RECOVERING FROM OVER-CUTTING IN CHINA: AN EXAMINATION OF THE NATURAL FOREST PROTECTION PROJECT

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ABSTRACT

In the last century, China chose a planned economic system and formulated a strategy for the development of heavy industry. The chosen strategy for heavy industry has given forestry a half-century task, both to provide capital for industrial development, and to provide a sustainable supply of timber for this industrial development. Long-term over-cutting has exhausted the forest resources in much of China. Conflicts between economic, ecological and social objectives were acute. After 50 years of over-cutting, the economic, ecological and social objectives were not being satisfied. To solve these problems, China implemented the Natural Forest Protection Project (NFPP). NFPP focuses on the work of state-owned forests previously used for timber production. The function of forests has not changed, but the NFPP changed the status of the economic and ecological functions of forests, so that the original emphasis on the forest's economic function has been replaced by its ecological function.

The objective of this thesis is to evaluate the effectiveness of the NFPP. This evaluation is based on achievements, over the first 10 years of the new century, of the NFPP. China's north-east forest is used as a case study for this purpose; and is the evaluation based on an analysis of the Sixth National Forest Inventory (2004) and the Eighth National Forest Inventory (2013).

The conclusion of this thesis is that the NFPP did not completely solve all problems arising from over-cutting. This is ultimately because: a) the conflicting objectives society places upon forests are permanent; and b) given the slow rate at which forests grow, a long time is needed to realize the objectives of the NFPP. In addition, we also conclude that the future success of the NFPP hinges upon the government continuing to invest more capital in order to reform the structure of the forest industry in China.

Keywords: forest management, over-cutting, China, Natural Forest Protection Project

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1.0 INTRODUCTION

In this thesis, China's Natural Forest Protection Project (NFPP) is examined and evaluated. China's north-eastern forest region is used as a case study for this purpose. Based on the results of the Sixth National Forest Inventory (2004) and the Eighth National Forest Inventory (2013), the forest situation in the north-eastern region will be analyzed and evaluated. The data collected and analyzed constitute the method of this thesis. China's Forestry Yearbook data, from 1998 to 2014, and data from two national inventories data are the sources of all Figures and Tables presented in this thesis.

1.1 Problems of Over-Cutting

In 1949, New China chose a planned economic system and formulated a strategy for the development of heavy industry. This strategy was developed with the objective of selecting the optimal means of meeting of China's economic, political, social, environmental, and ideological objectives. The chosen developmental strategy for heavy industry has given the industry of forestry a half-century task-- both to provide capital for the for the forest industry, and to provide the timber supply needed for economic development.

Since 1949, China's timber harvesting was conducted mostly in natural forests, in which large diameter timber was strongly preferred. According to the Forestry Year Book (2000), from 1949 to 2000, national timber production required the annual harvesting of 50 billion cubic meters, of which 60% -70% came from natural forests.

In 1997, the national output of commodity timber was 56.14 million cubic meters, of which 61% came from natural forests, while planted forests accounted for 39%. In addition, 98.5% of the timber harvested in the northeastern, northwest, and southwestern state-owned wooded areas, came from 131 timber harvesting enterprises operating in natural forests (Hu 2009).

During period of 1949 to 1993, over-cutting flourished. According to the results of the Third National Forest Resource Inventory (1993), China's mature timber forest underwent an annual average deficit of 1.7 billion m^3. Within the three provinces of Inner Mongolia, mature forest was reduced by 1.1 million m^3 per year. Furthermore, according to the 1989-1993 inventory, forests containing valuable timber had been in continuous decline during the period between the two inventories, thus reducing the annual harvest by 200 million m^3, and resulting in an annual deficit of 54 million m^3. According to the forecast of Chen (1999), 60% of the National Forestry Enterprises would to have no forest to harvest by the year 2000.

Over-cutting impacts the stability of the economy and of society. Given the history of over-cutting, forest resources have diminished, and forest ecosystems have degenerated. As a result of the rapid decline of forest resources, the whole forest industry experienced a slump, and the welfare benefits of workers declined. As a result, societies in forested areas were facing severe challenges. The management of forestry enterprises, therefore, had to address acute challenges in order to meet the objective of sustaining social stability. Without a specific, practical solution, an increase in unemployment was destined to rise.

1.2 Reaction to Problem: The Natural Forest Protection Project of 1998

In 1998, after 50 years of over-cutting, it became acutely apparent that the economic, ecological and social objectives of state-owned forests were increasingly difficult to satisfy. State-owned forests had been through a redistribution period, and the government also began to assign a higher priority to meeting ecological objectives.

Restoration of the National Forests' ecosystems, and the provision of ecological benefits, requires two important conditions: i) the first is a huge investment in capital in intensively managed plantations to replace natural forests as the dominant source of wood supply; and ii) the second is a long period of time needed for recovery. China is a developing country, and, in 1998, was unable to provide the required investment in capital. If the government were to wait until the economy improved, thus providing the necessary funding for plantations, then there may, in the meantime, be an irreversible transformation of the ecological environment of natural forests.

In this situation, an innovative policy was needed, and was brought forth in 1998. It is known as the Natural Forest Protection Project (NFPP). The basic strategy of the NFPP is to replace the supply of timber from natural forests with a supply of timber from artificial, intensively managed plantations and thereby protect natural forests without a drastic downturn in timber supply. Since 1998, China has invested much capital to start the implementation of the Natural Forest Protection Project. Reality requires China to complete the process of industrialization and modernization in a relatively short period of time and to catch up with the Western developed countries;

and the NFPP was designed not to repeat the mistakes of the industrialized Western countries with regard to the permanent degradation of natural forests. The vision of NFPP is to lay the groundwork for a new industrialized civilization, in which the process of industrialization does not threaten the protection of natural forest resources (Cao 2000). The NFPP was designed to focus on the multiple benefits of state-owned forests. These benefits include timber production, the protection of the natural forest environment, and construction of a strong forest industry, from which society may benefit sustainably.

The implementation of the Natural Forest Protection Project requires the following broad steps to be taken (Baidu 2016): i) reclassification and zoning of natural forests; ii) redirection of forest management, for purposes of timber supply, from natural forests to plantations; and iii) the promotion of natural forest resources protection. Through these means, the NFPP was designed to meet ecological, social and national economic objectives sustainably.

A more detailed look into the NFPP (Li 2014) reveals a commitment to accomplishing the following actions:

1. Clearly define, classify, and identify geographically, the diversity of China's natural forest resources. In each of the categorically distinct natural forests, core protected areas must be established, where the prohibition of cutting and hunting must be enforced, and the elimination of forest fires and any types of destruction must be managed.

2. Establish and enforce the paid use of natural forest resources. Collected funds will

be used to compensate to the communities dependent upon forests.

3. Protect the legitimate rights of operators and staff working on National Forests.

4. Establish and improve protection mechanisms necessary for the preservation of natural forest resources.

In the NFPP, the functions of forests have not changed. What has changed is the status of the economic *versus* ecological functions of the forest.

1.3 Natural Forest Protection Project Content

The Natural Forest Protection Project is to be implemented over three periods:

1. Experimental period (1998-2000 in North-East forest).
2. First period (2000-2010).
3. Second period (2011- 2020).

1.3.1 Experimental Period: 1998-2000

The experimental period of the NFPP occurred in the North-East forest, from 1998 to 2000. The State Forestry Administration implemented the plan of the NFPP in key, state-owned forest regions of Inner Mongolia and the Northeast. The experimental period of the NFPP required that the forest be divided into three categories: i) forests where cutting is forbidden; ii) forests where limited cutting is permitted; and iii) forests where intensive commercial management is to occur.

The total area of forest protected in the Northeast of China and of Inner Mongolia is now 317446 ha, of which 2377800000 ha were designated as ecological protection

areas. The total area to be protected accounts for 74.9% of the total forested area. Commercial forest management areas were allocated 796 ha, accounting for 25.1% of the total forest area (SFA 2000).

1.3.2 First Period: 2000-2010

The first period of NFPP occurred from 2000 to 2010, on a national scale. The goals were (State Council 2006): i) to reduce the timber production from natural forests; ii) to restore the ecological functions of natural forests, and iii) to enforce the protection of natural forests.

These three goals entailed: a ban on harvesting from natural, state-owned forests in the North-east and Inner Mongolia, and strict control over the consumption of timber. These steps were achieved by the managed protection of natural forests, thus alleviating the deterioration of the ecological conditions of natural forests.

1.3.3 Second Period: 2011-2020

The second period of NFPP is to occur between 2011 and 2020. The main mission is to continue to implement forestry classification, and to improve industrial efficiency (SFA, 2011). This mission requires:

1. Continued refinement and implementation of a scientifically rigourous forestry classification system, and a commitment to improving the industrial efficiency of intensively managed plantations.
2. Further reduction in timber production, in the North-East and Inner Mongolia, on

key, state-owned forests.

3. Strengthening the commitment to sustainable forest management, planning, and protection.

4. Strengthening the cultivation of forest resources on plantations and expanding the forest areas under such a management regime in order to optimize the National Forest's age-class structure, and to improve the quality of the timber supplied.

5. Guaranteeing and improving the livelihood of the societies dependent on forest resources.

1.3.4 Implications for Supply and Demand of Timber

The content of the NFPP represents a long-term commitment the design of a forest classification system, the permanent establishment of forests serving the public welfare through ecological protection, and the construction of economically efficient and intensively managed plantations (Zhou 2000).

The NFPP divides the forest into two main types: public welfare forests and commodity forests. After the immediate implementation of the NFPP, timber production was significantly reduced, resulting in the expansion of a gap between timber supply and demand. In the short-term, this gap will be filled by a rise in the import of logs. In the long-term, this gap will be filled by the supply of timber from intensively managed forests (Chen 1999).

The implementation of the NFPP will affect the income and living standards of the

people dependent on timber production, in the short-term. Therefore, cultivating new economic growth requires maintaining local incomes. This is an important part of the implementation of the NFPP. The planning of economic projects, during the conversion period from reliance on natural forests to plantations, is, therefore a key to the success of the NFPP (Zhuang 2003).

1.4 Evaluation of the NFPP's Solution

A report (State Forestry Administration 2008) on the social and economic benefits of key forestry projects, that occurred in 2007, reveals that: the implementation of the NFPP has effectively alleviated the forest resource crisis and the enterprises' dangerous situation. Natural forests have been effectively protected, forest vegetation has been effectively restored, the reform has been further deepened, and the economy has been rapidly developed (SFA 2008).

According to the 1988-1992 National Forest Inventory (Figure 1.1), the national forest area reached 130.93 million hectares, stock volume reached 10.9 billion cubic meters, and the forest coverage rate rose to 13.63% (DFRM 1994).

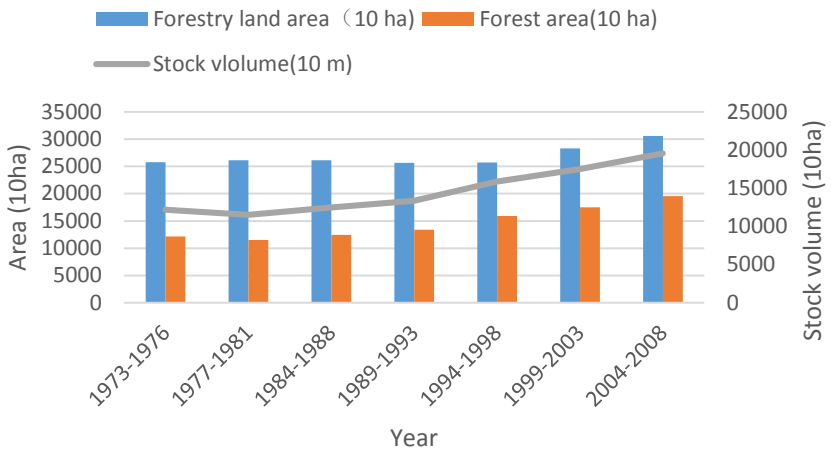

Figure 1.1: National forest change between national forest inventories

(Source: China Forestry Network, 2008).

Compared with the Second National Forest Inventory (1977-1981), the forest area increased by 12.2 million hectares, the standing timber stock increased by 202 million cubic meters, and the forest coverage increased by 1.27 percentage points. Figure 1.1 also reveals that the NFPP has achieved growth in both forest area and forest volume. On the other hand, the Report showed that the volume of timber that could be harvested in mature forest still showed a decreasing trend.

Since 1998, due to the implementation of the NFPP and the construction of capital investment, natural forest cutting has been reduced, and forest cultivation has increased (Bai 2008). Table 1.1 reveals that, after 1998, China's forest resources experienced a recovery, and the growing stock and forest area experienced a rapid increase.

Table 1.1: The current forest resources of China.

Period	Forestry land area (10^4 ha)	Forest area (10^4 ha)	Stock volume(10^4 m^3)	Forest cover rate (%)
1973-1976	25,760	12,186	865,600	12.7
1977-1981	26,102	11,528	902,800	12
1984-1988	26,131	12,465	914,100	12.98
1989-1993	25,677	13,370	1,013,700	13.92
1994-1998	25,705	15,894	1,126,700	16.55
1999-2003	28,280	17,491	1,245,600	18.21
2004-2008	30,590	19,545	1,372,100	20.36

Source: Forestry Yearbook, 2008.

After 1998, China's forest resources experienced a recovery and the stock volume and area began increasing (see Table 1.1); but the young and medium aged forest proportion remained high, while the proportion of mature and over-mature forest remained low.

The results of the Seventh Forest Resource Inventory show that, in the period of 2004-2008, the natural forest was effectively protected, the area of natural forest increased by 3.93 million ha (see Figure 1.2, below), and the standing volume increased by approximately 676 million m^3.

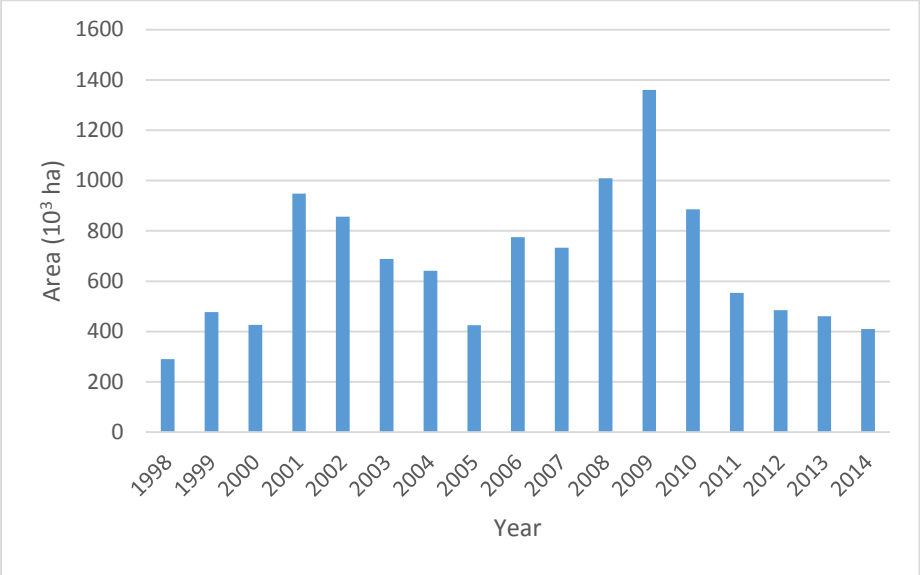

Figure 1.2, Afforestation area over the years by NFPP
Source: China Forestry Network, 2014

Over the same period, the area and accumulation of plantations also increased rapidly. The area of plantations increased by 843.11 million m^2 and standing volume increased by 447 million m^3. In addition, the harvesting of timber was gradually shifted from natural forests to plantations; and the volume of plantations comprised approximately 40% of the total.

In addition, the practice of forest management also underwent fundamental changes between 2004 and 2008. After the reform of forest tenure, the individual management area of forest land increased by 11.39% (Zhu 2006). Privately managed plantations had become the main component of forest land management. Although China's forest resources experienced a recovery between 2004 and 2008, forest resources still remained scarce, relative to historical supply levels.

Hence, in the first phase of the NFPP (1998-2010), the problem of recovering from over-cutting had been slightly alleviated; but, after the second period, the country executed a more comprehensive set of measures, such as artificial reforestation and cultivation to speed up the cultivation of reserve resources, and thereby improve the stand structure and the forest productivity of the country's forests (Forestry Agency 2011).

From an economic perspective, there are several noteworthy impacts of the Natural Forest Production Project (Zhuang 2000).

1. Impact on timber supply and forest structure:

China's troubling gap, between supply and demand for timber, persisted after the implementation of the NFPP. The gap persisted mainly among precious tree species of large diameter, and high-grade pulp fiber material. Natural forests had been the main source of supply of these products.

2. Impact on import and exports of forest products trade:

After the implementation of the NFPP, there was a clear reduction in the quantity of timber harvested, but demand remained high. Hence, there was a major increase in the importation of logs from abroad (Jiang 2015).

3. Impacts on forestry enterprises and forestry companies:

The implementation of the NFPP completely stopped logging in natural forest areas, thereby reducing the country's timber production. Therefore, the forest industry enterprises were faced with a necessary transition (Liu 2013); i.e.,a transition from an exclusive emphasis on harvesting to broader practices of forest management.

4. Impact on traditional wood processing industry:

The reduction in the domestic supply of wood will lead to a decline in the supply of domestically processed forest products (Hu 2010).

1.5 Evaluation

China invested about 110 billion RMB in the NFPP over its first period. This investment of the NFPP was mainly spent on management fees, basic old-age insurance subsidies, the policy of social spending subsidies, laid-off workers, resettlement fees, and other subsidies (SFA 2001). It is, therefore, not surprising that different people have formed different evaluations on the efficacy of the 110 billion yuan of capital investment.

Some people think that, although the amount of investment is huge (for state-owned forests), there remains no fundamental solution to the problem of recovering from the over-harvesting of natural forests. For example, Cao (2009) has argued that the massive capital investment only made the trend in the deterioration of forest resources mildly suppressed. In addition, Cao (2009) argued that the economic benefits, previously enjoyed from harvesting, will remain in decline, and that the massive investment did not transform the forest economy such that long-term, sustainable economic objectives can be met (Cao 2009). In conclusion, an evaluation of the economic, social, and ecological benefits of the NFPP forces one to concede these benefits are not unanimously obvious.

The NFPP is a policy that the government provided to manage the forest sustainably.

The NFPP, however, did not, and could not, solve all problems. The conflicts between sustainable forests and human demands have existed for more than half a century, in all developing countries. People, therefore, must understand that the full benefits of this policy need a long time to reach fruition. In addition, the government's investment in the NFPP cannot waiver in the future, if the objectives of the policy are to be met.

An evaluation of the NFPP must be balanced. On the one hand, the NFPP appears to be a sound reaction to solving the over-cutting problems in China; for it relieves the unsustainable pressure placed upon natural forests to meet China's timber-supply needs. As a result, the growing stock of natural forests has since increased. In addition, the NFPP has led to an increase in the import of timber and timber products in order to replace the supply that had previously been met by harvesting natural forests. On the other hand, the focus of the government on tending and protecting of natural forests is not enough to exploit the full potential of China's forests in a sustainable manner. In addition, over-control of local enterprises from government tends to decrease economic efficiency. Finally, the structure of forest enterprises still requires deep reform.

In this thesis, the major effects of over-cutting in the North-East forest area will be presented and analyzed. The changes that happened in the North-east area are presented in tables and graphs. The North-East forest area will be used as a case study by which to evaluate the NFPP.

2.0 METHODS

In this thesis, an exploration and evaluation of the NFPP is the objective. This objective is met by examining data on the condition of forest resources and the supply of timber in north-eastern China after the implementation of the NFPP. In other words, data from the northeastern region is to be used a case-study by which to evaluate the NFPP. The northeastern region is used a case study because: a) forestry is highly significant to the region; and b) data collection for the entire country would be too large an undertaking for an undergraduate thesis.

The data collected on the condition of China's northeastern forest region was collected from the Sixth National Forest Inventory (2004), the Eighth National Forest Inventory (2013) and Forestry Yearbook data from 1998 to 2014. Hence, data collection and analysis constitute the central methods of this thesis.

Evaluation of the NFPP was based on the criteria of successful advances made in: i) forest ecosystem protection, and ii) economic achievements. The economic criteria will be represented by data on wood production, investment, and afforestation. The protection of forest ecosystems will be represented by data collected on forest coverage, age class structure, forest volume, plantation forest area and other indicators. Success of the NFPP is measured by comparing data related to these two criteria both before and after the implementation of the NFPP.

3.0 RESULTS

3.1 Introductory Data on North-East Forest

The northeast state-owned forest area is composed of forests in Heilongjiang and Jilin provinces. The state-owned forest areas of Heilongjiang province are mainly distributed in the great Xing'a Mountains, small Xing'an Mountains and Changbai Mountains, which contain the main bodies of terrestrial ecosystem in northeastern China. The state-owned forest area of Jilin Province is in the core area of Changbai Mountain forest (see Figure 3.1).

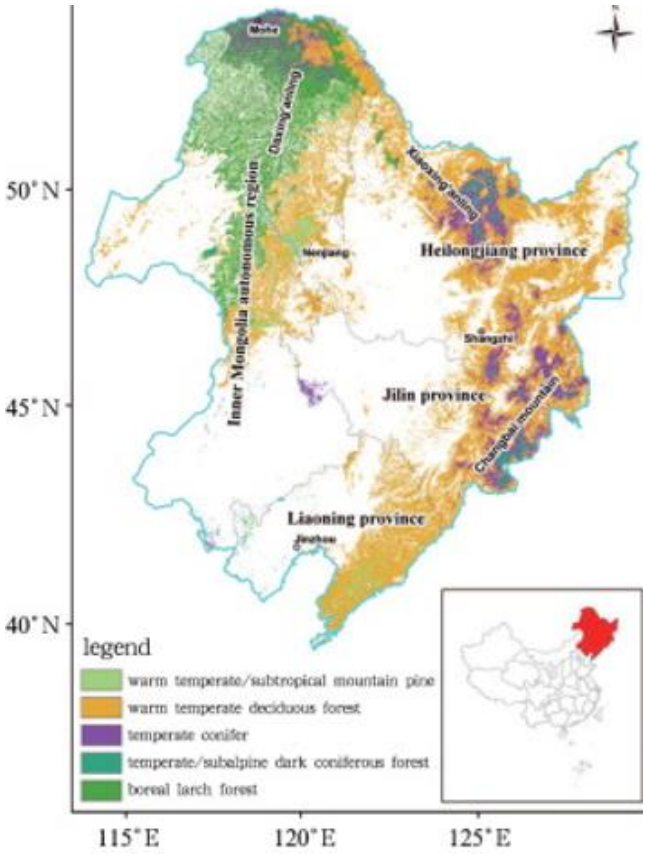

Figure 3.1 The location and distribution of main forests in northeast China
Source: Geodata.cn 2016

Jilin Province is in the central part of northeast China. The terrain tilts from the southeast to the northwest. The eastern part of the province is mountainous area and is rich in forest resources while the western part is dominated by plains, agricultural belts, and protected forest. The forest vegetation types are coniferous forest and deciduous broad-leaved forest. According to the results of the Eighth Inventory (2009), the forest area of Jilin Province is 8,561,900 hectares, 96,100 hectares of which is regarded as economic forest area. The forest coverage rate is 40.4%. The total standing volume is 922.5737 million cubic meters, and the mean volume per ha is 122.45 cubic meters per hectare. The ownership of forest resources is dominated by state-owned forests: 76.5% of the forest area and 87.7% of the forest volume in Jilin are state-owned. Natural forest area occupies 78.96% of the total forest area and contains 88.73% of the province's standing volume (Forestry Agency 2010).

Table 3.1: Current forest dimensions in Jilin province and Heilongjiang province

	Forest area(10^4 ha)	Forest cover rate (%)	Stock volume($10^4 m^3$)	Nature forest area cover rate (%)
Jilin	8,561,900	40.38	92257	87.72%
Heilongjiang	19,621,300	43.16	164487	87.44%

Source: Forestry Agency, 2013

Heilongjiang Province is in the northeastern part of China. Forest resources are abundant in this province, and are mainly distributed in the large Xing'an Mountains, small Xing'an Mountains, Changbai Mountains. Wandashan, is one of China's key state-owned forest areas. The main types of forest vegetation are coniferous forest and

broad-leaved mixed forest and deciduous broad-leaved forest. According to the results of the Eighth Inventory of Heilongjiang Province (Table 3.1), forest land area is 22.0740 million hectares, 124.3 thousand hectares is economic forest, and the proportion of the province covered by forest is 43.16%. The total standing volume is 164,487 million cubic meters. The mean volume per hectare per hectare is 84.37 cubic meters.

In Heilongjiang Province, the proportion of forest resources that are state-owned is relatively large: 94.01%. Natural forest comprises 87.44% of the total forest area. Natural forest accumulation accounts for 90.02% of the proportion of forest accumulation (Forestry Agency 2010).

3.2 The Northeastern Forest within the National Context

The distribution of forest resources in China (see Table 3.2) is mainly characterized by the following: the forest resources are unevenly distributed, the natural forest resources are scarce, and are mainly distributed in the northeast, Inner Mongolia and southwestern state forest regions. In addition, and the distribution of forest resources does not match the wood processing industry.

Table 3.2: Forest regions in China

Area	Forest area (10^6 ha)	Proportion (%)	Forest Volume (10^9 ha)	Proportion of whole area(%)	Forest cover rate(%)
North-ease	36.57	27.8	3	30.3	23.3
South-west	28.11	21.3	4.46	45	22.07
South	46.64	35.4	1.46	14.7	30.05
Other	20.41	15.5	1	10	5.06

Source: China Forestry Network, 2013

From Table 3.2, one can observe that the southwestern and northeastern regions contain the highest volumes of standing timber and that the central and southern regions contain the lowest.

3.3 Economic Impact of NFPP in the Northeast.

The results of the Seventh Forest Resource Inventory (2009) show that, between the years 2004-2008, the natural forest was effectively protected, the area of natural forest increased by 3.93 million hectares and the standing volume increased by about 676 million cubic meters.

Over the same period, the area of plantations also increased by 843.11 million ha and the standing volume increased by 447 million ha (see Figure 3.1). In addition, the harvesting of timber gradually shifted from natural forests to artificial forests, and the volume of plantations grew to comprise about 40% of the total forest area (SFA 2011).

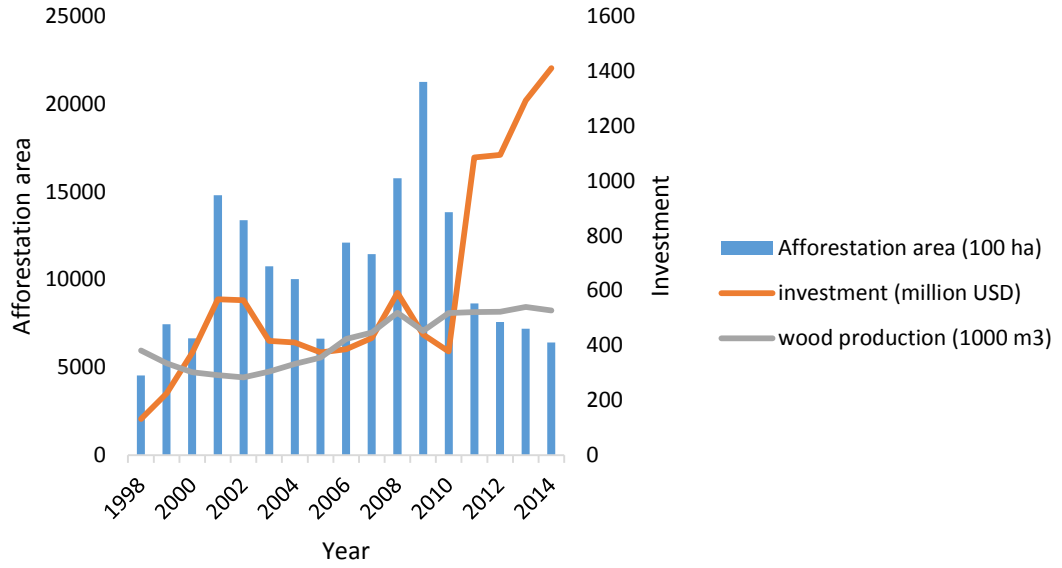

Figure 3.1: Data on afforestation, investment, and wood production from 1998-2014.

Source: Forestry Yearbook, 2004

Since the implementation of the NFPP, the consumption of forest resources decreased by 61 million m^3, the commercial timber production declined by 12.39 million m^3, and the area of forest increased to 86 million hectares (Figure 3.1). Over this same period, the decline of production in the Northeastern forest was 7.51 million m^3.

Figure 3.1 also shows that the investment from the government increased—especially after the second period of the NFPP, in 2010. This investment was aimed at restructuring the forestry industry.

Figure 3.2 shows that the trend in volume harvested over time. Here one can observe that the harvested volume declined from 1996 to 2010 (first period of NFPP). The percentage of decline was about 25% in Heilongjiang province, 30% in Inner Mongolia province and 15% in Jilin province. As of 2014, the decline was about 75% for Heilongjiang province, 40% for Jilin province, and 60% for Inner Mongolia.

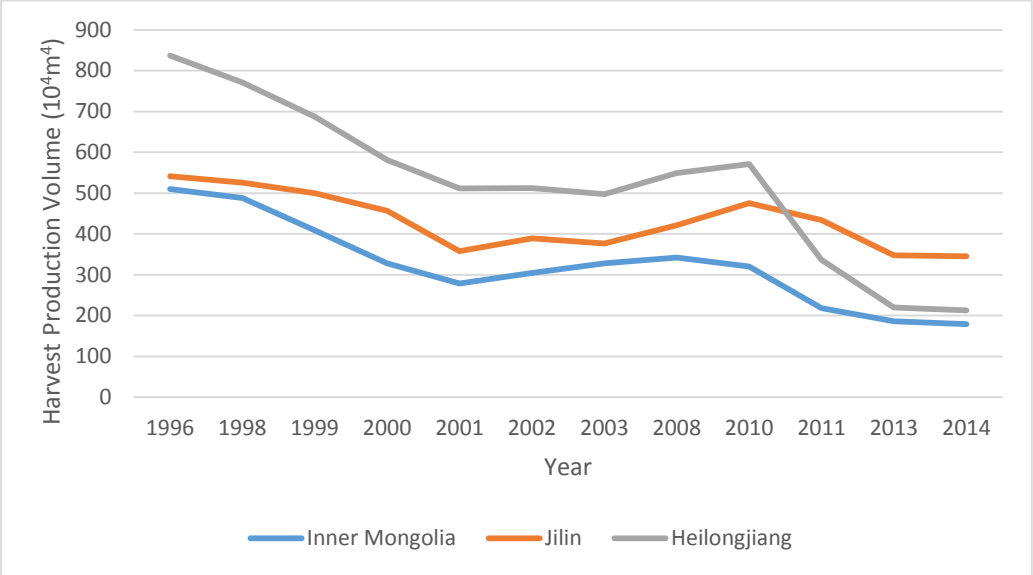

Figure 3.2 Annual harvest rates in three northeastern provinces
Source: Forestry Yearbook, 2014

Figure 3.3 (below) shows the changes in plantation areas in the northeast between 2004 and 2013. The plantation area in Jilin was 1,726,300 m^2 in 2004 and increased to 24,653 m^2 in 2013. The plantation area of Heilongjiang was 14822 m^2 in 2004 and increased to 16056 m^2 in 2013. Since 2004, the area devoted to forest plantations has increased 600000 m^2 in Jilin and 200000 m^2 in Heilongjiang (a big part of Inner Mongolia is grassland). Jilin province, because of its location, is a key province to develop commercial forestry. The importance of Jilin is another reason that it did not experience so acute a reduction in its harvest levels as Heilongjiang did.

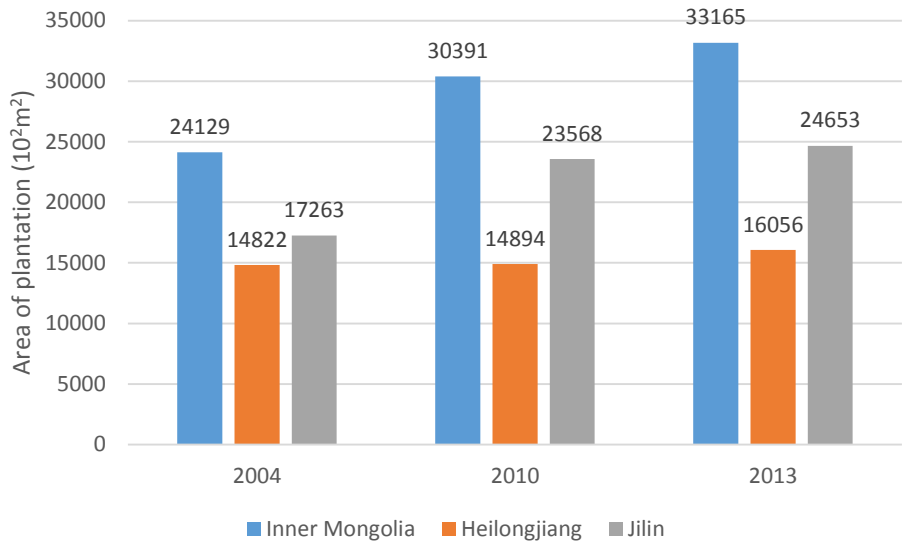

Figure 3.3: Area of plantation by year for three provinces

Source: China Forestry Network, 2014

3.3 Ecological Impact of the NFPP in the Northeast

Table 3.3 shows that the area of forest in Jilin Province is now the largest in the northeast, with an area of 4.08 million hectares, accounting for 53.42% of the total forest area in the northeast. The forest volume is distributed as follows: 35.04% is in shelter forests, 9.91% is in special purpose forests, 55.02% is timber forests, and 0.03% is firewood forests (Table 3.3).

Table 3.3 Growing stock volume, area by usage type, and ages in Heilongjiang and Jilin in 2013.

Province	Species	Total		Young		Medium		Near-mature		Mature		Over-mature	
		Area (10^2ha)	Volume (10^2m^3)	Area (10^2ha)	Volume (10^2m^3)	Area (10^2ha)	Volume (10^2m^3)	Area (10^2ha)	Volume (10^2m^3)	Area (10^2ha)	Volume (10^2m^3)	Area (10^2ha)	Volume (10^2m^3)
Heilongjiang	Total	194970	16448701	44754	1597433	80707	6763851	36065	4078961	22850	2740376	10594	1268080
	Shelter forest	123439	10373794	29289	1087773	50437	4199409	22750	2596698	14042	1710420	6921	779494
	Special purposes	18792	1782686	3771	90645	6939	602845	3449	414183	3067	421564	1566	253449
	Timer forests	52548	4287531	11599	419015	23299	1959970	9866	1068080	5677	605329	2107	235137
	Fuel-wood	191	4690	95		32	1627			64	3063		
Jilin	Total	75342	9225737	18598	736880	20054	2165464	19203	2903926	13569	2547366	3918	872101
	Shelter forest	29083	3232326	7362	229375	7441	747843	7804	1092971	4831	833349	1645	328788
	Special purposes	5217	914301	851	29172	1262	144793	1359	255762	1379	367201	366	117373
	Timer forests	40807	5075956	10150	475179	11351	1272828	10040	1555193	7359	1346816	1907	425940
	Fuel-wood	235	3154	235	3154								

Source: China Forestry Network, 2014

Table 3.3 also shows that shelter forests are largest in Heilongjiang, taking up 12.349 million hectares, and accounting for 62.91% of the total. As a percentage of total volume, 63.07% is found in shelter forests, 10.84% is in special purpose forests, 26.06% is in timber forests, and 0.03% is in firewood forest (Table 3.3).

Figure 3.4 (below) shows the age-class structure of the forests in Heilongjiang and Jilin in 2014. In Heilongjiang province, the young and medium aged forests take up 64% of the total area and 51% of the total volume; the near-mature and mature age forests take up 30% of the total area and 42% of the total standing volume. In Jilin province, the young and medium age forests take up 52% of the total area and 31% of the total volume. The near-mature and mature age forests take up 43% of the total area and 59% of the total volume.

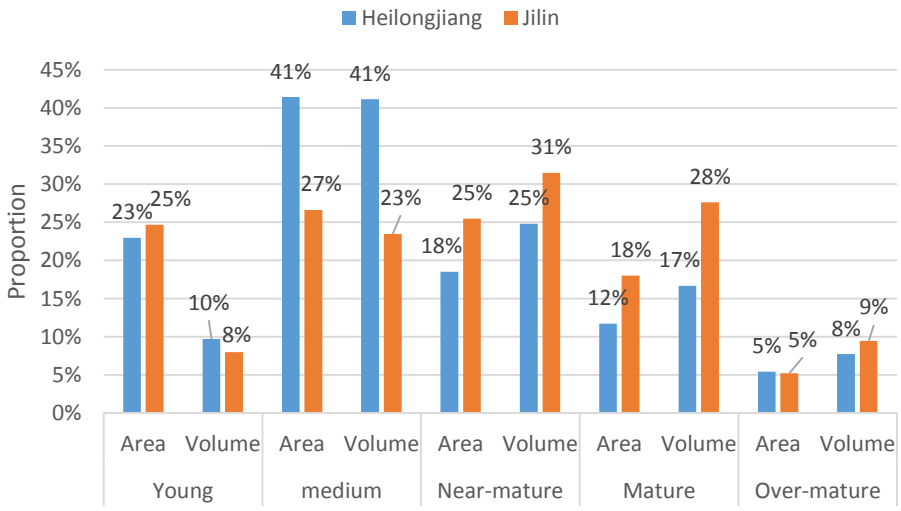

Figure 3.4: Age class structure of forests in Heilongjiang and Jilin in 2013.
Source: China Forestry Network, 2014

Figure 3.5 (below) shows the age class structure of forests in Heilongjiang and Jilin in 2004. In Heilongjiang province, the young and medium age forests took up 72% of

the area and 57% of the volume of the total in the northeast. The near-mature and mature age forests take up 23% area and 35% of the volume of the total. In Jilin province, the young and medium age forests take up 58% of the area and 38% of the volume of the total. The near-mature and mature age forests take up 38% area and 52% volume of the total.

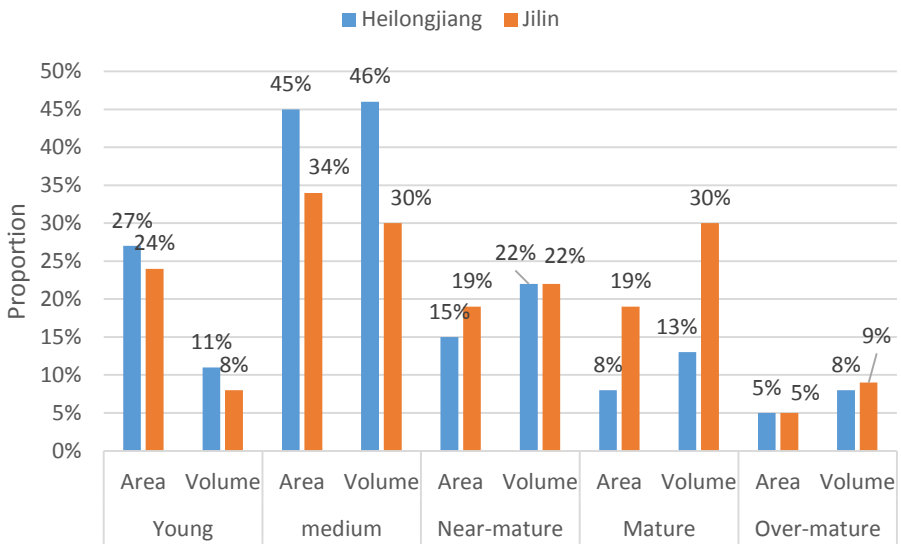

Figure 3.5: Area and accumulation Proportion of forest trees of Heilongjiang and Jilin in 2004
Source: China Forestry Network, 2005

In Figure 3.7 (below), changes in the mean volume per ha, in the northeastern forests, from 2004 to 2013, are presented. Here, one can observe that the volume per ha has remained relatively steady in all three provinces through this period. Heilongjiang has the highest volume per ha, which is approximately 300 m^3/ha. This is because Heilongjiang still has some old growth. Inner Mongolia has lowest level because it has more grassland than forest land. There is no obvious increase in volume

per ha volume since the implementation of the NFPP. Hence, the quantity and quality of timber resources have remained a serious challenge in the northeastern China since the implementation of the NFPP.

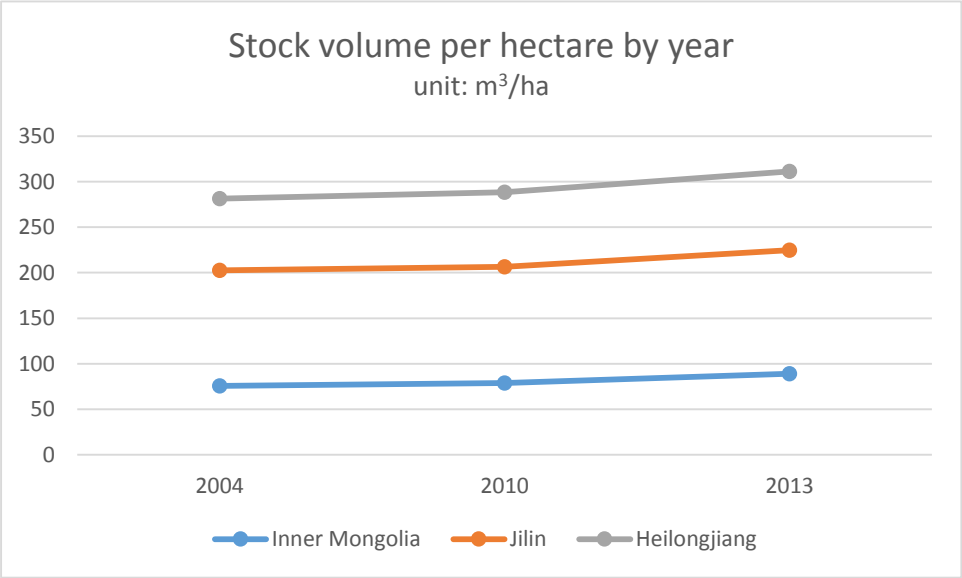

Figure 3.7: Stock volume per hectare by year for three provinces.
Source: China Forestry Network, 2014

4.0 DISCUSSION

4.1 Economic Impact of the NFPP on China's Northeast

The forest resources of China are not evenly distributed (see Table 3.2). The northeastern forest is the main source of timber supply for China. After the founding of new China in 1949, the cumulative production of wood from the northeastern forest was more than 1 billion cubic meters (DFRM 2010). In the initial stage of this history, the development of the forest economy was dependent exclusively to the logging of timber from natural forests. Hence, the initial economic and industrial development model placed an over-reliance on natural timber resources (Li 2004). The development of the northeast state-owned forest area was therefore reliant on unsustainable harvest levels and was thereby caught in a "resource trap". As a result, a series of economic and social problems has appeared and the pace of economic development in the forest-based economy had slowed down and even retrogressed in some areas.

In addition to the unsustainable harvest levels, the northeastern forests economy has also been affected by a change in values, resulting in a demand of the state to protect natural forests. These two factors have resulted in a steady decline in timber production in the northeast, as illustrated in Figure 3.2. This decline in timber supply has greatly stimulated timber imports to compensate for the lack of timber production from the Northeast forest (Figure 3.1).

The northeastern forest-based economy, if it is retain its prominent role in China,

must therefore develop intensively managed plantations to meet the demand for timber products. The NFPP clearly includes a response to this ultimate necessity for increased plantations. This response has been not merely in words, but in accomplishments: the area of plantations in Jilin and Inner Mongolia has increased between 2004 and 2010 and still going up after the second phase of the NFPP, after 2010 (Figure 3.3).

After the implementation of the NFPP in 1998, the investment from government in the forest industry of the northeast has increased gradually. The area of plantation has increased in three provinces (Figure 3.3) to meet the commercial requirements of local enterprises. In addition, the management structure of local enterprises is undergoing reforms in order to increase efficiency.

The forest structure in the northeast has shown an observable reform since 1998, but this is because of the no cutting policy of NFPP. The forest-based economy continues to suffer because the harvest levels have decreased in all three provinces (Figure 3.2). These data therefore point to the necessity that investment from government in the forest-based economy of the northeast must continue in the future.

4.2 Ecological Impact of the NFPP on China's Northeast

The age class structure of a forest is a major indicator used to evaluate the objective of conserving biodiversity. At present, the age-class structure of the forests in China's northeast is not positive. For example, Figures 3.4 and 3.5 show that the young, and medium age forests take up a big part of the entire forest, which reflect the achievement

of plantation treatment; but that there is a shortage of older forests needed to provide habitat for species dependent on old growth.

Mature and near-mature forest are under-represented in whole North-east forest. This is because timber harvesting has traditionally been more concentrated in these age-classes, where the timber quality is high. Jilin Province is slightly better than Heilongjiang Province with regard to the conservation of mature forest, but mature forest resources are still acutely under-represented (Figure 3.4). Compared to the statistics in 2004 (Figure 3.5), the area of near-mature and mature forest increased, but the volume decreased, which means the forest quality is declining with regard to providing habitat for species dependent on old growth.

4.3 Economic Problems and Solutions

4.3.1 Forest Industry Problems

Timber harvesting is still the main source of income for many business enterprises in the northeast, and plantations now play a major in supplying timber. Since the mean volume per ha is low (Figure 3.6), artificial forests must therefore expand in area to supply timber China's demand. There remains a major shortage in the supply of large diameter timber, and this problem has been temporarily solved by elevated levels of large diameter log imports (Wang 2011).

A sustainable future supply of Chinese logs is not, therefore, simply a matter of temporarily balancing supply with demand, but one of reforming the age-class structure on plantations; and this problem will take a long time to solve, given the slow rate at

which forests grow. In the meantime, China's economic and social development requires that the demand for logs be satisfied by additional imports, both in terms of quantity and quality.

The restructuring of the forest industry, entailed by the NFPP, has also included tenure reform. After the reform of forest tenure system, the individual management area of forest land has increased by 11.39% (Office of the State Council 2016). The self-managed plantation has already become the main body of forest land management. Although China's forest resources can recover over the long-term, China’s forest resources remain acutely scarce. The demand for timber is increasing, and the forest industry structure should therefore persist in tenure reform in order that the supply of logs can become more efficient and natural forests be protected (Figure 3.5).

Through the NFPP, reforms in the state-owned forest area have accelerated. The government has launched six pilot projects on forest management reform in the northeast and Inner Mongolia. In addition, Jilin Province has divested its forest enterprises from social functions, and transferred the schools and hospitals run by the enterprises to the local governments. The Jilin Forest Industry Group has implemented a new shareholding system in the wood processing industry (SFA 2000). Yichun, of Heilongjiang province, also carries out reformed forest land contracting (Zhou 2008).

These reforms have achieved many positive effects, but the overall reform related to deep-level, institutional problems has not yet been fully addressed. That is, the reform thus far implemented have addressed problems in the forest resource management system and the forest property rights system; but the profound problems

of institutional mechanisms and their relation to social functions at the local levels have not been rectified yet; and the issue of separation of government and enterprise has also not been fully addressed.

Due to the high cost of reform, lack of sufficient funds, problems left over by history, and many other factors, the progress of reform is a huge challenge: the ultimate direction and intuitional depth of reform remains an incomplete vision, property rights have become blurred, and the intimate union of government and enterprises still persists (Wu 2013).

4.3.2 Development of New Industries

New industries need to be developed in order to offset the economic losses resulting from a decline in harvest levels from natural forests. In the northeast, the opportunity exists to refine or develop four major industries.

1. Forest Products Industry: The forest products industry needs to develop an advanced, value-added approach to processing wood. The value-added processing of wood, can greatly increase the value of wood products. Through intensive processing, compared with the past, the same unit of the wood can be increased in value several times, or even ten times. Hence, the development of a value-added industry in the northeast can achieve a large increase in the output value of forest products industry.
2. Forest Land Industry: Some of the forest land use in the northeast can be diversified to cultivate products other than wood. The potential exists for the

establishment of aquaculture, planting high-value agricultural products, and other production bases.

3. Green food industry. The green food industry holds the potential to for rapid returns on the cultivation of land previously used for slow-growing forests. The aquaculture industry is well disposed to help meet China's demand for green food. Employment opportunities can be expanded by the planting and gathering industry. Further economic development can occur by advanced processing of green food and integrating advanced green food products within the supply chain of China's food industry..
4. Forest Tourism: The increasing prosperity of China has resulted in an explosion of the tourism industry, and the forests of the northeast are an attractive destination. Forest tourism to Changbai Mountain is well established, but can be expanded further. The northeast must take full advantage of the great beauty of its natural scenery and vigorously develop forest-tourism through the establishment of nature reserves, forest parks and tourist routes. The clean air and unique beauty of the northeastern forests gives it the potential to become an international tourist destination. This ultimate vision of international tourism in the northeast must be propagated and pursued.

4.4 Ecosystem Problems and Solutions

4.4.1 Problems

The complete ecological restoration of forests in northeast is goal to be realized in

the distant future. At present, the task of protecting the existing growing stock of natural forests is paramount. In addition, the age-class structure of these natural forests must be managed to increase the area near-mature and mature forest.

The current age-class composition of forests in the northeast is not positive (Figure 2.3). Mature and near-mature forest proportion are not a big part in whole of the northeast. Given the protection of mature forests, timber harvesting must be concentrated upon the near-mature and middle-aged forest where the timber quality is not high, and the supply is limited (Figure 2.4). Jilin Province is slightly better than Heilongjiang Province with regard to the supply of middle-aged timber, but mature forest resources are still limited (Figure 2.4). Compared to the forest statistics of 2004 (Figure 2.5), the area of near-mature and mature forest has increased, but the volume has decreased, which means the forest quality is declining.

4.4.2 Intensive Management is the Future

For solving the ecosystem problem, the implementation of mixed species cultivation, through planting and tending of secondary forests. is needed. The artificial cultivation of Pinus koraiensis forests holds great promise. Planting should average to 1,500 seedlings per hectare; and then gradually, the thinning out low-quality, non-purpose tree species should be executed. Ideally, , the cultivation of a mixed species forest should be an artificial combination of coniferous and broad-leaved species (Li 2014).

The implementation of the NFPP requires the Forestry Bureau not only to reduce

the amount of cutting, but also to strengthen forest management and protection. Practices cannot be like in the past where the focus was only on logging. Specifically, in order to strengthen the forest management and protection, we must refine and improve the management and protection ecological mechanisms.

Forest management can exploit the potential to combine its goals with workers engaged in the ditch bidding system. This means that workers in the ditch maintenance system can both assume roles for the protection of forests (including forest fire prevention, pest control and prevention of illegal logging, etc.). Management responsibilities can be given to ditch maintenance workers also include planting, gathering, aquaculture, etc. This new symbiotic mechanism combines the interests of the state, enterprises, and individuals. Through these management measures, over time, the past poor results of afforestation can be reversed. The afforestation funds will play a vital in solving the afforestation problem.

4.5 Policy Suggestions

The implementation of the NFPP is conducive to the improvement of forest resources in state-owned forest areas; but there are still some problems. This section presents some specific policy recommendations that are conducive to the improved operation of state-owned forests.

4.5.1 Increase Management Funding and Update the Facilities

The funds provided for the of management of forests has were initially set in 1998. This resulted in a shortage of funds needed for intensive management and tending (Guo

2011). At the same time, management facilities were outdated, which made it difficult to adapt to the requirements of intensive forest management and protection. Outdated facilities lead to growth and yield forecasting that were not accurate and not conducive to the protection of forest resources (Chen 2011). Therefore, for the public welfare, increasing the funds must be made available for: forest management, and updating the facilities needed for management, and increasing the investment in fire protection and pest control.

4.5.2 Approval for Tending Natural Forests

Nature forests were protected with a no-cutting policy in the first period of NFPP. However, not tending or thinning these natural forests is not conducive to the realization their growth potential. Therefore, the government should approve a quota for tending and thinning of natural forests.

4.5.3 Strengthening Intensive Management

Forest management should gradually shift its emphasis from protection to intensive management. At present, the forest quality in the northeast is not high; therefore a gradual. Controlled expansion of intensive management into natural forests should be pursued in such a manner that regional biodiversity is not threatened. It is possible to increasing the productivity of natural forests in tandem with strict conservation objectives. The government should therefore increase the investment in the cultivation of natural forests in tandem with a strategy to conserve the biodiversity of these forests.

4.5.4 Exploring New Industry Management System

The original system of managing forests in China required the central government to set up and manage enterprises to manage the forests. This system should be gradually decentralized such that the provincial governments could participate in the management of forests. Since provinces would receive the benefits of such management, competition and efficiency would thereby be fostered. The allowance for competition alone could stimulate the implementation of the right reforms needed in the forest industry.

CONCLUSION

Due to the implementation of NFPP, the forest resources in the northeast of China experienced a recovery to a certain extent. Both forest area and stock volume increased over the past 19 years. The present situation in the northeast of China is a microcosm of forest management in China over the past few decades, and the outstanding problems are universal.

The first outstanding problem is the lack of a business philosophy. The philosophy of making timber production the central objective of forest management and the pursuit of the most economically efficient means to meet this objective is deeply ingrained within the minds of forest managers. A new business philosophy, in which both economic and ecological objectives are equally important, must be developed and refined by experience. For this philosophy to become a reality, time, research, and funding is needed.

The second outstanding problem is to be found in not understanding shortcomings of the NFPP. Without understanding these shortcomings, improvements cannot be made. The major shortcomings of the NFPP have been its irrational classification division and the comprehensive logging ban in the no-cutting areas. These shortcomings have hindered the normal tending activities and delayed the natural forests from reaching their full potential.

For the NFPP to succeed in the long term, the government needs to fund the construction of artificial commercial forests. The total area devoted artificial forest must be enlarged to meet China’s increasing demand for forest resources.

The NFPP will continue to impact the northeast for at least five more years. The target of China is to become a high-income country. For forestry, although the ecosystem has got a release from the first and second phases of NFPP, the economic structure still needs to be reformed. Therefore, the turning point of 2020 is key for future forestry development. If the forest structure has not changed adequately by 2020, the third phase of NFPP would be necessary.

With regard to the conservation of China's natural forests, the NFPP has succeeded in its conservation objective over the past 19 years. However, the problem of forest quality is still serious. Many nature forests should be tended and managed. The NFPP should, in its third period, implement a massive intensive management program to continue to improve the age class structure of the country's forests.

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