

**TECHNICAL COOPERATION FOR THE DEVELOPMENT
OF THE PARAGUAYAN AGRICULTURE AND FORESTRY**

THE REPORT OF THE PRELIMINARY SURVEY

FORESTRY SECTION

MAY 1978

JAPAN INTERNATIONAL COOPERATION AGENCY



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OF THE PARAGUAYAN AGRICULTURE AND FORESTRY**

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FORESTRY SECTION

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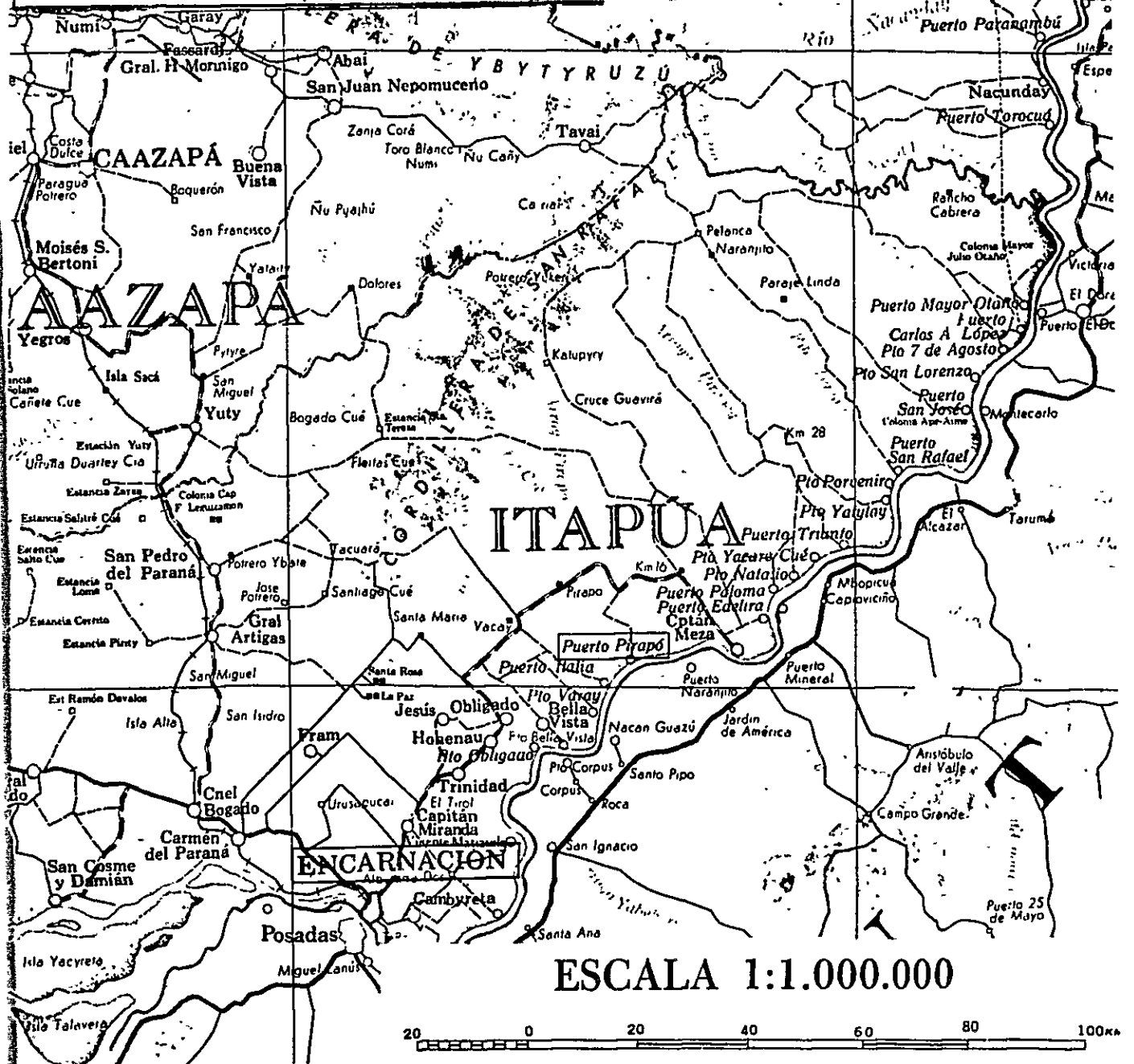
JAPAN INTERNATIONAL COOPERATION AGENCY

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OUTLINE MAP OF ITAPUÍA PROVINCE, PARAGUAY



FORESTRY SECTION

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o Reference Materials

1. Working Report of the Survey Group
2. Request from Paraguay
 - o Request of November 1976 to the Economic Cooperation Survey Group
 - o Request regarding the Wood Processing Center
 - o Request for Aid to Promote Food Production (K/R Aid)



The center of the capital, Asuncion
The purple flowering trees are
Jacaranda.



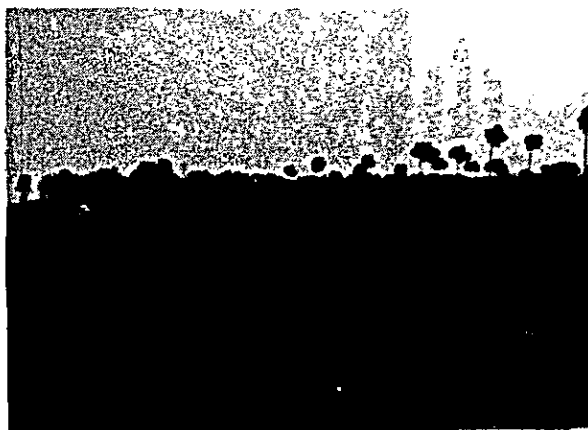
Director General of Forest Service
Mr. Calabrese (second from left) with
the survey group, the expert Mr. Kadono
and FAO experts.



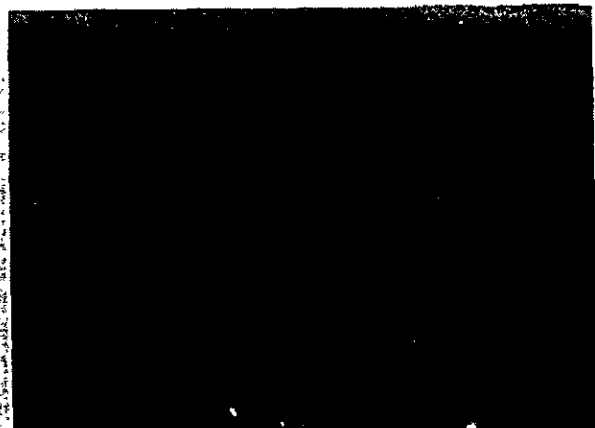
Product exhibition by Paraguayans of
Japanese descent held in Asuncion
city.



Suburb of Encarnacion in Itapúa
Department.



A Japanese-Paraguayan farm at Pirapó
in Itapúa. In front is the farm, in
the middle distance is a Paulownia
planting area and in the far distance
is remaining natural forest.



An aerial view of the same region as
in the photograph to the left.



Following rooting out and felling of the natural forest (in Pirapo colony, Itapúa Department).



Burning for land clearing from conditions similar to that shown in the picture to the left.



Logging at the saw mill in the Iguasu Colony.



A government nursery at Hoenau in Itapúa Department. Elliottii Pine nursery stock.



Parana Pine experimental planting area located at CRIA in Capitan Miranda in Itapúa Department (14 years old).



Elliottii Pine experimental planting area at IAN in Caacupé in Cordillera Department (13 years old).

FOREST INDUSTRY SECTION

I. Request of Paraguay and the Purpose of This Survey.

I-1. Background of the Request

As described in the "4th National Social and Economic Development Plan" of Paraguay, among the important agricultural products to be promoted for export, efforts are to be concentrated on the production of soy beans, cotton, etc., and in addition, lumber is also included. The production of coniferous lumber is also to be encouraged for future use as raw pulp material.

Although 56% of the land in Paraguay is forest, its usage has not always necessarily been appropriate, and the clearing of the forests has proceeded rapidly due to agricultural development, etc. In the meantime, due to undeveloped techniques for log utilization, there is a huge supply of trees which could be utilized but which are being burned in waste, being considered only as an obstacle for farm land development.

The Paraguayan government, facing such a forest situation (the vanishing of the forest), obtained the cooperation of the American Agricultural Technical Cooperation Organization, the United Nations, the F.A.O., etc., and established the Forestry Law in 1973 under the planning Agency and the Ministry of Agriculture and Livestock of Paraguay, in order to develop a policy with the intent to maintain the multilateral functions of the forest and to utilize forest products properly and practically. The Forestry Service was created with exclusive jurisdiction to administer forestry matters and a "Forestry Development Five Year Plan" was established.

This five year plan includes the following items concerning the Paraguayan forest and future forest industry:

- ① The promotion of reforestation by fast-growing trees for use as raw material for paper pulp.
- ② The rational use of forest resources (utilization of non-commercial trees)
- ③ Protection of nature.
- ④ Modernization of the forest industry.

With the intention of strengthening the Forest Service organization, technical cooperation is to be requested from abroad, in order to develop these measures.

As a concrete policy step for the forest industry, the government has considered proceeding with the afforestation by conifers such as the Elliottii pine, the parana pine (Araucaria), etc., for use as pulp material, in Itapua in and around the reclamation settlement area promoted by the Instituto Bienestar Rural (IBR), and initially requested the technical and financial aid (K/R aid, Grant aid) from Japan for the development of a pilot afforestation project of about 5000 ha which may be the key means to disseminate knowledge of afforestation techniques to the settlers.

Moreover, the government requested technical guidance on many individual plans based on the above described "Forest Development Five Year Plan", including guidance on wood processing (including utilization of non-commercial trees), modernization of the wood industry, management of the subtropical and tropical natural forests and the conservation of the watershed in the Itaipu dam area, as well as technical cooperation in the taking of the forest inventory in the northeast district.

I-2. Contents of the Request

Contents of the request are shown in the attached reference materials. A summary is as follows:

① Reforestation

Purpose: ① To plant conifers in a 5000 ha area over a seven year period, utilizing participation by the settlement, as a pilot project for disseminating training in forest development techniques.

② To increase local employment opportunity and to promote local industry through the development of the forestry and forest products industries.

Proposed area: Of the 7000 ha within the planned settlement area in Itapúa, 5000 ha are for forestry development and 2000 ha are for training in agriculture and live-stock farming.

Work plan: ① Control and management of the reforestation of the 5000 ha plantation and production and distribution of seeds and seedlings.

② Forestry experiments.

③ Technical study and training for forestry technicians.

④ Training for operators and repairmen of forestry machinery.

⑤ Development of 2000 ha for agricultural land.

Work schedule	Reforestation	Agricultural land development
1st year	100 ha	100 ha
2nd year	300 ha	100 ha
3rd year	500 ha	300 ha
4th to 7th years	@1000 - 1100 ha	300 - 500 ha
Total	5000 ha	2000 ha

Necessary facilities:

land: 7000 ha
 staff (professional)
 nursery
 road within the planned area
 buildings such as accommodations, workshops,
 warehouse, etc.
 business machines, vehicles, machinery,
 and instruments for laboratory use.

② Wood processing center

Purpose: For proper forest development of the settlement area in Itapúa, with the intention of promoting the rational use of wood.

Area: Near Capitan Meza in Itapúa.

Work Plan: to establish a saw mill with a production capacity of 5000 m³ for sawing, 2500 m³ for kiln drying, 2500 m³ for housing materials.

Necessary facilities: sawmill, woodworking factory, saw-fitting room, maintenance room, etc. generator, sawmill facility, woodworking equipment, impregnation equipment, dry kiln, etc.

③ Other

- ① Technical guidance regarding conservation of the watershed at the catchment area of each dam at Itaipu, Yacyreta and Corpus. (for one year)
- ② Carrying out the forest inventory in the northeast district (for two years)
- ③ Technical guidance regarding management of the sub-tropical and tropical zone natural forests (for two years).
- ④ Technical guidance regarding modernization of the wood industry (for one year).

In regard to the above items, a professional delegation would be dispatched to Paraguay, machinery and equipment would be furnished and trainees would be invited to Japan for study and training.

I-3. The Purpose of the Survey

Based on the request from Paraguay as described above, regarding the possibility of technical cooperation concerning the development of the forest industry including reforestation, wood processing, etc., in Itapúa, a field survey was made over 25 days from October 12 to November 4, 1977 and discussions were held with Paraguay's related organizations.

Items covered in the survey and in the discussions were the following:

- 1) The fundamental direction of Paraguay's forestry policy.
- 2) Present forest industry techniques in Paraguay such as timber production, reforestation, wood processing, etc.

- 3) Present conditions of forestry development in Itapúa.
- 4) The feasibility of technical cooperation for forestry development in Itapúa and the fundamental plan to carry it out.

II The Situation of the Forest and Forest Industry in Paraguay.

II-1. Outline of the forest and forest industry

Total forest area in Paraguay is 22,725,000 ha, 55.9% of the total area of the country; 38.5% of the land is for live-stock use and 3.3% is land for agricultural use with 2.3% remaining. The 55.9% forest rate is a figure lacking nothing compared with the 40% of neighboring Brazil's forest land, or 40% in the Philippines and 60% in Indonesia in Southeast Asia. Moreover, the forest area per head is 1.5 ha, and exceeds both the 1.2 ha/head of world average and the 0.2 ha/head in Japan.

The composition of this forest is mostly natural forest as described below, and forest ownership is mostly private. There are only 1,080,000 ha of National Park and Reserved Forest and 3,460,000 in other state land, making up the national forest.

The percentage of the gross national product held by forest industry production obtained from the above described forest resources fluctuates at 4%, but the yearly growth rate in the production amount shows 5 to 10%, showing a high index rate compared to the growth rates of agriculture and livestock. Also, the amount of logs handled in Paraguay in 1975 was 1,330,000 m³ and the number of wood processing factories total 486.

Paraguay's forest products make up 19% of the total exports, which in combination with agricultural and live-stock products make a total sum of US \$33,649,000. However, in 1976, the share held by forest products decreased as a result of the worsening economic conditions in importing nations (mainly Argentina) and the increasing

export of other agricultural products; however, the forest industry is still one of the mainstays, with agriculture and livestock, which support the Paraguayan economy.

Dividing the whole forest and forest industry into categories, three distinctive areas in Paraguay may be seen:

The first is the Chaco district forest which expands from the western side of the Paraguay River southward to the central area of the country and takes as its share the Western half of the country. In this area precipitation per year varies near 1100 mm. It is considered Dry Tropical Scrub Forest from a botanical ecological view and includes the quebracho, a commercail tree which is the raw material for tannin. Under present conditions, however, rapid forestry development in this area is difficult to expect both technically and economically, and the capacity of the wood processing industry in this area is only 6% of the country's whole. Future rational use of this forest may be for firewood and charcoal, especially for characoal as the raw material for the manufacture of iron. Then, the possibility may be examined for the intensive forestry development of the cut area, with reforestation by Eucalyptus, a tree which adapts to arid land.

On the other hand, the eastern half of the country, expanding from the east side of the Paraguay river, is the Dry Tropical Forest Zone, the second category of forest, where there are agricultural and livestock zones, where the central departments developed long ago centering around the cities of Asuncin and Encarnación, including the departments of central Cordillera, Paraguari and Misiones. In this area, agricultural land, pasture land and swamp land abound, with the remaining natural forest poor in quality and quantity, and compared to Japan's level rural areas, the proportion of forest area to its utilization by the forest industry is poor.

However, even in this area, there exists a wood processing industry based on crude logs supplied from the surrounding forest which takes nearly a 40% share of the total country's capacity for wood processing. Also, reforestation by the farmers has started to develop with man-made forests of Paulownia Kawakami, Araucaria angustifolia, Pinus Elliottii and Eucalyptus spp. The beginning of such intensive forestry is a result of the administrative and technical guidance from the Servicio Forestal Nacional, the Escuela Técnica Forestal, the Instituto Agronomico Nacional, the Centro Regional Investigacion Agricola and others, showing a favorable trend for the conservation of the natural environment, watershed control for public benefit, etc.

The third category includes several areas, such as the departments of Amambay, Canendiyu, Alto Paraná, Itapúa, etc., sharing the southeastern area of Paraguay covered mostly by natural Dry Tropical Forest, previously described. The area making up the natural forest (excluding the forest of "campos") in these 4 prefectures is 2,930,000 ha, and a 53% share of the total area. In these natural forests, trees show superior growth in the fertile Terra Roxa soil and under ideal weather conditions (precipitation per year is 1600-1800 mm, yearly average temperature is 24.5°C). Growing stock reaches 300 m³ per 1 ha, and forms the main forest zone of the country.

This area is the main target for forest production, comprising nearly a 60% share of the wood processing industry's capacity.

However, from observations of the forest and forest industry in this area, it must be said that present forest utilization is still careless. Out of the exceedingly large variety of trees which is characteristic of tropical forest, only a few kinds are being utilized, as follow: Cedro

(*Cedrela tubiflora*), Lapacho (*Tabebuia* spp.), Incienso (*Myrocarpus frondosus*), Gantambu (*Balfourodendron riedelianum*), Petereby (*Cordia trichotoma*), Perova (*Aspidosperma* spp.), Ybyrapyta (*Peltophorum vogelianun*), Ybyraro (*Pepterogyne nitens*), and, at the largest estimate, only around 10 species are used for saw log and peeler; others are left even if the logs are of large diameter, or, when the land is developed for agricultural use, the remainder are cut and burned. Therefore, the number of trees which are used as lumber are less than five per 1 ha, or even less, especially as in the past, with the rooting out and felling of trees in the forest producing one or none; the low utilization rate compares poorly to the 5 to 10 trees per 1 ha among the logging of the Dipterocarpaceae in Southeast Asia. Needless to say, the logging cost exceeds the timber price, because there are many non-commercial species of tree, and moreover, the means of production are poor, including the roads, the logging equipment and materials, the system of logging technique, the wood processing facilities, etc. Because most of the precious forest resources do not have commercial value, they are being wasted without being utilized. Considering that the forest is a decreasing natural resource, this is a problem not only for Paraguay but more widely for the world, and which demands urgent measures.

Even in this area, mainly in the colonies of Japanese and German descended immigrants in Itapúa, Alto Paraná, etc, man-made reforestation has been begun with the species of trees mentioned before. Among the settlement farms, in addition to the single year grain crops, the number of people who intend to reforest their own land, even in just small areas, is increasing, and strong interest is being shown in forestry management and permanent cultivation.

II-2. Present condition of the wood industry

(1) Sawmill industry

In Paraguay, the rate of utilization of wood for housing material is low, and as buildings are generally of brick construction, the amount of wood consumption is comparatively small. According to a 1975 survey, factories engaged in saw-milling and wood processing number 486, but these are small scale and the technique level of sawmilling and wood processing is generally low.

The wood industry is limited to sawmilling, kiln drying, plywood industry, veneer industry and peeling. There are no pulp, blockboard or particle or fiber board factories. In the countryside, except for FINAP, described below, on-the-spot saw-milling is done mostly in the Japanese and German settlements, and the collection of logs is limited to 20 km from the factory. One saw mill with a capacity of 4000 m³ (log consumption amount), located in a Japanese settlement, has 18 factory employees, 7 logging workers and 3 sawing machines for heading, middle size and small strip cutting. 80% of the trees used for sawmilling are Lapacho and Cedro, with some others, such as Canafist, Guatambú, Ybyraró, Guaica, Timbó, etc., altogether comprising at most 5 or 6 species. Necessary cost for sawmilling is 1 cubico (1 cubico = 100 pulugada; 1 pulugada is 1 × 1 (inch) × 1 (meter)) costing 240 - 300 guarani (¥500 to ¥600). Logs with diameters over 16 inches are used for sawmilling. The price of the saw-milling product for Lapacho is about 10 yen/1 pulugada, and for Guatambu, about 6 yen/1 pulugada. The recovery ratio is said to be 75% for Lapacho and 60% for Cedro, however 75% for Lapacho seems too high.

Lapacho is mainly used as housing material, and recently Canafist was a substitute tree species. On the

other hand, Cedro used for furniture, is being exhausted, and the supply of Petereby is running low.

Saw mills in Paraguay are generally on-the-spot saw mills, and most of them have 1 or 2 sawing machines and feed carriage (by hand). Techniques to distinguish quality of lumber and saw-fitting are generally low.

(2) FINAP wood processing factory.

FINAP is located in a suburb of Asuncion, a model factory which has installed the newest Italian facilities to institute the modernization of the wood industry in Paraguay. Private capital made up 70% of the investment, and that the of national bank and the World Bank each were 15%. The facility has 200,000 ha of its own forest. Employees number 350 including those at the logging site.

This factory was established in 1976, with only saw-milling and woodworking sections starting operation at that time, while part of the remaining sections started to operate from 1977. Production capacity and the amount of present production in the manufacturing section is shown in Table 1.

The species of trees used at FINAP are comparatively varied as shown in Table 2, and in addition to the species mentioned above, Incienso (*Myrocarpus frondosus*), Laurel Negro (*Ocotea* sp), Taperyva Guazu (*Ferreirea spectabilis*) and Trebol (*Amburana tarresea*) are used, especially for peeling, contributing to the utilization of non-commercial species.

80% of the sawmill production is from orders and for foreign consumption. Only Lapacho has a domestic demand, with nearly 20% of the sawmilling products selling domestically.

Sawmilling logs are usually 5 to 6 m in length, but sawmilling is possible to a maximum length of 9 m.

The sawmilling section at FINAP has a production capacity of 35,000 m³, therefore it is large compared to the scale of Japan's sawmilling factories. For comparison, the present situation of Japan's sawmilling factories is as follows: there are nearly 23,600 factories (1975 survey) nationwide, with an average horsepower of 300-500 kw; employees number 18 - 23/factory, and in recent years many factories have introduced more efficient facilities. Among the sawing machinery used in Japan, there is an increasing trend to install auto (roller) table band saws, power conveyor belts, forklifts, etc. Further, Japan's consumption of saw log is slightly decreased since the peak around 1974, but the figure for combined domestic and imported log use is 51,430,000 m³ (1975). Converted to a figure per factory, it reaches 2,180 m³ per year.

(3) The plywood industry

It is no exaggeration to say that the only plywood factory in Paraguay is FINAP, described above. FINAP is presently operating at 65% of its production capacity. The species of trees used include Cedro, 40% of all plywood, Guatambú, with 30%, Timb, 20% and Yvyraró and Laurel Guaica, 10%. The plywood is for the most part ordinary plywood, with 8 different thicknesses: 3, 4, 5, 6, 9, 11, 18 and 22 (mm). Length is a standard 122 x 244 cm, with an additional size for door production of 80 or 90 x 214 cm. Rotary veneer rather than plywood is more often exported, primarily to Argentina, Italy and Denmark.

In addition, three peeling machines have been installed with production of 6000 m³ per year (50% of capacity). At the present time, exports to Argentina are at a low point.

As reference, the amount of ordinary plywood production in Japan, showing a decreasing trend since the peak of 1974, is 17,800,000,000 m³ (converted to 4 mm, 1976 survey), and the number of factories is: including those for veneer, 57; ordinary plywood, 200; special plywood, 415; and others, 52, with a total of 726 factories.

(4) Paper mills, Pulp Factories

Paper mills and pulp factories do not exist in this country. The consumption of paper per head in South American countries is nearly half that of world average. Of all, Bolivia and Paraguay have the lowest consumption. The production of newsprint has only limited production in countries such as Brazil, Argentina, Chile, Uruguay, etc. In the province of Misiones in Argentina, there is a paper and pulp mill exclusively for conifer pulp. Paraguay is encouraging reforestation of fast growing conifers including parana pine (*Araucaria angustifolia*), Elliottii pine (*P. Elliottii*) and Taeda pine (*P. Taeda*), and expects to export logs as a result of thinning, to the pulp factory in Argentina. At present, Paraguay has very few conifer resources, either in natural or man-made forests, and also, at the present time, electricity conditions are quite poor. Therefore, until completion of the dam construction presently proceeding as part of the Alto Paraná River Development Utilization Plan, and, additionally, until the preparation of a self-supplying system of pulpwood is made, the development of a pulp factory would be quite difficult.

As reference, the condition of Japan's paper and pulp industry includes 574 enterprises (fiscal year 1975) and, of this number, 91% of the paper and paper board factories are of small and middle size (under 300 employees). On the other hand, 76% of the pulp factories (including pulp production and paper manufacture) are large and middle size factories.

The total number of employees in the industry is about 82,000 and according to industrial classification, the personnel percentages are 56% in the paper industry, 25% in the paper factories and 19% in the pulp factories. The ratio of conifer to broad leaved trees used for pulp is 49:51 (Table 3).

(5) Others

As part of the wood industry of Paraguay, in addition to that mentioned above, firewood and charcoal, and processed charcoal is produced on a small scale. In the future, Paraguay also desires to establish an iron industry, therefore utilization of eucalyptus for charcoal may be expected.

In Japan, there are various wood processing industries, such as the particle board industry, fiber board industry, flooring industry, and the preservation, insect proofing and kiln drying industries, but these kinds of industries have not yet been established in Paraguay. Of them, the flooring industry and kiln drying, preservation and insect proof industries are the types which will have very high demand in terms of promotion of exports and the effective use of presently non-commercial wood, therefore technical cooperation in these matters is of particularly high priority.

(6) Technical problems in Wood Utilization

From the results of the forest inventory in the departments of Amambay, Alto Paraná, Itapúa, there are 75 or 80 species which have utilization possibilities in these areas with a standing volume of over 100,000,000 m³. Among them, however, present utilization, even with overestimation, includes only about ten species. Moreover, first class wood, such as Lapacho, Cedro, Petereby and Ybyraro makes up only 14% of the whole standing volume. Present conditions show a density of Cedro and Lapacho in many areas to be under 20 m³ per ha, with the 150 to 200 m³ of other varieties of trees remaining being burned after felling. Also, the Guatambú; a first class white wood for flooring use, has low durability after felling, and because it cannot be left long in the felling site, its care is difficult and utilization decreases.

The main species which show utilization possibilities are shown in Table 4.

Beside these, due to the well-recognized intricacy of large fibers on trees from tropical and subtropical zones, many species will have problems during processing or final treatment (surface treatment, coating with paint, etc.).

With large inner stem stress, it is necessary to consider developing techniques to prevent the cracking and splitting which largely influences the ratio of finished product to sawmilled material.

Due to the composition of the Paraguayan forest where many species have a comparatively high specific gravity, it is necessary to establish sufficient and proper kiln drying conditions for each species.

The cancharana, with wood color similar to Cedro, has a bulk density of nearly 600 kg/m^3 , but it takes a very long time for drying.

Quite a large amount of data about the physical and strength characteristics of each species of tree has been accumulated by the Institute of Industrial Technique (INTN) since 1966.

However, differences in physical properties varying from tree to tree are a large problem. For instance, with the previously mentioned Guatambú, with wood obtained on an experimental basis from the same stand of trees, the bulk density of each varied to the extent of 700 to 900 kg/m^3 on the average.

Moisture content by natural seasoning is similar to that of European and North American trees, about 12%, but lumber for export necessitates the reduction of the moisture content to around 8%, therefore technical guidance concerning the maintenance of artificial drying facilities is necessary.

Table 1.

Production and Capacity at FINAP

Name of product	Production amount
Lumber	
Actual production amount	12,000
for export	8,400
for housing material use	3,600
Production capacity	35,000
Sliced veneer	
Actual production amount	6,000
Production capacity	12,000
Rotary veneer	
Actual production amount	10,000
Production capacity	18,000
Plywood	
Actual production amount	8,000
Production capacity	12,000
Others	
Production capacity	4,300

Table 2. Species Used at FINAP

Local name Nombres comunes	Local name Familia	Scientific term	Note
For plywood			
Cedro (40%)	Meliaceae	<i>Cedrela tubiflora</i>	Paraguayan Cedar
Guatambú (30%)	Rutaceae	<i>Balfourodendron riedelia-</i> <i>nun Engl.</i>	Paraguayan Maple
Timbó (20%)	Leguminosae	<i>Enterolobium sp.</i>	
Yvyraró (10%)	Leguminosae	<i>Pepterogyne spectabilis</i>	
For sawn timber			
Lapacho (50%)	Bignoniaceae	<i>Tabebuia ipé</i>	First class lumber Paraguayan Greenheart
Cedro	Meliaceae	<i>Cedrela tubiflora</i>	"
Guatambú	Rutaceae	<i>Balfourodendron riedelia-</i> <i>nun Engl.</i>	"
Yvyraró	Leguminosae	<i>Pterogyne nitens Tul</i>	Paraguayan Mahogany
Yvyrapytá	Leguminosae	<i>Peltophorum dubim (Spreng)</i> <i>Taub.</i>	Paraguayan Redwood
Timbo	Leguminosae	<i>Enterolobium contortisili-</i> <i>quum (Vell) Morong</i>	"
Petereby	Boraginaceae	<i>Cordia trichotoma (Johnst)</i> <i>Arrab.</i>	Second class lumber Paraguayan Walnut
Kurupay	Leguminosae	<i>Piptadenia sp.</i>	"
Kupay	Leguminosae	<i>Copaifera langsdorfii</i> <i>Desf.</i>	"
Urundéy pará	Anacardiaceae	<i>Astronium fraxinifolium</i> <i>Schott.</i>	"

Table 3.

Ratio of conifers to non-conifers and pulp specifications, with the standard consumption of wood in Japan.

Classification	Total number	Dissolving pulp	Pulp for paper						
			Total	S.P	K.P	S.C.P	C.G.P	R.G.P	G.P
Percentage of composition	N Conifer trees	7.1	50.9	97.5	49.0	9.3	1.6	99.5	99.0
	L Broad leaved trees	92.9	49.1	25	51.0	90.7	98.4	0.5	1.0
Standard consumption of wood - m ³ /ton	3.33	3.92	3.31	3.53	38.9	2.47	2.16	2.36	2.03

Note: According to the Ministry of International Trade and Industry, "Annual Statistical Report on Paper and Pulp."

Table 4. Commercial Species (Includes possibility of commercial value)

Local name	Scientific term	Family name	Growing stock xl, 000m ³	Rank for usage	Specific gravity (air-dry)
Aguaf	<i>Chrysophyllum gonocarpum</i> Engl.	Sapotaceae	1,152	D	0.62
Amba'y guasú	<i>Didymopanax serototoni</i> Dome et Planch	Araliaceae	367	E	0.42
Agros secos	<i>Heliocarpus americanus</i> L.	Tiliaceae	217	D	0.26
Guajayví	<i>Polygonum americanum</i> L.	Boraginaceae	2,326	C	0.66
Guavirá	<i>Carpomanesia xanthocarpa</i> Berg.	Myrtaceae			0.66
Incienso	<i>Myrcarpus frondosus</i> L.	Leguminosae	1,456	A	0.72
Inga	<i>Inga</i> sp.	Leguminosae	379	E	0.58
Kancharana	<i>Cabralea oblongifolia</i> C. DC.	Meliaceae	4,656	B	0.52
Kupa'y	<i>Copaifera langsdorffii</i> Desf.	Leguminosae	259	C	-
Kurupa'y pã	<i>Piptadenia rigida</i> Benth.	Leguminosae	6,611	B	0.85
Laurelaju'y	<i>Nectandra</i> sp.	Lauraceae	4,287	B	0.52
Laurel quaicó	<i>Ocotea puberula</i>	Lauraceae	3,027	B	0.37
Laurel hd	<i>Nectandra megapotamica</i> Hassler	Lauraceae	6,721	C	0.50
Loro blanco	<i>Bastardopsis deniflora</i> : Hassler	Malvaceae	1,740	D	0.55
Mbavy	<i>Casearia gossypiosperma</i> Briq.	Flacourtiaceae	242	D	0.73
Pakuri	<i>Rheedia gardneriana</i> Pl. & Tr.	Guttiferae	65	D	0.72
Para para'y guasú	<i>Pentapanax warmingianus</i> Harms	Araliaceae	1,010	D	0.48
Rabo melle	<i>Lonchocarpus</i> sp.	Leguminosae	1,679	E	0.69
Samu'g	<i>Chorisia</i> sp.	Bombacaceae	802	E	0.19
Tanlmbd rã	<i>Pisonia Zapallo</i> Gris	Nyctagynaceae	-	-	0.32
Timbó	<i>Enterolobium contortisiliquum</i> Morong.	Leguminosae	3,288	B	0.37
Urunde'y parã	<i>Astronium fraxinifolium</i> Schott.	Anacardiaceae	2,375	C	0.83
Ysapy'y morotí	<i>Machaerium Stipitatum</i> Vog.	Leguminosae	0	D	0.57
Yvá porotí	<i>Myrciaria</i> sp.	Myrtaceae	0	D	0.62
Yvá ró	<i>Prunus sellowii</i> Koehne	Rosaceae	983	C	0.58
Yvyrá itã	<i>Lonchocarpus leucanthus</i> Burk	Leguminosae	-	-	-
Yvyrá jg	<i>Albizia hassleri</i> (Chodat & Hassler) Burkart.	Leguminosae	110	D	0.61
Yvyrá ovf	<i>Helietta cuspidata</i> Chod.	Rutaceae	108	C	0.71
Yvyrá pepé	<i>Holocalyx balansae</i> Michx	Leguminosae			0.74
Yvyrá peré	<i>Apuleia leiocarpa</i> Macbr.	Leguminosae	1,930	B	0.69
Yvyrá ró	<i>Pterogyne nitens</i> Tul	Leguminosae	434	A	0.64
Zota caballo	<i>Luehea diversicata</i> Hart.	Leguminosae	1,166	C	-

II-3. Present Conditions of Forest Industry Techniques

(1) Logging techniques

In Paraguay, as already described, it is no exaggeration to say the forest presently being cut is almost totally natural forest.

Reasons for logging the natural forest can be roughly divided into the following two categories:

One is logging for purposes other than the forest industry, such as development of land for agriculture use. In this case, all trees are felled.

The other category is for wood production, and the number of species (Cedro, Lapacho, around 10 others) possible to sell domestically or abroad, and which have an excellent shape- is quite limited compared to the number of standing trees in the natural forest.

For both categories, the chain saw, in addition to the hand axe and hand saw are used. With the logging for agriculture land development which takes a major share of the present logging activity, individuals who receive each lot of the natural forest fell the trees by themselves, or the logging is contracted to the logger's trade, therefore consideration for wood utilization is limited. Judging from the cutting height, shape of the cut end, etc., there is room for improvement in logging techniques and skills.

Concerning log transport, the cable yarding generally used in Japan is not employed, as most stand is flat, and tractors are used. As these machines are expensive, requiring great cost and time for maintenance and repair, they are not sufficiently practical, and it may be considered that there is room for improvement in work efficiency.

For small scale yarding, livestock power is utilized.

Much log transportation is made by large trailer trucks, but transportation both near the sawmills or to remote plywood factories is made with the full size logs, so due to imperfect completion of public roads and forest roads, transportation costs are high.

As described above, modern log yarding and transportation techniques are practiced to some extent, but, in addition to shortage of machinery, there is deficiency in the maintenance system, and there is a shortage of skilled operators, so there are many improvements to be made in order to establish an efficient logging system. The effects of this may be expected to be large.

Present logging techniques, as mentioned above, are quite unsatisfactory for the effective utilization of wood resources. This problem should be solved soon. For this, it is necessary to organize logging techniques and to systematize the logging industry, while developing methods for utilization of non-commercial species. Definite measures for this might include the further training of managers and technicians, the improvement of machinery and the establishment of a maintenance system.

(2) Silviculture techniques

As described above, the history of artificial reforestation in Paraguay is quite short. There are quite a few areas of experimentally planted man-made forest, but these have been in existence for only the past 10 - 15 years. Therefore, it must be said that the establishment of a management system for man-made forest and the development and growth of silviculture techniques are problems for the future.

① Species for afforestation

Presently, the major species which are being planted in Paraguay are pines, mainly the Taeda and Elliottii Pines, the Parana Pine (*Araucaria augustifolia*) and *Eucalyptus* spp; in addition, the planting of *Paulownia* has been started.

These species are all exotic species for Paraguay, but quite excellent growth for both the single trees and stand crops has been confirmed in the Terra Roxa zone where the present survey was made. Moreover, judging from the data from the Misiones Province in Argentina, which has a similar natural environment, there are good prospects for the artificial reforestation by the aforementioned species.

Therefore, for the present, development of an artificial reforestation area by means of planting these species may be considered appropriate.

In addition, from a long term view, the choice of other valuable species for reforestation may also be considered as necessary for the healthy development of the future forest and forest industry of the country.

The above mentioned species presently planted, or planned for planting, are fast growing species and are suitable for mass production as material for industrial, use, such as pulp, etc., but they bring low prices, therefore, uncertainly remains as to the value of repeating future reforestation. It is necessary to examine the reforestation by high value species to provide the raw material for the wood processing industry to use timber in furniture and interiors.

For this, trial artificial reforestation by valuable indigenous species should be undertaken, and, at the same time, it is necessary to improve valuable exotic species for experimental introduction.

Further, considering the diversity of vegetation and ideal natural conditions, regeneration of forests only by artificial reforestation is not the exclusive way. Survey and research on a working system for natural forests to improve them with high productivity in amount and in price are quite important.

② Ensuring the Supply of seeds

At the time of developing man-made forests, first of all a system is necessary to ensure the obtaining of excellent seeds for seedling production. At the present, most of the seeds planted in Paraguay are imported from foreign countries, such as the neighboring countries, therefore, it is not only difficult to choose seeds of excellent clone with excellent inherited quality, but it is also difficult even to ensure the amount, of, for example, parana pine.

Therefore, in addition to the necessity of developing a Mother Stand suitable for the production of seeds, Plus trees and Elite trees from the existing man-made forests must be selected to hurry the development of a seed orchard by the cloning of these trees. For this it is necessary to introduce a method of selecting the Plus trees and Elite trees, and to introduce forest tree breeding techniques including selection of Elite trees and stimulating of seed production.

③ Seedling production

In Paraguay, as a result of most artificial reforestation being carried out only recently, facilities

for seedling production are incomplete and there is also room for improvement of seedling production techniques. Considering the nursery as the basic seedling production facility, the introduction of techniques for maintaining fertility of the soil is indispensable. At the moment, because only a few years have passed since the nursery was set up, and also because of the ideal and rich soil called Terra Roxa, no noticeable evil can be seen to have occurred. However, in the future, for a large production nursery with high nutritional demand, permanently installed at the same place, the maintenance of fertility of soil and techniques for soil improvement may be considered essential.

Moreover, along with techniques to prevent soil fungi, nematodes, etc., it is necessary to develop the techniques to prevent harm from special problems that are not seen in Japan.

Regarding nursery techniques, it can be seen that there is room for further study and improvement in the number of seedlings on a unit areas, decisions as to proper density, and growth promotion of root system (the improvement of T/R ratio by root cutting).

In particular, the introduction of mechanized work in seedling production is necessary.

The mechanization of seedling production not only makes possible a reduction in the amount of labor investment but it also brings production improvements technically and economically by the ability to distribute work at the most suitable time and the ability of the most even and effective application.

Especially in a country such as Paraguay, in order to promote smooth reforestation on a large scale where the geography of the country is suitable for mechanization and where there is a labor shortage, the mechanization of reforestation work is essential. It may be said that standardized seedling production of even quality through the mechanization of the nursery work, is an important prerequisite for the promotion of reforestation.

However, due to the special characteristic of the seedlings being unsuited for long hours and long distance transportation, the unit scale of the nurseries is limited. It is necessary that the mechanization of the nursery is made mainly with small or ordinary size machinery.

④ Planting and maintenance

At the present time when there is such a short history of artificial reforestation, and when there are few man-made forests, analysis and review of the present conditions of the planting and maintenance may be considered inappropriate.

Among the existing man-made forests, the only one to have a management report is the experimental man-made forest established by the Escuela Técnica Forestal located 12 km west of Stroessner. Even in this experimental forest, management experiments were not instituted, rather it constituted only a step to hasten experimental planting and to observe the changes in growth.

Consequently, the establishment of a work plan for planting and maintenance may be said to have been put

aside as a problem for the future.

In such conditions, close examination should first be made of the results of the experiments conducted to the present time in addition to examination of data from neighboring countries, before deciding on the tree species best suited for reforestation according to the physical, economic and social conditions of the country.

⑤ Other

Relating to the above mentioned silviculture, special consideration should be taken of the following two matters.

First, since the country has extensive and level forest on suitable land, and since the population density is low, and especially since the target area for forest development is primarily in the undeveloped area of the country, much future development of man-made forest cannot be expected without depending on mechanical power.

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Consequently, since there are various problems which cannot be solved through the experience of small scale experimental planting found in the country up to the present, it is necessary to respond with a new system.

Frankly speaking, due to the geographic conditions in Japan which restrict planting and maintenance work by large machinery, results and data of large machinery system are not abundant, but combining the reforestation techniques used in Japan and the large size machinery techniques used in actual place in Paraguay, great possibilities for cooperation may be seen to develop and establish a working system of reforestation and maintenance using large machinery.

Second, an item to be considered involves the future marketing of the lumber produced by artificial reforestation.

Although there is said to be a world wide shortage of lumber, this merchandise can easily vary unexpectedly in price according to freshness, etc., and there are additionally many restrictions on sales destination. And when reforestation species in Paraguay are of the same kind as in neighboring countries, while there is the advantage of having a ready market in the neighboring country, there is the hidden possibility of Paraguay becoming an area of limited supply to an advanced area of supply, therefore, taking this all into consideration, efforts should be made to develop a domestic demand in addition to developing export destinations for forest products which will be produced several years ahead, in order to establish a rational distribution system and to select reforestation species of high quality lumber as described previously.

(3) Wood processing techniques

The modern wood industry in Paraguay is represented by the one company of FINAP Located in Asuncion. However, there are nearly 600 sawmilling and secondary

wood processing factories, even though small scale, at various places within the country. The technical levels of sawmilling and wood working in these factories are low, and the exporting of the processed products to Argentina, Brazil, etc., is nearly impossible.

In Japan, many wood industrial complexes has been established aiming at rationalization and consistency of wood industry, as a result, automation of production is advancing rapidly, however, considering the present conditions in Paraguay, it is believed that the primary pressing need is to raise the level of the technicians engaged in the small size factories.

Appropriate fields for technical cooperation at the present is saw-milling, wood-working, kiln drying preservation and insect control. Trainees acquiring general knowledge and practical techniques in these fields and striving for production accuracy in the product and the improvement of efficiently in each factory, will ensure the development of the wood industry in Paraguay. At the same time, the necessity for efficient utilization (utilization of non-commercial wood) of resources, and the necessity for reforestation may be recognized.

It is desirable that the practice of wood processing, the knowledge of timber and standards of lumber is done collectively at one place (the Pirapo area). Further, the contents of this technical cooperation should be limited to only those necessary fundamental techniques for direct wood usage. The fields relating to secondary usage including plywood, paper, pulp, fiber board and particle board products should be examined subsequently.

III. Technical Cooperation Plan

III-1. Outline of the technical cooperation plan

(1) Technical cooperation project

As the result both of discussions with the related organizations and of the field survey, in order to develop the forest industry in Itapúa, recognizing the necessity for the investigation and training in the field of wood processing techniques and for the investigation and training in the field of reforestation, the mission recommends to carry out a technical cooperation between the Paraguayan Government and the Japanese Government as follows:

- 1) Establishing the Center of Forestry Development in Itapúa and setting up two sections for guidance of wood processing techniques and for guidance of reforestation techniques.
- 2) In the section for guidance of wood processing techniques (Wood processing guidance section), present conditions where the majority of tree species in natural forests is burned unutilized, are to be changed with the purpose of helping the efficient use of forest resources and the promotion of reforestation and technical training is to be offered regarding saw-milling and wood working, and the experimental development for utilization of non-commercial trees.
- 3) In the section for guidance in reforestation techniques (reforestation guidance section), with the purpose of training technicians to carry out the leading duty of promoting all the reforestation in

Itapúa, and to establish a reforestation technique system, technical training is to be given, with technical development regarding the construction of roads for natural forests, land preparation, planting, maintenance, protection against damages, seedling production, etc.

- 4) Because of the natural and social conditions in Itapúa, and the necessity to introduce mechanized reforestation techniques, a Center of Forestry Mechanization (work shop) is to be established mainly for learning maintenance and repair techniques for this machinery, in addition to the Center of Agriculture Mechanization (work shop).
- 5) For the technical development and training as mentioned above, the Paraguayan government and the Japanese government in cooperation will prepare the facilities such as a center office, training station, saw-mill, woodworking factory, testing room for wood processing, nursery, training forest, the Center for Forest Mechanization and attached facilities and the machinery.

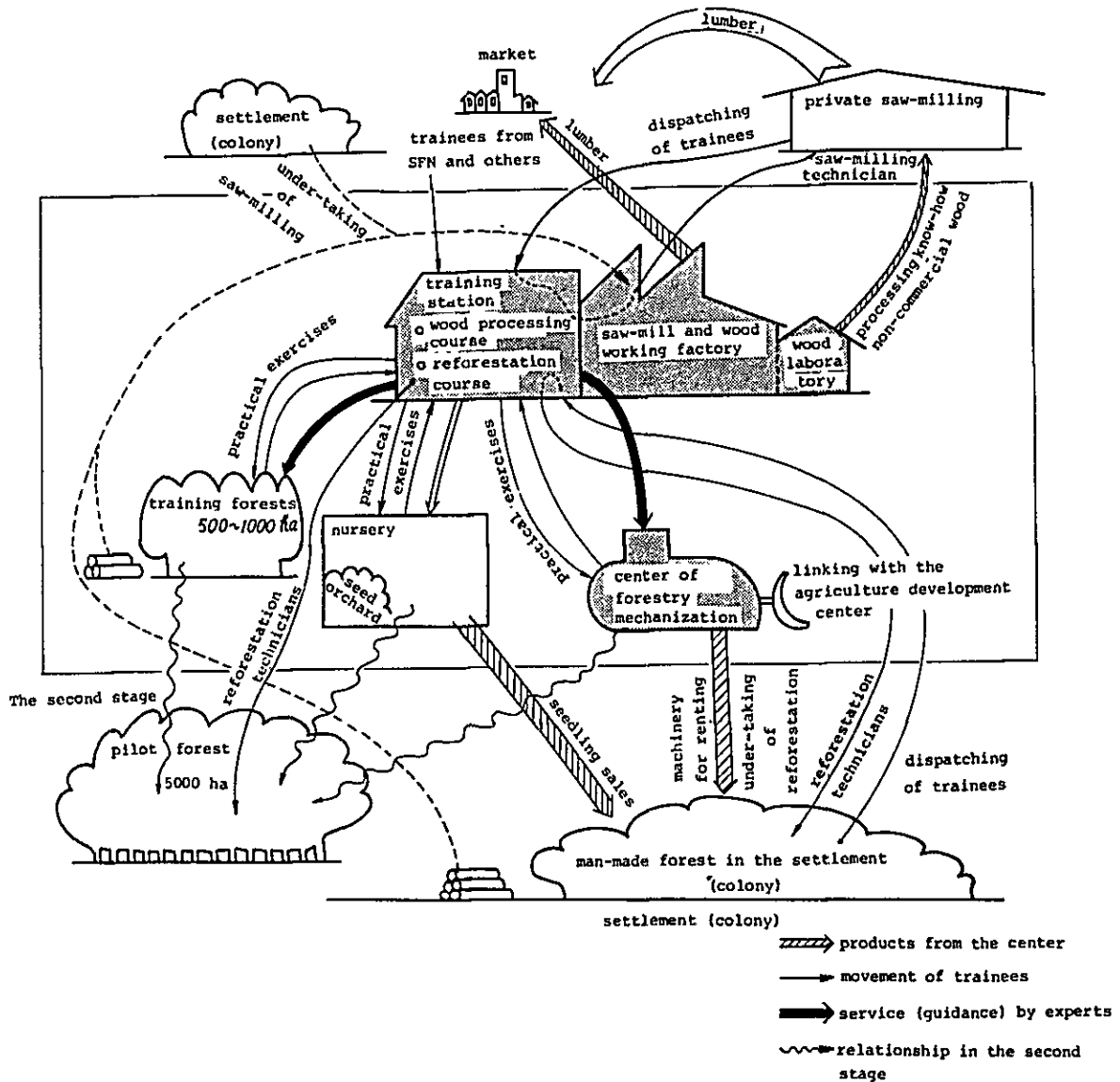
For the utilization of the techniques which may be learned at the above described Center of Forestry Development, and at the Center of Forestry Mechanization (workshop), the survey group recognizes the importance of the plan to establish the 5000 ha pilot reforestation will be done by the Paraguayan Government, as a barometer of reforestation in Itapúa. And believes that there is the necessity to examine the Japanese cooperation with this project.

Illustrating specific parts in the above cooperation project are Chart 2 and Chart 3.

The main facilities are as follows;

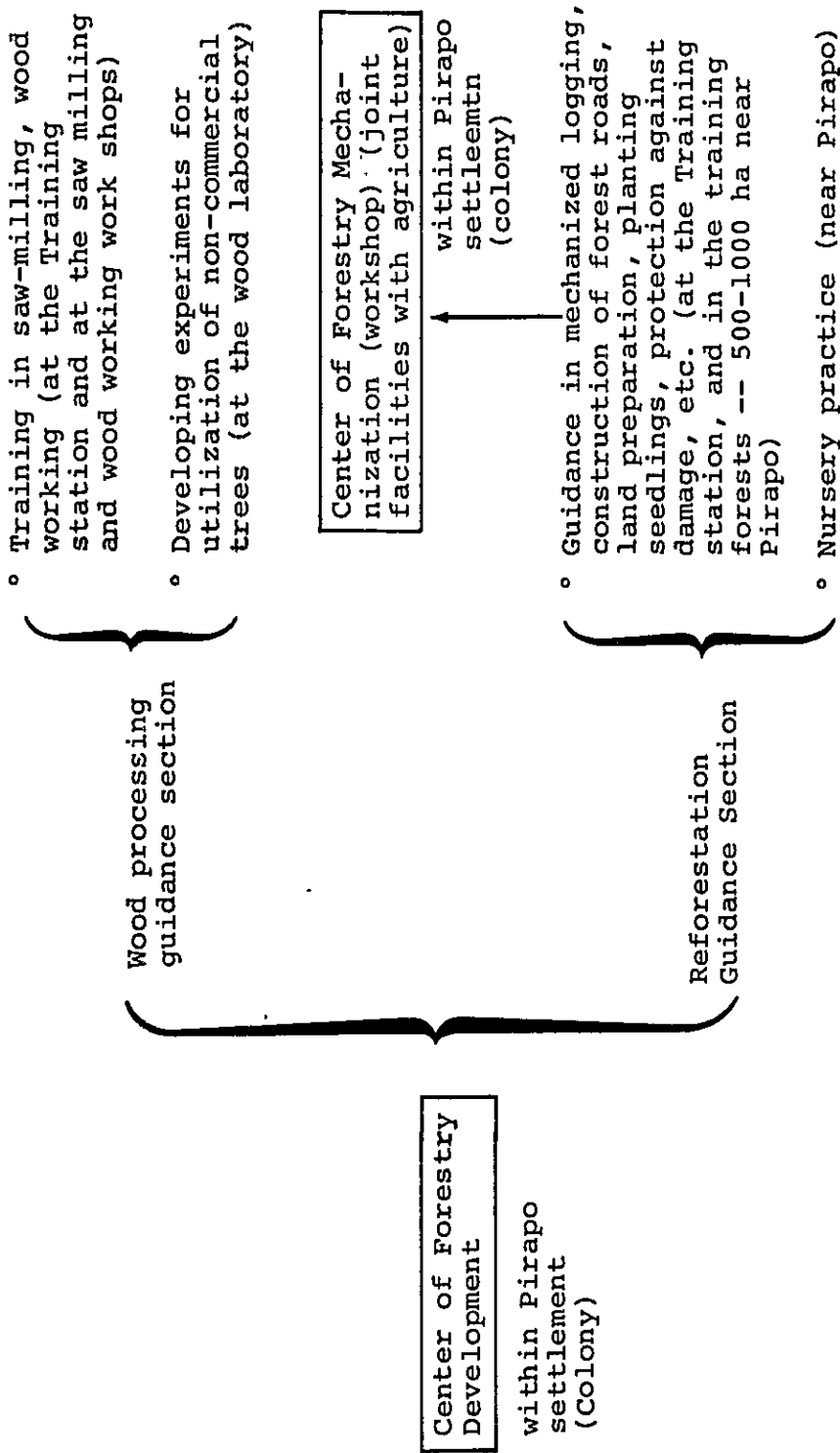
- 1) Center Building (office, training station, other facilities) Pirapo (Grant aid)
- 2) Saw Mill, wood working factory Pirapo (Grant aid)
- 3) Nursery 10-20 ha near Pirapo
- 4) Training Forest 500 - 1000 ha ----- 3 - 5 areas near Pirapo
- 5) Center of Forestry Mechanization ----- consolidated with the Pirapo agriculture machinery center (Grant aid)

Chart 3 Mechanism of Project



Note: The pilot forest is the man-made forest planted by Paraguayan (mainly trainees having completed their training). The Project (center) gives technical support.

Chart 2 System of Project



(2) Schedule for the future

Concerning a project of technical cooperation for the future, with close communication between the Paraguayan and Japanese governments to continuously examine and plan in actual practice, the following tentative schedule is proposed:

- ① The dispatching of one or two long term investigators during the first half of 1978.
- ② The sending to Japan of one or two first or second level trainees from Paraguay for inspection of the Japanese forest industry, aiming for the first half of 1978.
- ③ The dispatching of consulting team to help implement and decide on the plan to actualize Japan's cooperation, in the middle of 1978.
- ④ In mid 1978, to dispatch a designing team to actualize the plans for the necessary facilities to realize the Project.
- ⑤ To facilitate numbers ① - ④ above, Paraguay will begin necessary preparations, and at the same time, in order to actualize the Project, will begin examination of the measures necessary to ensure the lease of the land which will be necessary for the Project, to maintain partnership and for local cost considerations.

(3) Response to the other requests

In addition to the above Technical Cooperation Project, Japanese cooperation is requested by Paraguay for development of the forest industry as described in the related sections are;

- ① Forest inventory in the northeast departments.
- ② Examination for conservation of the watershed of the Itaipu Dam, etc.
- ③ Management of the tropical forest.
- ④ Modernization of the forest industry.
- ⑤ Financial aid for man-made forests and wood processing technical cooperation undertakings.

Regarding the first request, the Paraguayan Government in cooperation from the F.A.O. has received the counsel of experts since 1967 concerning the forest and forest industry of the country. As a result, an inventory of the forest in the northeast Departments which makes up the main forest zone in Paraguay, is under consideration and where the Forest Service has decided for the location of one of its important projects. The intention of this survey is to assist the modernization of the forest industry through the planning of technical development and efficient utilization of resources regarding the management of the forest in this area.

The forest area to be surveyed in the northeast departments includes the remaining large scale forest in the country, and into which, in the future, agricultural development will enter. Therefore the survey should be carried out as soon as possible to determine which areas should be preserved as forest, and which areas should be used by the forest industry, and which for agriculture development. The significance of the classification of land-use is quite large, and it is desired that Japan cooperate in this survey not only for the development of the forest industry, but also with the consideration of proper new settlement (colony) development. This means that the

importance of a land utilization plan is recognized, to conserve, for example, the forest, etc., for water-source conservation and soil conservation in the area where future development will take place. In the areas where agriculture development is advanced, as in Itapúa, etc., the unconcerned burning of the forest has brought inevitable secondary problems. The item is one where the Forest Service of Paraguay expects the most technical cooperation.

Relating to this are requests number 3 and 4. As can be determined by the forest survey, the forest is not just to be left as is, but it is necessary to utilize the precious wood resources properly and efficiently, with the retaining of a sustained yield. It will be necessary to dispatch experts to develop techniques for this. From this point of view, cooperation is thought to be desirable, with as much consideration as possible for requests numbers 3 and 4.

Concerning request #2, for the conservation of the watershed at the Itaipú dam, this is a problem which must be solved immediately, in contrast to the other 3 requests which will build the foundations for the development of the future forest industry.

Although it is difficult to recover already destroyed forest, the question of the watershed will have a great influence on future existence of natural and man-made forest development. It is desirable for Japan to cooperate in responding to this request as much as possible.

Regarding the request #5, financial aid cooperation, this can be divided to two sections according to its contents. One is the request for Japanese grant aid for buildings and facilities of the Center of Forestry Development and of the Center of Forestry Mechanization (workshop).

The other section is the request for allocation of funds through Japanese K/R aid for the expenses involved in the work of the 5000 ha man-made forest and the expenses for managing the wood processing guidance section at the Center of Forestry Development (refer to attached materials).

As already described, even though the laws, and the administrative organization of the Forest Industry are expanding and improving rapidly over the last few years, the actual conditions, the stocks and the total finances of Paraguay are still poor as compared with some developing countries.

In particular, because of the short history of Paraguay's Forest Service, the shortage of public facilities relating to the forest industry (The Forestry Experimental Institute, the training workshops, extension and guidance centers, etc.) and the shortage of funds for man-made forest work are the obstacles to establishing a forestry administration. As the sole facility of its type, there is one forestry school as described near the Japanese settlement (colony) in Alto Parana and this building and facility was completed by Switzerland.

The shortage of funds for man-made forests prevents the Forest Service from carrying out its intended projects and prevents the implementations of the suggestions from the FAO for the management of the natural forests.

According to these actual conditions, it is necessary to examine closely the grant aid necessary for building the Center of Forestry Development, and the Center of Forestry Mechanization (workshop), as well as financial cooperation for the operation and management expenditures for the man-made forest work and center. This aid will not only allow the smooth and efficient realization of

the Technical Cooperation Project, but as the project is to be made within the Japanese settlement (colony) area in Itapúa, it will also bring benefits for the agricultural and forestry development by the settlers.

At the time of this survey group's visit to Paraguay, the Paraguayan Forest Service strongly expressed their desire for the following:

Staff members who will be partners in the technical cooperation project are to be immediately chosen, in order to best achieve cooperation with the Japanese experts.

It is suggested that a number of Paraguayan forest officials, including Paraguayans of Japanese descent, be sent to Japan for lengthy study as soon as possible so that upon initiation of the Project, these officials will have completed useful cooperation as the counter parts.

These requests come from Paraguay's deep zeal for this cooperation project and accepting trainees even before beginning the project would be recognized as a strongly positive response.

III-2. Program contents for the Cooperation Center

(1) Study and training in the Wood Processing Guidance Section.

① Study and training in saw milling techniques

- 1) Knowledge and technology regarding sawing machine and sawing (including saw fitting).
- 2) Technology of band saw and circular saw
- 3) Technology of sawing procedure
- 4) Knowledge of production process, work efficiency, factory management, slashing management

- ② Study and training of kiln drying technology
 - 1) Knowledge of kiln drying equipment, drying velocity, etc.
 - 2) Technology of kiln drying operation
- ③ Study and training of wood working technology
 - 1) Techniques of the cutting process (wood working machinery, sawing process, planing process, shaping process, boring and drilling process)
 - 2) Study and training of the techniques for joining (metal fittings, binding agents, joinery, etc.)
 - 3) Study and training of the techniques of tool finishing (quality of tools, abrasives for tools, grinding etc.)
 - 4) Painting technology
- ④ Study and training in techniques of wood preservation.
 - 1) Knowledge of wood durability
 - 2) Techniques for wood preservation against fungi and insects
- ⑤ Experiments for the utilization of non-commercial trees
 - 1) Fundamental wood quality (physical properties of wood, classification of usage, elimination of defects)
 - 2) Kiln drying experiments (discovery and elimination of any flaws, sorting of wood, tests for drying times.

3) Standard of wood (standard of logs, standard of lumbers)

(2) Facilities for the Wood Processing Guidance Section.

The necessary facilities for the study and training and research described above are shown in Tables 12, 13 and Charts 4, 5. In addition, the amount of electricity necessary, considering simultaneous use, is shown in Table 14.

Table 12 Necessary Facilities for the Saw-Mill

Name of machine	Name of machine
1. 1200 mm log band mill	19. storage - carrier with roller
2. 1000 mm auto-feed carriage	20. stopper
3. 1100 mm band saw machine	21. storage (manpower)
4. 900 mm light duty auto-feed carriage	22. storage (manpower)
5. 1000 mm table band resaw	23. stopper
6. 1000 mm roller band resaw	24. storage (manpower)
7. cross-cut band saw machine	25. Conveyor belt
8. two speed transmission	26. saw-fitting room
9. storage (rail system)	27. sawdust silo
10. storage (manpower)	28. chipper
11. storage (manpower)	29. cutoff saw
12. dead roller	30. chipper silo
13. dead roller	31. saw dust exhaust equipment (including silo)
14. stopper	32. band saw sharpener
15. stopper	1200 mm exclusive
16. chain live deck	1100 mm exclusive
17. log turner	1000 mm exclusive
18. stopper	three machines
	33. band saw roll stretcher
	34. other, saw fitting equipment (swage, swage base, gas welder, etc.)

- o Machinery for Transportation Use:
 - ① Forklift log use 1
 - ② Forklift products use 1
 - ③ Hand carriage 3-4
- o Products warehouse: scale depends on secondary processing and marketing.
- o Log yard: In a usual facility, it is necessary to have an area nearly three times the total building area, however, for the training factory, 2 times the area may be considered sufficient.
- o Facilities for sawmilling training to deal logs of approximately 110 cm in diameter.

Optimum trainees to operate - 15-20 persons

Production amount per day - 20-30 m³, 8 hours actual work (amount of wood consumption)

Necessary power: 14-150 kW

Dividing by category

Sawing machinery 100-110 kW

Exhaust equipment (11-12) × 2 kW

Saw fitting, other 4-5 kW

Automatic conveying equipment 15 kW

Chart 4 Lay-out of Saw-Mill (example)
Numbers correspond to Table 12

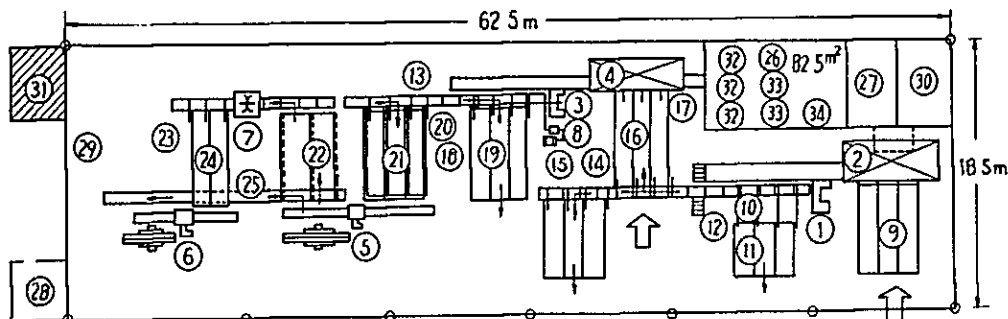
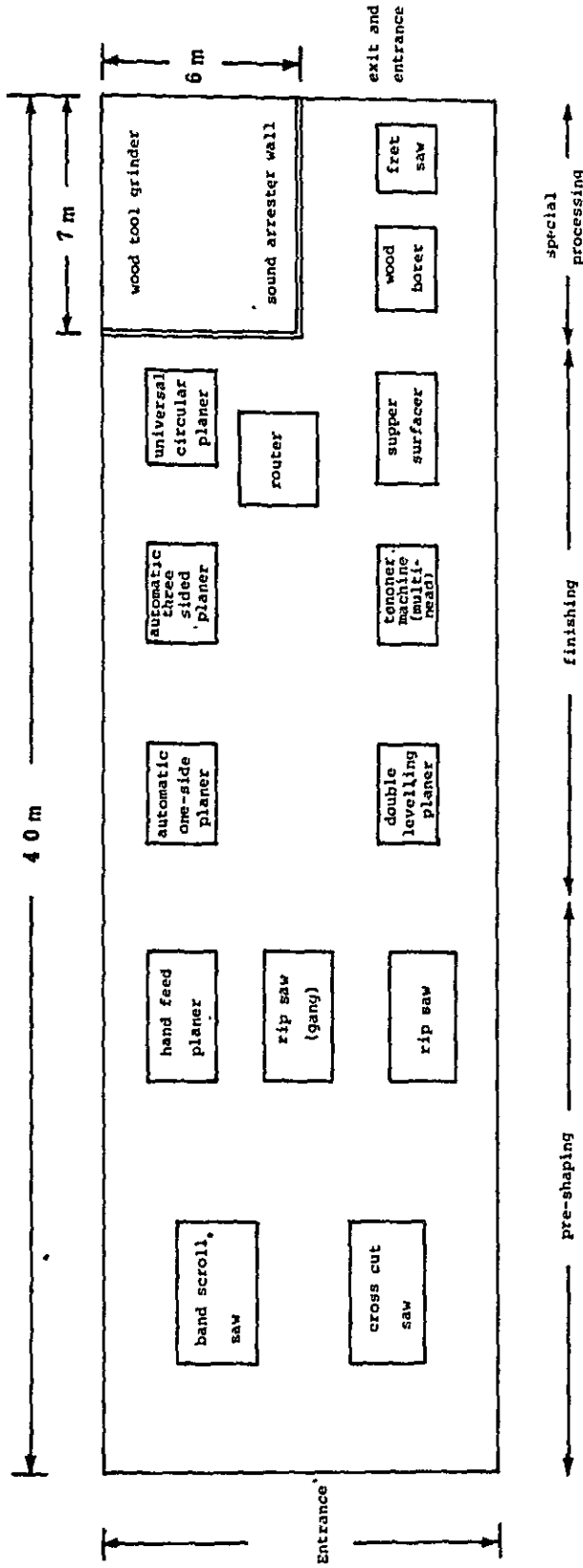


Table 14 Necessary Amount of Electricity

	Amount of electricity kW
for Saw-mill	140 ~ 150
for Wood working factory	51 ~ 108
for Disposal of scrap wood	10 ~ 20
for kiln drying, preservation, mold prevention	30 ~ 40
for wood laboratory	30 ~ 40
for other, administration office, recreation room	10
Small diesel generator 1	350 ~ 500

(Lay-out of Wood working factory)



Wood working area 480 m²

Wood working machines 16

Consumption of electricity excluding the gang rip saw and the double-headed tenoner (multi)

(simultaneous operation) all types of machines including the double-headed tenoner

51.5 kW, 69.1 kW, 108.1 kW (excluding wood tool grinding room)

Table 13 Facilities Necessary for wood working Factory

Name of machine	Maximum size of material for use mm	Electric motor power kW	Dimensions of table mm
① Automatic one side planer	600 × 500	5.5	1150
② Double levelling planer			
③ Rip saw	60	Saw axis use 5.5 feeding 1.5	
④ gang rip saw	1220 × 140 (27 sheets)	3.7 × 2.2	3050 × 2270
⑤ Cross cut saw		1.5	1000 × 2000
⑥ automatic three-side planing and moulding machine	450 × (200)	3.7 feeding 2.2 3.7 2	550 × 1945 (2090 1250)
⑦ Universal circular planer			1000 × 1000
⑧ Double ended tenoner	1950 (Length) 75	2.2 × 8	(3700 × 2650)
⑨ Tenoner machine (multi-headed)	305 × 75 (Material)	2.2	(1425 × 1345)
⑩ Hand feed planer	400	2.2	2300 × 960
⑪ Supper surfacer	610 × 150	3.7	660 × 1200 (1300 1355)
⑫ Wood turning lathe		1.0	1000 × 1500
⑬ Wood borer		0.75	600 × 600
⑭ Router		3.75	1000 × 1000
⑮ Band scroll saw		2.2	(1700 × 850)
⑯ Fret saw			
⑰ Wood tool grinder			
Knife grinder (for 600 mm)			
Automatic cutter sharpener			
Drill sharpener (profiling machine)			

Facilities necessary for wood laboratory lecture room

Administrative	{	Lecture room
		Office
		Testing room for wood properties (I)
		Testing room for wood properties (II)
		Guest room
		Dormitory
		Other

In the above mentioned testing room for wood properties (I), the following equipment is to be installed.

- Small size wood kiln drying equipment (for experimental use)

Wood accommodation capacity

$$1.3\text{m} \times 1.4\text{m} \times 4.8\text{m} = 8.74 \text{ m}^3$$

$$\text{actual kiln drying capacity} = 8.74 \text{ m}^3 \times 1/2 = 4.4 \text{ m}^3$$

electricity for use 2.5 kW

steam power for use 60 kg/ha

weight: 1100 kg size: 1.3 m(width) × 1.4 m(height)
× 48 m(depth)

- Stereo microscope 1
- Microscope 1
- Projector 1
- Scales 120G 1
1 kg 1
- Apparatus for measuring length 1
- Universal mechanical testing machine (Olsen-type) 10 ton
- In addition to the above, equipment for wood preservation, prevention of mold

(3) Study and training at the Reforestation Guidance Section

① Study and training of nursery techniques

- 1) Knowledge and technology concerning selection of a superior mother tree
- 2) Technology concerning the development of seed orchard (establishment of a seed orchard)
- 3) Technology to stimulate fruiting
- 4) Technology for the maintenance and management of seeds
- 5) Technology of the seeding and nursery practice. (Establishment of the nursery)
- 6) Improvement of soil, Technology concerning fertilization
- 7) Technology concerning nursery machinery
- 8) Technology for disease prevention and prevention of insect damage

② Study and training for planting techniques

- 1) Mechanization techniques, such as land preparation, planting, weeding, etc. (establishment of training forest)
- 2) Knowledge and technology for soil survey
- 3) Knowledge concerning progeny tests (establishment of stand for progeny test)

③ The study and training of tending techniques

- 1) Knowledge of thinning, density management
- 2) Mechanization techniques for thinning

(4) Facilities for the Reforestation Guidance Section

The main facilities necessary such as for study and training, for the seed orchard, nursery and training forest as described above are as follows;

- o One set of seed storage facilities
- o Watering facilities
- o Nursery office (pre-fab)
- o Compost storage
- o Small tractor (wheel type)
- o Small truck
- o Large tractor for land preparation (crawler type) with attachments
- o Same (wheel type)
- o Trailer truck for logging use
- o Log loader for logging use
- o Chain saw
- o Bush cleaner
- o Silviculture work vehicle (truck)
- o Land Rover
- o Microbus
- o Tree-feller (small size, thinnings)
- o One set communications machine
- o One set soil analysis machine
- o Stationery machine
- o Audio-visual aids

(5) Function and Facilities for the Center of Forestry Mechanization

Considering the condition of the forest and the geographical features, and the labor supply, mechanization is the most rational direction for work such as logging, transportation of wood, afforestation etc., and would eliminate the need to depend on manpower or livestock power. However, with mechanization must be developed as a matter of course facilities for the systematic maintenance and repair of the agricultural and forestry machinery. As facilities are presently inadequate, a Center of Forestry

Mechanization (workshop) must be established to maintain and repair the forestry machinery and also to improve and disseminate the knowledge for the training of repair technicians. The center will function not only to allow the smooth operation of the forestry machinery to be used in the cooperative Project, but will also promote the mechanization of the future forestry in the country.

- ① Study of the factors of the machinery
- ② Study of the electric system
- ③ Study of the oil pressure apparatus
- ④ Study for the dismantling and assembly of the machinery
- ⑤ Study and practice in use of work shop machinery
- ⑥ Study for general maintenance and inspection

The facilities estimated to be necessary for this mechanization center include the following:

- ① Buildings
 - 1) Workshop 420 m²
 - 2) Office 70 m²
 - 3) Dormitory 210 m²
 - 4) Warehouse for parts 35 m²
 - 5) Warehouse for machinery 35 m²
 - 6) Oil storehouse 16 m²
 - 7) Generator room 12 m²
 - 8) Water pump room 12 m²
 - 9) Garage 280 m²
 - 10) Unloading facility

② Workshop, repair tools

- 1) Precision engine lathe
(length between centers 670 cm)
- 2) Upright drilling machine
(drill diameter 40 mm)
- 3) Electric welding set
- 4) Gas welding set
- 5) Grinder (205 mm diameter)
- 6) Disk sander (150 mm diameter)
- 7) Chain block (5 ton use, elevation 5 m)
- 8) Garage jack (5 ton use, elevation 560 mm)
- 9) Oil jack (15 ton use, elevation 165 mm)
- 10) Steam cleaner (output capacity 400 l/h)
- 11) Air compressor (tank capacity 65 l)
- 12) Electric drill
- 13) Air impact trench
- 14) Engine driven AC generator (37 kW)
- 15) Silicon battery charger (200 V)
- 16) Battery tester
- 17) Electro tester
- 18) Nozzle tester
- 19) Wash bench for parts

③ Tools

- 1) Tools for measuring (gauge, vernoer caliper, micrometer caliper, etc.)
- 2) Tools for dismantling and assembly (spanner, wrench, screwdrivers, hammer, etc.)

3) Tools for processing (metal jack, files, tap, dyes, etc.)

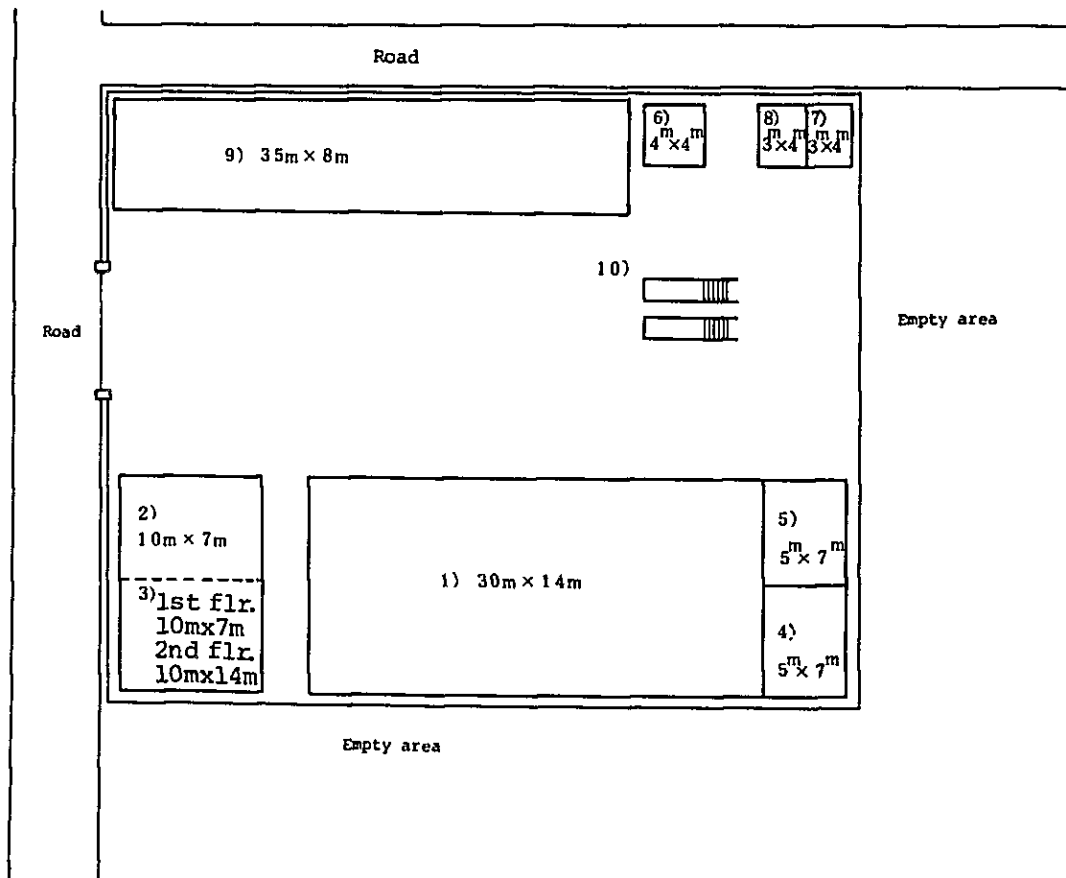
④ Vehicles

1) Service car (working vehicle)

Chart 6 shows an example for the building layout for the proposed Center of Forestry Mechanization

Chart 6 Layout for Center of Forestry Mechanization (example)

Numbers correspond to building numbers found in the report.



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