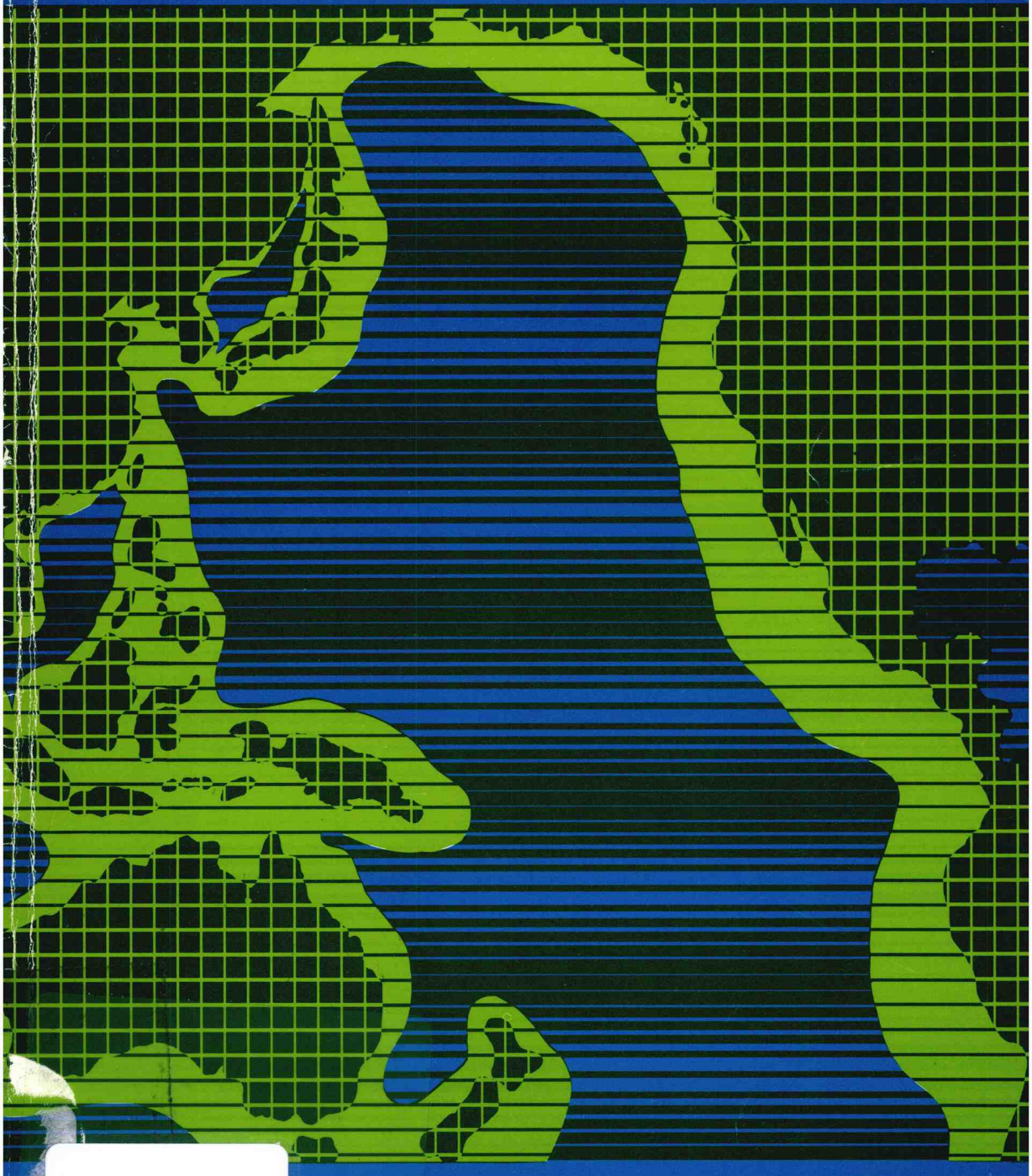
Renewable Resources in the Pacific

Proceedings of the 12th Pacific Trade and Development Conference, held in Vancouver, Canada, 7–11 September 1981



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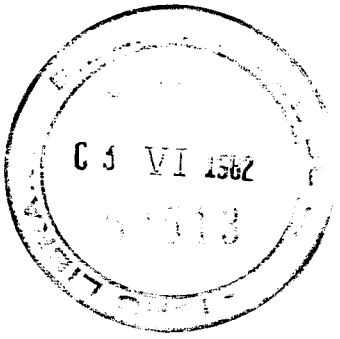
Editors: H.E. English[1] and Anthony Scott[2]



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Forest Plantations, Production, and Trade in the Pacific Basin

Roger A. Sedjo

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This paper describes the forest-project flows within the Pacific basin, discusses the transition from old-growth to plantation forests, and summarizes the results of another study that examines the comparative economic potential of plantations in several locations within the Pacific basin.

La présente communication décrit la circulation des produits forestiers dans la région en bordure du Pacifique, la transformation des anciennes forêts en plantations nouvelles et résume les résultats d'une autre étude comparée sur le potentiel économique de ces nouveaux peuplements dans divers endroits de la région.

The Pacific-basin countries are a major source of the world's industrial wood supply. Nature endowed the west coast of North America — Alaska, British Columbia, the Pacific northwest region of the United States, and California — with vast inventories of prime conifer timber. Across the Pacific, Indonesia, Malaysia, the Philippines, and to a lesser extent Papua New Guinea have similarly large stocks of high-quality tropical hardwood stands and have become the major world suppliers of these woods. Also, the Pacific region provides an outlet for the vast timber resources of Siberia. Certain other countries in the region, such as Chile and New Zealand, are becoming, or have the potential to become, important producers and exporters of wood and wood products.

Trade Flows

The Pacific coast of North America, particularly British Columbia and the U.S. Pacific northwest, is the origin for softwood products of all types, the most important being logs, lumber, and wood chips, newsprint, and pulpwood (Sedjo and Radcliffe 1981). Although these products flow to all parts of the globe, a substantial portion go to Pacific-basin countries, particularly Japan. The East Indian Archipelago is the origin of a massive flow of hardwood forest products (Takeuchi 1974). In this case, the principal outflow is logs, with modest amounts of lumber and wood panels. The major final market is Japan, with the United States and Europe being lesser, but important, final markets. However, much of the processing (particularly of veneers and plywood) is done at an intermediate location, most commonly Taiwan and South Korea. The final major flow of trade consists almost exclusively of Siberian logs from the USSR moving to the Japanese market. The USSR supplies about 40% of Japan's substantial imports of softwood logs. In addition, relatively small, but substantial, flows of forest products, largely softwood logs, go from New Zealand and Chile to Japan, and small flows are from New Zealand to Australia and from Chile to non-Pacific-basin countries.

The flow of forest products within the Pacific basin is profoundly affected by Japan. Historically, Japan was heavily wooded and relied upon wood to provide a variety of its needs, especially construction. The post-World War II boom found the Japanese forest unable to provide for domestic needs. Part of the reason was forest overuse and neglect during the War, and part was the relatively low productivity of Japanese forests compared with the demands of the growing Japanese economy. However, the plentiful forests of Southeast Asia, initially the Philippines and Malaysia and later Indonesia, provided abundant, accessible forest resources at low

prices. The early 1950s saw the growth of Japanese imports of Southeast Asian tropical hardwood logs. Initially, the logs were processed in Japan into lumber and plywood, some of which was used for local consumption but much of which, especially the plywood, was exported to foreign markets, principally the United States. In the early 1960s, the Great Columbus Day Storm ravaged the forests of the Pacific northwest of the United States. The ensuing salvage operations generated large volumes of logs lacking available markets. The Japanese market was "discovered" as an outlet for the temporary glut. Once the benefits of such a trade pattern were recognized, U.S.–Japanese log trade continued to expand and grow until, by the 1970s, U.S. log-export earnings from Japan approached $1 billion. Subsequently, the rapidly expanding domestic market has diverted domestic production of goods such as plywood from the export market into the domestic market. Furthermore, to meet domestic demand in Japan, imports of processed wood have increased, particularly hardwood plywood that is now being processed in countries such as South Korea and Taiwan.

This is not to suggest that Japan is entirely dependent upon external suppliers of wood. Japan has substantial domestic forests, some 24 Mha — of which about 10 Mha are artificial. However, the enormous wood requirement means that domestic production must be supplemented with vast forest-product imports.

Hence, Japan can be viewed as the hub of the great wheel called the Pacific basin, drawing a variety of forest products from all parts of the rim: softwood logs, wood chips, lumber, and some pulp and paper products from North America; hardwood logs and, increasingly, lumber and plywood from Southeast Asia; softwood logs from Siberia; and the recent modest flows, largely of logs, from New Zealand and Chile.

An interesting feature of Pacific-basin, forest-product trade is found in the unique set of commodities commonly traded. Logs and wood chips are not typically heavily traded products in non-Pacific-rim countries. Within the Pacific basin, however, these commodities are traded rather than the more highly processed lumber and wood pulp that tend to dominate trade flows elsewhere.

The Forest Transition

Forestry today is experiencing a transition similar to that which occurred in agriculture much earlier in human history. Like the transition from gathering and hunting to cropping and livestock raising, the current transition is from old-growth, natural forests to planted, managed, and harvested forests. The decisions involved in modern agriculture about location, crop type, technological inputs, and management mode are similar for forestry.

Much of this transition can be examined in terms of a simple stock-adjustment model (Lyon 1981) that can be applied either to a particular forest (given qualifications) or to the global forest. In terms of this model, initially the actual stock of forest resources is greater than the desired stock. Thus, the economically rational policy is simply to draw the old growth (actual stock). In such a world, the initial price of stumpage would be very low, approaching zero, and there would be no economic incentive to invest in tree growing. In fact, the stumpage price was often negative, since the timber resources had no economic value but were merely an obstacle to alternative uses of the land. This situation existed until recently, for example, in much of North America. Gradually, however, an adjustment was occurring. Increases in demand, together with a reduction in old-growth stocks, brought desired and actual forest stocks into closer relationship. As this occurred, stumpage prices would be expected to exhibit real-price increases as has happened (Manthy 1978).

As increases in the real price of timber resources occur and expectations develop that such price increases will continue, the economic incentives are created to induce investments in industrial forest plantations. These increases for some types of timber resources, expectations of future real-price increases, and technological innovations that reduce the costs of forest plantation establishment and reduce the real costs of transportation to major markets all contribute to an environment in which the incentives for investments in plantations are continuously improving.

In this environment, the role of plantations as a supplier of industrial wood could be expected to increase gradually. Simultaneously, the old-growth forests will gradually supply relatively lesser amounts as the high-quality accessible stands gradually give way to lower-quality, less accessible old growth.

Another important feature of the transition should be noted. There is no reason to expect that the regions that have large and valuable stands of old growth will necessarily be the regions that are the most prolific and profitable timber growers. The economics of harvesting an inventory of old growth that has grown over several hundred years are quite different from the economics of timber growing. The latter will depend upon such features as the establishment costs, the biologic

rate of growth, the rotation period, alternative land use, etc. Thus, it is quite possible, if not probable, that some regions with high-value, high-quality old growth will not lend themselves to economically profitable plantations. Also, some regions that never have had extensive high-quality forests may, because of the introduction of exotic species, become dynamic and profitable timber-growing regions, e.g., Venezuela.

Perhaps the principal economic advantage of a previously forested region in the process of timber growing is the probable existence of an infrastructure that was created to facilitate the harvest of the old growth. Much of this infrastructure can probably be used for timber-growing activities.

Industrial Forest Plantations

The transition from natural to plantation forests has, thus far, been very gradual. Typically, plantations have been established to replace the harvested natural forest. This is particularly true in regions such as Europe and much of North America, where the process of natural regeneration is increasingly being displaced by artificial regeneration.

In the tropics and the southern hemisphere, the introduction of industrial forest plantations proceeded slowly. Before World War II some local plantations were established, but, on a global scale, these activities were quite modest. Since World War II and particularly beginning in the 1960s, the tempo of forest plantation development has increased dramatically in regions of the tropics and the southern hemisphere. The preliminary successes of many of these plantations, the rapid biologic growth often achieved, and the vast land areas potentially available suggest the long-term possibility for meeting much of the world's increasing requirement for wood and wood fibre with increased production from the forest plantations of the tropics and the southern hemisphere.

Plantation Types

Three major plantation types can be characterized as occurring currently across the world. First, in temperate regions that traditionally produced the majority of the world's industrial wood — northern Europe and North America — plantations utilizing indigenous species have typically replaced cutover natural forests. Second, other temperate regions that have not traditionally produced major industrial wood supplies are commonly introducing in their plantations exotic temperate-climate species (largely North American) that exhibit rapid growth and desired marketability. Third, certain tropical regions are introducing exotic species (tropical pines, eucalyptus, and gmelina) that exhibit desirable growth and marketability from other tropical regions. Although experience with exotic plantations in the tropics is limited, results thus far are so dramatic that some knowledgeable observers maintain that tropical regions will eventually become dominant wood suppliers.

Although plantations are a small fraction of the world's total forested area, the current land areas involved belie their true potential. Industrial potential is the result not only of more land being converted into forest plantations but also of the volume of output per land unit. These volumes are likely to be large for plantations because the location is usually determined, at least partially, by considerations of high biologic growth and also because the management practices usually increase usable growth. Thus, fast-growing forest plantations offer the potential of meeting a major share of the world's timber requirements from relatively small areas.

Global Trends in Forest Plantations

Although data on the extent and status of forest plantations are extremely sketchy, a recent FAO study (FAO 1978b) provides some perspective on the global extent of forest plantations. Total area regenerated by artificial means was about 90 Mha in the mid-1970s. This is roughly 3% of the area of closed-canopy forest and includes all areas regenerated by artificial means including conventional afforestation and reforestation techniques. These plantations were, for the most part, located in the traditional wood-producing temperate regions of Europe, North America, and the USSR. Conifers are generally the preferred species, although large areas of eucalyptus and gmelina have been established in Latin America, particularly in Brazil.

Although most forest plantations are situated in the northern hemisphere temperate regions, attention has increased recently in plantation activities in the tropics and subtropics and in the southern hemisphere temperate regions. Lanly and Clement (1979) estimated that the tropic and subtropic regions of Central and South America, Africa, and Asia had about 11.8 Mha of plantation forest in the mid-1970s. Of this, about 6.7 Mha were industrial forest plantations. By 1980, only 5 years later, the industrial forest plantations were projected (FAO 1978) to increase by 36% to 9.1 Mha, and projections for the year 2000 were that the industrial plantations in that region would reach over 21 Mha. Although these figures include slow-growing specialty woods such as

teak, most of the present and projected tropic and subtropic industrial plantations consist of fast-growing conifers and hardwoods designated for ordinary solid wood and fibre production.

Plantation Activity

Within the Pacific basin, major forest plantation activities have taken place in several regions. Historically, the Pacific northwest of North America relied upon natural regeneration. Recently, beginning in perhaps the mid-1960s, however, greater attention has been paid to plantation forestry and to planting, growing, and research activities, e.g., to genetic improvement of trees. Large areas are now being artificially reforested with indigenous species and managed for their commercial values.

Plantations with exotic species have been developed in Chile since about 1900. Today, about 700 000 ha of plantation forest exist, much of it monterey pine, which originated in North America. In recent years, Chile has increased the rate of plantation creation to almost 80 000 ha/year. New Zealand currently has about 1 Mha of exotic plantations and is adding about 50 000 ha/year. As in Chile, most of New Zealand's plantations are monterey pine. The fertile soils of New Zealand and the long growing season result in extremely rapid rates of growth. Given the plantation age distribution, New Zealand expects that its plantation output will increase severalfold between now and the first decade of the 21st century. Similar activities are under way in Australia, although at a somewhat more modest level.

Within Indonesia, forest plantations of teak and other expensive specialty woods have been in place for a considerable time. However, plantations with fast-growing exotics are quite new and still experimental. Nevertheless, the rapid growth and low opportunity costs of some of the land suggest good economic potential.

In China, 30–40 Mha of plantation forest have been created since the revolution. However, much of this forest is designated for protection and fuelwood, and, therefore, the industrial potential is limited. Korea, like China, has reforested large areas, about 4 Mha. However, as with China, much of the reforestation is intended for protection and fuelwood purposes.

In Japan, about 10 Mha of its 24 Mha of forest are artificial. Predominantly local species were used, and the output is directed at the specialized local markets. In addition to these countries, Costa Rica, Colombia, Fiji, Australia, Malaysia, and the Philippines all have plantation forests.

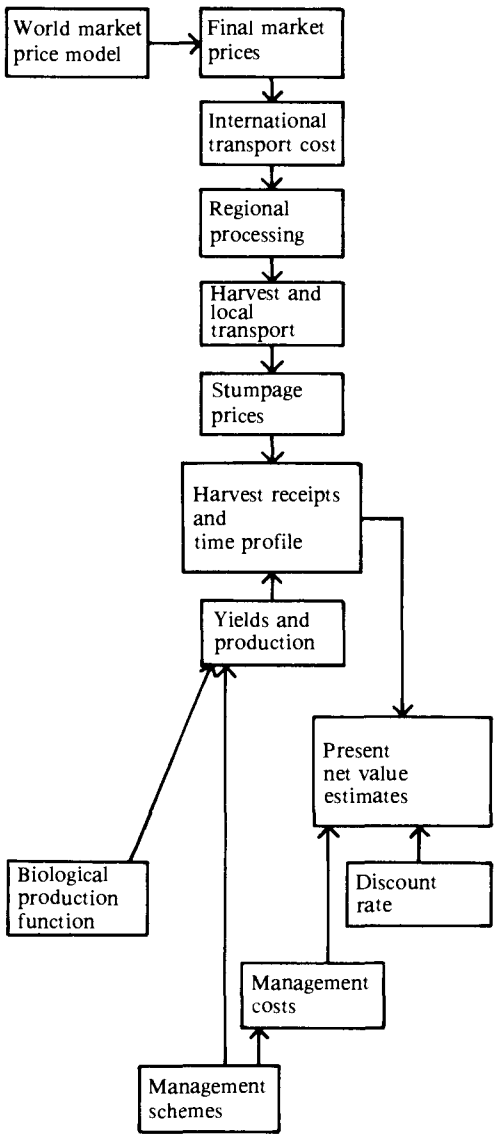

Fig. 1. Conceptual approach to forest plantations.

Comparative Economics

Resources for the Future recently undertook a study of the comparative economics of plantation forestry in 12 regions of the world (Sedjo 1980) using a conceptual approach (Fig. 1). The regions chosen either had large-scale plantation activities already or were thought to have substantial economic potential on the basis of growth rates, wood quality, and location vis-à-vis world markets. In each case, the analysis was

Table 1. Pacific-basin international plantations: present net values (at 5% discount rate for 1979 constant prices in perpetuity and internal rate of return in 1979 US.$/ha).

Case/species	Present net values		Internal rate of return	
	Pulpwood	Sawtimber[a]	Pulpwood	Sawtimber
North America				
[b]U.S. south/loblolly pine	1748	2474	12.02	12.45
[b]U.S. south/loblolly pine/high site	2830	3742	13.91	14.12
Pacific northwest/douglas-fir	- 34	336	4.87	5.92
Pacific northwest/douglas-fir/high site	- 44	1236	4.83	7.51
South America				
Chile/radiata pine	3649	4509	23.39	17.50
Oceania				
Australia/radiata pine	2005	2141	10.68	10.06
New Zealand/radiata pine	2903	4118	11.90	13.11
Europe				
[b]Nordic/Norway spruce	- 100	154	4.61	5.57
Asia				
Borneo/pine	1851	2364	12.94	14.73

[a]Integrated to use residues in pulping.
[b]For comparison purposes.

based upon the country's ability to export to major world markets — Japan, the eastern United States, and northern Europe. Of the 12 regions selected, 5 were in the Pacific basin — Kalimantan (Indonesia), Australia, New Zealand, Chile, and the Pacific northwest region of North America.

The following presents the basic results briefly, without indicating the degree to which these would be sensitive to changing assumptions or conditions.

The model

The preliminary findings of the formal model are shown as estimates of present net values and internal rates of return for the Pacific-basin countries. The present net value and internal rate of return investment criteria related receipts from the wood outputs to the direct costs of forest stand establishment and the costs of subsequent management. Neither land acquisition costs nor development costs enter into these calculations. In the absence of development costs and given an efficient market, the present net value calculated in this manner is an estimate of the per-hectare market price of the land (Table 1).

It should be stressed that, for these quantitative results, no provision is made for political risks and uncertainties that may affect an investment's viability. Also, the quantitative results should not be viewed as definitive but rather only as preliminary and partial indications of economic viability.

The plantations of New Zealand, Chile, Australia, and Borneo performed quite well using either of the quantitative measures. Chile and New Zealand did particularly well. The Pacific northwest's performance, although the poorest within the Pacific basin, was still adequate to justify plantation investments; the long rotation cycle clearly reduces the economic attractiveness of plantations in this region vis-à-vis others examined.

Development costs

A more complete evaluation requires that development costs, risk, and alternative land opportunities all be introduced into the analysis. These can be introduced qualitatively. Development costs are those necessary to provide the physical base to undertake forest-plantation activities. They would include the provision of required infrastructure, both within the plantation boundaries and also of access to the sea. These costs are likely to vary considerably across regions. These costs are generally likely to be small for the U.S., Australia, New Zealand, and Chile due to the location of the plantations and the general level of infrastructure development.

In the areas examined, one would expect these costs to be highest in Borneo and, generally, in the area of Southeast Asia that has the vast inventories of old-growth hardwoods. The process of logging the old growth, if properly done, could provide a basic infrastructure for the establishment of plantation forests.

Summary and Conclusions

The Pacific-basin countries are a major source of the world's industrial wood supply. Much of

the international trade in forest products within the basin moves from producing regions along the Pacific rim to Japanese markets.

As the world's old-growth forests have gradually been used as an industrial wood resource, future forest requirements are increasingly being met by forest plantations. Rising real prices for the wood resource have provided economic incentives to undertake investments in industrial plantations. The choice of location for new forest plantations is not confined to regions that have traditionally been important producers; it includes regions that have particularly favourable biologic or locational features. A simulation study has indicated that the economics are quite favourable for plantation investments in many countries in the Pacific basin, including some that have not been traditional producers.

Discussion

K. Hemmi: The Sedjo paper is excellent, although I must confess that the results of the analysis are so abbreviated that I could not judge the legitimacy of the figures in Table 1. For example, costs in developing a plantation forest may be huge and could change the figures dramatically. My impression, however, is that high rates of growth, wood quality, and location vis-à-vis world markets are main determinants of the competitiveness of the plantations. I agree with Sedjo that the introduction of *Pinus radiata* into New Zealand and Chile opened a new dimension for industrial plantation forests.

This paper complements Darr's because regions that Darr examines are in the Pacific basin, and the comparative economics among them would decide the competitiveness of each wood-producing region. Each of these wood-producing regions is in the forest transition detailed by Sedjo.

Sedjo's projections for the year 2000 that industrial plantations in the tropics and subtropics will be more than 21 Mha suggest that the demand for wood will be met by the supply from the industrial plantation forests. If my understanding is correct, there will be no increase in the real price of wood, and competition among various locations will increase immensely.

Moreover, there will be increasing competition from nonrenewable, inexhaustible natural resources, such as iron, aluminum, and cement. As Darr states in his paper, management of the existing forests will be intensified. In my experience in managing the university forests of the University of Tokyo, selective logging can produce almost the same amount of wood yearly as do plantation forests.

I believe that the positive environmental effects of forests will be more and more appreciated in the future and that public funds will be increasingly invested in protection forests. If this thinking is correct, selective logging in protection forests will be more competitive than the industrial plantation forests, at least in areas where the climate is severe.

In my understanding, the reasons that industrial plantation forests have increased in the past are the increasing price of wood and the improved technology in plantation techniques, including management. If my judgment is correct and if there is no technical breakthrough in silviculture in the tropics and subtropics, or in extremely cold regions, the industrial plantation forest will be limited to temperate zones. In regions of severe climate the transition may be from the mining phase in forestry to selective logging and not to plantations.