THE WOOD PRODUCTION POTENTIAL IN CHINA

BY

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A THESIS

Submitted to
Michigan State University
in partial fulfillment of the requirements
for the degree of

MASTER OF SCIENCE

Department of Forestry

1985

ABSTRACT

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This paper gives a general picture of forestry development in China before 1985 and projects wood production in the future. Four key factors: forestry policy, plantation efforts, timber demand, and timber supply are studied in this paper. New changes in government forestry policy will have significant impact on wood production during the coming decades. The plantation efforts in the past 34 years (1949-1983) resulted in 38 million hectares of plantation establishment. Wood production was 52 million cubic meters in 1983. China's timber consumption will be 101 million cubic meters by year 2000 if 4 percent annual growth in timber consumption is obtained. In contrast to demand, the projected physical timber supply would be 295 million cubic meters by year 2000. If the government begins to make improvements in management, wood production, wood utilization, marketing and planting quality, China may become a big exporter of timber products.

ACKNOWLEDGEMENTS

I wish to express my sincere appreciation to all the people who helped me in the preparation of this thesis. I am primarily indebted to my principal advisor-Dr. James Hanover-who made the great effort not only to create the opportunity for me to study at MSU, but also to make my stay at MSU so pleasant and unforgettable. I would like to take this opportunity to express my heartfelt thanks to Mrs. Hanover who gave thoughtful consideration to my accommodations on my arrival. My family and I will always be grateful for their kindness.

Thanks should also be given to Dr. Lee James who helped me generate, focus and refine the ideas presented in this thesis. He and Dr. Paul Nickel carefully read the draft and their detailed comments resulted in a significantly improved final version.

I am deeply grateful to Betty Holmer-Heckman and Dr. Michal Gold who painstakingly edited this thesis for me. Their excellent assistance significantly improved the readability and clarity of the thesis.

I am especially thankful to Dr. Cherukat Chandrasekharan and my friends in both the Chinese Ministry of Forestry and the Chinese Academy of Forestry, who sent me necessary

information for writing this paper. My study could not have been completed without their help.

Finally, I wish to thank Dr. Raymond Miller, Dr. John Heckman, Mike O'Connor and all other individuals who helped me during my study at MSU.

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CHAPTER I

INTRODUCTION

The most populated country in the world, China[1] has over one billion people and occupies 9.6 million square kilometers of territory. Extending approximately 5,000 kilometers from east to west, 5,500 kilometers from south to north, with its southern border descending from west to east, China shares 28,072 kilometers of borders with 12 countries.

China's forest now covers an aggregate area of 115 million hectares, amounting to 9 billion cubic meters of stocking volume (Ministry of Forestry,1984). BY its extremely diverse geographic features, China has more than 7,000 species of woody plants, of which more than 2,800 species are arboreal. Of the 30 genera of Pinaceae and Taxodiaceae in the world, 26 genera (about 200 species) are found in China. In addition, 260 genera of broad-leaf trees (containing 2,000 species) are located within the borders of China. Many species are unique to China, including

[1] All forestry data in this dissertation expect forest land area and timber volume apply to mainland China only.

Gingko biloba, Metasequoia glyptostroboides, Glyptostrobus pensilis, Cathaya argyronhylla, and Cunninghamia lanceolata. In addition, there are nearly 300 bamboo species in China (11).

Forest Classification

China's forest can be divided into six forest belts:

1. A coniferous belt in the frigid and temperate zone (Da Xinganling).
2. A coniferous and deciduous mixed forest belt in the temperate zone (Xiao Xinganling, Mt.Chang Beishan).
3. A deciduous forest belt in the warm temperate zone (northern China, Liaodong Peninsula, Shandong Peninsula).
4. Evergreen and deciduous forest in the north subtropical zone (the Hanjiang River valley, the middle and lower reaches of Yangtze River).
5. Evergreen broad leaf forest belt of the subtropical zone (southern China).
6. Monsoon forest and rain forest belt of the south-sub-tropical and tropical zone (Hainan Island, Xishangbanna southern part of Taiwan province).

China's forest is further classified into the following five categories based on their different uses:

1. Protection forests

   The protection forests consist of windbreak, sand dune stabilization, farmland and pasture shelter-belts, water and soil conservation forest, water

resources containment forests, river bank and road side protection forests, and national defense forests.

2. Timber forests

Timber forests mainly mean commercial forests and bamboo forest.

3. Economic forests

These forests are for the production of fruit, edible oil, industrial raw materials and medicine.

4. Fuelwood forests

Fuelwood forests contain trees and shrubs that produce firewood and charcoal.

5. Forests for special uses

These forests and trees are used for environmental protection, scientific purposes (including seed production areas), landscape forests, and natural preserves.

Natural forests are limited in area and unevenly distributed. Sixty percent of the forest volume is concentrated in two geographic regions: 1) The northeastern provinces of Heilongjiang, Jilin; and 2) The southwestern provinces of Yunan, Xizang and Sichuan. The most ofthe forests are over-mature and have never been exploited because of inaccessibility.

Forestry in the National Economy

Forestry's share in the gross value of agricultural output remains relatively small but has increased steadily

from less than 1% in the early 1950s to 4.1% in 1982 (equivalent to 9.5 billion Yuan in value). There are 2.2 million employees (less than 1% of the rural work force) in forestry and forest industries, with nearly 60% involved in wood processing, 30% in land preparation and planting, and 10% in nursery operations, logging, etc. Annual per capita consumption of timber products is about 0.05 cubic meters (excluding fuelwood), compared to 0.08 cubic meters in India and 1.50 cubic meters in the United States (6). The imports of timber have increased from 270,000 cubic meters in 1975 to 1.82 million cubic meters in 1982. By 1982,the value of imported timber products including pulp, paper, and plywood reached over US $ 600 million. Timber exports have been in a small scale, ranging from 220,000 to 360,000 cubic meters annually during the past decade.

Afforestation

Afforestation has been carried out on an extensive scale in the last few decades. Provinces in southern China have planted 5.3 million hectares of timber forest which is mainly Chinese fir (Cunninghamia lanceolata) and 1.33 million hectares of bamboo groves. An additional 4.74 million hectares of trees of economic value have been planted throughout the country. Aerial-seeding has covered 3.09 million hectares in sparsely populated and inaccessible areas. A network of forests has been built across 12.66 million hectares of farmland on plains in central and northern China. Many hills are closed off for natural regeneration. In the

afforestation drive, over 340 bases have been set up for tree improvement, covering 21,000 hectares, and over 1900 state-owned nurseries have been established, cultivating 2,000 hectares of seedlings each year. A total of 4,076 state-owned forest farms have been set up with an area of 48 million hectares, of which 6.7 million hectares are new forests. There are 175,000 collectively owned forest farms, covering 16.66 million hectares. Seedlings planted before the 1970's have become a new source of timber (11).

The "Three North Shelter Belts Project" (Northwest, Northeast and northern part of North China) began in 1978. This undertaking has become known as the "Great Green Wall." Seventy five percent of the first phase of this project has been completed, amounting to 4.4 million hectares of forest.

In the early years of the People's Republic of China, national forest cover comprised only 8.6% of the land base. China's rigorous afforestation efforts have resulted in a significant increase in natural forest cover, now estimated to be over 12% (11).

Timber Products Industry

Along with the development of forests in the Northeast, Northwest and Southwest, 163 state-owned forest industry enterprises have been set up. In the state-owned forests, there are 131 logging enterprises with an annual production capacity of 27 million cubic meters of timber. Over 90,000 kilometers of forest roads and 13,000 kilometers of forest railways have been built, while 57,000 kilometers of waterways

for wood transportation have been dredged. The forest enterprises, paying attention to both exploitation and conservation, are felling trees in a rational way, and have planted 2.43 million hectares of new trees. In the collective-owned forests, with an annual production capacity of 13 million cubic meters, management and control has been improved, and facilities for timber shipment and storage have been built. Under the current state plan, the annual timber production in the national forests now stands at 50 million cubic meters, compared to only 5 million cubic meters in the early fifties. Many lumber mills have been built. In 1983, China's lumber mills sawed 14 million cubic meters of logs. A wood-based panel industry (plywood, fiber board and particle board) has sprung up since 1958. Its annual output has reached 1.39 million cubic meters, 39 times higher than in the early 1950s. The forest chemical industry is turning out a greater variety of products, in larger quantities and of better quality. China is the largest producer and exporter of rosin in the world (11).

Forest Protection

China has 7,600 professional forest fire fighters and has developed 135,000 kilometers of fire breaks. Approximately 2,000 watchtowers have been erected and 30,000 kilometers of special communication lines devoted to fire prevention have been laid. In Northeast China and Inner Mongolia, there is a forest protection aviation bureau which supervises 9 aviation stations manned with parachute fire fighting brigades.

Forest insect and disease control efforts consist of 2 biological control centers, 500 control stations and 2,000 observation posts which have been set up throughout North and South China. Due to environmental concerns, biological control combined with other measures are gradually replacing manual and chemical methods of control. Concurrently, quarantine efforts have been strengthened and increased attention is being paid to the selection of insect-and disease-resistant strains and the enlargement of mixed forests (11).

Research

Rapid progress has been made in scientific research in forestry since the founding of New China in 1949. The Central Research Institute of Forestry was set up in 1952, which was enlarged in 1958 and renamed the Chinese Academy of Forestry. The Academy is a forest science research center featuring a comprehensive multidisciplinary research program. It is composed of 12 research institutes, laboratories and experimental farms, which specialize in forestry, timber industry, forest economics, forest chemical industry, subtropical forestry, tropical forestry, forest technical information, etc. Forest research institutes have also been set up in all provinces, municipalities directly under the Central Government, autonomous regions, and in some prefectures and counties. With a research staff of 7,600, the national network of 679 research institutes are the core of China's national forestry research efforts. Over the last 35 years, 1,424 forestry-related research projects have

proven fruitful, resulting in increased production. Approximately 12 improved poplar (Populus spp.) clones have been planted on 100,000 hectares, where new, fast growing techniques have been applied. China's first generation Cunninghamia seed orchards can produce 25,000 kilograms of improved seeds every year, enough for 66,000 hectares of plantation.

Education

China now has 11 forestry colleges and 18 forestry departments within its agricultural colleges. There are 4,400 faculty members, of whom 460 are professors or associate professors. The total enrollment includes 250 graduate students and 14,000 undergraduates. They now graduate some 3,000 students each year. In addition, 37 forestry schools offer 13 specialties in biology and engineering. The faculty members total 1,900, and enrollment is 13,000. Four thousand students graduate from these schools annually. By the end of 1983, China's forestry colleges and forestry schools had graduated 57,000 and 69,000 students respectively.

The government has also set up 18 training colleges and schools for cadres (officers). Several evening colleges for workers, educational programs carried by radio and television, along with secondary technical training centers of short courses, all aimed at giving forest workers an opportunity to study forestry technology and management (11).

Natural reserves

There are 120 natural reserves under the administration of the forestry departments comprising an area of 7.8 million hectares. Rare plants under protection include *Metasequoia glyotostroboids, Cathaya argyronhylla, Pseudolarix amabilis, Bretschnei bera sinensis* and *Davidia involucrata*. Rare animals under protection include the giant panda, golden-haired monkey, takin, white-lipped deer, crested ibis and red crested crane, etc. In April 1983, the State Council promulgated the "Circular Order on Strengthening the Protection of Wild Animals" to improve the protection work. In December 1983, the China Wildlife Conservation Association was set up. To promote international cooperation in this field, China has acceded to the "Convention on International Trade in Endangered Species of Wild Fauna and Flora" (11).

Goals and Objectives

According to the strategic objectives set by the 12th Party Congress in 1979, the goals in forestry are: 1) to raise forest percentage of cover in China from the present 12% to 20% of the nation's total land area; 2) to increase the timber output from the present 50 million cubic meters to 100 million cubic meters; 3) to increase the total forest volume by 12 billion cubic meters; and 4) to quadruple the 1980 total output value of the forest industry by the end of the century (11).

CHAPTER II

FORESTRY POLICY

Leftist Influence

Many of China's current forestry policies were formulated as early as the mid 1950's. These policies included "sustained yield forest based on silvicultural principles"; "fuller utilization of timber"; "planting the trees based on appropriate species/site characteristics "; and "greening the country." The past 35 years have shown that most of these policies are still relevant for forestry development in the 1980's. However, these policies have not been completely implemented because of the influence of various political decisions.

Forest resources suffered severe damage during the "great leap forward" when the government placed undue stress on steel and grain production. Thousands of hectares of forest were cut for manufacturing steel and were converted into farmland.

China is a country with a population of one billion with only 10.5 percent arable land. The food problem is the first priority of the government. However, the government has overemphasized grain production while ignoring the beneficial function of forests. The Ministry of Forestry

was merged with the Ministry of Agriculture during the late 1960s and 1979, and staff members were reduced from 1000 to 100. During that period, many areas which were not suited to growing grain crops were claimed as farmlands under the slogan "Taking the grain as the key link." As a result of these policies, serious deforestation occurred.

The Ministry of Forestry was considered by some leaders as the Ministry responsible for wood production and as a result, wood production was inadequately stressed and the funds for afforestation were small and uncertain. Some logging enterprises, overloaded by felling tasks set by the state plan could not plant trees within two years after harvesting according to "sustained yield forest based on silvicultural principles."

The number of people in the rural areas comprise over 80 percent of the total population in China. In the past 35 years, they have planted more than 80 percent of China's forest plantations. A main distinction between good and bad forestry policy is whether it gives incentives to peasants to plant trees. Marketable trees such as tea oil tree (Camellia oleosa Rehd), tung oil tree (Aleurites fordii Hemsl), fruit trees, and fast-growing timber trees, are attractive to peasants because they can bring them cash income. However, when the Left were in power, they emphasized an equalization of wealth. The marketable trees planted surounding peasant houses were labeled as "Capitalist tails" and taken away from them. This abnormal

situation lasted for a long period. As described by Ross: "on the one hand, the government has lent strong, continuing symbolic endorsement to greenification, on the other hand, frequent policy reversals, uncertainties over ownership rights, and inadequate investment have interferred with forestry development," (13).

Changes in Forestry Policy

Obvious changes have been taking place since 1979. The first Forest Law was adopted by the Standing Committee of the Fifth National People's Congress on February 23, 1979. The Law, reiterating good regulations in forest operation and protection, states that: 1) The total area of forest cover in China should be increased to 30 percent; 2) A fixed forest silviculture fee should be levied on the selling of timber, bamboo or other forest products; 3) The principle of "planter as owner" is stressed; 4) People of the whole country have an obligation and right to plant trees and protect forests; and 5) Cities, industrial areas and mining areas should have at least 5 square meters of forest enviroment per person. Wood operation enterprises are required to replant trees within two years after felling. The coal and paper manufacturing industries may use the silviculture fees which are collected from coal and paper output to establish their own production forests.

An amended draft of the Forest Law was adopted by the Sixth Session of the Standing Committee of the Sixth National People's Congress on July 5th, 1984. The government, as

specified in the draft, will issue licenses of forest ownership and operation of forest land (including public and private lands). The right and interests of license holders are protected by the law. Trees planted by people surounding their houses and family fuelwood plots are the property of the planters. The ownership of these trees can be inherited or transferred. The draft has tightened the control of felling by mandating "cutting less than the mean annual increment and maintaining the principles of sustained yield." All the harvesters (including private) should apply for felling licenses before felling takes place. Realizing that long term and large investments are needed in forest development, the government will increase its funding in forestry. Meanwhile, it will expand the range of fees levied on forest silviculture operations. The punishment for violation of the law has increased since its implementation.

The People's Congress requires all able-bodied Chinese over 11 years of age to plant 3-5 trees every year as an obligation of all Chinese citizens. Revegetation committees were set up at the local, provincial and national level to organize the plantation activities. In addition, such industries and service groups as coal mining, paper manufacture, water conservantion, power and highway departments, railroads, and travel agencies are required to set aside certain funds for plantations.

The system of contracts and production responsibilities has been a great success in agriculture production. It is now being applied to forestry. Recently, the mountainous

areas (over 16.7 million hectares) were assigned to 50 million peasant families. The government encourages people to plant trees by allocating subsidies (105 Yuan/ha) and low interest loans, thus enhancing the law to protect planters' rights and interests.

Past experience has shown that the implementation of good policy requires conscientious leaders. The government stresses that the leaders at all levels should take responsibility for doing good revegetation work. Demonstrated responsibility will be an important criterion used in reviewing the qualifications of the leaders (12).

The new forestry policy has had significant impact on forestry development. The people's willingness (particularly the peasants) for planting has greatly increased. Many peasant families have signed contracts with the government for planting trees in mountain areas and several families have organized themselves to establish forest farms. The results are obvious. There were 10.8 million hectares planted in 1982 and 1983 according to the plantation figures released by the Ministry of Forestry (12).

Forestry in China will be very promising if the new forestry policy is maintained and the government continues its efforts in forestry development for the next 10-15 years.

CHAPTER III

PLANTATIONS

General Outlook

In comparison with the massive size of its population, China has few forest resources. The only way to meet the increasing demand for wood and wood products is to plant more trees. Since 1979, increased governmental efforts have included the issuance of a new Forest Law, restoration of the Ministry of Forestry, adjustment of forestry policy, allocation of increased funds for plantation establishment, settlement of forest ownership claims, etc. Obvious results have been achieved from the government's efforts. It is the government's goal to increase forest cover from 12% to 20% by the end of this century. At the first glance, it would not appear to be a difficult task because only 4.5 million hectares of plantation needs to be established each year during the rest of the century while 4.8 million hectares of trees have been planted annually in the last ten years. However, looking at the 31% survival rate of the plantations in the past 30 years, it is not an easy task. Something should be done to increase the survival rate. It is expected

that the rate of preservation will be increased by adoption of contract and production responsibility systems in plantations.

One hundred and twenty-three million hectares of trees were planted in the open lands in the last 35 years, of which 38 million hectares of these plantations have survived. In addition, 7.6 million hectares of plantings were established on the areas harvested from 1950-1982 (11).

Planting on Open Lands

There are 4,076 state forest farms (with over 410,000 workers) and 175,000 forest farms owned by communes and brigades (11). Some private forest farms have recently been established following the changes in governmental forestry policy. The people in communes and brigades conduct over 80% of all afforestation. Subsidies of up to 105 Yuan/ha are given within 2-3 years after the trees are planted and planting quality is inspected. Of the 123 million hectares of land which were planted during 1949-1983, only 38 million hectares have survived. The success rate was only 31%.

Areas of successful plantings on open land for all purposes are summarized in Table 1. Timber plantations cover 30.7 million hectares. All other tree plantings--miscellaneous nontimber tree crops, shelterbelts, protection forests and fuelwood crops--cover 7.7 million hectares.

Table 1.--Successful plantings on open lands, by function, 1949-83

Plantation function	Area planted	Percent of total
	(Million ha)	
Timber	30.7	79.8
Nontimber crops	4.5	11.8
Shelterbelt and protection	2.4	6.3
Fuelwood	.8	2.1
Total	38.4	100.0

Source: Percentages (from FAO, 1982) applied to total area estimates.

Species Used in Planting

Populus species are considered as one of the fast growing and high yielding species which are planted in China. Populus species are good for pulp and plywood manufacturing. There are about 3.83 million hectares of Populus distributed throughout north, northeast and northwest China. However, only 20% of the fiber used in paper production is wood pulp, the remaining 80% is derived from other raw materials including bamboo, bagasse and straw. China also imports a number of pulp and paper products to meet its domestic demand. The current consumption of paper products per capita is only 4 kilograms per year which is one-tenth of the world average.

If China were to attain the world average in its paper consumption, this standard of consumption could be met with 13 million hectares of Populus. Many areas are available for such planting-- secondary forest (low yield) in Heilongjiang province (13 million hectares), open land in Jiling and Inner Mongolia Autonomous region (1.9 million hectares), and grasslands (200 million hectares) (8).

Paulownia is called "cash tree" by peasants in northern China. It can easily reach 30-40 cm in diameter and 0.4-0.5 cubic meters in volume per tree within 10 years. It is planted in 23 provinces and autonomous regions. If 2 billion Paulownia tree seedlings are planted before 1985, 200 million trees could be harvested annually beginning 1995. There would then be 40-60 million cubic meters of additional wood available, which equals the current rate of wood consumption in the whole country (based on a calculation of 0.2-0.3 cubic meters per tree) (9). With low labor costs and short transportation distances, China is expected to become a major Paulownia supplier to Japan.

Cunninghamia lanceolata, the most important species planted in China, is planted in 16 provinces in southern China and comprises 25% of the total commercial wood production. C. lanceolata grows on a 20-year rotation with an average volume yield of 300 cubic meters/hectare. Plans project an estimated 1.33 million hectares of Cunninghamia to be planted each year in Fujian Province from 1984-1994.

The harvest is expected to start by the year 2000 with 666,000 hectares harvested per year yielding 10 million cubic meters annually. The estimated income to Fujian provincial government will be one billion Yuan after the timber is processed (12).

Bamboo has the same nickname as Paulownia--"cash tree." It is distributed in the area of 24^{o}-32^{o} north latitude and 102^{o}-122^{o} east longitude. It takes only 2 months for sprouting to regrow to full size, but requires an additional 5-6 years to reach harvestable maturity. Bamboo products can substitute for many wood products including furniture, farming tools, musical instruments, poles, beams, and home construction materials. Fifty pieces of bamboo are equivalent to one cubic meter of wood and 3 tons of bamboo yield 1 ton of pulp. The output of bamboo per hectare is 23-30 metric tons and there are currently 5 million hectares of bamboo in China (4).

Eucalyptus was introduced into China in the early part of the 19th century. By its ecological requirements, it has been planted in the southern provinces. Where planted, it has exhibited fast growth and high yield. The most successful plantation was established on Leizhou Peninsula in Guangdong province yielding 189 cubic meters per hectare at 12 years of age. More than 60,000 hectares of Eucalyptus have been planted on Leizhou Peninsula with an annual harvest of 400,000 cubic meters. The leaves of the Eucalyptus contain high oil and tanning compounds ranging from 0.7-1.7% oil content and 5.6-13.6% tanning content (4).

A large amount of Pinus elliottii, P. taeda and P. caribaea seeds were imported during 1973-1976 and 1982-1983. These pines have performed well in southern provinces and planted areas have been expanded to 40,000 hectares (15). The resin content of P. elliottii is 19.2-22.3%, 5-6% higher than in the native species P. massoniana. So P. elliottii may take the place of P. massoniana as the major resin species in China, providing rosin and turpentine oil for industrial and medicinal uses. The planted areas of the above mentioned exotic species are expected to be continuously increased.

Areas Planted by Species

The percentage of the total open area planted in each species or species group was derived from information provided by FAO and the Chinese Academy of Forestry. By applying the species percentages to the total plantation area successfully planted (38.4 million hectares), the areas occupied by different species could be calculated (Table 2).

The rate of open land successful planted built up rapidly to the middle 1950's and increased more slowly in recent years. Annual successful planting averaged 1.2 million hectares in the period 1954-58, 1.3 million hectares in 1969-73, and 1.5 million hectares in 1979-83.

About 80 percent of the plantings shown in Table 2 are intended for timber production. All the Cunninghamia lanceolata, Pinus massoniana, Phyllostachys pubescens,

Table 2.-- Tree Plantations Established and Surviving on Open Lands, by Species 1949-83.

Species	All years	Years of Planting 1949 -53	1954 -58	1959 -63	1964 -68	1969 -73	1974 -78	1979 -83
		(Thousand hectares)						
Cunninghamia lanceolata	7662	173	1179	851	1123	1328	1506	1602
Pinus massoniana	6127	138	943	681	898	1062	1204	1201
Phyllostachys pubescens (Bamboo)	5117	115	787	569	750	887	1006	1003
Populus spp.	3626	86	589	425	561	664	753	751
Paulownia spp.	2491	55	337	272	440	425	482	480
other	13194	303	2075	1472	1858	2294	2599	2593
Total	38420	870	5910	4270	5630	6660	7550	7530

Source: Total plantings by species from FAO, 1982, the China Statistics Bureau, 1983, Chinese Academy of Agriculture and Forestry, 1976. Total plantings reduced, using 31 percent survival rate obtained in correspondence with Chinese Academy of Forestry.

and Paulownia spp. are intended for timber production. In the "other" category, however, most planting has been for nontimber purposes. In the later case, 13.2 million hectares have been planted, of which only 5.5 million hectares are considered to be timber plantings. The distribution of timber species planted on open lands is shown in Table 3.

Shelterbelts

Among the nontimber objectives in planting, shelterbelts deserve special mention. Although the shelterbelts have nontimber primary objectives, they can produce considerable quantities of wood. An entire county in Henan province has established shelterbelts with an estimated wood volume of 1.2 million cubic meters. The county now provides annually 30,000 to 40,000 cubic meters of timber to the market.

Shelterbelts are divided into four categories: 1) shelterbelt for protecting farmland, 2) shelterbelt for grazing land, 3) shelterbelt for soil and water conservation, and 4) shelterbelt for wind breaks and sand fixation.

More than 333 million hectares of land, one third of the total land area in China, are endangered by wind damage, drought, and serious soil and water erosion. The Gobi desert, salt desert, and sand lands in northern, northeastern and northwestern China, comprise thirteen percent (128 million hectares) of total land. In addition, there are 23,000 kilometers of coast line in southeastern China where there are problems of sand land and salt desert, wind damage, and severe water and soil erosion (7).

Table 3. Estimated percentage of timber species planted on open lands

Species	Area of successful plantations	Timber plantations
	(million hectares)	(%)
Cunninghamia lanceolata	7.67	25
Pinus massoniana	6.13	20
Phyllostachys pubescens (Bamboo)	5.12	16.7
Populus spp.	3.83	12.5
Paulownia spp.	2.45	8
Other conifers and broad leaf trees	5.45	17.8
Total	30.66	100

Source: (2), (3), (4), (9).

The big shelterbelt project in China is called the "Three North Project" (north China, northeast and northwest China) or the "Green Wall Project.". The engineering plan of the project was approved by the People's Congress in 1979 and the first phase of the project is expected to be completed by 1985. The shelterbelt will be 7,000 kilometers in length running approximately parallel with and to the north of the Great Wall. The budget of the project is about 900 million yuan ($ 450 million US) and a special department has been created to carry out the work (4). There are 8 provinces, 3 autonomous regions and one municipality in north, northeast and northwest parts of China involved in the project.

To date there have been 5.77 million hectares of trees planted in shelterbelt areas, of which 4.4 million hectares of plantings were have been successful (11).

CHAPTER IV

PROJECTED TIMBER YIELDS FROM PLANTATIONS

Estimated percentages of the major timber species planted from 1949-1983 are used for projecting future timber yields. The projection is based on the assumption that later plantings will have the same species distribution as earlier plantings. Projections begin with the year 1984 and are made for 5-year intervals.

The projections are based on expected harvests from plantings established on open lands and replanting on previously harvested areas. They do not include harvests from some unlisted tree species (17.8 percent of all plantations on open lands) or timber harvested from shelterbelts or other nontimber plantings. Fire loss, and insect and disease damage have not been considered in the projections.

Timber Yields by Species

To project future timber yields, growth estimates and rotations are needed by species. The estimates used are summarized in Table 4.

The estimates used for *Cunninghamia lanceolata* are based on an average performance in 9 different climatic regions (2). Estimates for *Populus* spp. are based on an

Table 4.--Volume Yields of Major Tree Species Planted in China

Species	Annual Growth	Rotation Length	Yield at End of Rotation
	(Cu.m./ha)	(Years)	(Cu.m./ha)
Paulownia spp.	34.6	9	311
Populus spp.	31.3	11	344
Sassafras spp.	26.7	15	400
Cunninghamia lanceolata	15.8	20	316
Eucalyptus spp	15.7	12	189
Pinus massoniana	12.0	35	420
Larix spp.	7.7	43	332
Pinus koraiensis	6.4	45	287
	(Metric tons/ha)		(Metric tons)
phyllostachys pubescens	3.8-5.0	6	23-30

Source: (2), (4), (8), (9), (10).

average performance of stands of Populus simonii x nigra var italica, P.nigra var italica, P. x euramericana cv Sacrau 79, P. Canadensis. Estimates for Larix spp. are based on average performance of Larix gmelini, L.principis-rupprechtii, L. olgensis, L.sibirica. Estimates for other species rest on more limited data, but all are based on recorded measurements.

Projected Timber Yields from Plantings Established on Areas Harvested

The normal practice of replanting on harvested areas is carried out by professional groups within two years after the trees are felled. Projected yield estimates (Table 5) are based on a high rate of survival and an average growth performance of Pinus koraiensis, Larix gmelini, L.principis-rupprechtii, L.olgensis and L.sibirica. These are the major species used to replant harvested areas in Northeastern China. P. koraiensis yields an average of 287 cubic meters per hectare, managed on a rotation of 45 years; Larix spp yield an average of 332 cubic meters per hectare, managed on a rotation of 43 years. In addition, some other species are planted, but information is not available. Table 5 assumes an average rotation of 44 years and a yield of 310 cubic meters per hectare from all replantings on harvested areas.

Northeastern China supplies 60-70% of the wood needed in the country. The remaining harvest areas are in the northwest and western parts of China, where higher yields are assumed because the climate is milder.

Table 5.--Future Timber Yields Expected from Plantings Established on Areas Harvested from 1950 to 1979

Years Planted	Area Planted	Future Timber Yields Expected					
		1994-1998	1999-2003	2004-2008	2009-2013	2014-2018	2019-2023
	(1,000 ha)	(Million cubic meters)					
1950-54	79	25					
1955-59	1140		353				
1960-64	1135			352			
1965-69	1336				414		
1970-74	1671					518	
1975-79	2126						659
Total	7487						2320

Source: Areas planted from China Statistics Bureau, 1983. Timber yields expected based on assumption of a 44-year rotation and average yields of 310 cubic meters per hectare.

Under the assumptions of Table 5, the area planted in 1950 will be ready to harvest by 1994. The expected harvestable volume in the period 1994-98 is projected to be only 25 million cubic meters, but it will dramatically increase to 353 million cubic meters in the years 1999-2003. The plantations established from 1950 to 1978 will bring China a total volume of 2,320 million cubic meters of timber by 2023.

Projected Timber Yields from Plantings on Open Lands

Since most of the plantings on open lands are short-rotation species generally grown 6-20 years (average about 15 years), the projection of harvests has been limited to the more recently established plantations. Projections have been based on stands established after 1973 and those that will be planted later but harvested before the year 2023. The average planting rate for 1974-83 (4.8 million hectares) is the rate assumed for future plantings. Species representation in the future plantings is also assumed to remain the same as it was in 1974-83. Further assumptions are that the historical survival rate, 31 percent, will remain unchanged, and that the percentage of trees planted for timber purposes, 80 percent of the tree planted for all purposes will remain unchanged.

By the assumptions above and the rotation lengths and yields listed in Table 4, expected future timber harvests from plantations on open land have been projected by species. The results are shown in Table 6. These are conservative

Table 6.--Projected Timber Yields from Plantations Established and Surviving on Open Lands, By Species, 1984-2023

Species	1984 -88	1989 -93	1994 -98	1999- 2003	2004 -08	2009 -13	2014 -18	2019 -23
				(Million cubic meters)				
Pinus massoniana						504	504	504
Cunninghamia lanceolata			474	474	474	474	474	474
Populus spp.	258	258	258	258	258	258	258	206
Paulownia spp.	150	150	150	150	150	150	150	180
Total	408	408	882	882	882	1386	1386	1364
				(Million metric tons)				
Phyllostachys pubescens (Bamboo)	27	27	27	27	27	27	27	21

estimates. They do not include harvests from tree species not listed in the tabulation, nor plantings established before 1974, nor plantings in natural forest areas, nor yields from plantings established primarily for nontimber purposes. Moreover, there is no recognition in the projections that the rate of planting will likely increase to meet the target of 20 percent forest cover in China by the year 2000.

Despite the conservative approach to the projections, the projected yields calculated increase rapidly over the projection period with 82 million cubic meters of wood plus 5 million metric tons of bamboo annually in 1984-88 to 273 million and 5 million annually in 2019-23. In contrast to 50 million cubic meters of present wood consumption in China, 273 million cubic meters annual yield of wood would bring China a total different picture in wood consumption.

Projected Timber Yields from all Plantings

The projected yields from plantations on areas harvested and open lands are illustrated in Table 5 and Table 6 respectively. The Table 7, a simple combination of Tables 5 and 6, shows projected timber yields from all plantings.

Table 7.-- The Projected Timber Yields from all Plantings (1984-2023)

Species	Future Timber Yields Expected							
	1984 -88	1989 -93	1994 -98	1999- 2003	2004 -08	2009 -13	2014 -18	2019 -23
	(Million cubic meters)							
Pinus massoniana						504	504	504
Cunninghamia lanceolata			474	474	474	474	474	474
P.koraiensis & Larix spp.			25	353	352	414	518	659
Populus spp.	258	258	258	258	258	258	258	206
Paulownia spp.	150	150	150	150	150	150	150	180
Total	408	408	906	1235	1234	1800	1904	2023
	(Million metric tons)							
Phyllostachys pubescens	27	27	27	27	27	27	27	21

CHAPTER V

TIMBER DEMAND

The demand for timber is a result of many factors--consumer preferences, income level, the abundance of forest resources, prices at which timber products can be made available to consumers, and the availableness and prices of substitute materials.

Current Consumption

China has had a long history of chronic timber shortage. This situation together with a large population (1,024 million in 1983) and low income levels has resulted in a low timber demand. Average 1983 net income per capita was 310 Yuan in rural areas and 826 Yuan for employees (salary and wage earners)--equivalent to $ US 413 (12).

Timber products consumption was 52 million cubic meters in 1983, one-fortieth of the United States consumption. Even this level of consumption has been difficult to maintain since timber cutting restrictions were tightened in 1979. Imports increased from 539,000 cubic meters in 1977 to 1,552,000 cubic meters in 1981, valued at $ US 595 million (6).

Substitutes for wood are commonplace. For example, it is a common practice to use steel doors and windows in housing construction, concrete sleepers as railroads ties,

concrete street-light poles, concrete boats, etc. Bamboo is widely used for housing, furniture and paper manufacturing.

Future Demand

Future demand for timber products can be dealt with here only in a general way. Some indications can be obtained from population and income projections and government development programs of various kinds.

Population increase alone will raise the level of wood consumption even if annual per capita industrial timber consumption remains constant at .05 cubic meters. The 1983 population of 1,024 million is increasing by 9.5 million annually (12). At this rate, the population will reach 1.1 billion in 1990, 1.14 billion in 1995, and 1.19 billion in the year 2000. Assuming no increase in per capita consumption of industrial wood, aggregate consumption will increase 3.3 million cubic meters by 1990, 5.7 million cubic meters by 1995 and 8 million cubic meters by the year 2000.

Consumption of timber will change in response to changes in GNP and personal income. According to the "Four Modernizations" plan (modernizations on agriculture, industry, national defense, science and technology), it is the government's goal to quadruple the GNP within 20 years (1981-2000) and for employee's income to reach 2,000 Yuan. Undoubtedly, such large increase in GNP and personal income will be difficult to achieve, but to the extent that increase do occur, timber consumption will increase.

Production and trade data indicate that the volume of timber consumption has increased an average of about 3 percent annually over the past 10 years (3). Sales of timber from 1982 to 1983 were reported to increase 6.3 percent, and paper and paper products, 12.2 percent (12). Government plans suggest a continued drive toward development and, as a consequence, continued expansion in wood consumption. For example, the sixth five-year plan (1981-85) calls for an additional coal output of 80 million tons, which will require more than 1 million cubic meters of softwood props (1.3 cubic meters per 100 tons). An increase of 2,000 kilometers of rails and double tracking of a 1,700 kilometers of existing railways will require an additional 740,000 cubic meters of roundwood (200 cubic meters per kilometer). Housing construction is developing rapidly. In 1983, 115 million square meters of housing construction were completed in urban areas and 700 million square meters of farm housing in rural areas.

To project timber demand is a hazardous undertaking, but the rate of increase under way and government targets for development suggest a range of increases on which expectations can be built. An assumption of a lower rate of growth in consumption, such as 2 percent, would project to 60 million cubic meters by 1990, 73 million cubic meters by 2000, and 77 million cubic meters by 2020. At a higher rate of growth in consumption, such as 4 percent, the projection

would reach 68 million cubic meters in 1990, 101 million in 2000, and 222 million in 2020.

A medium-level rate of growth in annual timber consumption would approximate the 3 percent achieved in the past 10 years. Such a rate would increase consumption to 64 million cubic meter by 1990 and 86 million cubic meters by 2000. To carry the projection further, annual timber consumption would reach 116 million cubic meters by 2010 and 155 million cubic meters by 2020.

CHAPTER VI

TIMBER SUPPLY

The supply of industrial timber products is heavily dependent on the forest resources available and industry's capacity to manufacture and distribute products. In view of projected demand, large increases in supply are considered necessary, and it is anticipated that such increases will be forthcoming. Growth in timber-products output which increased from 567,000 cubic meters in 1949 to 52,320,000 cubic meters in 1983, is expected to continue.

Forest Resources

China has 5.8 million hectares of virgin forest with 1,400 million cubic meters of growing stock in the Xizhang (Tibet) autonomous region (10). Although this forest presently is inaccessible and untouched, the government plans to build a railway from Sichuan province that will tap the virgin forest and make a significant contribution to wood production by the end of this century.

Other timber forest areas, located mainly in the Northeast and Southwest, cover 92 million hectares. Total growing stock of the timber forests (58 percent conifer) is estimated at 7.7 billion cubic meters. These forest currently supply most of the wood products harvested, and they are expected

to remain the primary source of timber for another decade. With sustained yield as a goal, the government has set the harvest ceiling about 50 million cubic meters of commercial timber per year. The harvest ceiling recognizes that some 70 million cubic meters are lost to forest fires, disease, insects, forest land clearing, etc.(13).

The immense plantation program will change the future sustained-yield harvest situation dramatically. In addition to annual output of 50 million cubic meters of wood from natural forests, plantations will be able to sustain annual outputs of 180 million cubic meters by 1994, 245 million cubic meters by 1999, 360 million cubic meters by 2009 and 404 million cubic meters by 2019 (Table 7).

It can also be expected that with improvement in the manufacturing of wood products, still larger output of product will be obtained from the projected yields.

The physical supply of timber from plantations is far in excess of any reasonable projections of wood demand in China. For example, if the medium-level rate of growth in annual timber consumption (3 percent) is maintained, China's timber consumption will reach 155 million cubic meters by 2020, little more than one-third of the sustainable physical supply of plantation that will be available.

Physical wood supply is not the same as economic supply. The industrial infrastructure necessary to use the timber that will become available--including roads, logging equipment, and processing plants--is immense, and there is a

question about the costs at which products can be produced. But there is a developing opportunity for China to not only meet its internal wood needs, but also to become a significant exporter of forest products.

Forest-Products Industries

With current annual consumption limited to some 52 million cubic meters of industrial timber and frequent efforts made to substitute other products for wood, forest-products industries do not represent a high stage of development. There are 209 sawmills and 244 wood-based panel plants which include plywood plants, fiberboard plants, and particle board plants (4). Pulp and paper mills number over 1,000, but these are generally small and insufficient to meet China's current demand.

Existing wood-using industries face several problems. One problem is the location of mills in cities far from raw material sources, which creates high transportation costs. Another frequent problem in mills is the use of out-of-date equipment and machinery. This affects quality of product and production costs. A third problem resides in the small size of mills. Such mills have been favored in the past because they limit the capital investment required and make greater use of labor, but the small mills are neither efficient nor economical. The government, recognizing production problems in wood-using industries, increased investment in new equipment and technology in 1983 by 23 percent (12).

Sawn Timber

Sawn timber is still the major wood product in China. The output of sawn timber in 1983 was 14 million cubic meters, comprising 30% of all industrial wood production (12). The productive capacity in China's sawmills ranges from 100,000 to 200,000 cubic meters per year (4).

An estimated one half of China's lumber goes into the construction industry. The extraction industry (mainly coal mining) uses an estimated 20% of the lumber supply. Boxwood and furniture account for 9%, pulp and paper about 5%, while the remainder is used for building railway sleepers, transmission poles, wood-based panels (plywood, particle board and fiberboard) and other miscellaneous items (5).

Plywood

Plywood production began in 1951 with an annual capacity of 17,000 cubic meters and reached 351,000 cubic meters by 1981. China has exported plywood products since 1955, but the quantity is insignificant. Most of the machinery used in plywood manufacturing is made in China except some key equipment including slicers, peelers, jointers, etc., which are imported from other countries. China is able to manufacture machines and equipment for plywood plants with a capacity less than 30,000 cubic meters per year. Several plywood plants, with an annual capacity between 30,000 and 50,000 cubic meters, are to be imported and assembled in Hunan, Jilin, and Fujian provinces. These new plants will greatly increase plywood production.

Fiberboard

Fiberboard production began with some small scale wet-process mills and one plant with 18,000 tons of output capacity imported from Sweden. Production increased from 12,000 tons in 1959 to 568,000 tons in 1981 (14). China developed its own softboard plant and dry-process hardboard plant in 1970. A medium density fiberboard plant with an annual output of 10,000 tons was built in Hunan province in early 1980's.

China has made an effort to catch up to the rest of the world in wood processing development. A medium density fiberboard plant with a 50,000 ton annual capacity was imported to Fujian province from the United States in 1982 and a similar medium density fiberboard plant was introduced from Sweden to Heilongjiang province. Several plants with smaller output are scheduled to be built in Sichuan and Guangdong provinces, and in the cities of Beijing, Shanghai and Tiajin.

The main problems in current fiberboard production are: 1) the machinery is old and outmoded; and 2) water pollution from the wet process needs to be reduced. As a solution, the government plans to replace some of the older equipment and import technology and equipment to control water pollution.

Particle Board

Progress in the production of particle board has been slow. Production began in 1962 with 5,000 cubic meters annually and reached only 77,000 cubic meters by 1981 (14).

The main reason for this slow progress has been an insufficient supply of adhesive. It appears that China may have finally solved this problem because several particle board plants have recently been established. China is able to produce equipment for particle board production facilities with an annual productive capacity between 10,000 to 15,000 cubic meters. In addition to the establishment of particle board plants with equipment manufactured in country, China has imported several plants with 30,000 to 50,000 cubic meters output capacity in recent years. These plants have been installed or are going to be installed in the cities of Beijing, Tianjin and Guangzhou, and the provinces of Heilongjiang, Jilin, Hunan and Sichuan. Particle board production will increase dramatically within the next few years.

Pulp and Paper

There are more than 1,000 paper mills in China ranging in capacity from 1,000 metric tons per year to 100,000 metric tons per year (4). Over 20 percent of the raw material used in Chinese paper is wood pulp. The remainder of the fiber materials are drawn from other sources including bamboo, straw, crop stocks, etc. The total output from paper and paperboard manufacturing facilities in 1983 was 6.61 million metric tons (12), which is not sufficient to meet the demand. China has to import large amounts of wood pulp and paper products. The need for the importation of wood pulp and paper products will continue for some years

Chemical Products

There are some valuable chemical products derived from trees. The oil content of Eucalyptus spp. averages 1.2%. One hectare of Eucalyptus plantation can produce 7.5 metric tons of leaves from which oil and tannin are extracted. There are about 60,000 hectares of Eucalyptus plantation in China which can yield 5,400 metric tons of oil. The tannin output of Eucalyptus is much higher since the content in Eucalyptus is 8 times higher than that of oil (4). A study shows the resin and oil content in Pinus elliottii is 19.2-22.3%, 5-6% higher than that of Pinus massoniana (2).

The production of chemical products can be expected to expand greatly with the development of plantations in China. A new gasifying rosin plant, imported from Japan, was put into production in 1983 in the Guangxi Autonomous Region. Similar plants will be built in the southern provinces.

Through its own efforts, China has developed a variety of adhesives for plywood, particle board, and surface finishing production. A partial list of these adhesives includes urea-formaldehyde resin, phenol-formaldehyde resin, melamine, tego film, phenol-formaldehyde resin for impregnation, polyvinyl acetate emulsion, modified melamine resin, rubber resin, NDA-binary polymer resin and EVA hot melt adhesive. The percentage of surface treated products has been increased in recent years. Examples of common uses of surface treatment include thin decorative paper and PVC film overlay by roll

pressing, direct printing on the surface of particle board, micro-veneer overlay, low pressure melamine overlay, etc.(14).

Marketing of Forest Products

Forest product marketing in China is strictly controlled by the State. The distribution of all timber products in forest areas is under a unified plan and management. Railways are prohibited from shipping out any wood without a forestry administrations certificate. Five state organizations- Ministry of Forestry, State Planning Commission (SPC), State Bureau of Commodity Prices (SBCP), Ministry of Commerce and the Ministry of Railways and Communications are involved in the marketing of forest products. This is largely based on a unified production and purchase plan which includes all forest farm production and 70-90% of commune-owned forestry production (5).

The user departments and units are required to submit their requirements to the SPC, where the requirements are incorporated into the national unified production and purchase plan. The Ministry of Forestry prepares its annual production plan according to the plan from SPC and allocates production goals to all state forest farms and commune-owned forestry production units. These farms and units are required to supply their products at prices fixed by SBCP. The products are sold to the users through the commercial departments in conformity with SPC plan (5).

Market prices of timber set by the SBCP vary from one region to another depending on species, location and quality. Timber prices have long been set at low levels. This was partly because the SBCP is basing the price on the direct costs of lumber production and neglecting the costs of afforestation and maintenance. This pricing policy allowed little or no margin to the producing units to finance their development programs. That was one reason cutting far exceeded planting (5). There was a pricing adjustment of lumber values in 1979 and as a result lumber prices increased over 50%. Following this price hike, manufactured timber product prices for plywood, furniture, etc., increased about 10%.

Trees owned by individuals do not come under the state unified plan and can be sold in the local market. Some of the timber products produced by commune-owned forestry production units are also sold in local markets.[1/] The local market price operates according to supply and demand. However, the price of timber products in the local market is always higher than the state price. It is expected that the local markets will play an increasingly important role in timber supply as the new forestry policy is carried out.

1/ The government allows commune-owned forestry production units to keep a certain percentage of the timber products they have produced. The production units can dispose of these retained timber products as they will.

CHAPTER VII

Fuelwood

About 40 percent of rural household energy is provided by fuelwood. Wood is an important source of energy, but the historical shortage of wood in most of China has encouraged the economical use of fuelwood for rural cooking and heating and the search for alternative sources of energy.

Fuel sources vary depending on geographical location in China. In the rural area in northern China (particularly the forest areas), one can easily find large wood piles behind houses. However, in southern China, wood piles are replaced by piles of wheat straw, rice straw, cotton stock, soybean stock, etc. In areas such as Tibet and Inner Mongolia, people use dried cattle or horse dung as fuel. Use of methane-generating pit, an inexpensive source of energy, has developed rapidly in China. Some peasants have started to use electrical cooking facilities since inexpensive electricity is now available from small hydroelectric power stations which have been built by peasants. Solar energy is being tried for cooking, heating, and lighting in some households in the northwest part of China. The government has also loosened its restrictions on small coal mines operated by peasants enabling them to obtain coal for fuel.

Table 8 shows the relative dependence of rural China on different sources of household energy. At present only

Table 8 -- Rural Household Energy Consumption in China by Type of Fuel

Fuel	Quantity	Coal Energy Equivalent	Percentage of Total Energy
	(million tons)		
Crop residues	266	129.2	44.4
Fuelwood	180	115.7	39.7
Coal	53	37.9	13.0
Dung	10	5.5	1.9
Kerosene	1	1.5	0.5
Electricity	---	1.0	0.3
Biogas	---	0.6	0.2
Total		291.4	100.0

Source: (5).

three sources are important--crop residues, fuelwood. and ?#c coal--although minor sources such as biogas and electricity are gaining in use. Fuelwood, representing 40 percent of the energy used by rural households, appears to be at least holding its own as a source of energy. Its use, increasing from 129 million cubic meters in 1970 to 157 million in 1981 (3), is increasing annually at a 2 percent rate, somewhat faster than population growth.

Government policy does assign priority to fuelwood planting, but it does not promote fuelwood planting on a scale commensurate with that of timber planting. According to one recent report, about 770,000 hectares of fuelwood plantations have been established since 1950 (4). And in recent years, small plots of wasteland have been assigned to rural families in which to grow fuelwood, and the ownership of such plots is protected by law. In the aggregate, such private plots comprise about 16.7 million hectares. This development of private plots for fuelwood will play an increasing role in meeting rural household energy requirements (5).

It is also understood that the massive program of plantations for timber and other purposes will supply great quantities of wood byproducts--dead branches, dead trees, logging debris, etc.--which can be used as fuelwood. The need for large scale fuelwood plantations is not seen as a critical need.

CHAPTER VIII

IMPROVEMENTS NEEDED

In contrast to other areas of national development, forestry development requires the government's long-term commitment and its strong and real (not symbolic) support. The government's commitment to forestry has been small compared with that of agriculture in the past 35 years. The government has supported the extension of forest planting, but it needs to increase investment in management and the production, utilization, and marketing of forest products which are critical to the future development of China. It is of vital importance to expand the current policy which favors forestry development. This policy should not be subject to revision whenever the leading bodies in government are replaced. The success of the current plantation program hinges on how the peasants react toward the current policy and its continuation.

Efficiency Improvement

Foreign business interests often find it difficult to establish contacts with the right department when they want to do business in forest products with China. The main responsibilities of the Ministry of Forestry are planting trees and providing wood products. Pulp and paper

manufacturing, and a portion of furniture-making, and wood-based panel plants are the responsibility of the Ministry of Light Industry. The export and import of wood products is carried out by the China National Native Produce and the Animal By-products Import and Export Corporation. The import and export of forestry equipment and machinery are the responsibility of the China National Machinery Import and Export Corporation. If new technology and complete sets of equipment are involved, the China National Complete Plant Import Corporation and China National Technical Import Corporation will be the responding bodies. This complicated organizational system is not only confusing to foreign businessmen, it is also inefficient. In a typical case in the early 1980's, the Ministry of Forestry lost a good opportunity to purchase a wood-based panel plant because of the mountains of red tape required by corporations and governmental departments.

There was a government organizational adjustment in 1982, but this did not involve any change in the above-mentioned arrangements. The government has tried to improve working efficiency and has changed some departments into companies. This has not had much impact because these companies are still administered in the same way. The main problem is that people committed to business are not allowed to make the decisions, and those who do make the decisions are not actually involved in business. It is hard to believe

that these decision makers can do a good job without more specific knowledge about the actual business. Future projections indicate that China will greatly expand wood exports in the early 1990s. To help insure that these projections are realized, China should make some organizational adjustments, improve its way of doing business and ready herself to enter the world market.

Attract Foreign Investment

China has rapidly expanded its cooperation with world organizations and other countries in recent years. Several international assistance projects are now being carried on in China. However, there are few foreign investments or joint venture projects in forestry because of inadequate attention to seeking foreign investment. In addition, there are no specific regulations on foreign investment and joint ventures in forestry. Forest road density is only one meter of road per hectare of area which is far from sufficient and most of the equipment and machinery in wood processing plants are out-dated. To meet the expanding demand for wood production in the 1990's, the replacement of old equipment and the construction of forest roads should begin. However, as the government is unable to provide sufficient funds to meet all the aforementioned needs, the Ministry of Forestry should develop sound investment regulations to attract foreign investment.

Give Full Play to China's Advantages

China's biggest advantage is its abundant supply of labor. If combined with advanced technology and government backing , China will be a strongest competitors in the world market. China can now manufacture small scale wood processing equipment at competitive prices. This equipment is welcomed by developing countries. In spite of its obvious potential, neither salesmen nor product catalogs have paid proper attention to this situation. An effort should be made to improve the quality of products to move into the world market. In addition, the factories producing the exported products should be involved in this trade and kept well informed of the situation in the world market to derive the greatest share of benefit from such trade.

Salesmen and Businessmen Needed

In the near future, China is going to bring its wood products into the world market and start forest development projects in other developing countries. Many qualified people will be needed to carry out the work. To do business in world markets, China should have salesmen and businessmen who have forestry and business knowledge and are fluent in foreign languages. Now China lacks this type of person. Business and marketing courses are suggested as additions to the curricula of forestry colleges so that interested students can have 2-3 years of forestry training and 2-3 years of study in business and foreign languages. Another way to fulfill this need is to send some forestry graduates to

business colleges for training. To serve the immediate needs, interpreters who have worked several years in the Ministry of Forestry can be trained in forestry and business for 2-3 years. Business and marketing research offices should be established in key foreign countries.

Improve the Quality of Planting

A big plantation campaign was launched in 1980. Bearing in mind that the success rate of plantations was only 31% in the past 30 years, the plantation figures should not be overstressed. Increased attention should be paid to the quality of plantations. In addition, the importance of using genetically improved seeds should be fully understood. The Ministry of Forestry should put more investment in and pay more attention to seed orchards and improved seed production so that the percentage of improved seeds used in plantations will increase as soon as possible. Seed users should not only know the comparative prices of seed, but they should understand the benefits of using improved seed.

CHAPTER IX

Conclusion

China has attained impressive progress in forestry development in the past 35 years. One hundred and twenty three million hectares of trees were planted in the open lands during the period of 1950-1983, of which 38 million hectares of these plantations have survived. In addition, 7.6 million hectares of planting were established on the areas harvested from 1950-1982. As a result, forest coverage in China has increased from 8 percent to 12 percent. The immense plantation program will change the future sustained-yield harvest situation dramatically. In addition to the annual output of 52 million cubic meters of wood from natural forest, plantations will be able to sustain annual outputs of 180 million cubic meters by 1994, 245 million cubic meters by 1999, 360 million cubic meters by 2009, and 404 million cubic meters by 2019.

Consumption of timber has increased steadily from 12.33 million cubic meters in 1952 to 52 million cubic meters in 1983. The per capita consumption of timber products is about 0.5 cubic meters. It is expected that the timber consumption will continue to increase in response to increase of GNP, personal income, and population.

Undoubtedly, the government's 20 year-goal (1981-2000) of quadrupled GNP and employee's income increasing from 650 to 2,000 Yuan will increase timber consumption dramatically. A higher rate of growth in annual timber consumption (4 percent) would increase consumption to 68 million cubic meters by 1990 and 101 million cubic meters by 2000.

Timber-products output which increased from 567,000 cubic meters in 1949 to 52,320,000 cubic meters in 1983, is expected to continue increasing. The physical supply of timber from plantation and natural forest will be able to reach 230 million cubic meters by 1994, 295 million cubic meters by 1999, and 454 million cubic meters by 2019. If the higher rate of growth in annual timber consumption (4 percent) is obtained, China's timber consumption will be about one-third of the sustainable supply of plantation and natural forest that will be available. If the Chinese government starts to pay more attention to industrial infrastructure such as roads, logging equipment, and processing plants, there is a developing opportunity for China to not only meet its industrial wood needs, but also to become a significant exporter of forest products.

The Chinese government has these targets for the year 2000 : 1) 20 percent forest cover; 2) 100 million cubic meters of timber output annually; 3) 12 billion cubic meters of forest stock; and 4) quadrupled output value of the forest industry. To accomplish the above-mentioned goals, a special effort should be made to translate forest policy into laws

which would not be subject to quick change and to pursue the development of capable and efficient administra-tion. These aspects of policy are interrelated and interact with one another. Good forestry policy lays a foundation for sound forestry development, but it should be supported and protected by the law to ensure it's continuation and effectiveness. The establishment of laws relating to forestry development should help to prevent interference from political movements and changes in leadership. However, because good forestry policies and their enforcement are carried out by leaders at all levels of government, it is important to have knowledgeable and conscientious leaders working in forestry departments.

This paper shows that China has great potential in wood production. If it continues to keep efforts concentrated on plantations, China will not only completely change the situation of wood shortage, but also become a major wood exporting country by the middle of the 1990s.

China, the giant standing in the East, will certainly provide a large share of wood production as its contribution to the world.

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