Chapter 1.
China's Forest Sector: the Reform Era

1.1 Introduction

China is often referred to as being "forest poor" (Démurger et al. 2009; Liu and Diamond 2005; Liu et al. 2003; Liu 1998). Per capita forest coverage is one-fifth the global average, and per capita standing forest stock is just one-eighth the global average. China's constrained domestic resource base is, in many ways, not new. Thousands of years of extraction and everyday use of forests left the country with a depleted resource base before the modern era even began (Li 2004; Song et al. 1997; Menzies 1994; Shaw 1914). Yet China is now the world's largest producer and exporter of forest products (SFA 2009). Questions surrounding long-term forest ecological health and sustainability, the welfare of rural residents who depend on forests or trees for their livelihoods, and industry's reliance on timber for the mass production of forest products are now inextricably linked. In fact, these questions are relevant domestically within China, as well as for countries on which it now relies to supply its wood resources and for countries to which it exports wood products. In order to understand China's current role in the global forest products market, it is useful to examine changes over the course of the modern period, particularly during the reform period beginning in 1978.

The aim of this chapter is to provide an overview of China's forest sector, within the context of three broad stakeholders: the forests themselves, the people who live in or near forested areas, and the forest products industry. The period from 1949 through 1978 will be presented in brief, with the objective to introduce land ownership types and provide a background to the period beginning in 1978. The main emphasis of this chapter is on the reform period beginning in 1978. The chapter

will include a review of reforms aimed at the collective sector, forest development in the relatively recent era of protection and conservation programs, current forest and forest industry conditions, as well as a discussion of the ongoing challenges faced by China's forest sector.

1.2 Background: 1949-1978

In the early 1950s, land reform was introduced as a fundamental campaign in the creation of the socialist state (table 1.1). The primary intent of land reallocation was "to further rural revolution

Table 1.1 Land Tenure: 1950-1980

Period	Defining Features
1950-1955	• Removal of land from private ownership • Establishment of state-owned and collective-owned forests • Integration of tree ownership and land ownership • Households maintain rights to fruit and non-timber trees
1956-1981	• Collectives become dominant form of ownership • Introduction of communes: up to 4,800 households per commune • Widespread deforestation and land conversion for purposes of agricultural expansion • Policy reversals first devolve ownership and management to households, then reinstate commune-level collectivization • Collective forest removals used primarily for fuelwood and local uses; state removals used for construction, transportation and other major sectors.

Adapted from Liu (2001)

and only secondarily to improve land usage" (Ross 1980). During this process, all forestland was removed from private ownership and redistributed as either state-controlled forestland or collective forestland (Richardson 1966). This two-pronged land ownership structure largely continues today, although national-level reforms enacted in 2008 will eventually lead to the large-scale reallocation of collective forestland to households or self-assigned communities. State ownership has historically been characterized by its vertically integrated silvicultural, logging and processing capacity (Zhang 2000), and tended to cover large tracts of land, located in natural forests in the upper reaches of river basins and mountainous regions (Xu et al. 2004). Collective ownership comprises townships, administrative villages and village household groups (Liu 2001). Another distinction may be made by

identifying the differences in resource ownership and land ownership. Under state ownership, both land and trees are owned by the state; at the collective level, land ownership and tree ownership may be separated, with land ownership retained by the collective, while trees may be owned by individual households (Démurger et al. 2009). State ownership is dominant in the northeast and southwest, while collective ownership is dominant in the central region. Approximately 58% of forests (by area) are under collective ownership, while 42% of forests are under state-owned entities (SFA 2005a).

By 1956, 96% of rural land had been placed under the jurisdiction of village leaders (Richardson 1991). Collective forestlands were initially controlled by units consisting of 20 to 30 households; by 1956, the management level had grown to 200-600 households; with the advent of communes in 1958, this grew even larger to 4,800 households (Liu 2001). This meant that while ownership was ostensibly "collective", it was effectively highly centralized with few households making any independent decisions about planting and harvesting. The majority of wood removals on collective forestlands were used for fuelwood and other local uses (Ross 1980).

Within the state sector, forest bureaus and forest farms were vertically integrated, and operated timber management, logging, and wood processing activities. Enterprises were given fixed production quotas and set prices under which they were expected to operate. The main objective of the state forest sector was to supply inexpensive logs to support industrialization (Démurger et al. 2007). Wood production to supply the construction, mining, and transportation sectors came primarily from the state sector, which was charged with the bulk of timber production (Ross 1980). Investment in regeneration and equipment under both collective and state ownership structures was low.

Extraction during this era came predominantly from virgin or natural forest areas (Yang 2001). During the Great Leap Forward, it is estimated that nearly 10% of forests were cleared for the

use of wood as fuel (Shapiro 2001). The widespread destruction of forests that served to fuel "backyard furnaces" aimed at producing steel was of dubious economic benefit. Although no inventory data are available for the 1950s, estimates of forest coverage at the time vary: Ross (1980) estimated that forest coverage was between 5% and 8% of total land area; other estimates show that forest coverage increased from 8.6% in 1949 to 11.8% by 1962 (Zhang and Song 2006). The northeast had the largest area of forest (Ross 1980). Although the southwest appears to have had the highest stocking density, it was also the most remote. While the central and southeast coastal regions had more accessible forests; combined, they accounted for less than 1% of total forest area and had the lowest stocking density (Ross 1980).

After this period, and the massive famine from 1959 to 1961, the government responded with a series of reforms that devolved forest tenure from the commune level to lower administrative levels and even returned certain management responsibilities back to individual households (Liu 2001; Wang et al. 2004). How forestland rights were devolved depended greatly on the location and was left to local governments to decide (Shen et al. 2009). However, these reforms were short lived; in the 1960s, a renewed effort at class struggle came in the form of the Cultural Revolution. Management by households was soon regarded as a return to private ownership (Liu 2001). During this period, as huge numbers of urban residents were sent to the countryside for re-education and to expand agricultural production, forestland was cleared for the creation of new farmland. This period was marked by an abandonment of the reforms implemented post-Great Leap Forward. For the most part, there was no active forest management despite widespread intensive harvesting (Wang et al. 2004). Investment in both silviculture and industry declined from 1965 to 1969, and did not return to pre-1965 levels again until 1972. According to official estimates, timber production grew from 5.7 million cubic meters (CUM) in 1949, increasing gradually before spiking to

45.2 million CUM in 1959 (table 1.2); during the 1960s, it then declined precipitously, bottoming out two years later at

Table 1.2 Log and product production, 1949-1979, in million CUM

Year	Logs	Lumber	Panels	Year	Logs	Lumber	Panels
1949	5.67	NA	NA	1965	39.78	11.6	0.22
1951	7.64	NA	NA	1967	32.49	11.57	0.17
1953	17.53	6.64	0.04	1969	32.83	10.05	0.2
1955	20.93	6.78	0.05	1971	40.67	11.05	0.28
1957	27.87	11.88	0.07	1973	44.67	9.99	0.35
1959	45.18	14.55	0.16	1975	47.03	10.69	0.37
1961	21.94	16.23	0.09	1977	49.67	11.25	0.46
1963	32.5	8.26	0.14	1979	54.39	12.71	0.77

Source: China Forestry Yearbook (2010)

21.9 million CUM in 1961 before gradually increasing again. Lumber production also followed this trajectory, spiking between 1958-1960, before declining rapidly and not recovering Great Leap Forward production levels again until after 1979.

The period between 1949 and 1978 was marked by rapid resource exploitation and depletion, with little concern for regeneration or active management. Although 58% of forests were placed under collective ownership, households had little control over resource decisions. Widespread harvests and forest destruction were aimed toward fueling economic growth and freeing up land for agricultural production. Unfortunately, this appropriation of resources did not serve to drive rapid economic growth, and it was not until the Reform Era that policies designed to promote both economic growth and forest regeneration would take place simultaneously.

1.3 The Forest Sector in the Reform Era: 1978 – Present

Not long after Mao's death in 1976, Deng Xiaoping ushered in a new era of economic reform and revitalization. China's forest sector since 1978 is best understood within the context of these massive economic reforms, as it too has undergone its own series of reforms. Although the overall

reform period began in 1978, forestry reforms were not initiated until 1981. Forest sector reforms have been defined by the following three objectives: 1) improving rural livelihoods, 2) improving forest ecology and overall environmental protection, and 3) growing the forest industry. The remainder of this chapter will present a review of these three targets, and discuss progress to date.

1.3.1 Rural Livelihoods

Land tenure reforms since 1981 have been the most consequential for the long-term economic welfare and stability of rural populations. Agricultural reform is widely recognized as having been a propelling force in expanding economic reforms to other sectors during the early part of the reform process. Less recognized are the concurrent forestland tenure reforms. This section will discuss collective forest reforms since they have had the greatest impact on rural residents. Reforms in the forest sector have not been as consistently successful as those in the agricultural sector, and have thus followed even more of a "trial and error" process (Shen et al. 2009; Yin et al. 2003).

In the early part of the reform era, decentralization of collective property rights and an upward shift in agricultural prices led to dramatic improvements in the incomes of rural people. Reforms in the forest sector were intended to be as pragmatic as those in agriculture. The first collective forest reform was the introduction of the Resolution on Issues Concerning Forest Protection and Development, also known as the "Three Fixes Policy" in 1981. This reform led to three new forms of management. The first was the creation of family plots (*ziliushan*). These often consisted of denuded and brush lands, turned over to individual households to replant and manage for production purposes (Liu and Edmunds 2003a). The amount of land turned over depended on household size (Shen et al. 2009). The second was responsibility hills (*zerenshan*), where families shared management responsibilities and split the income from timber sales between the collective and individual households. The third was where collectives maintained all management decisions (*tongguanshan*), but individual households were granted monetary shares and allowed the

opportunity to contribute to management recommendations. Although management and resource ownership shifted, land ownership itself was retained by the collective. Each province differed in terms of what has become the primary management type and the extent. For example, by 1986, in Zhejiang, nearly 77% of collective forests were managed at the household level, and in Jiangxi, nearly 92% were at the household level (Shen et al. 2009; Xu 2008); Fujian, however, pursued an independent path, with a shareholding system evolving out of *tongguanshan* (Song et al. 1997).

Although these reforms were intended to improve tenure security, they have since been described as initially exacerbating the problem (Démurger et al. 2009). A combination of competing interests for land usage and policy instability led to a lack of confidence in ownership rights (Liu 2001). In some cases, fear of fluctuating land tenure policies may have led some farmers to harvest trees on their property at the outset of the reform era (Prosterman et al. 2000; Harkness 1998). As households gained access to forested resources, they quickly saw the financial gains to be had from immediate harvesting (Shapiro 2001). Initially, households had been permitted to sell timber produced above quota; then in 1985, the two-price system was dropped and households were allowed to sell at market prices, although within certain limitations established by the Ministry of Forestry (Zhang 2003). At that time, prices rose precipitously and induced speculation (Yin et al. 2003). Farmers rushed to harvest and engaged in sparse replanting (Yin et al. 2003; Liu 2001).

This initial period of reform witnessed widespread illegal cutting (Song et al. 1997), and a 10% reduction in forest coverage in southern collective forests (Liu 2001). Some analysts have pointed to the high-grading and selective harvesting of large diameter trees as contributing to the overall economic growth during the early 1980s (Albers et al. 1998); this was certainly not limited to the collective sector and took place across the state sector as well. The high rates of harvest during this time also led to changes in stocking, species composition, and fragmentation of forests (Liu and Edmunds 2003b). In response, the government quickly reversed course, suspending household

tenure reforms in 1985 (Xu 2008; Song et al. 1997). Timber markets reverted back to state control in 1986, although they were once again liberalized in 1993 (Hyde et al. 2003; Yin et al. 2003; Yin 1998).

No province was required to implement the 1981 Resolution and the implementation of forest reforms has varied by province, and thus their impacts have varied regionally. The southern collective region has faced timber quotas, low fixed procurement prices and high taxes, while the north has been subject to no such fixed procurement system, low taxes and no quotas. Liu and Landell-Mills (2003) described additional charges collected in the southern collective region for forest restoration, insect and disease control, fire protection, as well as administration charges. This regional discrepancy has been blamed for the low investment in afforestation and replanting in the south (Liu 2001). The agricultural tax, which formerly comprised up to a 16% rate of timber-derived income, was eliminated in 2009. However, further reforms in timber-related fiscal policies are still needed; given that multiple jurisdictions collect fees and levies, in many areas the tax rates amount to between 35-62% of the log sale price (Liu et al. 2004; Zhang 2003).

Table 1.3 Collective land tenure: 1980-2010

Period	Defining Features
1980-2000	• "Three Fixes" policy introduces three forms of household and shared landholding within collective forests • Responsibility largely returned to households • Policies implemented differently across provinces • Two timber harvest price system dropped in 1985, leads to widespread harvesting • Price system reinstated through early 1990s • South characterized by high taxes and fees, restrictions such as quotas and permits and fixed procurement system; north not subject to such policies
2001-2010	• Reinvigorated efforts at improving rural livelihoods • 2003 Collective reforms establish 6-7 forms of household and share landholding within collective forests • 2008 Reforms further establish households as primary landholder and allow for lease or transfer of rights • 2009 Agricultural tax eliminated

Particularly since 2003, with the Resolution on the Development of Forestry (State Council 2003), there has been a renewed effort aimed at individualizing collective forests and securing tenure rights. This has followed the introduction of the Rural Contract Law and the New Countryside Development Initiative in 2002 (Xu 2008). Further reforms were introduced in 2008 with the Comprehensive Collective Forests Reform (Xinhua 2008). Although retaining collective ownership, this policy established individual farmers as the dominant landholder, allowing them to lease or transfer their plots to other farmers. It established the length of the contract period as 70 years, with the right to extend. It also calls for the clear demarcation between commercial and public benefit forests[1], distinguishing commercial forests as subject to household management decisions.

However, there are still few studies to date that have examined the impacts since either the 2003 or 2008 reforms. Xu (2008) identified the primary intent of the 2003 reforms implemented at provincial levels as the following: increased timber harvests in provinces where de-collectivization is occurring, increased the share of forestry household income, and increased afforestation efforts by farmers. Currently, particularly in the southern region, collective forests are largely made up of plantation and production forests, as well as fruit and cash crop orchards (Wang et al. 2004). In fact, more than 80% of plantations are on collective forestlands. Effective implementation of reforms will help enhance the productive use of these lands, particularly in the context of improving rural livelihoods.

Despite the early phenomenal impact of reform on the agricultural sector, rural household business income continues to lag significantly behind urban and off-farm income[2]. Adjusted for

[1] These are also referred to as ecological welfare forests.
[2] The Rural Household Survey (SSB 2006) defines household business incomes as consisting of three sources (primary, secondary and tertiary production). Primary production includes agriculture, forestry, livestock, and fishing. Forestry income is cash income derived from household forestry activities.

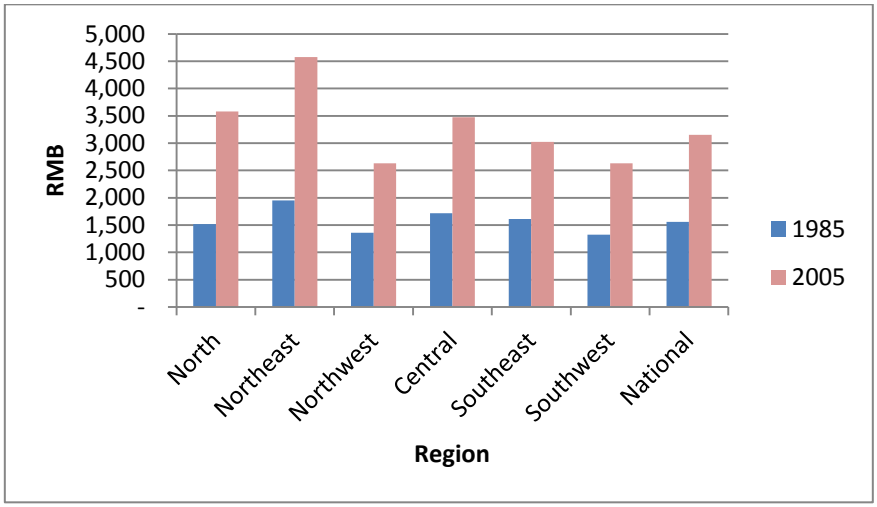

Figure 1.1 Adjusted farm household income, by region
Source: SSB (2006)

inflation, farm-derived incomes approximately doubled between 1985 and 2005, with the national household average rising from 1,559 Renminbi (RMB) (195 USD) to 3,164 RMB (396 USD) (figure 1.1).

Conversely, off-farm incomes are rising. On average, 28% of total rural household income came from off-farm wages in 2005. This percentage was highest among rural areas near urban centers, such as Beijing and Shanghai, and coastal provinces, such as Guangdong and Jiangsu, but it was also high among many non-coastal provinces, such as Jiangxi and Anhui. A notable exception is the island of Hainan, where forestry contributes the highest percentage to farm-derived income, and which has one of the lowest shares of non-farm wage income (table 1.4).[3] This is important as the government is actively seeking to raise the incomes of rural residents by keeping them engaged in agricultural and forestry activities.

[3] This higher than average ratio is likely due to the island's small population (less than 1% of the total national population in 2005), resulting in a high density of forest to farmer.

Table 1.4 Relationship between forest coverage and income among five most heavily forested provinces (2005).

Province	coverage as % of total area of province	% of forestry to farm income	% of non-farm wage income to total rural household income
Fujian	62%	3%	33%
Jiangxi	58%	2%	30%
Zhejiang	55%	3%	40%
Hainan	50%	13%	12%
Guangdong	49%	1%	47%

Sources: SSB (2007); SFA (2006).

For most rural residents across the country, forestry obviously does not contribute to average farm income. For forest-dependent communities, the story differs. National statistics do not provide data on these farmers' incomes, but according to a survey conducted by Xu (2008), amongst forest farmers in Fujian, forestry contributes as much as 16% to their overall income; in Jiangxi, it contributes almost 13% of their incomes. Some studies report that up to as much as 70-80% of incomes in forest-dependent communities can come from forest-related activities (Ruiz Pérez et al. 2004). But even for those whose primary source of income stems from forestry, given the high tax and fee rates described above, there is in fact, little left for the farmer; rural residents in forest-dependent communities continue to be among the country's poorest (Miao and West 2004). These communities are often the poorest because of their geographical remoteness, which affects opportunities for economic development. Liu and Yin (2004) found that increased productivity in rural households and the contribution of forestry to livelihood improvements was offset by increases in production input costs. This has the effect of essentially putting already-impoverished areas at an additional disadvantage in terms of economic development. If the government expects farm-derived incomes to compete with off-farm income sources, the ability to catch up and compete will be critical to improving rural livelihoods.

Viewing rural livelihood improvement solely through the lens of increasing incomes ignores the fact that many rural people rely on a mixture of cash and subsistence farming or agroforestry. This is particularly true in upland forest-dependent communities, where households depend on access to forest resources for fuelwood, building materials and non-timber forest products (NTFPs). However, peripheral people in China have long been viewed as "uncivilized", and those practicing shifting cultivation in upland areas as the most primitive (Sturgeon 2005). After 1949, the resources these peripheral people depended on, and had managed through traditional ecological practices, were placed under state or collective management and treated as free goods to be extracted and exploited as the state saw fit (Harkness 1998). Resource policies were further intended to both civilize peripheral people and direct their production efforts toward state goals (Sturgeon 2005).

Studies have shown how the establishment and closing off of nature reserves or conversion of forestland to plantations has led to the reduction or elimination of NTFP collection opportunities, and therefore a reduction of food or income sources (Fu et al. 2009). Additionally, even where there is access to modern and more efficient fuel sources, such as electricity, households do not necessarily conform to efforts to "modernize" them, choosing instead to use a mixture of fuelwood and electricity (Trac 2011). In many areas, these communities have been marginalized by the policy-making processes and technical assistance programs (Wilkes 2006), while local knowledge and inclusion in policy development is ignored (Urgenson et al. 2011). They have little say in how land is restricted, assigned or, in the cases where conservation policies have prohibited agricultural or grazing practices (see section 1.3.2.2), what commercial timber species may be planted. This marginalization does not bode well for the long-term adoption of state priorities, including conservation policies since the government often provides little incentive to cooperate (Xu and Wilkes 2007).

For rural people, the impacts of the first round of reform have been mixed, and it is too early to assess the impacts of the most recent round of reforms. Regional administrative variation has significantly impacted the type and effectiveness of reforms. The periodic reversal of tenure rights has left many feeling insecure about their rights. Studies have indicated that incomes for forest-dependent communities have increased in the years since the reform began, but nationally, forestry does not contribute much to rural incomes. The government faces a difficult task in meeting its objectives to increase forestry incomes as a portion of rural on-farm incomes, to introduce new rural economic opportunities that will stem the rural-urban migration, and to provide greater inclusion of rural people in resource decision-making processes at the local level. Alleviating many of the tax and fee burdens and ensuring property rights are certainly central to doing so, but increased activities are also necessary. This may come in the form of increased production as young plantations mature and are harvested, but there are also many uncertainties associated with the protection and conservation efforts described in the following section.

1.3.2 Forests: Ecology and the Environment

From the 1950s through the 1970s, little effort was made in terms of time or money in investing in silviculture and regeneration. This shifted slightly in the 1970s, with the introduction of the first active conservation efforts. In 1998, persistent rains over a three month period in the summer of 1998 led to a series of devastating floods along the Yangtze River, resulting in the deaths of more than 3,500 people and billions of dollars in damage. These floods were widely blamed on previous excessive logging in steep areas and poor forest management. Conservation and silvicultural improvement efforts increased exponentially after these floods; the narrative that these floods created cannot be underestimated as they have been used as a catalyst for significantly shifting the forest sector from production to conservation. This section will first discuss forest coverage changes and then protection and conservation policies.

1.3.2.1 Forest Coverage

After the establishment of the People's Republic in 1949, the first forest-specific regulation clearly recognized the degraded state of the forestland base and was aimed at increasing forest coverage. The Directive on Mass Afforestation, Cultivation of Forests and Protection of Forests was promulgated in 1953 and mobilized collectives to begin large scale afforestation efforts to rehabilitate "wastelands," bare hills, and tree planting in and around villages for shelterbelts and along roads, canals and river banks (FAO 1982). The government called for the afforestation of nearly 100 million hectares (approximately 10% of total land area) during the 1950s, with the focus on creating protected areas and planting fast-growing species of high economic value (FAO 1982). However, these early efforts at afforestation have been largely dismissed as ineffectual, with high rates of mortality; a lack of technical expertise, poor selection of sites and species and an inadequate definition of responsibility that led to neglect in the maintenance and protection of young forests (FAO 1982).

A forest inventory was launched in 1954 but not completed until the 1960s, leaving experts without a comprehensive picture of the domestic resource base. The first national inventory to rigorously catalogue the country's forest resources took place from 1973-76. Since then, inventories have been conducted in five-year intervals, with the most recent completed in 2008. Since the second national inventory, inventories have been conducted through the use of permanent sample plots, which make use of both remote sensing and ground plots (Lei et al. 2009).

At the time of the 1973-1976 inventory, it was estimated that forest cover stood at 121.9 million hectares, or nearly 13% of total land area (Démurger et al. 2009). Forest inventories reported a decline in forest cover between 1980 and 1988; a period of ineffectual reforms, very intensive timber harvesting and land conversion. The mid to late 1980s witnessed a period of reforestation and the creation of forest plantations, although in some cases those plantations replaced natural

forests, a trend that has many concerned about the ecological health of these forests (Stone 2009; Albers et al. 1998).

Afforestation schemes contributed significantly to the increase in forest cover, recovering approximately 5 million hectares per year (WFI 1998). Shelterbelts have received considerable attention; probably the best known is the Great Green Wall, which was first planted in 1978. However, there is some question about the structure, quality and diversity of the trees planted in such programs (Rozelle et al. 2003). There are even questions about whether afforestation efforts are leading to the degradation of soils, thereby potentially exacerbating the very desertification problems that such a policy was intended to combat (Cao 2008). Particularly since 1998, subsidies from the government and loans from the World Bank have facilitated the establishment of large-scale, fast-growing plantations (Zhang and Chen 2001). It has been pointed out that there are very few close-to-mature forests remaining, that young and middle aged forests have a lower stocking level than older forests, and have lower productivity (Yin 1998). Additionally, the government's definition of forest area has changed. Fruit trees and cash crops began to be included in the mid 1980s, followed by a reduction in canopy cover requirements, and later by the inclusion of shrubs (Démurger et al. 2009). At present, forestland is defined as land with at least 20% canopy cover.[4] Forest cover, as indicated above, includes all trees, including fruit and other cash crop trees, and shrubs.

The Seventh Forest Inventory 2004-2008 (SFA 2009) reported a 12% overall increase in forest coverage (table 1.5). Total forestland increased by 20 million hectares (ha) to 195 million ha from the previous inventory, and forests now account for 21% of total land area. The government's goal is to increase national forest cover to 26% by 2025 (Wang et al. 2008). Figure 1.2 shows forest area by

[4] The canopy coverage requirement for forest area has declined from 40% in the mid-1980s, to 30% in the early 1990s, to 20% by the late 1990s.

Table 1.5 Forest area by region (million ha), and as percentage of total land[5]

	Forest area			As % of total land		
	1999-2003	2004-2008	% increase	Total area	1999-2003	2004-2008
North	26.35	30.67	16%	151.86	17%	20%
Northeast	32.51	36.15	11%	79.18	41%	46%
Northwest	18.12	22.79	26%	304.42	6%	7%
Coastal	28.66	30.53	7%	80.86	35%	38%
Central	36.03	41.66	16%	101.60	35%	41%
Southwest	50.18	57.84	15%	232.77	22%	25%
National	174.91	195.45	12%	950.69	18%	21%

Source: SSB (2009); SFA (2005, 2009).

province. Inner Mongolia , Yunnan, Heilongjiang, and Sichuan have the largest areas of forest, although there is mounting evidence that many of these increases cannot be documented (Trac et al. 2007; Weyerhaeuser et al. 2005). Much of the total increase in inventory occurred in Guangxi, Yunnan, Inner Mongolia, Sichuan and Gansu. The northwest region, which has the lowest overall forest coverage, experienced the greatest increase, rising 26% above its previous level. The central and southwest continue to account for the largest areas of forestland, and together account for half the total forest coverage in the country. The northeast and the north regions combined account for 34% of total forest cover in China.

[5] See Appendix B for a list of geographic regions

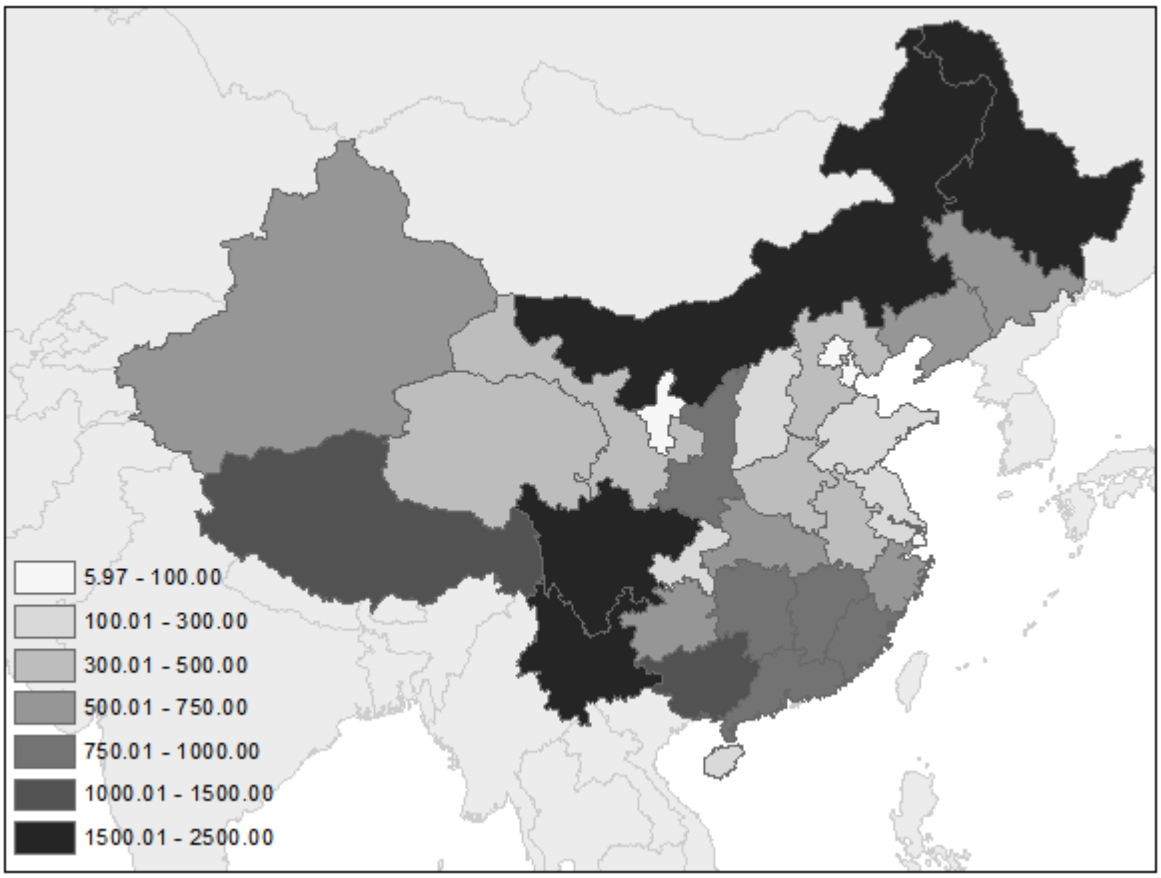

Figure 1.2 Forest area by province (ha), 2004-2008

1.3.2.2 Protection and Conservation Policies

Soon after the beginning of the reform era, the government introduced a series of new laws aimed at the protection of forests and biodiversity. In 1978, the Three North Forest Protection Project, or Great Green Wall, was launched. This program is the country's oldest ongoing afforestation effort and continues today. In 1979 the government issued the Forest Law, Wildlife Protection Law and Regulations on Wildlife Forest Reserves. These decrees, in conjunction with several others issued in the early 1980s, such as Instruction of Vigorous Development of Afforestation, Regulations for the Implementation of the National Compulsory Tree Planting Campaign, and the Targeted Afforestation Responsibility System were intended to ensure implementation of afforestation plans.

The late 1980s and early 1990s saw an expansion of the legal framework surrounding forest resources, as well as the adoption of several international agreements. In 1992, after attending the UNCED conferences in Rio de Janeiro, the Chinese government issued the Guidelines for Forest Activities, and an Action Plan on Biodiversity Maintenance (Yang 2001). In 1995, following on the heels of the Rio Summit and the Chinese government's Agenda 21, the Ministry of Forestry put together the Forestry Action Plan for China's Agenda 21. The Action Plan is characterized by three main objectives: a) ensuring sustainable forestry and increasing overall forest coverage and volume; b) modernizing forestry as an industry and raising productivity and efficiency levels; c) revamping the management system and improving education and public awareness (MOF 1995). Producing an Action Plan according to international standards signified an important step for China's forestry officials in bringing its management and production goals in line with international standards. The development of the forest sector since then has largely conformed to the guidelines outlined in this framework.

All of the above efforts were dwarfed, however, by the policies introduced in the wake of severe flooding along the Yangtze River in 1998. As a consequence of the massive floods, the Central Committee and State Council introduced the National Key Forest Program (NKFP), which is characterized by two monumental conservation efforts: first the Natural Forest Protection Plan (NFPP), followed in 1999 by the Sloping Land Conversion Program (SLCP)[6].

The NFPP called for a reduction in annual timber harvests from natural forests from 32 million cubic meters to 12 million cubic meters, the conservation of nearly 90 million hectares of forest and the afforestation and revegetation of 31 million hectares (Cao et al. 2010). The specific objectives included implementing logging bans in the upper reaches of the Yangtze and Yellow Rivers, reducing logging in state-owned forests, engaging in reforestation and improved silvicultural

[6] The SLCP also goes by the names Green for Grain, Grain to Green, and the Conversion of Cropland to Forest program. The latter is the most accurate translation.

treatments, and subsequently providing alternative employment opportunities for state workers formerly employed in harvesting activities (Miao and West 2004). The NFPP's reach is extensive; covering 18 provinces and autonomous regions, and focuses mainly on the upper Yangtze and Yellow Rivers, as well as state-owned forests in the northeast and on Hainan Island.

The NFPP has been plagued by several problems. First, the central government provided 80% of the funding for implementation, leaving the remainder to come from already hard-pressed local governments (Cao et al. 2010; Xu et al. 2006). Although not targeted directly at collective forests, participation is required, and in regions where collective forests overlap with the ban, landowners are not compensated for economic losses stemming from the reduction in available harvest (Miao and West 2004). As employment among forest-dependent communities has shrunk, it is estimated that rural income will have shrunk by 3-7 billion RMB (469 million USD – 1.09 billion USD), pushing many landowners back into poverty (Xu et al. 2003).

The second policy with important consequences for collective forest owners is the Sloping Land Conversion Program (SLCP). The purpose of this ambitious 337 billion RMB plan is to reduce water and soil erosion and increase forest coverage by converting certain crop growing areas with steep slopes above a 25% grade into grass or forest lands (Xu et al. 2010). The SLCP has been held up as the world's largest payment for ecosystem services program, and claims poverty alleviation as a key component to the program. The primary activity of this program pays for farmers to receive grain and cash subsidies and saplings to plant in lieu of engaging in agricultural activities. A secondary goal of the program is to shift rural farmers into less intensive agricultural activities and off-farm employment (Xu et al. 2004). To date, the SLCP has enrolled more than 21 million hectares (Table 1.6). By the end of the program, it will have enrolled or affected the landholding size of an estimated 40-60 million households, living in 2,000 counties across 25 provinces (Xu et al. 2010; Bennett 2008).

Table 1.6 Lands enrolled in Six Key Forest Protection Programs and per hectare cost, 2009.

2009	Total hectares enrolled	Average real cost per hectare 1999-2009 (current RMB/USD)
Total NKPP	**83,121,310**	**447 RMB/$66**
NFPP	8,630,590	253RMB/$37
SLCP	21,921,080	572RMB/$84
Beijing-Tianjin Sand Control Program	5,773,690	61RMB/$9
Three Norths and other programs	44,876,280	9 RMB/$1

Source: SFA (2010)

Taken altogether, the six national key forest programs, of which the NFPP and SLCP are two, will comprise the most expensive reforestation and conservation program in the world. Between 1999-2009, approximately 269 billion RMB ($42 billion USD) was invested in these programs. These programs vary in terms of their cost (table 1.5). The average real cost per hectare for the NFPP from 1998-2009 was approximately 237 RMB ($37 USD), while the average per hectare cost for the SLCP during this same period was 538 RMB ($84 USD). The SLCP has been compared to the Conservation Reserve Program (CRP) in the US (Uchida et al. 2005); the per hectare cost of the CRP in 2009 was 838 RMB ($131 USD) (USDA 2009). However, the SLCP is more than twice as expensive as the NFPP and significantly more expensive than some of the government's other conservation efforts, such as the Three Norths Shelterbelt. In total, though, through the NKPP, more than 83 million hectares have been enrolled, an area equal to slightly less than half of all forestland. Most of the cost of the programs is covered by the central government, with some contributions from multilateral institutions and local governments.

Assessments have found that in some regions the program may be overcompensating landowners for retiring their lands, making the program cost-inefficient (Uchida et al. 2005). In others, there have been large shortfalls in payment delivery and/or landowners have suffered

significant income losses amounting to half or more of their income (Bennett 2008). Many rural people have seen their traditional access rights significantly restricted (Xu and Melick 2007), not just in terms of their agricultural practices, but also NTFP and firewood collection, as well as livestock grazing. In place of forest-product based industries, eco-tourism based industries have sprung up, creating a limited number of new economic opportunities (Xu et al. 2006). In general though, these programs are not creating short-term economic opportunities and have a fixed period within which they will continue to provide payments. In terms of their ecological mandates, they have ostensibly met their targets for harvest reductions and resource protection (Xu et al. 2006). It is unclear what the effect on the long-term timber supply will be: although up to 75% of the land is slated to be planted as production forests (Bennett 2008), the survival of the trees and shrubs planted has been called into question (Trac et al. 2007; Weyerhaeuser et al. 2005). Not surprisingly, access to better technical support has been suggested as a means of increasing survival rates and reducing program costs (Bennett et al. 2011).

Both programs suffer from a top-down approach that leaves little apparent room for flexibility in local choices (Xu et al. 2010; Bennett 2008; Xu et al. 2006). State directives control even the species permitted to be planted and areas required to enroll, regardless of the ecological suitability (Uchida et al. 2007, 2005). The top-down approach to the NKPP has left many landowners feeling a lack of decision-making autonomy. The longevity of the program's conservation effects have been called into question as landowners may be inclined to reinitiate previous cultivation practices after the subsidies end. Consequently, the poverty alleviation and rural livelihood component may be in conflict with the ecological objectives of the protection programs if greater long-term economic opportunities for rural residents are not created and if local needs and local knowledge are not better incorporated.

1.3.4 Industry Reforms

Since the 1950s, China's forest sector has changed dramatically, both in scale and in structure. To gain a sense of the scale of change, one can begin by examining investment and its changes. In the 1950s, investment was small and dedicated almost exclusively to industry (Figure 1.3). From the

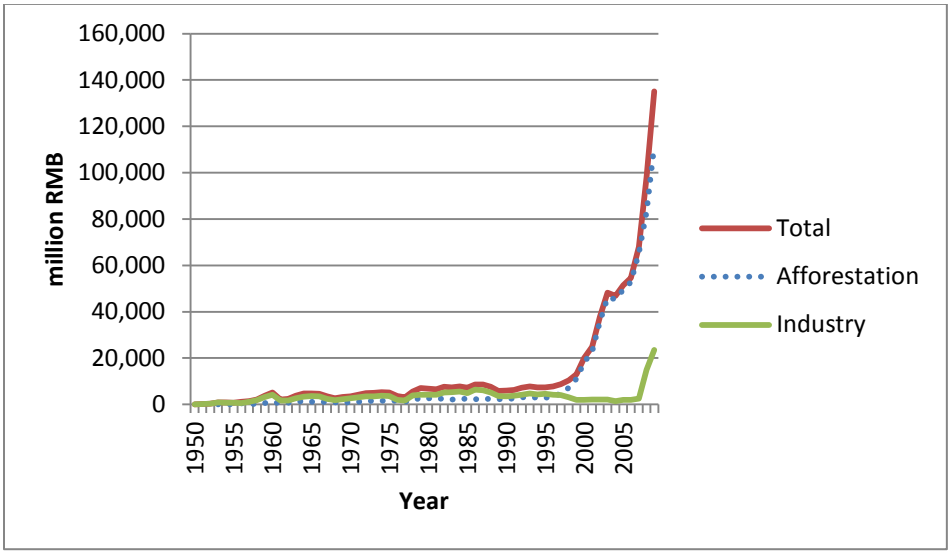

Figure 1.3 Total real investment in China's forest sector, in million RMB, 1950-2009
Source: SFA (2009)

1960s through the end of the 1990s, investment grew slowly and still largely favored industry over silviculture and afforestation by a ratio of 2:1. However, after 1998, expenditures were dramatically shifted into afforestation and silviculture, with expenditures in this sector coming to dominate industry by a ratio of 9:1. Only since 2008 has industry again increased as a percentage of total investment.

Additionally, while investment in the early years came exclusively from the government, the share of government investment has been consistently decreasing. From 2003 to 2009 alone, the government share of investment dropped from 77% to 53% (table 1.7). During this same period,

Table 1.7 Share of investment in the forest sector, by source, 2003-2009

	2003	2004	2005	2006	2007	2008	2009
Government	77%	78%	77%	75%	69%	51%	53%
Foreign	5%	11%	17%	9%	5%	4%	1%
Undefined	18%	11%	70%	16%	26%	45%	56%

Source: SFA (2004-2010)

investment from foreign sources has fluctuated from a peak of 17% in 2005 to a low of 1% in 2009. Approximately 38% of foreign investment went toward silviculture, 29% toward processing, and the remainder toward other aspects of industry and education. The official data does not present the sources of other investment (labeled undefined in table 1.6), which comes from private domestic entities and local governments. These are growing sources, since between 2007 and 2009, while foreign investment shrank, other sources of investment in China's forest sector doubled from 65 to 135 billion RMB (10 to 21 billion USD).

State-owned forest bureaus once consisted of vertically integrated units that managed forestland, logging operations and wood processing and were responsible for bringing them to market. These enterprises employed huge numbers of people. For example, the Sanchazi Forestry Bureau in Jilin Province once covered 220,000 ha of forestland and employed 20,000 people (Zhang 2000); while it still manages as much forestland, it now employs fewer than 4,000 people. These large bureaus have dominated the forest ownership and production structure in Heilongjiang, Jilin, and Inner Mongolia[7]. Although the management entities, logging companies and mills still exist, they are no longer vertically integrated, large bureaus. Investment in these now constitutes about one tenth of overall investment. Reforms in the state-owned forest bureaus began simultaneous to those in other state-owned industries, and to some extent, have undergone similar challenges in terms of becoming more market-oriented. It was not until 1989 that this structure was formally

[7] Other provinces with large areas of state-owned forests include Yunnan, Sichuan, Shaanxi, Gansu, Qinghai, and Xinjiang.

decentralized into separate, albeit still connected, units (Zhang 2000). Silvicultural management was further decentralized by splitting up some of the large forest farms and contracting out to collectives, which, as discussed above, further contracted out to household or groups of households (Zhang 2000).

Over the last decade, about three quarters of overall investment in SOFEs has come from government sources, with decreasing dependency. Although most of the investment in these state-owned enterprises was directed at silviculture and afforestation in the earlier part of the 2000s, by the end of the decade, industry's share of investment in SOFEs had risen from 16% to 55%. However, the number of people employed by state-owned forests is shrinking rapidly: between 1999 and 2008, the total number of full time employees declined by 30 percent, and the number of full time employees in state-owned processing enterprises decreased by 85%.

This decline mirrors the overall structural change in employment by ownership type in the processing sector (table 1.8). As the state sector has declined, private ownership has flourished. The share of privately-owned processing enterprises grew from 15% in 1999 to 75% in 2008. From 1999 through 2008, overall employment in this sector increased from 479,898 to 1,312,978. While SOFEs, collectives, foreign, cooperative, and shareholding all shrank their share of employment, privately-owned and other ownership types increased their share of employment.

Table 1.8 Employment in wood processing enterprises, share by type of ownership, 1999-2008[8]

Owner Type	1999	2008
SOE	26.03%	1.85%
Collectives	26.47%	1.61%
Foreign	22.15%	15.11%
Private	10.18%	64.56%
Cooperatives	5.37%	0.64%
Shareholding	4.89%	3.17%
Other	4.91%	13.07%
Total Percentage	100.00%	100.00%
Total Number	479,898	1,312,978

Source: SSB (2000b-2009b)

The number of employees per enterprise shifted, but not as greatly as one might expect given the downsizing in SOEs. This would indicate that while the structure of ownership shifted, the enterprises themselves continued to operate and maintained their general size of operations. In 1999, the average number of employees per enterprise was 198, by 2008, this had shrunk to 127. In all, only five provinces experienced a net loss in employment in the timber processing sector. Those working in the timber processing sector earn less than those in the manufacturing sector overall (figure 1.4). For the ten-year period between 1999 and 2008, real manufacturing wages averaged 36% higher than those in the timber processing sector. The average rate of change in timber processing wages follows the same pattern as the rate of change in manufacturing wages across provinces and rose by an average annual rate of 10% between 1999 and 2008.

[8] Note: "Other" is vaguely defined by the State Statistical Bureau and encompasses all other enterprises not included in the preceding list. In effect, any enterprise that is not wholly-owned under one of the other classifications (i.e., jointly owned: state-own joint, collective-own, other limited, etc.).

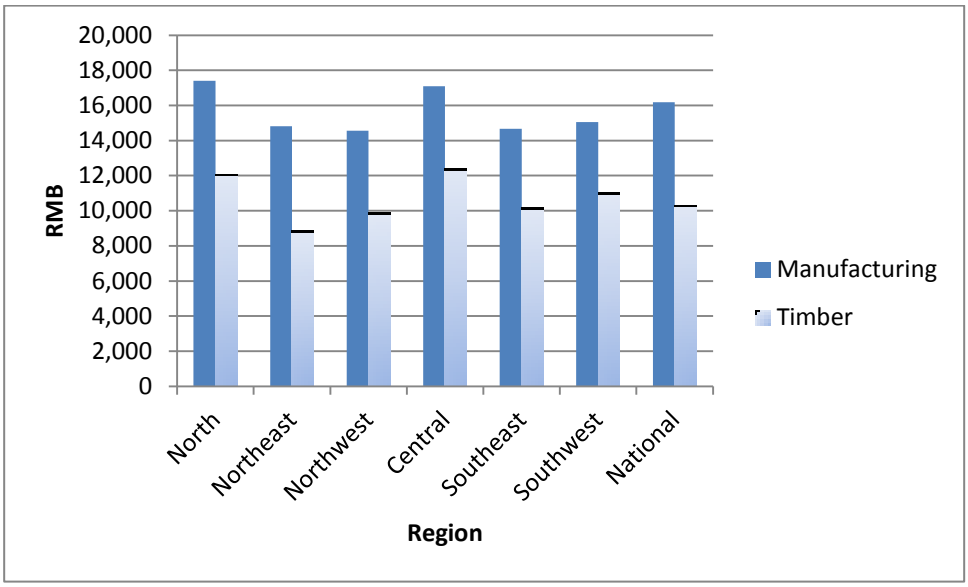

Figure 1.4 Real ten-year average manufacturing and timber processing wages, 1999-2008
Source: SSB (2000-2009)

The greatest growth in number of wood processing enterprises has occurred primarily along the coast (table 1.9). Jiangsu, Shandong, Fujian, Zhejiang and Guangxi experienced the most significant

Table 1.9 Number of wood processing enterprises, by region

	1999	2008	% change
Northeast	185	249	35%
North	361	1,309	263%
Northwest	61	43	-30%
Coastal	1,001	6,007	500%
Central	654	2,315	254%
Southwest	158	390	147%

Source: SSB (2000b-2009b)

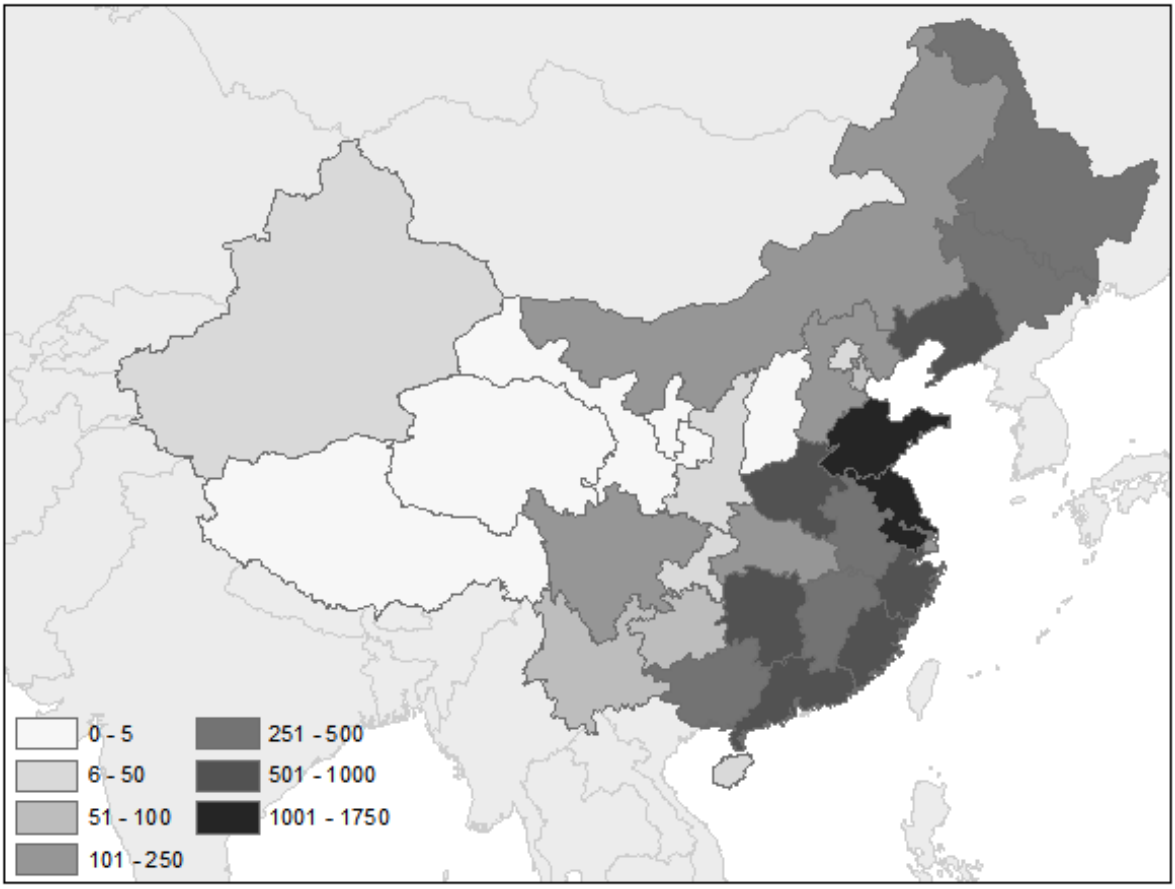

Figure 1.5 Distribution of forest processing enterprises by province, 2008

expansion in number of enterprises. Other provinces, including Guangdong, Henan and Hunan, also grew during this period, increasing their overall number of enterprises. Although Liaoning, Anhui, Jilin, Heilongjiang, Jiangxi and Shanghai were all large centers of industry at the start of this period, they experienced slower growth through 2008. The only region to experience a decline was the northwest, which lost 30% of its enterprises. Figure 1.5 shows the distribution of processing enterprises, with a higher density along the coast.

In terms of volume of secondary materials, the coastal region produces more than the other five regions combined. This is largely because the coastal region is the center of wood panels and flooring production, although it is also the primary center of production of lumber, wooden beds

and veneer. In 2009, the coastal region produced 61% of the country's wooden flooring, and 48% of its panels. In particular, Zhejiang and Jiangsu provinces are the primary centers of production for flooring, while Jiangsu is the largest producer of panels. This is also demonstrated in the location of processing enterprises (table 1.9).

Production of logs is controlled by quotas set by the central government that are intended to limit harvest to volumes at or below the annual incremental growth. Domestic logs are consumed or processed domestically, with essentially no log exports. The central region is the highest log producing region (figure 1.6), with Guangxi, Hunan and Guangdong in the top five producing provinces (see Appendix). Fujian, in the coastal region, and Yunnan, in the southwest region, are also among the top five producing provinces. From 2003 to 2008, total harvest of logs increased from 43.2 million CUM to 73.6 million CUM, although the harvest volume in 2009 dropped to near-2007 levels, at 70.7 million CUM. However, these official statistics ignore above-quota production, which may be close to double the reported production volume. For example, in 2003, the SFA estimated that above-quota log production had averaged 75.5 million cubic meters per year from 1998-2003 (Démurger et al. 2007). Underestimation of domestic production of logs or imported log volumes presents challenges in reconciling production, consumption and exports of processed wood products. Lumber, panels and other semi-finished and finished goods are much less likely to be underreported than are timber

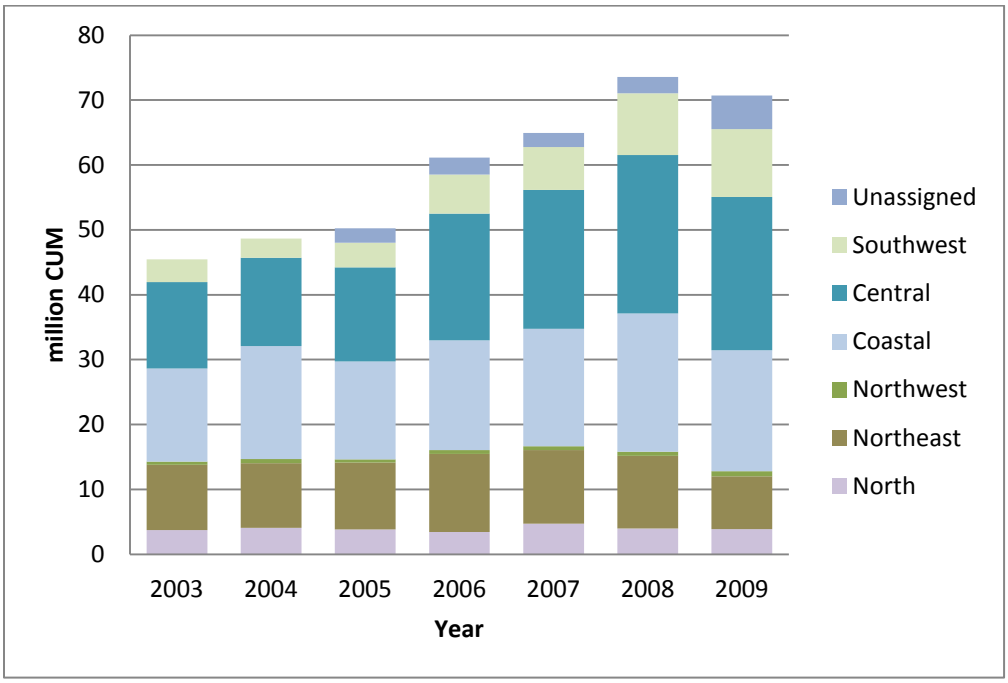

Figure 1.6 Log production by region 2003-2009
Source: SFA (2004-2010)

resources; given the more than 19% annual growth rate in lumber and panel production in China in the last decade, it seems improbable that total log consumption did not also grow apace.

Fraud appears to be widespread: between 2003 and 2008, 1.7 million cases of forestry "misconduct" were reported (Xinhua 2011). Misconduct includes activities such as falsified logging permits and ownership certificates. Recent discoveries of falsified documents at companies such as Sino Forest and Cathay Forest point to an expansion of the problem into the private sector. As a result of the revelation of such scandals, these companies have seen their stock prices plummet. This type of fraud poses a threat to continued foreign and private investment in forest management, which may become increasingly important as the government continues to reduce its own investment levels.

Although official production of roundwood has increased, demand continues to outpace the domestic supply (figure 1.7). As a major producer of semi-finished (e.g., plywood) and finished wood

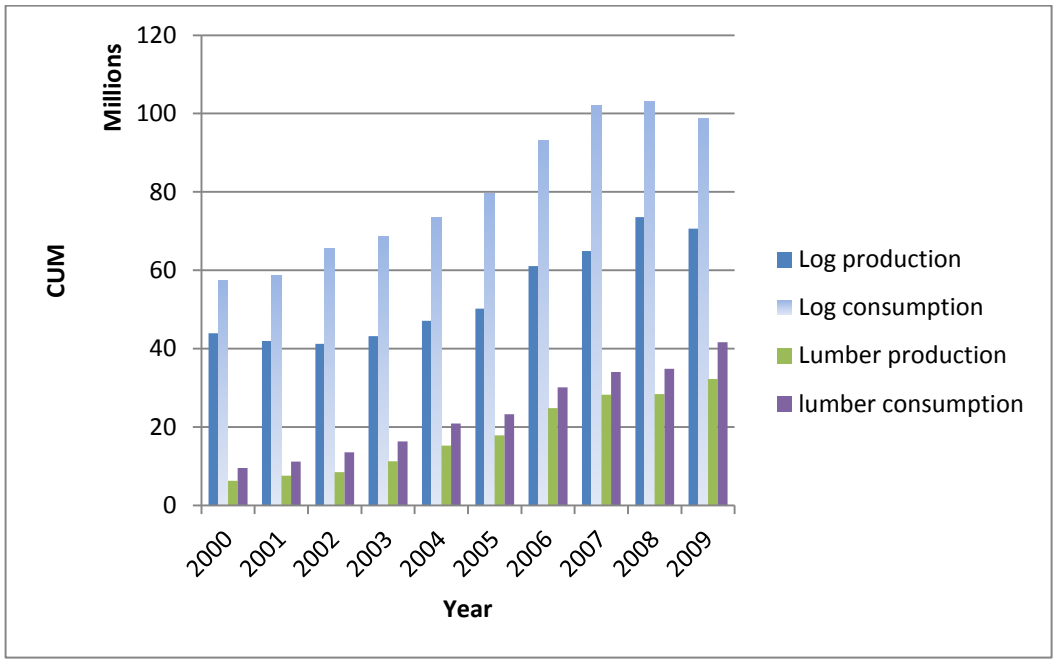

Figure 1.7 Officially reported log and lumber production and consumption 2000-2009
Source: SFA (2000-2020)

products (e.g., furniture), China is now often referred to as a "wood workshop." However, it is increasingly reliant on wood imports to fuel its "workshop". According to official Chinese statistics, total consumption of logs, by volume, grew at an average annual rate of 7.6% between 2000 and 2008, before declining by 4.2% in 2009. The average contribution of imports to this (official) consumption was 33% (table 1.10). The growth in consumption has led China to become the largest importer of tropical logs, accounting for nearly a third of global imports of coniferous and non-coniferous logs (table 1.11).

Table 1.10 Total official log production and contribution of imports, 2005-2009 (million CUM).

	Domestic production	SFA Reported Imports	Imports as % of total consumption	FAO Reported Imports	Imports as % of total consumption
2005	50.23	29.37	31%	30.73	38%
2006	61.12	32.15	33%	33.08	35%
2007	64.92	37.13	38%	37.92	37%
2008	73.57	29.57	30%	30.30	29%
2009	70.68	28.06	29%	28.65	28%

Source: SFA 2006-2010; FAO 2011.

Table 1.11 China's share of global imports of logs, 2003-2009

	2003	2004	2005	2006	2007	2008	2009
C Quantity	20.3%	20.9%	22.3%	23.9%	27.4%	26.8%	31.5%
NC Quantity	10.2%	9.4%	14.5%	14.1%	17.5%	13.7%	8.7%
T Quantity	56.9%	57.3%	54.6%	55.7%	57.3%	55.8%	77.9%
C Value	18.8%	19.3%	21.7%	24.1%	27.5%	37.8%	37.7%
NC Value	16.3%	11.0%	22.1%	25.2%	28.4%	27.1%	13.5%
T Value	53.1%	53.8%	47.2%	49.8%	51.3%	80.0%	88.0%

C = Coniferous, NC = Non-coniferous, non-tropical T = Tropical

Source: FAO (2011)

The total value of wood product exports grew from 27 billion RMB ($3.34 billion USD) in 2000 to more than 102 billion RMB ($15 billion USD) in 2009, while imports grew from 28 billion RMB ($3.4 billion USD) to 51 billion RMB ($7.5 billion USD), meaning that nearly half of the value of its exports came from the cost of imports (figure 1.8). This relative value has declined during this time, having peaked in 2000, when the value of imports exceeded the value of exports. This reflects the growth of the processing industry within China.

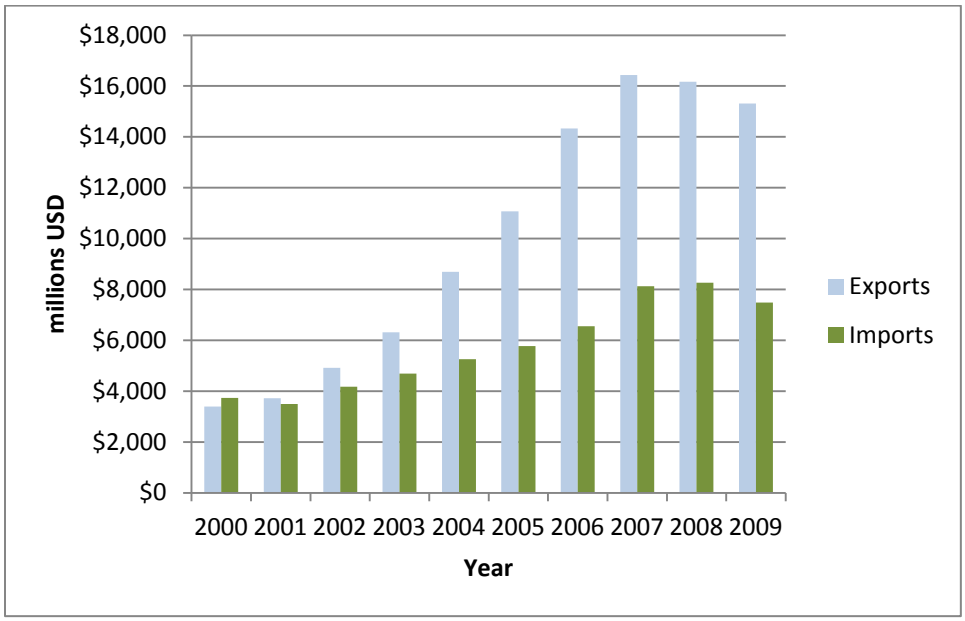

Figure 1.8: Total value of imports as compared to exports,
Source: Global Trade Atlas (2011)

China's exports largely go to the EU, Japan and the US. Having risen to become one of the largest producers of wood products, it is still perceived as a producer of low- to mid-quality products and to have a low production cost advantage. However, the precise sources of its cost advantages are still unclear. Although it is certainly true that China has enjoyed a low labor cost advantage, lower environmental regulations and worker health and safety regulations, other lower-labor cost countries such as Vietnam, are beginning to make inroads into the market. Many outside of China view the low value of the RMB as another advantage. It is argued that an undervalued RMB presents makes Chinese exports less expensive in importing countries and that, as a result, Chinese manufacturers are able to outcompete their foreign counterparts. This debate is now at the center of proposed US legislation aimed at pressuring the Chinese government to raise the value of the RMB.

China relies heavily on the developing world for its tropical log imports. The largest source of tropical logs in 2008 was Malaysia, supplying 48% of its tropical logs. There is wide concern that

Malaysia serves not only as a source of logs, but also as an intermediate for logs exported illegally from Indonesia, which ranked very low in terms of its own exports to China. According to the FAO, other primary sources included Papua New Guinea, Gabon, and to a lesser extent, Congo, Myanmar, Cameroon, and Equitorial Guinea.[9] The largest single source for both coniferous and non-coniferous logs is Russia (figure 1.9). In 2008, Russia supplied 75% of coniferous logs, and 44% of non-coniferous logs imported by China. Other primary sources of coniferous logs include New Zealand, the US and Canada.

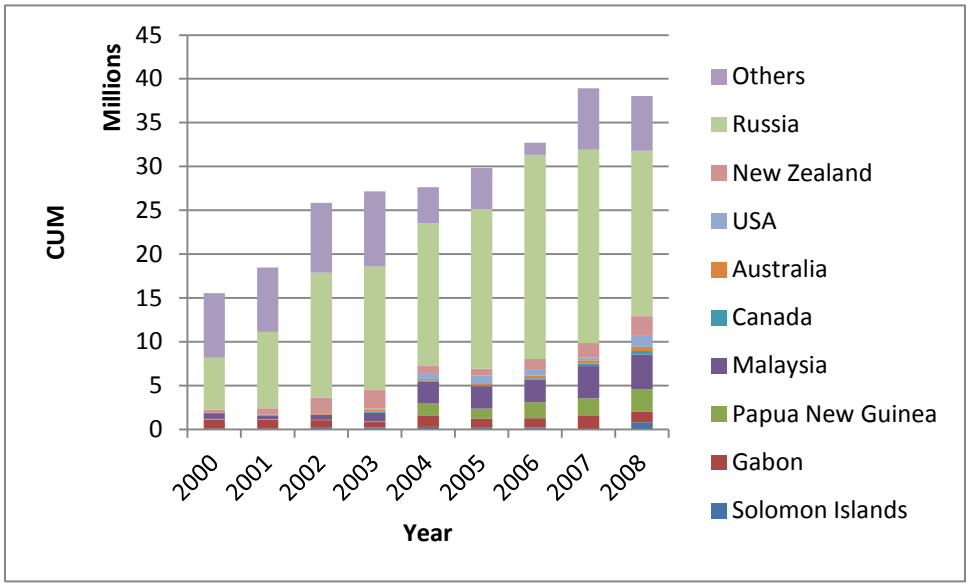

Figure 1.9: Log imports by source 2000-2008
Source: FAO (2011)

Domestic constraints to international trade are almost non-existent. Import tariffs on logs were eliminated in 1999 and anyone holding an import license is eligible to import forest products into China. Concerns about the legality of the world's wood products trade, including those that flow through China, have led to the emergence of non-tariff barriers from many of China's most

[9] Estimates for China's imports of tropical roundwood from the International Tropical Trade Organization (ITTO) vary from those of the FAO. The ITTO reports Guyana, Togo and the Central African Republic as exporting larger quantities than Equitorial Guinea and Myanmar.

important export destinations. The EU's Forest Law Enforcement, Governance and Trade (FLEGT) program and Voluntary Partnership Agreements serve as de-facto trade agreements, providing licensing rights to "ensure only legally harvested timber is imported into the EU from countries agreeing to take part in this scheme" (EC 2008). The US' Lacey Act Amendment requires importers to supply adequate documentation proving the legality of wood brought into the US.

Non-policy mechanisms are also being implemented to control the supply chain of illegal and unsustainable wood products. Many international NGOs and multilateral institutions have collaborated with the Chinese government to encourage the development and expansion of forest management and chain of custody certification schemes within China. Three current schemes exist: the Programme for the Endorsement of Forest Certification (PEFC), the Forest Stewardship Council (FSC), and the emerging national China Forest Certification Council (CFCC). The FSC certification system has particularly benefited from the efforts to build certification capacity. As of early 2011, FSC had issued 1,610 certificates within China, while PEFC has a much smaller presence, with only 108 chain of custody certificates issued (PEFC 2011). The CFCC has only recently been launched, although it is expected that 2.66 million ha will be certified in Heilongjiang Province under the scheme (CFCN 2011).

The CFCC program is administered by the State Forestry Administration and is expected to receive mutual recognition under PEFC. All three schemes contain elements that are intended to address the three legs of the sustainability stool: environment, economics and society. In 2010, 98% of FSC's certifications were for chain of custody certificates (FSC 2011). Only 51 certificates had been issued for combined forest management and chain of custody. This reflects a much greater effort on the part of NGOs to create demand in end markets for FSC products, and on the part of environmental NGOs to drive certification expansion of FSC certified forest management units.

1.4 Conclusion

The biggest challenges to collective forestry reforms can be summarized in a few sentences. Rural people continue to lack awareness and confidence in their rights. Complaints plague the reform efforts; corruption at local levels is systemic and a top-down approach to conservation conflicts with the tenure reform efforts. Household plots are too small to be significant at the individual level; while aggregation may improve the situation, it will require linking objectives between households. Better options to consolidate and rent land are necessary to improve the contribution of forestry to farm incomes. The 2008 reforms were designed to rectify many of these problems, but they have yet to be fully implemented. More attention should be paid to communities who depend on agroforestry or agropastoral practices either for subsistence products or to supplement their incomes. Households in these communities may respond differently to efforts to reform their fuel use (electricity instead of fuelwood) and conservation policies that limit their ability to collect NTFPs or their willingness to continue to implement conservation efforts according to state directives after the programs and outreach conclude. The rise in payments for environmental services, through programs such as the SLCP, have been widely touted as successful programs in promoting forest conservation and improving rural livelihoods; however, many of these programs are subsidized by the central government, and cannot continue indefinitely. Without improved access to economic opportunities and tenure security, the conservation programs could impede, not improve, rural livelihoods in forest-dependent communities. Problems have also continued to plague the state-owned sector, including a concern that the central government has limited capacity to monitor harvest quotas and logging restrictions (Xu et al. 2004; Zhang 2000). The above-quota harvesting estimates mentioned earlier point to this very problem. If this problem is not adequately addressed, it will contribute to a potential overestimation of inventory and forest coverage. China may soon find itself at a crossroads between having to decide whether its investments in forest conservation

in rural areas represent investments solely in forest protection or whether they will result in an expanded resource base from which rural people can draw upon to contribute to their livelihoods.

The government has been acutely aware of resource shortages since before massive flooding prompted conservation-oriented logging restrictions in 1998. In 1985, the government implemented an annual allowable cut, now administered by the SFA. More recently, quotas, permits, high taxes, and other restrictions have been used to constrain supply. It is widely recognized that the domestic resource base is extremely constrained and will be for the foreseeable future, particularly since per capita forest coverage is low and demand is high for fiber, both for industrial and non-industrial uses. The concern over illegal logging has largely been referred to in the context of imports. However, it continues to be a problem domestically, as evidenced in the harvest estimates and fraudulent logging permits and ownership certificates. Although the government has constrained domestic supply by restricting harvests, it has done little to curb demand, in part because domestic demand is still closely linked to its export industry. Consumption has only partly been addressed with product substitution policies by encouraging the use of non-wood building materials such as concrete and brick in construction, which of course, are not without their own adverse environmental effects. This has pushed the country to become increasingly reliant on imports to fuel its export-oriented wood products industry. One result is that many of these timber products come from countries with lower costs and poorly enforced environmental standards. How efficiently the processing industry operates has not been widely examined and should be of interest both within China and externally, for those concerned with global natural resource flows as well as China's competitiveness in the global forest products markets.

The most important changes in the forest industry have come about as a result of market reforms: the transformation of state-owned entities and township and rural enterprises into private enterprises. During the period 1999-2008, there was a near tripling of jobs and a quadrupling in the

gross output value in the wood processing sector. Trade liberalization by the Chinese has opened up markets for foreign imports, exports and sources of capital. Wages in the timber processing sector are on average lower than those in the overall manufacturing sector, indicating that timber processing in China represent lower skilled jobs than other sub-sectors. However, in the last few years, the government has begun to direct increased attention to developing its wood processing industry, as evidenced by the Forestry Development Plan (SFA 2009), and increased investments, which rose from 3% to 17% of total forestry investments between 2007 and 2009. These moves indicate a strong commitment by the government to affirm China's role as an exporter and a more efficient producer of higher-quality goods. However, for improvements to be effective, these investments need to be efficiently used, and this remains to be seen.

There is no doubt that China has made enormous strides in its efforts to improve rural livelihoods, improve its forest ecology and grow its forest-based industries. Yet, the results are, in many ways, mixed. Forest-dependent communities continue to be among the poorest and their economic development continues to lag far behind the coastal and urban regions; these same communities are often left out of the decision-making process, thereby further marginalizing them. The push to reform land tenure has proven to be complex. This is particularly true given the long-term nature of investments in forest management, which differ from those of agricultural investments that can be more immediately reaped. Complicating the process of devolution of property rights are conservation-oriented directives that often conflict with the promises of land reform. Forest coverage has increased, but gains may be overstated until the ongoing problems of illegal logging and forest quality within China are acknowledged and controlled. Lastly, the forest industry has expanded rapidly in the last fifteen years or so, particularly along the coast, but it has become reliant on imports to fuel this growth and China will be expected to play an increasing role in ensuring the use of well-managed and legally harvested timber materials, not just at home but

abroad as well. It is clear that questions of economic, social and ecological sustainability, both domestically and globally, will not disappear any time soon.

References

Albers, H.J., S. Rozelle, and L. Guo. 1998. China's forests under economic reform: timber supplies, environmental protection, and rural resource access. Contemporary Economic Policy. 16: 22-33.

Bennett, M. 2008. China's sloping land conversion program: institutional innovation or business as usual? Ecological Economics. 65: 699-711.

Bennett, M., A. Mehta, and J. Xu. 2011. Incomplete property rights, exposure to markets and the provision of environmental services in China. China Economic Review. Doi:10.1016/j.chieco.2010.12.002

Bull, G.Q., and S. Nilsson. 2004. An assessment of China's forest resources. International Forestry Review. 6: 317-326.

Cao, S. 2008. Why large-scale afforestation efforts in China have failed to solve the desertification problem. Environmental Science and Technology 42: 1826–1831.

Cao, S., X. Wang, Y. Song, L. Chen, and Q. Feng. 2010. Impacts of the natural forest conservation program on the livelihoods of residents in northwestern China: perceptions of residents affected by the Program. Ecological Economics. 69: 1454-1462.

China Forest Certification Network (CFCN). 2011. Accessed March 8, 2011 http://www.cfcn.cn/xiang.asp?id=1246/.

Dai, L., F. Zhao, G. Shao, L. Zhou, and L. Tang. 2008. China's classification-based forest management: procedures, problems, and prospects. Environmental Management. 43: 1162-1173.

Démurger, S., Y. Hou, and W. Yang. 2007. Forest management policies and resource balance in China: an assessment of the current situation. GATE Working Paper No. 07-12. Lyon: University of Lyon.

Démurger, S., Y. Hou, and W. Yang. 2009. Forest management policies and resource balance in China an assessment of the current situation. Journal of Environment and Development. 18:17-41.

European Commission (EC). 2008. FLEGT Briefing Note.

Food and Agricultural Organization (FAO). 1979. China: integrated wood processing industries. FAO Forestry Paper 16. Rome: FAO.

_____. 1982. Forestry in China. FAO Forestry Paper 35. Rome: FAO.

_____. 2011. FAOSTAT. Accessed August 31, 2011, http://faostat.fao.org/.

Forest Stewardship Council (FSC). 2011. Accessed June 10, 2011, www.fsc.org.

Fu, Y., J. Chen, H. Guo, A. Chen, J. Cui, H. Hu. 2009. The role of non-timber forest products during agroecosystem shift in Xishuangbanna, southwestern China. Forest Policy and Economics. 11:18-25.

Han, X., Y. Wen, and S. Kant. 2009. The global competitiveness of the Chinese wooden furniture industry. Forest Policy and Economics. 11: 561-569.

Harkness, J. 1998. Recent trends in forestry and conservation of biodiversity in China. The China Quarterly. 156: 911-934.

Hyde, W.F., J. Xu,and B. Belcher. 2003. Introduction. In Hyde, W.F., B. Belcher, J. Xu, editors. China's forests: global lessons from market reforms. Washington DC: Resources for the Future.

Lei, X., M. Tang, Y. Lu, L. Hong, and D.Tian. 2009. Forest inventory in China: status and challenges. International Forestry Review. 11: 52-63.

Li, P. 2008. China's legal framework on collective forestland rights: problems and recommendations. Presentation at International Conference on Forest Tenure and Regulatory Reforms, Beijing, PRC, February 2008.

Li, W. 2004. Degradation and restoration of forest ecosystems in China. Forest Ecology and Management. 201: 33–41.

Liu, D., and D. Edmunds. 2003a. Devolution as a means of expanding local forest management in south China: lessons from the past twenty years. P. 27-44. In Hyde, W. B. Belcher, J. Xu. 2003. China's forests: global lessons from market reforms. Washington DC: Resources for the Future.

_____. 2003b. The promises and limitations of devolution and local forest management in China. In Edmunds, D., E. Wollenberg, eds. London: Earthscan Publications Ltd.

Liu, J., and N. Landell-Mills. 2003. Taxes and fees in the southern collective region. P. 45-58. In Hyde, W. B. Belcher, J. Xu. 2003. China's forests: global lessons from market reforms. Washington DC: Resources for the Future.

Liu, J., S. Zhang, J. Ye, and Y. Wang. 2004. Forestry revenue policy in China: what has happened and why. International Forestry Review. 6: 335-340.

Liu, J., and J. Diamond. 2005. Nature. China's environment in a globalizing world. 435: 1179-1186

Liu, C., and R. Yin. 2004. Poverty dynamics revealed in production performance and forestry in improving livelihoods: the case of West Anhui, China. Forest Policy and Economics. 6: 291-401.

Liu, D. 2001. Tenure and management of non-state forests in China since 1950. Environmental History. 6:239-263.

Liu, J., Z. Ouyang, S. Pimm,P.H. Raven, X. Wang, H. Miao, and N. Han. 2003. Protecting China's biodiversity. Science. 300: 1240-1241.

Liu, X. 1998. Adjusted forest accounts for China. Ecological Economics. 27: 283-298.

Ma, Q. 2004. Appraisal of tree planting options to control desertification: experiences from three-north shelterbelt programme. International Forestry Review. 6: 327-335.

Menzies, N. 1994. Forest and land management in imperial China. New York : St. Martin's Press.

Miao, G., and R.A. West. 2004. China collective forestlands: contributions and constraints. International Forestry Review. 6(3-4): 282-298.

Ministry of Forestry. 1995. Forestry action plan for China's Agenda 21. Beijing: Ministry of Forestry.

Programme for the Endorsement of Forest Certification (PEFC). 2011. Accessed June 10, 2011. http://www.pefc.org/.

Prosterman, R., B. Schwarzwalder, and J. Ye. 2000. Implementation of 30-Year land use rights for farmers under China's 1998 Land Management Law: an analysis and recommendations based on a 17 province survey. Pacific Rim Law & Policy Journal. 3: 508-568.

Richardson, S.D. 1966. Forestry in communist China. 1966. Baltimore: The Johns Hopkins press.

_____. 1990. Forests and forestry in China: Changing Patterns of Resource Development. Washington DC: Island Press.

Ross, L. 1980. Forestry policy in China. Ann Arbor: University of Michigan.

Rozelle, S., J. Huang, and V. Benziger. 2003. Forest exploitation and protection in reform China: assessing the impacts of policy and economic growth. In Hyde, W. B. Belcher, J. Xu. 2003. China's forests: Lessons from market reforms. Washington DC: Resources for the Future.

Ruiz Pérez, M., B. Belcher, M. Fu, and X. Yang. 2004. Looking through the bamboo curtain: an analysis of the changing role of forest and farm income in rural livelihoods in China. International Forestry Review. 6: 306-316.

Shapiro, J. 2001. Mao's War against nature: politics and the environment in revolutionary China. Cambridge: Cambridge University Press.

Shaw, N. 1914. Chinese forest trees and timber supplies. London: T. Fisher Unwin.

Shen, Y., Y. Zhang, X. Xu, Z. Zhu, and C. Jiang. 2009. Towards decentralization and privatization of China's collective forestlands: a study of nine villages in three provinces. International Forestry Review. 11: 456-463.

State Forestry Administration (SFA). 2001-2009. China forestry statistical yearbook 2000-2009. Beijing: China Forestry Publishing House.

State Forestry Administration (SFA). 2005a. China forest resources report 2005. Beijing: State Forestry Administration.

State Forestry Administration. 2009. China Forestry Development Plan 2010-2012. Accessed May 25, 2011, from China Encalypt Research Center of State Forestry Administration: http://www.chinaeuc.com/show.asp?id=358.

State Statistical Bureau (SSB). 2007. China rural household survey 2005. Beijing: China Statistical Press.

State Statistical Bureau (SSB). 2000a-2009a. China statistical yearbook 1999-2008. Beijing: China Statistical Press.

State Statistical Bureau (SSB). 2000b-2009b. China industrial surveys 1999-2008. Beijing: China Statistical Press.

Sturgeon, J. 2005. Border landscapres: the politices of Akha land use in China and Thailand. Seattle: University of Washington Press.

Song, Y., W.B. Burch, G. Geballe, and L. Geng. 1997. New organizational strategy for managing the forests of southeast China: the shareholding integrated forestry tenure (SHIFT) system. Forest Ecology and Management. 91: 183-194.

Stone, R. 2009. Nursing China's ailing forests back to health. Science. 325: 556-558.

Sun, C. 1999. Surviving in the jungle: public policy and the role of state in a changing forest landscape in China. Sinosphere. Spring: 34-40.

Sun, X., N. Cheng, and K. Canby. 2005. China's forest product exports: An overview of trends by segment and destinations. Forest Trends.

Trac, C. 2011. Climbing without the energy ladder: limitations of rural energy development for forest conservation. Rural Society. 20: 308-320.

Trac, C.J. S. Harrell, T. M. Hinckley, and A.C. Henck. 2007. Reforestation programs in southwest China: reported success, observed failure, and the reasons why. Journal of Mountain Science. 4(4): 275-292.

Uchida, E., J. Xu, and S. Rozelle, 2005. Grain for green: cost-effectiveness and sustainability of China's conservation set-aside program. Land Economics. 81(2): 247-264.

Uchida, E., J. Xu, Z. Xu, and S. Rozelle, 2007. Are the poor benefiting from China's land conservation program? Environment and Development Economics. 12: 593-620.

United States Department of Agriculture (USDA). 2009. Conservation Reserve Program Monthly Update December 2009.

Urgenson, L., R. K. Hagmann, A.C. Henck, S. Harrell, T. M. Hinckley, S. J. Shepler, B. L. Grub, P. M. Chi. Socio-ecological resilience of a Nuosu community-linked watershed, southwest Sichuan, China. Ecology and Society. 15: 2.

Wang, S., G.C. van Looten, and B. Wilson. 2004. Mosaic of reform: forest policy in post-1978 China. Forest Policy and Economics. 6:71-83.

Wang, G., J.L. Innes, J. Lei, S. Dai, and S.W. Wu. 2007. China's forestry reforms. Science. 318: 1556-1557.

Wang, G., J.L. Innes, J. Lei, S. Dai, and S.W. Wu. 2008. Towards a new paradigm: the development of China's forestry in the 21st century. International Forestry Review. 10: 619-631.

Weyerhaeuser, H., A. Wilkes, and F. Kahrl. 2005. Local impacts and responses to regional forest conservation and rehabilitation programs in China's northwest Yunnan province. Agricultural Systems. 85: 234–253.

World Forest Institute (WFI). 1998. China forestry and the wood products industry. Portland: World Forest Institute.

White, A. 2008. Enabling forestry's contribution to social and economic development. Presentation at International Conference on Forest Tenure and Regulatory Reforms, Beijing, PRC, February 2008.

Wilkes, A. 2006. Innovation to support agropastoralist livelihoods in northwest Yunnan, China. Mountain Research and Development. 26: 209-213.

Xinhua News Service (Xinhua). 2008. CPC Central Committee and State Council on the reform of collective forest right system. Accessed October 28, 2011: http://www.gov.cn/jrzg/2008-07/14/content_1044403.htm.

Xinhua News Service (Xinhua). 2011. China investigates 1.7 mln cases of forestry misconduct during 2006-2010. Accessed May 30, 2011: http://news.xinhuanet.com/english2010/china/2011-04/26/c_13847024.htm.

Xu, Z. M. T. Bennett, R. Tao, and J. Xu. 2004. China's Sloping Land Conversion Programme four years on: current situation and pending issues. International Forestry Review. 6: 317-326.

Xu, J., and D. R. Melick. 2007. Rethinking the effectiveness of protected areas in southwestern China. Conservation Biology. 21: 318-328.

Xu, J. 2008. Collective forest tenure reform in China: what has been achieved so far? Working Paper.

Xu, J., Y. Yu, C. Xie, C. Li, B. Chen, and L. Kou. 2003. Impacts of the Natural Forest Conservation Program to collective forestry and community economic development. Forestry Economics. 6:28-32. In Chinese.

Xu, J., R. Tao, and G.S. Amacher. An empirical analysis of China's state-owned forests. Forest Policy and Economics. 6: 379-390.

Xu, J., R. Yin, Z. Li, and C. Liu. 2006. China's ecological rehabilitation: unprecedented efforts, dramatic impacts, and requisite policies. Ecological Economics. 57: 595-607.

Xu, J., R. Tao, Z. Xu, and M. T. Bennett. 2010. China's Sloping Land Conversion: does expansion equal success? Land Economics. 86:219-244.

Xu, J. 2010. Personal communication.

Yang, Y. 2001. Impacts and Effectiveness of Logging Bans in Natural Forests: People's Republic of China. In Forests Out of Bounds: Impacts and Effectiveness of Logging Bans in Natural Forests in the Asia-Pacific. Bangkok: Food and Agriculture Organization.

Yin, R. 1998. Forestry and the environment in China: the current situation and strategic choice. World Development. 26: 2153-2167.

____. 2003. Central characteristics of reform: measures of the effects of improved property rights, a stable policy environment and environmental protection. In Hyde, W. B. Belcher, J. Xu. 2003. China's forests: lessons from market reforms. Washington DC: Resources for the Future.

Yin, R., J. Xu, Z. Li. 2003. Building institutions for markets: experiences and lessons from China's rural forest sector. Environment, Development and Sustainability. 5: 331-351.

Zhang, D. 2003. Policy reform and investment in forestry. In Hyde, W. B. Belcher, J. Xu. 2003. China's forests: lessons from market reforms. Washington DC: Resources for the Future.

Zhang, J., X. Chen. 2001. Review and prospects of China's forestry reform. Presented at The Lessons from the Chinese forest policy experience, Dujiangyan, Sichuan, PRC, June 2001.

Zhang, Y. 2000. Reforms in China's state-owned forest management. Development Policy Review. 18: 285-306.

Zhang, Y., and C. Song. 2006. Impacts of afforestation, deforestation, and reforestation on forest cover in China from 1949 to 2003. Journal of Forestry. October/November: 383-387.

Appendix A: Log production by province, 2003-2009, in million CUM

	2003	2004	2005	2006	2007	2008	2009
National	47.59	47.12	50.23	61.12	64.92	73.57	70.68
Beijing	0.03	0.03	0.03	0.06	0.07	0.07	0.08
Tianjin	0.00	0.00	0.00	0.00	0.05	0.05	0.05
Hebei	0.39	0.38	0.46	0.47	0.51	0.47	0.58
Shanxi	0.05	0.06	0.05	0.09	0.09	0.07	0.06
Inner Mongolia	3.28	3.58	3.28	3.27	4.00	3.31	3.12
Liaoning	1.30	1.30	1.40	2.22	1.86	1.69	2.30
Jilin	3.77	3.95	4.16	4.39	4.16	4.18	1.87
Heilongjiang	4.98	4.74	4.75	5.43	5.32	5.34	3.95
Shanghai	0.00	0.00	0.00	0.00	0.01	0.00	0.00
Jiangsu	0.38	0.61	0.55	0.58	0.73	1.06	0.99
Zhejiang	2.04	1.58	1.67	1.79	1.87	2.95	1.97
Anhui	2.79	2.40	2.66	3.34	3.46	3.40	3.74
Fujian	5.18	5.18	5.61	5.97	6.18	6.56	6.35
Jiangxi	3.54	3.64	3.96	4.25	4.34	5.78	3.40
Shandong	0.43	4.01	0.62	0.98	1.52	1.58	2.21
Henan	0.60	0.65	0.63	2.11	1.42	0.52	1.10
Hubei	1.07	0.77	1.29	1.65	1.70	1.91	2.19
Hunan	4.12	4.36	4.50	5.91	6.34	8.16	5.46
Guangdong	3.08	3.09	3.24	3.62	4.16	4.72	5.25
Guangxi	4.45	4.73	4.86	6.25	7.74	9.09	9.64
Hainan	0.71	0.38	0.54	0.60	0.64	0.88	1.53
Chongqing	0.00	0.01	0.02	0.11	0.17	0.20	0.24
Sichuan	0.51	0.40	0.68	0.94	0.98	2.53	1.92
Guizhou	0.29	0.33	0.54	0.88	1.20	2.07	1.30
Yunnan	1.80	1.75	1.90	3.30	3.57	3.81	4.76
Tibet	0.20	0.12	0.10	0.17	0.06	0.06	0.67
Shaanxi	0.15	0.11	0.10	0.14	0.15	0.20	0.37
Gansu	0.01	0.03	0.04	0.03	0.05	0.08	0.04
Qinghai	0.02	0.02	0.02	0.02	0.02	0.01	0.00
Ningxia	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Xinjiang	0.32	0.47	0.34	0.41	0.38	0.32	0.37

Source: SFA 2004-2010

Appendix B: Geographic regions