

China's Forests

*Global Lessons from
Market Reforms*

EDITED BY
William F. Hyde
Brian Belcher
Jintao Xu

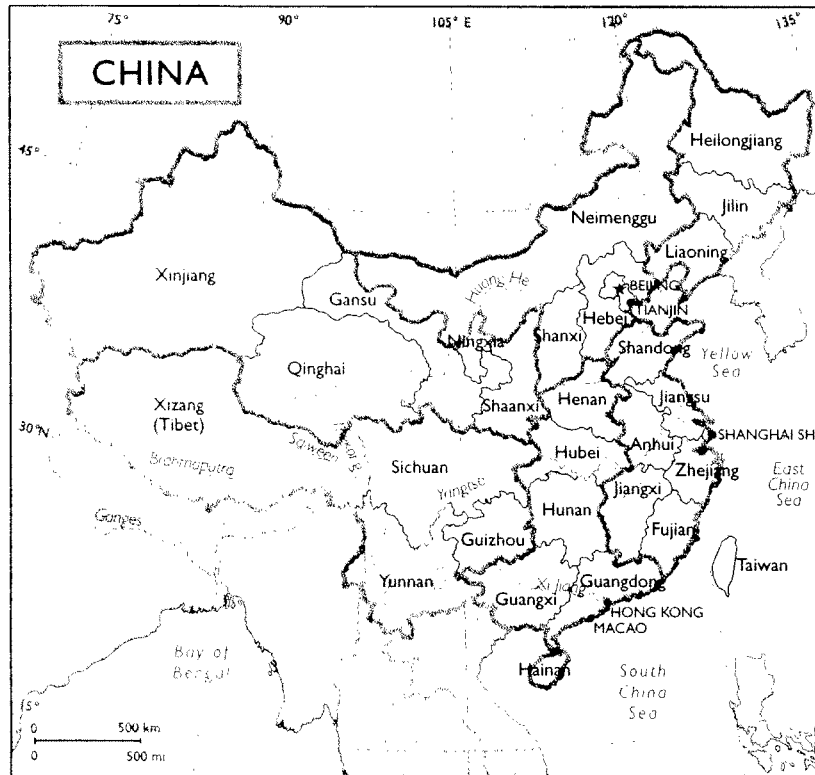
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CENTER FOR INTERNATIONAL
FORESTRY RESEARCH

CHAPTER I

Introduction

William F. Hyde, Jintao Xu, and Brian Belcher



Note: China, showing six forest regions and the provinces and autonomous regions within each. The North region includes Hebei, Neimenggu, Shanxi, and Tianjin. The Northeast region includes Heilongjiang, Jilin, and Liaoning. The Northwest region includes Gansu, Ningxia, Qinghai, Shaanxi, and Xinjiang. The South Central region includes Guangdong, Guangxi, Hainan, Henan, Hubei, and Hunan. The Southeast region includes Anhui, Fujian, Jiangsu, Jiangxi, Shandong, and Zhejiang. The Southwest region includes Guizhou, Sichuan, Xizang, and Yunnan.

CHINA HAS UNDERGONE a remarkable transition since the introduction of rural reforms in 1978. The summary effects are well-known: average annual growth in gross domestic product (GDP) regularly exceeding 10%, and more than a quadrupling of per capita income. Rural households were the first to benefit. As industrial, financial, and then trade reforms followed the initial rural reforms, nearly all members of Chinese society have benefited.

The reforms have continued since 1978—gradually, but with dramatic results—and China's leaders now seek to maintain the growth that the populace has come to expect. However, with reform and growth, new problems have arisen. China avoided most of the trials suffered by its neighbors as a result of the East Asian financial crisis of 1997, but 20 years of growth have created regional income disparities and new environmental problems, including some with serious implications for forest management.

This book is about the impacts of China's reforms on the forestry sector of its economy. Forestry-sector reforms followed agricultural reforms in time and in structure, but within the forestry sector, neither the marketing nor the administrative reforms have been as complete as they are in agriculture. Moreover, forestry's longer production period delays some of the evidence of improved performance. For these reasons, it is not surprising that the impacts of reform on forestry, while substantial, have not been as immediately and uniformly spectacular as those for agriculture. For example, the value of agricultural output has increased fourfold, while China's forest cover has only doubled and the level of annual timber harvests has remained largely unchanged since 1978 (*China Statistical Yearbook 2000*).

Forestry is also different from agriculture in that spillover effects from reforms

estry than some of the new forest policies themselves. In contrast, we would argue that spillover effects have gone the other direction for agriculture, from agricultural policy to benefit of the rest of China's economy.

Finally, the forestry sector provides an interesting perspective on China's emerging distributive and environmental issues. In many societies, forest-based communities and forest-dependent households tend to be poorer than communities and households in other sectors of the economy, and their income flows tend to be more variable. These distributive issues may be especially important in China, where a historically egalitarian society increasingly objects to growing disparities in regional development and household wealth. Forest ministries, international donors, and nongovernmental organizations often look to the forestry sector for activities that can modify these disparities, but the limits to the sector's potential in this regard are not well-established, in China or anywhere else.

And what about the environment? Forests are conservatories of a great many environmental values. In China, many of these values have increased with the improvements in household wealth, and China's population can now afford a more farsighted view of its general welfare. The net environmental effects of economic growth, however, are complex. Total forest cover has expanded, and this has helped contain the effects of wind erosion and desertification, two problems whose combined effects may be worse in China than anywhere else in the world. Meanwhile, China's natural forest cover and its reservoir of biodiversity have declined as a result of timber harvesting and land conversion to agricultural crops and for use by grazing livestock. Furthermore, industrial growth has been a source of pollution. The pulp and paper industry, an important component of the forestry sector, has become the largest polluter of China's rural environment. Understanding the complexity of effects on the forest environment as well as the inducements for them that have been generated by China's reforms is surely a crucial step toward improving China's long-term welfare.

Objective

The objective of this book is to examine the experience of China's forestry sector with respect to the full set of forest and nonforest policy reforms introduced since 1978. The authors of the chapters rely on empirical evidence when it is available and tie specific forestry-sector impacts to select categories of policy inducements when these ties can be identified. They review what has been established in the analytical literature of the field and add insights from their own research. They will conclude that some old questions remain unanswered even as they identify newly emerging policy issues.

The lessons of this book are important for China, and for the rest the world as well. For China, the analyses in each chapter provide rigorous evidence on those policies that have worked and on how well they have worked. Furthermore, they provide some support for, as well as some contrast with, the agricultural bench-

reforms have added still more diversity in the terms of contracts for land use; in tax systems, marketing policy, and administration; and in the emerging income distributive issues.

The unanswered questions and emerging issues that arise from these analyses will help us recognize the unanticipated effects of China's reforms. These should be important ingredients in the decisionmaking process for future reforms as China's government continues to pursue economic growth and broadly improved welfare of all its people, from the 3% of its population employed in the forestry sector to the much larger share that consumes forest products and benefits from forest-based environmental services.

In 2003, China has just become a member of the World Trade Organization. It is embarking on a new western regional development program and a forest protection program as well. All three promise serious implications for the future of forestry. Domestic timber harvest levels have already declined, and roundwood imports have increased sharply (182%, or from 4.8 million to 13.6 million m³ in the first two years of these programs). Yet many of the effects of China's newest government programs remain matters of debate. The analyses of prior reforms in this book may help us understand the right questions to ask about the new programs. They may even anticipate the effects of newer reforms and surely they provide material for helpful reflection as China's leaders consider improvements in the design of long-term forest policy.

The lessons from China are also important for the rest of the world. For example, many eastern European and some Asian countries are undergoing a similar economic transition from centrally planned to more market-oriented economies. Others, such as Indonesia and the Philippines, are making the transition from economies with highly concentrated political and market power to a wider distribution of economic authority and less-administered markets. Still others, such as India, are attempting broad market deregulation. All can learn from China's experience.

China's experience is even more broadly relevant because so many of its forests—like those of most countries, developing and developed—have been under the authority of a central forest ministry. China, like most countries today, faces the difficulties of centralized forest management in the presence of powerful local values. In fact, the decentralization of forest management and the development of management systems that are more responsive to local economic and social pressures may be the most global issue of modern forest policy. Some degree of decentralization is known as “community participation” in the United States and Canada; “joint forest management” in India; and “community forestry” or “community-based resource management” in Bolivia, Colombia, Mexico, Nepal, the Philippines, Tanzania, and Zambia. Similar terms are used for related experiences in a host of other countries as well. China has had more experience than any other country in transferring some centralized administration and land-use rights to local administration and even to individual households.

The common question for these transfers has to do with just how far a gov-

argument against decentralization is that farmers have little experience planting trees and, furthermore, they would not plant trees even if they had the experience. Their time horizons are just too short. China now has more than 20 years of experience against which to test this fundamental perception. A related argument holds that individual farmers will not respond to the natural environmental benefits of reforestation because those benefits are shared widely. This argument anticipates that most of the benefits of reforestation accrue to the farmer's neighbors and even to those who live farther away. Therefore, it concludes that private action is unlikely and that some level of public action will be necessary to provide these environmental services. China has experience against which to judge this argument, as well.

Finally, the lessons from China can be convincing because the evidence is so very clear. China's geographic breadth and tremendous economic growth mean that the data incorporate great variability, and variability in data is a requirement for statistically meaningful results. Imagine, for example, measuring the effects of tree-planting incentives in a region of slow and steady development, perhaps a region like North America's Great Plains, versus measuring the effects of similar incentives in China's grain-producing northern plains. We might observe some success in the Great Plains, but the additional numbers of trees planted would probably be small and it might be difficult to distinguish among a number of market and policy factors that could have induced the additional planting. Now consider an example from China. The number of trees planted in some parts of China's northern plains since 1978 has almost tripled. The market and policy factors that induced the new planting in China may be similar to those affecting the Great Plains but, because China has experienced so much growth, the statistical exercise of separating these factors influencing growth and measuring their effects will probably be more reliable in China. And what is true for this example of tree planting is true for many activities in an economy of great variability, diversity, and growth. As a result, lessons that hold elsewhere in the world are often clearer in a context such as China's.

Background

The rest of this introductory chapter provides a summary of the changes affecting China's forests since 1978, a synopsis of China's forest administration and its geographic organization, and a chronology of China's general reforms and their broad effects. The chapter closes with a review of specific forestry-sector reforms and an introduction to the analytical chapters that follow.

*China's Forestry Sector since 1978*¹

Although China's forest history extends over hundreds of years, its current experience is a matter of the past 25 years. In all but the least accessible regions, few

moil in other parts of the world cause us to anticipate the consumption of stock resources like standing forests during periods of severe political unrest and economic hardship. China's experience may be an extreme example, if only because its forests suffered for so long—more than 40 years—without much opportunity for recovery.

The central government recognized the problem and addressed it with land-rehabilitation projects in the early 1950s. These initially focused on biological and engineering improvements, including afforestation projects for controlling wind and water erosion and the salinization of soils. Later, the economic adjustments of the early 1960s promoted multipurpose afforestation activities such as intercropping and shelterbelts, which also had the objectives of protecting the environment and improving agricultural productivity.

However, the very limited new forest resources were rapidly depleted during the period of collectivization and industrialization that began in 1958. Collectivization raised doubts about ownership security for forest resources, and thousands of backyard furnaces constructed for steel production consumed most of the small stock of farm trees that remained after the war with Japan, World War II, and the establishment of the communist government. Subsequently, during the Cultural Revolution (1966–1976), large areas of the remaining natural forest were cleared as part of a campaign to expand cropland. Finally, the inventory of state-owned forests was also depleted to support production and birthright employment in state-owned sawmills.

The Cultural Revolution and the political struggles that dominated Chinese society for the decade that followed restricted any real opportunity for economic growth or environmental conservation in the broader economy. Agricultural and forest production stagnated. Per capita annual income in the communes was only 62.8 yuan (about US\$25) in 1976; more than one-third of rural households were in debt; and many households lived with insufficient fuel, clothing, and housing. About 100 million people suffered from food shortages (Lu 1986).

At the outset of economic reforms in 1978, China's forests were seriously depleted, and many existing plantations were in their second or third rotations from the same basic stock. Production was declining. Forests covered 82.6 million ha in 1978, but this was only 8.6% of China's total land area or 0.10 ha per capita, among the lowest per capita shares in the world (*China Forestry Yearbook* 1986). Of course, the small per capita stock indicates the likelihood of low volumes of timber harvests and more severe environmental stress than we expect to observe in many developing countries. It also suggests relatively high prices for whatever timber and nontimber forest products were extracted from the remaining forest.

Table 1-1 summarizes conditions in China in 1978 at the outset of the reform period, as well as China's growth through 1998. 1978 marks the introduction of reforms, and it is also a year for which China has a complete inventory of forestland and standing forest volume. 1998 marks China's most recent complete forest survey. Forest surveys consume a lot of resources and each survey requires several

Table 1-1. *Economic Growth, 1978–1998*

<i>Growth</i>	<i>1978^a</i>	<i>1998</i>	<i>Change (%)</i>
GDP (1978 monetary value)			
Aggregate	362	2,312	538
GDP per capita	379	1,869	390
Rural GDP per capita	133	945	610
Forest products (× 1,000 m³)			
Production			
Logs	51,673	55,557	7
Lumber	11,055	17,876	62
Wood-based panels	1,017	10,563	939
Paper and paperboard	4,390	21,256	385
Imports			
Logs	1,870	4,820	158
Lumber	75	1,679	2,139
Wood-based panels	258	1,977 ^b	666
Paper and paperboard	767	5,760	651
Exports			
Logs	28	63 ^c	125
Lumber	13	255	1,862
Wood-based panels	10	598	5,980
Paper and paperboard	229	250	9
Forest cover			
Area (million ha)	115	154	35
Standing volume (million m ³)	8,801	10,086	15

^aData for imports are from 1981 and data for exports are from 1983.

^bData are from 1997.

Sources: *China Statistical Yearbook 2000*, *China Forestry Development Report 2000*.

with our period of interest.² Nevertheless, the 1978–1998 snapshot is imperfect for our purposes because it does not reflect the more recent expansion in log imports that accompanied the Natural Forest Protection Program and a logging ban on the upper watersheds of the Yellow and Yangtze Rivers.

China's real GDP has increased fivefold and its per capita GDP has increased almost fourfold since the introduction of reforms. China's vast rural economy, including forest-based communities and many other households dependent on the forest for some or all of their livelihood, has shown the greatest improvement. Rural per capita GDP has increased a phenomenal sixfold during the same 20-year period (Table 1-1).

Growth in the forestry sector has been more variable and, in some parts, not as

kept pace with double-digit annual growth in the general manufacturing sector, expanding to almost five times its former level. The contrast in growth between lumber and paper is not entirely unexpected. Lumber consumption in most economies is income-inelastic, whereas paper consumption is more income-responsive and may even be elastic over a range of incomes. Therefore, we expect paper production to expand more rapidly than lumber production in order to keep up with the more rapidly expanding demand for paper that generally accompanies economic growth.

The expansion in paper production anticipates a critical handmaiden of early economic development: deteriorating environmental conditions. The pulping technology that is an antecedent to papermaking can be a serious polluter, emitting fibrous solids and chemical waste in its effluents. In China, the pulp and paper industry has become the largest source of rural environmental pollution. Meanwhile, environmental protection has become a serious objective of the central government and, in 1999, President Jiang Zemin announced that any enterprise not in compliance with environmental regulations by 2000 would be closed.³ More than 2,000 small papermaking enterprises have already been shut down.

The information on nonmarket forest products and services cannot be summarized as easily. Aggregate data on products such as fuelwood, bamboo products, mushrooms, and the many herbs collected from natural forests, and forest-based environmental services such as erosion control, protection of biodiversity, and forest recreation are simply not available. Nevertheless, the evidence that is available is instructive.

Forests are the source of perhaps 40% of rural energy in China, but we are unsure how this estimate has changed over the course of 20 years of development. We are equally uncertain about the effect of China's rapid growth on other nontimber and nonmarket forest products. We can only anticipate that the subsistence-based consumption of many nontimber forest products tends to increase with early development and then eventually decreases as development proceeds and incomes rise further yet. This is a common hypothesis, but its validity has not been demonstrated for China. If it accurately reflects subsistence-based forest consumption in China, then we would want to know the income inflection point at which these consumptive demands on the forest begin to decrease. Has China's economic growth approached or exceeded this point? We don't know.

Although some consumptive demands on the forests may decrease as China continues to grow, we can also anticipate that nonconsumptive demands on the forest will increase. In general, as household incomes increase and overall human welfare improves, recreational uses of natural resources such as forests and demands for all varieties of environmental services also tend to increase. This too is a hypothesis based on general experience, but we are more confident of its validity for China. Casual observations from any of China's mountain or lake resorts reveal a rapid increase in outdoor recreation over the past few years, and the central government's decisions to enforce environmental compliance and establish sustainable development as one of two fundamental strategies for the

We can conclude that specific demands on the forest have been variable in their relative growth, but the overall importance of China's forests is undoubtedly increasing. How does this expectation compare with aggregate trends in the forest inventory since 1978? Table 1-1 shows that forest cover has increased a modest 35%, while standing forest volume has only increased 15%. The difference is not surprising. New seedlings and new forests grow slowly at first, and their growth in the first few years is generally too small for measurement in most forest surveys. Nevertheless, the expansion in forest cover appears to be proceeding more slowly than the increasing demands for either commercial forest products or non-consumptive forest-based environmental services.

Furthermore, net imports do not account for the difference between the increasing demand for forest products and the relatively constant forest base. The level of exports has been small compared with domestic production, and the level of imports has not been much larger. Therefore, China's industry has relied on substitute raw materials to absorb the difference; for example, using bamboo as a substitute for wood in some construction activities and agricultural residues as a substitute for wood fiber in paper production. Under most conditions wood and wood fiber are the preferred raw materials, and we can only anticipate that these preferences are another reason why China's forests will become even more important as the country continues to develop.

Table 1-1 summarizes China's rapid growth and the more variable experience of its forestry sector. China's experience has been variable in other respects as well. Reform was experimental, pragmatic, and gradual. There was no overall blueprint. As a result, China has experienced at least three economic cycles during the past 25 years, significant regional variation in the applications of the reforms and in their results, and also differences between broad institutional categories of management. We will summarize these regional differences in forest organization and then trace the chronology of the reforms themselves in the next section.

Forest Organization and Administration⁵

China organizes its official forest statistics by region and administrative responsibility. Table 1-2 records the land area under forest cover for three national forest surveys conducted between 1977 and 1998 in each of six principal geographic regions and according to its classification as either state-owned or collective. The Northeast and the Southwest, followed by the South Central region, contain the largest forests. The map that appears on page xvi of this book outlines the geographic extent of these regions and identifies the provinces within them.

The state-owned forests include approximately 3,000 independent forest farms and about 135 state forest bureaus. The bureaus control their own forest farms, and most of them control their own wood-processing facilities as well. The bureaus were originally set up as logging operations for natural forests, although

Table 1-2. *Forestland Area*

Region and administration	Forest stands (million ha)			Change (%)
	1977-1981	1984-1988	1994-1998	
Northeast				
State-owned	21.37	20.55	23.50	9.97
Collective	2.33	3.96	4.20	80.26
Total	23.70	24.51	27.70	16.88
Northwest				
State-owned	2.48	5.30	5.78	133.06
Collective	1.96	2.80	3.19	62.76
Total	7.24	8.10	8.97	23.90
	(4.44) ^a			(102.03) ^a
Southeast				
State-owned	1.32	1.73	2.49	88.64
Collective	10.84	12.01	16.55	52.68
Total	12.16	13.74	19.04	56.58
Southwest				
State-owned	NA	8.15	9.42	
Collective	NA	12.24	17.39	
Total	23.53	20.39	26.81	13.94
South Central				
State-owned	1.78	2.18	2.55	43.26
Collective	10.32	14.92	22.44	117.44
Total	17.35	17.10	24.99	44.03
	(12.10) ^a			(106.53) ^a
North China Plains				
State-owned	13.26	13.11	14.18	6.94
Collective	1.55	2.13	3.43	121.29
Total	14.83	15.23	17.61	18.75
	(14.81) ^a			(18.91) ^a
All China				
State-owned	NA	51.01	62.01	
			(57.93) ^a	
Collective	NA	48.06	67.19	
Total	98.81	99.07	129.20	30.76
			(125.12) ^a	(26.63) ^a

Notes: NA, data not available. China separates the reporting of its forest inventory into "economic forests" (tree crops, such as orchards and rubber), "bamboo forests," and "forest stands" (what most of the rest of the world calls "forests"). The values reported in this table are "forest stands."

^aIn China's second forest inventory (1977-1981), data from some smaller provinces were included in the total but not in the disaggregation into state-owned and collective lands. The first value in the "total" row for the three regions is the value reported in the national forest inventory. The value in parentheses is the sum of recorded state-owned and collective lands for larger provinces in those three regions. The difference

vincial governments for personnel and planning but both are subject to the forest management guidelines of the State Forest Administration (SFA, the Ministry of Forestry before 1998).

Collective forests are forests that were managed by local forest and agricultural collectives until 1978. Since then, individual households have gradually assumed long-term contractual responsibility for more and more of the collective lands. About 60% of China's total forestland now belongs to the collectives, and individual households manage about 80% of that.

The land areas in state-owned and collective forests have expanded gradually, but the collective forests have grown more rapidly in most regions. Nevertheless, standing forest volume per hectare remains almost three times greater in the state-owned forests, even in the 1998 forest inventory. We would anticipate this ordering because some state-owned forests are inaccessible and biologically mature, whereas all collective forests are accessible and, therefore, almost certain to be harvested at younger ages and smaller volumes as they attain economic maturity.⁶ The standing volumes in the state forests of most countries exceed the volumes of their nonstate counterparts for the same reason. However, a threefold difference in volumes per hectare between state and nonstate forests is uncommon. Is this difference in China simply due to the common difficulties of measuring the newest young growth in any forest survey—while the collective forests support a disproportionate share of young stands? Or, is it due to China's accounting system for forests, which includes commercial tree crops such as orchards, which contain less standing timber volume per hectare and are almost totally concentrated on the collective lands? Or, is the difference due to uncertainty and a range of other factors that discourage private investment? We will be interested to observe whether China's collective forest volumes increase rapidly and whether the difference in standing volume between state and nonstate forests diminishes as the effects of the reform incentives for planting and management are more completely absorbed into the measurable growth that will be captured in future forest surveys.

Some discussions of China's forests modify the regional organization of Table 1-2 to reflect management responsibilities more closely. For example, the Northeast and Southwest are sometimes combined (Northeast Southwest State Forest Region, or NSSFR) as the regions of predominantly state-owned forest and as China's major sources of industrial wood. The objective of these state forests has been to support employment in the local mills. Their standing inventory declined because the procurement prices paid by the mills were too low to support reforestation. The Southern Collective Forest Region (SCFR; including the Southeast, South Central, and some of the Southwest from Table 1-2) is the next most productive region. It, too, has suffered from procurement prices that are still too low to encourage reforestation without external financial assistance. The North-Northwest Farm Forest Region (NNFFR) covers the remainder of the country. The western part of the NNFFR is a dry area that supports few forests; the eastern part is a major agricultural area. The only significant forests in this region are government-supported shelterbelts.

agroforestry activities that have significantly altered the landscape in the eastern part of the SCFR. More recent reforms of the SFA and the state forest bureaus plus a few large-scale government plantations may have had greater impacts on the NSSFR.

Chronology of Reform

China's reforms began in the agricultural sector in 1978 and eventually spread to other sectors of the rural and then the urban economy. We can anticipate that the impacts on forestry and the forestry sector occurred largely in response to reforms in other sectors—due to the desire of those in the forestry sector to obtain incentives similar to those that had been successful in other sectors and due to the expanding demands for forest products originating from other, more rapidly growing sectors of China's economy. Therefore, it will be useful to identify the chronology of broader reforms in all sectors as well as of the specific reforms in the forestry sector. It will also be useful to separate the responses to forestry reforms themselves from forestry's responses to reforms in other sectors in the analytical chapters that follow.

The history of reform has been cyclic with initial reforms followed by growth, then inflation and budget deficits in the central government, then retrenchment, and then another round of reforms and growth. China experienced three of these cycles between 1978 and 1994.

1978–1984. Agricultural reforms contained two fundamental elements: the decentralization of property rights from the prior system of centrally administered collectives and production teams, and upward adjustments in the prices for agricultural outputs. Both elements improved the incentives of farm households. The grassroots appeal of both was great, although neither was sanctioned by the central government until September 1980. The original sanction was only for poor, remote, and hilly regions. Nevertheless, the reforms spread rapidly because they appealed to farmers and government officials alike. Both groups found advantage in the diminished transactions costs and risks of government organization that accompanied reforms, as well as in the increased agricultural production that followed rapidly.

The institutional change in property rights began in Fengyang County, Anhui Province, in 1978. It took different forms in different counties. In the most popular version, known as the household responsibility system (HRS), the commune contracted everything (i.e., land, animals, implements, output quotas, and taxes) to its member households. The distribution of land and animals occurred on a largely egalitarian (per capita) basis. The contracts required the households to sell their production quotas at centrally determined procurement prices but permitted them to sell production in excess of these quotas at market prices. This contract system developed slowly until 1981, and then expanded rapidly to 70% of all rural communities by the end of 1982.

quotas at market prices. Government surpluses accumulated, even as the government raised its procurement prices to levels that were closer to market prices.

Sharp increases in procurement prices followed, and the central government suffered budget and trade deficits in 1979 and 1984. Inflation reached a record 6% in 1980. The aggregate economic conditions caused some rethinking, and the authorities withdrew HRS rights from some households. Nevertheless, these rights extended to almost all agricultural production units by the end of 1984. Compulsory production quotas and the two-price system for outputs were finally abandoned in 1985. Still, all was not perfect. Households saved and invested in durable consumer goods, but agricultural investment lagged, particularly in irrigation. The general suspicion is that this lag was due to uncertainty—uncertainty regarding policy and administration in general, and uncertainty with respect to the durability of the HRS contracts for land in particular. (We will see that these uncertainties became critical issues for forestry as well.) Nevertheless, the overall effect of the initial agricultural reforms was positive and impressive. Land productivity increased 225% between 1978 and 1984, and the productivity of agricultural labor increased by 172%.

1985–1990. A second round of reforms began in 1985. China experienced another cycle of inflation and tighter central controls on expenditures in 1986 before a period of easier credit and expansion beginning in 1987. This round of reforms supported the development of nonagricultural enterprises in rural areas and the extension of the contract responsibility system to the industrial and financial sectors in urban areas. China's leaders first spoke of establishing a market economy during this period.

The central government continued its standing restriction on regional labor mobility, a policy that it expressed as “leave the land but not the countryside.” The government provided little direct stimulus for rural nonagricultural development, but it improved the environment for local enterprise by decentralizing the administration of nonagricultural activities and transferring the tax and investment decisions and the administration of environmental controls to the counties. Decentralization encouraged diversification and specialization according to local comparative advantage, as well as regional interdependencies and market relationships that benefited all.

Meanwhile, improvements in agricultural wealth led to an increase in household savings—which were already among the highest in the world. The high level of accumulated household savings provided the financial means for local investment. It financed the new opportunities for local enterprise, known as township and village enterprises (TVEs), that emerged under contract with the local administrative authorities.

The contracts that developed between TVE managers and local authorities were (and still are) similar to those developed under the HRS system for agriculture. Individual enterprise managers contract for fixed responsibilities, and their

incentives are tied to performance. Profits from performance greater than

growth of these enterprises. The incentives are limited, however. Local governments do not have the financial resources of the central government. Therefore, they insist on tighter budget constraints. Within the administrative discretion of the local authorities, the TVEs became almost entirely market-oriented by the mid-1980s.

The rural nonagricultural sector expanded simultaneously with agriculture throughout the early 1980s. Then, as the rate of agricultural growth began to decline, the TVEs entered their period of most rapid growth. Growth in China in general slowed in 1986 as some central authority was reimposed following another period of inflation. However, for the full period between 1978 and 1998, the rural nonagricultural sector grew at a rate of more than 20% annually. The TVEs became an outlet for underemployed agricultural labor, absorbing new labor at an annual rate of 15%. Their production surged, and their share of gross rural product increased from 26% in 1984 to 45% in 1992. The TVEs accounted for one-half of the increase in China's per capita income during the 1980s.

Two industries of special interest to forestry, wood products and pulp and paper, are generally located in rural areas. The firms in each are small. Yet TVEs accounted for 90% of the enterprises in the paper industry by the late 1980s, and production grew more rapidly in the TVEs than in the generally larger state-owned enterprises (SOEs) for both industries. TVE production more than doubled between 1978 and 1989 for both industries.

New problems emerged along with the success of the TVEs. Some expanded more rapidly than their markets justified. Some local governments tried to protect their own shares of revenue flows from these enterprises by introducing barriers to interregional trade. Excess capacity resulted and this led to the excess use of some productive inputs, including the excess conversion of agricultural land and forestland. And, like most other examples of early industrial growth, air and water quality suffered as well.

The first signs of change in the previously egalitarian distribution of income appeared during this period. Generally, agricultural income is less variable than the income from some nonagricultural activities, including income from the wood products and paper industries. Therefore, growth in the TVEs increased the income disparity within regions. Furthermore, the success of the TVEs was distributed unevenly across regions and this created regional income disparities. Regions with better infrastructure, more capital, better education, and better access to major urban areas and outlets for foreign trade grew faster. As a result, household incomes and local government revenues and budgets for social services became more uneven. Nearly all households and counties benefited, but they did not benefit uniformly.

Finally, the industrial- and financial-sector reforms of this second period also emphasized the transfer of the contract responsibility system that had been so successful in agriculture. In this case, the transfer was to the largely urban state-owned industrial and financial sectors. The central government allowed the managers of SOEs discretion on variable inputs and on output levels and mixes. The

right: children of employees were entitled to work in the same SOE that employed their parents. Despite these constraints on decisions about labor and fixed capital, managers improved input efficiency sufficiently to increase productivity at an annual rate of more than 15% for the full manufacturing sector.

1991–2000. A third period of reforms followed the events of Tiananmen Square in mid-1989, a crackdown by hard-line political leaders, and then a cooling-off period that extended until 1991. The reforms of this period continued the previous period's focus on SOEs, and the role of the central government continued to decline.

Beginning in 1991, the government allowed the sale of some SOEs and permitted others to go out of business. Seventy percent of small SOEs were privatized by 1997. The government also allowed managers to release redundant employees beginning in 1995 and, by 1998, one-fifth of all employees of SOEs (7 million people) had been released. Most either found employment in TVEs or lived off their severance allowances. Meanwhile, the government itself downsized, reducing its budgetary role in most SOEs, simplifying the tax system, and decreasing the number of civil servants from 8 million to 4 million. Most retail prices became market-determined. Managerial discretion and productivity continued to increase as a result. (The industrial sector grew at an annual rate of 6% in the early 1990s but declined slightly in the late 1990s as redundant labor was released and first East Asia, then the world, experienced economic decline [*China Statistical Yearbook 2000*].)

Finally, the government liberalized the markets for tradable goods. It allowed the retention of earnings from foreign trade in 1984, removed direct export subsidies in 1991, and eliminated centrally regulated exchange rates in 1994. It officially allowed joint ventures with foreign capital as early as 1979, but this opportunity did not become important until the late 1980s and early 1990s when the government approved the location of joint ventures in some coastal counties.

Household incomes continued to increase, and so did savings. Accumulated savings were 6% of GDP in 1978 and a phenomenal 62% of GDP in 1998. The reservoir of savings may reflect current investment opportunity, or it may reflect household decisions to protect against a future that many still perceive as uncertain. In either case, it indicates a deep well of opportunity for future investment and growth. The first 15-year period for most HRS contracts expired in the mid- to late 1990s. The government did not alter its policies when these contracts expired. Therefore, agricultural households may now have greater confidence in the stability of government policy. Is this the confidence they need to begin investing? Time will tell.

Despite these reforms, the central government remains a major actor in the economy. Most of the largest firms are still state-owned, and many unprofitable SOEs remain in operation. The government's role is an active one in other respects as well. It continues to restrict labor mobility between regions and to the

ing fees for emissions, discussing tradable permits, and even closing some firms that are not in environmental compliance, including several thousand small paper mills.

Forestry-Sector Reforms and Chapter Overview

China introduced a number of reforms that were specific to forestry. This section introduces the most important, reflects on their place within the context of China's overall economic reforms, and considers the questions they raise for the subsequent chapters of this book and for the design of forest policy around the world. (The Appendix Table provides a chronology of important central government forest policy decisions.)

The Three North Forest Protection Project (also known as the Green Great Wall) was the first large government program initiated after reforms began. The Green Great Wall is a shelterbelt reforestation program that was designed to combat desertification and wind erosion. Its construction began in 1978 and continued throughout the reform period, eventually extending to 4 million km². This large program became a component of larger government policy to accelerate afforestation in 1980.

The massive government reforestation program was impressive, but successful agricultural policy clearly provided the earliest incentives for forest policy reform and development. The agricultural reforms that began in 1978 produced a phenomenal increase in agricultural production. Two effects on forestry followed directly. First, some agricultural households, once they received HRS rights to their lands, also invested in trees. This effect was most noticeable in the grain-producing North Central Plains where wind erosion was a serious problem that could be modified by planting trees and where forestry had been only a minor crop that was largely overlooked by the government's regulatory authorities.

Second, forest-dependent households observed agriculture's success with HRS rights, and the members of forest collectives demanded similar rights for themselves. A comparable system known as the contract responsibility system (CRS) was introduced in 1981 for forest cooperatives and forest households. This system became the third component of the "Three-Fix" policy for forestry (stabilizing the rights to and ownership of forests and mountains, identifying boundaries of household plots, and establishing a forest production responsibility system) that was implemented in the SCFR between 1981 and 1985.

The share of households participating in the CRS rapidly increased to 55% of those in forest collectives by 1983, and by 1984 approximately 30 million ha had been designated for private management by about 57 million households. The reforms continued when the government liberalized markets in the collective forest areas in 1985 by abolishing the state monopoly on the purchase, sale, and distribution of logs. Real timber prices increased 43% in the SCFR that year.

Differences existed, however, even between counties, in the pace and extent

trees. With the inflation of 1986 and the general retrenchment that followed, some local authorities withdrew CRS rights from some households until only 52% of households in forest collectives possessed these rights in 1988. The state monopoly on timber purchase was also reestablished in the SCFR in 1987. (The state monopoly was repudiated and an open market policy was reconfirmed once more in 1993.)

The next two chapters of this book examine these experiences and other characteristics of the devolution of authority and responsibility from the central government to local authorities and local households. Liu and Edmunds, in Chapter 2, describe the change in the institutional arrangements for property rights to the former collective forestlands and the shifts in oversight responsibility for these lands from central to regional and local governments. They rely on national forest survey data and their own research experience in 22 villages in China's South and Southwest to illustrate the impacts of these changes. (Seventy percent of the affected forests are located in the South and Southwest.) Liu and Edmunds show that the effects of reforms have changed over time; for example, from an initial period of rapid deforestation in the early 1980s to gradual reforestation and forest growth in the 1990s. They also describe some of the variation in impacts between households and between regions and they suggest some of the remaining opportunities for policy reform in the sector.

Despite the devolution of authority and the growth in both forestland and forest stock, investments in forest management remain more constrained than those in comparable agricultural activities. Individual households now possess the rights to the products of their household plots, and most of the controls on the inputs of productive activities were removed by the late 1980s, but the local forest bureaus maintain the right to limit harvest levels and shipments of forest products.

Liu and Edmunds point out that various levels of government also impose an array of timber taxes and charges that account for more than 50% of the market value of timber in some provinces. The relevant agencies began increasing these fees shortly after timber prices began to rise in response to market liberalization in 1985. The agencies saw an opportunity to increase their own revenues, and they took advantage of it. Since then, taxes and charges have risen more rapidly than timber prices. This contention is well-known among Chinese foresters and also in the English literature (e.g., Bruce et al. 1995; Albers et al. 1998; Yin 1998; Li 1999; Zhang 1999; Chen et al. 1999, 2000; Zhang 2001). Liu and Landell-Mills remove it from the realm of contention in Chapter 3. They provide a detailed description and numerous local examples of these disincentives for one region, the SCFR. Their example is particularly appropriate because the SCFR is a major region for commercial forestry and, along with the eastern part of the NNFFR, one of two large regions where individual households are the most important forest managers.

The second set of two chapters continues the inquiry into forest investment, but with a more analytical approach. In Chapter 4 Yin conducts econometric assessments of three questions that arise in the discussions of Chapters 2 and 3. In

external sources, as well as the household sources that were the focus of Chapters 2 and 3.

Yin's chapter begins with an examination of two central features of reform described in Chapter 2. Yin estimates the effect of CRS rights on household timber production and investment and then continues with an estimate of the effects of the uncertain policy environment on the inventory of forests and forestlands. Surely, improved land-use rights must have led to an increase in forest investment. Just as surely, the act of giving CRS rights for forestlands and then withdrawing them from some households must have created an uncertain environment for investment, and that uncertainty must have affected forest management. Yin demonstrates these effects with contrasting observations from adjacent parts of the country. In the northern plains, forestry activities were less regulated, and households responded rapidly to new incentives to plant trees. Forestry has traditionally played a larger role in the economy of the provinces just south of this region. However, the same government policies were applied in a less even and predictable manner in the southern region. As a result, households in this second region modified their behavior with regard to both planting and timber harvesting to the detriment of longer-term forest management.

These observations on improved private land-use rights are important in light of the global attention given to potential transfers in forest tenures, especially transfers from state lands to local communities. The authors of Chapter 2 remind us, however, that any sort of major modification of land-use rights is likely to be complex and subject to much experimentation and modification before successful local arrangements develop. As in Chapter 2, it is implicit in Yin's results that individual private rights are superior to community rights, at least in some cases. Both chapters' observations on policy uncertainty introduce an issue that most discussions of forest policy overlook but one which is critical in the many countries of the world that are subject to rapid economic and political change. That is, although the flexibility to respond to local differences is desirable, frequent policy experimentation creates uncertainty and imposes significant environmental and social costs.

The authors of Chapters 2 and 3 identify the serious disincentive of China's burdensome taxes on timber. This raises Yin's third question. How can the expansion in forest cover on the collective lands be explained in the presence of confiscatory taxes and regulations? For at least one region, Yin demonstrates that even poor farmers with new HRS rights but short time horizons comprehend the advantage of improving the agricultural environment. Farmers in the northern plains planted trees and obtained almost immediate benefits in the form of erosion control and improved soil conditions—reflected in measurable increases in agricultural productivity. This evidence urges caution for the forest authorities in China and elsewhere who doubt that farmers will plant trees of their own accord and also for those who presume that public action is necessary to obtain environmental benefits. Farmers do appreciate the benefits and they do plant trees—at least in some cases.

farm investors, and foreign investors. He examines the incentives and tracks the performance of each. His observations for farm households are consistent with those of the prior chapters. Zhang's more interesting contributions lie in the observed patterns of government and private nonfarm investment. Government funding has tended to shift toward large silvicultural investments over the last 10 years. However, it has not produced much response in terms of growth in standing forest volume. Its results have been unlike those for farm household investment. Private nonfarm investment, a third category, is small but growing. Zhang traces the returns on investment for private firms and determines that their investments are riskier than those in other manufacturing-sector activities. Apparently, uncertain policy, high taxes, and insecure property rights deter further growth in these investments—much like they deter further growth in farm household investment.

Zhang also speculates on the future. In the presence of general economic growth and the absence of significant increases in forest production, the wood-consuming construction and paper industries must obtain their raw materials elsewhere, probably from imports and from substitute materials. Zhang speculates on these alternative sources and the adjustments they would impose on China's economy.

The chapters to this point focus on reforms that were designed for their prospective impacts on the agricultural or forestry sectors. The third set of two chapters examines the contention that market and policy activities outside the forestry sector are as important to forestry and the markets for forest products as forest policies themselves. In Chapter 6, Rozelle, Huang, and Benziger first discuss the trends in China's regional forest inventories between 1978 and 1994 and then examine those trends as econometric functions of forest and agricultural markets and policies and as a function of China's general economic performance. They add a discussion of China's forest data, the basic data on which their chapter and several others rely.

In Chapter 7, Y. Zhang, Uusivuori, Kuuluvainen, and Kant conduct an assessment of changing forest conditions on the island province of Hainan. Their assessment is comparable to the assessment in Chapter 6 in that it is an econometric search for the broad market and policy determinants of forest cover. However, Zhang et al. obtain more instructive results by separating effects on managed stands from effects on natural stands. Their analysis reflects a narrower geographic range but a better identified single market than that of Chapter 6, and its observations are more robust as a result.

The authors of Chapters 6 and 7 conclude that market and policy activity in the broader economy are important determinants of forest cover and standing forest stocks. They also emphasize the importance of distinguishing between natural forests and managed forests. These two categories of forest provide different forest resource services, and the markets and policies that affect one category can have different and even opposite effects on the other. Increasing prices, for example, encourage increased harvesting and reduction in the natural forest area, but

Both components of this observation are important lessons for all of forestry, globally as well as in China. Surely, it is important to specify first which forest resource services a policymaker intends to enhance, then to identify the categories of forests that support them and, finally, to design policy to target only the selected forests and their resource services. Just as surely, spillover effects from markets and policies outside the forestry sector itself often affect forestry, with different impacts on different categories of forests. Errors in judgement and policy are common when analysts and policymakers disregard these fundamental observations.

The final analytical chapters introduce two emerging concerns: income distribution and the environment. There is no well-developed literature on forestry's role in these issues in China—perhaps because they are relatively new to the policy discourse. These chapters offer a brief introduction to some of their important elements.

Most household incomes in China have risen substantially since 1978, but the disparities between households also have increased, within provinces and even more greatly across broad regions.⁷ Many rural households remain poor. Furthermore, among 592 counties officially designated as poor, 496 are in mountainous areas where various forestry activities are major sources of household welfare. The question is whether forest policy reforms and forest development can alter these conditions. Have they helped the poorest households and counties and mitigated the increasing income disparity?

In Chapter 8, Ruiz Pérez, Belcher, Fu, and Yang examine one forest product, bamboo, and the effect of its growth on income classes and general regional development. Bamboo, in all its many uses, is probably the third-most-important forest product in China (after fuelwood and commercial timber). It is a particularly useful product for the inquiry of this chapter because bamboo has not been subject to as many external policy restrictions as products like commercial timber. Therefore, its recent history is more representative of the impacts that unfettered forestry-sector development could have on household incomes and general regional development.

Ruiz Pérez and his coauthors challenge us to rethink the conventional wisdom. Who benefits from bamboo (or forest) development? If many benefit, then which income groups benefit the most? Can we reasonably expect forestry-sector reform to benefit the poorest? Is additional forest-based income the benefit itself, or does the diversification that this income adds comprise the greater benefit for local households? And regarding regional economic development, just what are the limits forestry as a leading sector for regional growth? This chapter does not set out to be comprehensive. The data are extensive, but only for one product and for one region. Nevertheless, the detail in the analysis should cause us to consider carefully each of these questions for other forestry activities in other regions of China and the world.

The changing forest environment is the final issue addressed in this book. In general, poor countries draw on natural resources as capital that can be consumed

outcome. Fortunately, as they develop, some countries become more aware of and more concerned with resource depletion and other environmental problems, and act to mitigate them. Furthermore, development itself may create the financial means to address these problems.

China's environmental problems are serious, but China has begun to address some of them. The list of policies and policy objectives in appendix Table 1-A reflects the increasing attention that the central government has directed toward environmental issues in forest management since the late 1980s. Environmental management has gradually become a central responsibility for all forests, but particularly for the state forests.

Sayer and Sun, two experienced environmental analysts, discuss the topic in Chapter 9. The data for environmental assessments of China's forests are sparse at best. Therefore, Sayer and Sun survey general impressions before focusing on one representative topic, the loss of biodiversity that necessarily occurs as China depletes its natural forests. China's large expanse of natural forest may support the largest range of biodiversity of any country in the world. However, the depletion of its natural forests suggests a large loss of biodiversity as well. Sayer and Sun reemphasize the point from Chapters 6 and 7 about distinguishing between managed and natural forests. Managed forests support some environmental services and they play a crucial role in controlling erosion, but they are not as important as natural forests for the protection of critical habitats and general biodiversity.

The central government has identified the environment as a focal policy issue for the twenty-first century, and it has begun enforcing compliance with environmental regulations on polluting industries. As it begins to add the forest environment to its policy concerns, Sayer and Sun emphasize the importance of the physical sources of each forest-based environmental problem. It is insufficient to presume that comprehensive rules such as increasing forest cover in general, or even saving all natural forests, will solve all forestry problems. This instruction is entirely consistent with the observations of Rozelle et al. and Y. Zhang et al. in Chapters 6 and 7 that managed and natural forests provide different resource services and respond differently to market and policy incentives. Surely, some natural forest habitats are more important than others. Surely, plantations can address some environmental problems. Surely, the problems of forest environments are as real and as far-reaching as Sayer and Sun suggest in Chapter 9. And surely, these problems and their resolutions are as complex as the forest environments themselves. Better data and more thorough analyses are needed to assess the relative magnitudes of these problems and the most effective means of addressing them.

The final chapter reviews the findings of the empirical chapters, summarizes their observations for China, and explains these observations within the context of global forest policy. The institutions that define land tenure and the means of delivering tenurial rights is one great theme of China's experience—and this book. The impacts of spillovers from policy reform in other sectors and from general economic growth is another.

income distribution and the environment, and one must carefully think through the role of forestry in these issues.

Forest environmental issues are particularly complex. For example, the pulp and paper industry is the source of 10% of China's industrial wastewater emissions and one-fourth of its chemical oxygen demand. This industry currently uses agricultural residues at a three-to-one ratio over wood fiber. Yet the papermaking process is less damaging to the environment when it uses wood. Would it be better to increase the proportion of wood fiber—thereby further depleting China's forests? Does it matter that greater use of wood fiber would require increasing wood imports—thus increasing the resource cost in other countries? In another example, China's new Natural Forest Protection Program (NFPP) and its logging ban on the upper extents of the Yellow and Yangtze River watersheds is intended to restore the upland environments and limit erosion and downstream flooding. Are these expectations reasonable? The NFPP includes provisions to assist the financially strapped forest authorities as their responsibilities shift to the ecological functions of the forest, and also the forest workers who will be displaced. What are the reasonable expectations for these activities? How much assistance will be necessary and how successful will it be?

Finally, tenure continues to be an issue, sometimes with a distributive theme, sometimes with an efficiency theme. Land-use rights have been reallocated yet again in some of the regions used as examples in this book. Rights were reallocated on local demand and to maintain a degree of household equity. We can anticipate the effects, but they have been largely ignored in the literature outside of China. Meanwhile, restrictions on household harvests and shipments as well as high levels of forest taxation continue to constrain household forestry incentives. The central government recognizes these issues, but local administrators will largely determine whether future growth in China's forestry sector is characterized by imports and product substitution or by domestic production.

Index Table. Policy Reform in China's Forestry

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Title	Issued by	Principal objectives/impacts
Introduction of Vigorous Development of Afforestation	Central Committee of CPC, State Council	Accelerates the greening of China, promotes national afforestation and greening.
Decision on Several Issues Related to Forest Protection and Development (the "Tree-Fix" policy)	Central Committee of CPC, State Council	Sets rules and policies for forest protection and development. For forestry reform, determines the ownership of mountains and forests, designates mountain slopes for household use, and defines a forestry responsibility system. Ownership certificates were issued for 97 million ha of mountain forests, of which 3 million ha were designated as privately managed mountains. For about 57 million rural households.
Decision on Reform of the Economic System	The 3rd Plenary Session of the 12th Central Committee of CPC	Shifts the priority of reforms from rural to urban and the emphasis to state-owned enterprises, market development, and price reform.
The Forest Law of the People's Republic of China (China's first forest law)	People's Congress	Formally recognizes the division of forests between the state and collectives. States general objectives for forest management, establishes timber harvest quotas, and requires shipping permits.
Ten Reforms To Further Stimulate the Rural Economy	Central Committee of CPC and State Council	Abolishes the state monopoly (the Unified Procurement System) for timber purchase, sale, and distribution in collective forest regions, and opens the markets for wood.
Implementation Rules for the Forest Law of China	State Council	Implements the forest law; protects forest resources and develops the forest industry.
Enhancement of Forest Resource Management and Interdiction of Runous Cutting in the Southern Collective Forest Region	Central Committee of CPC and State Council	Halts runous cutting; implements the responsibility system of government leadership at all levels in the protection and development of forest resources. Resumes the state monopoly on timber purchased in the Southern Collective Forest Region.
The Provisional Regulation of State-Owned Enterprise Management Responsible Contracting System	State Council	Improves control over the consumption of forest resources and improves the financial operation of state-owned forests. These enterprises were requested to adhere to annual timber cutting quotas, promote reforestation, diversify management and the comprehensive use of resources, and enhance production safety, forest protection, and fire prevention.
Notice of Strengthening the Management of Logging with Certificates	Forestry Ministry	Reinforces the logging quota system and the requirement that forest growth had to exceed timber harvest levels.
Decision on Several Issues Concerning the Establishment of the Socialist Market Economic System	The 3rd Plenary Session of the 14th Central Committee of CPC	Accelerates introduction of the market system and reform of taxation, finance, prices, and rules for foreign investment.
China's Agenda for Forestry Action Plan in the 21st Century (first environmental objectives for forest management)	Forestry Ministry	Presents, in a general way, the development plan for different elements of China's forest sector.
Notice of Implementing the System of Using Forest Land with Certificates	Forestry Ministry	Requires certificates for all forestlands. Differentiates forestland from other land uses. Effectively restricts conversion to other land use and ensures that this land will be regulated in accordance with forest law.
General Outline for Restructuring the Forestry Economic System	Forestry Ministry	Pushes forest enterprises toward the market, mobilizes and enhances financial support to forestry through tax policy, strengthens infrastructure development, reduces the role of government, and reinforces administrative support for forestry.
Instructions on the Decision about Accelerating Progress by the Central Committee of CPC and State Council	Forestry Ministry	Establishes guidelines of reform, for science and technology education, set forth science and technology as the guiding ideology for promoting forest development, and set the major mission for "the new future through" 2010.

continued on next page

Index Table. Policy Reform in China's Forestry (continued)

Title	Issued by	Principal objectives/impacts
Experiment on the Reform of the Development of Classified Management of Forestry	Forestry Ministry	Promotes the reform of classified management and operation. Classifies forests according to commercial, environmental (public interest), and mixed objectives.
Decision on Several Issues Related to Deepening the Reform in the State-Owned Forest Farms	Forestry Ministry	Emphasizes two points: (1) classified management reform must differentiate between commercial and environmental forests and should be appropriate for local economic and social development conditions and (2) industry structure of forestry farm must be optimized.
National Ecological Environment Establishment Program	State Council	Continues the shift toward environmental justifications for state forest management.
Amended "Forestry Law of the People's Republic of China"	People's Congress	Legalizes transfer rights for family plots and extends the period of user rights, essentially stabilizing forest tenures in collective forests; emphasizes that the principal role of forestry is to provide environmental services.
Notice on "Protecting Forest Resources, Interdicting Ruinous Deforestation, and Occupation of Forest Land"	State Council	Protects forest resources by preventing the conversion of forestland for agriculture and other development purposes.
National Forest Protection Plan	State Council	Bans logging in natural forests at the upper reaches of Yangtze River and upper and middle reaches of Yellow River; reduces timber production of state-owned forest farms in the Northeast and inner Mongolia by 19.91 million m ³ ; establishes 12.7 million ha of plantations, and redirects and resettles 740,000 excess workers.

JCG, Communist Party of China, ha, lectures.

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Notes

- Many have reviewed and assessed this experience. We cross-checked the material in this section with reviews in Ho 1994, Chai 1997, Lingge 1997, Chen 1999, Du 1999, Qian 2000, Zhang 2001, Zhang and Chen 2001, and Wang and van Kooten 2001.
- China conducted its first national forest survey between 1972 and 1976, its second between 1977 and 1981, its third between 1984 and 1988, its fourth between 1989 and 1993, and its fifth between 1994 and 1998. As a matter of nomenclature, forest surveys collect the information. The assembled information is called a "forest inventory". The terms "survey" and "inventory" are often interchangeable.
- In his address to the annual workshop on Population, Resource, and Environment on March 13.
- Premier Zhu Rongji, in the Government Report to the National People's Congress on March 5, 1999.
- Richardson 1990 is the standard English language reference for the natural science, geographic variation, organization, administration, and production practices of China's forestry prior to the late 1980s.
- In fact, the inventories of *accessible* state-owned forests were also drawn down severely. Of 131 state-owned forest bureaus in the Northeast and Southwest in 1978, 25 had exhausted their mature wood resources by 1993.
- China's Gini coefficient, a measure of its household income inequality, rose sharply from approximately 0.20 in the late 1970s to 0.30–0.35 in 1990 (Chai and Chai 1994, Chen et al. 1995). It may be around 0.40 today. Demographers often consider a coefficient that is much greater than 0.40 as indicative of serious maldistribution and potential social unrest.

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