

OVERVIEW OF FOREST DEGRADATION AND CONSERVATION EFFORTS IN THE AMUR BASIN IN THE TWENTIETH CENTURY, WITH A FOCUS ON HEILONGJIANG PROVINCE, CHINA

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1. INTRODUCTION

Forests are a key element of the landscape in the Amur Basin and play a very important role in maintaining the watershed's ecosystem and material flows, from the Amur River's upper tributaries in China to the Okhotsk Sea in the Russian Federation. Since the beginning of the twentieth century, however, the forests in the basin have been destroyed or seriously degraded, mainly due to farmland development, forestry development, and forest fires.

Various reports have been published on the state of the forests, forestry activities, and the causes of forest fires on Russia's side of the basin (i.e., Kakizawa 2004; Sheingauz and Kakizawa 2003; Kakizawa and Yamane 2003; Kakizawa et al. 2005). For this project, studies of areas such as forest policy and the timber trade were conducted with the aim of clarifying the direct and indirect impacts of human activities on the forests in the basin, with a focus on the northeastern province of Heilongjiang in China.

As for forestry activities on China's side of the basin, a detailed study of Heilongjiang Province (Dai 2000) was based on various earlier studies (e.g., Ikebe 1933; Ogino 1965; Tao 1987). Information in reports on forest fires and conservation efforts in the area is fragmentary, however, and thus compiling a multifaceted review is helpful in examining the causes of forest loss and to aid discussion of a forward-looking agenda.

In order to examine the impact of human activities on the forests of Heilongjiang, this article reviews the following three subjects, based on key documents and other available information:

1. Changes in forest resources in China in the latter half of the twentieth century, highlighting the relative position of Heilongjiang Province
2. The state of forestry development and forest fires in Heilongjiang as major proximate causes of forest loss on China's side of the Amur Basin
3. An outline of important recent forest conservation policies

2. CHANGES IN FOREST RESOURCES IN THE LATTER HALF OF THE TWENTIETH CENTURY

In 1950, forests covered only 8.3 percent of the total land area of China. This is because China's forests had been devastated due to decades of war and incursion by the Russian Empire and Japan at the end of the nineteenth century.

The general coverage of forest area has increased considerably since then, compared with

the state of forests at the time of founding of the People's Republic of China in 1949, although this fluctuated a little during the 1970s to 1970s. China's forested area in 1993-1998 was 158.941 million hectares (ha), accounting for 16.6 percent of its total land area. Among them, the forested area is 133.704 million ha, increased by 9.051 million ha compared with the area in 1984-1988, when China's third regular forest resource survey was conducted.

At the establishment of the People's Republic of China, forested land was unevenly distributed, but the regions of the northeast (Heilongjiang, Jilin, and Liaoning provinces) and southeast (Yunnan and Sichuan provinces) held more than 70 percent of China's total forest area.

Based on the national forest resource inventory (1993–1998), forested land in China covered 16.8 percent of the country, although its distribution was still not uniform. At the time, three northeastern provinces (Heilongjiang, Jilin, and Inner Mongolia) and ten southern provinces (Zhejiang, Anhui, Fujian, Jiangxi, Hubei, Hunan, Guangdong, Guangxi, Hainan, and Guizhou), contained more than 30 percent of China's remaining forests. Two western provinces—Sichuan and Yunnan—held nearly 20 percent of the total. Thus the growing stock is concentrated in these three regions.

Heilongjiang's forests were left almost untouched until the middle of the nineteenth century. Since that century's end, however, forestry development in the area progressed significantly, and, consequently, forest coverage of the province's total land area had decreased to 37.6 percent by the middle of the twentieth century. Even so, the forests of Heilongjiang were still important, because they represented more than 20 percent of China's total forested area and were still a significant resource for timber production.

Thus, intensive timber production continued during the latter half of the twentieth century, and the forested area

Table 1. Forested area and forest coverage in China and Heilongjiang Province in the latter half of the twentieth century

Index/year	China	Heilongjiang	Heilongjiang's share (%)
Total land area	960,272	45,461	4.7
Forested area (1,000 ha)	1950	79,703	21.5
	1973-76	121,860	20.7
	1977-81	115,277	13.3
	1984-88	124,653	12.5
	1988-93	133,704	12.1
1994-98	158,941	17,603	11.1
Forest coverage (%)	1950	8.3	37.6
	1973-76	12.7	34.9
	1977-81	12.0	33.6
	1984-88	13.0	34.4
	1988-93	13.9	35.6
1994-98	16.8	38.7	

Sources: State of Current Forest Resources in China 1949-1993, Ministry of Forestry, 1996-1998.

Table 2. Several indices of forest resource degradation in Heilongjiang's state forests during the latter half of the twentieth century

Year	1962	1986
Share of coniferous forests' stand volume (m ³)	68.6	18.5
Mean timber volume (m ³)	1.2	0.5
Mean stand DBH* (cm)	32.3	13.3
Mean stand volume of natural forest (m ³)	199	111
Mean stand volume of mature forest (m ³)	226	157
Mean stand age (years)	220	100

Source: Dai (2000) *Diameter at breast height.

decreased to 15.3 million ha by 1977-81 as a result (Table 1). Forest coverage also decreased to four points.

The forests recovered gradually after the 1980s, and in 1994-98 forest coverage exceeded that in the 1950s, but the degradation of forest resources, including notable loss of mature forests and the resultant smaller sizes of timber being harvested, continued until the end of the twentieth century (Table 2).

To summarize, severe forest loss occurred in Heilongjiang during the twentieth century, and it can be assumed that the changes in forest cover had considerable effects on the watershed ecosystem and material flows in the Amur Basin.

3. FORESTRY DEVELOPMENT IN HEILONGJIANG PROVINCE¹

3.1. Before the establishment of the People's Republic of China

At the end of the nineteenth century the construction of the Chinese Eastern Railway, which started at Chita and went through Manzhouli, Harbin, and Suifunhe to Vladivostok, was a catalyst of forestry development in Heilongjiang (Figure 1).

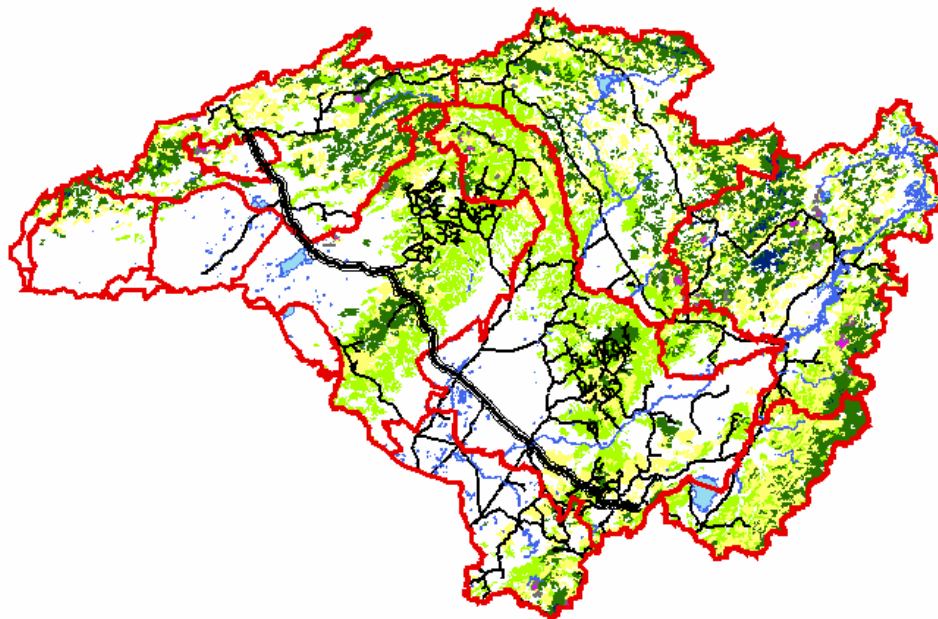


Figure 1. Map of Heilongjiang Province. Current administrative boundaries (red lines), forest distribution (green-colored areas), and the railway network in the Amur Basin (black lines). The route of the Chinese Eastern Railway is the bold black line.

Until the 1850s, close to the end of the Qing Dynasty, the government had employed a strict conservation policy to protect the forests in the northeast region of the territory, and the forests were still in their natural state. After the dynasty's end, however, the Russian Empire undertook construction of the Chinese Eastern Railway, and then logging was begun to produce a huge amount of wooden ties for rail lines and fuel wood for the train locomotives.

¹ This section is based on an article written by Dai (2000)

As a result, any land within 70 kilometers of the Chinese Eastern Railway line was deforested by Russian Empire outfits and China–Imperial Japan joint ventures until around 1930. From 1931 to 1945 the still-untouched forests in the Amur Basin in northeast Heilongjiang, such as those in the Lesser Khingan Range and the Songhua River basin, were developed into the hinterlands when Manchuria, established by Imperial Japan, constructed a logging railroad connecting up with the Chinese Eastern Railway line. An estimated 1.17 billion cubic meters (m³) of timber was extracted during this period, indicating that forestry activities became more intense than ever. Consequently, the forested area in the province decreased from 27.8 million ha in the 1930s to 17.1 million ha in 1945, and the volume of standing stock saw a large decrease from 3.6 billion m³ to 2.4 billion m³.

3.2. From establishment of the People's Republic of China to the middle of the 1970s

After Communist Party leader Mao Tse-Tung (Mao Zedong) founded the People's Republic of China, the forests on China's side of the Amur Basin were designated as state forest. Forestry development then progressed more intensely under the control of the central government. Initially, from 1945 to 1952, the area produced a massive amount of timber to support the liberation war and post-war reconstruction. Timber production during the time was estimated at 21 million m³ totally, half of the total timber production of the whole country (Figure 2). Heilongjiang's local government decided to develop infrastructure with the aim of strengthening forestry development, resulting in various extensive projects, such as railway recovery, new railway construction for logging, relocation of sawmills, and extension of logging rail lines from resource-depleted areas to the resource frontier. As a result, forestry development expanded again into pristine areas.

When the new China entered a strong phase of economic development after 1953, the country succeeded in establishing a centralized economic planning system modeled after the system in the former Soviet Union. The state forest in Heilongjiang was allocated an annual

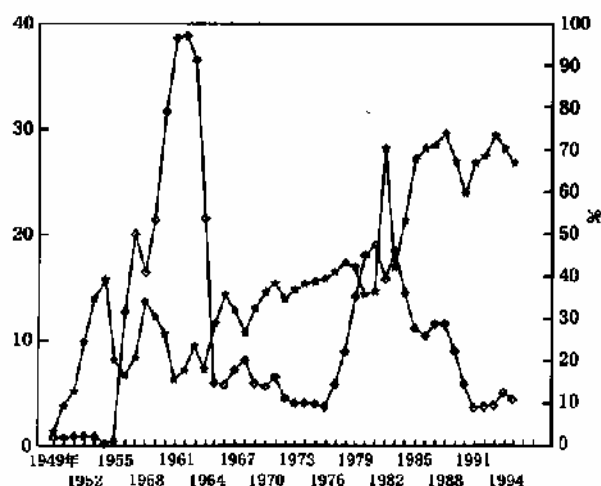


Figure 2. Change in logging area (★=million ha) and the rate of clear-cutting (◇=percent.) in Heilongjiang state forests. Source: Dai 2000.

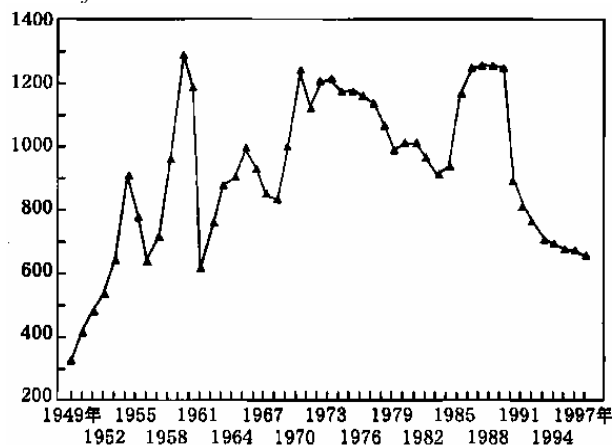


Figure 3. Change of logging volume (million m³) in Heilongjiang state forests. Source: Dai 2000.

planned timber production volume by the central government, and thus forest management leaned further towards unsustainable methods to achieve the imposed production target.

Since Heilongjiang Province contained the most abundant natural resources, such as coal, timber, and reclaimable barren lands, in addition to having suitable infrastructure for resource development and industrialization, the province was assigned to be a major natural resource-driven industry area. As for the state forests in the province, the “northeast state forest regional development master plan” was established, and more intensive forestry development was started based on the plan.

Because of this situation, a very high target of timber production was set for the province, and unsustainable forestry activities accelerated rapidly as a result. Some areas began to employ intensive selective-cutting in timber production, and the rate of clear-cutting by logging operations also increased significantly. Consequently, the speed of forest loss in the province accelerated further (Figure 3).

This forest management style based on over-harvesting continued until 1962, when the Great Leap Forward² ended. After that, the government tried to modify forest management policy to be more sustainable. Unfortunately, this attempt did not last long. The Great Proletarian Cultural Revolution started in 1966, which eliminated the state’s forest management system, and unsustainable practices recommenced.

The annual mean timber production volume in Heilongjiang’s state forest during this period was more than 20 million m³, and more than 50 percent of the area logged was being clear-cut and not replanted. As a result, forest loss in the province worsened.

3.3. From the latter half of the 1970s to 1998

The Great Cultural Revolution in China ended in 1976, and then the country rapidly evolved into a commodity-based economy under planned socialism. In the background of such policy change, the state decided to switch its forest management policy from being destructive to being more sustainable under the forest law of the country, which was established in 1979 and finally entered into force in 1984. Unfortunately, over-exploitation continued due to the unabated pressure on the forests in Heilongjiang to achieve high production goals, and forest loss in the area continued. Annual mean resource depletion reached 38 million m³, which was twice the annual growing stock in the area.

After 1992, when China’s transition to a market economy accelerated, a decrease in timber production due to forest resource depletion in the area became a serious issue, and consequently deficits in income from state forests became more acute. The cumulative deficit of state forests reached 1 billion yuan, and half of all state forests stayed in the red for more than two consecutive years until 1995.

The cumulative impacts of forestry development on the land led to devastating floods downstream of logged areas after the 1980s. Large-scale floods continue to occur frequently

²An economic and social plan used from 1958 to early 1962 which aimed to use China's vast population to rapidly transform mainland China from a primarily agrarian economy dominated by peasant farmers into a modern, industrialized communist society (Source: Wikipedia, <http://en.wikipedia.org/>).

and the damage they cause has become more extensive. A catastrophic flood in 1998 in the watersheds of the Songhua, Yellow, and Yantze rivers, which killed 3,000 and affected 240 million people, is still fresh in the people's memory. Finally, the Natural Forest Protection Project was launched in 1998, leading to significant cuts in timber production from state forests. Structural over-exploitation of natural forests in the area,, which had continued throughout the twentieth century, finally ended.

4. FOREST FIRES AND THEIR CAUSES IN CHINA AND HEILONGJIANG IN THE LATTER HALF OF THE TWENTIETH CENTURY

4.1. Dynamics

China is one of the countries in the world with a large number of forest fires occurring annually. According to forest distribution figures, the characteristics of climate in China and forest fire statistics collected for nearly 50 years, it can be concluded that most forest fires occur in the northeast (the provinces of Heilongjiang, Jilin, and Inner Mongolia), where the main tree species are larch and Korean pine, and in the southwest (Yunnan, Sichuan and east Xizang provinces), where the main species are Yunnan pine (*Pinus yunnanensis*) and Simao pine (*Pinus kesiya* var. *langbianensis*).

In the 40 years between 1950 and 1990, around 620,000 fires were recorded (Figure 4), burning 36 million ha of forest (Figure 5). Most fires were observed in state forests in the three northeastern provinces, and frequent fires have accelerated the degradation of forest resources, mainly in natural forests.

Forest fires occurred most frequently until the middle of the 1960s. More than 20,000 fires per year were recorded in seven of the years between 1950 and 1965.

The number of forest fires then decreased slightly until 1968, but during the 1970s it

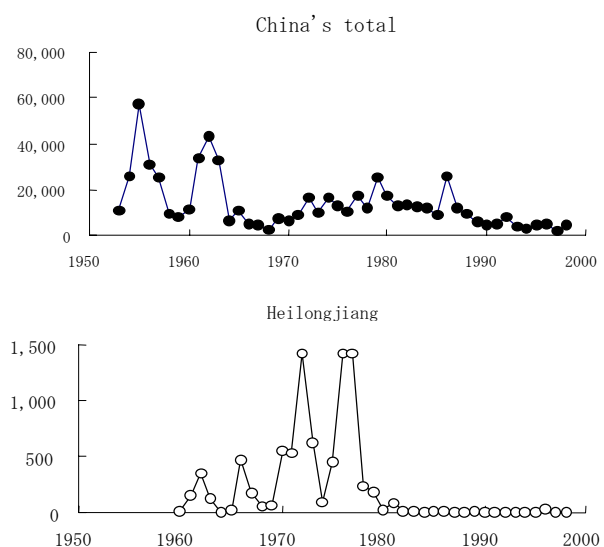


Figure 4. Change in the number of forest fires in all parts of the country and Heilongjiang from 1950 to 1998.

Sources: National Forestry Statistical Materials, Ministry of Forestry for 1985–1997 data; China Forestry Statistical Yearbook 1998, State Forestry Administration for 1998 data.

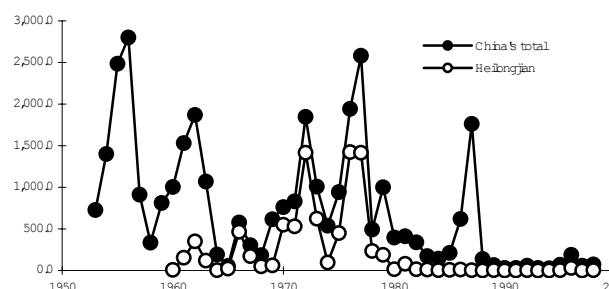


Figure 5. Change in the affected forest area in 1,000 ha of forest fires in all parts of the country and in Heilongjiang from 1950 to 1998. Source: Same as figure 4.

increased again, with more than 10,000 fires recorded per year. In the 1990s the number of fires dropped significantly to 5,000, due to the strengthening of fire control and diminished forestry activities.

Changes in the frequency of forest fires in Heilongjiang vary slightly compared to the rest of China. Forest fires in the province occurred most frequently in the 1970s, with the number being from 500 to 1,500 per year, but the number dropped dramatically thereafter.

The sizes of affected forest areas follow similar trends to the number of forest fires. Until the middle of the 1960s, during years with many recorded forest fires, more than 1 million ha were affected annually in Heilongjiang, indicating that forest fires, along with forestry development, were a major proximate cause of forest loss here.

From 1970 to 1990, four years suffered extremely large fires, which affected a forest area of more than 1 million ha, and thus forest fires remained a major proximate cause of forest loss in the country. The forest areas affected in the whole country from the middle of the 1960s to 1978 showed closely similar dynamics as in Heilongjiang ($r = 0.95$), and the share of Heilongjiang exceeded 50 percent for most years during this period. Thus the facts indicate that forest fires in China during the period were predominantly in Heilongjiang.

After catastrophic forest fires occurred in the northeast region in 1987, the central government strengthened the fire control system. The frequency of fires and area damaged by forest fires decreased dramatically in the 1990s. The cumulative damage of fire on forest resources over the years, however, is serious and cannot be ignored.

4.2. Causes

Although the causes of forest fires vary, there are only two main categories of cause: human or natural (Table 3). Relatively few forest fires have natural origins, mainly lightning. Forest fires caused by lightning are relatively more common in unexploited forested areas in the northeast. Depending on origins, forest fires caused by humans are classified as “production” fires, “non-production” fires, and fires due to negligence.

Table 3. Causes of forest fires in China from 1989 to 1990 and from 1996 to 1998

Causes	1989-90	1996-98
Production origin (%)	49.3	38.2
Non-production origin (%) (mainly negligence origin)	48.3	53.6
Lightning	0.5	0.8
Others (%)	1.9	1.1
Total number of forest fires (%)	11,901	11868

Source: Research on China’s Natural Disaster Deduction Countermeasures - Volume 2, China Science and Technology Publishing House, 1998

Burning for cultivation and fires caused by machinery fall under the production fire origin classification. Burning for cultivation is the main cause of forest fires in the southwest, where many local ethnic groups use traditional slash-and-burn cultivation in agriculture. This tradition is changing as cultivation methods change, but it is still used to some extent, and can cause forest fires very easily. Train locomotives running along railways are the main cause of forest fires in the northeast, and farm tractors moving along roads may cause sparks or flames,

sometimes leading to large forest fires.

In the northeast, most forest fires are of non-production origin, livelihood origin, or accidental origin. Smoking in the forest, using fire for heating or cooking, burning paper for devotional purposes in tombs, etc., are customary uses of fire in day-to-day life as people follow their cultural traditions. It is likely that most forest fires in Heilongjiang are closely related to human activities, since both the number and area of forest fires increased in sync with the over-exploitation of forest resources.

5. RECENT EFFORTS IN FOREST CONSERVATION

5.1. Afforestation

Since the founding of the People's Republic of China in 1949, vast areas of forests on steep slopes have been converted to cultivated land or pasture. Cultivated land with a slope of more than 25 degrees was estimated at over 6 million ha in the 1990s. Conversion of steep forestlands has caused a decrease of wood production for home consumption (such as for fuel or construction) and serious topsoil erosion.

On the other hand, the central government promoted various afforestation projects since the end of the 1970s and developed a large area of man-made forests (Figure 3). As a result, a substantial increase of forest area and total growing stock can be seen in forest resource statistics. These resources have not yet matured, however, because of the brief history of afforestation.

Although forests in Heilongjiang have been degraded since the end of the nineteenth century due to intensive forestry development and frequent forest fires, afforestation was encouraged only after the 1990s. The area of afforestation was very small until 1970. Even in the 1980s, when several national afforestation projects were launched, the average area of afforestation was only around 100,000 ha per year, still a low level compared to the total forested area of the province. Eventually, in the 1990s, afforestation was intensified. Consequently, the province had many young man-made forests and few mature ones at the end of the twentieth century.

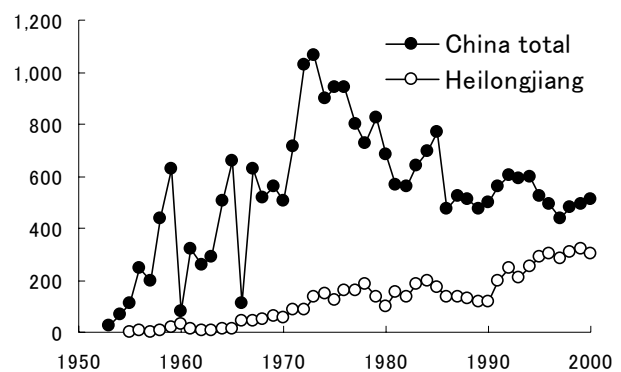


Figure 6. Change of afforestation area in China and Heilongjiang from 1949 to 2000. Sources: National Forestry Statistical Materials, Ministry of Forestry, 1985–1997; China Forestry Statistical Yearbook 1998–2000

5.2. Natural Forest Protection Project

The most recent key national forest policy for forest conservation is the Natural Forest Protection Project (NFPP). It was announced in 1997 and launched in 1998 in order to

accelerate the improvement of the ecological environment in degraded natural forests and, at the same time, to realize biodiversity conservation and sustainable development for social and economic welfare. According to the master plan, this project focuses on natural forests in 17 provinces or autonomous regions, including the state forests in Heilongjiang Province.

The Chinese government has implemented the NFPP with great enthusiasm by means of such measures as concentrated investments, full-scale implementation jointly mandated by central and local governments, and rapid structural reforms of the forest sector, with mainly governmental and central control of implementation. The project was divided into a first phase (1998–2000) and a second phase (2001–2010).

Remarkable progress has been made since 1998 in natural forest protection through intensive implementation of the NFPP group of newly launched forest policies. Between 1998 and 2000 the central government invested 2.68 billion yuan (US\$322 million) in the project (Chinawood 2001, February). In 2000, in addition to 1.3 billion yuan (\$156 million) spent on natural forest protection, the government allocated a subsidy of 420 million yuan (\$50.4 million) for the conversion of farmland into forest and pasture, and a subsidy of 92 million yuan (\$11 million) for dealing with desertification.

So far, 4.64 million ha in the forest zones and 790,000 ha in other areas have been afforested. Additionally, 516,000 ha of natural forest areas were allocated for regeneration with supplementary silvicultural work (Yamane 2002).

State forest restructuring has also been promoted at a rapid pace. A reshuffling of personnel affected 190,000 workers. Moreover, the numbers of retired employees and layoffs in 1998 reached 110,000 and 90,000, respectively. In fiscal 1999, 280,000 positions were reshuffled, in addition to 320,000 retirements and 150,000 layoffs. In this way the project has steadily progressed by a top-down approach. On the other hand, the drastic changes in natural forest management and reforms of state forest policies have caused various negative economic and social impacts at the local level.

Domestic timber production has continued shrinking due in part to the implementation of the NFPP (Figure 7). In 1999, the nation’s planned timber production was registered at 53.27 million m³, a drop of 8.9 percent from the year before. The year 2000 saw domestic planned timber production shrink to 46.73 million m³, a reduction of 6.54 million m³ from 1999. The drop in log production in protected zones was dramatic, falling 62.1 percent from 32.05 million m³ in 1997 to 12.15 million m³ in 2003. In northeast state forests, it dropped to 11.02 million m³ in 2003 from 18.53 million m³ in 1997. The largest reduction was in state forests in Heilongjiang.

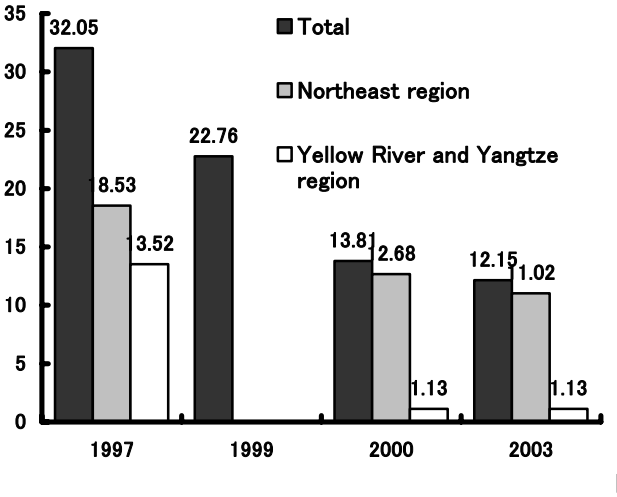


Figure 7. Change of timber production due to the NFPP (million m³)

The strict implementation of the NFPP has brought various impacts not only on regional communities and industry but also on the national economy, including the timber trade and industry.

The most notable impact was a rapid increase of log imports from Russia (e.g., Yamane 2001; Yamane and Lu 2001; Zhu 2002). With the very strong demand for timber from natural forests in the country, the timber shortage caused by implementation of the NFPP has been compensated for by importing timber, especially from Russia. Russian logs have dominated China's timber trade for a number of reasons (Yamane 2001). First, Russian logs were higher in quality and larger in diameter compared with Chinese timber, and in terms of potential uses they compare well to alternatives coming from China's northeast region, such as Mongolian pine, Korean pine, and larch. Second, Russian timber was cheap or moderate in price due to low labor costs in Russia and because of low transportation costs brought about by the volume of border trade. Third, imported Russian timber can readily replace the dwindling supplies from China's natural forests in the northeastern and northwestern regions, where harvesting has decreased or even stopped altogether as a result of logging bans imposed under the NFPP.

As shown in Figure 5, log imports from Russia jumped from 1997 to 1998 and since then have increased continuously. In 2001 China passed Japan to become the top timber importer from Russia. The total log import volume reached around 20 million m³ in 2005. The number is almost equal to the domestic production cut caused by the NFPP, and it means that imported Russian logs have become a substitute of timber from natural forests in China.

Russian logs exported to China are harvested in eastern Siberia and the Russian Far East. The Russian side of the Amur Basin inevitably became a major source of timber, because untouched forests still existed even at the end of the twentieth century. This means that the NFPP, which is aimed at conservation of degraded forests in China, will likely cause the rapid loss of Russian forests.

6. CONCLUSION

As this paper has outlined, rapid forest loss occurred on China's side of the Amur Basin during the twentieth century due to the intensive impacts of human activities, such as human-caused forest fires and forestry development for timber production. Forest conservation efforts, with a focus on afforestation, were implemented in the second half of the twentieth century. Unfortunately, forest loss did not stop because forests in the area were considered to be an unlimited source of timber for the country. Eventually, the forest resources were depleted, leading to a serious drop in production and to a rise in environmental devastation such as large-scale floods, which reached unprecedented levels. Thus, a radical forest conservation policy, named the Natural Forest Protection Project, which includes logging bans or restrictions, was launched in 1998. Forests on China's side of the Amur Basin have subsequently benefited from the conservation efforts in China. Unfortunately, due to the growing demand for timber in China, a sudden drop of domestic timber supply brought a steep increase in timber imports from Russia, and this has accelerated forest loss on Russia's

side of the Amur Basin. Moving forward, timely action is needed to rectify this unsustainable situation. A shift toward policies that promote basin-wide forest planning and conservation through China–Russia bilateral cooperation are major challenges in the twenty-first century.

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Appendix 1. Log production in China and its northeast provinces from 1985 to 1998 (m³)

Year	China total	Heilongjiang Province	Share (%)	Inner-Mongolia	Share (%)	Jilin Province	Share (%)	Total share of the three provinces
1985	53,135,500	14,938,500	28.1	4,096,900	7.7	5,367,300	10.1	45.9
1986	54,186,900	16,025,700	29.6	4,845,200	8.9	5,682,400	10.5	49.0
1987	53,861,200	15,971,900	29.7	5,211,800	9.7	5,735,800	10.6	50.0
1988	51,937,200	16,555,700	31.9	5,318,500	10.2	5,362,200	10.3	52.4
1989	50,370,600	16,679,900	33.1	4,939,000	9.8	5,614,800	11.1	54.1
1990	51,085,300	13,603,800	26.6	4,933,500	9.7	5,436,000	10.6	46.9
1991	52,892,800	12,263,800	23.2	4,562,300	8.6	5,091,300	9.6	41.4
1992	56,268,900	11,756,800	20.9	4,706,400	8.4	4,721,300	8.4	37.6
1993	58,603,900	11,476,900	19.6	4,808,500	8.2	4,923,300	8.4	36.2
1994	60,133,900	11,635,300	19.3	4,722,600	7.9	5,222,500	8.7	35.9
1995	62,469,900	11,632,600	18.6	5,104,000	8.2	5,504,400	8.8	35.6
1996	60,730,900	11,926,600	19.6	5,101,400	8.4	5,411,200	8.9	36.9
1997	59,354,400	11,247,400	18.9	4,987,600	8.4	5,296,600	8.9	36.3
1998	55,557,400	10,520,600	18.9	4,720,800	8.5	4,912,700	8.8	36.3

Sources: National Forestry Statistical Materials, Ministry of Forestry, 1985-1997

Note; log imports (million m³, bar) and share (% , line) of total imports