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Mosaic of reform: forest policy in post-1978 China

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Abstract

With the start of economic reforms in 1978, China's forest sector was caught up in a whirlwind of change. It began with the devolution of forest tenures in rural areas, but led to reform of state-owned forest enterprises via introduction of stumpage fees and liberalized forest product prices. From the early 1990s to 1998, while China increasingly embraced the market economy, the nation's natural forests continued to be depleted despite repeated emphasis on sustainable development. Then, in the wake of the 1998 floods in the Yangtze River basin, there was a shift in focus from timber production to environmental protection, with policy redirected toward the rehabilitation of damaged forest ecosystems, afforestation in desertified and degraded areas, and a ban on logging in natural forests. We provide an overview of the central themes of reform in China's forestry sector, identify the major factors that influenced policy formulation, and show that the outcomes of China's forest policy changes in the aggregate represent a paradigm shift.

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1. Introduction

Since December 1978, the People's Republic of China has undertaken major economic reforms. These have unleashed peasants' entrepreneurship, which had been suppressed for more than two decades. Although land has remained in the public domain, each household was allocated, on the basis of family size, land to produce agricultural outputs for their own benefit. In parallel, special economic zones were created in Shenzhen, Zhuhai, Shantou

and Xiamen, because of their proximity to Hong Kong and Macao, which had for decades served as China's windows on capitalism. On account of their success in attracting foreign direct investment and integrating China into the global economy, 14 major coastal cities were designated open cities in 1986. Shortly after being granted provincial status in 1987, Hainan Island became the country's largest special economic zone. China's economic reforms and open-door policy expanded even further in the wake of Deng Xiaoping's remarks that he saw no fundamental contradictions between socialism and a market economy. Deng's statement helped prepare the Chinese leadership, at least ideologically, to embrace markets, the results of

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which became increasingly apparent during the 1990s (Waters, 1997).

The essence of China's post-1978 economic reforms was two-fold: (i) the politically motivated dogma of class struggle was replaced by the pragmatic economic goals of enhancing productivity and economic growth; and (ii) the outside world was opened, enabling China to access scientific and technological advances and attract foreign investment. The fundamental change in philosophy and governance was rooted in the recognition that China was in urgent need of modernization.

The Chinese forestry sector has also undergone a radical transformation through institutional restructuring, the formulation and delivery of programs, and changes in societal values with respect to the forest. This has resulted in a fundamental shift in the country's forest management paradigm. Chinese forest policy is no longer focused on fiber output, but is characterized by three equally important objectives: enhancing the role of forests in ecological rehabilitation and environmental protection, increasing timber supply by commercial investment, and promoting rural well-being and poverty reduction through agroforestry.

In this paper, we examine the major changes in China's forest policy since 1978. Our purpose is to identify the major factors that have affected policy formulation, with a view to uncovering the general policy patterns. We do this by highlighting the policies and events of significance that have shaped institutional restructuring in forestry, and by explaining the waxing and waning of the major

forestry programs. We conclude with some observations about how the changes will affect the future of the Chinese forest sector.

2. Current forest resource base

China's forests are unevenly distributed and cover less than 17% of the country's land base. According to the latest National Forest Inventory (State Forestry Administration, hereafter SFA, 2000), forested land is concentrated in three of five regions (Table 1)—the Northeast (including Heilongjiang, Jilin and the eastern part of Inner Mongolia), the Southwest (including Sichuan, Yunnan and Tibet), and the South. Together, the Central North and the vast Northwest account for only 12.6% of the country's forestland. The geographical concentration is even more apparent when one considers that the remote Southwest and the Northeast account, respectively, for 43.9% and 29.6% of timber reserves. Conifers account for 52% of total area and 56% of total stock volume. The total forested area also includes 20.2 million ha of 'economic forests', such as cash-crop and fruit-bearing trees, and 4.4 million ha of bamboo forests.

The state owns some 42% of the country's forests, with the remaining forests collectively owned (Table 2). State-owned forests are largely natural and mainly situated in the Northeast and the Southwest. The southern provinces are home to predominantly collectively-owned forests, which are largely plantations and bamboo forests. In terms of age-class distribution, the country's for-

Table 1
China's forest resources, by region

Region	Land area		Forest resources			
	(10 ⁶ ha)	% of total	Area (10 ⁶ ha)	% of total	Timber volume (10 ⁶ m ³)	% of total
Northeast	194.8	20.3	43.9	27.6	3340.3	29.6
Central North	69.1	7.2	9.6	6.1	191.8	1.7
Northwest	309.1	32.2	10.3	6.5	767.3	6.8
South	152.0	15.8	57.9	36.4	2020.8	17.9
Southwest	235.4	24.5	37.1	23.4	4946.5	43.9
Overall	960.3	100.0	158.9	100.0	11 266.6	100.0

Source: Adapted from SFA (2000). Totals may not add up due to rounding.

Table 2
China's forest resources, by ownership

Category	State owned		Collectively owned		Total
	Amount	%	Amount	%	
Forest stands					
area (10 ⁶ ha)	62.0	48	67.2	52	129.2
volume (10 ⁶ m ³)	7124.2	71	2961.5	29	10 085.7
of which plantations					
area (10 ⁶ ha)	7.7	26	21.4	74	29.1
volume (10 ⁶ m ³)	378.3	37	634.7	63	1013.0
Economic forests (10 ⁶ ha)	1.6	8	18.6	92	20.2
Bamboo forests (10 ⁶ ha)	0.3	7	3.9	93	4.2
Total forested area (10 ⁶ ha)	63.9	42	89.7	58	153.6

Source: SFA (2000).

ests are heavily skewed toward the young and middle-age-groups (Table 3).

All together the data indicate that China's forest resources are characterized by low forest cover, uneven spatial distribution, undesirable age-class distribution, and relatively low volume in growing stock (SFA, 2000). The forests available for harvest are rather limited. These problems have huge implications for the country's forest policies and they underlie the major forestry programs.

3. Forest-sector reform

In the early years of the People's Republic, the government pursued a forest policy characterized by tree planting on barren lands and timber harvesting in major forest regions, while expressing concern about protecting forests (Ministry of Forestry, 1986). Large-scale tree planting of wastelands, especially in the North, began in the mid-1950s.

Apart from tree planting, a theme characterizing Chinese forestry to the present, the main focus of the forestry sector was timber production. A 'Big Leap Forward' campaign was launched in 1958 to encourage the use of homemade furnaces for steel making, but it led to thousands of inefficient furnaces and massive destruction of forests. The compulsory elevation of millions of peasants' cooperatives to People's Communes, along with the failure of the Big Leap Forward, contributed to famine that lasted for three years (1960–1962). Nationwide calamities and tragedies forced the central government to readjust policies and adopt measures to relax taxation rules in rural areas. In the countryside, for example, peasants were allowed to retain more agricultural produce on collectively-owned land. This enabled the national economy to recover rather quickly. Forest industries began to grow rapidly with the opening up of the Greater Xing'An Mountains in the Northeast

Table 3
China's forest resources, by age class

Forest type	Young and middle-aged		Mature and over-mature		Total	
	Area (10 ⁶ ha)	Volume (10 ⁶ m ³)	Area (10 ⁶ ha)	Volume (10 ⁶ m ³)	Area (10 ⁶ ha)	Volume (10 ⁶ m ³)
Timber forest	74.0	3368.6	25.4	3 837.6	99.4	7206.2
Shelterbelts	11.9	554.0	9.5	1639.0	21.4	2193.0
Fuelwood forest	4.2	66.9	0.3	20.6	4.5	87.5
Special forest	1.8	161.7	2.1	437.3	4.0	599.0
Total	91.9	4151.1	37.3	5934.5	129.2	10 085.6

Source: Adapted from SFA (2000).

and the Jinsha River forest region in the Southwest in the 1960s. However, the Cultural Revolution (1966–1976) catapulted China into unprecedented political chaos and anarchy. During ‘the lost decade’, most forestry programs were discontinued, except rampant timber cutting and highly inefficient afforestation campaigns.

For three decades prior to the 1978 economic reforms, the forest sector supplied under-priced logs to support the national economic development. Although many professional foresters appealed for the protection of ecosystems and wildlife habitat, and for increased investment in silviculture, the sector was seen only as a supplier of cheap raw materials. As a consequence, while over one billion cubic meters of timber was supplied nationwide during the period 1949–1979, the country’s forest resource base was devastated. Achievements on the tree-planting front were dismal: out of a total of 104 million ha planted during the same period, the rate of success was a mere 20%. The pre-reform period was characterized by rhetoric-laden campaigns aimed at mass mobilization for tree planting, and by unsustainable timber harvest in primary forest areas (Richardson, 2000).

3.1. Governance restructuring

In 1978, the Chinese government decided to promote forestry by providing the Ministry of Forestry with the mandate, among other things, to oversee timber production in state-owned forests and afforestation across the country. Due to central planning, the Ministry functioned via administrative linkages with forestry departments at the provincial level, forestry bureaus at the county level, and work stations at the grass-roots level of townships. In the meantime, the Chinese Academy of Forestry, which came into being in 1958, was strengthened, and several forestry colleges were expanded under the auspices of the Ministry.

China did not have any formal forestry legislation prior to 1979, when the country’s first Forest Law was passed. After a trial period, the legislation officially entered into force on January 1, 1984. The legislation provided the legal basis for the Ministry of Forestry to formulate relevant policies. One of the most influential legal documents was

the ministerial notice that introduced the allowable annual cut (AAC) in June 1985. It ushered in modern forest management.

As a result of a series of reforms in the administrative hierarchy in the late 1980s and early 1990s, state-owned forest companies became increasingly autonomous and the central forestry authorities loosened their control over corporate decisions pertaining to the production of products such as lumber and panel boards. This decentralization enabled the Ministry of Forestry to focus better on administration as well as the formulation of policy, leaving production decisions and operations to the companies.

The fortunes of the Ministry of Forestry have waxed and waned over the past quarter century, and its primary responsibilities have changed. The Ministry survived three rounds of administrative streamlining, in 1986, 1988 and 1993 (SFA, 1999). However, it was downgraded in 1998 to the State Forestry Administration, or SFA. The downgrade from a ministry to a sub-ministerial agency marked a turning point, because the mandate of the central forestry authority had gradually shrunk in scope. Today its functions are to protect existing natural forests, and preserve biodiversity and a range of forest-related values and attributes, as well as engage in afforestation of barren hills and sandy land.

3.2. Devolution in forest tenures

Since 1978, significant changes have taken place in China’s land-tenure system. The popularity of the household production responsibility system in the countryside at the end of the 1970s exerted pressure on forestry to follow suit, especially in southern China where forestland had predominantly been owned and controlled collectively. Despite initial resistance to change by the central forestry authorities, the first signs of relaxation in government policies appeared with respect to wastelands in mountainous areas. Rural households were encouraged to sign contracts to take responsibility for afforesting bare land. In exchange for usufruct rights to the land for tree planting and, possibly, intercropping, peasants agreed to share the harvest. Although it was mainly designed to provide eco-

conomic incentives for villagers to plant vegetation on barren hills, this policy change had an important impact because it affected subsequent government decisions about forest estates under collective ownership. Generally, peasants showed a strong interest in the policy because it promised new opportunities to access timber and secure additional land for tree planting and intercropping.

By the mid-1980s, a great number of collectively-owned woodlots had been distributed to peasants under a variety of contractual forms that granted them an entitlement to the forested land and its harvest. In some places, local authorities even declared that the rights may be inheritable and that agreements would remain valid for up to 50 years. More recently, the Chinese government adopted new regulations to permit leases of publicly owned forestland for up to 99 years.

The changes in forest tenures have been recognized as a crucial driver in China's forestry reforms (Richardson, 1990, 1994, 2000; Yin, 1994, 1995; Liu, 2001; Lu et al., 2002). Recognizing that tenure reform was not homogeneous throughout the country, Song et al. (1997) examined factors influencing the adoption of a unique organizational innovation for local forest management in Sanming, a forest municipality in Fujian province that boasted a forest cover of 71%. Known as the share-holding, integrated forest tenure, it nominally allocated former collectively-owned woodlots to peasants, but under unified management by an elected village council. As each household in the village had its share in the forest estates, peasants would be entitled to share in any profits arising from the forest.

3.3. *Economic incentives and policy instruments*

China's forestry reforms include two major policy instruments: (i) command and control (C&C), and (ii) economic incentives. Under C&C, the AAC and the target outcome of forest coverage against which local government officials are evaluated are the two primary instruments. Economic measures include timber pricing and the allocation of funds through programs and projects. Until the mid-1980s, China's forest industries had faced distorted product prices for decades. In an effort

to promote forestry development, the central government relied increasingly on pricing mechanisms. Despite repeated upward adjustments in wood product prices after 1979, the pricing signal failed to generate expected results. Recognizing that forest product prices were integral to reforms in the nation's overall pricing systems, the Ministry of Forestry decided to proceed with sectoral reforms in the stumpage system. After 1991, logging companies were required to pay stumpage fees in the major forest areas of northeastern China (Zhang, 2000).

A summary of the major programs affecting China's forestry sector since 1978 is provided in Table 4. Three stages of forest sector reforms can be identified. (1) During the early reform stage, 1978–1991, timber pricing and forestry sector policy were two of the key issues for revamping China's forest resources (Li et al., 1988). Yin (1995) examined the major institutional changes of this period, while Albers et al. (1998) provided a status report on the impact of the reform measures on three categories of forest benefits, namely, timber, environmental services, and rural resource extraction. (2) From 1992 to 1998, there was a nationwide drive toward a market economy—the gear-shifting period. It was accepted that China had to develop a market economy in order to achieve long-term, sustainable productivity growth. (3) In the wake of the huge floods of 1998 in the Yangtze River basin and the north-eastern parts of the country that resulted in the loss of several thousand lives and hundreds of thousands of people becoming homeless, the Chinese government decided to impose a logging ban in ecologically sensitive natural forests and restrict harvest levels in severely degraded watersheds. With the implementation of these programs, China entered an era of ecosystem rehabilitation and timber production took a backseat to environmental protection.

4. **Paradigm shift**

Fruitful examination of forest policy changes calls for an effective analytical framework. Such a framework is necessarily multi-dimensional, and it may take on a sector or stakeholder orientation. Among other things, forestry is characterized by

Table 4
China's major forestry programs

Program	Year	Principal objectives and features
	launched	
<i>Top 10 ecological programs</i>		
1. Three-North Shelterbelt	1978	Building shelterbelt system stretching some 4500 km across North China
2. Agroforestry in Plain Areas	1987	Providing a framework for agroforestry
3. Conservation Forest on Upper and Middle Reaches of Yangtze River	1989	Protecting headwaters and rehabilitating habitat
4. Afforestation of Taihang Mountains	1990	Promoting rural economy and protecting environment around Beijing and Tianjin
5. Coastal Windbreak Forest	1991	Developing windbreaks on some 25 million ha along coast
6. Combating Desertification	1991	Fixing sand dunes and reducing dust storms
7. Huai River and Tai Lake Conservation Forest	1995	Improving forest ecosystems in the Yangtze Delta region
8. Conservation Forest on Middle Reaches of Yellow River	1995	Rehabilitating damaged ecosystems on Loess Plateau
9. Liao River Valley Conservation Forest	1995	Building conservation forests in parts of Hebei, Inner Mongolia, Liaoning and Jilin
10. Pearl River Valley Conservation Forest	1995	Improving forest ecosystems in the Pearl River Delta region
<i>Other forestry programs</i>		
Fast-Growing and High-Yield Forest Plantations	Early 1980s	Developing commercial timber plantations in 16 provinces in eastern, central and southern China
Natural Forest Protection	1998	Protecting remaining natural forests around headwaters and sensitive ecological regions
Conversion of Steep-Slope Marginal Cropland to Forest and Grasses	1999	Ecological restoration and poverty reduction
Control of Dust Storms and Land Degradation in Beijing-Adjacent Areas	2000	Fighting dust storms and addressing land degradation problems in Beijing and surrounding areas

Source: SFA (1999, 2001).

dual connections with agriculture and industrial manufacturing because, on the one hand, forestland is subject to the forces affecting agriculture, while, on the other, harvests of mature forests are needed to drive manufacturing—to make a variety of wood-based products. Increasingly, forests' ecological functions in terms of climatic regulation, biodiversity preservation and soil and water conservation have gained wide recognition. In this section, we outline an analytical framework and describe its relevance to the outcomes of China's economic reforms by comparing and contrasting the old model with the emerging paradigm. For the analytical framework, we propose a three-gradient approach: (a) the sector gradient, (b) the

stakeholder gradient, and (c) the program gradient. These gradients are suggestive of possible avenues of future enquiry.

4.1. The forestry sector: high priority but low position

Characterizing forestry as an industrial sector enables the securing of funds in a centrally planned economy. Under central planning, however, the logging sector is often the target of exploitation as it serves as a cost center for secondary manufacturing. China's forest industry has occupied a peculiar position in the national economy. Wood fiber was one of the three essential materials,

along with steel and cement, under tight central control, but, until the early 1980s, the forest industry was believed to account for only a small portion of the gross national product. Price distortions as a result of deliberate government policy turned the sector into a supplier of cheap materials, with forest rents arbitrarily captured by upstream manufacturers—the construction sector and light industries, including wood processing and paper-making. Exploitation of natural forests was used as a means of achieving a number of social objectives, such as regional development and the provision of low-cost construction materials.

When forestry is considered a part of agriculture, it tends to be viewed as a subordinate sector. Prior to 1978, China's agricultural policy emphasized grain production (known as *yi liang wei gang*), so large areas of natural forests were cleared to grow cereals. A rising population placed great pressure on croplands, further limiting the growth of forestry. Thus, China's forestry sector was given high priority but low position in the national economic hierarchy—rhetoric about funding was abundant, but actual financing was limited.

Prior to the 1980s, there was no comprehensive master plan for forestry because the Ministry of Forestry was not in a position to prepare such a plan without involving other sectors, such as pulp and paper production. The state planning authorities had only a nominal interest in the need to rationalize the nation's forestry structure. After all, forestry paled in national development priorities compared with sectors such as energy, transportation and communications. As a result, the Ministry of Forestry was compelled to adopt a piecemeal approach to programming.

After the economic reforms of 1978, there was impetus for the forestry sector to shift course. Those who planted trees would be entitled to the material benefits, while barren hilly land could be auctioned off to the highest bidders for afforestation purposes. However, due to the long rotation periods to grow trees and the high levels of uncertainty associated with forestry activities, the incentives to plant trees proved inadequate. Rather, deforestation increased (Lu et al., 2002). The state-owned forest enterprises, two-thirds of which were concentrated in the Northeast, experienced some

major reforms beginning in the early 1990s, with the consequent emergence of a number of large forest industry groups. This was an important step in the decentralization process for the entire forest sector. With reduced government interference, forest companies were able to respond to market needs and thus improve economic efficiency.

4.2. Stakeholders: the principal-agent problem

In the Chinese context, the major stakeholders have traditionally been grouped into: (1) the state as forest owner and the state-owned forest companies; and (2) the collectives and peasants. Recall the spatial dichotomy in the ownership of the Chinese forests: the state-owned forests are located mainly in the Northeast and the Southwest, whereas the southern provinces are home to the majority of the collectively-owned forests. From principal-agent theory (Wang and van Kooten, 2001), the state and the collectives may be viewed as principals, while forest companies and peasants are the agents. Prior to 1978, the principals had tight control over the forests. Although state-owned forest companies were involved in timber cutting, they had little freedom concerning forest management. In addition, although most forest companies started off with access to high quality forest assets, they were also burdened by large financial obligations, partly because they were compelled to perform most local administrative and social welfare functions.

After 1978, the principals' monopoly on decision making was weakened—first in the collectively-owned forests in southern China in the 1980s and then in the state-owned forests in the Northeast and Southwest in the 1990s. A general trend is that the principals have gradually become nominal owners, with management power transferred to the agents. In particular, a number of integrated forest companies have emerged from the aggregation of local forest companies.

In an earlier study, Sun (1992) discussed the shifting relationship between people and trees, stating that "... the people-tree relationship in southern China has undergone fundamental

changes in response to changing land and tree tenure regimes and timber market structures” (p. 35). However, in the case of commercial plantations, the insecurity of property rights and policy uncertainties led to timber theft. Deforestation was exacerbated in the first few years of reforms. Due to the devolution process, illegal cutting became rampant. In southern China, after being allocated timberland, many peasants quickly cut trees and converted logs to cash. The reason was that the new tenure was perceived as incomplete, insecure and uncertain. Combined with high discount rates and slow growing trees, the most sensible thing from the peasants’ perspective was to cut down the trees and turn them into a more secure and mobile asset (Lu et al., 2002).

4.3. Forestry programs

As already noted, prior to 1978 the Chinese forestry sector essentially did two things: cut timber and afforest barren land. During the 1980s, the commercial plantation program became one of the two primary drivers for the forestry sector. The other was the use of AAC as a means of timber harvest control. The Chinese forestry authorities made an effort to reverse the chronic resource deficit by stepping up afforestation on the one hand and restricting harvest on the other. In the late 1980s, the Ministry of Forestry decided to undertake a transition from timber ‘mining’ to promoting forest protection and ecological restoration in an attempt to restore heavily degraded forest ecosystems. Specifically, the following four strategic transitions were proposed: (i) shift from excessive exploitation of natural forests to developing commercial plantations through appropriate silviculture; (ii) shift from timber cutting to comprehensive utilization of forests for multiple values; (iii) shift from extensive to intensive forest management, with greater reliance on science and technology; and (iv) shift from undertaking forest management by foresters alone to a management system involving the general public.

When China began to open its doors to the rest of the world, the greatest handicap to Chinese forestry was a high level of ignorance due to China’s three decades of isolation. Ehrenreich

(1980) commented that, while the outside world progressed from an era of wood production and wood utilization to one of scientific management of resources that included treating wildland as an integral part of the ecosystem, Chinese forestry continued in the timberland exploitation stage. In recognition of the severity of the problem, a research team under Yong Wentao, a former Minister of Forestry, recommended a combination of forestland zoning and multiple use forestry. Specifically, it proposed establishment of timber production zones, forest reserves and integrated land-use zones where multiple values could be derived.

China had no time to implement Yong’s recommendations, however, as the wind of sustainable forest management (SFM) blew across the country in the 1990s, and China quickly embraced SFM. ‘China’s Agenda 21—The Forestry Chapter’, which was prepared by the Ministry of Forestry, marked the end of an era of environmental degradation in which soil erosion was tolerated as a by-product of logging. China finally recognized that it was threatened by environmental catastrophes as a result of past policies, and the threats would affect ecological as well as human health, economic productivity and the supply of raw materials. Unfortunately, the threats turned into reality, on account of the huge floods that occurred in 1998. Since then, China has taken to its western region the environmental agenda, with the announcement of a series of programs aimed at rehabilitating badly damaged ecosystems (Wang et al., 2000). By early 2001, the State Forestry Administration had undergone a process of consolidating existing forestry programs to formulate a new national forest strategy.

The essence of the new national forest strategy lies in its paramount emphasis on the role of forests in ecological safety. The major difference between the concerns of the 1950s and 1960s and those of today is that the focus is no longer on opening up unutilized forests, but rather on safeguarding the existing resource base and developing new ‘wood baskets’. As Lei (2002) put it, in contrast to the old model that was characterized by a concentration of timber production in the

Northeast and Southwest, China's new forestry paradigm has the following components:

1. Protect natural forests in state-owned forest regions in the Northeast and Southwest, including headwater protection and conversion of marginal cropland (generally exceeding 25° in slope) to forest and grass cover, with funding coming mainly from the central government;
2. Combat desertification through the implementation of a newly launched Western China Development initiative, which is funded by both the central and provincial governments and seen as an important solution to ecological degradation, while continuing programs such as the Three-North shelterbelt development;
3. Establish conservation forests on the upper and middle reaches of the Yellow and Yangtze rivers, and along the coastline;
4. Develop nature reserves and restore wilderness features required to maintain biodiversity;
5. Promote agroforestry for rural development in mountainous areas and plains; and
6. Develop fast-growing and high-yield timber plantations in the South as a solution to inadequate timber supply (jointly funded by the governments at the central and provincial levels, in collaboration with international financial organizations such as the World Bank).

In summary, government policy has shifted in recent years from encouraging maximum timber harvest to promoting protection of existing natural forests and restoration of heavily degraded ecosystems (Yin, 1998; Zhang et al., 2000; Zhao and Shao, 2002). China plans to more than double forest cover to 45% in the upper Yangtze River and to 27% in the Yellow River valleys over the next three decades. The overall national goal is to increase the country's forest cover to 26% (SFA, 1999). China's mid- and long-term objectives are to maintain the ecological stability and site productivity of forest plantations, and develop planting techniques for afforestation of wastelands, deserted industrial sites and desertified land in arid and semi-arid areas. Clearly, China's new forest policy is geared toward protection of existing forests, desertification control and ecological restoration. What is crucial about the new policy is

that increasing forest cover is now a means rather than the end of forestry activities.

5. Afforestation: a statistical analysis of the drivers

Since 1978, economic reforms have brought about higher per-capita income in China. As a result of improved standards of living, the demand for non-food items, including wood products, has increased. The growing demand for wood products has placed an additional strain on the country's limited forest resources. Although China ranks fifth globally in terms of total forest area, on a per capita basis the country has only 0.1 ha of forest vs. 0.6 ha for the world (FAO, 2002). Since China's economic reforms began in rural areas, there was a lag of approximately one decade before reforms found their way into the industrial sectors. As a result, until the early 1990s, wood fiber continued to be an under-priced raw material. The current state of affairs is a consequence of decades of heavy utilization of the resource base and lack of input in forest renewal (Wang and Wilson, 2001). Because of faster growth rates in the industrial sectors, higher opportunity costs of capital in these sectors made it less attractive to invest in forestry, which further depressed silvicultural investment. By the time China embarked on its economic reforms, the forestry authorities at the central level recognized that previous tree planting had been inadequate and that efforts needed to be intensified. An imminent fiber shortfall loomed ahead unless afforestation and reforestation were boosted. Thus, the desire to increase forest cover has been, perhaps, the single most consistent policy in the mosaic that constitutes China's forestry policy.

China's forestry sector was considerably behind many other sectors when the economic reform process began. The sector was generally quite conservative because of its role and position as a natural resource supplier. Only in the 1980s did forestry become a trend-setting sector. Since the beginning of the 1990s, forestry has frequently hit headline news due largely to the shelterbelt programs. For example, the 'Great Green Wall' Shelterbelt Program has made China a showcase for

Table 5
Regression analysis of afforestation in China

Variable	Estimated coefficient	t-ratio
Timber harvest levels	0.1055	4.758
Lagged GDP	−0.0004	−3.467
Silvicultural expenditures	0.002	3.813
Time period dummy (1 = post-1978 years, 0 otherwise)	−0.3241	−0.733
Constant	0.0163	0.017
<i>N</i> = 49		
Adjusted $R^2 = 0.555$		

the rest of the world. In recent years, large ecological programs brought rich rewards in terms of prestige and inflows of cash. This is precisely why a new agenda has emerged for the entire sector.

In analyzing the forces that affect forest policy in China, there is very little that is amenable to rigorous statistical analysis. A key constraint is the lack of reliable data, both time series and cross-section. In an attempt to fill the gap, we focus on afforestation. Economic theory suggests that tree planting ought to be an economic activity undertaken in response to market signals—trees are planted in anticipation of expected future benefits. However, in China, until recently, market forces played little role, as there were no markets for logs and timber-based products.

To determine factors that explain tree planting in China over the past nearly half century, we develop a simple linear regression model with the dependent variable being area planted (y):

$$y = \beta_0 + \beta_1 \times \text{harvest} + \beta_2 \times \text{GDP} + \beta_3 \times \text{investment} + \beta_4 \times \text{reform} + \varepsilon$$

where *harvest* refers to timber harvest volume in million m^3 ; *GDP* is gross domestic product in billion *yuan* RMB (lagged 1 year); *investment* indicates silvicultural expenditures in million *yuan* RMB; *reform* is a dummy variable (= 1 for post-1978 years, and 0 otherwise); β_i are coefficients to be estimated; and ε are independent, identically distributed error terms. We postulate that the coefficients to be estimated are all positive ($\beta_i \geq 0, \forall i$). Timber harvest levels are hypothesized to have a positive effect on tree planting, because planners intended to undertake afforestation in response to the dwindling mature timber resources.

The inflation-adjusted GDP variable is expected to capture the effect of the macro-economic conditions, based on the proposition that, as an economic activity, tree planting is dictated by the general state of national economic development; because of the nature of central planning, we lag the GDP variable by 1 year to allow for a linkage of the scale of tree planting operations with the previous year's GDP. Due to unavailability of specific data on afforestation expenditures, data on investments in fixed assets for silvicultural purposes are used as a proxy and have been adjusted for inflation; the investments should have a positive effect on tree planting, although they may be used for a variety of silvicultural programs. Lastly, a time period dummy variable is included to ascertain whether economic reform has affected tree planting.

The data used in the ordinary least squares regression cover the period 1953–2001, and are derived from several sources, including *China's Forestry Statistical Yearbook* (SFA, various editions), the various editions of *China's State Statistical Yearbook*, (China State Statistical Bureau) and the *International Financial Statistics Yearbook* published by the International Monetary Fund, various editions. The regression results are provided in Table 5.

With the exception of the reform dummy variable, all of the estimated coefficients are statistically significant at the 0.01 level or better. The results indicate that concern about future timber availability is the most important driver of tree planting, as expected. Tree planting is also positively correlated with silvicultural expenditures, as expected, but GDP is negatively correlated with

planting, contrary to expectations. There are two possible explanations. First, tree planting has historically been looked upon as a social as opposed to an economic program, and this was especially the case in the pre-reform era. Second, the extent of afforestation is subject to a certain set of opportunities and constraints such as availability of suitable planting sites. Economic well-being as measured by GDP gives some notion of ability and willingness to invest in tree planting that yields benefits far in the future, but it is only one factor. Indeed, Arrow et al. (1995) observed that the relationship between economic well-being and investment in environmental improvements is less likely to hold for resource stocks including forests. This might explain the negative coefficient on lagged GDP.

We had also expected reforms to lead to an increase in tree planting, but this appears not to have been the case. One reason was that the post-1978 devolution in forest tenure triggered rampant illegal timber cutting with reforestation and afforestation failing to keep pace. Further, despite recurrent appeal for tree planting over the past five decades, especially since the late 1970s, the reforms themselves did not seem to provide the required direct impetus to forest renewal on account of a series of irrational institutional arrangements including heavy burdens of taxes and charges (Lu et al., 2002). It is rather difficult to explain the statistical insignificance of the reform dummy variable but, nevertheless, we undertake this challenge in Section 6.

6. Discussion and conclusion

Since reforms began in 1978, China has witnessed a change in the tenure of collectively-owned forests, which were redistributed to peasants as part of overall agrarian reforms. Furthermore, state forest enterprises were confronted with stumpage fees and relaxed wood product markets, as there was increasing recognition that forests could no longer be exploited as a 'cheap' source of raw material for the industrial and construction sectors. Nationwide economic reforms brought about attitudinal changes that smoothed the way in forestry for greater use of economic incentives

to achieve a plethora of goals. The foregoing sections have outlined the transformation of China's forest policy. It is, perhaps, unfortunate that the regression results in the previous section fail to uncover any positive effects of the reforms on forestation. This may have arisen, in part, from the limitation of the model and the accuracy of the data employed. Meanwhile, other important factors are unaccounted for, such as physical constraints related to land available for tree planting, institutional variables like tenure types, timber prices, government subsidy levels, and taxes and charges. From a technical point of view, due to enormous variations between provinces, data on these important determinants are either unavailable or contradictory from one source to another, hence restricting our capacity to calibrate the model. From an institutional perspective, widening the scope of our enquiry would lead to a probe into the adequacy of the reforms and an evaluation of their impact on the constraints and opportunities in China's forestry sector and the regional/local institutional setting, for example, in terms of taxation. For a discussion on taxation and other possible instruments in China see Lu et al. (2002).

It is a daunting task to analyze the complex policy reforms without an appropriate framework. The analytical framework outlined in Section 4 appears to serve the purpose well. Given that China has been preoccupied with the need to increase its forest cover, forestation is chosen as the theme for discussion here. Although it had long been recognized that tree planting was important in combating desertification and soil erosion (e.g. through the planting of windbreaks), it was only after the post-1978 reforms that forest policy began to address this issue seriously by changing property rights to timber on collective lands. However, the reforms in China's forest tenure system seem incomplete and stop short of generating sufficient economic incentives for villagers to invest in forestry. The limitation of the tenure reforms has two effects, a continued lack of interest on the part of farmers in establishing and maintaining forest estates and a perpetual reliance on government sponsored forestation programs and financial support.

Table 6
Forces affecting afforestation in China

	Non-market forces	Market forces
Pull	Political considerations, environmental reasons	Market forces
Push	Agency, professionals, academic institutions	Socio-economic interests, forest-dependent communities

Forestry activities are subject to the interplay of ‘push and pull’ forces, Table 6 illustrates a matrix of factors relevant to the Chinese case. As the country is still in the process of adopting various principles of a market economy, the upper-right corner is not yet applicable. The lower-left corner reflects a mixed bag. Social desire for improved forestry has grown year by year along with heightened awareness of the role of forests in environmental quality. It is the economic forces for enhancing forestry development that need to be brought into play, but this will require structural changes in China’s overall institutional system. What is left, clearly, is the relationship between upper-level politics and the executive agency responsible for forestry that dominates the landscape of China’s forestry administration and program management. The recent consolidation of China’s various country-level programs into six integrated programs is testimony to this phenomenon. Indeed, the environmental crises of 1998—the massive floods in the Yangtze River basin—lifted the Chinese forestry sector to a top priority position in the national economy and, as a result, China began to implement policies similar to those that had appeared in developed countries one or two decades earlier (Wilson et al., 1998).

A major problem with agency-led programs, however, is accountability for the delivery of program activities in a timely and cost-effective manner and for the faithful adherence to established accounting principles during program implementation. This issue is of great importance given the huge budget increase for ecological restoration that the Chinese government has announced for the coming years (Zhou, 2002). Success in ecological rehabilitation is manifested by the prevention of natural disasters, such as dust storms and

floods, or minimization of their damage when they occur. Certainly, this is a tall order for the forestry authorities at various levels, particularly the State Forestry Administration.

The Chinese forest sector has been subject to a dramatic reform process since the late 1970s. This process continues in its transformation, driven by a new socio-economic context in which ecological security plays a more important role than in the past. In the initial period of the 21st century, China is confronted with a number of challenges. At the resource level, it needs to improve the cost-effectiveness of its tree planting programs, partly by creating the right kinds of incentives to landowners (and those with long-term use rights to the land) and those undertaking forest renewal activities. It needs to conduct studies to determine future timber supplies, where to invest in silviculture for production of commercial timber, how much, and what sorts of economic incentives to employ. At the industry level, it needs to address an anticipated shortfall between demand for fiber and its supply, and strategies need to be developed concerning imports of logs and other wood products. What is needed is further liberalization of log and wood product markets. At the policy level, a balance needs to be struck between proper state involvement and extensive participation by other stakeholders, including the private sector, in protecting the environmental amenities that forests provide (Lu et al., 2002). As experience in other countries has shown, none of these tasks will be easy, and they could be hindered by inappropriate policy failure elsewhere in the economy. Further research in the link between the forest sector and other sectors, and forestry and civil society, is needed to help improve forest policy design and implementation.

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