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日本の林業生産の特質に関する研究(生物生産学科)

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Studies on the Characteristics of Forestry Production in Japan

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Summary

Japan depends mostly on imported wood to meet domestic demand which continues to increase. This paper describes the characteristics of forestry production by studying current status of forest resources and forestry household, trends in timber production and forest plantation. The total forest covers about 25.2 million hectares, about 67 percent of total land area. Natural forest area is about 13.52 million hectares and artificial forests cover about 10.33 million hectares. Japan has a large forest plantation and forest resources are increasing substantially, but annual timber production and forest plantation area have decreased. The decrease in forestry production activity is due to (1) most of total plantation forest area covered by Sugi, Hinoki, and other species are under 35 years and not matured for cutting, (2) decreasing log prices at roadside, (3) forestry households own forest lands which are small-scale, (4) decreasing number and ageing forestry workers, (5) decrease in the number of loggers, (6) decrease in plantable land area, (7) the hilly topography of forest lands, etc. Increase in domestic wood self-sufficiency is very important in order to make forestry production active.

1. Introduction

Japan's annual self-sufficiency in timber output has been decreasing to a point where future sustained output has been debated. The country depends mostly on imported wood to meet domestic demand which continues to increase. Timber resources are accumulating over

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the years against many constraining factors but multiple benefits of the forest resource have been achieved through management trade-off. Recent trend in market forces, export countries' changing policies, coupled with recent actions of global environmental groups underpinned increasing apprehension in meeting future demands for timber resource. This paper describes the characteristics of forestry production by studying current status of forest resource and forestry household, trends in timber production and forest plantation. The current state of accumulated timber inventory and forest development, particularly, efforts to meet future demands through plantation establishments are explored. This information would add to knowledge in the forestry sector as a tool for forest economy and policy analysis.

2. Forest Resources and Forestry Household

The total land area of Japan is classified by topographical features into mountains, plains, and coastal areas. Mountains, hills, and volcanic cones take approximately 75 percent of total land. These mountains and hills have steep slopes and narrow valleys and are covered with forest. The climatic condition is favourable to forest resource development despite the negative effect of typhoons on planted forests.

There are four major types of climax native forest, and Kinji (1984) zoned these by temperature characteristics. These are from north to south (i) sub-frigid forests, (ii) Cool temperate forests, (iii) warm temperate forests, and (iv) subtropical forests.

The forest resources by 1993 covered about 67 percent of total area in relation to other land uses in Japan (Table 1). Agricultural activities covered 5.5 million hectares and builtup

Table 1. Japan's Forest Resource*

Unit:1,000ha

Forest Ownership	Forest Types			Total Area
	Artificial Forest	Natural Forest	Others**	
National forest	2,466	4,728	666	7,861 (31.0)
Non-national forest	7,861	8,795	695	17,351 (69.0)
private forest	6,673	7,393	586	14,651
public forest	1,188	1,402	110	2,700
	10,327 (41.0)	13,523 (54.0)	1,361 (5.0)	25,212 (100)

Source: The 70th Statistical Yearbook of MAFF, 1993-94, p.303

Note:* means status as at March 31, 1990

**means cut-over land and other lands, bamboo forest

() percentage distribution

lands, water bodies and other land uses covered the remaining land. Food and Agriculture Organization (1976) estimated that about 24.10 million hectares of total forest land is operable, the remaining occur on adverse sites, unfavourable terrain, or located on economically inaccessible lands. The wooded area of forest under management plan as of 1993 is 23.8 million hectares of which 10.3 million hectares is artificial forest and 13.5 million hectares is

natural forests. Due to the rugged topography, forests perform a crucial soil and hydrological functions in the country.

The inventoried growing stock as of 1993 for the entire forest resource is estimated at about 3.14 billion cubic metre, and is accumulating at an average annual rate of 76 million cubic metre (Forestry Agency, 1993). Stocked forests under management plan cover about 94 percent of total forest resource area, and represent 2.96 billion cubic metre. Coniferous trees make up 64 percent (1.88 billion cubic metre), whilst non-coniferous trees represent about 1.07 billion cubic metre. Both artificial and natural forests contain inventoried growing stock of approximately 1.48 billion cubic metre. Non-national forest land owners manage more than 73 percent (2.14 billion cubic metre) of this growing forest tree under plan, the remaining is under government management. Growing stock in exploitable forests under plan by 1993 is estimated to be more than 120 cubic metre per hectare and is increasing.

The forest ownership system in Japan which evolved through forestry development is broadly grouped into national and non-national owned. National forests are managed by the Forestry Agency. These include (i) purely government owned; (ii) government plantations on private lands; and (iii) those administered by other ministries and agencies. Forest resources owned privately or public are non-nationally owned. Public forests are under management of (i) Prefectural government; (ii) Municipal offices; (iii) Financial/Property ward; (iv) Habitual Joint Holding (Common forests); and (v) Cooperatives in local public bodies. Private forests are owned by (i) Individuals; (ii) Corporations/Companies; (iii) Unions bodies and Cooperatives; (iv) Joint Holding; and (v) Temples and Shrines. The non-national forest owners, particularly the private ones play an important role in the management and development of forest resources in Japan. The Forestry Agency (1993) reported that private forest covers about 84 percent (14.7 million hectares) of non-national forest land, and represents about 86 percent (1.97 billion cubic metre) of growing stock. Forest sizes of forestry household by 1990 are summarized in Table 2. According to a Ministry of Agriculture, Forestry and Fisheries (MAFF) survey in 1990, about 88.9 percent of forestry household manages 32.4 percent of their 6.8 million hectares (Forestry Agency, 1993).

Table 2. Number of Forest Households and Forest Holding (1990)

Forestry Households (Number of Owners)	Forest Holdings (ha)	% of Total Number
1,452,255	0.1~1.0	57.9
777,207	1.0~5.0	31.0
150,661	5.0~10.0	6.0
79,281	10.0~20.0	3.2
23,294	20.0~30.0	0.9
14,664	30.0~50.0	0.6
7,490	50.0~100.0	0.3
3,753	100 and over	0.1
2,508,605		100

Source : The 70th Statistical Yearbook of Ministry of Agric., Forestry, and Fisheries. 1993-1994, pp.284-285

The major characteristics of forestry household is the small-scale forestry. They operate forest lands of not more than 5 hectares with an average size of forest holding about 2.6 hectares. Over 79 percent of these individuals own artificial forests, with the remaining holding natural forests. These attributes impact on forest production and development in Japan (Forestry Agency,1993).

In agriculture, like forestry the total number of farm household by size of cultivated land is small and decreasing (MAFF,1994).

2. Timber Production

Output of forest products is intended to satisfy a whole range of direct and indirect socio-economic needs in Japan, among others (i) contribute to domestic economies and particularly to mountain and upstream villages, and (ii) service wood related industries, provide employment and income opportunities.

Logging, the primary activity in the timber manufacturing sector serves to secure material for the wood processing industries which among other related factors, dictate the level of operation of the logging industry. Mechanization process in the logging industry has developed and transformed logging with time. Currently, an expanded use of high performance forestry machinery has taken the use of manpower, and the process ensures efficiency, precision, increased productivity and safety.

The various types of management in logging operations are grouped into (i) private individuals;(ii) forest enterprise or companies;(iii) forestry cooperatives or owners association; and (iv) forestry unions and labour groups. Private individuals dominate the logging industry in number. Kitagawa (1988) gave a summary of trend in number of loggers in his text on log production and logging business. In 1960, the number of loggers was 69,304 but decreased to 21,151 by 1980 at a rate of 5.7 percent per annum within the period, and the trend may continue.

The primary industry particularly agriculture and forestry has experienced declining self-sufficiency in total product supply. In agriculture, self-sufficiency in grain output for human and farm animal use was 62 percent in 1965. However, it decreased to 30 percent in 1986, 29 percent in 1992, and an estimated 22 percent in 1993 (MAFF,1996). Industrial wood self-sufficiency decline has been a characteristics of the forestry sector as shown in Tables 3-1 and 3-2. Output of industrial timber for downstream processing decreased in absolute volume from 1967 fiscal year consistently with annual rates increasing. This shows domestic contribution to meet total national demand.

The major timber species produced are coniferous species, and annual share of these species is presented in Table 4. Sugi (*Cryptomeria japonica*) contributes more to total annual volume produced between 1989 and 1993, showing an upward trend. Other industrial timbers are usually small diameter logs, but the uses in Japan have almost being substituted by artificial products, hence their outputs have decreased consistently. Supply of these logs come from thinnings from artificial forests. About ten percent of these are converted into posts for urban forestry plantings.

Table 3-1. Industrial Roundlog Production. FY.1955-77
(1,000m³)

Year	Total Output	Industrial Timber Output	Logging Residue	Grand Total of Industrial Timber Supplied*(SSR %)**
1955	42,794	42,794	-----	45,278(94.5)
1956	45,238	45,238	-----	48,515(93.2)
1957	47,713	47,713	-----	51,214(93.2)
1958	43,794	43,794	-----	48,011(91.2)
1959	45,438	45,438	-----	51,124(88.9)
1960	49,006	48,515	491	56,547(86.7)
1961	50,816	49,893	923	61,565(82.5)
1962	50,802	49,807	995	63,956(79.4)
1963	51,119	50,193	926	67,761(75.4)
1964	51,660	50,678	982	70,828(72.9)
1965	50,375	49,534	841	70,530(71.4)
1966	51,835	51,023	812	76,876(67.4)
1967	52,741	51,813	928	85,947(61.4)
1968	48,963	48,169	794	91,806(53.3)
1969	46,817	46,062	755	95,570(49.0)
1970	46,241	45,351	890	102,679(45.0)
1971	45,966	45,253	713	101,405(45.3)
1972	43,941	43,114	827	106,504(41.3)
1973	42,209	41,584	625	117,581(35.9)
1974	39,474	38,874	600	113,040(34.9)
1975	34,577	34,155	422	96,369(35.9)
1976	35,760	35,271	489	102,609(34.9)
1977	34,231	33,793	438	101,854(33.6)

Source:Forestry Agency, The Annual Handbook of Forestry Statistics, FY. 1982. pp.38-39

*Includes imported timber

**SSR % is Self-sufficiency rate in percentage

Table 3-2. Industrial Roundlog Production (1,000 m³) FY.1978-94

Year	Total	Sawlogs	Veneer sheets & Plywood	Pulp & Woodchips	Others	Grand Total of Industrial Timber Supplied*(SSR %)**
1978	32,558	20,482	597	10,044	1,435	103,417(31.5)
1979	33,784	21,461	603	10,307	1,413	109,786(30.8)
1980	34,557	20,935	514	11,789	1,301	108,964(31.7)
1981	31,632	19,527	451	10,444	1,201	91,829(34.4)
1982	32,154	19,953	443	10,633	1,125	90,157(35.7)
1983	32,316	19,392	442	11,436	1,066	91,161(35.4)
1984	32,874	18,946	457	12,470	1,001	91,361(36.0)
1985	33,074	18,814	433	12,844	983	92,901(35.6)
1986	31,613	18,397	404	11,878	934	94,506(33.5)
1987	30,984	18,774	395	11,005	810	103,136(30.0)
1988	30,998	18,811	382	11,003	802	106,282(29.2)
1989	30,586	18,553	381	10,965	687	113,850(26.9)
1990	29,367	18,023	354	10,373	617	111,160(26.4)
1991	27,999	17,332	312	9,782	573	112,166(25.0)
1992	27,165	17,240	277	9,101	547	108,489(25.0)
1993	25,597	17,293	274	7,524	506	108,265(23.6)
1994	24,477	17,440	253	6,303	481	109,321(22.4)

Source:Forestry Agency of MAFF, Annual Forestry White Papers of FY. 1984(p.96), 1989 (p.133), 1993 (p.182), 1996 (p.146)

*Includes imported timber

**SSR % is Self-sufficiency rate in percentage.

Others:mine timber, telegraph pole, pile log, scaffolding pole, fibreboard etc.

Table 4. Major Tree Species Harvested

Species Name (Scientific name)	Contribution(1,000 m ³)		
	1989	1991	1993
<u>CONIFERS</u>			
Sugi	8,536	8,443	8,995
(<i>Cryptomeria japonica</i>)	(28.0)	(30.2)	(35.2)
Hinoki	3,328	3,081	3,051
(<i>Chamaecyparis obtusa</i>)	(10.9)	(16.2)	(11.9)
Akamatsu & Kuromatsu	2,993	2,591	2,255
(<i>Pinus densiflora</i> & <i>Pinus thunbergii</i>)	(9.8)	(9.3)	(8.8)
Todomatsu & Ezomatsu	2,659	2,519	2,194
(<i>Abies sachalinensis</i> & <i>Picea jezoensis</i>)	(8.7)	(9.0)	(8.6)
Karamatsu	1,641	1,670	1,543
(<i>Larix leptolepis</i>)	(5.4)	(6.0)	(6.0)
Momi & Tsuga	246	203	168
(<i>Abies firma</i> & <i>Tsuga sieboldii</i>)	(0.8)	(0.7)	(0.7)
Others	675	530	566
	(2.2)	(1.9)	(2.2)
	20,078(100)	19,037(100)	18,772(100)
<u>NON-CONIFERS</u>			
Nara	586	512	423
(<i>Quercus spp</i>)	(1.9)	(1.8)	(1.7)
Buna	572	462	390
(<i>Fagus crenata</i>)	(1.9)	(1.7)	(1.5)
Others	9,279	7,927	5,985
	(30.4)	(28.4)	(23.4)
	10,437(100)	8,901(100)	6,798(100)
	30,515	27,938	25,570

Source : The 70th Statistical Yearbook of MAFF, 1993-94, pp.306-307

Non-national forests dominate the annual contribution of total roundlog output, though their share continues to decreased. However, the rate of decrease in output from national forest was higher. Forest owners and other loggers are agents of timber supply in the log and lumber distribution system(Figure).

Log prices at roadside have been decreasing for the species produced (Forestry Agency,1995). The prices per cubic metre for Sugi(*Cryptomeria japonica*), Hinoki(*Chamaecyparis obtusa*) and Matsu (*Pinus species*) were ¥14,595, ¥33,607, and ¥7,528 respectively in 1990. However, in 1995 these prices per cubic metre fell to ¥11,730, ¥27,607, and ¥5,966 respectively serving as an economic disincentive to log production.

3. Forest Plantation

The extent to which afforestation programmes have received attention could be attributed to many related factors. These include (i) a favourable environmental condition for planting; (ii) a high level scientific development in silvicultural techniques of coniferous species; and (iii) realization that sustainable and economic replacement of the forest can only be achieved through afforestation strategy.

Afforestation is an integrated and multi-institutional programme in Japan. It is carried out by the government on national forests, non-national forest owners, and the Forest Development Corporation. The Public Corporations for Afforestation and Forest Development were formed under the Forest Structural Improvement Project to promote afforestation with private people. They engage in a tenurial system of yield sharing afforestation programmes with small scale forest owners under prefectural and municipal offices to plant government lands.

The process of regeneration gained prominence in the early 1950s. In 1980, the area planted was 160,218 hectares, 105,310 hectares in 1985, and 71,331 hectares in 1989. The annual planted area decreased consistently and the area as of 1990 is shown in Table 5. Sugi and

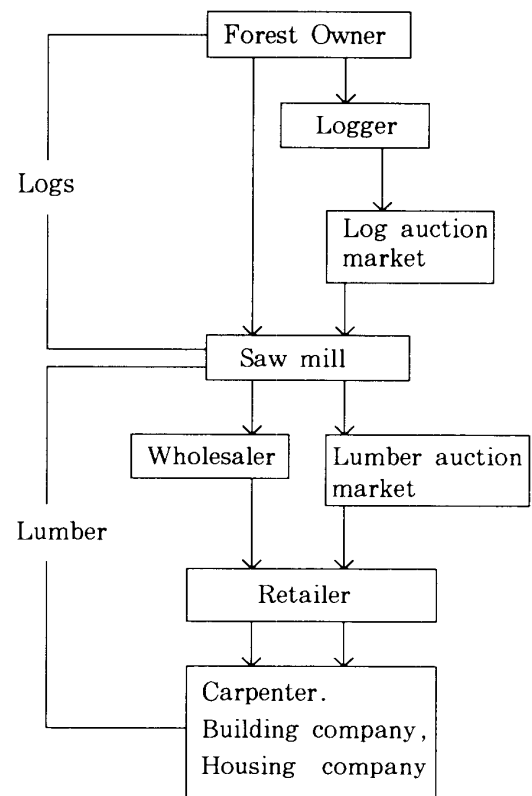


Fig. Distribution Channel of Domestic Wood Source : Forestry Agency, Forestry and Forest Industries in Japan, 1991, p.22

Table 5. Area of Plantation Forest by Species as at March 31, 1990

Speices	Area (1,000ha)	% of total area	Growing Stock (million m ³)	% Share
<u>CONIFERS</u>				
Sugi(<i>Cryptomeria japonica</i>)	4,539	44	932	59
Hinoki(<i>Chamaecypris obtusa</i>)	2,441	24	310	20
Karamatsu(<i>Laris leptolepsis</i>)	1,082	11	151	10
Matsu-ru(<i>Pinus species</i>)	1,029	10	132	8
Others	996	10	49	3
sub-total	10,087	98	1,574	99
NON-CONIFERS*	202	2	19	1
Grand total	10,289	100	1,593	100

Source : Planning Division of Forestry Agency. Present Condition of Our Forest Resources and Future Direction for Improvement. 456:8-9, 1992

*Non-conifers include Kunugi (*Quercus acutissima*), Nara(*Quercus spp*), etc

Hinoki covered 70 percent of the planted area in 1980, 69 percent in 1985, and 64 percent in 1989. However, the percentage share of land planted with Hinoki continues to increase as that of Sugi decreases. The characteristics of plantation forests by age as of 1990 is one which contain more immature trees (Table 6). Planted forests, about 80.3 percent which

Table 6. Characteristics of Plantation Forests by Age

Age Class	Age Class Limit	Area(10,000ha)	% of Total
1	1~5	44	4.2
2	6~10	70	6.8
3	11~15	94	9.1
4	16~20	135	13.1
5	21~25	169	16.4
6	26~30	175	17.0
7	31~35	141	13.7
8	36~40	78	7.6
9	41~45	27	2.6
10	46~50	22	2.1
11	51~55	18	1.8
12	56~60	15	1.5
13	61~65	12	1.2
14	66~70	9	0.9
15	71~75	8	0.8
16	76~80	5	0.5
17	Over 80	6	0.6
		1,028	100

Source : Forestry Agency, Forests and Forestry in Japan, 1993, p.307

Note : Data as at March 30, 1990

were below 35 years and economically not matured for harvesting constituted about 8.28 million hectares.

Non-national forest owners, particularly the private ones, remain the backbone to meet the annual planting targets (Table 7). The forestry cooperatives play a great role among the non-national forest owners. According to Forestry Agency (1995), in 1988 the percentage

Table 7. Plantation Established in Non-national Forests

Year	GrandTotal	Conifers						Non-conifers		
		Sub Total	Sugi	Hinoki	Matsu-ruii	Karamatsu	Others	Sub Total	Kunugi	Others
1961	337,501	334,979	144,489	66,548	67,772	43,860	12,304	2,522	-----	-----
1965	283,833	281,468	125,114	62,365	48,846	30,700	14,461	2,347	2,347	-----
1970	268,559	266,421	100,919	88,474	31468	28,854	16,706	2,138	1472	666
1975	170,205	164,640	63,162	58,993	14,382	11,639	16,464	5565	2,615	2,950
1980	116,266	111,947	44,817	44,140	5,190	5,183	12,617	4319	2,314	2,005
1985	80,582	73,267	27,668	32,019	1,682	4,044	7,854	7,315	4,999	2,316
1990	55,400	51,065	17,499	23,176	751	3,895	5,744	4,335	1,717	2,618

Source : Forestry Agency, 1992, Outlines of Plantation Forestry in Non-national Forests, pp.140-141

share of area occupied by forestry cooperatives in non-national forest plantation was 78 percent. This share continues to increase gradually and in 1992 it occupied 83 percent. Annual rate of planting in non-national forest lands decreased consistently due to a combination of factors. This decline in average annual planting sizes according to the Forestry Agency (1991) is attributed to these limiting factors. These are among others (i) a gradual decrease in suitable land for afforestation; (ii) changes in forest improvement policy based on the revised Forest Law; (iii) declining rate of return in forestry investment; and (iv) declining status of forestry labour. According to Forestry Agency (1993), the situation of forestry workers is getting worse with time. The ageing workforce has been an issue of concern to forest policy. From 1960, the percentage of forestry workers of age 50 years or more consistently increased to 1990. In 1960, of the 440,000 workers, they represented 23.7 percent, but when the number decreased to 170,000 in 1980, they increased to 47 percent. In 1990, they make up 67.9 percent of the 110,000 workers.

Japan has a unique silvicultural technique that promotes afforestation programme. The spacing of planted seedlings differs with each species and production target, ranging from 2,500-4,000 and 3,000-5,000 seedlings per hectare for Sugi and Hinoki respectively. The rotation age is generally 40-50 years. According to the national forest plan (Forestry Agency, 1981), standard rotation age by species are Sugi (35-50 years); Hinoki (40-50 years); Matsu (25-45 years); Karamatsu (30-50 years); and Ezomatsu (60 years). However, the desire for larger diameter and quality timber, effort to overcome low timber prices, and shortage of forestry workers tend to cause a shift in the rotation age sometimes to 80-100 years.

Unlike mainland Japan where conifers are mostly planted, subtropical and tropical climatic regions like Okinawa and Ghana respectively plant more non-coniferous species. For the sake of comparison, the main species planted in Okinawa and Ghana are shown in Table 8.

Table 8. Some Selected Ten Plantation Species Used in Okinawa* and Ghana**

Okinawa Species	Ghana Species
1. Sugi (<i>Cryptomeria japonica</i>)	1. Teak (<i>Tectona grandis</i>)
2. Mokumau (<i>Casuarina equisetifolia</i>)	2. Gmelina (<i>Gmelina arborea</i>)
3. Isunoki (<i>Distylium racemosum</i>)	3. Eucalyptus species
4. Kusunoki (<i>Cinnamomum camphora</i>)	4. Cedrela (<i>Cedrela odorata</i>)
5. Ryukyu Matsu (<i>Pinus luchuensis</i>)	5. Cassia (<i>Cassia siamea</i>)
6. Terihaboku (<i>Calophyllum inophyllum</i>)	6. Neem (<i>Azadirachta indica</i>)
7. Deigo (<i>Erythrina orientalis</i>)	7. Emeri (<i>Terminalia superba</i>)
8. Taiwanhannoki (<i>Alnus japonica</i>)	8. Baku (<i>Tieghemella heckelii</i>)
9. Iju (<i>Schima wallichii</i> Korthals)	9. Prono (<i>Mansonia altissima</i>)
10. Inumaki (<i>Podocarpus macrophylla</i>)	10. Wawa (<i>Triplochiton scleroxylon</i>)

Sources: * Okinawa Prefecture, Handbook of Useful Trees in Okinawa, 1981

** Annual Reports of Ghana Forestry Department.

6 . Conclusion

The current state of forest resources shows the level of increasing forestry development in Japan. Japan has a large forest plantation and forest resources are increasing substantially. Most of forest households operate small-scale forests.

The annual industrial timber output continues to decrease and this trend has caused a consistent decline in industrial timber self-sufficiency. Sugi and Hinoki timbers are the main annual timber production species. The annual timber output continues to decrease partly due to decreases in the number of loggers and log prices at roadside, the hilly topography of forest lands and the large plantation forests which are not matured.

Annual planting area and efforts in plantation forestry are decreasing consistently. Sugi and Hinoki cover a large portion of planted forests but their annual plantings are decreasing. Most of the age class composition of plantation forests shows one that contains immature trees. Forest cooperatives have played an important role in the development of forest plantation in non-national forests. The factors causing decreasing activity in plantation forestry among others are the limited annual plantable land area, lowering log prices at roadside, decreasing and ageing number of forest workers and the small-scale forest management.

From the above discussion, it can be inferred that recent trend in forestry production activity is diminishing. Increase in domestic wood self-sufficiency is very important in order to make forestry production active and increase future output of roundlog. Policy reform effort to improve this situation is highly necessary.

This study was conducted by Mark Aferdi Dadebo under the supervision of Prof. Dr. Takeo Shinohara.

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日本の林業生産の特質に関する研究

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要 約

日本は木材需要の大部分を外材に依存している。この論文は近年の日本の林業生産の特質を森林資源と林家、木材生産、人工造林の面から明らかにしている。日本の森林面積は2,521万haで、国土面積の67%を占め、天然林は1,352万ha、人工林は1,033万haである。日本は広大な人工林を有し、森林資源は充実しつつあるが、年々の木材生産及び人工造林は減少している。林業生産活動の低下は①スギ、ヒノキ等から成る人工林の大部分が35年生以下のまだ伐期に達していない若齢林であること、②山元立木価格の低下、③林家の林地所有規模が零細であること、④林業労働力の減少・高齢化、⑤素材生産業者（伐木業者）の減少、⑥造林適地の減少、⑦丘陵の多い林地の地形等に起因している。林業生産を活発にするためには木材自給率を高めることが、非常に大切である。

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