

Combining Timber Production and Wood Processing for Increasing Forestry Income: A Case Study of 6th Industrialization in Korean Forestry

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Abstract

This study was aimed to analyze the increased forestry incomes by combining timber production and wood processing, which is one of 6th industrialization types in Korean forestry. The selected household has been engaged in forestry for two generations and they produce timber and associated wood products in their own facility. The wood products include dimension lumber, interior wood material, cutting board, and cube chips, the household also utilize logging and sawmill residues as well as seed and seedlings as by-products. Incomes and expenses that have been incurred on individual processes of the sequential timber production and wood processing were surveyed, and we analyzed the economic outcomes of entire business. The results of this study indicate that the gross income of the household is 122.3 million Korean won and the net income is 93.6 million Korean won. The net income of the household is approximately 2.8 times higher than the average net income of whole households in the forestry of Korea in 2016, which is approximately 4.3 times higher than that of households that have been particularly engaged in timber production over the country. We found that the 6th industrialization by combining the two sequential processes creates approximately 3.2 times as much added value compared to the case relying on timber production only.

Key Words: timber production, wood processing, 6th Industrialization, added value, Korean forestry

Introduction

According to the national statistics of Korea (Korea Forest Service 2016), the current forest stock per hectare (146 m³ per ha in 2015) in South Korea is higher than the average forest stock of the OECD countries (FAO 2015). The forest area over 20 years old is 5.3 million ha, which accounts for 84% of entire forests in the country. Within the next 20 years, more than 70% of entire forests are estimated to be reached to rotation age. The Korean forestry has been

moved toward to a timber production era out of the tree plantation and growing period (Korea Forest Service 2014).

Average income of forestry household particularly engaged in timber production, such as tree growing or timber logging, is 21.9 million Korean won, it is lower than the average income of agricultural households (37.2 million Korean won) but lower than the average income of whole households in forestry (33.6 million Korean won). Low income of timber production contributes to decrease the amount of timber supply in the country as well as forest

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owner's willingness to manage their forest actively.

Agroforestry has become a popular alternative in Korean forestry (Lee 2013; Kim et al. 2014; Min and Kim 2014). It produces short-term income forest products and other non-timber forest products on mountainous forestlands. The agroforestry enhances forest associated incomes opportunities (Garrett 2009; Lee 2013) and diversify forest management (University of Minnesota Extension 2017). However, successful agroforestry requires high-level of skills in cultivation and a long experience of growing individual crops on the mountains: thus diversifying the type of product would not be an alternative for increasing economic outcomes of the business. Also, there is a limit in creating added-value through the cultivation of forest primary products itself.

Recently a 6th industrialization is being promoted as one of important issues to overcome the limitations of intrinsic competitiveness in a primary industry (Kobayasi and Lee 2012). The 6th industrialization is combining the primary products of agriculture, forestry and fisheries with the secondary industries that manufacture and process those primary products, or the tertiary industries that are based on the primary products (Park 2015). In forestry, the 6th industrialization could be achieved by management activities that process high value-added products with producing primary products in forests and offers various goods and services related to forest therapy, recreation, and tourism, which are involved in the tertiary industry in forestry (Jung and Won 2017). The objective of this study was to analyze the increased forestry incomes by combining timber production and wood processing, which is one of 6th industrialization types in Korean forestry.

Table 1. General information of the study household

General information	Status of the study household
Organization type	Individual owner
Forester type	Forest successor
6th industrialization type	Timber production and wood processing (primary industry + secondary industry)
Owner experience on business	4 years
Forest area owned	78 ha
<i>Japanese cypress</i> stands owned	50 ha

Materials and Methods

Study household

The selected household as a case study has been engaged in forestry for two generations. As one of 6th industrialization types in Korean forestry, the household integrates the primary and secondary industries, producing timber and associated wood products sequentially in their own facility. The wood products include dimension lumber, interior wood material, cutting board, and cube chips. The household also utilizes logging and sawmill residues as well as seed and seedlings as by-products.

The household owns total 78ha of forests but manages a 50 ha of forests for *Japanese cypress* timber production (Table 1). The household annually harvests 50 m³ of timber for timber production and wood processing. Table 2 shows the status of *Japanese cypress* stands of the household available for timber harvesting.

Management outcome analysis

Incomes and expenses that have been incurred on individual processes of the sequential timber production and wood processing were surveyed (Table 3). Income was calculated by applying the unit price to the sales volume of each product including logging residues (foliage and branch) and seed and seedlings as the products of the primary industry, wood products (board, lube, cutting board, and chip) and sawdust as the goods of the secondary industry.

The expenses of the household consist of owning and operating costs. The owning cost was calculated considering the depreciation of equipment and facility the study house-

Table 2. Status of *Japanese cypress* stands of the study household available for timber harvesting

Stand info	Unit	Average	Min-Max
Total area available	ha	20	-
Stand age	age	47	45-55
Tree Height	m	18	13-20
DBH*	cm	31	26-34
Standing stock	m ³ per ha	278	23-31
Tree per ha	no. of trees per ha	475	320-500

*Diameter at breast height.

hold owned. The sum of the purchase prices of individual items was divided by their useful life, which is 15 years. The operating cost was calculated considering labor and equipment maintenance cost, insurance, farming tool and material costs, water and oil costs, and taxes. Labor was self-provided thus we assumed there was no paid salaried in their business.

The economic outcomes of entire business were analyzed. The created added value of the 6th industrialization by combining the two sequential processes was also examined compared to the case relying on timber production only.

Results and Discussion

The 6th industrialization business model of the study household

Fig. 1 shows the primary and secondary products as well as their associated market consumers of the study household. Most of the manufactured products are sold by direct dealing. Logging residues, such as foliage and branch, are sold to oil processing companies and furniture companies. Seedlings and seeds are sold to seed dealers. Most of dimension lumbars and interior wood materials are sold to the furniture company, but cutting boards, cube chips, and sawdust are directly sold to consumers. The timber produced from the forests was used for wood processing, the

Table 3. Survey items for investigating incomes and expenses on individual processes of the sequential timber production and wood processing

Survey item		Detail
Income		Sales volume and price
Expense	Owning cost (Depreciation)	Logging equipment Excavator, wood-grab, trucks Facility Sawmill, storehouse Sawmill equipment Sawing machine
	Operating cost	Labor cost Equipment maintenance cost Insurance Farming tool and material cost Water and oil cost Taxes

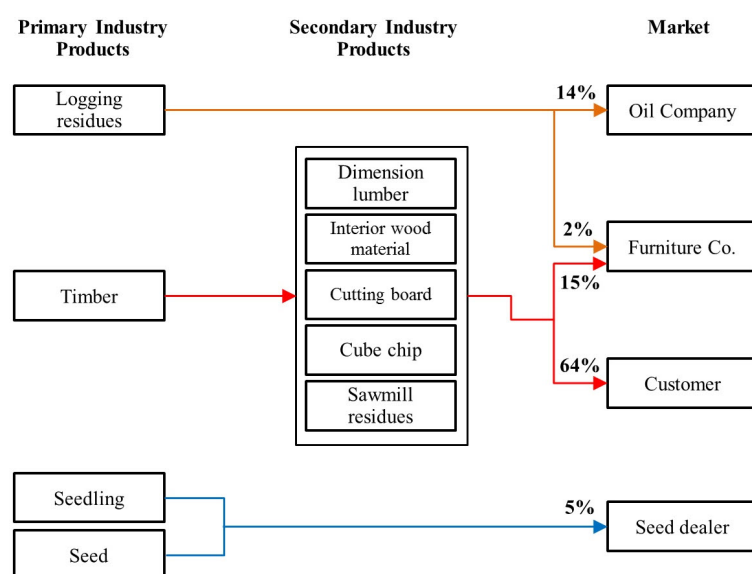


Fig. 1. Primary and secondary products as well as their associated consumers of the study household. The numbers indicate the proportions of individual sales on revenue from the entire business.

order of wood processing is dependent on the sales value of products. The numbers in Fig. 1 indicate the proportions of individual sales on the revenue of the household from the entire business.

Production expenses

Table 4 shows the annual expense on timber production and wood processing of the study household. The annual expenses was calculated as 28,640 thousand won for the entire production process (i.e. timber production and wood

processing). Owing costs amounted to 18,660 thousand won, which is accounting for 65% of the total expense. The reminder of the total expense was the operating cost, which was 9,980 thousand won. The calculated annual expense to produce the primary products of *Japanese cypress* was 12,260 thousand won. The annual production expense of secondary goods was relatively higher than that of the primary products. Among the all expense items, sawmill equipment cost was the highest, accounting for 35% out of total cost, followed by logging equipment costs by 23% and oil cost by

Table 4. Annual expense on timber production and wood processing of the study household (unit: Korean thousand won)

Expense		Primary industry: timber production	Secondary industry: wood processing	Total	Ratio (%)
Owning cost (Depreciation)	Logging equipment	6,660	-	6,660	23
	Facility	-	2,000	2,000	7
	Sawmill equipment	-	10,000	10,000	35
	Sub total	6,660	12,000	18,660	65
Operating cost	Oil cost	2,000	1,000	3,000	10
	Water cost	-	980	980	3
	Equipment maintenance cost	1,500	1,100	2,600	9
	Taxes and insurance	1,800	-	1,800	6
	Farming tool cost	300	-	300	1
	Material cost	-	1,300	1,300	5
	Sub total	5,600	4,380	9,980	35
	Total expense	12,260	16,380	28,640	100

Table 5. Sales of individual products and gross income of the study household

Product	Unit	Unit price (Korean won)	Sales		
			Revenue (Korean thousand won)	Ratio (%)	
Primary industry: timber production	Foliage*	kg	600	18,000	15
	Branch*	kg	1,500	1,500	1
	Seed	kg	108,000	5,400	4
	Seeding	2 m	20,000	2,000	2
	Sub total			26,900	22
Secondary industry: wood processing	Dimension lumber (board)	30×125×3,600 mm	3,200	48,000	39
	Wood interior material (luba)	15×105×2,400 mm	2,400	28,800	24
	Cutting board	ea	20,000	12,000	10
	Chip	kg	5,000	5,000	4
	Sawdust	kg	1,000	1,600	1
	Sub total			95,400	78
Gross income in total				122,300	100

*Logging residues.

10%, respectively. Labor cost was not required in production since it is considered as family labor.

Product sales and income

Table 5 shows the sales of individual products and gross income of the study household. The price of individual products was obtained through an interview with the owner of the household. The unit price of foliage was 600 won per kilogram and branches were sold at 1,500 won per kilogram. Those materials are traded at high values compared to typical logging residues since they are supposed to be utilized in oil and lumber production, respectively. Seeds were sold at 108,000 won per kilogram and seedlings were sold at 20,000 won per 2 m of tree height. The dimension lumbers were sold at 48,000 won for 30×125×3,600 mm and at 28,800 won for 15×105×2,400 mm. The cutting boards were sold at an average 20,000 won per ea. Cube chips were sold at 5,000 won per kilogram and sawdust at 1,000 won per kilogram.

The gross income in primary industry of the household was 26,900 thousand won while that of secondary industry was 95,400 thousand won. The gross income in total was estimated to be 122,300 thousand won. The two largest sales of the household were the dimension lumber and interior wood material. They are accounted for 39% and 24% of the total gross income, respectively. The sales of secondary products were higher than the sales of primary products.

Management outcomes and created added value of the 6th industrialization

The results of management outcome analysis indicate that the net income of the household was 93,660 thousand won through the combining timber production and wood processing (Table 6). The net income of the household is approximately 2.8 times higher than the average net income of whole households in the forestry of Korea in 2016 (Korea Forest Service 2017), which is approximately 4.3 times higher than that of households that have been particularly engaged in timber production over the country (Korea Forest Service 2017).

In the case of the primary industry that produce timbers for wood processing, the income of the primary production was 26,900 thousand won and the expense was 12,260 thousand won, respectively. The net income that subtracts the expense against from the gross income was estimated to be 14,640 thousand won. In the case of secondary processing, the expense was 16,380 thousand won and the net income was calculated as 79,020 thousand won. By comparison, the expense of the secondary production was 34% higher than that of the primary production while the net income of secondary production increased to 540% of the net income of the primary production: the secondary production is more cost-effective than the primary production in the case study.

Table 7 shows that the created added value on net income by combining timber production and wood processing

Table 6. Results of management outcome analysis for the study household (unit: Korean thousand won)

	Primary industry: timber production	Secondary industry: wood processing	Total
Gross income (A)	26,900 (100)	95,400 (100)	122,300 (100)
Total expense (B)	12,260 (46)	16,380 (17)	28,640 (23)
Net income (A-B)	14,640 (54)	79,020 (83)	93,660 (77)

Table 7. Created added value on net income by combining timber production and wood processing compared to the case relying on timber production only (unit: Korean thousand won)

	Timber production only (C)	Timber production and wood processing (D)	Ratio (D/C)
Gross income (A)	41,900	122,300	2.9
Total expense (B)	12,260	28,640	-
Net income (A-B)	29,640	93,660	3.2

compared to the case relying on timber production only. If the household produce timbers but does not operate a sawmill for wood processing, the net income of the household would be 29,640 thousand won, subtracting associated expense from the gross income that is obtainable by timber production. Thus we convinced that the 6th industrialization by combining the two sequential processes creates approximately 3.2 times as much added value compared to the case relying on timber production only.

Hwang and Lee (2016) reported that the integration of industries between primary and secondary or primary and tertiary is appropriate to promote farm household income in agriculture. Lee (2013) also found that several cases of agroforestry in the United States to increase forestry household income and suggested economic potential of agroforestry to Korean forestry. Although the estimated amounts of the economic benefits are different in individual studies, the both confirm that the increase in income and the creation of added value can be achieved through the 6th industrialization in forestry.

Conclusion

The objective of this study was to analyze the increased forestry incomes by combining timber production and wood processing, which is one of 6th industrialization types in Korean forestry. We examined the incomes and expenses of the case household that successfully manages their forest and conducts business in forestry through 6th industrialization.

With combining the timber production and wood processing, the income of the study household has increased. It is possible to earn more than 3 times of income by processing self-supplied timbers and selling wood products rather than producing timbers only: it can be a good alternative to increase the income of the forest household and increase the participation rate of forest owners in forest management.

However, the results of this study cannot generalize the 6th industrialization of forestry because it is a case in particular condition where 6th industrialization is applicable with the existing assets the household already owned. If a household needs an investment to operate a sawmill for wood processing, the new investment may hinder the household's decision for 6th industrialization due to their concerns

about failure.

In order to make appropriate decisions on investment or business expansion to the 6th industrialization in forestry, it is necessary to consider additional cost items, such as value of time and costs for planting and silvicultural practices, installation of equipment and facility required for timber harvesting and wood processing, etc. In addition, general forest household is difficult to acquire wood processing technology in a short period and to invest capital in processing facilities. Therefore, various research approaches and outputs that make policy more reasonable for the 6th industrialization in forestry is necessary.

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