JARQ 27, 42-48 (1993)

Balance and Profitability of Private Forestry in Japan

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Abstract

The market price of wood in Japan is considerably affected by the price of imported logs, which account for 75% of the wood supply. The decrease in the log prices in recent years has brought about a depreciation of the price of stumpage, while the cost of producing logs is rising due to constant increases in wages and material costs. This situation results in the decrease in the profitability of forestry year after year. The internal rate of return (IRR) in forestry that was most recently computed was around 1.5%. Furthermore, the shortage in forestry labor has become a major problem. At the same time, national expectations of the purposes of forests, such as environmental conservation, are triggering the development of new forestry projects and changes in the current management policy to increase the profitability of forestry activities.

Discipline: Forestry and forest products
Additional key words: forest net income, forest work, internal rate of return, management cost, private forest land

Introduction

This paper consists of two parts : 1) Analysis of production costs and profitability of private forestry in Japan ; 2) Evaluation of the possibility of diversifying forestry activities in taking account of the need to conserve the forest environment.

Current management of private forest land in Japan

In 1990, domestic demand for logs reached 111 million m^3, while the production of domestic logs was 29 million m^3, roughly one-quarter of the total demand. Among the domestic production, 20 million m^3, or 69% originated from private forest lands.

According to the 1990 World Agricultural and Forestry Census[4], the total number of forestry households in Japan was 2.51 million (except for the forests owned by companies, shrines or temples, or forests under common ownership), 64% of which were farm households.

Table 1 shows the distribution of private forestry households and forest land by size class. A common characteristic of forestry households in Japan is that they almost all own only very small forests.

Table 2 gives data on forestry household economy in 1990 for households of 5-500 ha.

In 1990, the average percentage of man-made forest area managed by forestry households was 60.1%. The 20-50 ha class accounted for the highest percentage of man-made forests at 63.8%. Artificial regeneration in Japan started on a large scale in about 1960. The increase in the proportion of man-made forests managed by forestry households indicates that the area requiring tending has gradually increased.

The price of domestic logs has been subjected to severe competition from that of imported logs and substitutes. The rise in the exchange rate of the yen

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Table 1. Distribution of private forestry households and forest land by size class

	Size class (ha)						No of forestry households (1,000 households)	Forest land (1,000 ha)
	<5	5−20	20−50	50−100	>100	Total		
Forestry households	88.8	9.2	1.5	0.3	0.2	100.0	2,509	−
Forest land	32.3	29.4	15.5	7.1	15.6	100.0	−	6,752

Source : Statistics and Information Department, Ministry of Agriculture, Forestry and Fisheries (MAFF)[4].

Table 2. Summary of forestry household economy

Fiscal year and size of operated forest area	No. of family members	Management of forest			Cut-over area final cutting of man-made forest	Area of artificial afforestartion	Working days for forestry operation
		Forest area	Area of man-made forest	Ratio of man-made forest			
	(person)	(a)	(a)	(%)	(a)	(a)	(man-days)
1985	4.9	1,557	893	57.4	5	4	37.7
1986	4.9	1,559	899	57.7	5	4	37.1
1987	4.8	1,543	903	58.5	3	4	34.5
1988	4.7	1,557	913	58.6	3	5	36.0
1989	4.7	1,560	915	58.7	4	4	32.9
1990	4.5	1,572	944	60.1	5	3	31.8
1990 5- 20 ha	4.5	919	534	58.1	2	1	23.3
1990 20- 50	4.7	3,197	2,039	63.8	10	9	58.8
1990 50-100	4.5	6,964	4,151	59.6	33	26	85.0
1990 100-500	4.6	18,188	10,834	59.6	76	45	209.0

Data of the 5−20 ha size were obtained from common samples in farm household economy survey, Statistics and Information Department, MAFF.
Source: Statistics and Information Department, MAFF: Forestry household economy survey (1990).

also resulted in the decrease of the demand and depreciation of domestic logs. The Japanese cedar (*Cryptomeria japonica*) is a typical example. The market price of Japanese cedar logs fell by 21% from 1980, when the price was at its peak (cost of logs= cost of stumpage + production cost). On the other hand, over the last 10 years, the ratio of the production cost to the total cost of logs increased by 10%[1].

Table 3 shows the average prices of stumpage of Japanese cedar during the period from 1977 to 1991. In 1991, the stumpage price of Japanese cedar was only 68% of that in 1980. In order to maintain reasonable profits for forest owners, it has become necessary to reduce as much as possible the planting and logging costs. Presently the traditional silvicultural system with labor-intensive-investment should be reconsidered.

Forestry management balance

As a typical example of breakdown of expenditure for silvicultural operations, operation cost of Japanese cedar in 1986 is shown in Table 4.

Due to the lack of detailed data, only average values of expenditure are respresented for the forest management level. Only the total values are shown for Japanese cypress (*Chamaecyparis obtusa*), Japanese red pine (*Pinus densiflora*), Japanese black pine (*Pinus thunbergii*) and Japanese larch (*Larix kaempferi*).

Expenses for harvesting : Road construction materials (stone, wood, cement, etc.), maintenance expenses, and direct material expenses such as tools, fuel, required for logging amounted to ¥135,000. Personnel expenses such as wages for the field

Table 3. Log prices and log production cost of Japanese cedar

(Unit:¥/m³, %)

Fiscal year	Price of stumpage (A)	Log production cost					Price of timber (A)+(B)	(B)/((A)+(B))×100
		Wage	Material	Transport	Indirect	Total(B)		
1977	22,514	5,441	823	1,817	1,128	9,208	31,722	29.0
1978	22,621	5,941	729	1,957	1,239	9,866	32,487	30.4
1979	25,790	5,602	976	1,781	1,562	9,922	35,712	27.8
1980	26,622	5,934	1,086	2,169	1,389	10,579	37,201	28.4
1981	22,470	6,317	1,093	2,137	1,563	11,110	33,580	33.1
1982	20,576	6,030	1,127	1,990	1,570	10,717	31,292	34.2
1983	19,752	6,246	1,091	2,011	1,518	10,815	30,617	35.5
1984	17,532	5,824	1,034	1,869	1,540	10,268	27,800	36.9
1985	15,700	6,272	1,031	1,899	1,655	10,858	26,557	40.9
1986	15,307	5,669	1,074	1,845	1,613	10,202	25,509	40.0
1987	17,991	5,839	1,160	1,810	1,497	10,306	28,297	36.4
1988	16,925	5,651	1,101	1,927	1,882	10,561	27,486	38.4
1989	18,694	5,796	1,278	1,855	1,917	10,846	29,540	36.7
1990	18,068	6,439	1,263	2,315	1,447	11,464	29,532	38.8
1991	18,230	5,982	1,363	2,381	1,496	11,222	29,452	38.1

Source: Forestry Agency (1989,1992)[1].

Table 4. Forestry operation cost (1986 Fiscal year)
(Total forestry operation cost for forest from 1 to 50 years of age)

(Unit:¥1,000/ha)

Item	Material	Wage	Social cost	Depreciation	Contract work	Owner's own work	Total
Japanese cedar	464.5	601.7	583.0	315.3	3,128.6	384.1	5,477.2
(1) Harvesting	135.1		568.9	244.1	2,650.2		3,598.3
(2) Regeneration							
・soil preparation		74.9				24.4	
・planting	190.7	59.1				21.2	
・re-planting	13.0	5.7				8.5	
・brushing and weeding		268.1				157.9	
・fertilizer application	1.0	0.4				0.3	
(3) Cleaning and pruning							
・lifting of fallen trees		45.8	14.1	71.2	478.4	37.7	1,781.7
・vine cutting		7.3				9.8	
・pre-commercial thinning		38.8				32.4	
・pruning		71.5				48.5	
(4) Forest improvement							
・drainage							
・fertilizer application	8.9	1.5				1.5	
(5) Forest protection and administration	53.7	5.2				30.2	
(6) Other costs	62.1	23.4				11.7	97.2
Japanese cypress	525.6	617.7	528.6	221.1	3,242.7	379.1	5,514.8
Japanese red and black pine	292.5	236.2	323.0	136.2	1,896.2	107.0	2,991.1
Japanese larch	226.5	44.5	192.1	160.8	1,723.1	105.1	2,452.1

Sources: ① Forestry Agency: Report of stumpage market survey (Fiscal year : 1986).
② Statistics and Information Department, MAFF : Farm household economy survey (Fiscal year : 1986).

administrator and supporting staff, miscellaneous expenses such as workmen's accident compensation insurance, and indirect expenses counted as social expenses, totalled ¥569,000. Machinery depreciation was ¥244,000. If all the felling, bucking, and logging operations were allotted to a contractor, the expenses would have totaled ¥2.65 million, mainly personnel expenses. The total expenses for harvesting thus reached a value of approximately ¥3.6 million.

Expenses for silvicultural operations: Land rent and interest were not included here. Material expenses amounted to ¥330,000, of which the seedling cost accounted for 62%. Weeding accounted for the major part of employment labor and family work. Another ¥250,000 was added to the cost of weeding for contract work up to 5 years. Thus approximately 40% of the cost of silvicultural operations was represented by weeding expenses. Workmen's accident compensation insurance and unemployment insurance were counted as social costs relating to silviculture, but the actual insurance cost was higher, because a part of it was also included in the contract rent for work. Since social costs except insurance were included in the wages and other management expenses, it is difficult to differentiate them.

Table 5 shows the labor input for each type of operation according to the forest age. Labor related to contract work was not included in this table which indicates that weeding accounted for the major part of labor.

Tables 6 and 7 show the balance of domestic forestry management [5] in 1990. Gross income from forestry per forestry household in 1990 increased by 7% from 1989. Gross income from silvicultural production also increased by 20% compared with the value in 1989, due to the increase in sales of stumpage. From the viewpoint of size class of forest, the production of logs was a very important source of gross income for owners of a forest area over 50 ha, while the production of mushrooms accounted for the largest part of the total forestry gross income for the owners of the 5-20 ha level. The higher the percentage of gross income from mushroom production, the smaller the scale of the owned forest. For the 5-20 ha level, gross forestry income from mushrooms accounted for half of the total forestry gross income.

Forestry expenditure per forestry household in 1990 decreased by 4% compared with the previous year. Material expenses decreased by 11% and contract charges by 13%. The percentage of wage increase, which included employment wages and contract charges, to the total forest management

Table 5. Labor input by kind of operations (1~50 years of age)

(Unit : man-days/ha)

1986 Fiscal year operation	Total	Age of trees 1~5	6~10	11~15	16~20	21~30	31~50
Japanese cedar	141.9	70.3	32.5	15.0	7.5	8.8	7.8
Soil preparation	14.8	14.8	0.0	—	0.0	0.0	0.0
Planting	12.0	12.0	—	—	—	—	—
Fertilizer application	0.3	0.3	0.0	0.0	—	—	0.0
Re-planting	1.8	1.7	0.1	0.0	0.0	0.0	0.0
Weeding	62.2	35.1	19.9	4.6	1.0	1.0	0.6
Lifting of fallen trees	11.1	3.1	4.7	1.9	0.5	0.7	0.2
Vine cutting	3.1	0.5	0.9	0.5	0.5	0.4	0.3
Pre-commercial thinning	11.0	0.7	1.1	2.7	1.8	2.9	1.8
Pruning	16.2	0.6	4.6	4.5	2.9	2.3	1.3
Other costs	9.4	1.5	1.2	0.8	0.8	1.5	3.6
Japanese cypress	128.4	62.7	26.4	12.4	7.4	10.7	8.8
Japanese red and black pine	48.2	23.1	5.3	6.1	4.0	3.8	5.9
Japanese larch	21.3	12.8	0.1	0.9	2.8	2.3	2.4

Source : Statistics and Information Department, MAFF: Report of forestry household economy survey— Forest management cost (1986).

Table 6. Balance of forestry management
(1) Forestry gross income – Forest household economy of 5-500 ha

(Unit : ¥1,000)

Fiscal year and size of operated forest area	Forestry gross income						
	Total*	(Cash)	Silviculture	Production of logs	Production of fuelwood and charcoal	Production of "Shiitake" and other mushrooms	Others
1985	534.9	(520.5)	190.3	137.9	18.0	154.4	34.3
1986	502.8	(489.6)	181.5	118.3	15.5	154.5	33.0
1987	591.8	(575.0)	174.6	170.3	14.6	194.4	37.9
1988	571.5	(548.1)	172.8	158.5	15.5	182.2	42.4
1989	606.2	(591.7)	195.0	187.2	9.8	171.8	42.4
1990	650.8	(637.2)	234.0	185.4	9.8	178.6	43.0
1990 5- 20 ha	358.0	(348.0)	114.7	41.7	9.4	177.0	15.2
1990 20- 50	1,245.5	(1,210.7)	573.8	391.8	11.9	184.4	83.6
1990 50-100	2,920.3	(2,903.0)	627.4	1,473.4	13.3	166.8	639.4
1990 100-500	10,098.4	(10,079.3)	4,115.3	5,470.0	8.0	255.9	249.2

*Total includes cash.
Source: Statistics and Information Department, MAFF: Report of forestry household economy survey (1990).

Table 7. Balance of forestry management
(2) Forestry expenditure – Forest household economy of 5-500 ha

(Unit : ¥1,000)

Fiscal year and size of operated forest area	Forestry expenditure							
	Total*	(Cash)	Payment for employees[a)]	Material wood cost	Materials cost[b)]	Contract rent for work	Others[c),*]	(Depreciation)
1985	251.6	(215.4)	39.5	21.6	32.5	72.9	85.1	(35.9)
1986	232.5	(195.9)	36.7	16.3	36.5	55.9	87.1	(36.4)
1987	251.0	(209.7)	36.8	14.0	42.2	63.2	94.8	(40.8)
1988	248.6	(208.6)	35.9	5.4	37.0	70.5	99.8	(40.4)
1989	252.9	(206.4)	38.9	9.5	36.6	68.5	99.4	(38.3)
1990	241.9	(199.9)	41.9	8.5	37.3	59.6	94.6	(41.6)
1990 5- 20 ha	126.9	(91.8)	12.4	8.3	31.5	14.7	60.0	(35.1)
1990 20- 50	473.6	(411.1)	87.2	8.6	48.0	135.8	194.0	(59.4)
1990 50-100	1,053.0	(955.1)	206.5	6.6	80.8	422.8	336.3	(95.6)
1990 100-500	4,164.2	(3,980.0)	1,325.5	26.2	240.7	1,654.8	917.0	(184.4)

a): Including workmen's accident compensation insurance.
b): Material cost includes the cost of planting stock and fungi, fertilizers and manures, forestry chemicals and miscellaneous materials.
c): Others include charges and fees.
*Total and others include cash and depreciation, respectively.
Source: Statistics and Information Department, MAFF: Report of forestry household economy survey (1990).

Table 8. Balance of management investment and internal rate of return[2]
(Japanese cedar: final cutting age 45, final cutting volume 300 m³/ha, national average)

Fiscal year	Forest management cost by age of trees (¥1,000/ha)						Stumpage price	Final income	Internal rate of return[a]
	1–5 age	6–10	11–20	21–30	31–45	Total	(¥1,000/m³)	(¥1,000/ha)	(%)
1961	72	21	19	11	10	133	9.1	2,724	8.1
1966	143	41	38	21	21	265	9.8	2,927	6.5
1971	274	79	86	38	42	519	12.0	3,612	5.3
1976	715	187	182	104	122	1,309	19.6	5,874	4.2
1981	1,184	414	319	153	133	2,203	20.2	6,064	2.8
1986	1,069	399	264	123	125	1,981	14.1	4,243	2.0

a) : $\frac{R}{(1+P)^{45}} = \sum_{n=1}^{45} \frac{Cn}{(1+P)^n}$

P : Internal rate of return,
R : Final income,
Cn: n-year management cost after planting.

expenses was 21% for the 5-20 ha level, 47% for the 20-50 ha level, 60% for the 50-100 ha level, and 72% for the 100-500 ha level. Clearly the percentage associated with wages increased with the scale of the owned forest.

Profitability of Japanese forestry

The price of domestic logs in Japan continues to decrease due to the low domestic demand for wood, steady imports of cheaper foreign logs, and development of wood substitutes. An estimation of the internal rate of return (hereinafter referred to as "IRR") was made here for the final cutting age of Japanese cedar at 45 years. Table 8 shows the values for every 5 years from 1961 to 1986[2]. The 8.1% IRR in 1961 decreased steadily to a value as low as 2.0% in 1986, and is now estimated to be around 1.5%, indicating that reforestation is difficult even with the use of reforestation funds at a low annual interest rate of 3.5% granted by the Agriculture, Forestry, and Fisheries Finance Corporation. These values were calculated without considering the afforestation subsidy, and the IRR increased slightly when about 40% of the expenses for silvicultural operations was subsidized. In some instances, a rise in the IRR of about 1-2% could be obtained by incorporatingthe subsidy[2].

Forestry households are now facing a situation where it is more advantageous to buy money goods, which yield a higher rate of return than the afforestation investment. A number of forestry households have discontinued afforestation investment by making contracts of proceeds-sharing afforestation with the forest development corporation or their prefecture, and thus have substantially reduced activities related to forestry.

Forestry profitability and labor-saving

The profitability of forestry is defined as the difference between the price of stumpage and the expenses related to silvicultural operations. Therefore, the reduction in these expenses can be correlated with the increase in profitability for the forestry households. As stated above, weeding is the most expensive part of silvicultural operations. For Japanese cedar, about 100 people per ha, including family members, hired workers, and contract labor, are required over 50 years. A total of 70 people are required over 5 years for planting and weeding. Labor-saving here is an important consideration.

To reduce the cost of silvicultural operations, labor-saving has been achieved in planting and pruning, but as the major part of the silvicultural activities in Japan is carried out in forest land with a steep topography, it is difficult to enhance silvicultural efficiency to a significant degree merely by mechanical means. Against this background, forestry households plan to reduce expenses by decreasing the labor investment. Thus, according to the Statistical Yearbook[5], the average labor invest-

ment per forestry household at the 20-500 ha level has been reduced from 113 people per year in 1985 to 93 people in 1990. In particular, the hired labor has been reduced markedly. The number of forestry households trying to reduce expenses through lower employment levels are increasing, showing that "omission forestry" is expanding.

As a production target must be set, silvicultural activities and the distribution of labor to achieve the target must be evaluated. That is, it is important to clearly distinguish between areas where labor-saving is possible and areas where it is not. Furthermore, we must reconsider the development of even-aged uniform forests, and short rotation and clear cutting systems, from the standpoint of profitability of forestry and conservation of the environment. Various types of forests and forestry activities will be required in the future.

To save labor for silvicultural operations and logging, the introduction of forestry machines is being actively encouraged. There are many technical and socio-economic problems regarding the mechanization of forestry in Japan, mainly due to the topography and the dispersion of small scale forest holdings. The enhancement of the working efficiency through mechanization is more likely to be achieved for logging than for the silvicultural operations. With mechanization proposals, natural conditions and the socio-economic conditions of an area must be taken into consideration.

The development of forestry machinery is necessary in order to compensate for the shortage of labor and to enhance profitability. Prior to this, however, it is important to consider issues such as systematization of production, distribution and wood processing, shortage of forestry workers, improvement of the forest road network and zoning of forests based on uses. Particularly with the zoning of forests based on use, if it could be possible to distinguish between forests which may lead to increased profits via the introduction of extensive mechanization from forests whose preservation should be considered as essential, targets of cost reduction would be clarified and efficient technical development may become possible[3].

Conclusion

The profitability of forestry in Japan is currently low. The IRR level is so low that reforestation is actually impossible without subsidies. Therefore, at first glance, it is unlikely that silvicultural management will take hold in most of Japan under the present conditions. However, this situation is due to the planting projects currently underway, and different approaches are likely to be adopted for almost all the man-made forests. Thus, it appears that the 10 million ha of man-made forests in Japan have became gradually mature due to the political support (subsidies) for tending work. For the majority of the forestry households, silvicultural investment several years ago was not counted as production expenses, and the net yearly income was considered to be an important issue. The final cutting age also tends to increase due to the low price of logs and shortage of labor. In addition, even-aged uniform forests with short rotation can not be developed over as large areas as before, due to the low profitability of forestry, the need to conserve the forest environment, labor shortage, etc. It thus appears that the conventional concept of soil rent is being gradually substituted for the concept of forest net income.

In order to preserve the forest environment to enhance the various functions of forests as well as to maintain a sustainable timber yield, it will be necessary for the future of Japanese forestry, to diversify forest management, to promote tending work at a low cost and labor-saving in forestry as well as to review the current planning and tax systems, based on the theory of forest net income.

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(Received for publication, Jan. 21, 1993)