Industrial Base Development Programme.

This section reviews recent policy changes that affect the sector, under four broad headings —

- Promotion of economic development;
- Natural resource management and environmental protection;
- Taxation and regulation of timber markets; and
- International trade and investment.

Policies to Promote Economic Development

Construction and Residential Housing Reforms in China

The National Housing Reform Programme has stimulated demand for new residential housing. The Programme has two objectives: (1) to transfer state-owned residential housing to private ownership, and (2) to improve the Chinese standard of living by increasing the average living space from 8 square meters in 1998 to 12 – 14 square meters in 2000, and to 15 – 18 square meters by 2010. Key policies pursued under the Programme include

- Raising rents for state-owned housing;

- Selling subsidised state-owned houses to employees;
- Marketing new residential housing publicly;
- Ensuring that banks provide mortgages to homeowners; and
- Developing a market economy for real estate.

These reforms have driven massive growth in residential housing construction and related demand for wood as a building material. According to the Ministry of Construction, for example, new housing starts reached 293 million square metres in 2001, up 25% from the year before (FAS 2002: 11). The rising number of new homeowners has also increased demand for wood products for interior decoration, furniture and flooring. Statistics from China's Interior Decoration Association indicate that Chinese consumers spent US $36 billion on interior decoration in 2001, of which 25% was spent on wood products (op cit: 16).

Western Regional Development Programme

In the late 1970s and the early 1980s, China's economic development programmes focused on the southern and eastern coastal regions. Since the 1980s, coastal regions have enjoyed favourable tax policies along with other financial support from the Government, and have experienced rapid levels of economic growth. This growth has widened the gap in living standards between populations on the coast and those in the interior of the country. In an effort to redress this imbalance, the Chinese Government initiated the Western Regional Development Programme in 2000, which aims to narrow the economic disparity between the coastal and western regions and create a more regionally equitable economy. The Western Regional Development Programme involves huge investments in infrastructure development, including highways, railways, airports, natural gas pipelines, electricity networks and telecommunication systems. It also provides for ecological protection to sustain agriculture, forestry and other rural industries, industrial restructuring, and education in science and technology.

Assuming these policies succeed in raising the standard of living and the volume of construction activity in China, particularly in Western China, they are likely to increase consumption of wood products.

Policies to Conserve the Environment

Natural Forest Protection Programme (NFPP)

China instituted the NFPP in late 1998, soon after devastating floods along the Yangtze River in the South and the Songhua River and Nen River in the Northeast. The Programme became one of the Six National Key Forest Programmes approved in the year 2000. The Government has set up a fund totaling 96.2 billion RMB (US$11.6 billion) for programme implementation (China SFA 2001a: 4).

Within the Yangtze and Yellow River catchments, the NFPP's objectives include

- A ban on logging in approximately 30 million hectares of natural forests, 27 million of which are collectively owned, until 2010;
- Permanent protection of an additional 31 million hectares of existing forests, shrub

forests and newly planted forest land; and

- Creation of nearly 13 million hectares of restored forest and grassland by closing access to over 3 million hectares of mountain land, seeding over 7 million hectares and replanting 2 million hectares.

In Inner Mongolia and Northeast China and the Northwest provinces of China and Hainan, the NFPP's objectives include

- Permanent protection of 33 million hectares of existing, but over-logged natural forests; and
- A 40% reduction in production of commercial timber by 2003, with production to be maintained at this level until 2010 (China SFA 2001a).

The NFPP also seeks to create new job opportunities for more than 740,000 workers from forest enterprises, who have been laid off due to the logging bans. The NFPP proposes that these workers will be retrained as necessary and re-employed in jobs dedicated to forest protection and management, tree planting, development and utilisation of other non-timber resources in the forests, and diversified economic management.

The NFPP is managed and implemented at the national level by the NFPP Management Centre under the auspices of the State Forestry Administration. Each province covered by the NFPP has a local management body, affiliated with provincial forestry departments. Generally, the implementation of the NFPP has been strict and planning and organisation of the project has occurred in a swift, top-down manner (Cohen and Vertinsky 2001; Zuo 2002: 8). However, the pace and pattern of implementation has varied from place to place. In the absence of detailed guidelines for implementation, provinces have interpreted the policy differently and pursued their own strategies at the provincial and county levels. These local applications often go beyond the measure described in the national policy (Katsigris 2002: 10).

Industry reaction to the NFPP has been mixed. In general, the logging prohibitions have reduced the profitability of forest enterprises. Some companies that had been profitable are now showing losses and of the nine forest centres, the largest are suffering the most. The NFPP has particularly hurt enterprises focusing on timber processing. However, certain forest enterprises that were experiencing economic problems prior to implementation of the NFPP, such as the Chuanxi Forest Bureau, have seen their balance sheets improve as a result of NFPP subsidies (op cit: 14).

The reduction in the income of forest companies has affected households and communities dependent on those companies for employment and income. Subsidies designed to relieve pressure on state-owned forest companies and local government do not extend to cover economic hardship faced by local communities dependent on the timber economy or non-timber forest products, but that are not formally a part of the state-owned forest sector. Community economies based on wood production from collective forests have, in some cases, collapsed entirely (op cit: 31). The blanket logging ban on collectively owned forests provides a powerful disincentive to farmers and the private sector to plant trees for wood production, which could lead to reduced supply of timber in the mid-to long-term. In Sichuan, Yunnan, and Shaanxi local timber markets have been closed to discourage timber harvesting and sale in contravention of the logging bans. However, local residents need timber. This creates a conflict that could lead to a black market for timber.

Sloping Land Conversion Programme ("Grain for Green")

The Sloping Land Conversion Programme, known colloquially as "Grain for Green" was mainly a response to the severe flooding in China in 1998. Pilot projects were initiated in Sichuan, Shaanxi and Gansu Provinces in 1999 to turn crop land into forest and grassland. The approach embodied in these pilots was later reaffirmed as one of the Six National Key Forest Programmes. In March 2000, the programme was expanded to 13 provinces in the upper reaches of Yangtze River and the middle and upper reaches of the Yellow River. By the end of 2001, Grain for Green was operational in 20 provinces (Zuo 2002b: 36).

Under the programme, grain, cash and planting stock are supplied as incentives for reforestation. For each hectare of restored forest or grassland, farmers receive —

- USD 40 per year for subsistence;
- Seeds and planting stock with an estimated average value of USD 90; and
- 2,250 kg of grain per year in the upper Yangtze and 1,500 kg per year in the upper and middle reaches of the Yellow River.

These entitlements continue for at least 8 years for ecological forests and 5 years for timber production forests and orchards, to ensure that farmers will not revert to agriculture in the areas designated for re-developed forest and grassland (China State Council 2002).

In addition to restoring forest cover, Grain for Green has a short-term objective of reducing stockpiles of grain. In the long term it seeks to increase grain output by restoring forest and grassland environmental functions such as the prevention of erosion and flood control.

A number of challenges confront the programme and suggest a need for more location-specific applications of current incentive policies. These include —

- Market distortions by flooding the market with tree crop products (particularly Sichuan pepper and fruits) that are effectively subsidized by the tree planting incentives. Given reduced income from agriculture, farmers tend to plant "cash-crop" forests, as opposed to varieties that perform more long-term ecological services such as forest/habitat restoration.
- Environmental concerns associated with clearance of herbaceous vegetation and establishment or re-establishment of terraces to plant economic trees. Low rates of tree survival and biodiversity loss have been noted where monoculture planting has occurred. In addition, the net environmental effect of replacing grass and bushes with bare soil and occasional trees will depend on how well terraces work and how they are maintained. Although this may seem paradoxical, such activities may actually result in more and not less soil erosion.
- Building a short-term grant culture in agriculture rather than helping farmers to produce a truly sustainable crop. Questions have been raised over the long-term financial and economic sustainability of the policies and measures implemented. Incentives compensate farmers for grain and allow for food needs to be met. However, alternative sources of income and livelihood will have to be found in the long run. Coupled with the logging ban, many villages and towns already face unemployment and more limited sources of income. In many cases, household income has been greatly reduced.

The long-term sustainability of the Grain for Green and its ability to prevent soil erosion and restore forests remains uncertain. Much of the restoration work has focused on the planting of orchards on steep slopes, which is creating a glut in selected fruits and nut products while doing little to stop erosion and habitat restoration. Programme implementation also varies greatly as provinces, counties and townships pursue different strategies according to their own natural, economic and political conditions (see generally, Xu and others 2002).

Other National Key Forest Programmes

Forest Industrial Base Development Programme

China has formalised its intention to increase the volume of wood available from domestic plantations in the Forest Industrial Base Development Programme in Key Regions. This programme promotes the establishment of fast-growing and high-yield timber plantations in selected regions, with the goal of producing 130 million m^3 of timber annually to supply China's domestic market. The goal is to plant 10.8 million ha of fast growing plantations between 2001 and 2015, including 5.8 million ha for pulpwood. Unlike other forest programmes, this programme relies on subsidized loans instead of special fiscal support. Private companies play an important role in the operation of the programme by leasing or sub-leasing state-owned and collectively owned land for plantation development (China SFA 2001b: 15).

Shelterbelt Development Programme

The largest shelterbelt programme in China, designed to combat erosion and desertification, covers the "Three North" regions (i.e. North, Northeast and Northwest China), the coastal region, the Pearl River, the Huaihe River, the Taihang Mountain, the Plain area, the Dongting, the Boyang Lake region and the middle and lower Yangtze River. The programme involves 1696 counties in 28 provinces, autonomous regions or municipalities. It is planned that 22.7 million ha of plantations will be established and 71.9 million ha of forests maintained. The total investment is US $8.5 billion from 2001 from 2010 (op cit).

Sand Control Programme for Areas in the Vicinity of Beijing

This programme is intended to solve the problem of sandstorms in areas in the vicinity of Beijing, covering 75 counties in the five provinces (autonomous regions or municipalities) Beijing, Tianjin, Hebei, Inner Mongolia and Shanxi. Forest and grass coverage is expected to grow from the current 6.7% to 21.4% by 2010. From 2001 to 2010, US $7 billion will be invested in this programme (op cit).

Wildlife Conservation and Nature Reserve Development Programme

The key targets of the programme are species conservation, nature conservation and wetland protection. It covers typical and representative natural ecosystems nationwide, including natural distribution areas endangered wildlife species and environmentally vulnerable areas. Priority will be given to rescue programmes for ten species (including the Giant Panda, Golden Monkey, Tibetan Antelope and plants in the orchid family) and 30 protection programmes for ecosystems (including forests, desert lands and wetlands) prior

to 2010. The programme includes 1276 nature reserves, of which 155 are national nature reserves. (op cit).

Other Domestic Environmental Policy Initiatives

Forest Zoning and Ecological Services Compensation Fund

A forest zoning framework was initiated in 1995, and pilot testing in Yunnan province commenced in 1996. The tested framework was then rapidly deployed across China with zoning for the entire forest estate completed by the end of 2000. According to the forest zoning policy, forests are classified into two categories: production forests and ecological services forests. Production forests are dedicated to commercial timber production. They consist of both natural forests and plantations, and the forest zoning policy allows conversion of forests in accordance with the applicable harvesting and regeneration regulations.

There are two types of ecological forests: (1) key ecological forests that possess very high ecological values, and (2) and general ecological forests. The zoning policy prohibits all logging in key ecological forests, which include protected areas, nature reserves, forest parks and critical steep slopes. The zoning policy allows some degree of commercial timber harvesting in general ecological forests, with restrictions such as bans on clear cutting, and limits on harvest volumes and species. The total area of ecological services forests is about 106 million hectares, not including protected forests in the areas where the NFPP is being implemented (China SFA 2000).

The Chinese Government is establishing an Ecological Services Compensation Fund (ESCF) to provide financial subsidies for ecological services forests. A 1998 enabling law provides that the programme will compensate owners of ecological forests. The law has yet to be implemented, however, and formulae for funding are still in development. To date, the Central Government has contributed 120 million USD in 11 pilot provinces for this project (China SFA 2002: 56).

The zoning policy and the ESCF are not particularly well integrated with other key forest policies. No matter how they have been zoned, all the forests in the NFPP region are covered by NFPP logging restrictions and bans till 2010. This may prevent wood harvesting in some forests zoned for production. However, when the NFPP and Grain for Green Programme end in 2010, the zoning policy and ESCF could be a means of maintaining these programme objectives in the future.

Controls on pollution from paper mills

In rural China, an extensive network of small pulp mills traditionally relied on straw and other agricultural residues (at a three to one ratio over wood fibre) for raw fibre inputs (Hyde and others 2003: 21). In the late 1990's, the Chinese Government stepped-up efforts to control the effluent from pulp and paper mills, mandating that any enterprise violating the water pollution regulations after the year 2000 would be closed. More than 4,000 of these small mills were in the 1990s (URS 2004). This development, coupled with incentives for foreign direct investment, is prompting a broad switch to larger and cleaner paper mills using predominantly wood-based fibre. The transfer to China of cleaner technologies for small-scale paper production using agricultural fibres could, however, allow growth in non-wood paper production in the longer term.

The Chinese Government attempted to curb domestic demand for wood by requiring the increased use of non-wood substitutes pursuant to the 1983 “Regulations for Economic and Rational Applications of Wood and Wood Substitutes.” Its efforts, however, were not entirely effective as the regulations were suspended in the mid-1990s, and were never formally applied to imported wood products (Daowei and others 1998).

More recently, in 1999, the Ministry of Construction and the State Forestry Administration jointly issued a national policy banning the use of timber from natural forests as raw material in doors and windows for public offices and residential buildings. This policy mandated the use of substitutes such as iron and cement in infrastructure such as railways, telecommunications, and construction. A recent World Bank report estimates that such demand-dampening policies save China up to 15 million cubic meters of timber per year, though no supporting analysis is provided (Rozelle and others 2000: 4).

Forestry Regulations, Taxation, and Market Policies

Harvesting Quotas and Licences

The State Council allocates a five-year quota on volume to be harvested in each province based on annual increment of growing stock. Its calculation allows for natural losses (fire, disease, etc) and non-commercial wood-use by local communities (fuel, construction, mushroom farming, etc). However, in the NFPP areas, the logging ban policies determine the quotas rather than a calculation based on growing stock. Because the logging bans are arbitrary and do not take into account the recently completed zoning process, forest production in provinces covered by the logging bans does not match the productive capacity of those provinces.

Timber harvesting in plantations or natural forests requires a licence to harvest, which specifies the allowable cut and sets conditions for harvesting, transportation and marketing. Local forest management authorities (state forest enterprises and county forest bureaus) submit annual harvesting plans to relevant provincial authorities. The provincial authority recommends the share of the quota to be allocated to each local management authority. The recommendations are then submitted to the State Forest Administration, which ascertains their compliance with regulations before approving the recommended allocations and issuing annual harvesting licenses. The management authorities can then use these licenses to conduct their own harvesting or contract harvesting out to collectives and local community groups.

Forestry Taxes and Fees

Charges and taxes on private forest production may absorb 35% – 60% of the sale value of timber, depending on the locality. By way of comparison, agricultural charges and taxes only amount to 10% – 20% of revenues (Hyde and others, 2003:11). The forest sector taxes and fees consist of various agricultural taxes, forestry fees and the value added tax (VAT). Agricultural taxes apply to agriculture, forestry and animal husbandry, and vary by region. Forestry fees include a range of items approved by the Ministry of Finance and the State Forest Administration. They include reforestation funds (royalties or stumpage fees),

maintenance fees, and numerous other items specified by various departments and districts. The number of items subject to forestry fees varies among districts.

The current value added tax (VAT) in China is imposed under the *Temporary Regulations on Value Added Tax of People's Republic of China, 1993*. These regulations stipulate that raw forest products, such as logs and lumber, fall into the category of agricultural products with a VAT rate of 13% and processed wood products have a VAT of 17%.

In some cases, forestry fees and taxes have served as a disincentive to farmers to develop timber plantations as after-tax revenues from harvesting planted trees are very low. The Chinese Government is currently reviewing its taxation and fees system, with the broad aim of adjusting taxes and eliminating fees that serve as a disincentive to the development of plantation forests. Although the taxes and fees need to be rationalized, reforms pose the risk that a sharp reduction could stimulate over-logging. Moreover, many county tax authorities are resistant to changing the current fee structure as the forestry fees are needed to pay their staff (Hyde and others 2003: 211).

Prices and Distribution/Marketing Policies

China is in transition from a planned economic system, where the prices and volumes of most commodities are set by the Government, to a market based economy. Under the planned economy, the State planned and controlled prices, production quantity and distribution of logs and timber products. The transition to a market economy can be viewed in three distinct phases: (i) planned allocation; (ii) the co-existence of planned allocation with liberalisation; and (iii) liberalisation under state supervision. In most instances, liberalisation has coincided with a significant rise in prices.

The transition process has proceeded erratically and not always in a linear fashion. In the Southern Collective Forest Region (SCFR), the State abandoned its monopoly on the purchase, sale and distribution of logs in 1985. It then re-established its monopoly in 1987, but subsequently repudiated it in 1993 (Hyde and others 2003: 15–16). Moreover, different regions have taken different paths. For example, in Northern China a planned allocation system governed the sale and distribution of timber until 1985. Prices were set centrally subject to minor and infrequent adjustment. Between 1985 and 1998 most timber was produced and sold according to centrally planned prices and quotas while a small amount was traded according to market forces. Not until 1998 was the timber market fully liberalised, subject to a permit system for supervision of logging and transport operations. In Southern China liberalisation followed a different timetable. Prior to 1980 timber was subject to state planned allocation. Between 1980 and 1985 a small proportion was liberalised. Full liberalisation occurred in 1985, allowing for the sale of timber at a negotiated market price.

Despite the overall trend towards market liberalisation, an array of procedures and regulations continue to constrain the ability of producers to adjust output volumes, prices and species to match market demand. Inflexible species-specific production quotas and complex permitting requirements cause uncertainty about when and if timber can be profitably sold (see Rozelle and others 2000: 4). Permits are required for cutting, processing, marketing and transporting wood products. Permits may be unavailable when quotas are tight, and even when available, the journey to the forest bureau to obtain the permit may impose a substantial burden on the household (Liu and Edmunds 2003: 39). The functioning of the domestic market may also be constrained by inefficient harvesting and

poor transportation infrastructure, although ongoing infrastructure improvements in Western China are likely to decrease hauling costs (see Rozelle and others 2000: 4; Hyde and others 2003: 211).

Management of forests

In China, all land, including forests, is technically owned by the State. However, forests and lands not directly managed by the State may be leased to collectives and other entities for forest production. Collectives control approximately 60% of China's total forest area. The other 40% of China's forests, primarily natural forests, are managed by the State in the form of 3000 independent State forest farms and 135 State forest bureaus (Hyde and others 2003: 8–10). As well as managing forests, many of the 135 state forest bureaus control their own wood processing facilities. State forest bureaus are line managed by local or provincial governments, but are subject to the State Forestry Administration guidelines on forestry practices, as are collective forests.

Before 1978, agriculture and forestry were centrally organized. Reform began in the agricultural sector, with individual households entering into household responsibility system contracts, which transferred the collectives' land use rights to individual households for periods of three to fifteen years. This reform was extremely successful, and similar arrangements were introduced for forestry in the 1980's. Individual households have gradually assumed long-term contractual responsibility for more of the lands under collective control and they now manage nearly 80% of these areas. For households involved in forestry, the Forest Law of China, effective since 1998, improved long term security of tenure and certainty over related contractual dealings, but uncertainties regarding land use rights remain, as illustrated by the imposition of the logging bans under the NFPP (Liu and Edmunds 2003).

Forest Certification

Forest certification is a process that leads to the issue of a certificate by an independent party verifying that an area of forest is managed to a defined standard. The Chinese Government is supporting work towards creating a standard for forest certification in China. In 2003, China issued a high level directive on strengthening the contribution of the forest sector to China's sustainable development and recognizing the need for ecological services provided by forests. Clause 12 of the directive calls for the opening of the forest sector to foreign investment and the acceleration of forest certification to meet international standards as soon as possible. Clause 17 calls for the establishment of a certification scheme to verify that ecological forests are being managed to provide ecological services (Central Committee of the Communist Party of China and China State Council 2003).

Government agencies, academics and forest experts in China are currently working to develop standards and systems for certification in China. Under new regulations these will need the approval of China's National Accreditation Committee. To attain market credibility, they will also need to satisfy the demands of international stakeholders for performance-based social and environmental standards, independent assessment and transparency. As of April 2004, two forest management units in China had received forest management certification under the Forest Stewardship Council system.

Certification's link to the market is created through a product label, which warrants that the timber or wood product originates from well-managed forests. Companies in the

supply chain hold chain of custody certificates so that the label can follow the wood from the forest to the finished product. As of June 2004, there were 64 wood processing companies in China that hold chain-of-custody certificates, and two FSC certified forests (UNEP-WCMC and Others 2004).

Trade and Investment Policies and China's Forest Resources

Trade Liberalisation

China's trade and investment policies have changed significantly over the last 15 years as a result of participation in APEC, accession to the WTO, and the opening of its economy in general, including reduction of trade barriers and encouraging foreign direct investment. China joined APEC in 1991 and has been an active participant in this regional forum for economic cooperation. General commitments include a 1994 agreement by members of APEC to gradually eliminate barriers to trade and investment. APEC members committed to a timetable for trade and investment liberalisation, with a deadline of 2010 for developed members and 2020 for developing members. In 1997, nine key sectors, including forest products, were identified for the Early Voluntary Sectoral Liberalisation.

China formally joined the WTO in December 2001, with a commitment to open up several sectors. This commitment does not, at present, extend to the forest products sector, where tariffs continue to be governed primarily by those commitments made under APEC. The increasing wood supply gap has prompted China to loosen controls over most wood-product imports. Tariffs on wood products have been reduced several times in the last ten years. Tariffs for logs, sawnwood, wastepaper and pulp have been reduced to zero. Furniture tariffs, which were 78% in 1992, were reduced to 22% in 1999. The import permit requirement for wood products was also relaxed in 1999 and the number of companies with importing authorisation increased significantly.

The changes in tariff levels, non-tariff barriers and domestic policy reforms have resulted in significant shifts in trade flows of major forest products. From 1998, wood products became the largest single import group for China. By 2000 China had become a net importer in all major categories of forest products.

The current tariff rates for wood-based products are set out in Table 1.1.

Table 1.1 Tariff rates on wood and wood products (2004)

Items	Tariff
Logs and sawnwood	0%
Paper and paperboard	10% – 22%
Veneer	4% – 10%
Plywood	2% – 12%
Fibreboard and particleboard	6.2% – 9.6%
Other processed wood products	3% – 6.8%

Source: Chinese Customs Office

China has adopted a preferential import policy with Russia, Vietnam and Myanmar. Imports from these countries have been subject to half the regular charge for tariff and VAT since 1996. The policy, which was originally designed to be a temporary measure to

encourage border trade, is still in place today.

Foreign Direct Investment

Until the mid-1990s foreign direct investment (FDI) was not a major driver of economic growth in China. However, FDI in all sectors, including forestry, has increased rapidly in recent years. China's former Ministry of Foreign Trade and Economic Cooperation reported FDI of US $52.7 billion in 2002, well above the US $44 billion invested in the United States during the same year (Bank of China 2003). China's foreign direct investment policies and general opening of its economy are enlarging China's wood processing capacity. This will lead to increased demand for wood, not only for consumption in China but for subsequent export to other countries.

In the forest sector, there are few restrictions on FDI, either for small timber processing operations or large pulp and paper mills, beyond compliance with China's domestic laws governing forestry and processing facilities. In the 1980's forest sector FDI was focused on the wood based panel industry. These investments generally financed new technology and equipment or joint ventures.

More recently, FDI has been concentrated in the pulp and paper industry — in pulpwood plantations and the development of facilities for pulp and paper processing. The Chinese pulp and paper industry is characterised by its heavy reliance on non-wood pulps, and remains highly fragmented, despite the closure of some 4,000 small, highly polluting mills in the mid-1990's. With this investment in high technology large scale pulp mills, pulp wood requirements will expand from 12.8 million cubic meters in 2000 to 29 million cubic meters. in 2015 (URS 2004). In southern China alone, the pulp wood deficit for these new mills from 2008 onwards has been estimated at around 1 million cubic meters per year, even if ambitious plantation expansion targets are met (Cossalter pers com. 2004).

SECTION II
DEMAND AND SUPPLY IN CHINA'S WOOD PRODUCTS MARKET

This section examines the dynamics of China's wood products market and the large and growing gap between Chinese demand for industrial wood and its domestic supply.

China's Forest Resources

Official statistics show that forest cover in China has increased over the last decade, from 145 million hectares in 1990 (15.6 per cent of the land area) to 163 million hectares in 2000 (17.5 per cent of the land area). In 2003, China issued a directive that set targets for increased forest cover of total land area in China: 2010 —19%, 2020 —23%, and 2050 —26% (Central Committee of the Communist Party of China and China State Council 2003).

Much of China's restored cover comprises limited-species plantations. China has one of the world's largest total areas of plantations (46.7 million hectares). Southern China has single species plantations of Chinese fir, masson's pine, eucalyptus, poplar and introduced pine species. In the north, most single-species plantations are mostly poplar. A recent surge in foreign direct investment in pulp plantations and pulp and paper processing facilities has spurred a new wave of planting in Southern China. However, most of the new plantations are still immature and will not supply fibre for some time.

Table 2.1 Comparison of China's forest resources 2000

	Forest Area (Billion ha)	Forest Volume (Billion m^3)	Portion of total land with forest cover (%)	Per Capita Forest Area (ha)
Russia	0.85	89	50	5.8
USA	0.23	31	25	0.5
Canada	0.24	29	27	7.9
China	0.16	8	18	0.12
World	3.9	386	30	0.6
China as % of the world	4.1	2	60	20

Data Source: FAO 2003

The focus on plantations to restore forest cover means China's forest diversity is probably declining. The afforestation rate is much higher than the regeneration rate,

implying that a significant portion of the natural forest is not being restocked naturally after harvesting (FAO 2003). Instead, most of the rise in forest cover is due to new single-species plantations on previously non-forested land.

China is relatively forest-poor given its large land area and population of over 1.3 billion people. Per capita forest coverage in China is estimated at only 0.12 hectares, about one-fifth of the global average. Table 2.1 compares the forest resources of major wood producing countries and shows that, relative to other large countries, China has limited forest resources.

China's Domestic Supply

According to official government statistics, China's industrial roundwood production grew from around 6 million cubic metres in 1949 to around 68 million cubic metres in 1995. Production declined from 1995, dropping to 44 million cubic meters in 2002, then it increasing to 48 million cubic metres in 2003 (see Figure 2.1). The decline in China's forest production began prior to China's logging bans and is largely a consequence of the depletion of China's mature natural forests. Eighty percent of China's state forest enterprises have exhausted their mature timber resources and cannot support their own mills (Hyde and others 2003: 200).

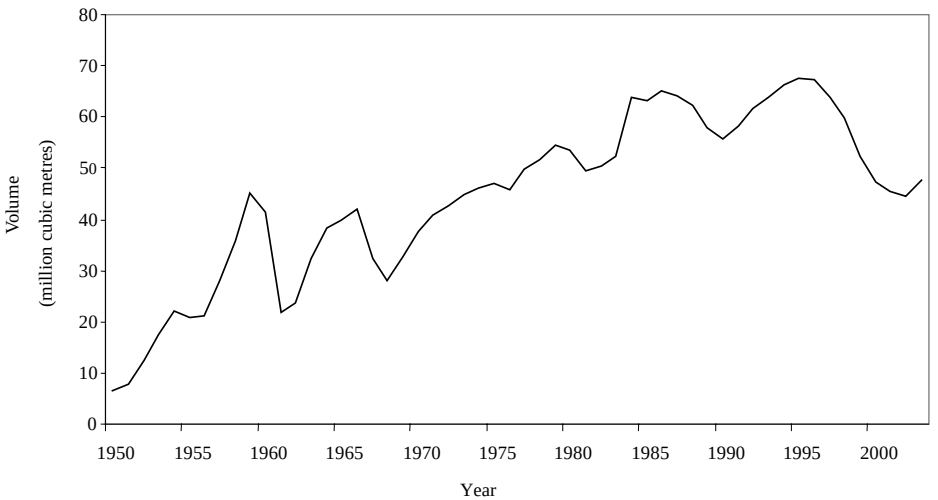

Figure 2.1 China's timber production trends (1950–2003)

China's forest resources are located in three main areas: Northeast China and Inner Mongolia (28% of forest area); Sichuan and Yunnan provinces in South-western China (19%); and ten provinces in Southern China (36%) (China SFA 1999). The Northeast and Southwest contain most of the remaining natural forest and are almost all managed by state forest enterprises, while the majority of plantations, which are primarily run by collectives, are located in the south.

Figure 2.2 shows that most of the recent drop in reported production is in the Southwest, with a smaller decrease in Northeast China and Inner Mongolia — both are regions with large tracts of natural forest. The data suggest that production was already declining in these regions before the logging ban policies were launched in 1998; however,

the decline was hastened by the introduction of the first bans. In the Southwest, production peaked in 1994 and thereafter declined, but the region saw the most rapid drop beginning in 1998. In Northeast China and Inner Mongolia, production began a slow decline in 1988, with the pace increasing slightly after 1998. Declining production in these areas has resulted in a smaller supply of high-grade logs. For example, between 1997 and 1999, annual production of high-grade logs decreased from 1.4 million cubic metres to 0.9 million cubic metres (Cohen and others 2001:47).

China's plantations have expanded from an estimated 14% of the total forested area in 1990 to 28% in 2000 (FAO 2003). China now has more area devoted to plantations than any other country in the world. Predominated by fast-growing species and short rotations, they are not intended to provide an alternative source of large, high-grade logs. Even the Southern Region, where new plantations are concentrated, experienced a decrease in reported production beginning in 1995, reflecting the high percentage of plantations that are not yet mature. The only region that increased its reported production during this time period was the North-Central region, where plantation production rose from around 0.8 million cubic metres before 1990 to 6.5 million cubic metres in 1995, and then increased more slowly to 7.2 million cubic metres in 2000 (this production is included within "Others" in Figure 2.2).

Figures 2.1 and 2.2 are based purely on China's official statistics for the output of provinces, autonomous regions and municipalities. Table 2.2, however, includes estimates of industrial timber production[1] not reported in these official statistics. These estimates adjust the domestic production figures upwards to take into account harvesting that does not enter the official production statistics for reasons such as the reluctance of local officials to report production in excess of official quotas.

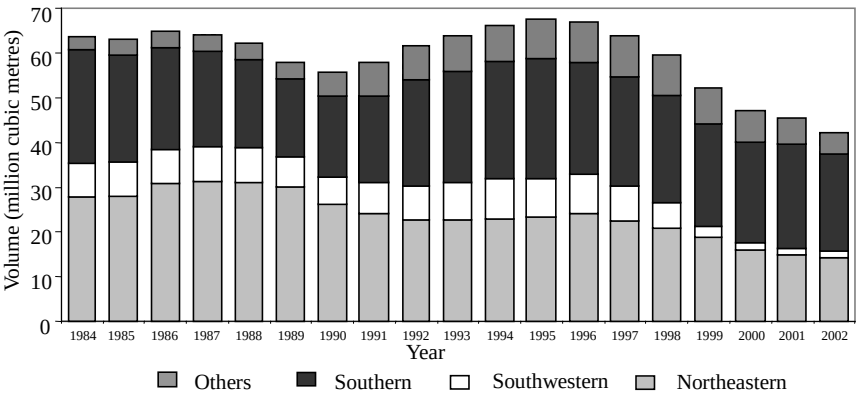

Figure 2.2 China's timber production (by region)[2]

The undeclared production is estimated by triangulating between three information sources — (a) official statistics on commercial timber production as shown in Figure 2.1; (b)

[1] Timber for industrial uses, such as building and infrastructure construction, furniture, flooring, panels, packaging, and pulp and paper, but not including fuelwood.

[2] Source: "China Yearbook of Statistics" (various years). "Yearbook of Forestry Statistics" (various years). Note 1: The data represent official statistics of industrial roundwood production. They do not take into account large quantities of undeclared production. Regions: 1. Northeastern: Heilongjiang, Neimenggu (/Inner Mongolia), Jilin, Daxinganling. 2. Southern: Zhejiang, Anhui, Fujian, Jiangxi, Hubei, Hunan, Guangdong, Leizhou Forestry Bureau, Guangxi, Hainan, Guizhou. 3. Southwestern: Yunnan and Sichuan 4. Others: Beijing, Tianjin, Hebei, Shanxi, Liaoning, Shanghai, Jiangsu, Shandong, Henan, Ningxia, Xizang (/Tibet), Shaanxi, Gansu, Qinghai, Xinjiang.

official statistics on consumption or use of forest resources; and (c) the National Forest Resource Inventory (NFRI). Official statistics on forest resource consumption are available from 1990 up to 1996 (the year of the last national survey on forest resource consumption). Consumption patterns are extrapolated for later years. The NFRI is conducted every five years in China, and is the most reliable source of data on changes in China's forest resource base. China's official production statistics show consistently smaller total volumes than the NFRI's calculations of the volume of wood harvested (produced) based on periodic comparisons of standing stock volumes. The precise methodology for estimation is described in Feng and others 1999.

Table 2.2 also makes allowance for fuelwood included in the official timber production statistics. The figures for timber production are reduced by the estimated volume of fuelwood included within official statistics to provide an estimate of purely industrial production.

Table 2.2 indicates the growth in the production of industrial roundwood logs in the 1980s and early 1990s, peaking at 100 million cubic metres in estimated output in 1995. After 1995, however, the domestic supply gradually declined, reaching a low of 75 million cubic metres in 2002, and then increasing slightly to 79 million cubic metres in 2003.

Table 2.2 China's industrial roundwood production (in millions of cubic metres)

Year	Industrial timber production, according to national statistics	Fuelwood included in the national statistics	Estimate of undeclared industrial production	Estimated industrial roundwood production
1984	63.8	6.6	19.7	77
1985	63.2	4.9	19.5	78
1986	65.0	5.4	20.1	80
1987	64.1	4.5	19.8	79
1988	62.2	4.7	19.2	77
1989	58.0	7.7	19.7	70
1990	55.7	4.6	18.9	70
1991	58.1	5.2	19.7	73
1992	61.7	5.5	20.9	77
1993	63.9	5.3	21.7	80
1994	66.2	6.0	36.3	96
1995	67.7	5.2	37.2	100
1996	67.1	6.4	36.8	98
1997	63.9	4.6	35.1	94
1998	59.7	4.1	32.8	88
1999	52.4	3.9	39.3	88
2000	47.2	3.3	35.4	79
2001	45.5	3.2	34.1	76
2002	44.4	3.1	33.3	75
2003	47.6	4.4	35.7	79

China's Wood Consumption

China's market for industrial timber, pulp and paper is currently the second largest in the world after the US market. In 2003, purely domestic industrial markets in China consumed around 138 million cubic metres (RWE)[1], while an additional 35 million cubic

[1] *Round Wood Equivalent* (RWE) is the volume of round wood (wood in log form) that is required to produce a given volume of processed timber or manufactured product. The difference between this and the output volume of processed wood comprises residual material and waste, some of which can be used in other timber products.

metres (RWE) were exported as value-added products.

Figure 2.3 graphs the trend-lines in China's industrial wood production and consumption over the last decade. It shows ten years of escalating imports. Import volumes of timber have more than tripled since 1993, reaching a massive 94 million cubic metres (RWE) in 2003. A large portion of the increase in imports filled the gap left by declining production in China.

In the year 2003, China's industrial wood consumption (production plus imports, minus exports) absorbed an estimated wood volume of 138 million cubic metres (RWE). However, consumption has increased relatively slowly over the last decade, lagging behind much higher growth rates for Gross Domestic Product.

In addition, China's wood products export sector has also enjoyed rapid growth since 1998. Thus an increasing proportion of the wood imported to China has been re-exported in the form of value-added products. In 2003, we estimate the volume of wood absorbed by China's exports reached 35 million cubic meters (RWE).

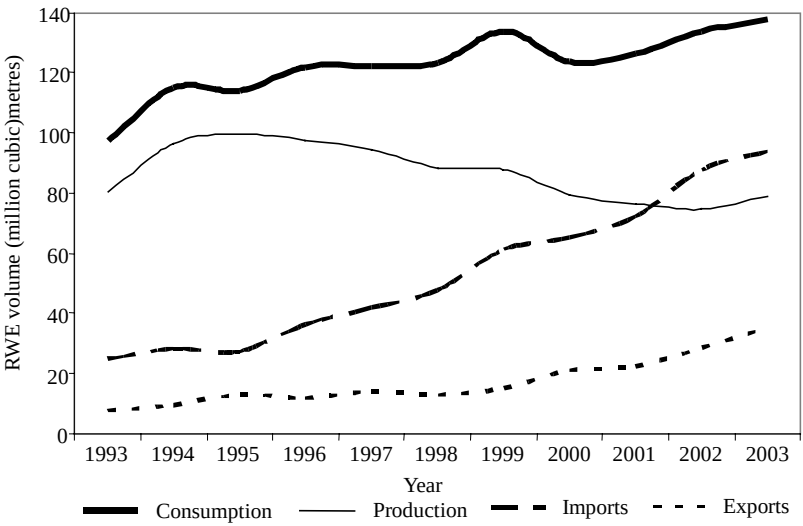

Figure 2.3 China's industrial wood consumption and production (including undeclared production)

China's Domestic Market

Housing and infrastructure construction comprises the bulk of demand for industrial roundwood in China. This report estimates that construction accounts for just over half the total volume of industrial wood used in China. Other research has made similar estimates and highlighted opposing sub-trends in the construction industry, with housing demand growing rapidly and infrastructure demand contracting (Cohen and others 2001:20). Other industrial uses for wood include furniture and papermaking and to a lesser extent, mining, railways, shipbuilding, chemical fibre and stationary (Table 2.3). Fuelwood is not included within the consumption statistics.

Table 2.3 China's industrial timber consumption (in millions of cubic metres)

	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Construction	67	76	68	71	68	66	70	68	70	73	75
Furniture	9	15	20	16	14	13	11	12	13	14	15
Pit props	9	9	10	9	8	9	9	7	7	8	8
Paper	6	9	10	18	22	23	29	26	27	30	32
Stationary	4	3	3	3	3	3	4	3	3	4	4
Vehicle & ship	2	3	3	3	2	3	3	2	2	2	3
Other	2	2	2	2	2	2	2	1	1	1	1
Total	102	119	118	125	121	121	131	121	125	132	138

Source: Data for 1993 to 1997 from Li 1997:28 and for 1998 to 2003 estimated using the methodology described in that reference.

Most urban dwellings in China are built using block and concrete methods. Wood is used for concrete forms, windows, doors, joists, beams and rafters, as well as for cabinets, flooring, moulding and wall panels in house interiors. The housing industry consumes an estimated 0.025 to 0.045 cubic metres of wood per square metre of floor area in urban areas and a higher ratio of 0.04 to 0.06 m^3/m^2 in rural areas. Interior design adds an estimated 0.025 m^3/m^2 to total wood use in housing (Cohen and others 2001:20). Under the National Housing Reform Programme, China plans to construct 5 billion square metres of new housing and 2 billion square metres of renovated housing by 2005 with the goal of doubling the average living space per unit of housing by 2010. In addition, the reforms seek to privatise much of the urban real estate in China. These reforms, coupled with a strong economy and increasing population, are expected to stimulate continued growth in housing with consequent strong demand for wood.

China's pulp and paper sector is also undergoing rapid growth. The Chinese industry remains extremely fragmented, with more than 6,000 paper mills operating. At least 80% of these mills are small and uncompetitive on the international stage, lacking the economies of scale and efficiency of the larger, more modern, mills. The smaller mill segment, whose output is based primarily on agricultural residues and other non-wood fibres rather than wood fibre, is under significant pressure to downsize, due both to its poor efficiency and because many of the mills discharge high levels of water pollutants. Stricter enforcement of environmental mills forced the closure of thousands of mills in the late 1990's. The closure of these small scale mills, coupled with the new large-scale wood-fibre mills, is likely to result in significant increases in China's overall demand for wood over the next five to fifteen years (URS Forestry 2004).

Another significant consumer of wood is the furniture industry. While the industry is still a small player in comparison to the construction industry, its demand for roundwood is expected to increase as more and more furniture is exported. According to the Chinese Customs Statistics Yearbook, wooden furniture exports account for about a third of furniture exports by value. By contrast, the domestic market for wooden furniture is stagnant, with domestic consumers increasingly buying furniture made from metal and plastic materials. A vibrant market in second-hand wooden furniture, particularly from urban areas to rural areas, also contributes to the low demand for new wooden furniture.

Although this report is focused on China's market for industrial wood, fuelwood consumption cannot be ignored. Fuelwood accounts for nearly half of total wood consumption in China (FAO 2003). This has a direct effect on the industrial wood supply because the annual allowable cut for timber, which includes both commercial timber and fuelwood production, is based upon the annual increment of the growing stock. Thus, if the

volume of fuelwood sourced from official timber production areas increases, it will result in a decrease in the volume of wood available for industrial uses.

China's Export Markets

A fast-growing share of the wood grown in China or imported into the country is exported in the form of finished or semi-finished manufactured products, paper and wood chips. From 1993 to 2003, the roundwood equivalent volume of wood-derived exports grew fivefold, with the largest growth being in furniture. In 2003, China's total exports of wood-derived products had a combined volume of 35 million cubic metres (RWE). Timber products comprised the bulk of exports (24 million cubic metres RWE) while paper and wood chips (11 million cubic metres RWE) formed the rest. China exports an insignificant amount of pulp, roughly 0.05 per cent of its total wood product exports.

Figure 2.4 shows the composition of China's wood product exports over the last decade. Growth in the export market has been driven in large part by wooden furniture, plywood and, since 1999, paper. This trend is consistent with the Government's efforts to restrict exports of primary products and encourage exports of value-added products. In 2003, furniture was the leading timber export from China, making up almost a third of the total by RWE volume. Furniture exports have increased rapidly over the last decade, with export wood volume growing eleven fold between 1993 and 2003.

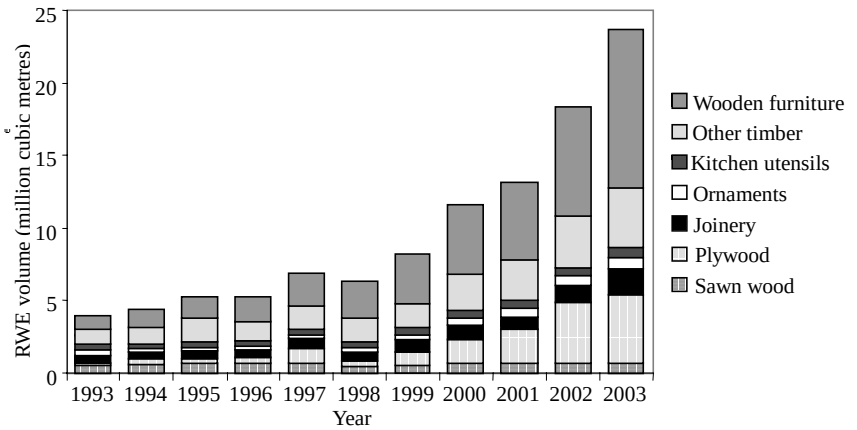

Figure 2.4 China's exports of timber products (by product type)

China's plywood exports rose fivefold between 1997 and 2003. Since 2001, China has been a net exporter of plywood. The principal export destinations for plywood in 2002 were Korea, Japan, USA, and Taiwan. Much of this plywood is coming from small-scale mills located on the coast near the port of Nanjing, the principal port of entry for tropical hardwood logs (Sun and others 2004).

Figure 2.5 shows, by destination, the strong growth in the volume of timber products exported over the last decade. Excluding wooden furniture, Japan was the largest market for China's timber exports until 2003, when it was overtaken by the USA. In 2003, Japan imported the majority of China's chopstick exports and a large share of China's sawnwood exports. Other top destinations for non-furniture products include Hong Kong and South Korea (particularly for plywood).

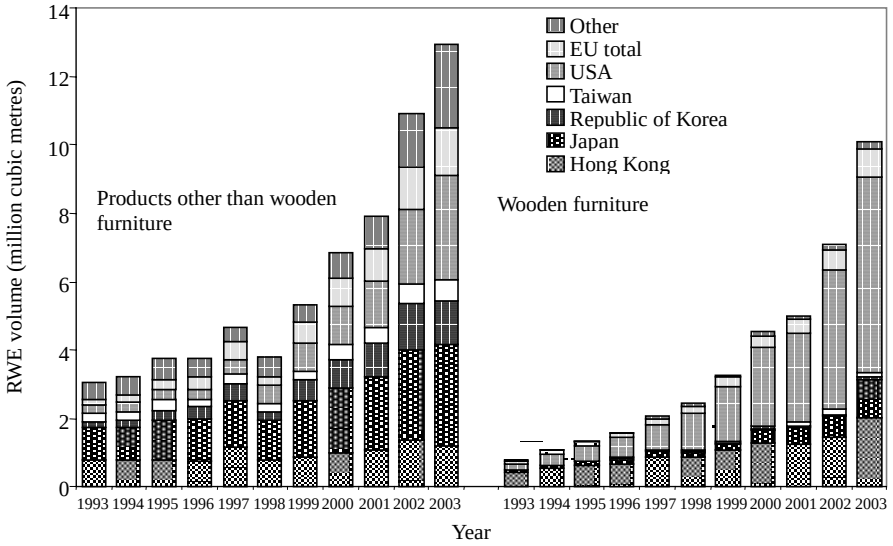

Figure 2.5 China's exports of timber products (by destination)

Figure 2.5 shows that wooden furniture exports are increasing rapidly and that the US and, to a lesser extent, Hong Kong, are the principal destination markets. Since 2002, China has supplied more than one-third of the US's wooden furniture imports. However, US trade sanctions threaten to dampen this trade in the future. In June 2004, the US trade authorities made a preliminary ruling to impose anti-dumping duties on producers/exporters of wooden bedroom furniture from China. The case was brought by a group of US manufacturers who argued that Chinese manufacturers had sold their products at prices below production cost. The value of the trade in the affected products from the USA to China had been $1.2 billion in 2003 (USA Department of Commerce 2004).

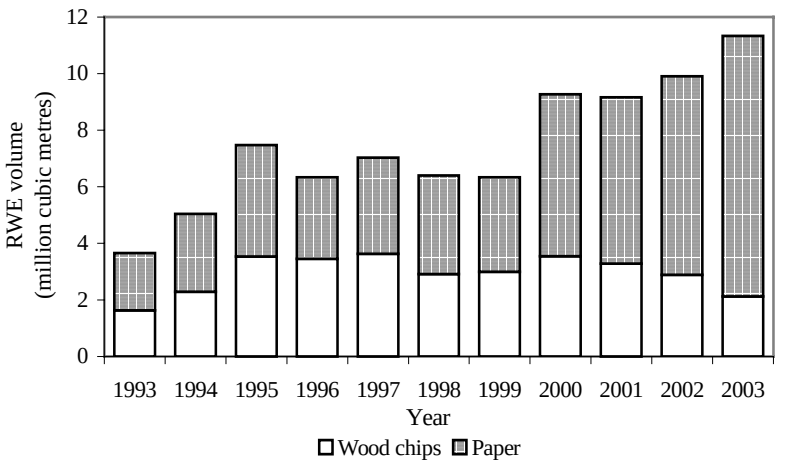

Figure 2.6 China's exports of paper and wood chips (by product type)

Foreign investment in factories in China, coupled with the supply of cheap wood and labour, as well as government support, has enabled China to create this demand. Beginning in the late 1980s, the Chinese Government encourage companies from Hong Kong and

Taiwan and other foreign companies from Singapore and Malaysia to invest in furniture manufacture in China, both for export and domestic consumption. By 1998, there were approximately 650 foreign-funded furniture companies in China. European and American companies have also begun to invest in furniture with an eye toward the developing European market (Shi and others 1999:86).

Exports of paper and wood chips have also experienced significant, though less even, growth over the last decade. As Figure 2.6 shows, exports increased in the early 1990s, flattened between 1996 and 1999, and then rose again over the next four years. While exports of wood chips hovered around 2 million cubic metres RWE from 1995 to 2002, and dropped to 1.6 million cubic metres in 2003, paper exports have surged from 2.7 million cubic metres RWE in 1999 to about 9.2 million cubic metres RWE in 2003.

Figure 2.7 shows exports of pulp, paper and wood chips by market destination. Japan, the primary importer of Chinese chips, imported roughly half of China's total chip exports in every year since 1993. Chips, taken from eucalyptus plantations in Guangdong and Hainan provinces as well as chips from branches and small diameter timber from Northeast China and Inner Mongolia, are exported to Japan, Taiwan and South Korea (Shi and others 1999). China's largest market for paper products over the past decade has been Hong Kong, but other export destinations including Japan, the United States and Taiwan have also attracted recent growth. Investment in new mills appears to have created a capacity in excess of China's appetite for paper. This excess capacity is driving export growth.

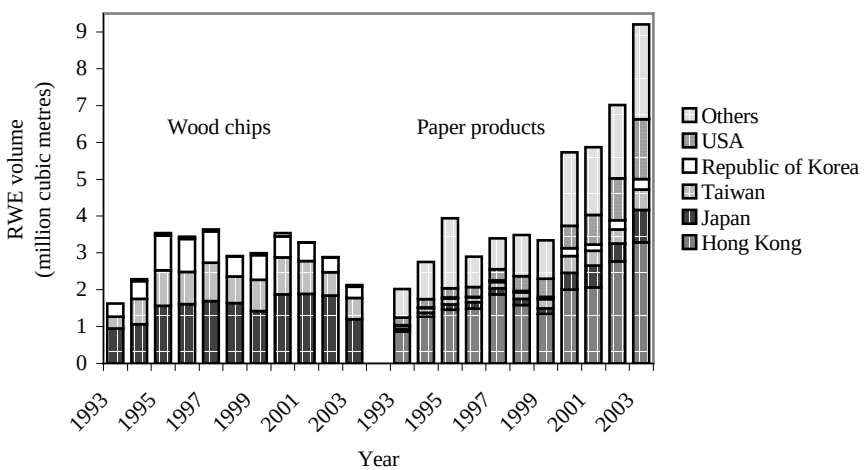

Figure 2.7 China's exports of paper and wood chips (by destination)

China's Imports

China's imports of processed and unprocessed wood products have increased substantially since the mid 1990s. In 2003, China imported around 42 million cubic metres (RWE) of timber products and 52 million cubic metres (RWE) of pulp and paper (excluding recycled waste-paper).

Figure 2.8 illustrates the recent rapid growth in the volume of China's timber imports. Annual import volume more than doubled between 1996 and 2003. Logs, and to a lesser extent sawnwood, led the increase in volume. Between 1996 and 2003, China's log imports

grew from 3.2 million cubic metres to 25.5 million cubic metres, while imports of sawnwood grew from 1.7 million cubic metres (RWE) to 10.0 million cubic metres (RWE). China's other imports — including plywood, once the largest import by volume—decreased or stagnated during the same time period as China's own plywood factories flourished and China switched to importing the raw material to supply these mills. Since 2001, logs and sawnwood have overwhelmingly dominated imports, making up 85 per cent of China's total import volume for timber. Logs now account for 60% of total timber imports — 25 million cubic metres from a total of 42 (RWE) million cubic metres in 2003.

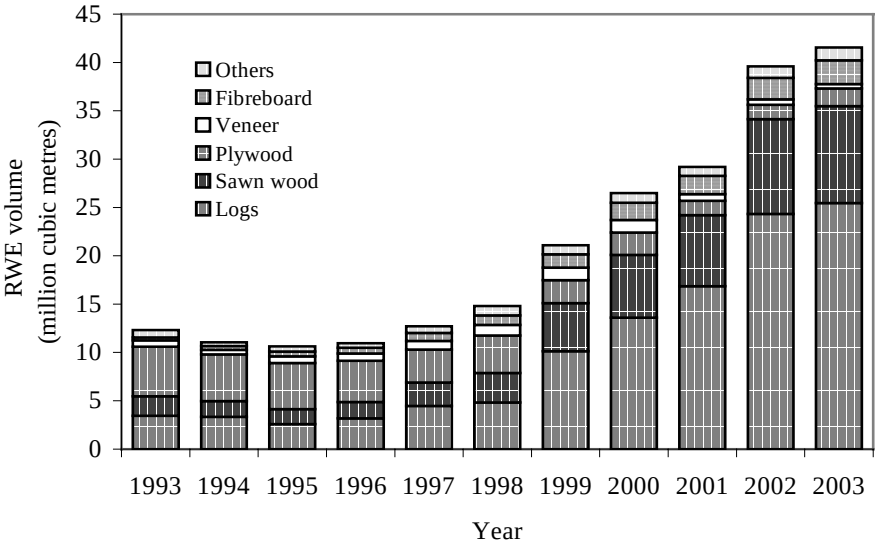

Figure 2.8 China's timber imports (by product type)

Figure 2.9 shows the steady growth in pulp and paper imports into China over the past decade. There has been an upward trend in total pulp and paper imports since 1993, with pulp imports growing at a faster rate than paper. In 1998, China imported twice as much paper by RWE volume (17 million cubic metres) as pulp (8 million cubic metres). However, by 2003 China imported around 28 million cubic metres of pulp, and 24 million cubic metres of paper (in RWE). This is directly linked to the proliferation of new paper plants using wood-based fibre.

While the volume of locally produced wood pulp has increased significantly in recent years, China has had to import an even greater quantity of wood pulp, particularly high-quality bleached pulp needed to make printing and writing grade paper. Mills producing this grade paper are the sector of the paper market with the strongest growth. Manufacturers of lower quality papers, such as newsprint, packaging and paperboard have located alternative sources of fibre, mainly wastepaper, both locally and, more recently, from overseas. China now also imports more than 6.4 million metric tonnes of wastepaper annually, a fivefold increase since 1996 (URS Forestry 2004).

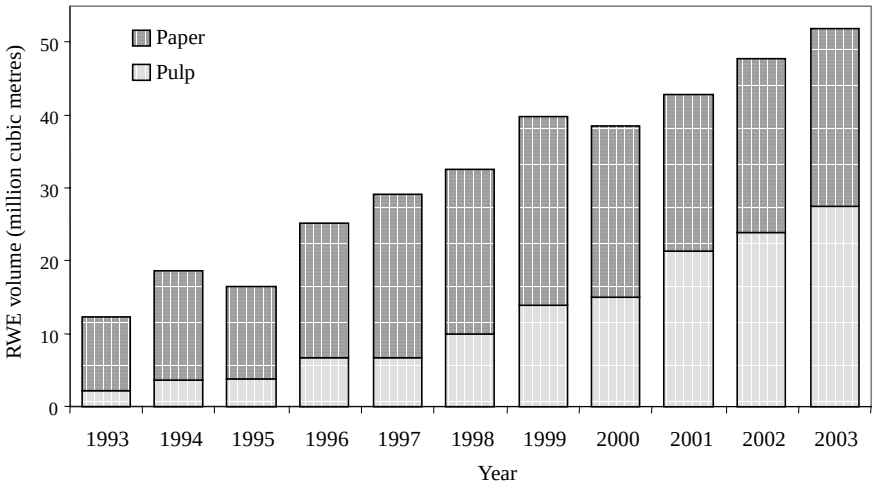

Figure 2.9 China's imports of pulp and paper (by product type)

Figure 2.10 shows Russia, Malaysia and Indonesia as the three largest suppliers of timber to China. In 2003, China's combined timber imports from these countries totalled around 24 million cubic metres (RWE). New Zealand, Gabon, Germany, Papua New Guinea, Thailand, the United States, Canada and Myanmar make up a second tier of countries that each supplied more than 800,000 cubic metres (RWE) of timber to China in 2003.

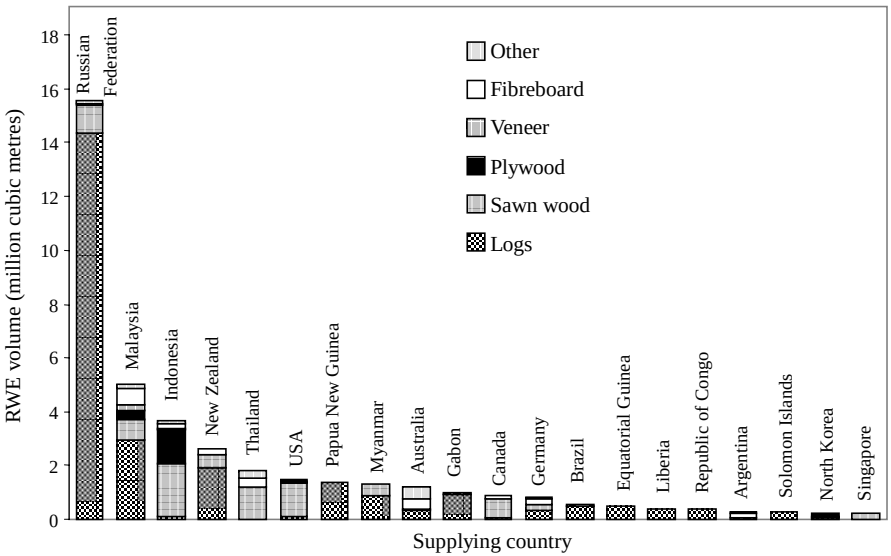

Figure 2.10 China's timber imports during 2003 (supplying countries, by product type)

Much of the current supply of good-quality hardwood is associated with over-harvesting and conversion of natural forests. Therefore it is doubtful whether some countries that supply China at present can maintain their capacity to supply China's future markets, particularly at the very low prices that prevail today. Those countries and

producers that can sustain productivity of hardwood forests over the long term are likely to find themselves in the enviable position of supplying a “seller’s market.”

Figure 2.11 shows the countries or regions that supplied pulp and paper to China in 2003. Indonesia, Russia, Canada, South Korea, USA, Taiwan, Brazil and Chile were the major supplier countries or regions. Some of these countries or regions (such as South Korea and Taiwan) largely process wood grown elsewhere. Other countries such as Indonesia, Russia and Canada predominantly export wood harvested from their natural forests. It is estimated that China will be particularly reliant on other countries to supply pulp, paper and paperboard and good quality hardwood for decorative use in buildings, houses and furniture.

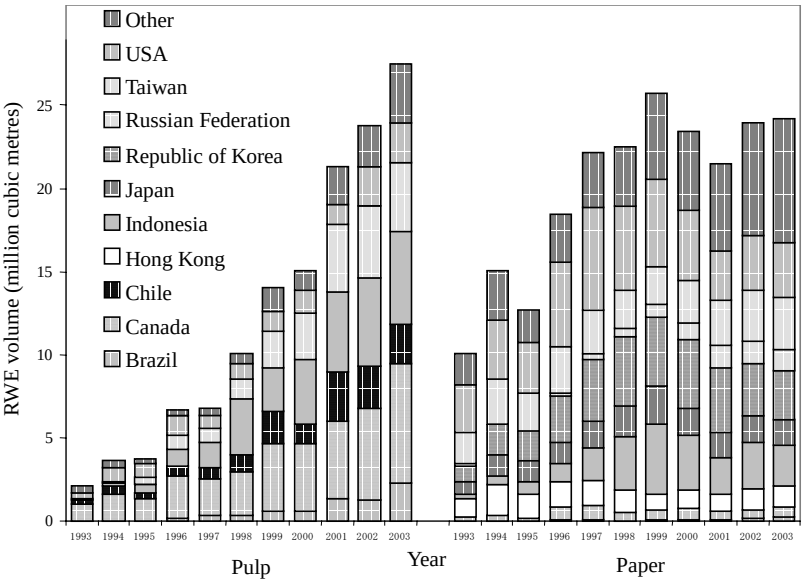

Figure 2.11 China’s imports of pulp and paper (by supplying country)

Demand from China’s growing export-oriented wood-product manufacturing sector contributed to this expansion. Reductions in import tariffs may also account for some of the increases in import volumes. In so far as these reductions have made smuggling less attractive, some of the apparent increase in imports may merely be a reduction in undeclared imports. The levels of imports by producer country are examined in detail in Section III in an effort to characterise the “ecological footprint” brought about by rising demand for wood in China for consumption and re-export, and efforts to meet this demand through increasing imports and increasing domestic production.

Future Trends

Many of the market attributes and trends in China’s forestry sector are likely to persist for the medium term. Expectations are that China’s domestic supply of conifers will continue to fall due to depleted stock in the volume of natural forests. The housing sector seems likely to continue to grow, paper consumption is likely to continue to shift away from non-wood fibre to wood-based papers, including recycled paper, demand for raw

material for plywood mills and pulp and paper mills should remain strong, and exports of wooden furniture should grow (unless dumping allegations proliferate and trade sanctions dampen this trade).

These expectations are predicated on some important assumptions. First, that China's economy will continue to enjoy strong economic growth. China is not immune from the effects of a weakening global economy and any slow-down in economic growth in China will impact its wood products sector. Second, that China will be able to continue to source inexpensive wood from other countries. Some of this wood is currently sourced from regions where low cost "cut and run" logging is prevalent. Any improvement in controls on logging or the collection of taxes and other charges in these regions could raise prices and/or constrict supply.

Under most scenarios, however, housing is expected to form a major part of demand for wood in the future. Even more wood may be needed if building techniques incorporate wood to a greater degree. Currently, building regulations are being modified to allow for the greater use of wood in structures. Despite the fact that it is currently rare, modern wood-frame construction is expected to increase in the next decade, particularly in the wealthier cities of eastern China. In addition rapid construction of hotels and other large buildings is likely to continue in large cities such as Beijing, Shanghai and Guangzhou (Hagler and others 2001:158).

It is difficult to predict whether infrastructure construction will continue to slow or will regain speed, as the effects of the economic correction in East Asia during the late 1990s wear off. Given that China's government plans to focus attention on development in the western region under its Western Regional Development Programme, there may be a renewed demand for timber for large infrastructure projects.

Growing domestic demand for better quality paper and demand from new large-scale wood pulp mills, attracted by China's Foreign Direct Investment policies, will result in increased demand for wood fibre. Although the wood pulp mills are expected to use fast growing plantations and recycled fibre, China will need to import large volumes of pulp and paper to supplement domestic production to keep pace with growing demand, at least in the medium term.

By 2010, we estimate that China's industrial wood consumption will have expanded further to 171 million cubic metres per year, with pulp and paper at 69 million cubic metres (RWE).[1] In addition to the wood consumed domestically, China's wood market will absorb additional volume for its export products. We estimate these exports will reach 68 million cubic metres in 2010 (RWE), based on a 10% percent rate of annual growth in exports from 2003 levels. This would put the total volume of wood input to the China market at 239 cubic metres (RWE).

While estimates of the size of China's future wood supply vary, it is clear that the supply of wood from short-rotation plantations will increase as newly planted areas in Southern China reach maturity. On the production side, we estimate that China will produce 114 million cubic metres of industrial roundwood in 2010.[2] This would mean that China would need to import 125 million cubic metres (RWE) in 2010 to satisfy our estimate of demand for wood for domestic consumption and re-export. This represents an increase over the 2003 level of imports of an additional 31 million cubic meters.

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[1] The estimates are based on assumptions and statistical methods described in Feng and others 1999 and detailed analysis in the following unpublished reports to the State Forestry Administration — Hou and Wang 1999, Sun X 1999, Lin 1999, Feng and Cui 1999.

[2] This estimate builds on the methodology described in Feng 2001.

Table 2.4 compares the findings of this report with the results of two other studies that attempt to estimate the size of China's industrial wood market in 2010. While the estimates vary considerably, the studies reach a common conclusion that China's domestic industrial wood supply will fall a long way short of demand in 2010. Wood Resources International estimates that in 2010, China will need to import around 119 million cubic metres (RWE) of industrial roundwood to balance supply and demand. The ITTO researchers predict a supply gap of 64 million cubic metres (RWE). This report, with the advantage of a few more years of historical data, estimates that in 2010, China's wood supply gap will be higher than predicted by both earlier studies — at 125 million cubic metres (RWE).

Table 2.4 Estimates of China's wood market (2010)

Study	China's domestic industrial wood supply (cubic metres — RWE)	Import volume needed to match demand(cubic metres — RWE)
This report	114 million	125 million
ITTO(Shi and others 1999)	180 million	64 million (21 million in tropical timber)
Wood Resources International (Hagler and others 2001)	113 million (83 million from short rotation plantations)	119 million

SECTION III
THE "ECOLOGICAL FOOTPRINT" OF CHINA'S WOOD CONSUMPTION

This section examines the environmental impact, or "ecological footprint" of China's increasing demand for raw logs, pulp and other wood products.

What is an Ecological Footprint?

WWF's *Living Planet Report* (WWF International 2004) features a measure of the ecological pressure of humanity on the Earth. This measure, known as the "ecological footprint," compares human consumption of natural resources with the Earth's biological capacity to regenerate them. The ecological footprint estimates how much productive land and water an individual, a city, a country, or humanity requires to produce the resources it consumes and to absorb the waste it generates, using prevailing technology. Globally, the footprint grew by 80 per cent between 1961 and 2001, to a level 21 per cent above the Earth's biological capacity. Natural resource consumption can exceed the planet's productive capacity by depleting the Earth's natural capital, but this cannot be sustained indefinitely.

The ecological footprint is also calculated for individual countries, thus enabling comparisons between their resource consumption patterns. The ecological footprint of the average consumer in the industrialised world is roughly four times that of the average consumer in lower income countries.

In addition to the per capita measures in the WWF *Living Planet Report*, in this section we use the "footprint" notion as a broader metaphor for the ecological impact of wood growing and harvesting operations in regions that supply industrial roundwood to China. We attempt to discern where that footprint falls and the pressure it exerts on the environment. An important aspect of this examination is the extent to which China's recent (domestically pro-environment) policy reforms have environmental impacts that were not anticipated in other countries.

China's expanding demand for wood is stimulating forest enterprise in many diverse regions. In regions with sound governance and a well-managed permanent forest estate, revenues from forest product exports to China may come without significant environmental cost. If China transfers its timber sourcing to such regions, and away from unsustainable and erosion-causing domestic production, it may reduce its net footprint. However, in frontier regions with poor forest governance, increased exports to China may result in a

larger ecological footprint in the form of migratory logging and indiscriminate forest clearing. In this section, we explore the extent to which China has taken the pressure off its own environment, yet as a side-effect, increased environmental pressure on other countries.

Our focus on ecological impacts should not be interpreted as a relegation of the importance of social impacts. Clearly the policy changes in China described in earlier sections have enormous positive and negative social impacts. Within China these range from removing the livelihoods of former state forest enterprise employees and communities dependent on forestry to reducing the long-term vulnerability of communities downstream to destructive floods. Outside China many wood supplying regions incur high social costs such as "boom-bust" local economies, aggravated land disputes, denial of customary tenure, loss of subsistence supplies of forest medicines, building materials and foods, and increasing floods and landslides. While beyond the scope of this section, a full appraisal of the consequences of supplying wood to China or other markets would necessarily include an assessment of social impacts.

China's Forest Footprint

One of the sub-components of the *Living Planet Report's* ecological footprint is the "forest footprint." This estimates the area, in average global terms, needed to produce the wood products that an individual consumes. The forest footprint measures the portion of the average person's ecological footprint that can be attributed to wood consumption (excluding fuelwood). Table 3.1 indicates that on a per capita basis, China had a small to average forest footprint of 0.08 global ha[1] area units in 2001, compared with 0.18 global ha of the world average, 1.35 global ha of the United States and 0.33 global ha of Japan.

Table 3.1 Forest footprint (global ha per person, 2001)

Countries	Forest footprint	Regions and World average	Forest footprint
China	0.08	Africa	0.06
India	0.01	Asia/Pacific	0.07
Indonesia	0.05	Latin America & Caribbean	0.20
Japan	0.33	Western Europe	0.58
Korea DPR	0.05	North America	1.35
Korea Rep	0.24	Middle East & Central Asia	0.06
Malaysia	0.19	Low income countries	0.03
New Zealand	1.45	Middle income countries	0.12
Russian Federation	0.30	High income countries	0.80
United States of America	1.35	World average	0.18

Source: WWF International: 2004.

Even though China's per capita forest footprint is relatively low, its large population makes it the world's second largest consumer of industrial roundwood after the United States, and just ahead of Japan (Figure 3.1). Nevertheless, the average citizen of the United States and Japan consumes 17 and 6 times more industrial wood, respectively, than the typical resident of mainland China.[2]

Countries (or regions) shown are confined to those consuming a roundwood equivalent volume exceeding 15 million cubic metres per annum. International standard abbreviations have been used to identify country names.

[1] A global hetare is a hectare whose biological productivity equals the global average (WWF Living Planet Report 2004).

[2] Comparisons are based on industrial wood consumption figures for the year 2000 (FAO: 2003) converted to a per capita figure.

In 2003, China was unable to source even 50 percent of its industrial wood products market. China needed a harvest of around 173 million cubic meters of industrial roundwood, but only produced half this amount, while the rest came from other countries.[1]

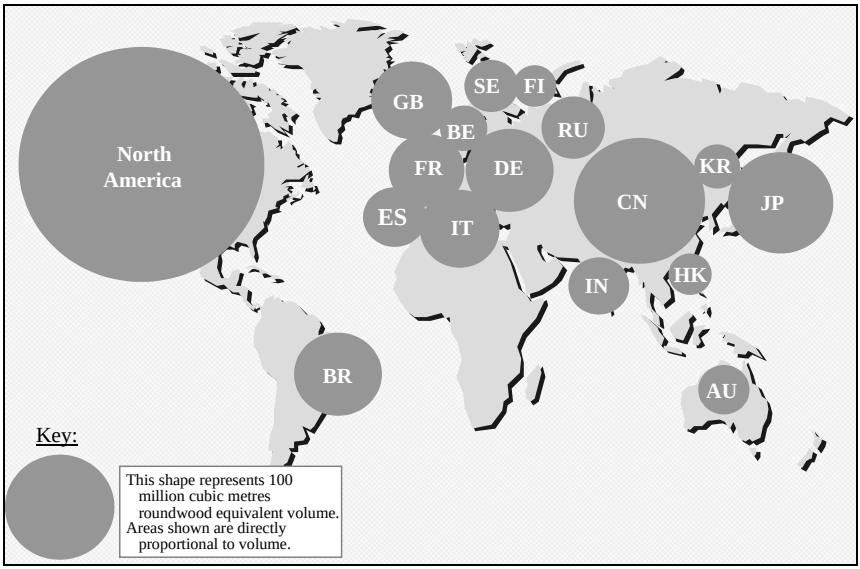

Figure 3.1 Consumption of timber, pulp and paper products during 2000 (by principal country)

In aggregate, China's wood market has a relatively large footprint both at home and abroad and the size of the market is expected to grow. This growth does not necessarily translate to a heavier ecological footprint, as a shift in sourcing from natural forest to fast rotation plantations could ease the impacts of growth.

China's Domestic Forest Footprint

The NFPP and the Grain for Green Programme were announced as direct responses to the massive flooding in the Yangtze River Basin and Songhua River and Nen River in Northeast China in 1998, which resulted in more than 3,000 deaths, the loss of about 5 million hectares of crops, and extensive damage to rural infrastructure. The logging bans under the NFPP have enormous potential to reduce the footprint of the timber industry within China itself. Environmental benefits could include enhanced protection, management or restoration of forests across 95 million hectares of forests in the upper reaches of the Yangtze River, the upper and middle reaches of the Yellow Rivers, Northeast China and Inner Mongolia, Northwest China and Hainan Island. Restoration of tree cover under the related Grain for Green Programme could also strengthen ecological integrity in deforested hill and mountain areas.

These reforms could give China's degraded forest landscapes a much-needed chance to recover. So far, the NFPP has successfully reduced wood harvesting in areas covered by the logging bans. In the implementation plan approved by the China State Council, commercial logging of 2001 had dropped by around 18.3 million cubic metres of

[1] Comparisons are based on industrial wood consumption figures from the year 2000 (FAO: 2003) converted to a per capita figure.

roundwood from 1997 levels and total reduction of 2003 is 23 million cubic metres of industrial roundwood. In provinces such as Sichuan, where timber resources were near exhaustion when the ban was put in place, the new policies may simply underline the inevitability of a cessation in production. Nevertheless, successful redeployment of forest industry workers in forest management and restoration could confer additional benefits to the cessation of logging.

Case studies on the early implementation of the NFPP and Grain for Green Programme show variation in the speed and strictness of their application from region to region within China. In some cases, provinces have added more stringent requirements to central-level policies on issues such as community access to forests for subsistence needs, or have increased the extent of the logging reductions required in forestlands held by state-owned forest enterprises. Logging in contravention of the bans continues in some regions. In Yunnan, for example, this is driven by local wood shortages, with the forests officially designated for fuel wood harvesting unable to meet local demand. This harvesting may have more severe impacts than legal logging due to the absence of supervision of logging practices and lack of support for regeneration (see Zuo 2002a).

The imposition of the logging ban in community forests has serious implications for people's livelihoods and ultimately may impact negatively on the forest itself by undermining the community's motivation to safeguard the forest. The China Council Task Force recommended exempting community forests from the bans for this reason (Xu and White 2002:65). Similarly, the ban may undermine customary forest stewardship systems of forest dwelling minorities. A study from Yunnan province cites the case of a minority group that was expected to relinquish its customary rights to the forests with no compensation, despite having a long history of protecting the forest through traditional practices (CBIK 2002:77).

Both the NFPP and the Grain for Green Programme are focused primarily on soil and water conservation. Other ecological values, biodiversity in particular, may well be overlooked (by, for example, promoting the replacement of biodiversity-rich vegetations with monoculture timber plantations). The risk of unanticipated environmental impacts is compounded by the lack of outcome-based monitoring and evaluation to determine whether the programmes are meeting their environmental objectives (Zuo 2002a:8, Zuo:2002b:46).

On balance, China's policies related to forest resources, including the NFPP and the Grain for Green Programme, hold out the prospect of more good than harm to China's ecosystems. However, with the logging ban due to be relaxed in 2010, the long term domestic impact of China's industrial forest sector will depend on how well production forests are managed in the period that follows. China will also need a coherent and effective forestry policy that links its production capacity to its wood processing capacity. Similarly, in the aftermath of the Grain for Green Programme, restored tree cover may be lost if current subsidies are exhausted without the creation of new incentives for farmers and ongoing soil conservation and maintenance measures. Problems are already surfacing, including low survival rates for trees with the consequent need for repeated plantings (Zuo 2002b:46).

Adjustments in these programmes, such as those recommended in section IV of this report, could reduce China's net forest footprint in two ways: (i) by maximizing positive environmental impacts within China, and (ii) by allowing environmentally responsible wood production in some resource-rich areas of China where logging is currently banned, to offset China's demand for wood from other countries, and in particular from regions where forest management is poor.

Trends in foreign direct investment in China indicate considerable interest in investment in the pulp and paper sector, particularly on a large scale, moving from the traditional small mills that predominated in the past. The transition to large and mega-scale production facilities will inevitably have scale effects with regard to the environmental impacts associated with the production of pulp and paper. Most of China's paper production has traditionally used non-wood pulp and waste-paper as inputs. Many of the modern paper machines currently being installed will rely exclusively on wood fibre pulp. As a result, China's annual consumption of wood pulp could continue to rise and China's trade liberalisation is likely to facilitate further increases in the volume of pulp and wood chips that are shipped to China. Until plantations are developed to generate this wood fibre, it is possible that the large pulp mills will place heavy pressure on China's existing natural and planted forests and might even threaten to undermine the NFPP bans on logging.

Other Countries Within China's Forest Footprint

China is, and will continue, importing wood to meet its demand. The environmental impacts of these imports will depend on a number of variables including where the raw logs come from, types of plantations and management practices and the proliferation of illegal or poorly planned logging in the source country. As shown in Figure 2.10, Russia, Indonesia and Malaysia were the three largest suppliers of timber to China in 2003. China's combined timber imports from these countries totalled around 24 million cubic metres (RWE), which is more than half of the total amount of 42 million cubic metres (RWE). New Zealand, Gabon, Germany, Papua New Guinea, Thailand, the United States, Canada and Myanmar make-up a second tier of countries that each supplied more than 800,000 cubic metres (RWE) of timber to China in 2003. Imports from Russia have tended to offset the reduction in production from forests affected by the NFPP.

The rapid increase of timber imports has had impacts outside of China. China imports from many countries where forest management is weak, which increases the potential negative impacts of China's imports in these countries. These impacts could be mitigated if supplier countries improved their forest management practices.

China's pulp and paper imports (totalling 52 million cubic metres in RWE in 2003 excluding recycled paper) derive from a larger volume of wood harvested in other countries than China's imports of timber logs (42 million cubic metres in RWE). However, this higher volume does not necessarily mean China's pulp and paper use has a larger international footprint than its timber use. A larger proportion of the pulp and paper supply may, for example, come from regions with higher standards of forest management or from plantations on formerly degraded land rather than logging in natural forests. Indonesia, Russia, Canada, Chile, South Korea, the United States, Taiwan, and Brazil were the major suppliers of pulp and paper to China in 2003 (Figure 2.11). Some suppliers (such as South Korea and Taiwan) largely process wood grown elsewhere. The exports of other countries (such as Indonesia, Russia, Canada and Chile) derive predominantly from their own harvests.

China's rapidly growing demand for wood pulp is likely to place pressures on the natural forests of Southeast Asia, Russia and Latin America. Pulp producers in Indonesia, Thailand, and Malaysia have shipped an increasingly large proportion of their output to the Chinese markets over the past few years. The Chinese Government has also entered into joint ventures with regional pulp producers to develop large-scale processing facilities in Thailand and Malaysia, with the aim of supplying pulp to Chinese paper mills.

A number of countries will be well placed to supply these product sectors in 2010. In terms of pulp, major suppliers to the Chinese market at present are Brazil, Chile, Russia, Canada, the United States and Indonesia. Countries likely to become increasingly important as sources of pulpwood over the next decade include New Zealand and Argentina. To the degree that China sources more of its pulpwood from fast growing plantations in these countries its footprint may be lighter. Fast-growing plantations produce an average yield of 5 to 10 times the global average from forests (Howard & Stead 2001:5). However, the footprint of plantation production depends on the manner in which the plantations are established. Plantations that replace high conservation value forests, destroy subsistence livelihoods, or drain water tables will have a heavier ecological impact than those that are planned in the context of restoring a range of forest functions and services at the landscape level (see Ecott 2002).

Impacts of China's Wood Demand Outside China

The charts below examine the countries that supply most of China's forest-product imports, according to the rate of change in forest cover (Figure 3.2) and environmental governance (Figure 3.3). These indices serve as a crude proxy for the degree of environmental threat posed by industrial wood production in each of these countries.

Figure 3.2 indicates that much of China's current offshore wood supply comes from countries where the overall size of the forest estate is in decline. However, the measure does not take into account the historical deficits of past extensive forest clearing in regions of Europe, North America and Oceania. Therefore, the measure does not penalise nations for past clearing of forests if they are maintaining their current, albeit diminished, forest cover. Figure 3.3 suggests that some countries within China's forest footprint have weak capacity for sound environmental governance.

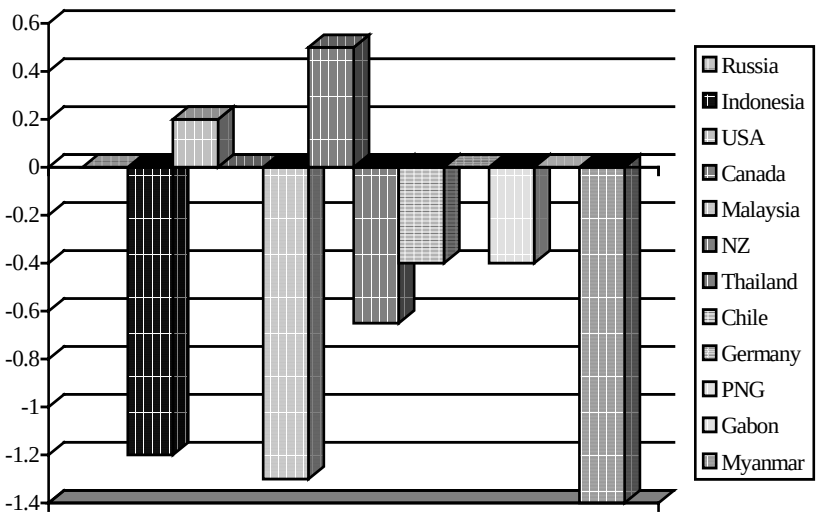

Figure 3.2 Annual rate of change in forest area 1990–2000, China's main suppliers (Data Source: FAO 2003).

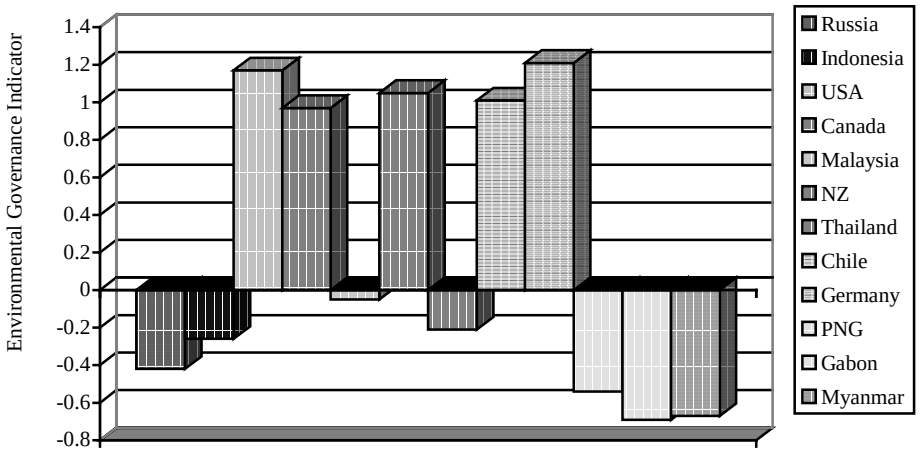

Figure 3.3 Environmental governance: China's main suppliers
source: Environmental Sustainability Index 2002, World Economic Forum, Yale Center for Environmental Law and Policy, and CIESIN.

Eastern Russia

The volume of exports of logs from the Russian Federation to China has grown dramatically in recent years, with over 14 million cubic metres of logs officially crossing the border to China in 2003, up from only 300,000 cubic metres in 1996. Russia is now the largest single supplier of wood-based products to China exporting almost 21 million cubic metres (RWE) in 2003 (16 million in timber, 4 million in pulp, one million in paper). The main species of Russian exports to China are the softwoods, larch, Mongolian pine and others including the legally restricted and high value Korean pine. Hardwoods include oak, birch and ash (Yamane & Lu 2001). (Note that in this section, we have used figures for Russia's timber exports other than to Europe as a proxy for the timber exports from Eastern Russia).

Russian exports are driven by China's strong demand, particularly for large-diameter logs, compared to weak demand in Russia's domestic markets. Additional factors include Chinese policies that favour cross-border trade, especially the "half-tax" policy that applies to both import tariff and VAT for small quantity timber imports (Yamane & Lu 2001). The volume of the log exports to China is about one eighth of Russia's total production, which the Food and Agriculture Organisation of the United Nations estimated at around 125 million cubic metres in 2002 (FAO 2004). These exports have impacted heavily on the forests close to Russian sea-ports or within easy reach of the Chinese border.

In aggregate, Russia's timber industry contracted during the 1990s due to privatisation of large state enterprises and the removal of transport and energy subsidies. While national timber production decreased, logging was concentrated around population centres and convenient export points. Demand for wood in Japan, South Korea and, increasingly, China has driven heavy over-logging in accessible forests in southern areas of the Russian Far East (Primorsky, Khabarovsk, Sakhalin and Amur regions) and Eastern Siberia (Irkutsk and Buryatia). The footprint of these export operations is enlarged by chronic waste (such as the

loss of felled logs in the collection and hauling process), irreparable ecosystem changes in logged permafrost areas, and poor fire control (in 1998 fires destroyed large forest areas in Khabarovsk and Sahkalin). Several recent studies have catalogued the environmental, social and economic stresses created by the log export trade in these regions (see FOE Japan and others 2000; Lebedev 2000; Kotlobay & Ptichnikov 2002).

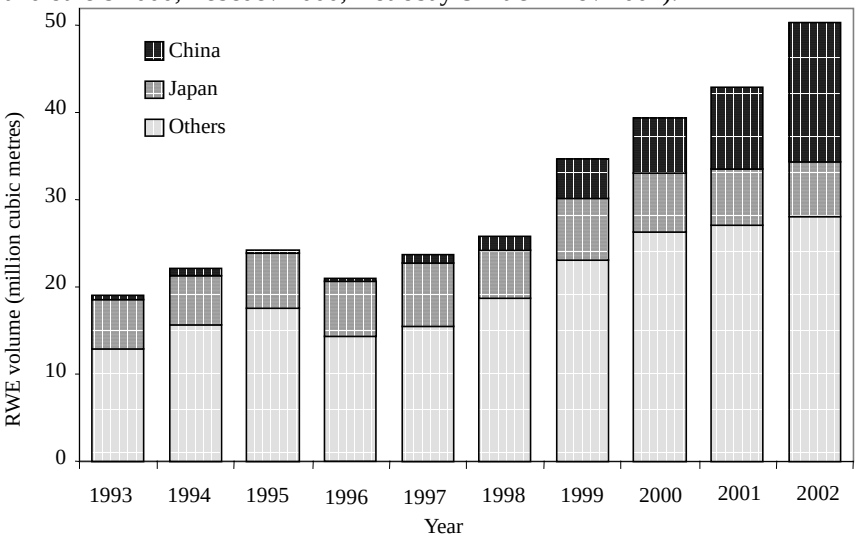

Figure 3.4 Russia's timber exports (higlighting imports by China and Japan)

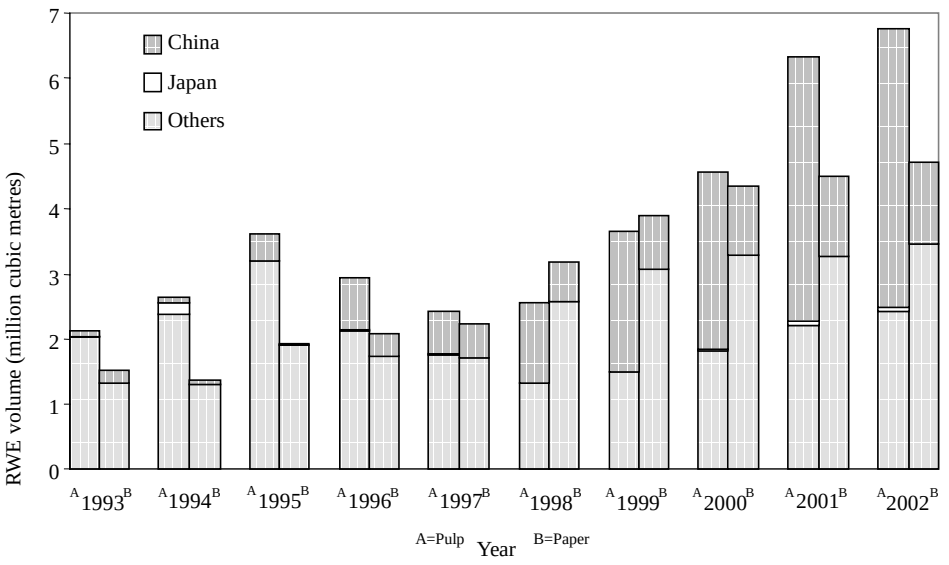

Figure 3.5 Russia's pulp and paper exports (highlighting imports by China and Japan)

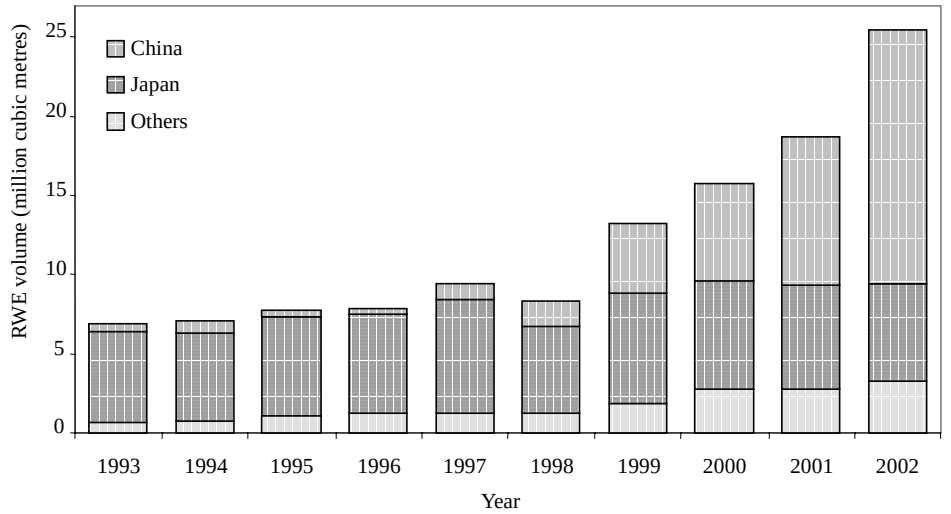

Figure 3.6 Eastern Russia's timber exports (highlighting imports by China and Japan)

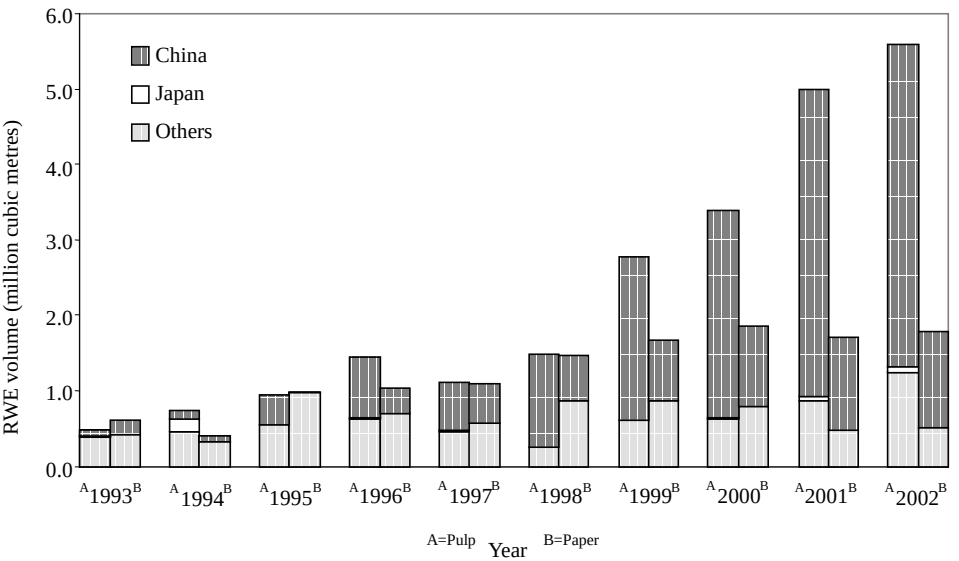

Figure 3.7 Eastern Russia's pulp and paper exports (highlighting imports by China and Japan)

Indonesia

Indonesia has around 100 million hectares of natural forest with varying levels of disturbance. Indonesia's forest comprises around 10 per cent of the Earth's remaining tropical forest and is second only to Brazil in terms of terrestrial biodiversity. Yet in the 1990's Indonesia lost an estimated 2 million hectares of forest per year (FWI/GFW 2002; Holmes 2002). Since then, a financial collapse, major political upheaval and numerous promises of forest reform have done little to abate the pace of forest loss and degradation. Currently, Indonesia is experiencing a "wood rush" as actors at all levels exploit the

vacuum in governance created by the demise of former President Soeharto's regime, and a rapid but confused transfer of regulatory powers to under-resourced local governments. This is exacerbated by the readiness of export markets to accept Indonesia's wood with little concern for the circumstances in which it was harvested. A recent analysis of remote sensing images concluded that if current behaviour continues the only extensive forests remaining in Sumatra, Kalimantan and Sulawesi after 2010 will be in the mountains. Lowland, non-swampy forests will become effectively extinct in Sumatra by about 2005 and in Kalimantan soon after 2010, and, extinction of swamp forests could follow by 2015 (Holmes 2002). A recent paper issued by the Department of Forestry claims that annual deforestation between 1997 and 2000 reached 3.8 million hectare per year (Purnama 2003), but the assertion is not substantiated by detailed data and methods.

Within the timber harvesting industry, both licensed and unlicensed operators are engaged in reckless logging practices that cause excessive canopy gaps, soil compaction, blocked streams, landslides and damage to residual trees. These impacts inhibit natural regeneration, increase vulnerability to fire, and cause downstream problems such as muddied drinking water and flash-floods. Against this backdrop, timber exports from Indonesia to China have surged in recent years. Although Japan remains the major market for Indonesia's timber, China's imports of timber from Indonesia reached more than 3 million cubic metres (RWE) in 2003. This is about one seventh of Indonesia's total timber exports. China imported almost half of the roundwood equivalent volume of logs and sawn wood that countries importing from Indonesia declared as Indonesian direct imports.

China also imports a significant amount of pulp and paper from Indonesia (Figure 3.9). Growth in the capacity of Indonesia's pulp and paper industry has far outpaced progress in securing a sustainable wood supply. The industry's overcapacity is a major driver of indiscriminate and illegal logging, including the clear-cutting of natural forests, that currently plagues Indonesia. Indonesia's pulp mills consume roughly 20 million cubic metres of roundwood — mostly mixed hardwoods from natural forests (Barr 2000). These mills pose a major threat to Indonesia's remaining lowland forests — the forests are vulnerable both as an immediate source of fibre and as targets for conversion to plantations that can supply the mills in the future.

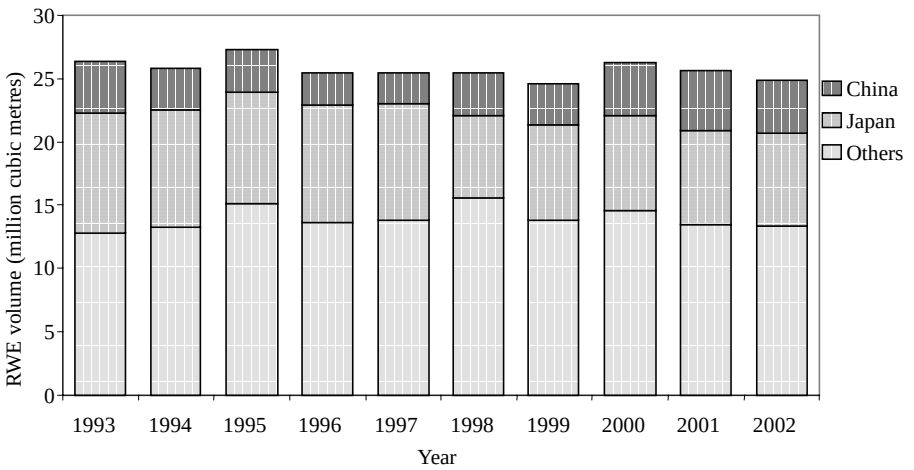

Figure 3.8 Indonesia's timber exports (highlighting imports by China and Japan)

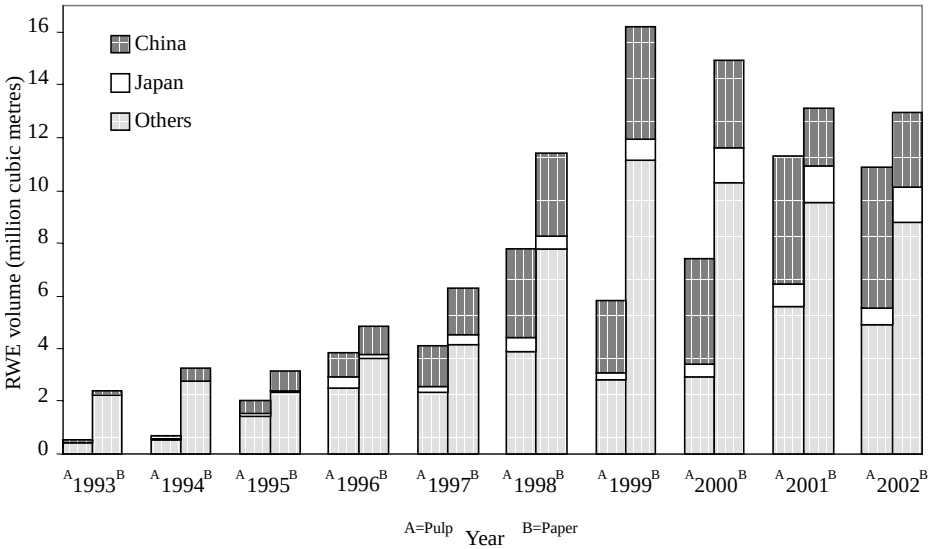

Figure 3.9 Indonesia's pulp and paper exports (highlighting imports by China and Japan)

Table 3.2 highlights the size of Indonesia's 'informal' forest products export industry. The volumes recorded in Indonesia's official customs statistics are significantly less than those recorded in China's import statistics (20% less in 2002). The figures suggest that in 2002, a roundwood equivalent volume of over 2.6 million cubic metres of wood-derived products were undeclared in Indonesia and shipped to China, and that a substantial volume of some products may have been misidentified in customs documentation. This trade robs Indonesia of significant tax revenues. It also takes a heavy toll on the environment. Although a statistical discrepancy alone does not mean that all 2.6 million cubic meters were harvested illegally, with logging in Indonesia running more than 75% above the cut the Ministry of Forestry allows (Brown 2002), it is highly probable that a majority of this unreported volume came from loggers whose harvesting practices are unsupervised and not bound by sustainable cutting levels or prohibitions on logging in parks, riparian reserves and steep slopes.

Table 3.2 Comparison of Indonesia's declared exports and China's declared inputs in 2002

Product	Unit	Indonesia's declared direct exports			China's declared direct imports			Excess of imports over exports	
		Quantity of given unit (million)	Export value (US$mifob)	RWE volume (Mm^3)	Quantity of given unit (million)	Export value (US$mifob)	RWE volume (Mm^3)	Quantity of given unit (million)	RWE volume (Mm^3)
Pulp	tonne	1.07	343	5.0	1.11	451	5.3	0.06	0.3
Paper	tonne	0.46	206	2.0	0.65	336	2.8	0.20	0.8
Logs	m^3	0.02	4	0.0	0.25	37	0.3	0.23	0.2
Sawn wood	m^3	0.30	63	0.5	1.42	282	2.6	1.12	2.0
Plywood	m^3	0.30	93	0.7	0.45	188	1.0	0.15	0.3
Fibre board	tonne	0.05	9	0.1	0.10	22	0.2	0.05	0.1
Joinery	tonne	0.12	57	0.6	0.00	0	0.0	–0.12	–0.6
Mouldings	tonne	0.28	76	0.7	0.01	2	0.0	–0.27	–0.7
Others	–	–	27	0.0	–	14	0.0	–	0.0
Total	–	–	878	9.7	–	1,132	12.3	–	2.6

The extent to which China's imports from Indonesia are illegal is open to debate. Indonesia's forestry laws changed substantially as a result of the 1999 Indonesia decentralization initiative, which in turn radically changed the regulation of Indonesian forestry and the reporting of data on forestry. Some analysts interpret this to mean that nearly all of the wood that China imports from Indonesia is illegal (Toyne et al. 2002; Global Timber 2003). Other researchers conclude any analysis of the issue requires further gathering and evaluation of current data from Indonesia (Brown 2002).

Malaysia

According to the latest statistics from the UN's Food and Agriculture Organisation (FAO 2003), Malaysia has 19 million hectares of forests (much of them already logged) that cover nearly 60 per cent of the country's total land area. The proportion of forested land is higher in the Borneo states of Sabah and Sarawak where the forest products industry is concentrated, than in more developed Peninsular Malaysia.

By the late 1980s, land clearing for development, poor logging practices and unsustainable harvesting rates for log exports had resulted in wood supply failing to match processing capacity. Around this time, the authorities banned the export of logs from Peninsula Malaysia and Sabah and progressively lowered the allowable cut for Sarawak. These domestic restrictions motivated some Malaysian companies to move logging operations offshore. Malaysian companies competed aggressively for access to forest resources in frontier regions of Papua New Guinea, Cambodia, Myanmar, Guyana, Suriname, the Russian Far East and Central Africa.

Malaysia has also become the major exit route for wood smuggled from Indonesia. A former secretary-general of Indonesia's forest department estimated that 80,000 to 100,000 cubic metres of timber were smuggled from East Kalimantan, 150,000 cubic metres from West Kalimantan and 70,000 cubic metres from Riau, Sumatra every month (Suripto 2000). These figures represent an annual volume of 2.5 million cubic metres smuggled into Malaysia and suggest that a high proportion of Malaysian exports to China are illegally sourced from Indonesia. The ecological footprint of China's timber imports from Malaysia would thus seem to fall largely on Indonesia.

Table 3.3 shows that, in 2002, the roundwood equivalent volume which China declared as timber imports from Malaysia was double what Malaysia declared as exports to China. Some of the difference may be attributable to exports from Malaysia's "free ports", at least one of which has been shown to re-export timber sourced from illegal logging operations in Indonesia (EIA 2004).

Table 3.3 Comparison of Malaysia's declared exports and China's declared imports in 2002

Product	Unit	Malaysia's declared direct exports			China's declareddirect imports			Excess of imports over exports	
		Quantity of given unit (million)	Export value (US$mifob)	RWE volume (Mm^3)	Quantity of given unit (million)	Export value (US$mifob)	RWE volume (Mm^3)	Quantity of given unit (million)	RWE volume (Mm^3)
Logs	m^3	1.11	96	1.1	2.12	243	2.1	1.01	1.0
Sawn wood	m^3	0.16	37	0.3	0.49	101	0.9	0.33	0.6
Plywood	m^3	0.09	24	0.2	0.10	33	0.2	0.01	0.0
Fibreboard	tonne	0.08	38	0.2	0.22	65	0.6	0.14	0.3
Particle	tonne	0.04	7	0.1	0.06	17	0.1	0.02	0.0
Venter	tonne	0.07	8	0.2	0.11	24	0.3	0.04	0.1
Other			8	0.0		6	0.0		0.0
Total			218	2.1		488	4.2		2.2

The fivefold growth in log imports (2.9 million cubic metres in 2003 compared to 570,000 in 1996) was matched by a decline in plywood imports (300,000 cubic metres in 2003 compared to 2 million in 1996). This reflects China's growing domestic capacity to manufacture plywood and a dilemma for Malaysia as Chinese plywood using Malaysian wood now competes with Malaysian plywood on the international market. Imports of sawnwood and veneer roughly doubled in volume between 1996 and 2000, although they have decreased since then.

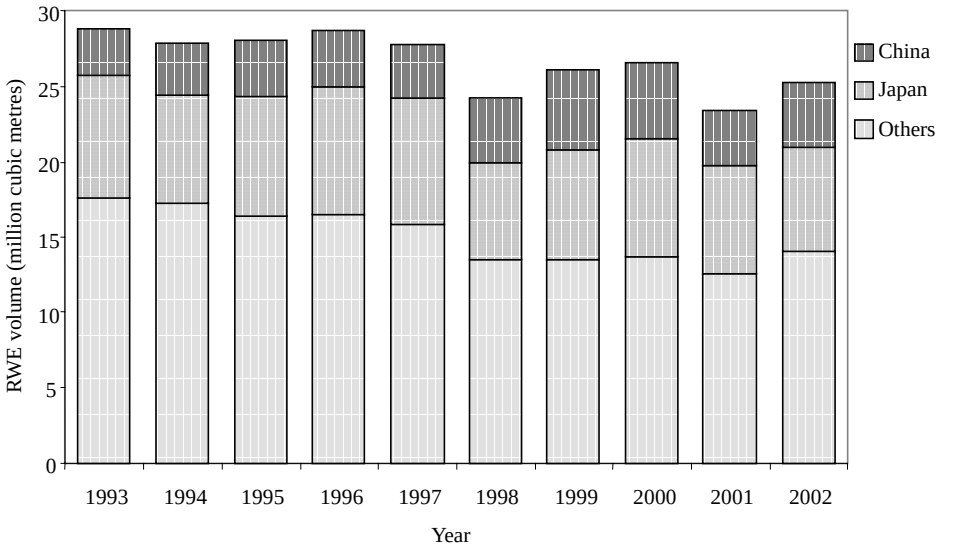

Figure 3.10 Malaysia's timber exports (highlighting imports by China and Japan)

Gabon and other African Countries

In 2003, China imported some 2.5 million cubic metres (RWE) of tropical timber from Africa, predominantly in the form of logs. The leading supplier was Gabon, with Equatorial Guinea, Liberia, Republic of Congo, and Cameroon each also exporting more than 200,000 cubic metres (RWE) to China.

Gabon's forests are part of the vast and species-rich tropical forest complex of the Congo Basin (the total area is almost 170 million hectares). Gabon is the least densely populated country in Central Africa and has an estimated forest cover of 18 million hectares or 80 percent of its land area. Vast areas are virtually uninhabited. Between 1957 and 1999, Gabon's logging concession area increased seven-fold to 12 million hectares (Collomb and others 2000). Commercial forestry activities are focused on selective logging, with a single species, *Okoumé*, comprising two thirds of the total harvest. This logging does not result in wholesale clearing; however, environmental impacts include damage to residual trees and excessive canopy disturbance and loss of wildlife due to commercial "bush-meat" hunting and ivory poaching around logging roads (White 1994; Van de Veen 2001).

In 2003, China imported 0.9 million cubic metres of logs from Gabon (up from 700,000 cubic metres in 1996 and despite a 50 percent reduction in production quotas for concessions in Gabon in 1998). This is about 45% of Gabon's total roundwood exports: around 2.5 million cubic meters, which can be seen from Figure 3.11.

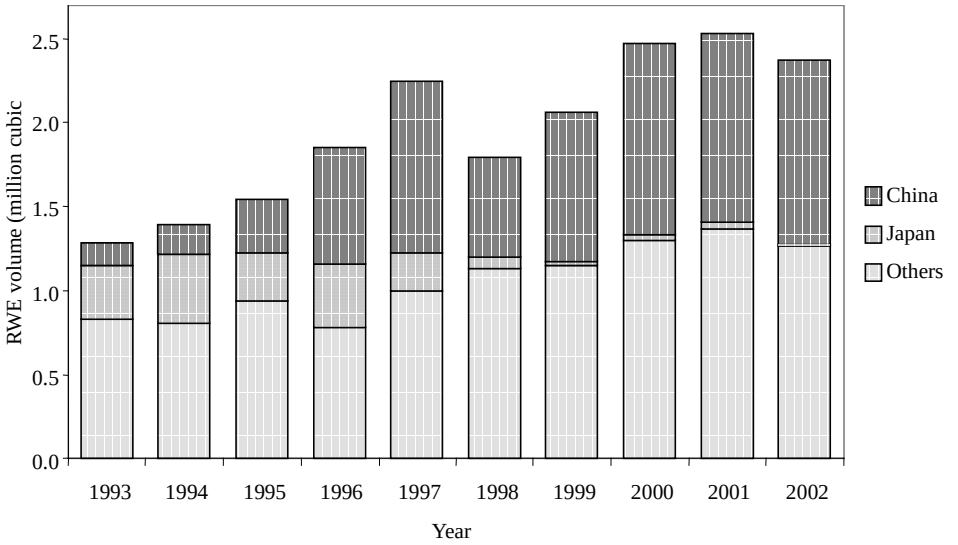

Figure 3.11 Gabon's timber exports (highlighting imports by China and Japan)

In Liberia, the Oriental Timber Company, a subsidiary of China-based Global Timber, negotiated a dominant position in the logging industry in 1999 (Global Witness 2001). In the next three years China's imports grew from zero to around two thirds of Liberia's timber exports (see Figure 3. 12). In mid 2003, the UN Security Council imposed an embargo on Liberian timber products, in an effort to end the relationship between the logging industry and regional conflict. Soon after, President Taylor resigned and went into exile. A transitional government formed and elections are scheduled for the year 2005. In the meantime, the embargo remains in place.

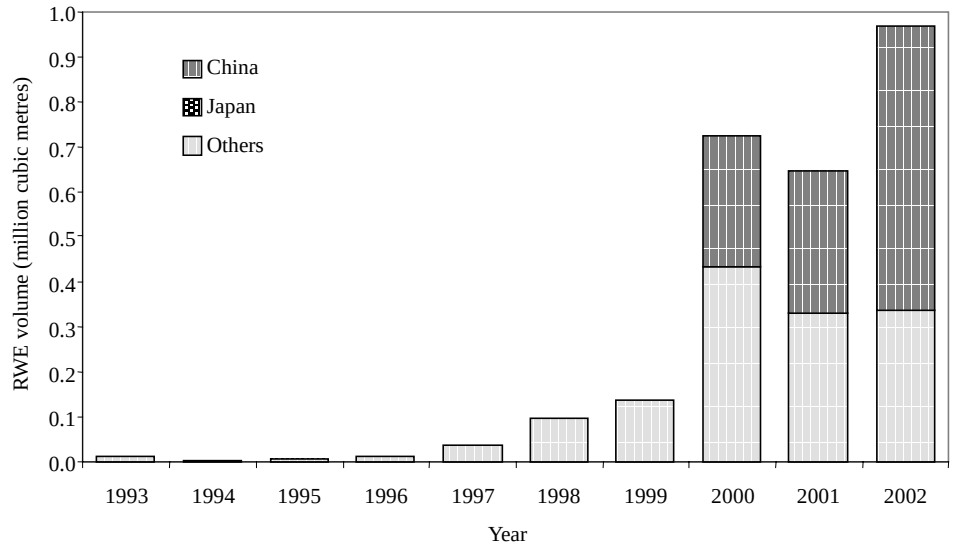

Figure 3.12 Liberia's timber exports (highlighting imports by China and Japan)

In Equatorial Guinea, exports to China began in the mid-1990s when Rimbunan Hijau, a Malaysian company, became dominant in the logging industry. Since then, China's imports rose from zero to five hundred thousand cubic metres per year, well over half Equatorial Guinea's timber production — which now exceeds the legal allowable cut by a substantial margin (Toyne and others 2002: 35).

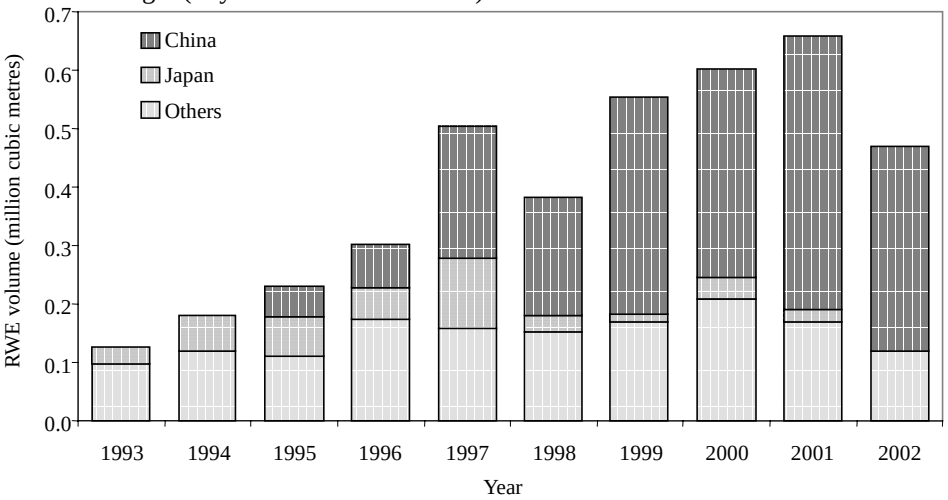

Figure 3.13 Equatorial Guinea's timber exports (highlighting imports by China and Japan)

Cameroon has natural forest covering about half its land area of 46.5 million hectares (FAO 2003). Cameroon has some innovative forest laws and policies, including an open auction system for awarding forest concessions to the highest bidder, with technical capacity as a factor, and export bans on certain species of logs. Despite the bans, logs account for the great majority of the timber that China imports from Cameroon, and China accounts for roughly half of Cameroon's log exports (see Figure 3.14). China has become the third largest importer of timber from Cameroon (behind Italy and Spain) importing 10 per cent of Cameroon's timber exports. A Hong Kong company, Vicwood, recently acquired a majority share in the ownership of a large logging company in Cameroon (and its subsidiaries in Central African Republic and the Republic of Congo), much of whose exports are now destined for China. (Collomb and Bikié 2001).

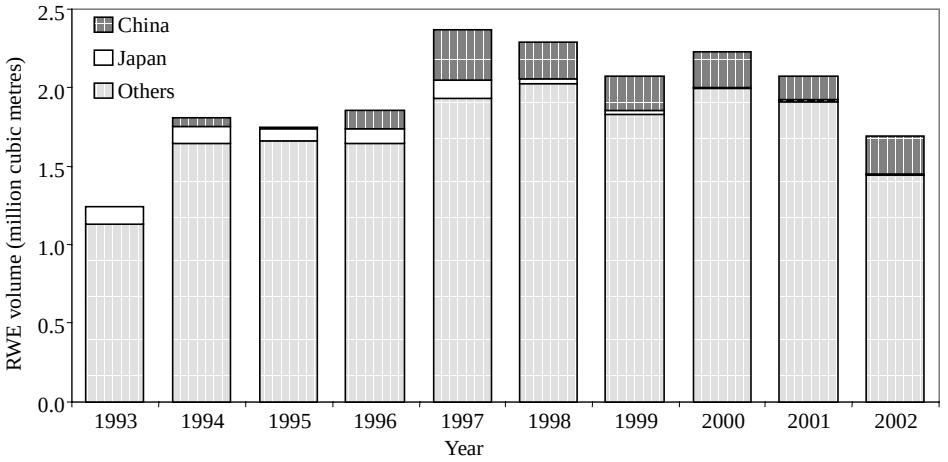

Figure 3.14 Cameroon's timber exports (highlighting imports by China and Japan)

In 2001, China started to import substantial volumes of logs from Republic of Congo (which had previously been engaged in civil war). China's imports in 2003, some 400,000 cubic metres (RWE), are likely to comprise almost half of Republic of Congo's timber exports (see Figure 3. 15). Timber from the south of the country — where China's influence appears particularly strong — competes with that from Gabon (whose efforts in trying to improve governance in the forest sector and in developing an export processing industry are handicapped by this competition) and, to a lesser extent, Equatorial Guinea.

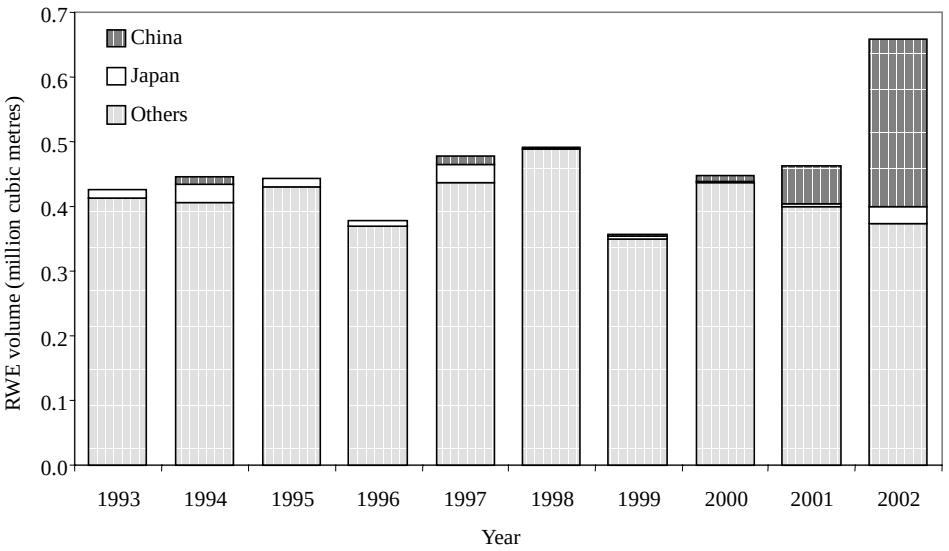

Figure 3.15 Republic of Congo's timber exports (highlighting imports by China and Japan)

The Indochina Region

The Indochina Region is comprised of Myanmar, Cambodia, Laos, Thailand and Vietnam. Across the region, forest clearing and exploitation have had significant impacts on the environment. Widespread deforestation has degraded water catchments, thereby accelerating soil erosion and exacerbating droughts and flooding. Impacts include the undermining of food security and loss of life. The heavy rains of September 2000, for example, caused widespread flooding across Indochina and the Mekong Delta, killing hundreds of people and forcing more than one million to flee from their homes in Cambodia, Vietnam, Laos and Thailand.

China's timber imports from the Indochina region have risen strongly since 1998. Due to the region's porous borders, it is difficult to determine the true country of origin of much of this wood. For example, in 2003 China imported 1.8 million cubic metres (RWE) of timber from Thailand—around one-third of Thailand's total timber exports (see Figure 3.16 and Figure 3.17). Given that Thailand has enforced a commercial logging ban in natural forests since 1989, much of this wood (excluding 0.5 million cubic metres of rubberwood) is likely to have been harvested in Myanmar, Cambodia and Laos, and re-exported from Thailand.

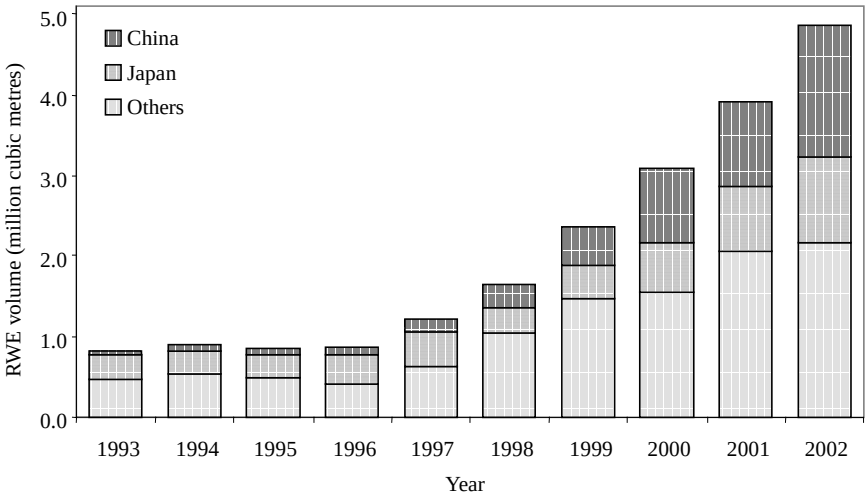

Figure 3.16 Thailand's timber exports (highlighting imports by China and Japan)

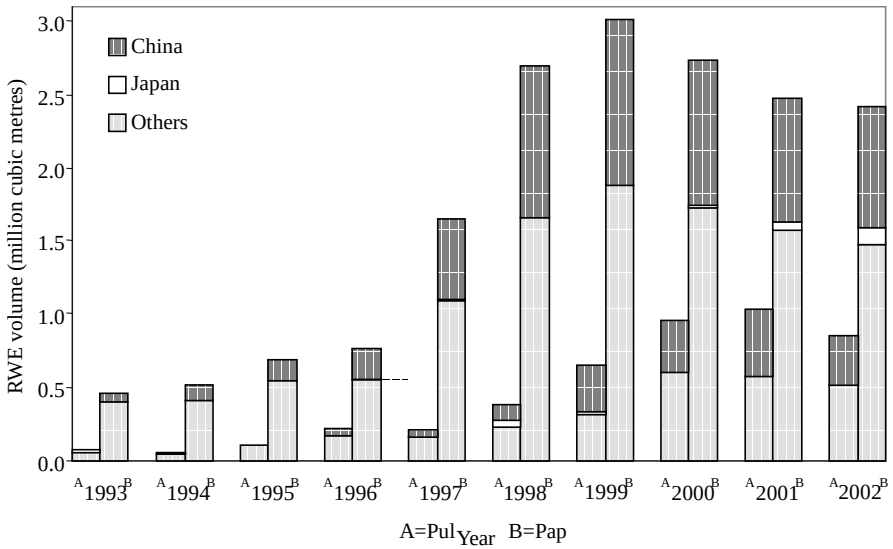

Figure 3.17 Thailand's pulp and paper exports (highlighting imports by China and Japan)

Forest cover in Cambodia is estimated at around 53 percent (FAO 2003), down from 70 per cent in the early 1970s. Much of this forest loss, along with degradation of remaining forests, has occurred since 1992 when Cambodia first entered the global market (May Sam and others 2001). Illegal logging is recognised as a major problem. In 1997, an estimated 3 to 4 million cubic metres of timber was harvested illegally, whereas the sustainable yield of Cambodia's combined forest resources is estimated to be only 0.5–1.5 million cubic metres per year (Magrath 2000). In 2002, the Cambodian government suspended all logging operations, due to non-compliance with new forest management planning requirements. Yet, logging operations have continued in a legal "grey area" with harvesting fees paid to commune chiefs, under arrangements that lack a statutory basis. The

government and major donors recently sponsored an independent forest sector review. The review team made far reaching recommendations including

- Continuation of the moratorium on logging operations;
- Abandoning the concession system;
- Transferring undisturbed forest areas from production to protection;
- Planning for multiple-use of forest through a landscape approach;
- Introducing tracking systems for legal logs—if the logging moratorium is lifted;
- Making community forestry self-financing and self-sustainable; and
- Prohibiting new roads in undisturbed forest, effectively transferring them into protection status (Shields and others 2004).

In Laos, the "New Economic Mechanism" introduced in 1986 encouraged the forestry industry to become more export-oriented. Associated high-intensity logging with little or no post-harvest management led to the progressive degradation of forests and corresponding decline in the volume, quality and value of timber harvested. In 1991, the government imposed a ban on commercial logging that was short-lived in practice. On paper, the Government has banned log exports and promotes domestic processing, but export figures for 2000 show that more than 80% of exports (almost 246,000 cubic metres) were in the form of roundwood (FAO 2003). Based on importing-country declarations, it appears that Laos' exports are growing rapidly and destined primarily for neighbouring Thailand, from where a proportion may well subsequently be exported.

Myanmar has more than half of mainland Southeast Asia's undisturbed natural forest. The Myanmar Timber Enterprise, operated by the military, officially controls all commercial forestry. However, ethnic resistance groups run numerous logging and saw-milling operations along the 1,780-kilometer border with China. The official regime permits this activity so long as the groups involved refrain from attacking Government forces. This unregulated logging and related agricultural encroachment has severely impacted teak-rich mixed deciduous forests — now Myanmar's most degraded habitat (Brunner and others 1998). Much of the logging currently taking place in the country is financing the military regime or insurgent groups engaged in conflict. The situation has been compounded by the involvement of Thai and Chinese logging companies, with widespread and destructive logging occurring along the border with China (Global Witness 2003).

Myanmar's most important wood export markets are its forest poor neighbours: China, India, and Thailand. Accurate statistics on Myanmar's exports are generally unavailable, due to the opaque nature of the border trade in timber. Using the import statistics of other countries, it appears that Myanmar exported around 2 million cubic metres of timber (RWE) per year in the early 1990s. This volume declined to a low of 750,000 cubic metres (RWE) in 1998, and has since rebounded to its former level (Figure 3.18). In 2003, China imported about 1.3 million cubic metres (RWE) of timber from Myanmar. Discrepancies in declared exports from Myanmar versus declared imports by China provide an indication of the extent of illegal trade taking place in the country. Chinese import records were 13 times the size of Myanmar's declared exports for 1999 and 27 times declared exports for 2000 (Johnson 2002).

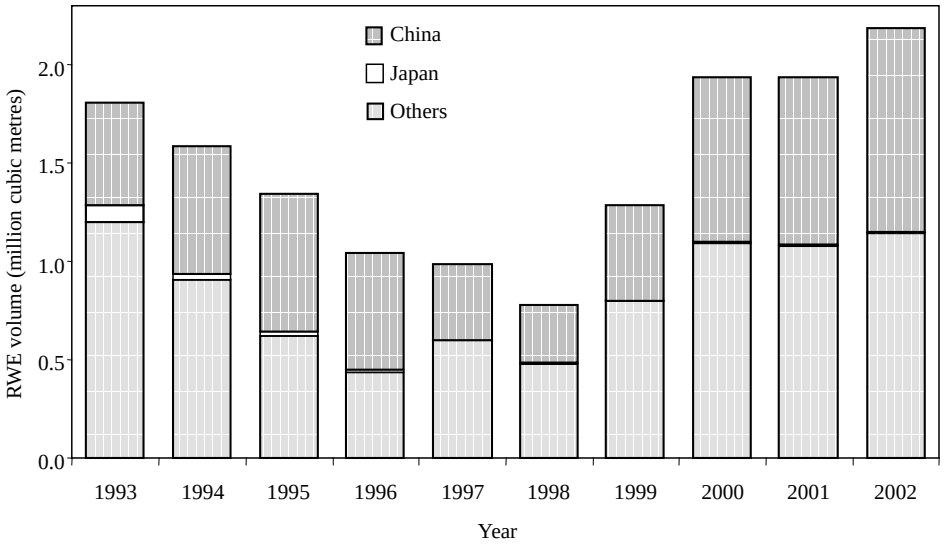

Figure 3.18 Myanmar's timber exports (highlighting imports by China and Japan)

Australasia

Australasia is comprised of Australia, Papua New Guinea, New Zealand and the small island nations of Fiji, the Solomon Islands, Vanuatu and French New Caledonia. In total the region exported around 7 million cubic metres (roundwood equivalent) of timber, pulp and paper products to China in 2003.

New Zealand is the region's leading exporter of wood to China supplying over 3.7 million cubic metres (RWE) in 2003. Two thirds of these exports were timber (logs and sawn wood), most of the rest was pulp and paper. New Zealand has pursued a consistent and vigorous programme of plantation forest establishment and management for more than 70 years. This has gradually enabled a reduction in the cut from natural forest. Most of the remaining 4.9 million hectares of remaining indigenous forest is now precluded from industrial harvesting.

Australia has an estimated 155 million hectares of natural forest and over a million hectares of plantations (FAO 2003). As in other developed countries there has been a shift away from logging of native forests due to environmental pressures. The great majority of Australia's timber exports (primarily wood chips) are destined for Japan's paper industry. However, China is the leading importer of Australia's paper with around 800,000 cubic metres (RWE) going to China in 2003.

Papua New Guinea has an estimated 31 million hectares of tropical forest (FAO 2003). The island of New Guinea (including the Indonesian province of Papua) is home to the third largest block of tropical forest on the planet after the Amazon and Congo basins. Most timber harvesting in Papua New Guinea is conducted under a selective logging regime in natural forests. However, poor logging practices have resulted in excessive canopy removal, damage to residual trees, soil erosion and siltation of rivers and reefs (Cameron & Vigus 1993). In Papua New Guinea, logging may have irreparable effects on 25 "fragile" forest types and has been identified as a threat to 54 individual tree species (Chatterton and others

2000). In 1999, Papua New Guinea introduced a moratorium on all new forestry concessions coupled with a review of compliance with allocation procedures. In announcing the moratorium, the Prime Minister acknowledged a poor record of governance in the forestry sector with "the side-effect of promoting corrupt practices and undermining sustainability in logging activities" (Morauta 1999). Subsequently, the review highlighted major procedural abuses by proponents of new projects and officials and concluded that the majority of proposed concession areas had insufficient resources to support the type of logging operation proposed (Papua New Guinea Eco-Forestry Forum 2001). A further government-sponsored review of the sustainability of logging projects recently produced a draft report. Findings included that logging projects have little long term benefits for customary resource owners, although the owners bear the environmental costs, and that many breaches of the logging standards go unreported and unactioned. The review team's overall conclusion was that "under the current market conditions, the current levels of log export tax, the current non-compliance with environmental standards, and the inadequate monitoring and control imposed by the government regulating agencies, timber production as currently practiced is not sustainable" (Papua New Guinea Logging Projects Review Team 2004).

For the last two decades, more than 90 per cent of the timber commercially harvested in Papua New Guinea has been exported in the form of logs**.** Since 1998, the volume of timber exports to China have expanded six fold (to 1.1 million cubic metres in 2002) even though the total volume of Papua New Guinea's timber exports dropped by over one third (Figure 3.19). Much of China's increasing market share can be attributed to a decline in exports to Japan. According to preliminary estimates, China consumed over 70% of the total log exports from PNG in 2003 of just over 2 million cubic metres (Bank of Papua New Guinea 2003:14).

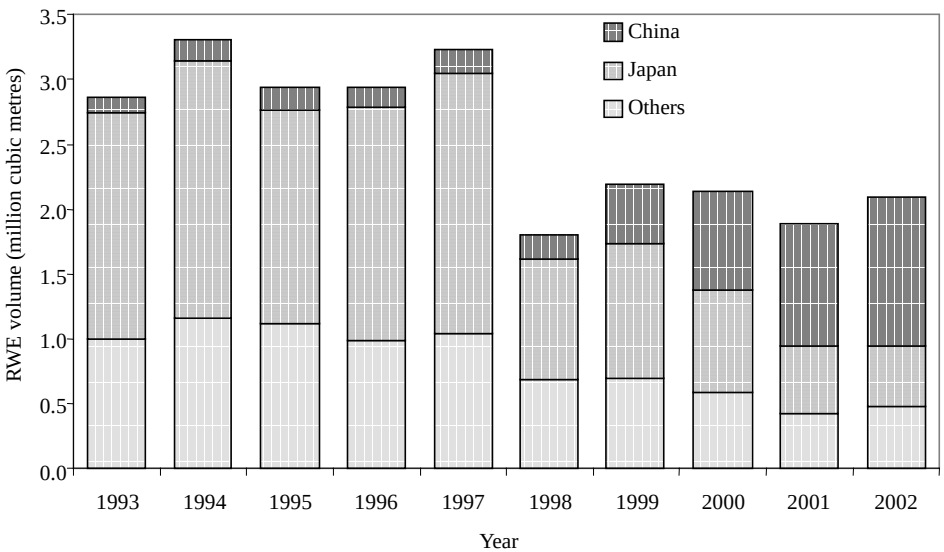

Figure 3.19 Papua New Guinea's timber exports (highlighting imports by China and Japan)

The Solomon Islands is a small country with extensive natural forest cover, estimated at 2.5 million hectares or 89 per cent of the total land area (FAO 2003). In 2002, the Solomon Islands exported some 0.6 million cubic metres (RWE) of timber in total, of

which 160,000 cubic metres went to China (World Trade Atlas). Current harvesting rates in natural forests are estimated to be two or three times the sustainable level, with poor logging practices impacting heavily on fragile island ecosystems. Civil unrest has shut down other major industries, resulting in reliance on timber exports for up to 85 per cent of the country's foreign earnings (Konairamo 2002). China's timber imports from the Solomon Islands have risen sharply in recent years. Thus, while exports from the Solomon Islands comprise a tiny portion of China's timber supply, this trade has major consequences for the environment and economy of the Solomon Islands. This is an example of a country from which China sources a relatively insignificant share of its timber supply, yet leaves a heavy ecological (and economic) footprint.

North America

In terms of total forest area, Canada and the United States rank third and fourth, respectively, at the global level (after the Russian Federation and Brazil). According to the FAO, natural forests make up 93% of this area (FAO 2003). A major policy shift in the United States during the last decade has resulted in a dramatic reduction in the timber produced from public lands, which are now more geared towards conservation and recreational uses. This decrease has been partly offset by an increase in harvest from privately owned lands as more intensively managed second-growth forest matures.

In Canada over 93 per cent of forestland is publicly owned. The majority of commercially exploitable forest is coniferous and is managed on an extensive rotation of 70 years or more. In Western Canada (British Columbia and Alberta) the export-oriented wood industry is a mainstay of the economy and the area is a major net exporter of wood products. The industry is embroiled in political controversy, with groups concerned over its environmental impact, calling for reductions or elimination of logging, particularly in temperate coastal forests.

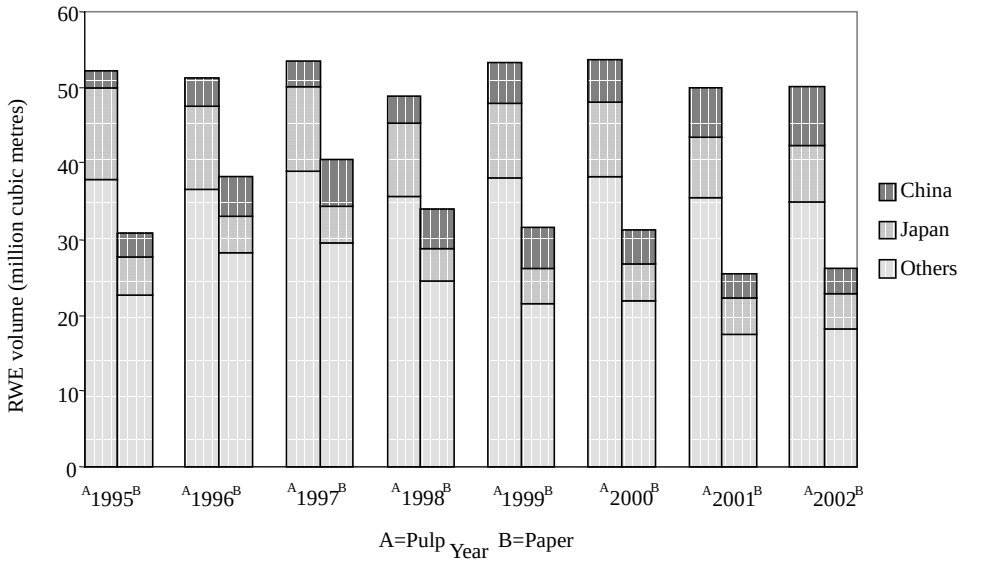

Figure 3.20 North America's pulp and paper exports (highlighting imports by China and Japan)

Figure 3.20 indicates that pulp exports to China from North America have grown steadily in recent years while corresponding paper exports have decreased. In 2003, the roundwood equivalent volume of North America's combined pulp and paper exports to China was over 13 million cubic metres (up from about 10 million cubic metres during the second half of the 1990s). The proportion of pulp in this rose from roughly 40% in the mid-1990s to over 70% in 2003. However, China has become the largest importer of recovered paper from the United States, importing more than 3.3 million tonnes in 2002 (Moore 2003: 24)

Since the mid-1990s, China has developed a large export-focused wooden furniture-manufacturing sector, half of whose output is destined for the United States. China supplies a third of North America's wooden furniture imports. A significant proportion of China's growing supply of imported timber is exported to the United States (see Figure 2.5). Therefore, an increasing share of China's timber supply can be assigned to the forest footprint of the United States.

Other Regions

Excluding Russia, Europe supplied about 6 per cent of China's total imports of timber. In 2003, Europe's leading exporters of timber to China were — Germany (850,000 cubic metres), France (80,000 cubic metres), Romania (180,000 cubic metres), Italy (110,000 cubic metres), Belgium (180,000 cubic metres) and Austria (70,000 cubic metres). German exports (particularly of beech) to China rose very strongly in 1999 and 2000, however, the demand for beech has since decreased.

Latin America (primarily Brazil) supplied less than 600,000 cubic metres (RWE) of timber to China in 2003. Although the quantity supplied is increasing rapidly, China has yet to become a major importer of timber from the region. The major trade between Latin America and China is the export of pulp from Brazil and Chile. China's imports from these two countries have risen markedly since the mid-1990s. In 2002, China's pulp imports from Chile had a roundwood equivalent volume of 2.3 million cubic metres, making China the largest importer of Chile's pulp (see Figure 2.11). Brazil's rapidly increasing exports of pulp to China (2.3 million cubic metres RWE in 2003) are second only to those to the USA. Argentina could also become a significant future supplier of pulp to China (Hagler and others 2001:221).

Conclusions

It is neither possible, nor useful, to offer a simple composite verdict on whether China's forest reforms are positive or negative for the aggregate environmental health of the planet. The impacts within China and abroad are variable, multi-faceted and will depend on the future direction of the global trade in wood products.

However, it is clear that a combination of China's reforms and international market forces have led to a surge in the volume of timber, especially logs, imported into China over the last five years. In some of the countries supplying these logs, industrial wood production poses enormous threats to the environment. The pace of export growth in itself is a threat in many jurisdictions as authorities struggle to keep up with the expanding regulatory workload.

China's imports of pulp have grown steadily for the past decade (although paper imports have declined since 1999 in line with the rapid growth in China's own paper

milling capacity). China's pulp and paper market now uses more of the world's wood than its timber market. China's pulp and paper use may have a smaller ecological footprint than its timber use, because a greater proportion of pulpwood comes from intensively managed forests and plantations, unless demand from China is influencing governments and companies to clear natural forest to grow short-term rotation crops to supply China's demand. Notable exceptions to this potentially smaller footprint are Russia and Indonesia, as most of their pulpwood is currently sourced through the logging and conversion of natural forests.

Trade statistics and various reports suggest that China is one of the major destinations for wood that may be illegal, either at source or somewhere along the supply chain. To reduce its footprint, China would have to reduce those of its imports of wood which it sources at high cost to the environment. China's wood buyers are unlikely to show concern for the environmental or legal credentials of their suppliers, without market or regulatory pressure to do so. However, as factories and processing facilities become larger and more sophisticated, there may be good commercial reasons for buyers to invest in wood tracking and supply chain management systems that shed more light on the sources of their wood and fibre supplies. Such systems would also assist importers to verify that they are sourcing from legal and/or sustainable sources (see Dykstra and others 2003).

China's government could motivate wood buyers towards more responsible sourcing by measures such as prohibiting the import of wood without verification that it has been sourced legally, green procurement policies, and trade agreements with supplier countries that address forestry issues (see Toyne et al. 2003, Marijnessen and others 2004). Some developments in this direction are already underway. In a memorandum of understanding signed with the government of Indonesia in 2002, China made in-principle commitments to curb imports of logs sourced illegally.[1] Another example is the joint declaration in 2001 from the Forest Law Enforcement and Governance East Asia Ministerial Conference, including China, to "take immediate action… to address violations of forest law and forest crime, in particular illegal logging, associated illegal trade and corruption, and their negative effects on the rule of law." The declaration acknowledged the threat posed by illegal logging and associated illegal trade to the rule of law as well as to forest ecosystems and biodiversity. Among other things the Ministers committed to undertake actions, including co-operation among the law enforcement authorities within and among countries, to prevent the movement of illegal timber, and explore ways in which the export and import of illegally harvested timber can be eliminated, including the possibility of a prior notification system for commercially traded timber.[2]

Finally, an increasing share of the wood imported into China will probably be re-exported as value-added products. Chinese manufacturers will thus need to respond to the environmental sensitivities in their export markets. That means that a growing share of China's wood imports will represent the forest footprint of end-consumers in other countries. If those consumers, or their governments, seek to reduce their forest footprint by discriminating in favour of environmentally sound wood (or at least demand certificates demonstrating chain of custody or legality), they will give China an incentive to follow suit.

1 Memorandum of Understanding between the Government of the People's Republic of China and the Government of the Republic of Indonesia Concerning Cooperation in Combating in Illegal Trade of Forest Products, signed 18 December 2002 by the Minister of Forestry of Indonesia and the Administrator of China State Forest Administration.

2 Ministerial Declaration, Forest Law Enforcement and Governance East Asia Ministerial Conference, Bali, Indonesia, 11–13 September 2001

SECTION IV
REDUCING THE ENVIRONMENTAL IMPACT OF CHINA'S WOOD AND PAPER MARKET

In this section, we explore potential policy changes and actions that could reduce the negative impacts of China's wood products market on the environment. These measures involve many different actors, both within China and elsewhere. Potential actions are grouped under the following broad strategies:

- Strengthening China's environmental protection initiatives;
- Encouraging environmentally sound wood and fibre production and processing in China;
- Improving efficiency of wood harvesting, distribution and use in China; and
- Encouraging imports or purchases of wood produced legally and from well-managed forests.

Strengthening China's Environmental Protection Initiatives

China's forest footprint can be reduced by optimising the positive impacts of environmental policies and programmes within China. Possible actions and policy changes to achieve this are outlined below.

- The Government of China could develop and clearly articulate exit strategies and incentives to maintain momentum of the Natural Forest Protection Programme and the Grain for Green Programme (see similar recommendations from the China Council for International Cooperation on Environment and Development's Western China Forests and Grasslands Task Force — Xu and White 2002:65). To avoid the potential loss of gains made during the life of these programmes, ongoing incentives will be needed to motivate farmers and local governments to maintain protected and restored forests. Without such measures, recovering forests and catchments, may revert to croplands and other uses that contribute to soil erosion and downstream environmental problems. The proposed Ecological Services Compensation Fund could play a central role in sustaining efforts to protect forests zoned as "ecological services forests".

- The Government of China could broaden the environmental objectives of the Natural Forest Protection Programme and the Grain for Green Programme to include other ecological concerns, biodiversity conservation in particular, that could otherwise be overlooked (e.g. replacing biodiversity-rich mixed vegetations with monoculture timber plantations may not always have a net environmental benefit) (see page 7 and 8 of this report).
- The Government of China could strengthen outcome-based monitoring and evaluation of the Natural Forest Protection Programme and Grain for Green to determine if environmental objectives are being met. The China Council Task Force has made similar recommendations (see Xu and White 2002:65). Such monitoring would mitigate the risk of unanticipated environmental impacts and provide the information needed for adaptive management to improve the efficiency of the programmes. Such monitoring could also test assumptions underlying these programmes. For example, as the China Council task force observes, a key assumption behind the Natural Forest Protection Programme is that a halt to logging is required in all cases to restore forest health, yet the reality could be that alternative silvicultural regimes such as selective logging and thinning may be required to restore highly manipulated forests (op cit:76).

Encouraging Environmentally Sound Wood and Fibre Production and Processing in China

China's demand for wood from other countries, and in particular from regions where forest management is poor, could be reduced through environmentally responsible wood production in resource-rich areas in China where logging is currently banned. Possible actions and policy changes to achieve this are outlined below.

- The Government of China could create an exemption from the logging bans, for those forests that have been designated for production under the forest zoning initiative, and introduce safeguards to ensure timber is produced sustainably. Similarly, resumption of logging after the blanket bans expire in 2010 could be based on the ability of a given forest management unit to satisfy sustainability safeguards. Such safeguards could be incorporated within forest management planning regulations and codes of practice. The Government could also recognize the attainment of forest certification under voluntary independent schemes, as evidence that a forest is being managed in an environmentally appropriate manner.
- Provinces in China could review their logging ban policies in collectively-owned forests. Sichuan, for example, has exempted collectively-owned forests from the ban. Strict logging bans in these forests have had serious impacts on people's livelihoods and may ultimately impact negatively on forests by reducing the motivation of local populations to safeguard collective forest resources and by undermining customary forest stewardship systems of forest dwelling minorities (see Xu and White 2002:65, Hyde and others 2003:210). At the very least, local communities that have traditionally relied on collective forests ought to be compensated for losses caused by an outright ban on harvesting.
- The relevant authorities could designate adequate fuel wood harvesting areas to meet local demand. This would bring harvesting to meet this demand under

supervision with a greater prospect for observance of sound cutting practices that maintain the capacity of the forest to regenerate.

- Rural Development Banks and government-sponsored credit schemes could lengthen the pay-back period of loans to tree farmers. This would allow farmers to pursue forest restoration and planting options that do not necessarily generate short-term cash returns. Farmers would then have the financial freedom to pursue ecologically friendly natural regeneration techniques and production of slower growing mixes of quality timber species rather than fast rotation monocultures or orchard species.
- The Government could encourage schemes that secure future harvesting and sale rights for households and collectives that plant trees and manage forests for wood production. This could involve learning from and replicating positive elements of the experience to date with family plots (*ziliushan*) and responsibility hills (*zerenshan*) (see Liu & Edmunds 2003:30).

Improving the Efficiency of Wood Harvesting, Distribution and Use in China

Efficient harvesting, transport and processing of wood products can make forestry a more viable land-use, as well as reduce waste, so that less can be harvested to produce the same output of manufactured products. Possible actions and policy changes to achieve this are outlined below —

- The government of China could further rationalize local administrative procedures for sale and transport of timber to avoid unjustified constraints on producers' ability to adjust harvesting schedules, prices, product types and delivery destinations to match market.
- The government of China could rationalise the taxation and fees system for timber production to remove disincentives for tree planting and wood production, while ensuring new incentives for over-logging are not created (see also Hyde and Others 2003:211, Xu and White 2002:68).
- China's planning agencies could integrate transport infrastructure planning with location of wood harvesting areas, plantation developments and processing mills (see also Cohen and Others 2001:8).
- Government and private sector interests could encourage recycling of formwork plywood and other materials.
- China's wood processing industries could improve efficiencies by full use of thinned logs, small logs, and harvesting and processing residues.
- Government agencies and environmental groups could encourage environmentally friendly resource-saving consumption. This could include, for example, restrictions on the use of "disposable" chopsticks. China is the biggest consumer, producer and exporter of chopsticks. According to one estimate, it fells 25 million trees a year to make 45 billion pairs. Two-thirds are used in China and few are recycled (Yang 1999).
- The private sector and government could promote research and technology transfer to develop cleaner, more efficient, technologies for small-scale, non-wood fibre mills. Such technologies would rely on fibre from agricultural residues and could

support the revitalization of a traditional small mill sector, which is now in decline due to large-scale investment in new wood-based pulp mills and new pollution laws.

- The private sector and Government could explore the environmental impacts, on a "cradle to grave" basis, of wood substitutes such as steel, plastic and composite materials. Where substitutes or composites are viable and cause less net environmental harm, their use could be encouraged in place of wood-based products, particularly in furniture manufacturing and construction projects.

Encouraging Imports or Purchases of Wood Produced Legally and from Well-managed Forests

The environmental impact associated with supplying wood to China's growing market, will be lessened to the extent that China can reduce its reliance on imports of wood sourced at high cost to the environment. Possible actions and policy changes to achieve this are outlined below—

- Retailers, government agencies, architects, building companies, and manufacturers sourcing or manufacturing wood or paper products in China can adopt responsible procurement policies. These policies could include refusal to purchase products containing illegally sourced timber, and a preference for wood and fibre sourced from well-managed forests (for detailed guidance on responsible procurement, see White & Sarshar 2004; Poynton 2003).
- Companies manufacturing or sourcing wood-based products in China can introduce systems to trace wood from its source to final use. Without a wood-tracing system, companies cannot be confident that they are purchasing wood from forests under sound stewardship, nor can they eliminate wood sourced illegally or from destructive logging operations for their supply chains. A vast array of systems and technologies are available that can support wood tracking (see Dykstra et al. 2003).
- Buyers of wood-based products can use forest certification (a process that leads to the issuance of a certificate by an independent auditor, attesting that an area of forest is managed to a defined standard) to verify the quality of forest management from a particular source. Some certification schemes include chain of custody requirements that oblige certificate holders to track all logs from certified forests, and also to track the products made from those logs. In the case of the Forest Stewardship Council certification system, a link to the market is created through a product label, which warrants that the timber or wood product originates from well-managed forests. Companies in the supply chain hold chain of custody certificates so that the label can follow the wood from the forest to the end-user.
- Governments can introduce policies and regulations to prevent the import of products containing illegally-sourced wood. For example, a recent report on options for the European Union for controlling imports of illegal timber trade (Brack and others 2002) recommended a range of measures including —
  - Using existing legislation on illegal goods and money laundering to target illegal timber.
  - Using government procurement policy to source legal and sustainable products, excluding illegal timber from an important section of the market.

- Regulating sources of finance for the forestry industry, thereby steering investment flows away from potentially illegal activities.
- Establishing systems to identify legal production in producer countries, and adopting new EU legislation to bar entry into the EU of products not identified as legal.
- Providing capacity-building assistance to developing countries to establish legality verification systems and to reform their forestry sectors.

- Governments can enhance bilateral and/or multilateral cooperation to combat illegal trade. Ministers participating in the Forest Law Enforcement and Governance East Asia Ministerial Conference in Bali in September 2001 jointly declared that they would take immediate action to address forest crime at the national level and to strengthen bilateral, multilateral and regional collaboration to address violations of forest law. A similar initiative is underway in Europe.
- The government of China could review the utility of its “temporary” half tax policy on border trade that has helped fuel massive imports of timber from Russia and other neighboring countries.

APPENDIX 1
DATA SOURCES AND TECHNICAL NOTES

Section II

Data Sources

Imports and exports: “China Customs Statistics Yearbook” (1993 to 1998), “World Trade Atlas” (1999 to 2003);

Domestic production and consumption:

“China Statistical Yearbook”, China’s National Forest Resource Inventory.

“Production” and “of which Fuelwood”) for 2003: ITTO Tropical Timber Market Report 01–15 June 2004

See Page 14 and 15 for explanation of estimates of undeclared production.

Notes

1. Source data has been converted to estimated roundwood equivalent volume using the conversion ratios set out in the table below.

2. Domestic consumption equals Production (excluding fuelwood but including estimates of undeclared production) plus Imports less Exports.

3. In Figure 2.2 only, timber processing waste is assumed all used in other wood-based products (reflecting impact on global consumption). In all other charts and tables, RWE volume data for timber imports and exports assumes that none of the wood waste which is created when processing any of the wood-based products which China imports is used in making any other of the wood-based products which China imports.

4. China’s exports and imports of wood chips are assumed here to be destined for the paper industry.

5. In Table 2.5 and 2.6 data for wood-based pulp exports are small (<c100, 000 cubic metres RWE) so are not shown.

Section III

Data Sources

Imports and exports : World Trade Atlas, Eurostat and national yearbooks of import and export statistics — which include China Customs Statistics Yearbook; Hong Kong — Trade Statistics (Imports); Monthly Statistics of the Foreign Trade of India (Imports); Indonesia Foreign Trade Statistics / Statistik perdagangaan Luar Negeri Indonesia; Japan

Exports and Imports; Malaysia External Trade Statistics (Imports); Foreign Trade of the Philippines; Singapore — Trade Statistics: Imports and Exports; South Korea — Monthly Foreign Trade Statistics Commodity by Country; Switzerland — Jahresstatistik Erster Band; Taiwan — Monthly Statistics of Imports; Foreign Trade Statistics of Thailand (Imports).

Notes

1. Import statistics of physical measures such as weight and volume are assumed to equal actual exports.

2. Source data have been converted to estimate roundwood equivalent volume, using the conversion ratios listed in the tables below.

Conversion to Rundwood Equivalent Volume

Factors to use when units of volume are either not provided or anomalous

1.4	to multiply weight (tonne) to estimate volume (cu.m.)
0.01	to multiply surface area (sq.m.) to estimate volume (cu.m.) — for plywood
0.001	to multiply surface area (sq.m.) to estimate volume (cu.m.) — for veneer

Factors used to convert wood volume to roundwood equivalent volume

HS code	Description	Factor	Source	Remark
4401	*Wood chips*	*1.15*	URS	*Regarded herein as raw material for the pulp and paper sector*
4402	Fuel wood	2	x	This factor would be an underestimate for charcoal
4403	Logs	1	ITTO/UCBD/FF	
4404	Hoopwood	2	x	
4405	Mill waste	1	x	
4406	Sleepers	2	x	
4407	Lumber	1.82	ITTO/UCBD/FF	
4408	Veneer	1.9	ITTO/UCBD/FF	
4409	Mouldings	1.9	FF/UCBD	
4410	Particleboard	1.4	ECE/TIM/BULL/50/3	
4411	Fibre board	1.8	ECE/TIM/BULL/50/3	
4412	Plywood	2.3	ITTO/UCBD/FF	
4413	Blockboard	2	x	
4414	Picture frames	3	FF	
4415	Packaging	2	FF	
4416	Casks and barrels	2	FF	
4417	Tools	3	FF	
4418	Joinery	3	FF	
4419	Table and kitchenware	2	x	Allowance for bamboo chopsticks has been made in deriving this factor
4420	Ornaments	3	FF	
4421	Other items	3	FF	
94*	Furniture	2	x	HS codes: 940161, 940169, 940330, 940340, 940350, 940360, and parts*

* but only when the commodity code is confined to parts for wooden furniture

Key:

ECE/TIM/BULL/50/3 — bulletin 50/3 published by FAO/United Nations Economic Commission for Europe

FF — a report by Friends of the Earth “Forests Foregone” (1993)

ITTO — annual reviews by the International Tropical Timber Organisation

UCBD — annual summary of imports by the European Hardwood Federation

(URS — personal communication 10 March 2004)

x — factor assumed

Notes:

1) Multiply wood volume by factor in order to estimate roundwood equivalent volume.

2) No allowance has been made for rubberwood — which might comprise a substantial proportion of furniture, picture frames and other items. The forest footprint of rubberwood is not equivalent to that of timber.

3) These conversion factors are estimates and aggregates — the actual conversion “efficiency” will vary with, for example, log diameter, log quality, species, and milling machinery and mill management.

4) These factors do not take into account differing amounts of wastage along the supply chain — which may be high.

5) The factors do not take into account the change (/loss) in asset (e.g. forest/land) value attributable to logging (including related access roads) — which will vary from forest area to forest area (e.g. according to conservation value, impact on forest people, and soil erosion).

6) The factors do not take into account the economic impact of logging on, for example, national foreign exchange earnings (actual and potential) and governance.

China’s Wooden Furniture Exports

A number of countries or regions (e.g. those of the European Union, Japan, Republic of Korea and Taiwan) declare the weight and value of the wooden furniture which they import and export. The weight of the furniture which these countries import from China in any year is deemed to be the weight which China exports to them in that year.

Major exceptions include Canada, China, Hong Kong and the USA — trade between which accounts for much of world trade in furniture.

Estimates of the unit value of China’s furniture exports to Hong Kong and the USA can be derived by comparing export values declared by China with weight declared by importing countries or regions whose economies (and geographic proximity) are similar to those of Hong Kong and the USA.

China’s wood chip imports and exports

The factor used to convert weight of wood chips to roundwood equivalent weight is 1.15. The factor used here to convert roundwood equivalent weight of wood chips to roundwood equivalent volume is 1.6 cubic metres per tonne.

China’s Pulp Imports

The conversion factors used are notional and based on a search of the literature,

focussing on countries which supply the majority of China's pulp imports.

The literature included producer company annual reports, consultants' reports, trade associations (e.g. CEPI), FAO/UNECE and national statistics.

These factors were used in deriving the charts which show China's pulp imports and the share of China and Japan in the exports of major producer countries.

Pulp based on recycled wood fibre or material other than wood fibre was excluded.

In units of cubic metres roundwood equivalent volume per tonne, the following factors were used -

4.7 for Canada, Chile, Finland, Indonesia, Russia, Sweden, USA
3.7 for Argentina, Japan, New Zealand, South Africa, Thailand
3.7 for all other countries

China's Pulp Exports

The conversion factor used was the average for China's pulp imports during the given year.

China's Paper Imports

The pulp from which China's paper imports was produced was deemed to have the same RWE volume to weight ratio as China's pulp imports.

One tonne of paper made entirely from virgin wood fibre is assumed to derive from one tonne of pulp.

For each of the 8-digit HS commodity codes included in source data, the proportion of virgin wood fibre was assumed to be either 100%, 80%, 60% or zero.

The conversion factor for each country's supplies of each type of paper in a given year was thus unique. For example, 2.2 for newsprint from Japan ($3.7 \times 60\%$) and 4.7 for printing paper from Indonesia ($4.7 \times 100\%$)

The charts which show the share of China and Japan in the paper exports of individual producer countries assume that the average conversion factor for China's imports applies to all other countries' imports from that producer country.

China's Paper Exports

The same general procedure for converting the weight of each paper product into roundwood equivalent volume was adopted for exports as well as for imports.

However, the quality of the pulp from which the paper was deemed to be based was that of the average of China's pulp imports during the given year.

Thus, no account was taken of products made from pulp based on non-wood fibre or recycled wood fibre imported by or produced within China.

Account was also not taken of imported paper products that were exported after further processing (or by way of packaging for other goods).

Notes:

1) There may be some scope for users in China to switch to papers whose virgin wood fibre content is lower than at present.

2) The potential for China to reduce its global footprint by importing a higher

proportion of its pulp from producers in countries which appear to require a lower roundwood equivalent volume of wood raw material per tonne of pulp is limited *inter alia* by the nature of the fibres which derive from those countries' forests.

List of Paper Products and Their Assumed Virgin Wood Fibre Content

Key: A=100%, B=80%, C=60%, Z=nil

HS commodity code	Proportion of virgin fibre assumed	HS commodity code	Proportion of virgin fibre assumed	HS commodity code	Proportion of virgin fibre assumed	HS commodity code	Proportion of virgin fibre assumed
48010000	C	48052400	C	48109900	B	48171000	A
48021000	A	48052500	C	48111000	C	48172000	A
48022000	A	48052900	B	48112100	A	48173000	A
48023000	A	48053000	B	48112900	A	48181000	B
48024000	B	48054000	B	48113100	B	48182000	C
48025100	B	48055000	B	48113110	B	48183000	C
48025200	B	48056000	B	48113190	B	48184000	B
48025300	B	48057000	B	48113900	B	48185000	B
48025400	B	48058000	B	48113910	B	48189000	A
48025500	B	48059100	B	48113911	B	48191000	C
48025600	B	48059200	B	48113919	B	48192000	C
48025700	B	48059300	B	48113990	B	48193000	C
48025800	B	48061000	A	48114000	B	48194000	C
48026000	B	48062000	A	48114010	B	48195000	B
48026110	B	48063000	A	48114090	B	48196000	C
48026190	B	48064000	A	48114100	A	48201000	A
48026200	B	48070000	B	48114900	A	48202000	A
48026910	B	48071000	B	48115110	B	48203000	A
48026990	B	48079000	B	48115190	B	48204000	A
48030000	C	48079100	Z	48115911	B	48205000	A
48031000	C	48079900	B	48115919	B	48209000	A
48039000	C	48081000	C	48115990	B	48211000	A
48041100	C	48082000	B	48116010	B	48219000	A
48041900	C	48083000	B	48116090	B	48221000	A
48042100	C	48089000	B	48119000	B	48229000	A
48042900	C	48091000	A	48119010	B	48231100	A
48043100	C	48092000	A	48119090	B	48231200	A
48043900	C	48099000	A	48120000	B	48231900	A
48044100	C	48101100	B	48131000	A	48232000	A
48044200	C	48101200	B	48132000	A	48233000	A
48044900	C	48101300	B	48139000	A	48234000	A
48045100	C	48101400	B	48141000	A	48235100	A
48045200	C	48101900	B	48142000	C	48235900	A
48045900	C	48102100	A	48143000	B	48236000	A
48051000	B	48102200	A	48149000	B	48237000	A
48051100	B	48102900	A	48150000	C	48239010	B
48051200	Z	48103100	B	48161000	A	48239020	B
48051900	C	48103200	B	48162000	A	48239030	B
48052100	C	48103900	B	48163000	A	48239040	B
48052200	C	48109100	B	48169010	A	48239090	B
48052300	C	48109200	B	48169090	A	–	–

APPENDIX 2
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WWF International
Avenue du Mont-Blanc
1196 Gland, Switzerland

Tel:+41 22 364 9008
Fax:+41 22 364 0640
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