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## **Improvement Plan of Forest Products and Establishment of Management Foundation for Economic Forest Regions – Focused on Hwapyeong and Jangsun Economic Forest Region in Korea –**

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This study was conducted to provide reasonable information to establish the basic plan for the systematic management of the Hwapyeong · Jangsun economic forest region. The objective forest type for pine stand can be set for the timber production forest with excellent medium and large-diameter poles in the future through systematic management. And for larch and rigida stands, they could be set for the production of normal small-diameter and excellent medium-diameter logs, respectively. The cultivation areas of nuts should be enlarged for increasing the short-term income of forest products and the cultivation areas should be collectivized and enlarged to enhance competitive power. To build the management base of economic forest regions the forest road plan should be established to get to the level of fundamental forest road density. And for the efficient mechanization of forestry it is recommended to use the machines of the Jinan equipment support center. And the forestry labor should be secured by building the forestry labor database of economic forest regions and by developing a systematic training program.

### INTRODUCTION

Korea has a plan for afforestation to recover land ruined since the early 1970s, and has carried out active forest development and achieved the greening of land. From then on, Korea has promoted to make the hilly countries of resources by developing a large scale of economic forest regions to increase the economic values of forest and by designating the promoted areas of forestry. As a result, the forest area of Korea has occupied 64% of the entire land with about 6.4 million ha that provide various types of economic and public benefits.

However, since most of forestation in the past has focused on the species of fast growing trees and fuel wood production that were not suitable for the production of timber, and the proper greening of the forest could not be achieved. Therefore, the productivity of the forest has deteriorated and this has led to a lack of economically efficient timber resources since the quality of timber was quite low. Korea, highly dependent on the timber supply of overseas countries, needs not only to develop economic forests for the security of timber resources, but also to manage the forest intensively. Through the promotion of the forest economic benefits can be obtained by combining the timber supply base together with the public functions of the forest.

Economic forest, as the forest mainly for the sustainable production of forest products, refers to the collectivized forest that satisfies the soil capacity of class III

forest, forest with potential abilities current and in the future, and forest that can be managed for the production purpose of fruits, medicinal plants and mushrooms in addition to the production of timbers (Korea Forest Service, 2003).

The 21<sup>st</sup> Century Forest Vision (Korea Forest Service, 2000) presents the directions that the future forestry of Korea has to move on and the important promotion strategies for the development of more valuable forest resources. The 4<sup>th</sup> plan of forest development started in 1998 has set the goals that guide the forest structure of sustainable production that can consistently produce a fixed amount of timber by developing a total of 3.5 million ha of economic forest that is 55% of the entire forest by the year 2030, and has grasped for the detailed strategies.

Accordingly, Korea Forest Service has confirmed 450 forestation regions of 2.92 million ha in 2005. Of these, there were 105 regions of national forest with 0.58 million ha and 345 regions of non-national forest with 2.34 million ha (Korea Forest Service, 2006), concentrating on the non-national forest for the development of economic forest.

The Korea Forest Service, to manage the economic forest, intends to establish the management plan of each promotion region by reflecting the forest development system including the details of basic forest plan and local forest plan, and to establish the promotion plan while considering the forest types and local conditions. The forest projects such as forestation and forest cultivation would be concentrated on the promotion regions of economic forest. And this direction of selection and concentration can be said to be reasonable, considering that the effects of forest projects are low and a limited amount of the budget can be used for them since the

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target places for promotion and development have not been clearly classified for a long period of time.

Therefore, this study was conducted to provide reasonable information to establish the basic plan for the systematic management of economic forest regions, linking to the upper-level plan and forest management plans such as the basic forest management plan and local forest management plan, when establishing the mid and long-term forest management plan to develop the economic forest regions in Wanju County of Jeonbuk Province according to current circumstances.

## MATERIALS AND METHODS

### Study data

Spatial scope of objective study place was the Hwapyeong · Jangsun region that makes up 64% (16,064 ha) of the entire areas from three economic forest regions of 25,394 ha in Wanju County of Jeonbuk Province. Data was used and analyzed comprehensively using the data from the review and analysis of statistical data, related laws and ordinances, and the forest tree resource assessment program of Korea Forest Research Institute.

### Methods

For the management plan of economic forest, a forest survey was conducted to find a rough production amount of forest products for 10 years and 30 years in the future and to establish the objective forest type by stand. Also, the analysis of improvement measures of production volume was performed after understanding the production situation of forest products for the short-term income generation in the regions of economic forest. And, the development directions for building the management base of economic forest such as forest road, forestry mechanization and security of labor forces were considered.

## RESULTS AND DISCUSSIONS

### Status of forest and economic forest in Wanju County

Forest of Wanju County makes up 13.2% of the entire forest in Jeonbuk Province with a total area of 59,428 ha. This is the second largest forest area of Jeonbuk Province next to that of Jinan County (60,901 ha), and the forest of Wanju County is comprised of national forest of 18.1% (10,742 ha), public forest of 9.3% (5,556 ha) and private forest of 72.6% (43,130 ha) (Korea Forest Service, 2005). Looking at the forest area of Wanju County by forest type, it is largely divided into the broad-leaved forest of 52.2% (10,742 ha), 28.1% (16,678 ha) of coniferous forest, 16.9% (10,039 ha) of mixed forest, and 3.0% (1,788 ha) of unstocked forest (Wanju County, 2005). On the other hand, the forest below the age class V occupies 94% of the entire forest and specifically, the forest area of age class III takes up 60.4% of the entire forest areas.

As for the policy of driving the forest project by first selecting the target places of intensively promoting economic forest to maximize the effect of forest business, Wanju County has designated, promoted and managed three regions of economic forest namely, Hwapyeong · Jangsun economic forest region, Sangdu · Woncheon economic forest region and Daea · Sinjeong economic forest region that have current and future potential ability with the collectivized forest of excellent soil depth. Hwapyeong · Jangsun region, of the entire economic forest area of 25,394 ha, shows the occupancy rate of 64% with an area of 16,064 ha, followed respectively by Sangdu · Woncheon region with 20% (5,179 ha), and Daea · Sinjeong region with 16% (4,151 ha) (Wanju County, 2006) as shown in Table 1.

As for Hwapyeong · Jangsun economic forest region, Jangsun region occupies the largest area with 5,000 ha,

**Table 1.** Status of economic forest regions in Wanju County

Name of economic forest complex	Name of map (1:25,000)	Economic forest areas (ha)
Hwapyeong · Jangsun economic forest	Daea	2,209
	Sinjeong	2,381
	Hwapyeong	4,451
	Jangsun	5,000
	Eumnae	2,023
	Total	16,064
Sangdu · Wonchon economic forest	Sangdu	2,147
	Jeonju	761
	Wonchon	1,318
	Gwanchon	953
	Total	5,179
Daea · Sinjeong economic forest	Daea	2,630
	Jeonju	910
	Sinjeong	611
	Total	4,151
	Total	25,394

Source: Wanju County. Department of forest and park.

followed by Hwapyeong area of 4,451 ha; for Sangdu · Woncheon economic forest region, Sangdu region comprises up the largest area with 2,147 ha; and for Daea · Sinjeong economic forest region, Daea region occupies the largest area.

The analysis of Geographic Information System showed that as for the diameter class distribution status of Hwapyeong · Jangsun economic forest region that is an important factor of timber production, the ratio of medium-diameter trees has occupied a relatively high percentage with 74.08%, followed respectively by small-diameter trees of 22.14%, large-diameter trees of 2.19%, and young trees of 1.59%. As for the status of age class distribution, the age class III, IV trees have occupied most of the area with 74.1%, followed respectively by the age class II of 22.14%, over age class V of 2.16%, and age class I of 1.59%.

Wanju County plans to raise the values of timber by establishing a realizable long-term plan for the economic forest regions around the Hwapyeong · Jangsun region and by promoting forestation and forest tending intensively.

### The production status and improvement schemes of forest products in Hwapyeong · Jangsun economic forest region

#### Timber

According to the result of forest investigation to check the timber production ability of Hwapyeong · Jangsun economic forest region, the major tree species of coniferous forests were pine, rigida, and larch stands. And according to the survey result of 6 sample areas for the pine tree forest within Hwapyeong · Jangsun economic forest region, the average tree age of the sample area high in density was 25 years old with the dominant tree height of 14 m. The number of trees per hectare on the yield table of these stands was 1,383 that were exceeded by 440 trees as compared to the number of trees per hectare of the sample area; the volume per hectare of the yield table was 161.75 m<sup>3</sup> and the volume

of the sample area has appeared to be 105.27 m<sup>3</sup>.

Therefore, to establish a reasonable analysis and timber production plan based on these results, a stand analysis was conducted using the tree resources evaluation and prediction program (Korea Forest Research Institute, 2003) that provides the diversified information and a stand yield table with volume and weight of stands through the sample area survey.

The possible amount of timber production was estimated from the stands of high timber production potentials and high density by setting the limiting factors of normal and merchantable timbers, respectively with the minimum top diameters of 16 cm and 6 cm and timber length of 2.7 m and 1.8 m. The result showed that the stand can produce the stand stem volume of 258.5 m<sup>3</sup>/ha and stand merchantable volume of 245.3 m<sup>3</sup>/ha after 10 years on the basis of current tree age of 25 years old. And when it reaches the tree age 55 after 30 years, the result showed that it can produce the stand stem volume of 335.3 m<sup>3</sup>/ha and stand merchantable volume of 322.3 m<sup>3</sup>/ha (Table 2).

However, since timber production would be possible after 50 years of the final age of pine tree, and timber production can be possible from the year 2036 that is 30 years from now according to the result of analysis. When the timber of 335.3 m<sup>3</sup>/ha can be produced in the final age of pine tree forest at 55 years old, it is judged that timber production can be made by using selective cutting.

Investigation of 12 sample areas of rigida stands were performed, but the breast diameter growth was not sufficient because of the tending of rigida stands has not been appropriate. The tree age of the stands with a high stand density was on average 25 years old. While the number of forest trees on the yield table of rigida stands has appeared to be 1,213 trees/ha, the number of trees per hectare of the sample areas has appeared to be excessively dense with 1,600 trees.

Since the rigida stands have a short final age of 25 years, estimation of the possible amount of production

**Table 2.** Expected timber yield of Hwapyeong · Jangsun economic forest by stand

Species	Tree age (Year)	Stand stem volume (m <sup>3</sup> )		Stand merchantable tree volume (m <sup>3</sup> )		Merchantable tree volume classified by the least top end diameter (m <sup>3</sup> )		Stand timber volume (m <sup>3</sup> )		
		Included bark	Excluded bark	Included bark	Excluded bark	6 cm	16 cm	General timber	Pulp wood	Oak mushroom bed-log
<i>Pinus densiflora</i>	25	161.7	141.5	149.3	131.6	149.3	53.8	28.7	98.7	–
	35	258.5	231.1	245.3	220.5	245.3	168.4	129.7	87.9	–
	55	335.3	305.9	322.3	295.1	322.3	291.4	249.6	42.7	–
<i>Pinus rigida</i>	25	211.9	170.4	199.9	161.1	199.9	96.8	60.4	96.3	–
	35	307.3	251.8	295.8	242.7	295.8	229.2	178.0	60.8	–
<i>Larix leptolepis</i>	25	168.1	148.6	159.5	141.2	159.5	86.6	67.0	71.2	–
	40	248.5	222.1	240.1	214.8	240.1	209.6	176.9	35.7	–
	55	305.8	274.4	297.0	266.7	297.0	275.1	236.4	28.3	–

was made for the future 10 years since production after 30 years would not be realistic. According to the analysis result by setting the limiting factor of possible timber production of the rigida stands identically to that of pine forest, the stands with high density could yield timber with the stand stem volume of 307.3 m<sup>3</sup>/ha and stand merchantable volume of 295.8 m<sup>3</sup>/ha after 10 years based on the current tree age of 25 years.

According to the survey results of the sample areas of larch forest, the forest had a high stand density state with 1,300 trees/ha as compared to a stand density of 796 trees/ha on the yield table. The volume of these stands with 182 m<sup>3</sup>/ha has shown a low level of growth as compared to that of the yield table even after considering the number of trees.

After setting the limiting factors identically to that of pine forest and calculating the possible production amount of larch forest, the larch forest with a high density has appeared to produce timber with the stand stem volume of 248.5 m<sup>3</sup>/ha and stand merchantable volume of 240.1 m<sup>3</sup>/ha after 15 years on the basis of the current tree age of 25 years old. Also, it is estimated that the stand stem volume of 305.8 m<sup>3</sup>/ha and stand merchantable volume of 297.0 m<sup>3</sup>/ha can be produced after 30 years.

Accordingly, the objective forest type would be set by summarizing the forest survey and analysis result of timber production. Since the constitution of pine forest currently consists of small-diameter trees with the age class II, III and IV, the objective forest type can be set for the timber production forest with excellent medium and large-diameter poles in the future through systematic management. Also since the larch forest is mainly consisted of small-diameter poles with the age class II, it could be set for the production of normal small-diameter logs through a controlled management of forest type.

Since the rigida stands mainly consist of small-diameter logs with the age class II, the excellent quality stands can be set as a forest of excellent medium-diameter log production and the defective quality stands can be set as the objective forest type for tree species improvements after strip cutting. Also, other broad-leaved forests should be guided for the production of quality timber and wooden crafted products and mixed forests may be led to scenic forests after going through an ecological stabilization.

#### Forest products for short-term income

Since the Hwapyeong · Jangsun economic forest region is bigger than other designated areas, its production amount of forest products is relatively large, this recent production trend of forest products is shown in Figure 1. While the production volume of nuts in 2001 had shown a much higher production volume with 759,555 kg as compared to that of an average year, it drastically dropped in 2002 with 377,570 kg and then gradually increased again beginning in 2003. When the production volume of nuts in 2005 (546,372 kg) is compared with that of the year 2000 (149,695 kg), a high growth rate of 265% (396,677 kg) was shown in 5 years.

Looking at the change trend of wild edible vegeta-

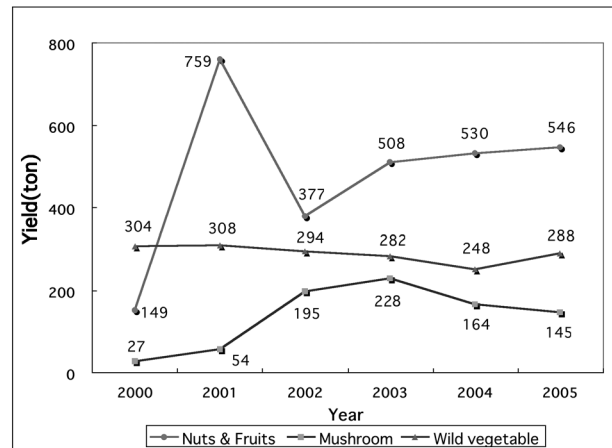


Fig. 1. Changes of forest products yield in Hwapyeong · angsun economic forest region.

bles production, the production tends to decrease slightly from the year 2001 to the year 2004 although there had not been much change in the amount of production from the year 2000 (304,860 kg) to the year 2005 (288,668 kg). The production volume tends to increase again in 2005, and this comprises 96% of the wild edible vegetables produced in the entire economic forest regions. Although the production volume of mushrooms decreased for two successive years, 2004 (164,970 kg) and 2005 (145,381 kg), after steadily increasing from the year 2000 (27,871 kg) to 2003 (228,049 kg), it showed a very high growth rate of 421% (117,510 kg) for five years since 2000, if the volume of mushroom production in 2000 (27,871 kg) is compared with that of 2005 (145,381 kg).

Trying to find the long-term development directions of short-term income forest products on a basis of production situation analysis, the production volume of wild edible vegetables in Hwapyeong · Jangsun economic forest region occupies 95% of the wild edible vegetables production in the entire Wanju County areas. Hence, it is judged that this place needs to be driven as a more intensive and long-term production region of wild edible vegetables as compared to other places. Also as for the production volume of nuts and mushrooms, it is judged that the management should target to achieve a yearly growth rate of 50% for following 10 years, considering the respective growth rates of 265% and 421% in 5 years.

Production of these short-term income forest products can improve the forestry income of production farmers by overcoming the economical weakness of long-term investments of forest management, and by using the economic forest region more intensively. In this way, various projects have to be performed to increase production of short-term income forest products.

Considering the production increase plan of short-term income forest products, it is necessary to advertise use of the facility together with expansion of the storage facility that expects the production volume in the future for the production increase of nuts that occupy the

greatest weight of forest product production in Hwapyeong · Jangsun economic forest region, and it has to be further promoted by selecting the production items carefully after having considered the weather and quality. Together with these, the cultivation areas should be collectivized and large-sized to enhance the competitive power.

Considering the situation that the demand for wild edible vegetables increases every year from the interests of people due to the increase of national income since they are clean forest products, it is necessary to promote nursery and integrated management. Also for the enhancement of competitive power, consistent production and price stabilization, the circulation steps should be reduced by building a circulation system linking the production site directly to the consumer and the circulation base facility should be consistently extended to protect the rights of producer and consumer at the same time in the circulation process. To achieve these, the circulation system should be organized to contribute to the income of local forest managers by further enhancing operation of the circulation system in the Forestry Association Union of Wanju County that is a representative circulation function. Also to improve the image of the clean forest products of Wanju County, the taste of consumers should be fulfilled by using the certification system of environment-friendly agricultural products.

**Building the management base of Hwapyeong · Jangsun economic forest region**

*Forest road*

Forest roads play a role in improving forestry productivity through the efficient development of the forest. Therefore, consistent expansion of forest roads and main-

tenance of forest roads networks are essential in building the forestry management base of economic forest. After considering the geographical features of hilly country and forest in Korea, the Korea Forest Research Institute (2004) has newly investigated the fundamental forest road density in a concept of social overhead capital, and the reasonable forest road density in a concept of forest management base facility for reasonable forestry management.

According to the standards, the average fundamental forest road density for the entire forest is 8.57 m/ha and the average fundamental forest road density of economic forest is 11.92 m/ha. On the other hand, the reasonable forest road density of the entire forest is 14.01m/ha on average and the average of economic forest is 26.17 m/ha (Table 3).

It is necessary to calculate the amount of forest road establishments according to the forest road density standards by the forest management type newly prepared in 2004; the estimated result of the number of forest roads necessary for the forest resource situation of economic forest is shown in Table 4.

The current forest road density of the entire economic forest regions in Wanju County is 4.47 m/ha, which is insufficient by 7.45 m/ha from the standards of fundamental density and lacks by 21.70 m/ha from that of reasonable forest road density. Accordingly, Wanju County has to establish a total forest road of 189.19 km following the standards of fundamental density for the economic forest and 551.05 km following the standards of reasonable forest road density. On the other hand, Hwapyeong · Jangsun region needs to establish forest roads of 127.71 km and 356.62 km, respectively according to the standards of fundamental forest road density

**Table 3.** Fundamental and reasonable forest roads density

Classification		Mean	Gentle slope	Normality slope	Steep slope
Forest	Fundamental	8.57	8.48	8.95	6.44
	Reasonable	14.01	16.43	14.57	8.28
Economic Forest	Fundamental	11.92	11.08	12.19	10.61
	Reasonable	26.17	29.27	26.15	19.65

Source: Korea Forest Research Institute. 2004 *Estimation of quantity of forest road density*.

**Table 4.** Forest road status and required forest road density for economic forest regions

Classification	Forest areas (ha)	Fundamental forest road density (m/ha)				Reasonable forest road density (m/ha)			
		Basis density	Present density	Lack density	Quantity of expansion (km)	Basis density	Present density	Lack density	Quantity of expansion (km)
Mean of Hwapyeong · Jangsun economic forest	16,064	11.92	3.97	7.95	127.71	26.17	3.97	22.20	356.62
Mean of economic Forest	25,394	11.92	4.47	7.45	189.19	26.17	4.47	21.70	551.05

and reasonable forest road density since the fundamental forest road density and reasonable forest road density of this region were insufficient by 7.95 m/ha and 22.20 m/ha, respectively.

However, considering the current situation and financial conditions of forestry investment, it is far away from meeting the standards of reasonable forest road density. Hence, it is judged that the forest road plan should be established to get to the level of fundamental forest road density, and the forest road establishment project should be concentrated primarily on Hwapyeong · Jangsun economic forest region that has the largest forest area and requires the establishment of the most of new forest roads.

When establishing new forest roads, it may be effective to connect the forest road by region starting from the area with the good conditions of established forest roads like the ground and forest environment within the economic forest regions. Also, the forest road facility should be established while considering the ecosystem and environmental-friendly scenery, and should be devised to activate the economic forest regions through promoting the mechanization of forestry and improving utilization of forest products by expanding new forest road facilities.

#### *Mechanization of forestry and labor*

The forestry machines necessary for forestation work have been distributed and used around the government and public offices such as Forest Service, local governments and forestry associations and the types of supplied machines mostly consist of small devices like power saws, yet lacking in the supply are medium and large-sized forest vehicles and various skidders. Also since the work result of forestry machines is highly dependent on the dexterity and functional operation of machine operators, quality manpower with a high level of dexterity should be secured.

And, forestry machines can be highly limited by the type of machine and work method used with the geographical features of work sites and job efficiency, therefore, can be greatly varied. Only, with the forest road density of 3.97 m/ha in Hwapyeong · Jangsun economic forest region, the mechanization of forestry is realistically impossible.

Hence, the development of forestry mechanization depends on the government, local governments and forestry associations. In particular, the investment will of the Office of Forestry and Wanju County is important since it is essential for relevant offices to powerfully drive the implementation of policy for forestry mechanization and to monetarily invest a great deal. Therefore, to drive the efficient forestry mechanization of Hwapyeong · Jangsun economic forest region, Wanju County has to exert all efforts to actively use the 'supply plan of mechanical equipments to forestry associations, sincere forest managers and cooperating companies' that is a link to the 'policy of mid · long-term forestry mechanization in the private sector, that the Forest Service drives positively. And as a device that forest managers within an economic forest region can borrow and repair equipments

inexpensively, it is recommended to use the machines of Jinan equipment support center among 6 forestry equipment support centers, which is near to the economic forest region of Wanju County.

To manage economic forest efficiently, it would be essential to secure the labor force specialized in forestry. However, it is quite difficult to secure enough manpower due to the insufficient labor force of mountain villages with the change in times. Although security of forestry labor is not a simple problem, various ways should be considered for the efficient security of forestry labor. Forest Service organizes the forest craft workers to contribute to the smooth execution of forest projects and income improvement of mountain village residents by selecting and training the forestation workers of mountain village residents to secure the forestry labor forces.

Therefore, it is necessary to use central government policy to secure a stable labor force and to consider the financial resources and investment conditions of the local government offices in Wanju County. The forest craft workers, as the professionals specialized in forestry, need to secure a sufficient volume of work in Hwapyeong · Jangsun economic forest region for the stabilization of living and the work should be properly distributed by times of a year. The next-generation forest managers should be trained by constructively supporting the forest management activities of forest successors and sincere forest managers in Wanju County, and the forestry labor should be secured by building the forestry labor database of economic forest regions and by developing a systematic training program proactively.

Hence, to secure the forestry labor, Wanju County needs to prepare the supply measures of forestry labor by predicting the necessary manpower for the forest project execution of economic forest, to improve the technical levels of forestry labor through consistent training and new technology diffusion, and to allow forestry labor to lead a stable life by settling down in mountain villages by systemizing wages and by preparing an appropriate welfare program. Therefore, the financial efforts of the local government of Wanju County can be the key for the successful security of forestry labor.

## CONCLUSION

This study was conducted to provide reasonable information to establish the basic plan for the systematic management of Hwapyeong · Jangsun economic forest region. The main findings are followed as below.

Since the constitution of pine forest currently consists of small-diameter trees with the age class II, III and IV, the objective forest type can be set for the timber production forest with excellent medium and large-diameter poles in the future through systematic management. Also since the larch forest mainly consists of small-diameter poles with the age class II, it could be set for the production of normal small-diameter logs through a controlled management of forest type. Because the rigida stands mainly consists of small-diameter logs with the age class II, the excellent quality stands can be set as a

forest of excellent medium-diameter log production, and the defective quality stands can be set as the objective forest type for tree species improvements after strip cutting.

Considering the production increase plan of short-term income forest products, it is necessary to advertise use of the facility together with expansion of the storage facility that expects the production volume in the future for the production increase of nuts that occupy the greatest weight of forest product production in Hwapyeong · Jangsun economic forest region, and it has to be further promoted by selecting the production items carefully after having considered the weather and quality. Together with these, the cultivation areas should be collectivized and large-sized to enhance the competitive power.

Contemplating the current situation and financial conditions of forestry investment, it is far away from meeting the standards of reasonable forest road density. Hence, it is judged that the forest road plan should be established to get to the level of fundamental forest road density. And for the efficient mechanization of forestry it is recommended to use the machines of Jinan equip-

ment support center which is near to the economic forest regions of Wanju County. The next-generation forest managers should be fostered by constructively supporting the forest management activities of forest successors and sincere forest managers in Wanju County, and the forestry labor should be secured by building the forestry labor database of economic forest regions and by developing a systematic training program.

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