

Development in Forestry in the Asia-Pacific Region

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I. INTRODUCTION

The Asia-Pacific region includes all countries in the Asia mainland and the countries in the Pacific bounded by Japan and the Rhukyus in the North and Australia and New Zealand in the south.

This region, which is among the most thickly populated in the world, contains the last remaining natural forests in the Far East. Some of these countries especially those in the Asia mainland are among the oldest in the world where earlier civilization has cleared the land of trees to such extent that today its effect is endangering the productive capacity of the land. Here too, lies newly developing countries whose forests are still unexploited and could very well supply the timber needs of the region but handicapped by financial and technical problems. Here may also be found young countries such as Australia and New Zealand, which have made great leaps forward in the establishment of man-made forests not only for their own needs but to feed the forest industries of other countries.

A timber famine is not yet eminent in the region since one country could fill the need of another. Some countries, however, have destroyed their forest to the point where reforestation and forest management are necessary to bring back the hydrologic capacity of the watersheds, to check floods and erosion and to hold back shifting sands that threaten to engulf agricultural lands. Where-

as timber needs may be solved through export, no nation can exist without forest whose important influence is a vital factor in the ability of the land to support life.

The FAO of the United Nations cognizant of the importance of forest and the varied forestry problems all over the world has supported many projects aimed at improving the forest situation in all member countries. The Asia-Pacific region with its tropical and sub-tropical forests have problems common to many member countries not only in forest production and management but also in the utilization of forest products. Because of the proximity of the nations to one another within the region, sharing more or less common problems, the FAO has organized the Asia-Pacific Forestry Commission with a Secretariat at Bangkok, Thailand which facilitate assistance priority, coordination and exchange of information.

Since its founding the Asia-Pacific Forestry Commission has held six conferences, each time in a different country within the region. The Seventh Session was held from September 22 to October 2, 1964 at Rotorua, New Zealand upon the invitation of the New Zealand Government.

Sixty-one participants representing thirteen nations attended the conference. The Director and Assistant Director of the Forestry and Forest Products Division of the F.A.O. and the Regional Secretary of the F.A.O. at Bangkok and observers from Sudan, the

forest industries of New Zealand, the Commonwealth Agricultural Bureaux (N.Z.), the International Union of Forest Research Organizations and the World Federation of the United Nations were also present.

II. PROGRESS OF FORESTRY DURING THE BIENNIUM 1962-1964

As a whole there is a marked progress in forestry in the Asia-Pacific region during the two-year period 1962-1964. This is true in all areas: forestry policy, survey and management of forest resources, harvesting and processing of forest products, marketing, education and research and forest economics. However, there are still the problems of capital, labor supply in both professional and sub-professional level and other problems traceable to local political and socio-economic limitations.

The progress in the region is a result of use of modern techniques especially the use of aerial photography in forest surveys, the introduction of modern machinery in logging, transportation and processing of forest products. Increase in the acreage of forests through reforestation, afforestation and the establishment of plantations of fast-growing species is among the notable achievements in the region. Majority of the countries have programs on water management. The conservation of wildlife has received notable attention. Research in all aspects of forestry is gaining momentum and the training of research men is an important function of forestry agencies in all countries. More forestry schools have been improved and new ones have been established.

The salient features of program and problems in each country within the Asia-Pacific regions are summarized in the following sections:

a. *Australia*

An Australian Forestry Council has been created. This is composed of the state and commonwealth ministers con-

cerned with forestry. This body will deliberate on forestry matters to be assisted by a Forestry Standing Committee consisting of the heads of the State Forest Services, the Director General of the Forestry and Timber Bureau and the Chief of the Division of Forest Products, C.S.I.R.O.; and a representative of the Department of Territories.

The survey of public forest and plantations are almost complete. Forest plantations are increasing by 30,000 acres annually.

The permanent forest area in the commonwealth increased but some poor forest lands were released for grazing. More lands were set aside for the conservation of wildlife. There was increased interest in water management policies. Government budget allocation for forestry was bigger than in previous years.

At present Australia imports about £80 million worth of forest products. She is investing £2 million a year on forest plantation with the aim of reducing imports considerably in about 36 years. By that time she expects to produce half of her requirement of 1.26 billion cubic feet of timber.

The methods of logging in steep terrain have improved. Sawmills and plywood mills are being modernized and one plant has installed a mechanical stress grading machine. There are now six particle board plants. The increase in the capacity of pulp mills has been notable in the last two years.

Improved efficiency of the mills has resulted in the reduction of the labor force in the wood-using industry.

In education the important achievement is the institution of a correspondence training course for sawmill managers. New research activities were on pest control, watershed management, physiology and genetics and electronic data processing.

b. *Brunei*

A definition of forest policy has been approved. The importance of forests is recognized not only because it is a source of revenue but also because of various benefits from forest influences. In view of this the policy includes management and maintenance of forests; protection through delineation of reservations; development of the forest for domestic, agricultural and industrial uses; and recruitment and training of government forestry personnel.

About 47,000 acres are under planned management. The sustained allowable cut is 1,500 acres. Cutting is based on diameter limit.

Forest utilization is mainly limited to timber production. Among the problems is the destruction of 1,700 acres of forest lands by fire and a constant shortage of technical labor.

c. *Ceylon*

In Ceylon more recognition is now being given to Forestry as a factor in land use planning. In all Land Development Schemes involving the clearing of forest, 10% of the cleared land is required to be replanted to forest trees.

All watersheds are maintained as forest land and the reforestation of watersheds in cleared land has been started.

Recent surveys show that Ceylon has 7,164,710 acres of forest land comprising 44 per cent of the total land area. Reforestation projects are small although the rate is increasing. Thirty-six thousand acres has been set aside for reforestation work.

The volume of the forest amounts to 4,533,543,000 merchantable cubic feet excluding the plantations. The allowable cut is 30,000,000 cubic feet per year.

The demand for wood products has increased. Three large sawmills and portable mills have been constructed. A government run plywood factory has increased its production. The construction of seasoning kilns and preservation plants are being planned.

The training of rangers and forest guards is done at Forest College, China Bay and at Madras. For Graduate education, Ceylon still depends on overseas training.

d. *Fiji*

The intensive management of smaller areas planted to fast growing exotic species has gained favor over setting aside big tract of indigenous forest. New plantations totalled 1,560 acres of which 1,000 acres are planted to mahogany and 400 acres to pine.

New forest reserves were established. The Yawara Forest Reserve was proclaimed a silvical area to protect reforestation work. Efforts to make the Samura Water Catchment into a Nature Reserve including two other areas are being exerted.

Aerial reconnaissance of the Serua Watershed for purposes of road alignment, location of gravel deposits and possibly nursery sites have been made.

Studies on identifying forest types by photo interpretation are being conducted.

Damage to mahogany seeds in the Island was caused by heavy rains. Plantings were supplemented by about 400 lbs. of seeds from Ceylon and the Philippines. The establishment of seed orchard for *Pinus caribaea* has been recommended.

Log production increased by 15 per cent over 1961, reaching a total of 20.5 million board feet as a result of the operation of one large sawmill.

The total importation of sawn lumber reached 5.09 million board feet in comparison with an export of 1.3 million board feet. Exports included half a million board feet of rain tree (*Samanea saman*) logs.

Research on seed extraction, drying and storage and nursery problems were done in Fiji. Timber research were conducted for the Islands by the Forest Products Laboratory in Melbourne.

A revised training schedule for rangers was instituted at the Forest Rangers School.

e. *Hongkong*

The main interest in forestry in Hongkong is in the afforestation of waste hill lands for erosion and flood control as protection of water supply; production of forest products on sustained yield basis; encouragement of private and village forestry; protection of vegetation in water catchment areas.

Most parts of the catchment areas of Hongkong have been planted to trees. The direct catchment area of the main reservoirs are free of agriculture and settlement.

Interest in the use of forests including watersheds for recreation is being studied. The protection of wild life is enforced by the Agriculture and Fisheries Department.

The forest plantations of Hongkong is estimated at 15,000 acres. It is hoped that this area will be increased by as much as 2,000 acres yearly when a major policy has been decided.

The wood-using industries of Hongkong is supported through importation of timber. Rattans for the manufacture of furniture are likewise imported. Fuel wood is imported from Brunei, Sabah and Malaysia

f. *India*

An overall developments in forestry is reported by India. The forest services expanded and training capacities in Colleges and schools were strengthened. Intensified forest management and planting fast growing species are new trends in forest practices. A 3½-year program is underway in the survey of 18,400 square kilometers of forest using aerial photography. She aims to expand forest plantations to 545,176 hectares. A plan for a dynamic forest inventory which will be revised every 10 to 20 years is being devised.

India has a forest area of 78,396,000 hectares out of which 57,741,000 hectares are accessible. There has been a steady progress in afforestation and reforestation work.

There is a rising interest in Wildlife Conservation. There are now 4 national parks, 80 game sanctuaries, 21 zoological gardens covering a total of 15,275 square kilometers.

Shifting cultivation is a problem but a human approach to the problem to discourage the practice is bringing favorable result.

The big problem in the country is soil erosion and sedimentation of reservoir due to overfelling of trees, heavy pressure of grazing, shifting cultivation and faulty methods of agriculture. Soil conservation measures are being applied to 55,800 hectares. Afforestation, contour trenching and terracing are being applied to 14 river projects. Eleven other projects are being considered.

Man power and animal logging methods are being supplanted by machines. New seasoning and preservation plants have been established. New plywood factories brought up the total plywood mills to 71. There are now 42 mills manufac-

turing paper and paper board with a combined capacity of 549,150 tons. These mills provide employment to 42,000 people. The match industry comprising 225 factories employ 24,500 workers.

Fuel consumption is 102 million tons yearly but still short to meet the needs and 55 million tons of cow dung cake is still being burned yearly for fuel.

Due to the heavy demand for forest products part of India's need is met through importation.

The Indian Forest College of Dehra Dun turned out a peak of 95 graduates in 1964.

g. Indonesia

The objectives of Indonesian forest policy is the promotion of production and export of forest products, establishment of industries, establishing plantations of fast-growing species in denuded areas and poor stands, increasing the extent of forests in thickly populated areas as in Java to 30% of the land area, encouraging farm forestry, intensifying the utilization of forest lands by multiple use concept, promotion of wild life management, application of sustained yield principle.

Sixty-five per cent of the total land area of Indonesia is under forest totalling 121,800,000 hectares. An aggregate area of 2,215,154 hectares has been set aside for nature and game reserves, 38,000 hectares of which has been reserved to protect the Javan Rhino. Other areas have been established to conserve deer, tiger, elephants, orang-outan and other animals and rare flora.

Specific plans for watershed management has been made.

Production figures for lumber hardly show progress. In spite of increase in the number of mills production has gone down in 2 years. Plywood production

went up slightly. Pulp and paper is on the increase. Production of hardboard remained the same. Pencil production has not yet met the country's requirement. The number of furniture factories has decreased.

There are five Government universities in Indonesia all having a faculty of forestry: University of Indonesia at Bogor, Gadjah Mada University in Djakjakarta, Hanudin University at Makassar, Telanapura University at Djambi, Swiridjaja University at Palembang. Of these universities 3 have not produced forestry graduates yet while University of Indonesia has turned out 131 foresters and Gadjah Mada, 45.

h. Japan

Japan has a forest area of 244 million hectares which is 68% of the total land area. The existing planted forests of 5.57 million hectares are expected to increase to 10 million hectares within 20 years. Private forests are subsidized at the rate of 24 per cent for reforestation and 48 per cent for afforestation.

Reforested area is increasing. The planted area, which in 1962 was 402,000 hectares is expected to increase 4,176,000 by 1972 and 3,582,000 by the year 2002 or an increase of 9 times the 1962 figure within the next 40 years.

The improvement of the growing stock, afforestation, fertilization, tree breeding is being planned.

The protection and propagation of wildlife is being assured through the establishment of a model school for loving birds and the appointment of a protection officer of wildlife in every community.

Forest roads in Japan are now motor car roads which have improved the socio-economic development of the rural areas. The system in the National forests totals

22,162 kilometers and in private forest, 37,761 kilometers. A 10-year program calls for 13,000 kilometers of national forest roads and 37,000 kilometers of private forest road (25,000 kilometers of which will be subsidized).

A notable achievement by Japan in promoting forest products utilization is the creation of a Forestry Credit Fund to help finance and to give credit to forest owners for the production and marketing of forest products.

Japan predicts an expected increase in the demand for forest products. Forestry law is being revised to suit supply and demand for forest products.

Logging and transport is being mechanized and modernized. Full tree skidding has been found to increase production by 24 per cent; reduce the number of men for measurement and increase utilization.

There have been increases in the production of sawmill, pulp, plywood, particle board, fiber board, but a decrease in fuelwood consumption. The importation of logs has likewise increased.

A shortage of labor and increase in wages is expected but this, it is believed, will be offset by improvement in operation and by mechanization.

There are now 24 Forestry Departments and 3 Forest Products Departments distributed in various Universities in Japan. The graduates from these schools total 800 annually. In addition there are 87 high schools offering forestry courses in wood processing, soil conservation and forest management.

The expansion of research facilities has resulted in the establishment of forest products departments in schools with a consequent increase in the knowledge of higher degree of utilization of timber.

Researchers include the study of short rotation species in tree breeding stations:

investigations in silviculture, wood technology, soil survey, protection and forest management.

i. *Korea*

The major policy in Korea is the conservation of national land since most of the forests in Korea are not productive. Erosion Control Law has been passed and 60% of the total expenditure for forestry in 1962 and 80% in 1963.

Demand for forest products is increasing so that the government is forced to supply domestic timber to very urgent industrial need and fill most of the national requirement through log importation. Wood-using industries are being urged to use wood substitutes in the effort to economize on wood consumption.

The forest area of Korea—6,750,324 hectares. This shows a decrease of 14,065 over the 1961 figure and there is fear of further reduction due to needs for food production.

Plywood production keeps increasing although all veneer logs are imported. Paper mill production is going up but the bulk of the pulp is also imported. The lumber industry produced 1,776,900 cubic meters of sawn lumber.

Forestry research is centered on finding better quality species and propagation studies.

j. *Territory of Papua and New Guinea*

On the whole the biennium is characterized by an increase in the demands for forest products and increase in log export (to Japan in particular). Concessions to remove merchantable timber has been granted to a foreign company, roads are being constructed to open up forest areas for utilization. Hydrographic survey was conducted in New Britain and Papua, major forest area has been sur-

veyed and volume determined by helicopter. Preservation of a wide range of species has been developed.

The present policy is geared towards increased local processing of forest products. Most of the wood-using industries have modern machines to increase production, reduce cost, reduce waste and improve the quality of finished products. By 1964 all sawmills are expected to be equipped for wood preservation mostly by dip-diffusion process. There is at present a modern plywood plant and there are plans for other industries such as pulp and chip board plant.

The forest products of New Guinea are exported primarily to Australia, Japan and the U.S.A. and to a certain extent to British Solomon Islands, New Zealand and the Pacific Islands. Minor forest products are exported to Hongkong, Germany, United Kingdom, Belgium, Holland and France.

k. *Malaya*

Similar to other countries in the Asia-Pacific Region, Malaya's policy is to perpetuate protection and production forests. As of now she has no policy on watershed management.

Improvement in logging methods and sawmilling and increase in wood preservation plants from 14 to 45 in the last two years marked the progress in wood utilization.

Malaya's problem is the shortage of qualified forestry officers and the absence of professional teaching facilities.

l. *Nepal*

In general, Nepal is struggling for forest conservation. The forest is being decimated through uncontrolled clearing and conservation of land for agriculture and other uses. Coordination of land use is non-existent.

The contribution of forest products to the development of Nepal is being recognized but forest industry is at its infancy and its socio-economic influence is not yet fully realized.

One of the main obstacles to forest utilization is the lack of roads. Logging and transportation of logs is still primitive. The lumber industry is small but gradually expanding.

The training of forestry officers is done in the Forest Institute. In 1962-1963, 25 graduated as forest rangers and 53 as foresters. In 1964 the number of graduates was 19 and 40 for rangers and foresters, respectively.

No organization for forest research is in existence but its establishment is being considered.

m. *New Zealand*

The exotic forest of New Zealand is now the base of the pulp and paper industry and sawn lumber. The extent of forest plantations in the country may be gauged from the fact that in spite of increasing utilization of forest products the cut in exotic forests is not yet equal to the rate of growth.

The number of forestry associations increased to 34 with a total membership of about 3,000. Further increase in acreage is expected with a goal of 100,000 acres by the year 2000 with the establishment of a Farm Forestry Incentive Loan Scheme.

Forest protection has been stepped up. Introduction of pests is guarded against through careful inspection of timber at the point of entry. A Forest Biology Survey team watch the build up of insect population in forests. The cutting of natural stands is regulated and enforcement of laws on trespass is strict although violation is rare.

The present logging practice is clear felling mostly from mature exotic stands.

Acceptance in the use of wood by engineers and architects has brought about diversified preservation treatment of railway sleepers, wharf and bridge decking and glue laminated members. A building code for timber construction has been established.

Progress has been made in the utilization of lesser known woods. Vegetable turpentine is now being produced in New Zealand and part of the product is being exported to Australia.

The production of sawn lumber is declining but pulp production is on the increase and production has reached 200,000 tons.

The timber industry has a problem of high labor turn over. The companies are trying to remedy the situation through some incentive plans. The problem is probably due to high demand for labor in the industry. Thirty-three thousand workers (out of 2.5 million population) are employed in the forest industries.

New Zealand does not now have a professional forestry school but hopes to have one in the near future. In sub-professional training emphasis is now placed on practical training.

The Forest Research Institute is conducting a wide range of forestry research. Among the most important projects are the critical review of silvicultural operations in exotic forests and the biological control of *Sirex noctilio*.

n. *Philippines*

During the past two years there has been a growing concern for forest protection and conservation as shown by the passage of about a dozen bills on forestry matters in the Philippine Congress.

Important forestry projects include aerial survey of the forest areas of western and central Mindanao which showed a reduction of 1.8 and 1.2 per cent, respectively, for the two regions due to release of forest areas for agriculture and destruction due to timber stealing and shifting cultivation. Reforestation of denuded areas has steadily been increasing and trial plantings of fast-growing species has been done. Permanent forest with a total area of 906,266 hectares has been demarcated.

Logging methods have been regulated to minimize damage to remaining trees (residuals) without hampering production. Trees are being cut closer to the ground and merchantable tops and branches are now being utilized. Better roads are paying off in the form of increased delivery throughout the year, lower road maintenance cost and less wear and tear on the equipment.

The wood-using industry is progressing. The number of plywood mills has gone up to 21. Another wall board factory is coming up and additional pulp and paper mills are being installed. More sawmills have gone into operation to meet the increasing demand for lumber. Exportation of logs and other forest products to Japan, United States, Canada, Australia, South Africa, Taiwan, South Korea and other countries increased.

Forestry education has been improving with the expansion of both faculty and facilities at the College of Forestry, University of the Philippines. Two major curricula: forest resources management and forest utilization, have been strengthened.

In addition to the professional courses there is also a sub-professional ranger course. Enrollment has gone up and graduates in the B.S.F. level increased although ranger graduates are on the decrease.



A close up view of a 20-year old exotic pine forest in New Zealand. Note the density of the stand.

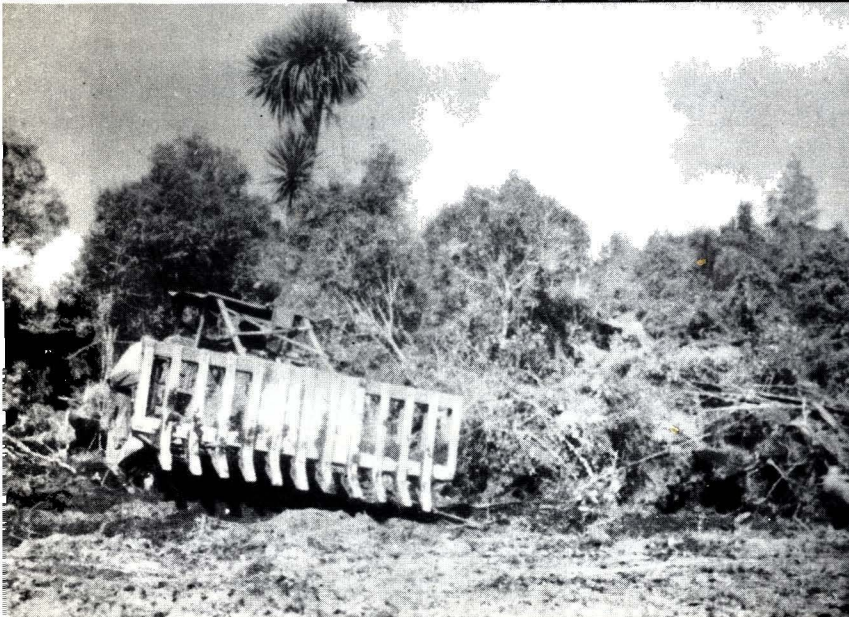


Yarding radiata pine. Note the clear cut felling of the stand.

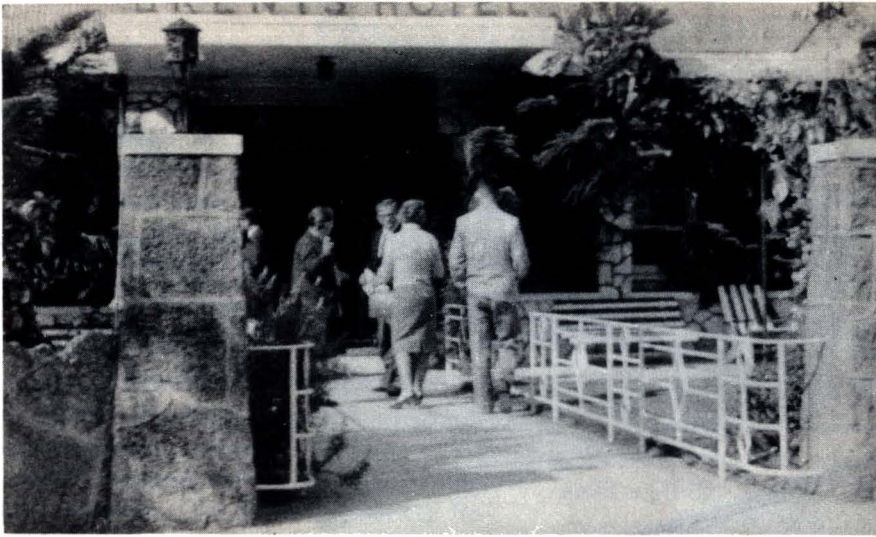


Preparing the ground for planting to radiata pine by means of a root raker.

Clear felling radiata pine for sawlogs and pulpwood.



Highland yarding radiata pine.

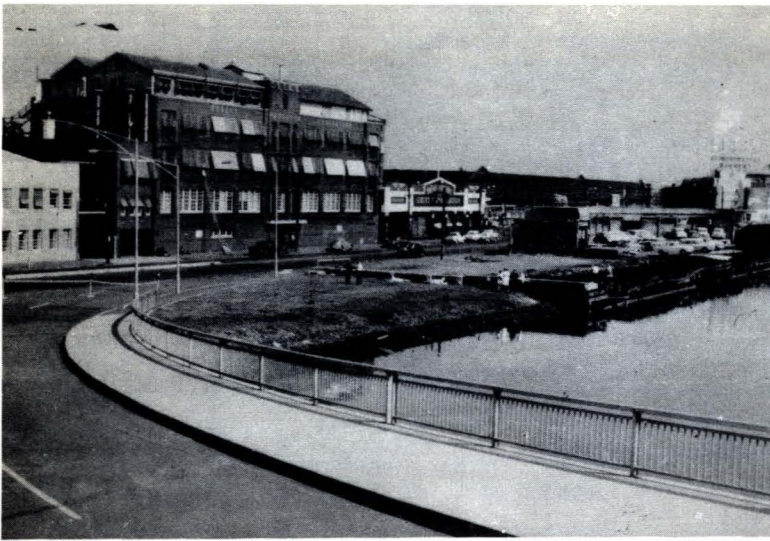


Bretons Hotel, Rotorua, New Zealand, where most of the delegates to the 7th Asia-Pacific Forestry Commission Conference held September 22 to October 2, 1964 stayed.



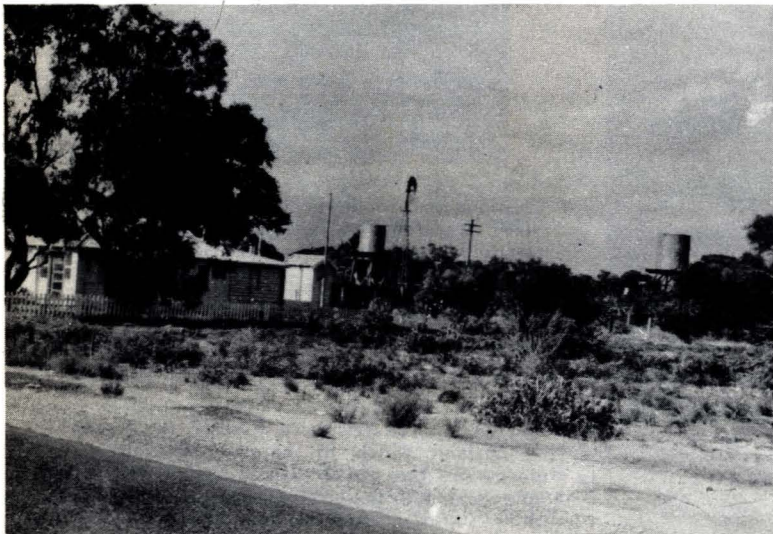
Giant red wood, *Sequoia gigantea*, planted in 1887 near the Post Office at Rotorua, New Zealand. Its growth, as manifested by its increase in d.b.h. and height, is being measured at regular intervals.

Geyser in Wakarewarewa Reserve in Rotorua, New Zealand, which, by the way, especially near Rotorua in the North Island, is dotted with numerous manifestations of geothermal activities such as sulfur springs, geysers, boiling mud and so on.



Main laboratory of the famous Forest Products Division of the Commonwealth Scientific and Industrial Research Organization (CSIRO) in Melbourne, Australia.

Wood chips from Eucalyptus species moving on a belt conveyor in a semi-chemical pulp mill somewhere in Tasmania, Australia. This pulp-mill produces pellets of semi-chemical pulp for bulk shipment to the mainland of Australia for conversion into paper.



Typical scenery outside of cities in Australia showing windmills used for pumping water to water livestock, gardens and so on.

A strong Forestry Extension has been established in the University of the Philippines College of Forestry. All media of communication, including the press, the radio and even television is used in this activity. The Reforestation Administration also uses the radio in its extension work.

Research activities in the Bureau of Forestry, Reforestation Administration and the Forest Products Research Institute have expanded although the Bureau of Forestry reported lack of funds for some of its projects. The Forest Products Research Institute made progress in the utilization of previously non-commercial woods.

Unfavorable report was made on the not too clearly defined policy on watershed management and the depletion of Philippine Wildlife.

o. British Solomon Islands Protectorate

Forestry in this area is administered by a Forestry Department established in 1952. At present it is still hampered by shortage of staff but forestry projects such as forestry surveys, botanical investigations and research on silviculture are making progress.

Large scale logging is a recent introduction and at present timber is exported. It is hoped that sawmilling and other industries will commence in the future.

Forestry training for personnel is done at the Forestry Training School in Fiji. The sending of men to Bulolo, Territory of Papua and New Guinea and the training of a senior officer in silvicultural research at Oxford is being contemplated.

p. Thailand

The forestry situation in Thailand has remained essentially the same for the biennium although progress in some areas are worth mentioning. A Division of

Forest Police has been created to make protection more effective. Protection against insects received considerable attention due to borer damage to teak plantations and saw flies attack on young pine needles.

The National Forest Act has brought about progress in demarcation of forest reserves and 20,000 sq. kms. of forest is expected to be reserved in 1964.

The forests of Thailand are managed under the selection system with improvement cutting. Replenishment of cut-over areas is done through reforestation with teak and other hardwood species at an annual rate of 1,600 hectares.

Forest research covered studies on forest soils, forest fires in Teak and Dipterocarp species, growth studies of some mangrove and Dipterocarpus species, the economics of the use of power saws and portable sawmills. Findings show that teak seedlings take 6-15 years to establish itself while *Shorea obtusa* requires as long as 15 years. Many species of orchids and a species of European Birch were discovered. Wood-using industries are progressing. A new type of portable mill run by a Massey-Ferguson tractor has been designed. The units of this mill include a 3½-foot circular main saw and two 2-foot saws for slash sawing and trimming, 3 benches and a detachable shed. This has been found to reduce waste in the extraction and conversion of teak logs.

Six dry kilns have been installed and 3 parquet flooring factories went in operation. There are plans for a paper and a fibre board factory.

New species have been introduced in the market for timber and plywood core

Professional forestry (5-year) course and sub-professional (3-year) course are given at Kasertsart University. The Prae Forestry School offers a 2-year sub-professional course. The Forest Products Re-

search Division offered a 5-week training course in air-seasoning and kiln drying to employees of the wood-using industry. Courses in wood structure and identification has also been conducted.

q. *Taiwan*

The total forest area of Taiwan is about 2.14 million hectares equal to about 60% of the total land area. The policy on this area is to ensure a sustained yield. Also included in the policy is a change from government logging to stumpage sales, encouragement of private planting of forest land, forest protection against destructive agencies and shifting cultivation, improved utilization of native timber, development of the wood-using industries and forest research.

The total annual area planted is very impressive being five times the area cut annually. While the annual cut remains constant government revenue is on the increase.

The need for research especially forest products has been expressed. Among the important projects were the preparation of yield tables for some species, timber stand improvement, ecological studies, seed storage and germination, propagation of bamboo, control of forest pests and diseases and study on vegetable drugs. In forest products research projects included the pulping of hardwood, mechanical properties of wood, preservation of wood and bamboo, plywood manufacture, solar drying, application of improved wood stabilization of hardwoods and bamboo, lamination, machining properties, kiln drying, wood waste utilization and lumber grading.

Forest industry is on the way up especially plywood manufacture although the veneer logs were all imported from the Philippines and North Borneo. Out

of the total export in 1962-1963, 65% was from wood products amounting to US \$28,000,000.00.

r. *Pakistan*

The utilization of the forest resources of Pakistan is still very young — starting only sometime in 1947. In spite of this government revenues from forest is about 4 times that of expenditure.

The forest area of East Pakistan constitute about 15.66% of the total area is constantly being destroyed by shifting cultivation (“Jhooming”) and a Jhoom Control Division has been established. To increase the forest area, 11,000 acres are being planted annually.

Logging is done manually, by animal power and by mechanical means. There is no big sawmill and primary sawing is done manually and resawing done in small band mills. Plywood production is limited to the manufacture of tea-chests and flush doors. The 18 match factories are supplying the country's need with some surplus for export.

Research in forestry has been directed to collection of growth data and the introduction of fast-growing species.

Professional training is done at the Pakistan Forest Institute at Peshawar while sub-professional training is given at the Forest School.

a. *Sabah, Malaysia*

Sabah has a rich forest resource of 5,960,000 hectares equal to 80% of the total land area. Of this 2,590,000 hectares is covered with accessible Dipterocarp forest and 2,072,000 sq. miles inaccessible Dipterocarp forest, 64,750 hectares productive fresh water swamp and 284,900 hectares of mangrove. About 777,000 hectares are under shifting cultivation.

Forest concessions are cut on sustained yield basis with a rotation of about

80 years. The concession agreement is for 21 years with provisions for renewal.

Regeneration operations are confined to logged over areas. Weed trees and "relics" are poisoned with sodium arsenite (two pounds per gallon of water). Production of timber shows an upward trend reaching 95,868,412 cubic feet which is 23.7% over the 1962 figure. Ninety-six per cent of the total cut belong to the Dipterocarpaceae family.

The usual log extraction method is by tractor and primarily transportation is by water.

Lumber production is low due to poor market conditions. The large band mills have stopped commercial operations and export figures dropped by 47.8 per cent over 1962 figures). One factor for this trend is higher profit for marketing logs.

The principal log markets are Japan, Hongkong, Formosa, Australia, Korea and Italy. The principal competitor is the Philippines, supplying 70% of the Japanese requirement.

Research work on the light of requirement of young Dipterocarp, collection, survival and growth of Dipterocarp seedlings, arboricide trials, thinning studies, growth of regeneration, plantation trials of softwoods, and fast-growing species comprise the important projects.

Forest education is limited to a two or three months basic training. Some students were sent to the Forest School at Kepong, Malaya for a 10-month training.

Professional education is wanting and forest officers are sent to Australia and India.

III. THE DEVELOPMENT OF FOREST INDUSTRIES AND THE ROLE OF FAST-GROWING SOFTWOODS IN MEETING WOOD REQUIREMENTS

The demand for forest products in the Asia-Pacific Region is predicted to increase

substantially by 1975. This will be true for industrial wood, pulpwood and pulp products. (See Table 1).

If the present trend of forest conservation continues, on the whole, Southeast Asia will have a surplus of 13,000,000 cubic meters of industrial wood yet the entire Asia-Pacific region will have a deficit of 21,600,000 cubic meters. (See Table 2).

The problem facing the region is a shortage of chemical pulp from softwoods as in other regions of the World. Europe will be short of pulpwood by 25 million cubic meters. North America, because of its own requirement, will have a diminishing surplus which can be channelled to the European market. It would seem, therefore, that the Asia-Pacific countries must have to look for substitute long fibered pulp as well as grow its own requirement.

The problem presented here leaves little doubt as to the importance that fast-growing softwoods plantations will play in future economic development. The success of existing softwood plantations demonstrates the feasibility of plantation forestry but there are still problems that need to be overcome.

There is a general lack of information on site requirement of species, improvement of natural ecological potentialities, plantation techniques and silvicultural measures, protection techniques, and products utilization. Exchange of data and research will be the key to the solution of these problems.

The fast growing softwood species observed in the region include *Pinus radiata*, *P. caribaea*, *P. elliottii*, *P. taeda*, *P. palustris*, *P. patula*, *P. strobus*, *P. ponderosa*, *P. contorta*, *P. merkussi*, *P. insularis*, *P. pinaster*, *P. calabrica*, *P. brutia*, *P. densiflora*, *P. masoniana*, *Agathis sp.*, *Araucaria cunninghamii*, *A. hunsteinii*, *Chamaecyparis obtusa*, *Cryptomenia japonica*, *Cupressus macrocarpa*, *Larix decidua*, *Larix leptolepis* and *Pseudotsuga menziesii*.

TABLE 1.— *Predicted Timber and Pulp Requirement in the Asia-Pacific Region by 1975*

	1053/55	1960	1975
Industrial wood	86,800,000 cu.m.	114,500,000 cu.m.	185,400,000 cu.m.
Pulpwood	11,100,000 cu.m.	19,500,000 cu.m.	49,700,000 cu.m.
Chemical pulp, softwoods	861,000 tons	—	3,231,000 tons
Mechanical pulp	872,000 tons	—	4,064,000 tons

TABLE 2.— *Expected production of Industrial Wood In The Asia-Pacific Region by 1975*

Region	1955		1975	
	Surplus (Cubic meters)	Deficit	Surplus (Cubic meters)	Deficit
Southeast Asia, Mainland		100,000	3,600,000	
Southeast Asia, Islands	2,000,000		9,400,000	
South Asia		900,000		10,400,000
East Asia		100,000		19,700,000
Oceania		2,200,000		4,500,000
T o t a l	2,000,000	3,300,000	13,000,000	34,600,000

IV. MANAGEMENT OF THE MAN-MADE SOFTWOOD FOREST OF NEW ZEALAND

The early settlers of New Zealand were primarily concerned with the production of food and wool. By the end of the 19th century the land cleared of natural forest for conversion into agricultural lands were so great that there arose apprehension on the future timber supply. The indigenous species are slow growing and regenerates very poorly. Early attempts to propagate them artificially for timber supply seemed too impractical due to the very slow growth.

Introduction of fast-growing species from Europe and America showed better promise.

In the 1890's Douglas fir, Corsican and ponderosa pines, larch, radiata pine and Eucalyptus were used for reforestation. Among these *Pinus radiata* exhibits rapid height and volume growth, good seeding, ease of establishment and adaptability which made it the most popular plantation species.

In 1920 the Forest Service was created and its report on the indigenous forest area to meet future needs was very discouraging. The Service decided to embark on a large scale tree planting program. At about the same time private interest saw prospects on woodlands and started commercial scale plantings. The program has progressed steadily so that today the rate of planting totals 25,000 acres annually.

The utilization of radiata pine timber started during the II World War. The war requirement promoted the use of timber which otherwise would have been rejected due to knots and other defects. The Forest Service demonstrated the feasibility of utilizing plantation-grown stock and developed gang frame saws for sawing logs. At the beginning the use of the timber was acceptable for cratings and form lumber for concrete but research and promotion programs showed the excellent qualities of radiata pine both for lumber and industrial raw material especially for pulp. Today the use of radiata pine has received general acceptance and is now the base of large-scale industry.

The impressive growth of radiata pine may be seen from the fact that at 40 years, on an unthinned stand on a good site, the height diameter of 18 inches or more with a volume of 12,000 cubic feet (calculated to 6-inch top) per acre from 160 trees.

Radiata pine is not suitable for wet or low fertility podsolized clays. It suffers windthrow in shallow soil especially where there is a hard pan. It suffers from frost so that in New Zealand the recommended altitudinal range is 2,000 ft. in the north Island and 1,500 feet in the south Island.

In the central pumice country of North Island site-quality indicator based on the secondary vegetation has been developed. This has been found helpful in the planning of plantations.

The main objectives of management of radiata pine plantation is to increase yield, improve the quality of the derived product and to have sustained yield. The measures being adopted to meet these objectives are intensive silviculture and tree improvement.

Radiata pine has been found to be prone to natural pruning and thinning, but dead branches are found to be persistent. This results in poor quality timber due to loose

knots hence, intensive silvicultural treatment is applied to preserve timber quality.

The thinning operations vary with the location of the forest with respect to the industry. Where there is a demand for pulp wood, thinning is done earlier and heavier than when there is no market for small poles. The operation is done at 20-25 years at which time the thinnings have reached saw log size.

The usual rotation is 30 to 40 years at present although in the central North Island some stands will probably remain up to the age of 60 or 70 years.

Seed orchards of superior trees are being established and progeny tests are in progress. This will probably supply seeds in the future but for the present production it is still small and bulk of the seeds for plantation establishment come from existing stands.

The establishment of the forest consists of clearing the land usually by burning or crushing of scrub or line cutting and then planting one year old seedlings with a stocking of 650 to 700 per acre although in some instances a stocking of 1,000 to 1,200 seedlings per acre has been used.

In some areas natural regeneration is suitable and may take a very dense cover which necessitates reduction to 800 to 1,000 stems per acre at the age of 3 to 5 years.

The allowable cut is determined from yield tables based on unthinned stands with sufficient allowance to cover up for a logging waste of about 5%.

V. INDUSTRIES DEPENDENT ON THE EXOTIC MAN-MADE FOREST OF NEW ZEALAND

Radiata pine is the main stay of the forest products industry of New Zealand. At the beginning the supply of raw materials came from indigenous forest. The change to plantation-grown timber necessitated change in

equipment and production techniques. The Forest Service in 1939 introduced various timber processing and handling techniques such as Swedish log frame for primary conversion of timber, anti-stain treatments and kiln drying.

Because of keen competition from higher grade indigenous timber, there was greater emphasis on standards and quality in the manufacturing of radiata pine. This has won the confidence of the people and as a result the use of radiata pine has been met with general acceptance. In time the consumer found its equally strong properties in comparison to naturally-grown species so that at present radiata pine dominates the market for frame timber, flooring, interior joining and manufactured items. Its ease of drying, preservation, machining, fastening and good strength-weight properties contributed much to its utilization. End jointing and finger jointing has helped in producing clear lumber. Lamination of beams has increased the load bearing construction of structures.

The per capita consumption of wood in New Zealand is one of the world's highest being 275 board feet annually. Out of the total production of 666 million board feet of timber 60% was exotic softwoods 90 per cent of which was *Pinus radiata*.

The single storey type house is most popular in New Zealand and radiata pine has filled the needs for frame structures. Its light weight, ease of machining and assembly and handling has made it suitable for pre-fabrication.

It is interesting to note that before the World War II there was no large-scale pulp industry in New Zealand. Today there are five pulp and paper mills. Three of these are integrated with sawn timber production. These mills produce chemical and mechanical pulp, newsprint, kraft paper, fiber board and paper board. New Zealand now is the world's 5th largest producer of newsprint (200,000 tons a year). Production of pulp

products today totals 300,000 metric tons a year. In 1963 exports reached 63,000 tons of pulp, 108,000 tons of newsprint and other pulp products with a total of \$31,000,000.

Veneer production from radiata pine is limited to the production of cross band material and short length face quality veneer derived from between branch nodes. Of the total volume of logs used for peelers only a third is radiata pine.

Laminated frames have been manufactured out of radiata pine in recent years although limited laminated construction materials have found their way in churches, schools, grandstands and gymnasium.

New Zealand claims to have the highest per capita consumption of treated timber in the world—a result of a short supply of durable timbers.

The progress of preservation treatment has brought about utilization of plantation thinnings. In 1963-1964, 40 per cent of the sawn timber production was treated with preservative.

There are 97 pressure treating plants using water soluble preservatives. Acid borate treatment by diffusion process is used for building timber. Coal tar creosote and pentachlorophenol are also used.

The widespread use of preserved wood has led to the creation of the Timber Preservation Authority which maintains quality control and authorizes preservatives, specifications, processes and standards.

The success of the wood-using industry lies to a great deal on government pioneering, support, research and technical guidance. The government did not only start reforestation efforts but has undertaken developmental and demonstration work in the processing of exotic species. It conducts training courses for men from the industry in all aspects of wood utilization.

VI. REPORT OF THE A.P.F.C. COMMITTEE ON FOREST WORKING TECHNIQUES AND TRAINING OF FOREST WORKERS

The A.P.F.C. Committee on forest working techniques and training of forest workers (headed by J. J. Spiers of New Zealand with members from Australia, India, Indonesia, Japan, North Borneo, the Philippines and Thailand) studied the forest working techniques and the training of forest workers in the Asia-Pacific region and came up with the following proposals:

a. *Training of Forest Workers, Foremen and Officers:*

- (1) Publish a list of all educational institutions providing vocational forestry training in the A.P.F.C. area including the complete curriculum facilities offered.
- (2) Publish a list of the specialized courses in forest work carried out in A.P.F.C. region in the past five years. Collect copies of the material offered for reprinting and distribution as required.
- (3) Publish an annual list of the courses to be offered in the region during the year ahead.
- (4) Attempt to assist member nations holding courses by providing qualified instructors where required.

b. *Safety and Accident Prevention:*

- (1) Collect accident statistics from all member countries, and attempt to reduce the main hazards by compiling literature on accident prevention in the critical fields. Such literature could be the basis for pamphlets distributed by members of their local supervisors.
- (2) Compile and publish a simple illustrated booklet comparing safe and unsafe practices by cartoon.

c. *Hand tools — their Use and Maintenance:*

- (1) Collect and circulate notes on hand tools use and maintenance.
- (2) Circulate notes on the use and maintenance of power chain saws, chains and bars. Considering the rapid increase in the use of power saws, this is particularly important.
- (3) Circulate notes on the development of new hand tools including chain saws.

d. *Organization and Mechanization of Forest Work:*

- (1) Compile a bibliography of publications on:
 - (a) Forest working techniques
 - (b) Logging methods and techniques
 - (c) Forest wood studies or work science
 - (d) Training of forest workers and machine operators.
- (2) Ask members to present annually notes on developments that have taken place in (a) to (b) above and compile a journal incorporating these notes for distribution to members.
- (3) Review work done by the similar E. C. E. Committee and include reports on the more pertinent subjects in the journal for distribution.

VII. SILVICULTURE AND FOREST MANAGEMENT RESEARCH*

In the tropical countries within the region the softwood species are limited mainly to the genera *Agathis*, *Araucaria*, *Callitris* and *Podocarpus*. Their occurrence is common in the evergreen forest type with an equally distributed rainfall of no less than 45 to 60

* Reported by Mr. Hari Singh, Inspector-General of Forests Ministry of Food and Agriculture, New Delhi, India, Chairman, Committee on Silvicultural and Forest Management Research.

inches (35 to 5 monthly) throughout the year and with 3 to 4 months of dry period. Limited number of species are found in deciduous type of forest with high rainfall. The absolute maximum temperature requirement is 103°F (75°—95°F average) and the absolute minimum is 25°F (55°—70°F average).

Araucaria cunninghamii shows promise for introduction in Queensland, Australia, Papua and New Guinea; *Araucaria hunsteinii* in Papua and New Guinea; *Agathis loranthifolia* in Indonesia. In the Northern Territory, Australia where there is low rainfall *Callitris intratropica* and *Callitris glauca* seem to thrive well.

Araucaria cunninghamii, *Araucaria hunsteinii* and *Agathis loranthifolia* have been noted to grow well from 0.0 elevation to 7,000 feet, with better growth in the upper limit.

In general *Callitris*, *Dacrydium* and *Podocarpus* are shrubs or small trees. *Podocarpus* may grow to timber size but very slow growing.

Studies on fast-growing hardwood and softwood species are recommended for the next biennium. Member countries are asked to report on improved methods of pruning including techniques, tools, economic considerations and literature on this operation.

VIII. WATERSHED AND FOREST RANGE MOVEMENT

Korea, Japan, New Zealand, Philippines, Thailand and Vietnam reported on the watershed management projects. Korea has two pilot demonstration areas under the assistance of the United Nations Special Fund. Japan has a ten-year program on a specific river project to be followed by a development program on all major aspects of water control and utilization. New Zealand reported on farm basis projects for stock water supply and a reforestation project in the catchment area of one river. The Philippines with United States assistance is undertaking

water resources surveys and investigation on a comprehensive program to cover seven major basins with a drainage area of 101,137 square kilometers. With a United Nations Special Fund assistance a pilot demonstration and training project of watershed management based on multiple-use concept will be started in the Ambuklao River basin. Thailand is working on two river projects. Vietnam reported a project in highland watersheds and in coastal areas to arrest shifting sand threat to agricultural land.

On the whole most of these projects revolve on water resources survey and development, flood control, erosion control, stream bank stabilization, prevention and control sedimentation, debris control and reforestation and afforestation of catchment areas.

A program on Forest Range Management for Asia and the Far East has been outlined.

- a. Interest of animal husbandry in relation to utilization of natural pasture lands: animal husbandry is concerned with production of the best meat and dairy products at minimum cost while utilization of range lands calls for high quality forage.
- b. Overcrowding and prolonged grazing hinders full production of fodder and exhaustion of palatable species.
- c. Problems in Animal Husbandry varies: some countries are studying how to raise production by reducing the number of animals or how to restore grazing land without harm to animal production by raising superior breeds. Other countries are endeavoring to increase production by increasing the number of animals.
- d. The need for improvement of existing pasture land establishment of new ones to relieve over grazing. Pasture land will be difficult to improve as long as pressure of livestock on the land exists.

- e. The lack of trained men in range management must have to be met.
- f. An adequate management plan require an adequate survey of range resources.

IX. REPORT OF THE TEAK SUB-COMMISSION

Interest on the growing of teak has spread to countries outside of the Asia-Pacific region. Because of these countries such as Dahomey, Ghana, Ivory Coast, Nigeria, Senegal, Togo, Sudan and Kenya will be invited to the Fourth Session of the Teak Sub-Commission tentatively scheduled for 1965 at Bangkok, Thailand, Cameroon, Malaya, Nyasaland, Sierra Leone, Tanganyika and Upper Volta have been recommended for addition to the list by the African Forestry Commission.

On the basis of teak conversion in Burma, Thailand and Indonesia the "Asia-Pacific Regional Grading Rules for Teak Conversion" has been finalized by the sub-commission. A grading rule for teak veneer logs has been recommended for study.

Teak provenance trials have been undertaken by Australia, Territory of Papua and New Guinea, Pakistan and the Philippines making new additional member countries to the participating countries: India, Burma, Thailand, Laos, Indonesia, Malaya and France.

X. FOREST PRODUCTS RESEARCH*

The thousands of species of plants found in the tropical and sub-tropical forests of the Asia-Pacific Region create complex problems in forest products utilization. Because of this every country is trying its best to study its own species and find the best utilization techniques. The various researches in the field of forest products in the region cover the following subjects:

- a. Wood identification
- b. Pulping properties
- c. Timber seasoning
- d. Timber preservation
- e. Physical and mechanical properties
- f. Tannin based wood adhesives
- g. Veneers, hardboard and particle board
- h. Timber for home construction
- i. Training course.

Majority of countries in the region are studying the identity of their own wood species and building up wood collections. Wood identification is basic to wood utilization.

Most countries in the region are importers of pulp and paper products. To utilize a mixed stand of tropical hardwoods for pulp is not a simple problem since species vary in their response to pulping processes and also exhibit different pulp properties. It is, therefore, understandable that pulp evaluation studies occupy an important area of forest products research in the region. The Philippines has been studying the potentialities of her own hardwood species and fast-growing exotics. Other countries wanting of facilities have been sending materials to better equipped countries like Australia for pulp studies.

Timber seasoning research is becoming an important project in many countries as the wood-using industry gets developed. Australia has set the pace in this field and has introduced pre-drying which is now being tried in some countries.

The preservation of timber and wood products has received considerable attention but more work on this has to be done to best utilize many hardwood species found in the region.

The mechanical properties of the commercial timbers are being studied in almost all countries. Japan, Australia and New Zealand are conducting studies on stress grading. Japan, Philippines and New Zealand are doing work on glue-laminated structural members.

* Reported by Dr. H. E. Dadswell, Chief Division of Forest Products C.S.I.R.O., Australia; Chairman Committee on Forest Products Research.

Australia has developed the commercial use of wattle tannin for tannin-formaldehyde adhesive for wood. The Philippines and India are conducting research on tannin-formaldehyde glue from their own species.

Many new tropical species are now used for peeling into veneer as a result of studies on veneer quality. More hardwood and particle boards are being manufactured and used in the region but more studies on these are necessary.

The use of timber for home construction is increasing although shortage of wood is being felt in some countries.

The training of men for forest products research is generally recognized and all countries have a program for personnel training.

XI. WOOD PRESERVATION

The preservation of timber in the region has become popular in the Asia-Pacific region and new preservation plants have been established. This has resulted in a number of weed and non-durable species being utilized.

The Secretariat reported the recommendations of the Meeting of Experts on Wood Preservation in Rome in 1959:

- a. Study on a regional basis the potentialities of the development of timber seasoning and wood preservation, taking into account the economic consideration, site, details of machinery and plant layout.
- b. List various research requirements.
- c. Evaluate service life of treated material.
- d. Establish a code on the use and treatment specifications.
- e. FAO organize special training courses.
- f. FAO assist in the organization of symposia on national, regional and world level.

In September 1963 the Working Party on wood preservation discussed the subject during the Fifth FAO conference on wood technology at Madison, Wisconsin, U.S.A.

The possible sources of funds for the proposals were enumerated as follows: EPTA, U.S. Special Fund and other agencies such as ILO.

The Secretariat recommends that should the commission decide on a training course, it should include not only training of technical personnel in research and production but also personnel from management groups.

A regional meeting on wood preservation was also suggested.

XII. STUDY TOURS

The Study Tours which supplemented the conference included a visit to the Rotoehu, the Whirinake and the Kaingaroa State forests, the New Zealand Forest Products Limited forest, the New Zealand Forest Research Institute and some of the wood-using industries in the vicinity of Rotorua. As a whole the study shows the feasibility of man-made forest and its potential as a steady source of raw materials to feed multi-million dollar processing plants.

a. Kaingaroa forest

The Kaingaroa forest is located in the Kaingaroa plains of North Island, New Zealand. This area used to be desolate wastelands covered with no more than a thin growth of scrubby vegetation [manuka (*Leptospermum scoparium*), bracken fern (*Pteridium esculentum*), monoao (*Dracophyllum subulatum*) and tussock grass (*Poa caespitosa*)]. Today, this forest is the biggest man-made forest in the world having a total area of 151,350 hectares (out of 400,000 hectares in all New Zealand) out of which 115,750 hectares are planted to conifers.

Plantings in this area started as early as 1897. The harvesting of matured *Pinus radiata* started in 1940 but not in a large scale until 1947.

The timber stands of Kaingaroa forest are as follows:

<i>Pinus radiata</i>	60,000 hectares
<i>P. ponderosa</i>	19,000 hectares
<i>Pseudotsuga taxifolia</i>	14,000 hectares
<i>Pinus nigra</i>	12,000 hectares
<i>P. contorta</i>	5,300 hectares
<i>Larix decidua</i>	1,200 hectares
Miscellaneous spp. ...	4,000 hectares
T o t a l	115,500 hectares

The net volume of the forest is 34,800,000 cubic meters, with a current annual increment of 1,530,000 cubic meters and a mean annual increment of 1,360,000 cubic meters.

The success of this forest lies on the unusual favorable conditions of growth and absence of destructive agencies. The climate is maritime with a rainfall of about 55 inches, evenly distributed throughout the year. The soil is porous which allow for maximum water percolation thereby minimizing surface water flow—hence soil erosion is reduced. Winds of gale force are seldom although strong northeasterly winds with heavy rain have caused minor damage to newly thinned stands.

b. Fire Protection

Because of the softwood constituent of the forest, fire is an ever present hazard. The investment on the forest plantations and on the wood processing plants are so big that this danger cannot be ignored. The government of New Zealand therefore has adopted numerous measures to minimize the danger and to combat fire. Among the steps

in fire prevention include communication network; maintenance of extensive roads within the forest (1,000 miles in Kaingaroa forest alone); establishment of fire breaks; planting of belts of fire resistant species around the boundaries and along public roads; observation of weather condition; logging by staggered settings; maintenance of water points; training of workers and efficient trespass control.

c. Silvicultural Practices

Various silvicultural practices in the exotic forests were shown particularly pruning and thinning. These operations improve the quality of the trees in the stand as well as afford maximum utilization of the area and allows for maximum production. Basically the idea is to plant as much trees as possible per unit area and periodically remove some of these trees as the demand for space increases with growth. In so doing, a continuous harvest of utilizable thinning is assured up to the time when the ultimate timber crop is left to mature.

The New Zealand exotic forest is characterized by a very high yield per unit area. Examples of this are shown in table 3.

Aside from conventional tools, poison (liquid ammate) is being used in the thinning of non-merchantable trees. A specially designed machine for boring and injecting poison into the stem allows a man to do thinning operation at a cost of about ₧10.00 per hectare. A pruning ladder likewise especially designed, allows pruning to 38 feet with pruning saw at the rate of about 40 trees per day.

TABLE 3. — *Examples of yields from exotic softwood plantations in New Zealand*

Species	Date Established	Volume per Hectare	Yield	Operation
<i>Pinus radiata</i>	1923	542 cu.m.	542 cu.m.	Strip, felling
”	1920	524*cu.m.	210 cu.m.	First thinning
<i>P. nigra</i>	1916	350*	503 cu.m.	2nd thinning
			629 ”	Thinning
<i>Pseudotsuga taxifolia</i>	1923	†	322 ”	Thinning

d. *Reforestation*

The stocking of the softwood plantations is usually by transplants spaced 4 x 4 feet and later 8 x 8 feet between seedlings. Later 6 x 6 feet planting has been practiced. Other methods of stocking include strip sowing in rows 6 feet apart, natural reproduction from seeds falling from felled tree, and aerial seeding.

Aerial seeding with *Pinus radiata* at 3.4 kilograms per hectare has been tried with satisfactory result giving a stocking range of about 5,900 to 37,000 stems per hectare. Thirodust is used as seed coating to serve as bird repellent.

e. *Preparation of the site for planting*

Where topography will permit the cut-over areas are prepared for planting by means of root raking the area with a D-8 tractor to remove the stumps and residues. The advantages of this operation is that the area is free from second growth hence, no release cutting will be required after planting.

Planting can be done in regular lines and full stocking of the area is possible.

In steep country the left over trees were felled and the area burned. This reduces re-growth after planting and reduces the cost of release cutting.

Planting ploughed strips reduces frost damage since the temperature at ground level on ploughed areas are several degrees (3°-4°F) higher than on unploughed areas.

Shelterwood and strip felling methods of harvesting are employed to improve the microclimate for the favorable growth of the regeneration especially as protection to frost damage. The strip method, however, is less expensive and less destructive to the reproductions.

f. *Other exotic species*

Poplars are being planted in New Zealand but this silviculture is still under study.

Current silvicultural practices are based on European standards. It is hoped that poplars will in the future fill the needs for peeler logs, pulp and wood of the match industry.

g. *Forest Products Industries of Rotorua*

The production of exotic timber began its expansion sometime in 1945. Rotorua which is centrally located among indigenous and man-made forest had a population of only 7,500 in 1945. Due to the development of the forest industry the population has grown to 20,000 in 1963.

The seven sawmills in the Rotorua area produced 48.5 million board feet in 1963 out of which only 12.8 million board feet are of indigenous species.

The development of the lumber industry using exotic species was initiated by the Government of New Zealand by establishing a government sawmill at Waipa with the aim of demonstrating the effective utilization of man-made forests and also to supply the needs of government projects for lumber. Today Waipa sawmill has a daily (8-hour day) production of 80 to 100 thousand board feet of sawn lumber, claims to have the largest batteries of dry kilns in the Southern Hemisphere and its preservation plant since 1954 has produced 250,000 telephone poles and 3 million fence posts.

Other industries include the Lockwood Building Limited which produces prefabricated houses at the rate of 120 units each year, the Bay Ply Company Limited producing veneer plywood out of native and plantation-grown trees.

There are three pulp and pulp products mills around the Rotorua area which are all dependent on exotic timber forests: Whakatake Board Mills, New Zealand Forest Products Limited at Kinleith and Tasman Pulp and Paper Company Limited at Kawerau. The first two get their timber supply from their own plantation of 100,000 hectares while

the last is supplied from government plantations. The three plants have a combined output of 394,000 tons of pulp yearly. In addition to paper, and other pulp products, these firms produce about 150,000,000 board feet of lumber yearly, has a distillation plant capable of producing 60,000 gallons of vegetable turpentine and cuts 50 million square feet of veneer.

h. *Forestry Research*

The center of forestry research in New Zealand is the New Zealand Forest Research Institute with a professional staff of 50 scientists.

Research in silviculture includes morphological variations of *Pinus radiata* and other species and the taxonomy of New Zealand flora. Growth studies and research on nutrition and soil fertility are also conducted.

Forest improvement studies include the control of weeds in the nurseries and plantations. Pre-emergent and post emergent sprays in the nurseries are studied using various weed killers. Control of woody species and tree ferns by using arboricides is being tried. Low volatile oil-based ester formulations of 2, 4-D and 2, 4, 5-T with diesel oil as carrier have been found effective in killing several species and are also being tried to kill coppice sprouts and second growths.

Bird repellent dressing have been found to protect seeds in seed beds and seeded areas.

Direct seeding in logged-over areas are also being studied especially in stands, felled during winter where natural seeding is poor.

The silviculture of indigenous species and the reforestation of indigenous forests, the ecology of natural forests and the economics of silvicultural operations are being studied.

The studies on forest tree improvement include provenance tests, tree selection and breeding.

Research is being conducted on volume estimation, growth and yield and growth predictions.

In forest pathology and entomology the greatest achievements is the biological control of *Sirex noctilio* attacking some of the softwood species particularly *Pinus radiata*. Certain species of *Rhyssa* and *Megarhyssa* wasp are used as the control parasite.

Surveys of watersheds are being made on the condition of the vegetation incidence of erosion and the state of all tributary of streams and behavior of stream channels are being noted.

In some areas of New Zealand four nutrient deficiencies have been found: phosphorus, nitrogen, boron and magnesium. About 6,000 hectares of exotic forest have been fertilized from the air with encouraging results.

In the area of forest products studies are being made on the mechanical and physical properties of wood, wood and fibre structure, wood chemistry, wood preservation and seasoning.

The relationship of strength properties to wood density, growth rate and latewood content is being studied with the aim of enabling the forester to regulate timber quality of the forest crop. The chemical composition of wood is being studied to determine the effects of site and cultural conditions and its possible application to pulp production. A dip-diffusion treatment of green wood with boron has been developed. Simple treatment methods have been devised to help farmers in the treatment of wood in the farms.

XIII. OBSERVATIONS AND COMMENTS

a. *The possibility of fast-growing species as plantation crops in the Philippines* — There is a growing interest in the propagation of fast-growing species in the region. The acreage devoted to this project is in-

creasing every year. The feasibility of forest plantations has been demonstrated in New Zealand and Australia. In the Philippines the effort has been limited to trial plantings and up to now the species together with the silvical requirements has not yet been found. *Albizia falcata* and *Antocephalus cadamba* and a few other species have shown excellent growth and are under observation as possible pulpwood materials. One drawback of most fast-growing broad leaf species is the shortness of bole in comparison to *Pinus radiata* which reaches about 100 feet at 40 years. Hence, the volume per unit area of our species cannot be expected to compare or excel that of *Pinus radiata*. On the other hand both *Albizia falcata* and *Antocephalus cadamba* mature earlier and the deficiency in volume may be made up by increasing the number of crops or cutting cycles.

Swietenia macrophylla has been growing luxuriantly in the Makiling Forest and in other places in the Philippines. At 40 or 50 years some trees have yielded amazingly high quality lumber with widths up to about 24 inches. Again most of the trees planted here tend to be short-boled.

It will, perhaps, be difficult to beat an all-purpose crop like the *Pinus radiata* and other conifers in the forest plantation of New Zealand and Australia. Nevertheless, some fast-growing species in the Philippines such as those previously mentioned may become the important plantation species that will supply many of our future needs.

The continuous climb of pulp products requirement is evident all over the world and it is feared that the needs for coniferous pulp wood will outpace the supply especially in Europe.

This same problem will be so in the Philippines and throughout the whole Asia-Pacific Region since we have limited source of long-fibered pulp. Hardwoods alone as a rule cannot supply high quality pulp and will require an admixture of long fibers to produce high grade newsprints.

Pinus insularis and *P. Merkusii* are the only pine species native to the Philippines. Planting in reforestation project in Cebu has been successful but there is a need for more areas to be planted to pine species. Although *Pinus insularis* has exhibited rapid growth more studies should be done in the introduction of new species to the Philippines. Many softwood species have been tried in other tropical and subtropical areas and information is readily available from other member countries in the Asia-Pacific region.

Teak is fast becoming popular not only in Asia but in Africa and the African Forestry Commission has recommended the inclusion of Africa in the forthcoming Teak Sub-Committee Session in Bangkok sometime in 1967. The Philippines has joined the active member countries of the Teak Sub-Commission in the study. Experience with teak in the Philippines has not been very encouraging due to the usual tendency of the species to produce a branchy stem. An exhaustive provenance study is in order which may change the outlook for this species in the Philippines.

b. Trends in Silvicultural practices

Silviculture is receiving plenty of attention and tree breeding studies are in progress in the region. In some countries even the establishment of seed orchards are under consideration if not already in existence. This is an area where the Philippines is quite behind. The Philippines may learn from the experience of Australia, New Zealand, Japan, India and other countries in the region.

The fertilization of forest lands by top dressing (aerial dusting) has proved successful in *Pinus radiata* stands. This is worthwhile trying in the Philippines in area where reforestation has failed due to poor growth. This will call for careful soil analysis to determine nutrient deficiency in the soil. The control of weed species by aerial spray may be a solution to one of our problems in reforestation work. This method is being tried in New Zealand.

c. *The position fo the Philippines in forest products utilization.*—The Philippines is among the heaviest timber producer in the region and dominates the timber export market. At present it is supporting many of the forest products industry of Japan, Korea and Taiwan. Australia to a certain extent also imports timber from this country. With the modern timber extraction methods and efficient transportation system in the Philippines, the lead in the timber trade is assured for the near future. However, Indonesia and Malaya and other countries report increasing timber exports and New Zealand is now exporting pulpwoods.

Almost all countries in the region is aiming for increased forest production to meet an ever increasing need, which according to estimates will more than double in the next ten years. This is an interesting fact in that the role of the Philippines as a supplier of finished forest products could have remained undisputed in this region for a long time because while other countries are short of supply or improving production, the Philippines has the technical experience, logging machinery and adequate timber resources. This country could have benefitted more than by shipping valuable timber out of the country. New Zealand with only 2½ million population cannot absorb its own production yet processes forest products for export and at the same time provide employment to about 33,000 people. India, an importer of raw wood material employs 42,000 people in her pulp product mills and 24,500 workers in her match industry. The number of people employed in the wood-using industry of Taiwan, Korea and Japan, all supported by imported raw materials from the Philippines will be, in all probability, too large to allow an accurate guess.

d. *Wildlife conservation.* — Wildlife in the Philippines has been reported as being decimated. The same situation exists in many countries in the region and it is encouraging to note that this situation is being met with concern. The Philippines should follow the

lead of other countries such as Japan, India, and Indonesia in establishing game and nature preserves. A wildlife conservation program should be instituted in the Philippines to save our wildlife from extinction.

e. *Watershed management.*—The importance of watershed management to control floods, erosion, siltation and water conservation is now generally recognized in many Asian countries. Many countries have a program on the management of watersheds and catchment areas. The Philippines has embarked on a project of its own. All forestry agencies should join efforts in soliciting public and government support in this project. This country has only a few rivers suited for hydro-electric projects and these few are valuable to the country. The success of industrialization must have to depend on electricity quite heavily in the absence of other fuel such as oil and coal. The development of our water resources for industry, irrigation and domestic use is of prime importance.

f. *Range management.*—Range management is still at its infancy in the Asia-Pacific Region. The Philippines has a long way to go in this field. The number of livestock per unit area, the quality of fodder in relation to animals per unit area, the quality of fodder and soil nutrients relationship, effect of stocking on soil erosion and so many other things need study. New Zealand and Australia with its rich experience in the livestock and dairy industry are repositories of information that will be valuable to member countries.

g. *Forestry education and research.*—The reports on research in forestry in the Asia-Pacific region is very encouraging. There is a concerted move in this direction and member countries can learn plenty from each other. All that is needed is a system of exchange of information.

The University of the Philippines College of Forestry must develop a strong research program and contribute to forestry knowl-

edge in the region. The College has good facilities and has a concentration of well-trained staff in forestry to undertake such a project.

There is a shortage of technical men in forestry in the Asia-Pacific Region and many forestry schools are being established and others are being improved. The Commission recommends the following:

- a. Countries in the region consult with F.A.O. Advisory Committee on Forestry Education before putting up schools.
- b. Strengthening of sub-professional forestry training.
- c. F.A.O. should investigate the possibility of organizing a training course in Forest and Forest Industry Development Planning.

The commission noted "a continued strengthening of institutions for forestry education and research... but only a few countries have implemented the recommendation of the Sixth Session to give greater attention to the training of forest economists, and forest products engineers and technicians."

In the light of this revelations on forestry education, it would seem that the current move to improve forestry education in the Philippines is quite timely. The College of Forestry, University of the Philippines, has before 1962 instituted a forest products curriculum in anticipation of the expansion of the forest industry. There is, however, a need for more activities in the area of forest economics especially on research. The institution of a separate ranger curriculum is a move in the right direction.

The U.P. College of Forestry has developed tremendously in the past years both in facilities and faculty build-up although there are yet plenty of improvement that needs to be done. The College must have to strengthen its undergraduate curricula to meet the needs of existing conditions. It must have to institute a graduate program to meet the needs of Forestry in the Philippines. The Asia-Pacific countries need men and the U.P. College of Forestry can help supply these men. The Philippines has the advantage of geographical location, a climate and vegetation not too different from other countries in Asia, uses English as a medium of instruction and has a way of life familiar to Asian countries and share forestry problems common in the region. This College can very well develop into a center of forestry learning in this part of the world.

h. *Forthcoming forestry conference.* — There will be important conferences in forestry in the near future where the University of the Philippines College of Forestry will benefit by sending representatives: The Pacific Sciences Congress in Tokyo in 1966, the World Forestry Congress in Madrid in 1966 and the proposed meeting of the Subcommittee on Forestry Education of the FAO. The attendance of conferences of these nature helps the College of Forestry posted on new development in forestry, establish contact with highly trained foresters in various fields, and gain experience in international exchange of technical knowledge. It is necessary at this stage to look for sources of travel funds for the purpose.

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