(2) Sawing and Plywood Industries

A total of 384 sawmills and plywood plants were registered with the SFN in 1999 (Table 4-20). However the actual number is believed to be more than 600 as many small, unregistered plants were also in operation. While the number of sawmills was 16 in the Caaguazu District where the sawing industry is most active, the actual number of sawmills in operation is inferred to be approximately 130.

Table 4-20 Number of Sawmills by District

District	Number of Sawmills
Concepción	44
San Pedro	42
Cordillera	0
Guairá	12
Caaguazú	16
Caazapá	31
Itapúa	94
Misiones	0
Paraguarí	1
Alto Paraná	64
Central	14
Ñeembucú	0
Amambay	36
Canindeyú	30
Total	384

Note : These sawmills include plywood plants.
Source : Registered Sawmills at the SFN (1999)

The sawmill size is generally small and few sawmills have drying facilities. In addition to producing a small quantity of final products for local consumption, many sawmills near cutting sites also produce half-processed products for truss, beam, board and flooring for sale to sawmills, wood working shops and furniture factories in such final consumption areas as Asuncion, Caaguazu and Ciudad del Este. Final products, including various construction timber, wooden window frames and furniture, are sold domestically or are exported. The drying of wood still predominantly relies on natural drying. Most export products are also naturally dried as only some facilities exporting their final products have an artificial drying system.

There are more than 10 sawmills handling logs produced from artificial forests in the Alto Parana and Itapua Districts where relatively many afforestation sites of pine are located. Most of these are small and saw timber to meet the local demand. One sawmill which was recently opened in the Alto Parana District and which specialises in pine is outstanding as it has modern equipment, including an artificial drying system, producing glued laminated timber using the finger joint technique. This sawmill also produces such final products as flooring, beading and door frames, etc. and 99% of its products are exported to the US (EEUU). There is one sawmill specialising in paraiso but there is no sawmill specialising in eucalyptus although several sawmills are interested in sawing eucalyptus.

Compared to sawmills, many veneer and plywood plants are larger and have relatively new equipment. Those located near cutting sites produce veneer for sale to plywood factories in urban areas. Most factories in urban areas are, in fact, plywood factories which process purchased veneer into plywood. There is a total of 27 veneer and plywood factories in Paraguay, most of which specialise in wood from natural forests. While seven factories also handle planted trees, no factory specialises in this type of tree (Table 4-21).

Table 4-21 Number of Plywood Factories

District	Eucalyptus	Pine	Eucalyptus and Pine	Eucalyptus and Paraiso	Indigenous Species	Total
Concepción	1	0	0	0	0	1
San Pedro	0	0	0	0	5	5
Guairá	1	0	0	0	0	1
Caaguazú	0	0	1	0	4	5
Itapúa	0	1	0	0	1	2
Alto Paraná	1	0	1	0	5	7
Central	0	0	0	1	1	2
Amambay	0	0	0	0	1	1
Canindeyú	0	0	0	0	3	3
Total	3	1	2	1	20	27

Source: SFN survey

While the most common product is 4 mm plywood (3 ply), 6 – 24 mm plywood (5 ply) is also produced. The species used to make plywood include cedro, guatambu, kupay, yvyra ro, laurel guaika, laurel hu, yvyra ju and ambay guasu, etc. from natural forests. The most popular species is guatambu. Cedro can be sold at a high price but its production volume

is small. Eucalyptus (mainly E. grandis), pine (P. taeda and P. elliottii) and paraiso (Melia azedarach var gigantea) come from artificial forests and the production volume is also small because of the small supply volume. Paraiso is highly reputed for plywood for furniture. It is also sliced for use as veneer for furniture even though the actual production volume is very small.

Furniture factories are mainly concentrated in the Caaguazu District. Most items are small for the domestic market and their prices are low to meet the public demand. Some furniture factories are located in Asuncion and its suburbs because of the presence of a large consumer population in the area and in Ciudad del Este on the Brazilian border. The furniture produced in Paraguay uses naturally dried wood and is almost exclusively sold in the domestic market. Only one factory exports complete furniture to neighbouring Argentina alone.

There is no factory producing particleboard and fiberboard, etc. in Paraguay. There is also no pulp/paper-making plant because of the low level of domestic consumption and few afforestation sites of pine and eucalyptus which provide the raw materials. It is, however, currently planned to build a pulp plant with foreign capital in the Itapua District to the south and construction work is scheduled to commence in 2002. Accordingly to this plan, the plant will be a BCTMP (mechanical system) without the use of chemicals. Eucalyptus (E. grandis) will be the only raw material. As this plant will require 600,000 tons of wood or an annual cutting area of 2,500 ha, it is expected to contribute to the promotion of afforestation in the district.

(3) Wood Supply and Demand

1) Supply

Forests in the Eastern Region of Paraguay are decreasing in accordance with the ongoing process of agricultural and stock raising development. As the area of development moves northwards, the timber production areas are also moving northwards. According to 1999 data compiled the Guia (Government Ordinance No.2840: Permit for Timber Transportation), more than 99% of the timber produced in Paraguay is produced in the Study Area, particularly in areas north of National Route 7 (Table 4-22, the figures of which differ from those in Table 4-23). By district, approximately one-third is produced in the San Pedro District, followed by the Canindeyu District (16.8%) and the Concepcion District (16.1%). These three northern districts account for approximately two-thirds of the timber production in Paraguay.

According to data compiled by the Central Bank of Paraguay, the cut volume of trees in Paraguay has increased by some 22% in the last 10 years (Table 4-23 and Fig. 4-7). The total production volume of wood in 2000 was 6,937,000 tons, consisting of 2,675,000 tons of log wood (39%), 3,828,000 tons of fuelwood (55%) and 434,000 tons of electric poles and others (6%), indicating the main use of wood as fuelwood. The relative ratios of log wood and fuelwood have remained almost unchanged in the last 10 years.

More than 70 species are cut in natural forests. However, only three species, i.e. guatambu (15.4%) kurupa'y (11.8%) and yvyra pyta (10.3%), have a share of more than 10%. An additional nine species have a share of more than 2%, i.e. lapacho (7.7%), cedro (5.7%), yvyra ro (5.4%), kurupa'y ra (5.2%), incienso (3.4%), kupay (3.1%), yvyra pere (2.8%), timbo (2.7%) and urundey para (2.1%) (Table 4-24).

Table 4-22 Cutting Volume by District

District	Cut Volume (m^3)	%
Concepción	117,956	16.1
San Pedro	214,713	29.4
Cordillera	343	0.0
Caaguazú	45,916	6.3
Caazapa	48,256	6.6
Itapúa	48,911	6.7
Alto Paraná	91,746	12.6
Amambay	37,217	5.1
Canindeyú	122,701	16.8
Chaco	3,028	0.4
Total	730,787	100.0

Source: SFN, "Permitted Distribution of Forest Products (1999)"

Table 4-23 Cutting Volume of Forests

(m^3)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000(*)
Logs											
Industrial	1,916,114	2,016,196	2,025,392	2,081,972	2,149,576	2,218,362	2,168,456	2,216,162	2,176,271	2,198,034	2,296,945
Agriculture and Stock Raising	296,289	300,437	304,343	313,778	322,250	330,950	340,819	349,783	358,982	368,315	377,892
Tannin Production	31,007	22,285	19,285	29,469	18,850	14,130	0	0	0	0	0
Sub-Total	2,243,410	2,338,918	2,349,020	2,425,219	2,490,676	2,563,442	2,509,275	2,565,945	2,535,253	2,566,349	2,674,837
Electric Poles	341,544	346,326	350,828	361,704	371,470	381,500	391,646	401,946	412,517	423,243	434,247
Railway Sleepers	5,393	12	1,524	1,092	0	3,417	2,951	0	0	0	0
Fuelwood											
Domestic	1,324,949	1,343,498	1,360,963	1,403,153	1,441,038	1,479,946	1,519,466	1,559,428	1,600,441	1,642,052	1,684,746
Industrial	1,656,571	1,666,510	1,673,176	1,706,640	1,732,240	1,755,546	1,721,182	1,717,740	1,734,917	1,717,567	1,734,743
Charcoal	120,115	190,623	324,250	324,899	384,031	385,759	389,698	394,374	387,276	391,148	408,750
Sub-Total	3,101,635	3,200,631	3,358,389	3,434,692	3,557,309	3,621,251	3,630,346	3,671,542	3,722,634	3,750,767	3,828,239
Total	5,691,982	5,885,887	6,059,761	6,222,707	6,419,455	6,569,610	6,534,218	6,639,433	6,670,404	6,740,359	6,937,323

Note : The figures for 2000 are provisional.
Source : National Account Statistics No.37 (Central Bank of Paraguay)

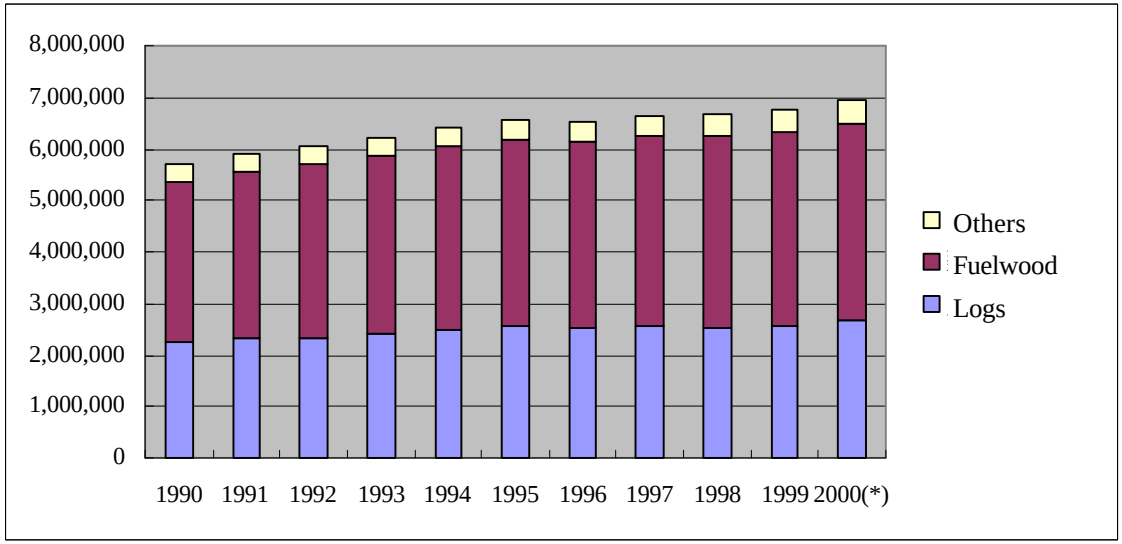


Fig. 4-7 Cutting Volume of Forests

Table 4-24 Cutting Volume by Species

Species	Volume (m^3)	%
Yvyra pyta	74,920	10.3
Yvyra ro	39,610	5.4
Lapacho	56,143	7.7
Timbo	19,695	2.7
Guatambu	112,819	15.4
Kurupa'y	86,504	11.8
Cedro	42,001	5.7
Peterevy	9,621	1.3
Incienso	24,845	3.4
Yvyra pere	20,317	2.8
Cancharana	7,633	1.0
Kurupa'y ra	37,996	5.2
Laurel guaika	8,502	1.2
Kupay	22,883	3.1
Guajayvy	9,161	1.3
Urunde'y para	14,984	2.1
Peroba	13,174	1.8
Laurel	11,688	1.6
Yvyra ju	12,823	1.8
Kurunai	13,324	1.8
Amba'y guazu	7,671	1.0
Others	84,473	11.6
Total	730,787	100.0

Source: SFN, "Permitted Distribution of Forest Products (1999)"

The cutting volume of artificial forests is around 30,000 m^3/year. By species, pine is the largest category, accounting for 74%, followed by paraiso with 16%, eucalyptus with 7% and parana pine with 3% based on statistical data for two and a half years (Table 4-25).

Table 4-25 Cutting Volume of Planted Trees

(Unit: m^3)

Species	1999	2000	2001	Total
Pine	29,627	19,958	11,790	61,375
Eucalyptus	750	310	4,500	5,560
Paraiso	3,487	10,250	140	13,877
Parana pine	750	150	1,615	2,515
Total	34,614	30,668	18,045	83,327

Note : The figures for 2001 are up to August.
Source : SNF

Most of the fuelwood marketed for commercial use comes from trees which have been cut to create new farm land. Parts of the limbs and tops produced at the time of log production are used as firewood by nearby farming households but are mostly burnt.

Based on the information given above, the figures in Table 4-23 are considered to represent the timber supply volume in Paraguay. At present, more than 90% of the timber produced in Paraguay comes from natural forests but it is anticipated that such production will experience a sharp decline in the future because of the decrease of the natural forest area due to the progressive conversion to farm land and the declining quality of the timber resources at the remaining forests. This situation definitely indicates the urgent need for the creation of artificial forests to ensure the continual domestic supply of timber in a sufficient quantity.

2) Demand

Paraguay imports wood products mainly from Argentina and Brazil, etc. As the wood import volume is less than 1% of the production volume of wood products (see Table 4-29), the total domestic demand for wood in Paraguay is considered here to be equivalent to the cutting volume at 6,937,323 tons.

While there are no statistics on the domestic consumption volume of wood products, it is estimated to be approximately 25% of the export volume. In addition, the volume of unregistered exports is said to be equivalent to 35% of the official export volume (opinion of the FEPAMA). As the export volume of wood products through customs in 2000 is said to have been 333,912 tons (Table 4-26), it can be estimated that the domestic consumption volume and the total export volume were 83,478 tons (16%) and 450,781 tons (84%) respectively, totalling 534,259 tons of wood production in the year in question.

Table 4-26 Export Volume and Export Value by Product (2000)

Product	Weight (tons)	%	Value (US$)	%
Second-Hand Corrugated Cardboard	2,100	0.6	34,000	0.0
Charcoal	34,839	10.4	1,913,455	2.4
Electric Poles	1,880	0.6	151,986	0.2
Piles	1,095	0.3	156,242	0.2
Railway Sleepers	10,775	3.2	1,119,767	1.4
Sawn Timber	149,718	44.8	18,570,759	23.5
Veneer Board	20,452	6.1	6,506,992	8.2
Parquet	73,292	21.9	30,994,428	39.2
Particleboard	12	0.0	3,011	0.0
Plywood	20,781	6.2	10,190,525	12.9
Wooden Boxes	2,888	0.9	335,479	0.4
Tool Handles	432	0.1	211,244	0.3
Wooden Products and Parts	15,001	4.5	8,137,073	10.3
Kitchen Furniture	13	0.0	5,685	0.0
Parquetry	2	0.0	744	0.0
Assembly Furniture	626	0.2	636,396	0.8
Furniture and Components	6	0.0	5,288	0.0
Total	333,912	100.0	78,973,072	100.0

Source: FEPAMA (based on customs clearance data at various ports)

The volume of industrial logs produced in 2000 was 367,511 tons (16%) for domestic consumption and 1,929,434 tons (84%) for export. Most of these logs served the sawing and other industries. Only a small volume (16%) was used for the production of agricultural materials. The export volume of charcoal in 2000 stood at 34,839 tons. As this volume of charcoal can be translated to 191,423 tons of firewood (one ton of firewood produces 182 kg of charcoal according to data by Acepar), the domestic consumption volume of firewood is calculated to be 1,684,746 tons for household consumption, 1,734,743 tons for industrial consumption and 217,327 tons for the production of charcoal. The breakdown of the wood demand in Paraguay is shown in Table 4-27.

Table 4-27 Wood Demand in 2000

(Unit: m^3)

	Domestic Demand	Export Demand	Total
Logs			
- Industrial	368,000	1,929,000	2,297,000
- Agriculture and Stock Raising	378,000	0	378,000
Sub-Total	746,000	1,929,000	2,675,000
Electric Poles	434,000	0	434,000
Firewood			
- Household	1,685,000	0	1,685,000
- Industrial	1,735,000	0	1,735,000
- Charcoal	217,000	191,000	408,000
Sub-Total	3,637,000	191,000	3,828,000
Total	4,817,000	2,120,000	6,937,000

In Paraguay which does not have any fossil fuel resources, the demand for fuelwood by the manufacturing sector will not sharply decline for some time because of the high cost of other energy sources. The use of eucalyptus and other artificially planted trees to meet the demand for fuelwood to replace natural trees should prove highly effective not only for the conservation of natural forests but also to shorten the transportation distance and to ensure a steady supply of fuelwood.

(4) Distribution and Markets

1) Distribution

With the progress of forest development, the main cutting sites are moving to the northeastern districts of San Pedro, Canindeyu and Concepcion, etc. which are far from the main consumption areas. Cut wood is mainly sawn locally or in nearby areas. Some is sold to local consumers in the form of such final products as flooring. Most logs are sawn to produce thick timber and are transported to sawmills in such areas as Caaguazu and Corenel Oviedo (furniture production areas), Asuncion (largest wood consumption area) and Ciudad del Este and Encarnacion (export bases for wood products) for processing to produce final products for consumers. The main means of transportation is trucks capable of carrying 30 tons. The distribution of wood, including logs, is mainly in the hands of sawmills and there are no specialist distributors. The main markets for wood products are Asuncion and its neighbouring cities, Ciudad del Este, Encarnacion and Corenel Oviedo. Caaguazu along National Route 7 is the centre for furniture production and sale. The final products are either directly sold by sawmills and furniture factories or via many retailers operating in cities. Fig. 4-8 shows the main production areas of logs and the distribution flow of logs and sawn timber.

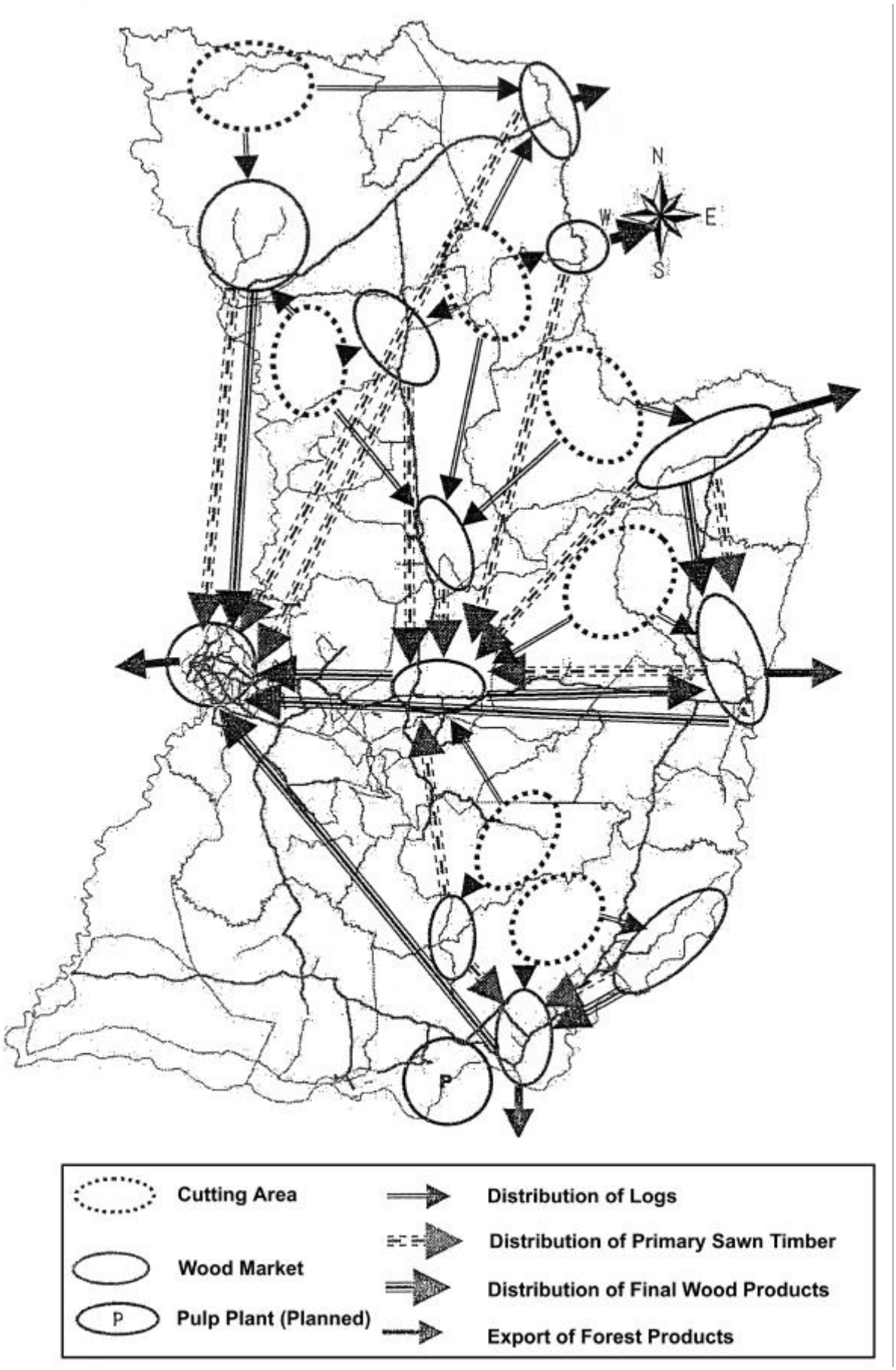


Fig. 4-8 Wood Distribution

The production areas of firewood and charcoal are those where farm land are actively created. Most firewood and charcoal are produced in the San Predro District and the Caaguazu District. The charcoal produced is purchased by middlemen travelling by truck and is then sold to such consumers as brick factories, ironworks and sugar factories as well as charcoal wholesalers in Asuncion and its neighbouring areas. The charcoal is repackaged in 1 kg – 3 kg bags by wholesalers and is sold to consumers via retailers. The charcoal consumed at grain silos which are scattered throughout agricultural areas and in local cities is supplied by neighbouring areas.

Wood products are exported from seven places. Export from Asuncion and Villeta is entirely by ship while export from other places is by truck. The export volume, value and countries of destination are shown in Table 4-28. Asuncion, the capital, tops the table in terms of both the export volume and value at 33.2% and 40.2% respectively.

Table 4-28 Export Volume by Export Base (2000)

City	Volume (tons)	%	Value (US$)	%	Main Destinations
Asuncion	111,137	33.2	31,938,075	40.2	Europe; Asia; USA
Ciudad del Este	110,165	32.9	21,885,356	27.6	Brazil; Uruguay; USA
Encarnacion	13,356	4.0	5,054,666	6.4	Argentina; Chile
Falcon	55,944	16.7	15,567,220	19.6	Argentina
P.J. Caballero	30,902	9.2	3,761,834	4.7	Brazil
Salto del Guaira	12,381	3.7	582,962	0.7	Brazil
Villeta	1,368	0.4	588,649	0.7	Europe; Asia; USA
Total	335,253	100.0	79,378,762	100.0	

Source: FEPAMA (based on customs clearance documents for each city)

2) Domestic Markets

Fig. 4-9 shows areas with at least five sawmills. The main local markets at present are located near Concepcion, P.J. Caballero and Capitan Bado in the Amambay District, Santa Rosa in the San Pedro District, Katuete in the Canindeyu District, Minga Pora and Naranjal in the Alto Parana District, Yuty in the Caazapa District and the area from Edelira to San Rafael in the Itapua District. As these markets follow the movement of the tree cutting sites, they are commonly found near cutting sites.

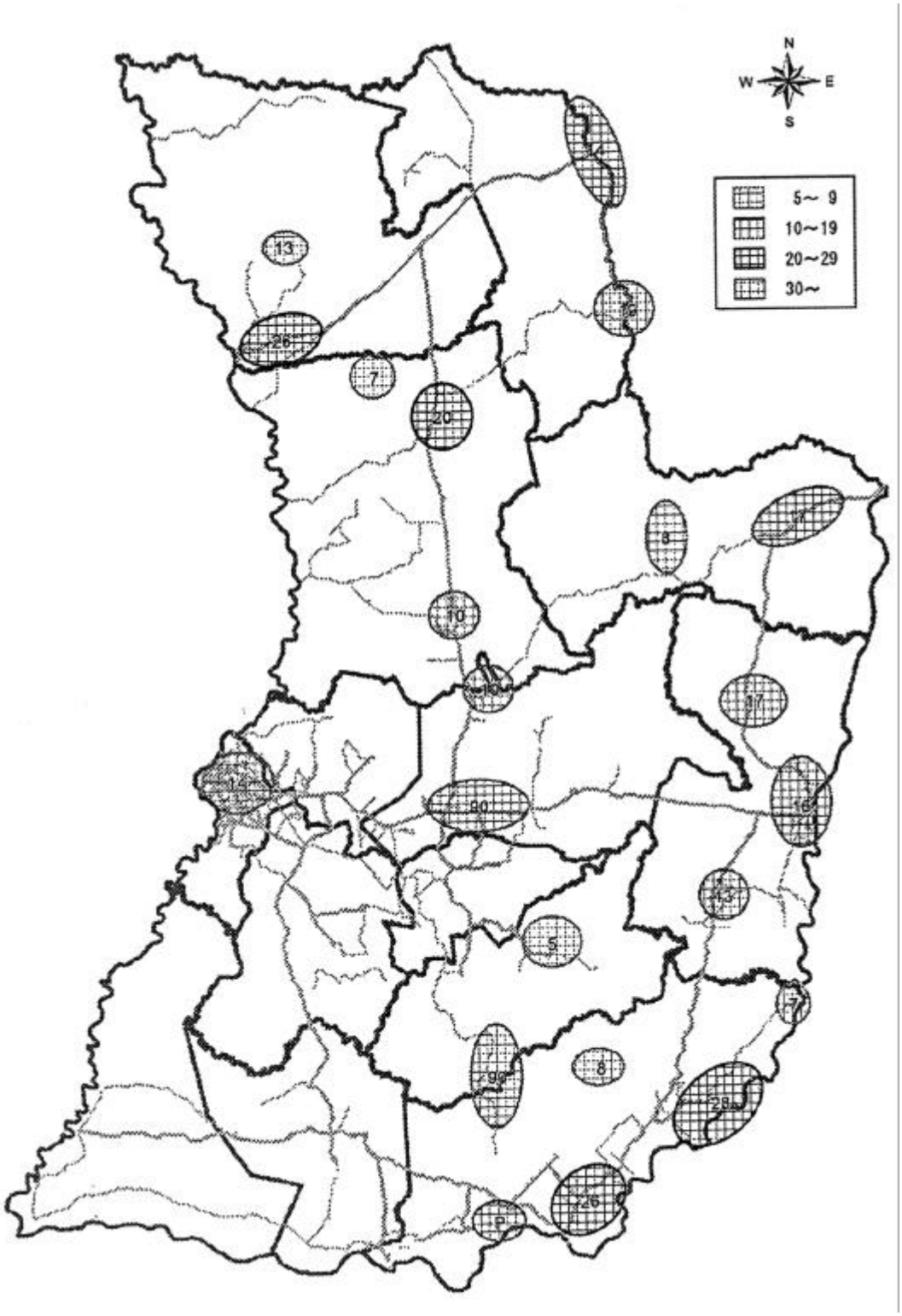


Fig. 4-9 Timber Markets (Number of Sawmills)

The production areas of such secondary products as furniture, window frames, doors and plywood, etc. have developed in those areas which are relatively near the final consumption places and which have good transport access. The main areas are the area from Corenel Oviedo to Caaguazu, near Encarnacion and the area from Ciudad del Este to Minga Guazu. Caaguazu is the largest furniture production base in Paraguay. As most domestically produced furniture is made in Caaguazu, there are many small-scale sawmills to support the furniture industry in the city.

The capital area around Asuncion forms the largest consumption area in the country and many furniture factories and woodworking shops producing final products are located in this area. There are more than 10 sawmills in the area which purchase primary products for processing to make final products for consumption.

The largest consumption sites of industrial charcoal are Tabati where many brick factories are concentrated and Asuncion, Guarambare and Ypane in the capital area where sugar, beer and other factories are located. A large proportion of industrial charcoal is consumed in these areas. The grain silos scattered throughout agricultural areas create a large demand for firewood. Given the situation in agricultural areas in Brazil, it appears that the use of firewood will continue in the future and will not be replaced by other energy sources. Firewood for home consumption is large consumed in rural areas.

Charcoal is also used for heating and cooking in urban areas and the capital area comprises the largest consumption area. An ironworks in a suburb of Asuncion consumes a large amount of charcoal and its annual charcoal consumption volume is equivalent to some 600,000 tons of wood. While charcoal is mainly produced in-house, the amount of charcoal externally purchased accounts for more than half of the domestic consumption volume of charcoal in Paraguay.

Even though the level of personal fuelwood consumption in urban and rural areas is low, the total consumption volume nationwide is quite large. The government statistics do not appear to be exhaustive. Table 4-29 and Table 4-30 show the import situation of wood products. The total volume is not large and almost exclusively consists of particleboard and fiberboard which are not produced in Paraguay. Neighbouring Argentina and Brazil are the predominant exporting countries of wood products to Paraguay. According to the interview survey results, imports of pine products from Argentina and Brazil are rapidly increasing. This can be attributed to imports by the factory specialising in pine mentioned earlier. In view of the fact that

there are not many pine afforestation sites which have reached the cutting age in Paraguay, the import volume of pine is expected to continually increase in the coming years.

Table 4-29 Import Volume by Product (2000)

Product	Volume (tons)	Pine	%	Value (US$)	Pine	%
Particleboard	1,094		30.2	430,956		21.4
Fiberboard	1,071		29.5	507,856		25.2
Sawn Timber	570	50	15.7	175,911	21,018	8.7
Thin, Short Board	241		6.6	68,792		3.4
Assembly Furniture	193	67	5.3	402,609	15,646	20.0
Wooden Boxes	132		3.6	65,180		3.2
Veneer Board	114	11	3.1	61,660	29,597	3.1
Woodworking Components	86	1	2.4	178,264	768	8.8
Electric Poles	25		0.7	5,089		0.3
Parquet	14		0.4	44,011		2.2
Others	86		2.4	76,145		3.8
Total	3,626	129	100.0	2,016,473	67,029	100.0

Source: FEPAMA (based on customs clearance data at various ports)

Table 4-30 Import Volume by Country (2000)

Exporting Country	Volume (tons)	Pine	%	Value (US$)	Pine	%
Argentina	1,872	56	51.6	872,537	15,571	43.3
Brazil	1,608	61	44.3	887,793	21,861	44.0
Bolivia	76		2.1	30,940		1.5
China	37		1.0	67,951		3.4
USA	21	11	0.6	124,682	29,597	6.2
Italy	6		0.2	1,160		0.1
Chile	2		0.1	10,553		0.5
Germany	1		0.0	4,295		0.2
Hong Kong	1		0.0	589		0.0
Mexico	1		0.0	1,370		0.1
Others	1		0.0	14,603		0.7
Total	3,626	128	100.0	2,016,473	67,029	100.0

Source: FEPAMA (based on customs clearance data at various ports)

3) Foreign Markets

The export value of wood products generally ranks third after oil seeds, such as soybeans and cotton. As such, wood products comprise an important export industry in Paraguay. The export value steadily increased up to 1996 and has since levelled despite minor fluctuations (Table 4-31).

Table 4-31 Export Value of Main Products (FOB)

(Unit: US$ 1,000)

Product	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000(*)
Oil Seeds	272,720	161,632	139,202	210,297	225,359	177,913	344,629	520,138	463,703	327,487	303,582
Cotton	332,906	318,911	209,415	160,058	165,108	268,115	170,615	88,294	83,740	62,896	84,175
Vegetable Oil	13,215	24,380	42,105	34,287	60,505	63,939	64,699	62,911	72,399	50,308	42,963
Oil Draff	20,490	31,467	54,438	29,942	95,500	41,015	54,201	113,992	72,145	57,633	82,319
Sawn Timber and Wood Products	37,746	44,348	53,242	62,648	77,703	89,482	86,399	80,776	75,305	86,979	78,973
Processed Meat and Frozen Meat	133,709	55,205	47,496	45,897	48,120	54,855	42,853	40,714	57,478	29,289	60,182

Notes 1) The figures for 2000 are provisional.
2) The figures for "sawn timber and wood products" for 1997 through 2000 are based on FEPAMA data.
Source : National Account Statistics No.37 (Central Bank of Paraguay)

Among the exported wood products (Table 4-26), sawn timber, an intermediate product, has the largest share in terms of volume with 45%, followed by parquet (22%), charcoal (10%), plywood (6%), veneer board (6%), woodworking products (5%) and sleepers (3%). Furniture (assembly furniture and furniture components) with the highest added value accounts for only 0.2% (632 tons). By export value, parquet with high added value has the largest share with 39%, followed by sawn timber (24%). The total value of exported furniture is only US$ 640,000 (0.8%). One major task for the forest products industry in Paraguay is to increase exports of furniture, the added value of which is far higher than that of sawn timber, against the background of the depletion of precious natural trees.

The export volume and value by country (destination) are shown in Table 4-32. The largest importing country of Paraguayan wood products in terms of volume is Brazil with 40%, followed by Argentina (24%), Taiwan (10%) and the US (7%). In terms of value, Argentina is at the top of the table with 28%, followed by the US (18%), Taiwan (15%), Brazil (11%) and Italy (6%). The reason for Brazil's relatively small share (11%) of the value despite its largest share of the volume (40%) is that Brazil imports sawn timber and other less processed products for reprocessing to produce

highly value added products, such as furniture. Despite its distance, Taiwan is highly ranked in terms of both volume and value. Some of the wood products exported to Taiwan are said to be reprocessed there for export to Japan. The other main importing countries include those of the Americas which are near Paraguay and European countries. Exports to Hong Kong, China, Korea and the Philippines in distant Asia are also recorded. Exports to Japan mainly comprise paulownia.

Table 4-32 Export Volume and Value of Wood Products by Country (2000)

Ranking (Value)	Country	Volume (tons)	%	Value (US$)	%
1	Argentina	78,999	23.7	21,999,410	27.9
2	USA	23,589	7.1	14,467,778	18.3
3	Taiwan	34,410	10.3	11,612,662	14.7
4	Brazil	133,003	39.8	8,844,222	11.2
5	Italy	8,681	2.6	4,829,251	6.1
6	Hong Kong	8,485	2.5	3,780,066	4.8
7	China	8,726	2.6	3,290,950	4.2
8	Chile	4,657	1.4	2,965,435	3.8
9	Uruguay	11,902	3.6	2,130,605	2.7
10	Germany	9,843	2.9	1,419,434	1.8
11	Netherlands	831	0.2	995,042	1.3
12	Spain	5,624	1.7	720,216	0.9
13	Korea	419	0.1	291,535	0.4
14	Philippines	110	0.0	224,294	0.3
15	Peru	1,003	0.3	156,728	0.2
16	Japan	87	0.0	153,709	0.2
	Others	3,543	1.1	1,091,735	1.4
	Total	33,912	100.0	78,973,072	100.0

Source: FEPAMA

Exports of wood products originating from artificial forests in the last three years were 8,423 tons in 1999, 7,183 tons in 2000 and 4,214 tons in 2001 (up to August), totalling 18,848 tons. The figure for each year accounts for approximately 2% of the total export volume. Given the current situation of artificial forests in Paraguay, a rapid increase of these types of exports is unlikely for some time. By species, pine is predominant with 97.2%, followed by paraiso (2.6%) and eucalyptus (0.2%). The export destinations of pine wood are the US (87.7%) and Brazil (9.4%). Eucalyptus wood is exclusively exported to Canada and Germany while paraiso wood is mainly

exported to Germany and Italy (Table 4-33). By product, woodworking products, such as glued laminated timber, has the largest share but there are wide-ranging products, including parquet, sawn timber, plywood, veneer board and wooden boxes. Eucalyptus is mostly processed to make electric poles although a small quantity is exported as plywood. Paraiso is commonly used for tool handles, sawn timber and parquet with a tiny quantity being used for plywood. The unit price per ton shows that paraiso is the most expensive species at US$ 1,019, 150% higher than the price of pine at US$ 687. As 98% of eucalyptus is used for electric poles, the unit price is as low as US$ 48/ton. By product, the price of paraiso plywood is 2.9 times and 1.9 times higher than that of eucalyptus plywood and pine plywood respectively. The price advantage of paraiso is further illustrated by its parquet and sawn timber prices which are 2.3 times and 4.5 times higher than the prices of the corresponding pine products (Table 3-34).

Table 4-33 Export Volume and Value of Wood Products from Artificial Forests by Country

Country	Eucalyptus		Paraiso		Pine	
	Volume (tons)	Value (US$)	Volume (tons)	Value (US$)	Volume (tons)	Value (US$)
Germany	25	8,156	149	245,985	0	
Canada	604	21,758	0	0	0	
Argentina	0	0	55	11,265	131	46,972
Netherlands	0	0	24	18,439	46	22,954
Antilles	0	0	0	0	212	103,589
Brazil	0	0	0	0	1,780	412,735
Chile	0	0	0	0	21	13,760
USA	0	0	0	0	16,522	12,318,641
Taiwan	0	0	0	0	75	16,280
Uruguay	0	0	0	0	22	5,200
Italy	0	0	114	72,938	0	0
Spain	0	0	0	0	40	3,515
Total	629	29,914	342	348,627	18,849	12,943,646

Note : Total for the period from 1999 to August, 2001.
Source : FEPAMA

Table 4-34 Export Volume and Value of Wood Products from Artificial Forests by Product

Product	Eucalyptus			Paraiso			Pine		
	Volume (tons)	Value (US$)	Unit Price (US$/ton)	Volume (ton)	Value (US$)	Unit Price (US$/ton)	Volume (ton)	Value (US$)	Unit Price (US$/ton)
Electric Poles	604	21,758	36.0						
Plywood	25	8,156	362.2	1	930	930.0	384	191,160	497.8
Sawn Timber	0	-	-	116	29,647	255.6	1,339	76,805	57.4
Parquet	0	-	-	94	127,744	1,359.0	2,775	1,666,150	600.4
Tool Handles	0	-	-	131	190,307	1,452.7	0	-	-
Woodworking Components	0	-	-	0	-	-	14,201	10,993,745	774.2
Veneer Board	0	-	-	0	-	-	107	14,736	137.7
Wooden Boxes	0	-	-	0	-	-	42	1,050	25.0
Total	629	29,914	47.6	342	348,627	1,019.4	18,848	12,943,646	686.7

Note: Total for the period from 1999 to August, 2001.
Source: FEPAMA

(5) Wood Prices

In normal trading, the price for logs from natural trees and the price for logs from planted trees use the unit of m^3 alto parana (= 1/15.50 m^3) and the unit of tons (the standard conversion rate is 1 ton = 1 m^3) respectively. In the case of wood products, sawn flooring and plywood (plywood and veneer board) use m^3 while other sawn products (beams and boards, etc.) use pulgada (= 1/1,550 m^3 which is also used as the unit for length at 2.54 cm).

The price of logs for sawing is US$ 50 – 60/m^3 for Class 1 species, such as cedro and guatambu, for natural trees with an end diameter class of 10 pulgada (25.4 cm). The price of Class 2 species, including kupay, is significantly lower at around US$ 30. The price also differs depending on the diameter size even for the same species. Among Class 1 species, cedro which is often used for furniture experiences large price fluctuations based on the diameter size while guatambu does not (Table 4-35). Although not shown in Table 4-35, the interview results and product prices appear to suggest that lapacho fetches the highest price.

Table 4-35 Log Prices (1)

Species	End Diameter (pulgada)	G/m^3	US$/$m^3$
Cedro	≧ 10	186,000	53.2
	≧ 12	294,500	84.1
	≧ 14	403,000	115.3
Guatambu	8	178,250	51.0
	≧ 10	240,250	68.7
Kupay	10	93,000	26.6
	≧ 12	155,000	44.4
Pinora	10	93,000	26.6
	≧ 12	124,000	35.5
Ambay	10	108,500	31.0
	≧ 12	186,000	53.2
Yvyra ju	≧ 10	124,000	35.5
Kaykay gua	10	93,000	26.6
	≧ 12	139,500	40.0
Laurel guaika	10	93,000	26.6
	≧ 12	139,500	40.0

Notes 1) The price is converted to the unit price per m^3 (1 m^3 = 15.5 m^3 Ap).
2) Guarani is converted to US dollars based on an exchange rate of 1 US$ to G3,495 (JICA rate for FY 1999).
Source : Industrial y Forestal del Norte (Santa Rosa sel Aguaray)

In the case of pine (P. elliottii and P. taeda), as the trading volume is still small, an interview survey was conducted at sawmills and plywood plants handling pine in the Itapua District and the Alto Parana District. The standing tree price for thinned pine wood is US$ 7.1 (the raw wood weight immediately after cutting is deemed to be 1 ton/m^3; hereinafter the same shall apply). The delivery price to the factory of final cutting wood is US$ 15/ton for logs with an end diameter of 20 cm or larger. Some 25% of this price, i.e. US$ 15/ton, is said to reflect the transportation cost. The standing tree price for wood used for plywood is US$ 20.7/ton for logs with an end diameter of 20 cm or larger. The factory delivery price is approximately US$ 30 – 40/ton depending on the hauling conditions, including the travelling distance. Table 4-36 shows the log prices in Argentina. In the Misiones District which neighbours Paraguay, the standing tree price for 20 – 30 cm diameter logs is US$ 19 – 23/ton. Considering the fact that many artificial forests in Argentina have been trimmed, there will be little price difference between Argentina and Paraguay for trees of similar quality. The same tendency is observed by the interview survey conducted in Brazil and Argentina as shown in Table 4-37.

Table 4-36 Log Prices (2) – Argentina

Species	Province	Unit	For Timber		For Plywood		Remarks
			Price (US$)	End Diameter (cm)	Price (US$)	End Diameter (cm)	
Eucalyptus grandis	Corrientes	ton	18 – 20	18 – 30			Standing tree
	Corrientes	ton			26 – 32	> 35	
	Misiones	ton			35 -	> 35	
	Entre Rios	ton	21 – 27	> 12			With bark
	Entre Rios	ton	12 – 16	> 12			Standing tree
Pinus eliottii Pinus taeda	Misiones	ton	13 – 16	14 – 18			Trimmed and not trimmed
	Misiones	ton	19 – 23	20 – 30	35 – 65	> 30	Trimmed and not trimmed
	Corrientes	ton	18 – 23	18 – 30			Standing tree
	Entre Rios	ton	16 – 19	> 14			Standing tree
	Entre Rios	ton	25 – 30	> 14			With bark
Pinus parana	Misiones	ton	40 – 55	20 – 30	60 – 90	> 35	
Paraiso	Misiones	ton	30 – 60	20 – 30	85 – 90	> 35	
	Misiones	ton			90 – 95	> 40	

Note : prices are delivery prices to the factory except for standing trees.
Source : Sagypya Forestal (Magazine) No.10, March, 1999

Table 4-37 Log Prices (3)

Pine						Eucalyptus	
Brazil		Argentina				Argentina	
Pisa Florestal		Forestal Maria Silva		Forestal Las Marias		Forestadora Tapebicua	
End Diameter (cm)	Price (US$/ton)	End Diameter (cm)	Price (US$/ton)	End Diameter (cm)	Price (US$/ton)	End Diameter (cm)	Price (US$/ton)
8 – 17	13.8	A1 barrer > 16	20.5	18 – 27	18	11 – 18	11
18 – 22	20.5	16 – 20	19	27 – 32	20	18 – 32	19
23 – 24	29.2	20 – 25	22	> 32	22	> 32	23
> 35	40.7	25 – 30	24	> 32 (poco nudo)	24		

Notes 1) The price of pine is the delivery price to the factory while the price of eucalyptus is the standing tree price.
2) End diameter of 8 – 18 cm for pulp, end diameter of 18 – 32 (34) cm for sawn timber and end diameter of 32 (35) cm or larger for plywood.
Source : Interview survey results

No survey data is collected on eucalyptus as it is hardly traded in Paraguay. In the case of the price of eucalyptus in Argentina, the price of standing trees of 18 – 30 cm in diameter is US$ 18 – 20/ton in Corrientes Province. The price per ton for pine (US$ 18 – 23 for pine trees of 18 – 30 cm in diameter) is higher than the price of eucalyptus in this province (Table 4-36). According to the interview survey results, the standing tree price is US$ 8/ton for pulp wood (11 – 18 cm), US$ 16/ton for timber wood (18 – 32 cm) and US$ 20/ton for wood used for plywood (Table 4-37).

The price of paraiso wood for timber is similar to that of araucaria but the price of paraiso wood (35 cm or larger) for timber of US$ 85 – 90/ton is higher than that of araucaria (US$ 60 – 90/ton) and is the highest priced wood from planted trees (Table 4-36). The price of paraiso wood is US$ 30 – 60/ton (average of US$ 45/ton) for an end diameter of 20 – 30 cm (average of 25 cm, i.e. 10 pulgada). Compared to the price level of the prices of wood from natural forests, it is similar to that of cedro, illustrating the status of paraiso as the planting species with the highest economic value.

For comparison of the sawn timber price by species, Table 4-38 shows the prices of intermediate products for reprocessing to produce construction timber and furniture. The highest priced species is lapacho of which the price is 3.8 times higher than the lowest priced eucalyptus. Paraiso is traded at a similar price level to guatambu. The highest prices of flooring, a final product, shown in Table 4-39, are fetched by lapacho and yvyra ro among the species of natural forests, followed by the same Class 1 species of kurupa’y and peterevy although their prices are 10 – 20% lower than those of lapacho and yvyra ro. The price of yvyra pyta is the lowest. Among planted species, paraiso fetches the highest price which is similar to that of peterevy. The price of pine is higher than the price of eucalyptus. Comparison of the price of pine between Paraguay and Argentina shows that the price in Misiones Province, which is the closest province in Argentina to Paraguay, is similar to that in Paraguay.

Table 4-38 Price of Sawn Timber

Species	Area	Unit	Dimensions	Price (US$)	Remarks
Lapacho	Asuncion	m^3	1×11 >	407	
Kurupa'y	Asuncion	"	1×11 >	285	
Yvyra ro	Asuncion	"	> 11 y 3 m >	345	
Peterevy	Asuncion	"	-	283	Class 1 wood; dried
Timbo	Asuncion	"	< 16	199	Class 1 wood
Guatambu	Asuncion	"	-	243	Class 1 wood
Yvyra pyta	Asuncion	"	-	155	Class 1 wood
Cedro	Asuncion	"	> 9	319	Class 1 wood; dried
Paraiso	Asuncion	"	< 10	244	Class 1 wood
Paraiso	Misiones	"		212	
Eucalyptus (grandis)	Entre Rios	"		106	Class 1 wood
Pine (elliottii and taeda)	Misiones	"		127	
Pine (elliottii and taeda)	Misiones	"		151	Dried

Sources: FEPAMA for Paraguay (as of 21st March, 2000) and Sagpya Forestal (Magazine) No.12 (September, 1999) for Argentina

Table 4-39 Price of Flooring

Species	Area	Dimensions (pulgada)	Price (US$/$m^3$)	
			Class 1	Class 2
Lapacho	Paraguay: Asuncion	1×4	10.51	7.71
		1×3	9.42	6.74
		1/2×3	6.46	4.17
Yvyra ro		1×4	10.74	7.43
		1/2×3	6.23	4.06
Kurupa'y		1×4	9.94	5.14
		3/4×3	5.71	4.23
		1/2×3	4.80	3.57
Guatambu		1/2×3	5.63	3.69
Yvyra pyta		1×3	5.49	4.14
		3/4×3	4.51	3.66
		1/2×3	3.60	2.80
Peterevy		1×4y5	9.14	8.00
		1/2×3	5.14	3.94
Paraiso		1×4	8.57	6.29
		1/2×3	5.37	3.89
Cancharana		1×4	7.43	6.00
		1/0×3	3.94	2.80
Pine (elliottii and taeda)	Argentina: Misiones	1×	5.00 – 5.50	-
		3/4x	3.60 – 3.80	-
		1/2×	2.40 – 2.60	-
	Entre Rios	1/2×	2.60 – 2.90	-
	Corrientes	1/2×	3.20 – 3.50	2.50 – 3.00
	Buenos Aires	1×	7.50	-
		3/4×	5.30	-
		1/2×	3.70	-
	Paraguay: Alto Parana		2.10	1.57
Eucalyptus	Argentina: Entre Rios	1/2×	2.30 – 2.50	

Note : Prices are converted to US dollars based on an exchange rate of 1 US$ to G3,495.
Sources : FEPAMA for Paraguay except for pine prices which are given by Machimbre Paraguayos and Sagpya Forestal (Magazine) No.2 (September, 1999) for Argentina

The price of plywood by species is shown in Table 4-40. Cedro fetches by far the highest price, even compared to other species of natural forests. Paraiso is traded at the same price level as cedro. The prices of pine and eucalyptus are high at some 90% of the cedro plywood price and are higher than those of such natural trees as guatambu, kupay and laurel.

Table 4-40 Plywood Price

Species	Thickness	Class	Price (G/m^2)	Price (US$/$m^2$)
Cedro	4 mm	1	9,922	2.68
Guatambu	4 mm	1	6,084	1.65
Kupay	4 mm	1	5,566	1.51
Laurel	4 mm	1	5,566	1.51
Paraiso	4 mm	1	9,922	2.68
Pine	4 mm	1	8,852	2.40
Eucalyptus	4 mm	1	8,852	2.40

Notes 1) As of February, 2001.
2) The guarani price is converted to the US dollar price based on an exchange rate of 1 US$ to G3,694.
Source : FEPAMA

The prices of firewood and charcoal are shown in Table 4-41. These prices were established through interviews with farmers (producers) in the production areas. An interview survey was also conducted at brick factories, sugar plants and ironworks which are large users and at charcoal distributors in the consumption areas. Firewood and charcoal in Paraguay mainly originate from natural forests and only a small quantity of charcoal made from planted eucalyptus trees is used as part of the charcoal used at ironworks. In recent years, brick factories, sugar plants and grain silo owners have begun planting to produce firewood for their own consumption. Accordingly, a survey on the price of firewood from artificial forests was conducted in Parana State in Brazil (Table 4-42). According to the findings of this survey, the price of firewood is low in the southern part which still has rich forests with fast growing indigenous species. The price level is approximately double in the northern part which is an agricultural area with few forests.

Table 4-41 Firewood and Charcoal Prices

Item	Area	Unit	Price (G)	Remarks
Firewood	San Jose de Obrero (San Pedro)	m^3	10,000	Production area
	Tobati	ton	25,000	Brick factory
	Arroyo y Esteros	ton	14,000	Sugar plant
	Guarambare	ton	15,000	Sugar plant
Charcoal	Capiibary	ton	100,000	Production area
	Villa Hayes	ton	175,000 – 183,000	Ironworks
	Caazapa	ton	180,000	Purchase price by distributor in production area
	San Lorenso	kg	250 – 330	Sales price by distributor to retailers

Source: Interview survey in each area

Table 4-42 Prices of Standing Trees for Firewood and Charcoal

(US$/$m^3$ stacked)

Species	Brazil (Parana State)		
	Agricultural Cooperative (Northern Part)	Northern Part	Southern Part
Eucalyptus	4.67*	2.67	
Indigenous Species (Acacia)			1.33
Grevirea	4.00*		
Natural Forest			

Note : * indicates the delivery price to the factory.
Sources : Agricultural Cooperative – interview survey; Northern and Southern Parts – Environmental Bureau, Parana Provincial Government

(6) Cutting and Hauling Costs

Sufficient data on the cutting and hauling costs in Paraguay could not be obtained in Paraguay as the cutting of artificial forests, which are generally small, is seldom conducted. To supplement the available data, a survey was conducted in neighbouring Argentina and Brazil. The survey results are shown in Table 4-43.

Table 4-43 Cutting and Hauling Costs

(US$/m^3)

	A (Paraguay)	B (Paraguay)	C (Paraguay)	D (Brazil)	E (Argentina)	F (Argentina)	G (Argentina)
Cutting					0.796		
Trimming; Bucking					0.896		
Yarding					1.596		
Sub-Total	14.1		11.57	2.450	3.288		
Loading	0.7		2.48	0.325	1.348		
Social Insurance					0.050		
Others					0.796		
Total	14.8	7.44	14.05	2.775	5.482	4.50 – 5.50	5.00

The costs appear to be much higher in Paraguay than in other countries because of the smaller work area and much manual work at the cutting sites.

Case A is thinning at artificial pine forests. Cutting is conducted using a chainsaw. Trimming and bucking are also conducted using a chainsaw at the same time as cutting. Yarding is manually conducted and the logs are loaded onto a simple vehicle which is pulled by a tractor to the wood yard. Loading at the wood yard is also manually conducted. The predominance of manual work and the small work volume because of the fact that many of the trees have a small diameter push up the work cost.

Case B involves the series of work from cutting, trimming and bucking (using a chainsaw) to yarding (by tractor) and loading (by crane). Because of the small work volume, the expected high efficiency of mechanised work does not appear to have been achieved yet.

Case C is selective cutting at natural forests. The selective cutting method appears to have pushed up the cost of constructing a spur road and the cutting and trimming costs. The loading cost is also high because of the heavy weight involved.

Case D is final cutting (clear cutting) at artificial pine forests. The work process consists of cutting (using a chainsaw), full tree logging (using a skidder), trimming and bucking (using a processor) and loading (using a grapple crane). High performance forestry machinery is partially used and the work conditions are better than Case E because of the presence of many large diameter trees. Accordingly the cost is half of the corresponding cost in Argentina and 20 – 40% of the corresponding cost in Paraguay.

Case E is also final cutting (clear cutting) at artificial pine forests. The observed working conditions at the sites in terms of the topography, size of the trees to be cut and work unit, etc. are favourable for the efficient use of machinery. The work process consists of cutting and trimming (using a chainsaw), tree length logging (using a skidder), bucking (using a chainsaw) and loading (using a grapple crane).

Case F is the result of an interview survey conducted at a pine sawmill and indicates the cutting and yarding cost of final cutting (clear cutting) at artificial pine forests. Although the detailed work process is unknown, it is assumed to be similar to Case E.

Case G is final cutting (clear cutting) at artificial eucalyptus forests. Prior to final cutting, small diameter trees (mainly less than 30 cm in diameter) undergo selective cutting, leaving some 80 trees of 40 cm in diameter or larger per ha. The topography is almost flat. The forest road density is high and the skidding distance is less than 50 m in most cases. The work process consists of cutting and tree length logging (using a feller-buncher), trimming and bucking (using a chainsaw) and loading (using a grapple crane).

Case D and Case G partially use high performance forestry machinery. The reasons for not using such machinery throughout the work process are (i) the unlikelihood of achieving the maximum use of the machinery given the present work volume and the different work efficiency of each machine and (ii) the social mission of foresters to provide employment opportunities.

As the work system currently adopted in Argentina can be introduced in Paraguay once the work conditions improve with an increase of the number of afforestation sites, it appears reasonable to assume a cutting and hauling cost (including loading cost) of approximately US$ 5.5/m^3 for estimation of the profitability in the future.

The production cost of firewood was surveyed at a production site in the San Pedro District (Table 4-44). The total cost, including the cutting cost and the transportation cost of ready-made firewood to the road side, is G4,953/m^3 (stacked) or US$ 1.32. The much lower production cost of firewood than logs can presumably be attributed to the relative proximity of the production sites to a road, the predominance of manual work because of the light weight of firewood compared to logs and the low personnel cost due to the use of the surplus labour of farmers during the off-season.

Table 4-44 Production Costs of Firewood and Charcoal

(Unit: G)

	Firewood/Cart (30 m^3 stacked)	Charcoal/lot (2,800 kg)
Cutting	28,600	20,000
Bucking	50,000	30,000
Skidding	70,000	30,000
Stacking in Kiln	-	60,000
Packing, Water and Others	-	30,000
Kiln Construction and Repair	-	5,700
Total	158,600	175,000
Unit Cost (G)	4,953/m^3 (stacked)	63/kg
Unit Cost (US$)	1.32/m^3 (stacked)	16.8/ton

Source: Interview survey results

The production cost of charcoal from initial cutting to transportation of the charcoal to the road side is G62,800/ton or US$ 16.7/ton according to the survey results for the San Pedro District (Table 4-44). Based on the results of the survey, the standing tree prices converted from the firewood and charcoal prices shown in Table 4-41 are G5,047 (US$ 1.35)/m^3 (= G10,000 – G4,953) for trees to produce firewood and G5,662 (US$ 1.51)/m^3 (= (G100 – G62.75)×152 kg) for trees to produce charcoal. Although the prices of fuelwood are much lower than the log prices, raw wood to produce firewood and charcoal currently comes from trees cut to create farm land. As such, the production of firewood and charcoal provides places of employment, i.e. sources of cash income, for local farmers. When the raw material for firewood changes to planted trees in the future, the firewood price is expected to approach that in the Northern Part of Parana State in Brazil shown in Table 4-42.

The wood transportation charge in Paraguay is negotiated each time between the trucker (haulier) and the client and there is no standard transportation tariff table. Table 4-45 shows the survey results on the transportation charge in Paraguay. Table 4-46 and Table 4-47 show the log transportation charge in Argentina and Brazil respectively. Following the comparative analysis of these tables, it is concluded that the Argentine transportation charge table is appropriate to estimate the profitability of forest management in the future.

Table 4-45 Transportation Charge

	Total Charge	Distance (km)		Unit (tons)	Transportation Charge (G/ton.km)	Transportation Charge (US$/ton.km)
Firewood	300,000	170	(30%)	25	70.6	0.019
Charcoal	380,000	250	(20%)	8	190.0	0.051
Logs (A) < 20 km	1,200	20	(100%)	0.065	923.1	0.246
Logs (B) > 20 km	2,200	80	(100%)	0.065	423.1	0.113
Logs (C)	25.0	200	(100%)	0.000645	193.8	0.052
Logs (D)			(100%)		387.5	0.103

Note: The figures in brackets indicate the proport ion of earth roads.

Table 4-46 Log Transportation Tariff Argentina (US$/ton)

	Transportation Charge Using Paved Roads (A)	Transportation Charge Using Earth Roads (B)
1	0.16	0.34
2	0.23	0.42
3	0.30	0.48
4	0.37	0.55
5	0.43	0.63
6	0.49	0.69
7	0.55	0.76
8	0.61	0.83
9	0.67	0.89
10	0.72	0.96
11	0.77	1.03
12	0.82	1.09
13	0.86	1.16
14	0.91	1.23
15	0.96	1.28
16	1.01	1.35
17	1.05	1.42
18	1.09	1.47
19	1.13	1.53
20	1.17	1.60
21	1.21	1.65
22	1.24	1.71
23	1.28	1.78
24	1.32	1.83
25	1.35	1.89
26	1.39	1.95
27	1.43	2.00
28	1.45	2.06
29	1.49	2.12
30	1.53	2.17
31-35	1.62	2.30
36-40	1.79	2.57
41-45	1.95	2.80
46-50	2.11	3.04
51-60	2.34	3.36
61-70	2.70	3.73
71-80	3.04	
81-90	3.37	
91-100	3.68	
101-125	4.09	
126-150	4.58	

Table 4-47 Log Transportation Tariff Brazil (US$/ton)

Distance (km)	Transportation Charge
10-15	1.55
15 - 20	1.76
20 - 25	2.23
25 - 30	2.44
30 - 35	2.65
35 - 40	3.04
40 - 45	3.25
45 - 50	3.70
50 - 55	3.91
55 - 60	4.12
60 - 65	4.67
65 - 70	4.88
70 - 75	5.08
75 - 80	5.29
80 - 85	6.02
85 - 90	6.22
90 - 95	6.43
95 - 100	6.64
100 - 105	6.85
105 - 110	7.05
110 - 115	7.26
115 - 120	7.47
120 - 125	7.67
125 - 130	7.88
130 - 135	8.09
135 - 140	8.30
140 - 145	8.51
145 - 150	8.72

Estimation formula: total transportation cost = (A + B) + 1 (waiting charge)

4.2 Survey on Afforestation Intentions

4.2.1 Purposes

The purposes of the survey on afforestation intentions were to establish a clear understanding of the intentions of land owners in the recommended afforestation areas regarding afforestation and to obtain basic information to determine the likely scale of the master plan for afforestation plans in the Eastern Region and to estimate the preferable work volume of the Five Year Afforestation Programme. Another purpose of this survey was to obtain basic data which would prove useful for the examination of possible measures to promote the active participation of land owners in afforestation work.

4.2.2 Survey Areas and Target Persons of the Survey

The recommended cities for afforestation and land owners in the survey areas were decided as the survey areas and target persons of the survey respectively.

4.2.3 Survey Method

The survey was conducted in the form of a questionnaire survey through interviews with the target land owners. The total number of samples was set at approximately 600 who were selected in accordance with the process described below. This survey was subcontracted to a local consultancy firm.

(1) Selection of Target Cities for Questionnaire Survey

The target cities for the questionnaire survey were selected from the recommended cities for afforestation in the following manner.

Firstly, using the draft land cover map prepared in Phase I, the recommended cities for afforestation were classified in three categories based on the land use situation: (i) stock raising cities, (ii) agricultural cities and (iii) other cities. Those cities where the area used for stock raising accounts for at least 90% of the total area of agricultural land and pasture land were classified as stock raising cities. Agricultural cities were those where the ratio of agricultural land is at least 30% of the total area of agricultural land and pasture land. Based on the classification results, the city with the largest recommended afforestation area was selected in each district and was designated as the target city for the questionnaire survey (hereinafter simply referred to as the target cities). Following

this selection process, nine stock raising cities, four agricultural cities and 11 other cities were selected for the questionnaire survey (Table 4-48).

(2) Classification of Land Owners and Distribution of Samples

Despite their large number, the combined total area of small-scale land owners is generally rather small and its impact on the scale of an afforestation plan is also small. In contrast, even though the number is small, each large-scale land owner has extensive land with quite a large impact on an afforestation Rates plan. If the samples were randomly selected regardless of the size of land ownership, the selected samples would overwhelming consist of small-scale land owners. Accordingly, it would be impossible to clarify the intentions of large-scale land owners which would have a significant affect on an afforestation plan. Because of this, land owners were classified based on their scale of land ownership so that the ratio of samples would be higher with large land owners.

Land owners in all of the target cities were classified in three categories: (i) land owners with less than 20 ha, (ii) land owners with 20 - 1,000 ha and (iii) land owners with 1,000 ha or more.

(3) Distribution of Samples to Target Cities

The finalised number of samples distributed to each category of land owner was redistributed to the target cities. In principle, the number of samples was equally distributed to each target city. When the number of target persons was smaller than the distributed number of samples, the surplus samples were redistributed to those cities where the number of target persons in the relevant land owner category was large. The resulting planned number of samples distributed by target city and by scale of land ownership is shown in Table 4-48.

In each target city, the samples were randomly selected to reach the predetermined number of samples in each land owner category and the questionnaire survey was conducted by means of direct interviews with the selected land owners.

Table 4-48 Number of Samples by Target City and by Scale of Land Ownership (Planned Figures)

District	Target City	City Category Based on Land Use	No. of Management Units by Scale of Land Ownership				Area by Scale of Land Ownership (ha)				No. of Samples by Scale of Land Ownership (Planned Figures)			
			～20ha	20～1000ha	1000ha～	Total	～20ha	20～1000ha	1000ha～	Total	～20ha	20～1000ha	1000ha～	Total
CONCEPCION	HORQUETA	Other	5,045	1,141	30	6,216	36,901	55,434	119,900	212,235	4	18	5	27
SAN PEDRO	SAN PEDRO	Stock raising	3,447	593	55	4,095	25,578	39,443	217,296	282,317	4	17	6	27
	SAN ESTANISLAO	Other	5,620	509	22	6,151	41,043	20,298	49,832	111,173	4	17	5	26
CORDILLERA	MBOCAYATY DEL YHAGUY	Stock raising	662	104	5	771	3,405	5,208	17,541	26,154	4	17	5	26
	TOBATÍ	Other	1,146	65	6	1,217	4,941	4,967	10,589	20,497	4	17	5	26
GUAIRA	INDEPENDENCIA	Stock raising	2,797	457	2	3,256	15,480	21,602	2,350	39,432	4	17	2	23
	MBOCAYATY	Other	743	61	5	809	2,982	2,937	9,710	15,629	4	17	5	26
CAAGUAZU	CORONEL OVIEDO	Stock raising	4,212	258	10	4,480	24,618	12,674	20,656	57,948	4	17	5	26
	YHÚ	Other	4,238	614	19	4,871	30,430	29,703	52,727	112,860	4	17	5	26
	DR. J. E. ESTIGARRIBIA	Agriculture	1,271	362	9	1,642	7,911	35,773	11,927	55,611	4	17	5	26
CAAZAPA	ABAÍ	Other	1,780	610	2	2,392	14,714	21,189	7,280	43,183	4	17	2	23
	YUTY	Stock raising	4,116	552	23	4,691	21,767	30,440	109,522	161,729	4	17	5	26
ITAPUA	ENCARNACION	Other	1,915	285	0	2,200	8,584	13,138	0	21,722	4	17	0	21
	SAN PEDRO DEL PARANA	Stock raising	3,264	698	24	3,986	20,255	43,800	84,473	148,528	4	18	5	27
	SAN RAFAEL DEL PARANA	Agriculture	1,742	512	3	2,257	14,452	27,615	6,500	48,567	4	17	3	24
PARAGUARI	CARAPEGUÁ	Other	3,335	226	1	3,562	14,169	13,921	1,375	29,465	4	17	1	22
	YBYTYMÍ	Stock raising	1,240	116	5	1,361	6,805	11,071	12,910	30,786	4	17	5	26
ALTO PARANA	HERNANDARIAS	Agriculture	619	416	19	1,054	4,580	36,280	35,858	76,718	4	17	5	26
	ITAKYRY	Other	1,726	409	8	2,143	12,675	25,452	22,625	60,752	4	17	5	26
CENTRAL	GUARAMBARÉ	Other	362	13	0	375	767	1,162	0	1,929	4	13	0	17
	YPACARAÍ	Stock raising	497	42	0	539	1,295	4,322	0	5,617	4	17	0	21
AMAMBAY	PEDRO JUAN CABALLERO	Stock raising	1,141	625	63	1,829	7,936	63,114	285,297	356,347	4	17	6	27
CANINDEYU	CURUGUATY	Other	2,962	724	35	3,721	23,702	42,319	109,702	175,723	4	18	6	28
	FRANCISCO CABALLERO ALVAREZ	Agriculture	1,197	707	32	1,936	9,790	64,916	124,620	199,326	4	18	5	27
Total			55,077	10,099	378	65,554	354,780	626,778	1,312,690	2,294,248	96	408	96	600

Table 4-49 Expected Total Area for Afforestation in the Recommended Afforestation Areas Based on the Intentions of Land Owners

Item				Scale of Land Ownership				
				≦20ha	20＜≦100ha	100＜≦500ha	500ha＜	Total
Recommended Cities for Afforestation	Area by scale of land ownership		ha	965,011	893,209	675,677	3,366,142	5,900,039
			%	16.4	15.1	11.5	57.1	100.0
Recommended Afforestation Areas	Area by type of land use	Area of dry farmland	ha	217,090	200,938	152,001	757,252	1,327,281
		Area of paddy fields	ha	150	139	105	523	917
		Area of non-flooded or seasonally flooded grassland	ha	311,151	288,000	217,860	1,085,355	1,902,366
		Area of artificial grassland	ha	118,096	109,309	82,688	411,941	722,034
		Area of shrub land	ha	4,703	4,353	3,293	16,404	28,752
Ratio of Target Area for Afforestation (Findings of Survey on Afforestation Intentions)	Ratio of area for afforestation using farm land (average of all replies, including those with no interest in afforestation)		%	15.0	11.6	5.4	2.2	
	Ratio of area for afforestation using pasture land (average of all replies, including those with no interest in afforestation)		%	10.7	11.4	11.2	11.7	
	Ratio of area for afforestation using shrub land (average of all replies, including those with no interest in afforestation)		%	3.5	3.6	3.0	2.2	
Expected Afforestation Area by Afforesters Interested in Afforestation Work in Recommended Afforestation Areas	Afforestation of dry farmland		ha	32,564	23,309	8,208	16,660	80,740
	Afforestation of paddy fields		ha	22	16	6	12	56
	Afforestation of non-flooded or seasonally flooded grassland		ha	33,293	32,832	24,400	126,986	217,512
	Afforestation of artificial grassland		ha	12,636	12,461	9,261	48,197	82,556
	Afforestation of shrub land		ha	165	157	99	361	781
	Total		ha	78,680	68,775	41,974	192,216	381,644

Notes 1) The area by scale of land ownership is based on the agricultural and stock raising census in 1991.
2) The area by type of land use is proportionally distributed based on the ratio of area by scale of land ownership in the recommended cities for afforestation using the draft land cover map prepared under the present Study.

4.2.4 Survey Results

The number of interviewees of the survey on afforestation intentions was 608 and their distribution by target city, scale of land ownership and type of land management is shown in Appendix B-1.

Based on the findings of the survey on afforestation intentions and the land cover map prepared under the Study, it was possible to infer that some 380,000 ha could be planted by those residents (land owners) in the recommended afforestation areas who are interested in conducted afforestation work on their land.

(1) Willingness and Purpose of Afforestation (see Appendix B-2)

To the question on their willingness to plant trees on their land, 37% replied that they "would like to conduct afforestation work if such work produces even a small profit from the planted sites". The second ranked reply (24%) was that they "would like to conduct afforestation work regardless of profitability". Only 13% replied that they "were not interested in afforestation work". Such a tendency was also observed when the replies were classified in terms of the scale of land ownership of the interviewees. The top ranked reply was that they "would like to conduct afforestation work if such work produces even a small profit from the planted sites". This reply was given by 36% of land owners with less than 20 ha, 39% of land owners with 20 – 500 ha and 34% of land owners with 500 ha or more. The second ranked reply that they "would like to conduct afforestation work regardless of profitability" was given by 23% of land owners with less than 20 ha, 24% of land owners with 20 – 500 ha and 23% of land owners with 500 ha or more. The same tendency was repeated when the replies were classified in terms of the land management type.

In regard to the purpose of afforestation, there were differences based on the scale of land ownership among those replying that they "would like to conduct afforestation work if such work provides even a small profit". The most popular purpose (45%) among land owners with less than 20 ha was "to earn income from afforestation at currently unprofitable farm land". In contrast, the top answer (36%) among land owners with 20 – 500 ha was "to earn income from afforestation at currently unprofitable sites on the stock farm". Among land owners with 500 ha or more, the top answer was "to produce and sell high quality timber wood and firewood even at the expense of existing farm land or pasture land to a certain extent".

Table 4-49 Expected Total Area for Afforestation in the Recommended Afforestation Areas Based on the Intentions of Land Owners

Item				Scale of Land Ownership				
				≦20ha	20＜≦100ha	100＜≦500ha	500ha＜	Total
Recommended Cities for Afforestation	Area by scale of land ownership		ha	965,011	893,209	675,677	3,366,142	5,900,039
			%	16.4	15.1	11.5	57.1	100.0
Recommended Afforestation Areas	Area by type of land use	Area of dry farmland	ha	217,090	200,938	152,001	757,252	1,327,281
		Area of paddy fields	ha	150	139	105	523	917
		Area of non-flooded or seasonally flooded grassland	ha	311,151	288,000	217,860	1,085,355	1,902,366
		Area of artificial grassland	ha	118,096	109,309	82,688	411,941	722,034
		Area of shrub land	ha	4,703	4,353	3,293	16,404	28,752
Ratio of Target Area for Afforestation (Findings of Survey on Afforestation Intentions)	Ratio of area for afforestation using farm land (average of all replies, including those with no interest in afforestation)		%	15.0	11.6	5.4	2.2	
	Ratio of area for afforestation using pasture land (average of all replies, including those with no interest in afforestation)		%	10.7	11.4	11.2	11.7	
	Ratio of area for afforestation using shrub land (average of all replies, including those with no interest in afforestation)		%	3.5	3.6	3.0	2.2	
Afforestation Intentions (Findings of Survey on Afforestation Intentions)	Ratio of persons wanting to conduct afforestation work regardless of profitability (Type A persons) among those interested in afforestation		%	26.1	27.6	29.1	26.5	
	Ratio of persons wanting to conduct afforestation work if profitable (Type B persons) among those interested in afforestation		%	40.2	43.6	45.3	38.8	
Expected Afforestation Area in Recommended Afforestation Areas	Expected afforestation area by Type A persons	Afforestation of dry farmland	ha	8,499	6,433	2,389	4,415	21,736
		Afforestation of paddy fields	ha	6	4	2	3	15
		Afforestation of non-flooded or seasonally flooded grassland	ha	8,690	9,062	7,101	33,651	58,503
		Afforestation of artificial grassland	ha	3,298	3,439	2,695	12,772	22,205
		Afforestation of shrub land	ha	43	43	29	96	211
		Total	ha	20,535	18,982	12,214	50,937	102,669
	Expected afforestation area by Type B persons	Afforestation of dry farmland	ha	13,091	10,163	3,718	6,464	33,435
		Afforestation of paddy fields	ha	9	7	3	4	23
		Afforestation of non-flooded or seasonally flooded grassland	ha	13,384	14,315	11,053	49,271	88,023
		Afforestation of artificial grassland	ha	5,080	5,433	4,195	18,700	33,409
		Afforestation of shrub land	ha	66	68	45	140	319
		Total	ha	31,629	29,986	19,014	74,580	155,209
	Expected afforestation area depending on intentions of land owners	Afforestation of dry farmland	ha	21,590	16,596	6,107	10,879	55,171
		Afforestation of paddy fields	ha	15	11	4	8	38
		Afforestation of non-flooded or seasonally flooded grassland	ha	22,073	23,376	18,154	82,922	146,526
		Afforestation of artificial grassland	ha	8,378	8,872	6,890	31,473	55,613
		Afforestation of shrub land	ha	109	112	73	236	530
		Total	ha	52,165	48,968	31,229	125,517	257,878

Notes 1) The area by scale of land ownership is based on the agricultural and stock raising census in 1991.
2) The area by type of land use is proportionally distributed based on the ratio of area by scale of land ownership in the recommended cities for afforestation using the draft land cover map prepared under the present Study.

The main purpose of afforestation for those replying that they "would like to conduct afforestation work regardless of profitability" was "to leave forests as assets" (62%), followed by "to maintain the health of the stock farm and livestock" (10%) and "to create a windbreak forest for farm land or the stock farm" (9%).

(2) Preferred Sites for Afforestation (see Appendix B-3)

Among those who would like to conduct afforestation work with or without conditions, the most preferred site for afforestation was "any suitable site for planting" (36%), followed by "sloping land" (19%) and "very windy sites" (16%) in the case of afforestation work at farm land.

In the case of afforestation work at pasture land, the most preferred site was again "any suitable site for planting" (38%), followed by "boundary site" (14%) and "very windy site" (13%).

In the case of afforestation work at shrub land, the most preferred site was "any suitable site for planting" (40%), followed by "along a river" (19%) and "boundary between farm land and pasture land" (17%).

(3) Target Area for Afforestation (see Appendix B-4)

To the question on the ratio of the intended afforestation area at farm land, land owners with less than 20% replied 15.0%, those with 20 – 500 ha replied 9.6% and those with 500 ha or more replied 2.2%, indicating a larger proportion of area for afforestation among smaller land owners (average of all replies, including those interviewed who are not interested in afforestation).

In the case of afforestation at stock farms (pasture land), land owners with less than 20 ha replied 10.7%, those with 20 – 500 ha replied 11.3% and those with 500 ha or more replied 11.7%, indicating a larger proportion of area for afforestation among larger land owners.

In the case of afforestation at shrub land, land owners with less than 20 ha replied 3.5%, those with 20 – 500 ha replied 3.4% and those with 500 ha or more replied 2.2%, indicating generally low enthusiasm among all categories of land owners for afforestation at shrub land.

(4) Preferred Species for Planting and Cutting Period (see Appendix B-5)

According to the same people referred to in (2) above who replied to the questions on the preferred species for planting and preferred cutting period, the most preferred species was eucalyptus (42%), followed by Paraiso gigante (18%), lapacho (12%) and pine (9%). Eucalyptus was the most preferred species for planting by scale of land ownership or by type of land management.

The preferred cutting period by preferred species for planting was nine years for eucalyptus, 11 years for Paraiso gigante, 18 years for lapacho and 11 years for pine.

(5) Expectations Regarding Afforestation Funds (see Appendices B-6, B-7 and B-8).

In regard to the question on how to secure the funds to conduct afforestation work, the most popular answer among those referred to in (2) above, i.e. those who would like to conduct afforestation work with or without conditions, was "a loan and subsidy" (32%), followed by "entirely a loan" (24%) and "entirely own funds" (14%). This ranking was repeated for each category of land ownership. The combined ratio of selected answers of "own funds and a subsidy", "own funds, a loan and a subsidy" and "a loan and a exceeded 50%, suggesting fairly strong expectations in regard to a subsidy. It was also noticeable that there appears to be strong intentions to conduct afforestation work with a loan as the combined ratio of the selected answers of "own funds and a loan" and "entirely a loan" was as high as 36%.

To the question on the minimum preferred loan ratio in the required funds, those opting to finance the afforestation cost by "a loan and a subsidy" totalled 30 50% while those opting for "own funds and a loan" and for "own funds, a loan and a subsidy" totalled 30 60% and 15 – 40% respectively.

In regard to the loan conditions, the average conditions expected by different groups of people whose selected answers included the use of a loan was a loan period of 8 – 14 years and a maximum interest rate of 11 – 13%/year for a garani loan and 2 – 3% for a US dollar loan with a grace period of 3 – 5 years.

The average expectations for the minimum subsidy ratio for the required funds ranged from 64% to 71% among those opting to finance the afforestation cost by "own funds and a subsidy", "own funds, a loan and a subsidy" and "a loan and a subsidy".

The most popular financing source was a semi-governmental institution (38%), followed by a private institution (31%) and a government institution (28%). The reasons given for

preferring a semi-governmental institution were “a high level of reliability”, “a high level of transparency” and “good service” in that order. In the case of a government institution, the top reason for preference was “a low interest rate”, followed by “large flexibility” and “a high level of reliability”.

(6) Expectations of the Government Regarding Implementation of Afforestation Work

The most popular answers to the question on expectations of the government regarding the implementation of afforestation work was “guarantee of the security of privately owned land” and “guarantee for distribution and markets” (both selected by 23 interviewees), followed by “exemption from tax” (13), “guarantee for land management investment” (10), “observance of laws (including Law No.536)” (9), “insurance (fire insurance, forest insurance and frost damage insurance)” (7), “sincerity, sense of responsibility, honesty and justice” (6), “technical assistance and guidance” (4), “low interest loan” (3), “infrastructure (including roads)” (3), “curtailment of bureaucracy” (3), “improved efficiency and swift procedure” (3) and “elimination of corruption and

4.3 Prospects of Wood Distribution/Markets and Wood Demand

4.3.1 Prospects of Wood Distribution/Markets and Forest Products Industry

(1) Prospects of Wood Production and Distribution

With the implementation of the planned afforestation plan, future wood production will increasingly be based on planted trees, particularly pine and eucalyptus, while the supply of wood from natural forests will substantially decrease in terms of both logs and fuelwood. The large, medium and small diameter trees produced at afforestation sites will be used for plywood, sawn timber and fuelwood/pulpwood respectively. Moreover, the increased ratio of firewood from artificial forests in the total volume of firewood due to the decreased supply of firewood from natural forests will force brick factories, sugar plants and grain silos to use eucalyptus and also partially pine as well as broad-leaved trees as a source of firewood. Though pine is inferior to eucalyptus firewood in caloric value, it should be suitable as a fuel for brick factories and others.

The expected concentration of working sites resulting from the expansion of the afforestation area will facilitate the mechanisation of cutting and the introduction of an efficient operation system to reduce the production cost. For example, the more efficient operation system (cutting and trimming using a chainsaw → tree length skidding using a large tractor → bucking using a chainsaw → loading using a grapple crane) currently

employed in Argentina will spread as the standard operation system. Some high performance forestry machinery, such as processors and feller-bunchers, may also be introduced in some areas. Accordingly, an average cost of cutting and hauling of US$ 5/m^3 for final cutting, US$ 6.5/m^3 for first thinning and US$ 6/m^3 for second and further thinning is assumed here (Table 4-50).

The development of the road network with an increase of the total paved road length will enlarge the economical zone for wood collection. In turn, this will reduce the number of small-scale sawmills near the cutting sites which will be replaced by large-scale sawmills at those places where the catchment area covers several wood production sites. At the same time, these large-scale sawmills will prompt the introduction of accompanying processing units of forest products, possibly leading to the formation of something like forest product industrial parks. Accordingly, an average transportation cost from a cutting site to a sawmill of US$ 4.24/m^3 is assumed (Table 4-50 and Fig. 4-10).

Table 4-50 also shows the estimation result of income from the sale of standing trees at future afforestation sites for the main species.

(2) Prospects of Forest Products Industry

It is expected that the raw materials for timber in the future will mainly be supplied from artificial forests in Paraguay. Accordingly, the present production system which is mainly based on wood from natural forests will be transformed to a production system relying on medium and small diameter wood suited to sawing which is produced by artificial forests as in the case of the more advanced Brazil and Argentina in this regard. Wood products using eucalyptus and pine will form the main trend of processed forest products. Various types of laminated wood using the finger joint technique and others will be produced together with the production of overlaid laminated wood as well as plywood using wood from artificial forests as the base and high quality sliced veneer from wood from natural forests for the surface. The creation of particleboard, MDF, paper and pulp industries will be considered to ensure the effective use of wood resources. The likely production machinery to be used at sawmills and others during the transitional stage of the forest products industry were examined, taking the findings of the field survey in Paraguay and the relevant examples in Brazil and Argentina into consideration.

Table 4-50 Total Standing Tree Price per ha

Species	Age	Production Cost (Cutting & Hauling Cost + Transportation Cost) (A)			Wood Price/m^3 (Delivery Price to Factory) (B)			Standing Tree Price/m^3 (Producer Price) (C = B – A)			Yield per ha (D)				Total Standing Tree Price/ha (= C×D)			
		Pulp/ Firewood	Timber	Plywood	Pulp/ Firewood	Timber	Plywood	Pulp/ Firewood	Timber	Plywood	Pulp/ Firewood	Timber	Plywood	Total	Pulp/ Firewood	Timber	Plywood	Total
Pine	10	10.74			11			0.26			39	0	0	39	10	0	0	10
	15	10.24	10.24		11	22		0.76	11.76		26	18	0	44	20	212	0	231
	20	10.24	10.24		11	24		0.76	13.76		3	20	3	26	2	275	0	148
	25	9.24	9.24	9.24	11	24	50	1.76	14.76	40.76	29	146	116	291	51	2,155	4,728	6,934
	Total										97	184	119	400	83	2,642	4,728	7,453
Eucalyptus	4	10.74			11			0.26			33	0	0	33	9			9
	8	10.24	10.24		11	22		0.76	11.76		29	20	0	49	22	235		257
	12	9.24	9.24	9.24	11	24	40	1.76	14.76	30.76	28	196	56	280	49	2,893	1,723	4,665
	Total										90	216	56	362	80	3,128	1,723	4,931
Paraiso	5										0	0	0	0				
	8		10.24			40			29.76		0	15	0	15		446		446
	12		9.24	9.24		55	90		45.76	80.76	0	45	44	89		2,059	3,553	5,613
	Total										0	60	44	104		2,506	3,553	6,059

Notes 1) Hauling distance of wood:
In Fig. 4-9 “Distance from Wood Market”, the average distance from an afforestation site to a wood market is estimated to be approximately 30 km in a straight line. Accordingly, the distance using a road is assumed to be 45 km. Given the road conditions in Paraguay where the ratio between paved roads and earth roads is roughly estimated to be 20: 80, this 45 km journey is assumed to consist of 9 km of paved road and 36 km of earth road.

2) Estimation of transportation cost/m^3 (based on “Transportation Tariff for Logs in Argentina”)

Paved road (A) : US$ 0.67
Earth road (B) : US$ 2.57
Transportation cost (A + B + 1) : US$ 4.27

3) The cutting and hauling cost in Argentina is used here (US$ 6.5 for first thinning, US$ 6 for second and further thinning and US$ 5 for final cutting).

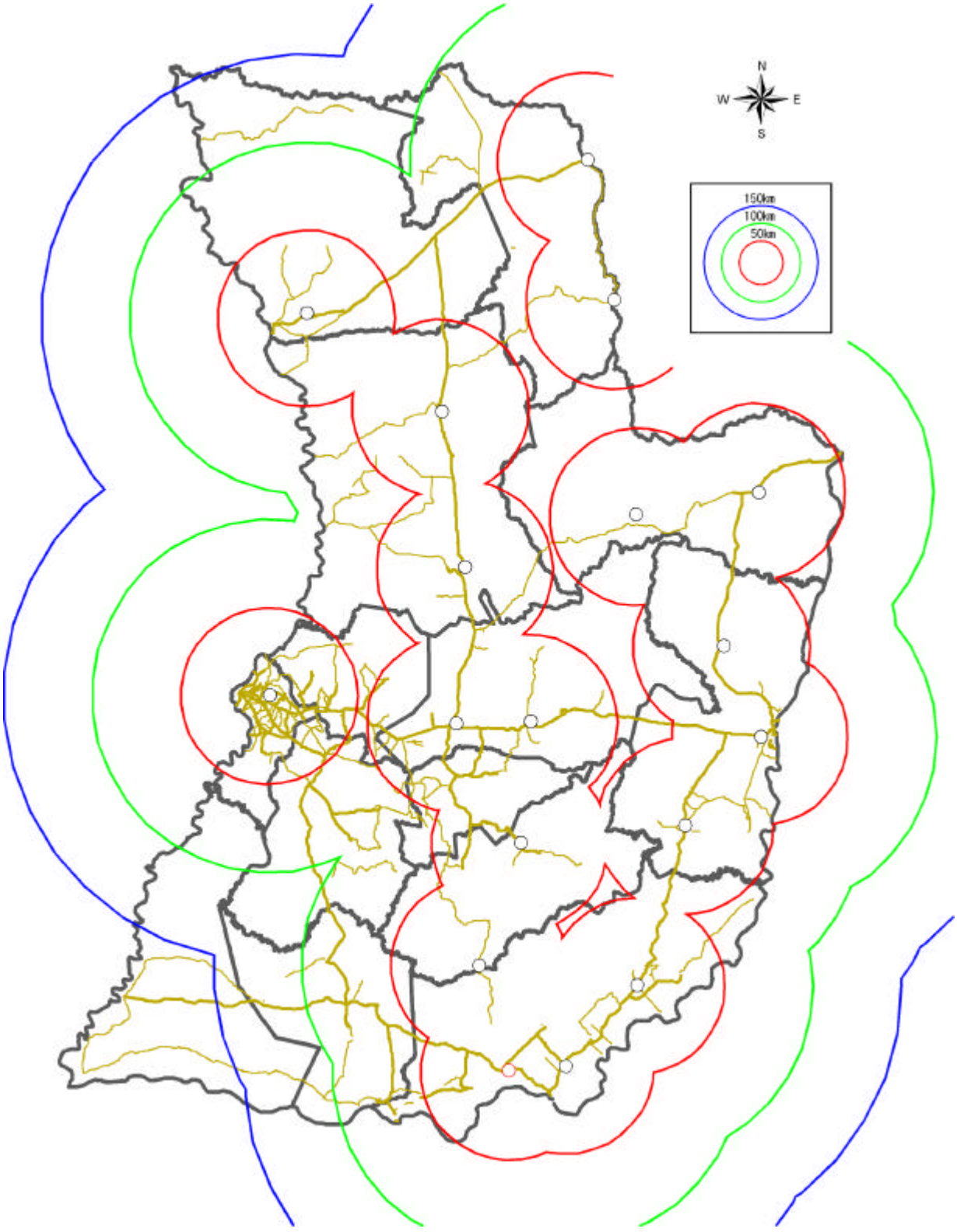


Fig. 4-10 Distance from Wood Market

From the technical point of view, there is no reason to object to the use of the sawing equipment currently used to saw wood from natural forests for the sawing of pine and eucalyptus wood from artificial forests. As the latter is generally softer than the former, a change of the teeth setting of the saw is all that will be required. In fact, there are cases of sawmills which used to saw wood from natural forests now specialising in sawing wood from artificial forests without any change of the machinery at all or with minor changes of the machinery to improve the productivity. There are many sawmills which use the same machinery to saw both wood from natural forests and wood from artificial forests. Many sawmills with a small production volume serving the local demand belong to this category. In the case of plywood plants, both wood from natural forests and wood from artificial forests can be processed using exactly the same machinery. This is especially true in the case of paraiso wood.

Judging from the above situation, the conventional sawing system should be sufficient for small sawmills serving the domestic market. In contrast, however, sawmills aiming at exporting their products are required to efficiently produce high quality timber to survive the competition with sawmills in neighbouring countries. This means that these sawmills will require a twin saw which can saw several pieces of timber from a log at the same time, a multiple edger with 4 – 6 blades and an artificial drying system. In addition, production facilities for finger joint laminated wood will also be required to produce high quality products together with flooring production machinery and finishing machinery, including a grinder, as a means of increasing the added value of products.

To improve conventional sawmills to make them capable of producing highly value-added flooring with high efficiency, a twin circular saw and flooring manufacturing machinery, costing some US$ 55,000 are newly required. It is said that investment of more than US$ 5 million is required to build a medium size export-oriented modern plant (for example, a plant equipped with (i) two sawing lines for medium and large diameter logs and small diameter logs, (ii) machinery to produce such finished products as laminated wood and flooring and (iiii) an artificial drying system) with a monthly production capacity of some 18,000 tons. In the case of a plywood plant, investment of at least US$ 3 million is said to be required to build a new plant with a monthly production capacity of some 2,000 m^3.

Given these estimates, some type of subsidy is believed to be necessary to cover the machinery cost when the production of wood from trees planted under the present afforestation plan commences.

(3) Prospects of Export Market

In regard to the prospects of timber exports from Paraguay, the Master Plan Study for the Development of Forest Products Industry in Uruguay (JICA, 1999) forecasts that "the long-term global demand for timber (non needle-leaved trees) will increase from 126.33 million m^3 in 1997 to 187.97 million m^3 in 2020 with an average annual increase of 2.68 million m^3". The same study also forecasts that "the demand for timber (needle-leaved trees) will increase from 315.84 million m^3 in 1997 to 459.43 million m^3 in 2020 with an average annual increase of 6.24 million m^3". In view of such a forecast, the prospects of timber exports from Paraguay appear to be promising depending on certain conditions.

At present, wood exported from Paraguay is almost entirely wood from artificial forests and the leading importing countries are such neighbouring countries as Argentina, Brazil and Chile where the production volume of wood from natural forests is small. These countries are already exporting wood from artificial forests and their production facilities, processing technologies and product design are superior to those of Paraguay. They will, therefore, be powerful competitors when wood from artificial forests becomes the main component of Paraguay's wood exports. The domestic demand in these countries is currently fairly large, however, and there is no strong orientation towards exports except for needle-leaved timber produced in Chile. One good example of the present situation is Argentina where the consumption volume still exceeds the production volume in the case of wood from non needle-leaved trees. Among the planted species, paraiso is highly marketable abroad because of its qualitative similarity to cedro. In these neighbouring countries, the planted area of paraiso is not yet very large and the absence of competitors gives paraiso strong export competitiveness. The expected export markets are European countries, the US and Asian countries in addition to Argentina and Brazil.

The absence of an ocean port given the fact that Paraguay is an inland country has proved to be a major obstacle for Paraguay's exports to effectively compete with those of neighbouring countries. The establishment of the MERCOSUR has, however, mitigated this problem and the slightly longer transportation distance does not necessarily pose a serious disadvantage for Paraguay compared to Argentina and Brazil. The fact that the completion of the Yacyreta Dam has made it possible for large vessels to travel to Encarnacion as in the case of Asuncion is another advantageous development for Paraguay. Compared to Brazil's Parana State which is a major artificial forest area, the Eastern Region of Paraguay is in a disadvantageous position in terms of the transportation distance to an export port. Its conditions are, however, similar to those of Misiones Province which is a major afforestation area in Argentina. The lower labour and electricity costs and fertile land in Paraguay can prove to be an advantage for

Paraguay. The important task for Paraguay in the coming years will be to catch up with Brazil and Argentina in the fields of sawing and processing technologies and product design. Conceivable measures to achieve this are listed below.

① Introduction of production facilities equipped with highly efficient sawing machinery and drying facilities suitable for a wood production system relying on artificial forests and the establishment of a system to produce highly value added final products in Paraguay

② Spread of the use of wood from natural forests at home to divert wood from natural forests, which has rarity value from the global point of view, for export and the production of overlaid glued laminated timber and overlaid plywood combining wood from natural forests and wood from artificial forests

③ Strengthening of university and research organizations to improve the processing technologies and design strength, improvement of the quality through the standardisation of wood products and the introduction of adequate standards

For the realisation of these measures, supporting measures should be introduced by the government together with stronger awareness and efforts by the wood industry.

The US which is a relatively short distance away from Paraguay will provide the largest market for wood products using planted trees. Such European countries as Italy and Spain, Taiwan and some other countries can also be considered promising export markets given their historical ties with Paraguay in terms of wood trade.

One factory in Ciudad del Este is already producing sawn timber and laminated wood and is exporting beading, window frames and flooring produced by the finger joint method to the US at the same prices as Brazilian products.

4.3.2 Prospects of Wood Demand

(1) Domestic Demand

1) Industrial Logs

It is believed that the domestic demand for wood products will steadily increase in the coming years due to the population increase and progress of economic development, particularly improvement of the living and educational standards in rural areas. Moreover, there will be a strong consumer drive for good quality but inexpensive products.

Table 4-51 Wood Demand Forecast (2020)

	Domestic Demand	Export Demand	Total
Logs			
Industrial	633,000	1,929,000	2,562,000
Agricultural	378,000	0	378,000
Sub-Total	1,011,000	1,929,000	2,940,000
Electric Poles	434,000	0	434,000
Fuelwood	3,637,000	191,000	3,828,000
Total	5,082,000	2,120,000	7,202,000

The domestic demand up to 2020 is expected to grow in proportion to the economic growth rate during the period. Here, an annual economic growth rate up to 2010 and thereafter up to 2020 of 3.1% and 2.4% respectively is assumed based on "Scenario 1: Preservation of the Present Standard" of the Study on Economic Development in Paraguay (JICA, 2000).

Based on the domestic demand for industrial wood in Paraguay of 368,000 tons in 2000, the corresponding demand in 2020 can be calculated as follows.

$$368{,}000 \times (1 + 0.031)^{10} \times (1 + 0.024)^{10} = 633{,}000 \text{ (tons)}$$

As already described in 4.2.3-(2), the construction of a new pulp plant is planned. If this plant is built, it will demand the annual supply of 600,000 tons of industrial logs (E. grandis), substantially changing the scale of the future demand. Given the uncertainty of this plan at present, however, this plant is not included in the future domestic demand.

* Scenario 1: Preservation of Present Standard

The economic growth rate required to preserve the present living standard must match the growth of the population. The past performance of Paraguay's economic growth rate shows an average growth rate of 2.5% for the period from 1990 to 1998. If it is assumed that the economic growth rate will remain at the level of the predicted growth rate of the productive population shown in Table 4-52, there will be no scope for improvement of the living standard. Given the fact that the baby boomer generation will reach working age during the target period of the action plan (2000 – 2006), the annual growth rate of the productive population of 3.1% will far exceed the predicted population growth rate for the same period of 2.4% a year. The difference between the two rates means an

increase of unemployment. Accordingly, the target GDP growth rate for the period from 2000 to 2006 should be above 3.1% if possible.

Table 4-52 Predicted Population and Productive (Working) Population Growth Rates

Period	Population Growth Rate (%)	Productive Population Growth Rate (%)
2000 – 2010	2.4	3.1
2000 – 2020	2.1	2.4

2) Agricultural Logs

The demand for agricultural logs has recorded an average annual growth rate of 2.6%. Because of the likelihood of alternative products being progressively used, the demand in 2020 is assumed to be similar to the present demand of 378,000 tons.

3) Logs for Electric Poles

It is also assumed that the demand for logs to produce electric poles in 2020 will remain at the present level of 434,000 tons on the grounds that the increased demand for poles due to the extension of transmission and distribution lines will be met by concrete poles.

4) Fuelwood

It is again assumed that the demand for fuelwood in 2020 will remain at the present level of 3,637,000 tons for domestic consumption and 191,000 tons for export. The underlying reason for this assumption is that despite the global trend of switching from fuelwood to electricity and natural gas, etc. as the main energy sources, there is a prospect of the continued supply of inexpensive fuelwood in Paraguay. The possible increase of the fuelwood demand in view of the urged reduction of fossil fuel consumption due to environmental considerations also contributes to this assumption.

(2) Export Demand

When wood exports from Paraguay mainly consist of wood from artificial forests because of the decrease of natural trees in the future, Paraguay will face an extremely difficult situation of trying to secure US and European markets while competing with such neighbouring countries as Argentina, Brazil and Chile which are more advanced in terms of production facilities and technologies. Meanwhile, maintenance of the present export level may be viable for Paraguay in view of the steady increase of the global demand for wood in the future and the assumed implementation of the various measures

mentioned earlier to improve the production facilities and technologies in Paraguay to catch up with its neighbours. Accordingly, it is assumed that the demand for industrial logs for export will remain at the present level of 1,929,000 tons.

Based on the above assumptions, the total demand for wood in 2020 is assumed to be 7,202,000 tons (Table 4-51).

4.4 Examination of Afforestation Assistance System and Fund Raising

4.4.1 Afforestation Assistance System

(1) Background of Subsidy System Under Law No. 536

The Government of Paraguay has had long-standing concern regarding the rapid decrease of the country's natural forests and introduced a system to provide some incentives to encourage afforestation by the early 1990's. However, this system failed to have much impact on afforestation activities in Paraguay.

Facing an accelerated decline of the natural forest area in these years, Law No.536 (Afforestation Promotion Law) was submitted to the parliament in 1994 to establish a subsidy level of as high as 75% of the afforestation cost to create a sizable afforestation industry in Paraguay and was enacted in early 1995. It is said that the competent authority planned a revision of the subsidy level after a few years on reviewing the subsidy awarding trend.

(2) Afforestation Performance and Effects of Subsidy System

The promise of a very generous afforestation subsidy led to a national surge of interest in afforestation work under Law No.536 and the rapid spread of afforestation work created some 30,000 ha of planted area by 2000 with some 10,000 ha being planted in both 1997 and 1998.

Note: As explained in Chapter 4, the total area of approved afforestation plans by the SFN up to September, 2001 exceeded 110,000 ha, indicating strong willingness to conduct afforestation work.

The payment of a generous afforestation subsidy under Law No. 536 was certainly effective in promoting serious afforestation work in Paraguay, including the practice aiming at large-scale farmers and stock farmers of hiring afforesters to conduct

afforestation in expectation of a subsidy payment. At the same time, Law No. 536 has assisted afforesters specialising in contracted afforestation work to firmly establish their business.

Meanwhile, some enterprises which commenced industrial afforestation in response to the afforestation promotion measures under Law. No. 536 are said to have conducted such work in order to receive a large subsidy and there are many cases where pruning and other tending work after planting have not been conducted, leaving the afforestation sites almost unattended. If a large proportion of the wood to be cut at these afforestation sites in the future is sold as low priced fuelwood or pulpwood, it will be tantamount to the waste of precious economic resources. There is concern that an excessive subsidy will have a negative economic outcome.

(3) Response to Problems Currently Faced by Law No. 536

The virtual non-payment of the subsidy since FY 1999 because of the substantial reduction of the Ministry of Finance budget due to the tight fiscal situation of the country has caused a rapid decrease of the planted area. As described earlier, the subsidy system is currently facing many problems six years after the enforcement of the Law as summarised in 4.1.2-(1)-1)-④. The promotion of afforestation with the subsidy system in the coming years will require (i) a proper understanding of the subsidy system by the public and (ii) conformity of the existing afforestation subsidy system with the reality of government finance and other relevant issues. For these purposes, the following measures should be implemented.

1) Clarification of Purposes of Law No. 536

As the clear basis for the provision of an afforestation subsidy using the government budget, the status of afforestation work led by the government should be defined, for example, as follows.

a. Priming for the development of local industries (creation of infrastructure for forestry and forest products industry)
b. Public investment for the development of social infrastructure (conservation of forest functions to benefit the public)
c. Welfare measures to combat poverty, etc. (creation of employment, etc.)
d. Obligation to restore forests which have been subject to excessive development

2) Measures to Promote Maximum Afforestation with Limited Budget for Afforestation Subsidy

a. Reduction of the subsidy rate (currently 70% → 50% → 30%)

b. Change of the uniform subsidy rate (subsidy rate in inverse proportion to the scale of land ownership)

c. Elimination of subsidy concentration on a small number of afforesters (subsidy provided for a planned afforestation area below a threshold)

d. Combination with a low interest loan and/or preferential taxation system, etc.)

e. Introduction of a realistic standard unit price

3) Measures to be Examined to Ensure Smooth Implementation of Subsidy System

a. Simplification of various administrative procedures to benefit afforesters

b. Decentralisation of subsidy-related administrative work and improvement of the subsidy awarding system

c. Partial privatisation of the plan approval work and implementation inspection work and strengthening of the administrative unit responsible for guidance on entrusted work

The above measures are put forward to promote maximum afforestation with the effective use of a limited subsidy budget under a situation where the fiscal base of the government is extremely weak.

Nevertheless, it is judged that the promotion of afforestation work for 50,000 ha under the Five Year Afforestation Programme and for a total of 400,000 ha under the Master Plan described in Chapter 5 with the existing afforestation subsidy system will be extremely difficult. It is, therefore, essential to introduce domestic as well as foreign investment funds to materialise the planned afforestation work under the Master Plan.

(4) Theoretical Basis for Subsidy System

Here, the theoretical basis for the subsidy system is examined. In principle, the provision of an incentive, such as a subsidy, for afforestation work is justified when the economic return from afforestation work exceeds the economic return from other production activities (farming and stock raising, etc.) Economic return here means not only the financial benefit but also the social, cultural and all other benefits, including positive impacts on the environment. As it is difficult to quantify these non-financial benefits,

various encouragement measures are introduced based on the administrative judgement that the non-financial benefits of forests are substantial. Various incentives are provided in many countries throughout the world to increase the forest area based on such judgement.

In Paraguay, there is no evidence that the suitability and justifiability of the subsidy in question as well as the subsidy level were verified prior to the enactment of Law. No.536. It is assumed that the case of Chile where afforestation work by the private sector has been successful with a subsidy of 75% of the afforestation cost and others were referred to.

Afforestation work in Paraguay can expect to achieve a high level of profitability as described in 6.4.1 – Financial Analysis. Nevertheless, the conventional subsidy system with a uniform subsidy level regardless of the afforestation scale should at least be modified.

Small-scale farmers should be given special consideration in view of the unique character of afforestation work. Moreover, the introduction of a loan scheme which is suitable for the unique character of afforestation work should be considered for medium and large-scale land owners.

(5) Loan Scheme for Afforestation

If the profitability of afforestation work is comparable with that of agriculture or stock raising, it can generally be argued that the work can be left to the judgement of individual farmers or stock farm owners without the involvement of a subsidy. For the promotion of the Master Plan, however, the establishment of a loan scheme is deemed necessary with due attention paid to the unique character of afforestation work together with the provision of preferential measures for small-scale farmers and technical support by forestry-related organizations for afforesters.

1) Funding for Afforestation Sector

Two distinctive characteristics of afforestation work after initial planting are as follows.

① At least 4 – 10 years are required for some form of cash income to materialise.
② 15 – 25 years are required for substantial income from final cutting to materialise.

Even if the profitability of afforestation work is confirmed by theoretical calculation, the work significantly affects the cash flow of individual afforesters. This is the major difference between afforestation work and farming or stock raising which in theory produces income every year.

The preparation of a loan scheme which incorporates preferential measures suitable for the characteristics of forestry is, therefore, necessary to promote afforestation work. To be more precise, both the loan period as well as the grace period should be long. It is even better if a reduced interest rate is applied.

What must be noted is that even if a loan with excellent conditions is secured with the first repayment of the principal being due in several years time, the borrower is required to repay the interest from the first year of the loan. Because of the lack of income from an afforestation site for a long time, an afforestation project depending on a loan is not viable unless the borrower has another source of income to raise cash to make the loan repayments in the meantime.

The adoption of agroforestry can reduce the burden on cash flow but does not appear to fully solve the cash flow problem because of (i) the relatively small income from agroforestry and (ii) the short production period of agroforestry compared to the loan period.

2) Loan Scheme for Afforestation Work

Based on the opinions expressed by several financial institutions in Paraguay, the likely loan scheme for afforestation work is outlined below, assuming the financial support of an overseas aid organization(s).

Loan amount	:	up to 75% of the required fund
Loan period	:	10 years (maximum of 12 years)
Grace period	:	2 – 3 years
Annual interest rate	:	Guarani-based loan – 20- 30%; US$-based loan – 4 – 8 %
Collateral	:	registered real or movable property, including land and house
Guarantee	:	joint and several liability by guarantor with equal or higher creditability than the borrower if real property cannot be provided as collateral. In the case of a group, all other members of the group become sureties liable joint and severally.

Note: The above loan conditions are based on the results of interviews with several domestic financial institutions and there is no guarantee that an afforestation loan scheme will be

established in Paraguay with these conditions. Some financial institutions using domestic funds to provide loans for afforestation work with a loan period of five years and an annual interest rate of approximately 22%. As these loans presume the awarding of a subsidy under Law No.536, their conditions cannot be compared to those of the loan described above.

As loans which can be obtained by the Government of Paraguay have a period of 20 – 25 years, it is possible for the government to extend the above-mentioned loan period, assuming the use of a two-step loan. Some financial institutions have, indeed, expressed such an intention.

The longer the loan period is, however, the higher the risk for a financial institution. In fact, the risk progressively increases. In order to maintain the health of financial institutions, an ultra long loan with a loan period of more than 10 – 12 years may be unrealistic to fund business activities.

The loan conditions for afforesters are determined to reflect the intentions of financial institutions which bear the credit risk and it appears to be practically impossible to expect financial institutions to offer conditions which perfectly match the unique cash flow of afforestation work.

3) Special Consideration for Small-Scale Farmers

As mentioned earlier, many small-scale farmers have participated in afforestation work under Law No.536. Their participation has been stimulated by the high subsidy level which has had the effect of turning home labour into cash. If the continuation of the present subsidy system is untenable, the participation of small-scale farmers must be examined from a new viewpoint.

Ultra-small farmers and tenant farmers (share-croppers): In view of the unique characteristics of afforestation work described earlier, the possibility of ultra-small farmers who possess extremely small land and mainly produce crops for self-consumption participating in afforestation work seems to be virtually non-existent (except in the following cases). The same can be said for tenant farmers who cultivate rented land.

Group borrowing by small-scale farmers: A large number of small-scale farmers are said not to have completed the registration of their land. (Therefore, they cannot use their land as collateral). The common measure to supplement their creditability in such a case is to organize farmers into groups, such as agricultural cooperatives, so that all participating farmers have joint and several liability. However, the demand

for joint and several liability for afforestation work, which does not produce any income for a long period of time, could constitute an excessive risk for the participating farmers and it is unlikely that this mechanism will satisfactorily function in the forestry sector.

Individual borrowing by small-scale farmers: It may be possible to provide an afforestation loan for those farmers who have some surplus production capacity and who have registered their land. For most small-scale farmers with limited surplus production capacity, however, the problem of a cash flow deficit for a long time, which is unique to forestry, remains unsolved.

Realistic measures for small-scale farmers: Based on the above examination, small-scale farmers cannot be expected to obtain a loan to fund the afforestation cost. There are, however, three realistic schemes to allow the participation of small-scale farmers in an afforestation project.

① Free Aid

The government provides such inputs as seedlings and agricultural chemicals (insecticide and fertiliser, etc.) free of charge while farmers provide their own labour. In this way, small-scale farmers with some surplus production capacity and surplus labour can conduct afforestation work.

② Loan Via Saw millers

Some saw millers who are forced to reduce their production volume or even to relocate their sawmill due to the decrease of raw materials are willing to provide free seedlings and agricultural chemicals for small-scale farmers in areas around their sawmill in order to encourage afforestation work to secure the supply of raw materials. The use of the funds raised by these saw millers using the loan scheme to finance the free supply of seedlings, etc. will allow the participation of small-scale farmers in an afforestation project. Farmers will hand the cut wood over to the saw millers in accordance with an agreed contract. The formula to calculate the profit shares of the two parties must be determined in advance.

③ Loan Via Agricultural Cooperatives

There is an example of an agricultural cooperative which provides an afforestation loan for its members with a view to obtaining firewood for the

silo. Under this mechanism, agricultural cooperatives with some degree of creditability can be considered for a loan.

Original fund	:	own fund of agricultural cooperative
Loan amount	:	approx. US$ 290/ha
Loan period	:	six years
Repayment method	:	repayment in kind with the harvested firewood; surplus firewood is purchased by the cooperative at the current price to create income for its members
Target area	:	100 ha (total funding required: approx. US$ 29,000)

Based on the above consideration, the following financing support schemes are to be examined for possible introduction under the project to implement the Afforestation Programme.

Medium and large-scale land owners	⇔	advantageous loan scheme
Small-scale land owners	⇔	free supply of afforestation inputs
	⇔	Loan via sawmillers
	⇔	Loan via agricultural cooperatives

4) Confirmation of Funding Demand

According to the findings of the survey on afforestation intentions described in 4.2, 24%, 32% and 14% of those willing to conduct afforestation work would opt for “entirely a loan”, “combination of a loan and a subsidy” and “own funds” respectively as a means of raising afforestation funds. Even though no concrete loan scheme was presented during this survey, it appears safe to assume that a relatively large proportion of potential afforesters have a funding demand for afforestation work.

5) Planting After Final Cutting

Afforestation work under the planned project will predominantly be conducted by private afforesters who will cut most artificial forests in due time to recover their investment.

Given the life of approximately five years of the afforestation loan scheme under the project, it is assumed that the situation of the afforestation sites after final cutting will resemble that prior to the commencement of the project.

One of the unique features of afforestation work is that the required funds are to almost entirely cover the production cost and, therefore, the level of funds required for re-investment is similar to that of the initial investment.

As the availability of a further loan scheme for reforestation cannot be assumed, the main funding source for reforestation will be the own funds of afforesters. Those afforesters who have obtained the profit level expected of long-term investment or even better profits may input some of the profits to reforestation work. In general, however, it is difficult to imagine that the scale of reforestation work will exceed the scale of the initial afforestation work.

(6) Question of Intermediary Financial Institutions

1) Presence of Intermediary Financial Institutions

For the development of a loan scheme for afforestation work, it is essential to confirm the presence of suitable intermediary financial institutions in Paraguay. Several representative government-affiliated financial institutions have been contacted in the course of the Study and many of them are willing to provide an afforestation loan, indicating the existence of reliable channels for the financing of afforestation work.

2) Reform of Government-Affiliated Financial Institutions

In accordance with consultations with the IMF and other international organizations*, the Government of Paraguay is to merge or abolish government-affiliated financial institutions. The historical background and current situation of the planned reform are outlined below.

* IMF, Paraguay, Staff Report for 2001 Article IV Consultation, 20 April, 2001

- Although the reform of government-affiliated financial institutions commenced around 1994, no tangible progress has yet been made.
- In 2000, a draft law to merge government-affiliated financial institutions was sent to the President's Office. The basic concept of this law is to integrate all government-affiliated financial institutions to the newly created Bank of the

Republic of Paraguay (BRP) so that the BRP can have both retail and wholesale functions. Although this draft law has been submitted by the President's Office to the parliament, it has not yet been discussed. It is now said that the law will be shelved in the end.

- Related international organizations oppose the above law and have instead proposed the establishment of banks to be responsible for the retail sector and the wholesale sector. A new study on this alternative proposal is due to commence. One possible idea is the merger of the National Industrial Bank (BNF), the Agricultural Development Credit Union (CAH) and the Livestock Fund (Fundo Ganadero) to form a bank responsible for the retail function while integrating the Industrial Development Fund (FDI), the Small Farmers Development Fund (FDC) and the Programme Execution Technical Unit (part of the Central Bank) into a bank responsible for the wholesale function.
- While there is a strong likelihood that the direction of reform will follow the lines presented above in several months time, nothing has yet been decided.
- One of the proposals made by the IMF in regard to the reform of the BNF is the specialisation in small loans for agriculture, agro industry and forestry (an upper limit of US$ 15,000 for individuals and US$ 50,000 for agricultural cooperatives, etc.) to allow private banks to handle large loans. It is unknown if this proposal will be implemented or if it will be applied to other government-affiliated financial institutions.

As described above, even if individual financial institutions show strong interest in afforestation loans, the future uncertainty regarding the possible merger or abolition of government-affiliated financial institutions is making everyone sit back to observe future developments.

3) Creation of National Forestry Fund

There is an initiative among organizations related to forestry to establish the National Forestry Fund (FFN) as a specialist financial institution for forestry and the relevant draft law has been submitted to the parliament. The status of the FFN, however, cannot be clearly established unless the general trend of the merger and abolition of government-affiliated financial institutions is determined. Accordingly, the future of this initiative is uncertain. Even if the FFN is established, many years will be required for its loan activities to be on track, eliminating the FFN as a candidate intermediary financial institution for the afforestation funds discussed at present.

4.4.2 Fund Raising by the Government

The relevant issues for the formation of a concrete afforestation project are examined below.

(1) Annual Borrowing Limit for Paraguay

Some international organizations consider the annual borrowing limit for Paraguay to be approximately US$ 120 million in view of Paraguay's repayment capability. Even though this figure is not internationally recognised, it still gives a rough idea of the annual borrowing limit for all sectors, including the forestry and agricultural sectors. In recent years, the amount of borrowing per project has been approximately US$ 10 – 40 million except for large-scale infrastructure development projects.

(2) Accumulated Foreign Debt

The ratio of accumulated foreign debt in Paraguay's GDP has sharply increased to the level of around 30% in recent years because of the execution of large loans in the last two years. During the period shown in the following table, the debt service ratio (ratio of interest payment and repayment of the principal to the total export value) almost doubled from 4.8% to 8.8%. The IMF predicts that this high debt service ratio will gradually decline in the coming years. Nevertheless, it is essential to consider the overall situation of Paraguay's foreign debt when discussing the size of individual projects.

(Ratio to GDP, %)

	1995	1996	1997	1998	1999	2000
Accumulated Foreign Debt	15.8	14.9	16.1	19.3	28.9	31.8
Debt Service Ratio	4.8	4.7	4.4	5.1	6.7	8.8
Fiscal Balance	-0.3	-0.8	-1.4	-1.0	-3.6	-4.5

Source: IMF, Paraguay, Staff Report for 2001, Article IV Consultation, 20 April, 2001

(3) Counterpart Fund

A project loan usually requires the provision of a counterpart (C/P) fund amounting to 20 – 25% of the loan itself. The main component of the planned project is an afforestation loan scheme and the C/P fund will mainly be provided in the form of the own funds of afforesters. Accordingly, it is unlikely that the project will impose a heavy burden on government finance. Even so, the fiscal balance of the Government of Paraguay has been continuously in the red and a sizable fiscal deficit has occurred in the last two years because of major expenditure to form government capital. As the same factor is behind

the increased fiscal deficit and the increase ratio of accumulated foreign debt to the GDP, the situation is expected to improve in the coming years. However, careful consideration is still required in the formulation of new projects given the continuing trend of a fiscal deficit and reports that the payment of salaries to some public sector employees has been delayed.

(4) Planned Afforestation Area

Under the policy to promote afforestation with a high subsidy level set forth by Law No.536, the peak annual planting performance was slightly more than 10,000 ha. Because of the virtual collapse of this subsidy system, it is difficult to infer whether or not the annual afforestation area has further increased in recent years. Even though the private sector is believed to have a strong will to conduct afforestation work, it is unlikely that afforesters (at least medium or large-scale afforesters) will enjoy better conditions under a new afforestation plan. It is, therefore, unrealistic to assume the viability of an afforestation plan covering several tens of thousand ha a year in the near future.

(5) Markets for Products and Risks

Possible markets for the planned planting species are predicted in 4.3.1. The domestic production volumes of these species have so far been quite small, however, and there is no 100% guarantee of future markets, particularly export markets, for the species in question. It can be said that the market risk is larger in accordance with a larger scale of afforestation.

Meanwhile, if the species planted to produce timber are only sold as fuelwood, the expected investment effect of the afforestation project will not materialise.

CHAPTER 5 AFFORESTATION PLAN (MASTER PLAN) FOR EASTERN REGION

CHAPTER 5

AFFORESTATION PLAN (MASTER PLAN) FOR EASTERN REGION

5.1 Basic Concept of Master Plan

In view of the importance of wood production for the national economy, the supply of wood resources from afforestation sites is essential to meet the wood demand in the future when natural wood resources are on the decline. Here, the creation of production forests in the Eastern Region is planned to secure wood resources and to create local employment opportunities in the said region. This afforestation plan sets forth the basic matters as the Master Plan to promote afforestation in the Eastern Region and acts as a guideline for the formulation of actual afforestation plan (projects) for the recommended afforestation areas which have strong potential for the creation of production forests.

The survey on afforestation intentions which was conducted in the recommended afforestation areas found that 87% of land owners in the said areas are interested in the implementation of afforestation work. Based on the findings of the said survey and the land cover map, it is inferred that approximately 380,000 ha out of the some 4.05 million ha of the said areas is expected to be planted by those land owners interested in conducting afforestation on their land. There is a strong intention to create forests producing timber wood, fuelwood and pulpwood regardless of the current land use, being it farm land, pasture land or shrub land, provided that the land is deemed suitable for planting. Strong interest is also shown in the creation of windbreak forests and boundary forests. The most popular planting species are found to be eucalyptus, paraiso, lapacho and pine.

Taking such intentions into consideration, the present Master Plan is primarily formulated for the recommended afforestation areas in the Eastern Region and the target sites as farming land, pasture land and shrub land. The survey on the wood demand found that the domestic demand for wood products is expected to steadily increase in the coming years and that there is a strong demand for fuelwood in addition to timber wood. The construction of a pulp plant locally is also plotted. At stock farms, shelter forests for animals are required to protect them from the severe cold winds and scorching temperatures. Existing cases of agroforestry in the Eastern Region suggest that agroforestry is feasible not only with afforestation by small-scale land owners but also with large-scale afforestation. Accordingly, the Master Plan provides for various types of forest management to suit the production of timber wood, production of pulpwood, production of fuelwood, agroforestry and silvopasture depending on the specific local conditions. More than one forest management type is proposed for each site so that each

land owner can select the preferred forest management type. The Master Plan does not specify the target area by forest management type.

The main planting species are eucalyptus, pine and paraiso based on the wood demand prospects, findings of the survey on afforestation intentions and local natural conditions, etc.

The target area for afforestation is 400,000 ha as described next based on the findings of the survey on afforestation intentions, wood demand prospects and recommendations of the National Forestry Board.

5.2 Target Work Volume for Afforestation

(1) Target Work Volume

In its recommendations for forestry policies, the National Forestry Board suggests that the target area for afforestation in the near future should be one million ha, taking the environmental impacts of such work into consideration, and that this target should be achieved in 20 years. A target afforestation area of 400,000 ha was adopted at the time of the enactment of Law No. 536 (Afforestation Promotion Law) (as described in the request made to the Government of Japan regarding the present project).

Meanwhile, the required afforestation area in view of the estimated future demand for wood, feasible supply volume of wood from natural forests and required supply volume of wood from afforestation sites is estimated to be approximately 400,000 ha (*1). The estimated afforestation area which is expected to be achieved by local land owners interested in afforestation in the recommended afforestation areas is approximately 380,000 ha based on the findings of the survey on afforestation intentions and the land cover map (Table 4-49). In short, the afforestation of 400,000 ha of land, mainly in the recommended afforestation areas in the Eastern Region, is highly achievable in view of the afforestation area suggested by the recommendations of the National Forestry Board, the wood demand and the findings of the survey on afforestation intentions, etc.

*1 ① Predicted wood demand in 2020: 7,202,000 m^3 (based on 4.3.2 Prospects of Wood Demand)
② Possible supply volume from productive natural forests:
Total high forests and open forest areas
1,724,000 ha^{*2} × 146 m^3/ha^{*3} × 1% (growth rate) × 0.4 (utilisation rate) × 0.5 (log production yield) = 504,000 m^3
③ Required supply volume from artificial forests: ① - ② = 6,698,000 m^3
④ Required area for artificial forests: ③/17 m^3 (annual growth per ha of artificial forests) = 394,000 ha
*2 Productive natural forest area based on 1999 satellite images
*3 1998, SFN-JICA pamphlet

Based on the above examination results and the feasibility of conducting the required afforestation in an integral manner, the target work volume for afforestation in the near future is set at 400,000 ha which will be completed in 15 years, taking the required funding size and mean final cutting age (approximately 16 years) of eucalyptus, pine and paraiso into consideration.

(2) Period to Complete Target Work Volume

In regard to the period to complete the target work volume, it is aimed at completing the planting of 400,000 ha in three phases, each phase consisting of a period of five years generally employed by similar plans, and the work volume in each phase is examined.

To be more precise, the work volume in each phase must be realistically set to ensure the smooth achievement of the target work volume of 400,000 ha. The work volume in Phase 1 is, therefore, set at 50,000 ha based on the annual loan limit for Paraguay and the accumulated foreign debt, both described in 4.4.2, the planting capacity in the near future and the market risks for foreign products, etc. This Phase 1 is considered to be the period in which the foundations for the implementation of the Master Plan are consolidated. The work volume in Phase 2 will be increased to 150,000 ha utilising the work implementation system and experience in Phase 1. The work volume in Phase 3 will be further increased to 200,000 ha based on the strengthened work implementation system and experience in Phase 2. Accordingly, the average annual work volume for Phase 1, Phase 2 and Phase 3 will be 10,000 ha, 30,000 ha and 40,000 ha respectively.

In regard to the existing capacity to conduct planting work over the planned area, the Association of Afforesters in Paraguay* states that ① its members have planted some 20,000 ha in the last three years and have the potential to plant some 45,000 ha a year, ② once the scale of afforestation work is enlarged, it will be possible for land owners and enterprises possessing tractors and other suitable machinery to conduct afforestation work and ③ it is also expected that small afforestation contractors will be able to plant an area of 200 – 300 ha/year.

For reference, the highest annual afforestation performance in the Eastern Region under Law No. 536 in the past is approximately 12,000 ha (1997).

The above figures indicate that the planned work volume in Phase 1 can be easily achieved and that the planned work volume in Phase 2 and Phase 3 can also be achieved with little difficulty.

* This is a non-profit organization established by afforestation-related enterprises and individual persons, etc.

5.3 Management Framework

(1) Types of Land Management and Forest Management Methods

The subject sites for afforestation under the plan are farming land, pastureland and shrub land. The field survey found that there is no difference in terms of the natural conditions, which are usually important for the planning of afforestation, for the different types of land management, i.e. agriculture and stock raising, etc. Based on this finding, it has been decided not to specify the forest management method based on the present type of land management and scale of land ownership. Instead, several forest management methods which land owners may adopt to manage their afforestation sites are proposed for selection by each land owner.

In the case of small-scale land owners, only those belonging to a voluntary organization formed by small-scale land owners hoping to plant trees on their land are considered for the planned afforestation work from the viewpoint of the efficient management of such work.

(2) Types of Forest Management

1) Points to Note in Forest Management Method Examination Process

① The objective forests to be created are production forests.
② Afforestation plan is planned based on the present technical standard to start with.
③ At some afforestation sites with paraiso in some areas, die-back after yellowing of the leaves and other diseases are observed but no prevention measures have yet been established.
④ The subject site for afforestation sites in the recommended afforestation areas are mainly farming land, pasture land and shrub land.
⑤ The scale of land ownership in the recommended afforestation areas varies from small to large.
⑥ Some land owners and experts are calling for the creation of windbreak forests at farming land and pasture land and also for animal shelter forests at pasture land in view of (i) the seasonally strong winds at some sites and (ii) the need to protect grazing livestock from such harsh weather conditions as cold winds in winter and scorching temperatures in summer, etc. to mitigate the stress on the animals to ensure their healthy growth.
⑦ Sawmills are hoping to receive the supply of good quality logs from artificial forests.

⑧ There is a demand for fuelwood by brick factories, sugar plants, ironworks and agricultural silos.

⑨ The construction of a pulp plant in Paraguay is planned.

2) Forest Management Types

Several forest management objectives are established for the present plan, taking the points to note in 1) above into consideration. A specific forest management method is determined for each objective as shown in Table 5-1. Individual land owners select the preferred method to conduct afforestation work. The objective of each forest management type is outlined below.

Production Forest I-1 : creation of an artificial forest to mainly produce timber wood

Production Forest I-2 : creation of an artificial forest to mainly produce fuelwood and pulpwood

Production Forest II : combination of the production of paraiso timber wood and the cultivation of farming crops using the space in a forest belonging to so-called agroforestry where income from farming crops can be earned at the initial stage of creating an artificial forest

Production Forest III : creation of an artificial forest to produce timber wood and to protect grazing livestock from such harsh weather conditions as cold winds in winter and scorching temperatures in summer to mitigate the stress on the animals to ensure their healthy growth

Production Forest IV-1 : creation of an artificial forest to produce timber wood and to act as a windbreak forest to protect crops and grass at sites with strong winds (5 m/second or stronger)

Production Forest IV-2 : production of fuelwood and pulpwood instead of timber wood in production forest IV-1

Production Forest V : production of timber wood and use of newly created artificial grassland for grazing purposes

Table 5-1 Objectives and Target Sites by Forest Management Type

Forest Management Type	Objectives	Target Sites	Remarks
Production Forest I-1	Production of timber wood	Farm land, pasture land and shrub land	
Production Forest I-2	Production of fuelwood and pulpwood	Farm land, pasture land and shrub land	Production of fuelwood near a fuelwood consumption area
Production Forest II	Agroforestry	Farm land	Mainly targeting small-scale land owners
Production Forest III	Production of timber wood and protection of livestock	Pasture land	
Production Forest IV-1	Production of timber wood and windbreak forest	Farm land and pasture land	Areas with seasonally strong winds
Production Forest IV-2	Production of fuelwood and windbreak forest	Farm land and pasture land	
Production Forest V	Silvopasture	Farm land and pasture land	

(3) Forest Management Method by Forest Management Type

Table 5-2 shows the forest management method by forest management type. Further explanation of this table is given below.

1) For all Types

The planting distance is sufficiently wide enough to permit mechanised work

2) Production Forest I-1

Direct seeding can be conducted for the regeneration of paraiso. It is recommended that the planting area of paraiso be restricted to a size which can be regularly monitored from the viewpoint of the early detection and control of diseases.

3) Production Forest I-2

Regeneration after the second and third final cutting should be conducted by means of regeneration by sprouting.

4) Production Forest II

The planting species is paraiso which has high added value. The crops are generally maize, beans (French beans), cotton, bananas, pineapples, papayas and mate. When

the initial planting density is 4 m×4 m, crops can be cultivated at an afforestation site for approximately three years.

5) Production Forest III

Paraiso is excluded from the planting species in view of the possibility of diseases due to damage to the trees by animals. The suggested forest size is given below in consideration of the travelling distance of livestock.

a) If the grazing area is larger than 100 ha, one afforestation site with a minimum size of 2 ha is created per 100 ha of pasture land.

b) If the grazing area is less than 100 ha, one afforestation site with a minimum size of 2 ha is created.

6) Production Forests IV-1 and IV-2

The size of an artificial forest and its creation method are as follows.

a) Paraiso is excluded from the planting species in view of wind.

b) An artificial forest of some 100 m wide and the required length is created at a right angle to the prevailing wind direction on the windward side of farming land or pasture land for wind protection.

c) Firstly, an artificial forest of some 50 m wide is created and grevillea is planted in a some 10 m wide zone next to this forest belt on the windward side at the same time (planting density: 3 m×3 m). This grevillea belt will not be cut when the artificial forest is cut.

d) When the artificial forest created in c) above passes the halfway point to the final cutting age, the same species is planted on the leeward side to create an artificial forest of some 50 m wide.

e) When the artificial forest created in c) above reaches its final cutting age, it is cut, followed by planting of the same species on the cut-over area. The same procedure applies to the artificial forest created in d) above. However, in the case of production forest IV-2, regeneration after the second and third final cutting is by sprouting.

f) The interval between artificial forests is approximately 500 m in the direction of the prevailing wind.

As such, an artificial forest created as production forest IV-1 or IV-2 always grows behind a permanent grevillea forest belt located on the windward side. There is no clear cutting of all of the planted trees as the forest consists of trees of two different ages. Fig. 5-1 illustrates the process of creating this artificial forest (production forest IV-1).

7) Production Forest V

Paraiso and pine are excluded from the planting species in consideration of possible diseases due to damage to the trees by animals in the case of the former and shading by the branches in the case of the latter. The planting distance and sites for artificial grassland are illustrated in Fig. 5-2. The types of grass, timing of seeding and the grazing period for this type of production forest are described below.

a) The recommended types of grass for seeding are brachiaria (dies in winter) of Gramineae and calopogonio (grows in winter) of Leguminosae because of their high adaptability to the topography and soil fertility.

b) The recommended timing for seeding is September – November or March – April after the completion of the first weeding at the afforestation site.

c) Animals should only be allowed to freely graze some six months after seeding and after the planted trees have grown to more than 2 m in height.

Table 5-2 Forest Management Method by Forest Management Type

Production Forest Type	Regeneration Method	Species	Planting Distance (m)	Pruning*2	Thinning*2	Final Cutting					Remarks
						Cutting Method	Age	No. of Living Trees	Expected Diameter (cm)	Annual Growth/ha (m^3)	
I-1	Planting (direct seeding)*1	E. camal.	3×2.5 (3×3)	○	○	Clear	12	530	23	30	Including planting at roadsides and along boundaries
		E. grandis	3×2.5 (3×3)	○	○	Clear	12	530	25	37	
		M. azedarach	4×4 (4×5, 5×5)	○	○	Clear	12	210	38	20	
		P. taeda	3×3 (3×2.5)	○	○	Clear	25	300	33	14	
		P. elliottii	3×3 (3×2.5)	○	○	Clear	25	300	38	20	
I-2	Planting (sprouting)*3	E. camal.	3×2.5 (3×3)		○	Clear	8	760	19	29	As above
		E. grandis	3×2.5 (3×3)		○	Clear	8	760	20	36	
II	Planting (direct seeding)*1	M. azedarach	4×4 (4×5, 5×5)	○	○	Clear	12	210	38	20	Combination with maize, beans, bananas, papayas, cotton, mate, etc.
III	Planting	E. camal.	3×2.5 (3×3)	○	○	Clear	12	530	23	30	Pasture land of more than 100 ha: one site per 100 ha (minimum size of some 2 ha/site) Pasture land of up to 100 ha: one site (minimum size of some 2 ha)
		E. grandis	3×2.5 (3×3)		○	Clear	12	530	25	37	
		P. taeda	3×3 (3×x2.5)	○	○	Clear	25	300	33	14	
		P. elliottii	3×3 (3×2.5)	○	○	Clear	25	300	38	20	
IV-1	Planting	E. camal.	3×2.5 (3×3)	○	○	Clear	12	530	23	30	100 m wide (two zones planted at an interval of half the cutting period for alternate cutting); planting of grevillea on windward site; creation of forests at some 500 m intervals
		E. grandis	3×2.5 (3×3)	○	○	Clear	12	530	25	37	
		P. taeda	3×3 (3×2.5)	○	○	Clear	25	300	33	14	
		P. elliottii	3×3 (3×2.5)	○	○	Clear	25	300	38	20	
IV-2	Planting (sprouting)*3	E. camal.	3×2.5 (3×3)		○	Clear	8	760	19	29	As above
		E. grandis	3×2.5 (3×3)		○	Clear	8	760	20	36	
V	Planting	E. camal.	3×3 + 3×5	○	○	Clear	12	330	25	24	Combination with grazing on artificial grassland (calopogonia, branchiaria)
		E. grandis	3×3 + 3×5	○	○	Clear	12	330	27	30	

Notes 1) M. azedarach = paraiso
2) *1: M. azedarach may be directly seeded.
3) *2: ○ indicates the implementation of pruning or thinning.
4) *3: Second and third regeneration is by sprouting.
5) Growth is 10% more than the existing growth (3% higher in terms of both diameter and height).
6) The volume for E. camaldulensis is 20% lower than the volume of E. grandis (7% lower in terms of both diameter and height).

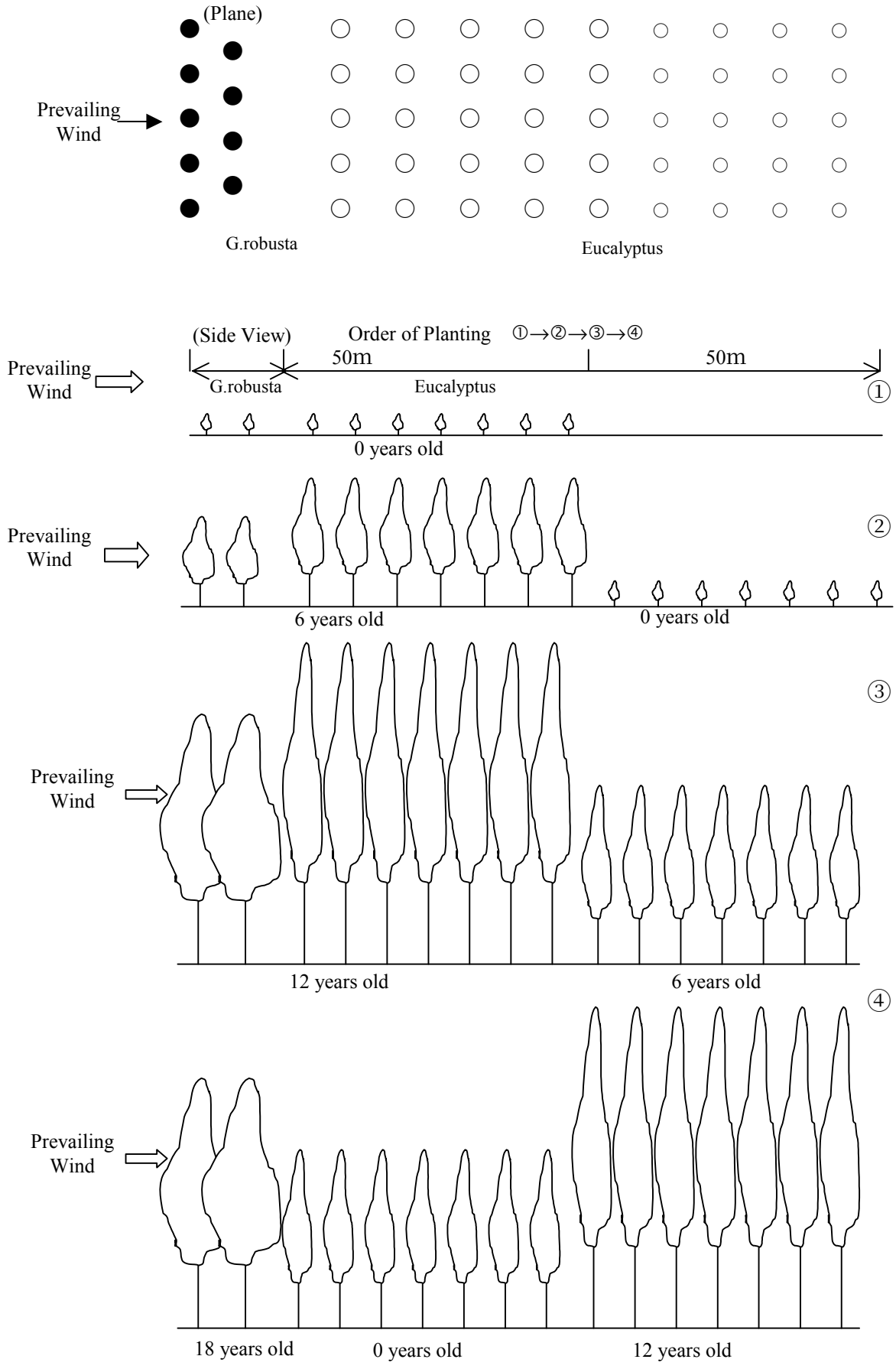


Fig. 5-1 Example of Artificial Forest of Production Forest Type IV-1 (Eucalyptus)

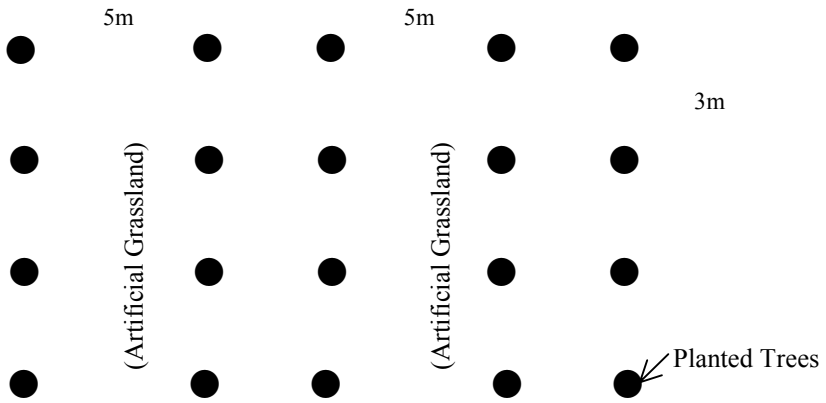


Fig. 5-2 Planting Distance for Production Forest Type V and Artificial Grassland

(4) Tending System by Forest Management Type

The tending system by forest management type is shown in Table 5-3 where the timing and extent of pruning and thinning are suggested to suit the objectives of forest management in regard to trees which have survived thanks to ant control measures around the time of planting and weeding after planting or direct seeding. Flexible tending is required in response to the growth situation of the planted (seeded) trees instead of the uniform application of the work suggested here.

Table 5-3 Tending System by Forest Management Type

Species: Pinus taeda, P. elliotti (Production Forests I-1, III and IV-1)

Work \ Age	1	2	3	4	9	10	14	15	20	25	Remarks
No. of Standing Trees/ha	1,111	1,055	1,055	1,055	1,055	1,055	530	530	370	300	Planting distance: 3m×3 m
Weeding	○	○	○								Weeding: mechanical with partial manual work
Pruning				Up to 2 m above ground	Up to 5 m above ground		Up to 8 m above ground				Thinning: line thinning + qualitative thinning
				530 trees	530 trees		300 trees				
Thinning						50%		30%	20%		
						530 trees		160 trees	70 trees		

Species: Melia azedarach (Production Forests I-1 and II)

Work \ Age	1	2	3	4	5	8	9	12			Remarks
No. of Standing Trees/ha	625	600	600	600	600	300	210	210			Planting distance: 4 m×4 m
Weeding	○	○	○								Weeding: mechanical with partial manual work
Pruning	Up to 1.5 m above ground	Up to 2.5 m above ground	Up to 5 m above ground								Thinning: line thinning + qualitative thinning
	600 trees	600 trees	600 trees								
Thinning					50%	30%					
					300 trees	90 trees					

Species: Eucalyptus grandis, E. camaldulensis (Production Forests I-1, III and IV-1)

Work \ Age	1	2	3	4	5	6	7	8	9	12	Remarks
No. of Standing Trees/ha	1,333	1,260	1,260	1,260	760	760	760	760	530	530	Planting distance: 3m×2.5 m
Weeding	○	○	○								Weeding: mechanical with partial manual work
Pruning		Up to 2 m above ground		Up to 5 m above ground		Up to 8 m above ground					Thinning: line thinning + qualitative thinning
		760 trees		530 trees		530 trees					
Thinning				40%				30%			
				500 trees				290 trees			

Species: Eucalyptus grandis, E. camaldulensis (Production Forests I-2 and IV-2)

Work \ Age	1	2	3	4	5	8					Remarks
No. of Standing Trees/ha	1,333	1,260	1,260	1,260	760	760					Planting distance: 3m×2.5m Weeding: mechanical with partial manual work Thinning: line thinning + qualitative thinning
Weeding	○	○	○								
Pruning											
Thinning				40% 500 trees							

Species: Eucalyptus grandis, E. camaldulensis (Production Forest V)

Work \ Age	1	2	3	4	5	6	7	8	9	12	Remarks
No. of Standing Trees/ha	834	780	780	780	550	550	550	550	330	330	Planting distance: 3m×3 m and 3 m×5 m Weeding: mechanical with partial manual work Thinning: qualitative thinning
Weeding	○	○	○								
Pruning		Up to 2 m above ground 550 trees		Up to 5 m above ground 330 trees		Up to 8 m above ground 330 trees					
Thinning				30% 230 trees				40% 220 trees			

5.4 Planting Species

(1) Selection of Species to be Used for Afforestation Plan

① The following points must be carefully considered in the selection of species for the afforestation plan.

- Wood product exports are still very important for Paraguay.
- In the coming years, the production of good quality logs for sawing from natural forests will rapidly decrease, making it necessary to opt for planted trees.
- There is a strong demand for fuelwood for the production of bricks, iron and sugar and for agricultural products drying.
- Careful attention is necessary in regard to the selection of species which are mainly suitable for small-scale land owners.
- The construction of a pulp plant in the near future is planned.

② The selected species should meet the following conditions as well as such natural conditions as the climate and soil, etc. in the Eastern Region.

- It should be suitable for the production of general-purpose timber.
- It should be suitable for the production of pulpwood and fuelwood.
- The remains after sawing timber can be used as fuelwood.
- It should be suitable for agroforestry.
- The initial growth should be vigorous in the face of the quick growth of weeds.

Given the above necessities, Eucalyptus grandis, E. camaldulensis, Pinus taeda, P. elliottii and Melia azadarach (Paraiso gigante) are mainly selected for the present afforestation plan on the grounds of their reliable performance for past afforestation work. It is hoped that the selection of these species will facilitate understanding of the economic advantages of afforestation by potential afforesters so that they will become actively engaged in afforestation work to achieve the target area of new production forests.

In regard to indigenous species, the planting of those species with relatively vigorous growth as supplementary species next to those sites where exotic species are planted and where the site conditions are relatively favourable is recommended while taking the issues described in ① through ③ below into consideration.

Possible indigenous species are guatambu (Balufourodendron riedelianum), peterev (Cordia trichotoma arrab. ex. sendo), yvyra pyta (Peltophorum dubium taubert), yvyra ro (Pterogyne nitens Tul) and lapacho (Tabebuia spp.).

① In general, it is desirable to avoid uniform afforestation using a single species for the creation of a healthy forest. The creation of a forest consisting of various species, including indigenous species, is desirable from the viewpoint of environmental conservation.

② While scattered, small-scale afforestation sites of indigenous species are observed, there is hardly any commercial size afforestation site of indigenous species. It is, therefore, believed that techniques for afforestation using indigenous species have not yet been established.

③ The questionnaire survey with land owners which was conducted as part of the Study found that an overwhelming majority prefer afforestation using exotic species. While lapacho is the most popular indigenous species for planting, the preferred cutting age is 15 – 28 years, indicating the general intention of avoiding a lengthy investment period.

(2) Production Purposes of Planting Species

The main production purposes of the planting species selected above are listed below.

- Eucalyptus grandis : - final cutting wood: general construction timber; furniture; plywood; electric poles; fencing
  - thinned wood: fuelwood; pulpwood
- Eucalyptus camaldulensis : - final cutting wood: general construction timber; electric poles; fending
  - thinned wood: fuelwood; pulpwood
- Pinus taeda : - final cutting wood: general construction timber; plywood
  - thinned wood: fuelwood; pulpwood
- Pinus elliottii : - final cutting wood: general construction timber; plywood
  - thinned wood: fuelwood; pulpwood
- Melia azedarach (Paraiso gigante) : - final cutting wood: furniture; plywood
  - thinned wood: fuelwood

(3) Regional and Site Adaptability of Species

1) Regional Adaptability

The field survey failed to gather a sufficient amount of data to enable examination of the suitability of the planting species in view of the land and meteorological conditions. In regard to the suitability of eucalyptus and pine, however, an existing document entitled "Zonificacion potencial para la reforestacion de la Region Oriental" (Arno Brune, Ph.D., 1993) is thought to provide useful information for the present Afforestation Plan and is outlined below for reference purposes*.

Paraiso, which is not mentioned in the document in question, shows good growth at relatively fertile and well-drained sites according to the findings of the field survey.

* Reference

E. grandis is suitable for relatively fertile, well-drained clayey soil and grows extremely well in Zones II, III and IV in Fig. 5-3 "Zoning of Eastern Region Based on Land and Meteorological Conditions". It also grows favourable at relatively high land without strong frost in Zones V and VI. E. camaldulensis is highly resistant to sandy soil, frost and salty soil and is recommended for planting throughout the Eastern Region except for those areas which are flooded for a long period of time during the year (excluding those which quickly dry out after seasonal flooding).

P. taeda and P. elliottii are more suitable for Zones V and VI than other species and can be planted at relatively low land in Zones II and III (sites with a relatively low temperature in summer and winter are preferable).

2) Adaptability to Site Conditions

The adaptability of the main species to the various site conditions is outlined in Table 5-4. In the case of a lowland or dipped site for example, all species other than E. camaldulensis show poor growth. E. grandis is less resistant to frost than E. camaldulensis. Needless to say, the growth of E. camaldulensis is better at sites with good conditions rather than lowland or dipped sites.

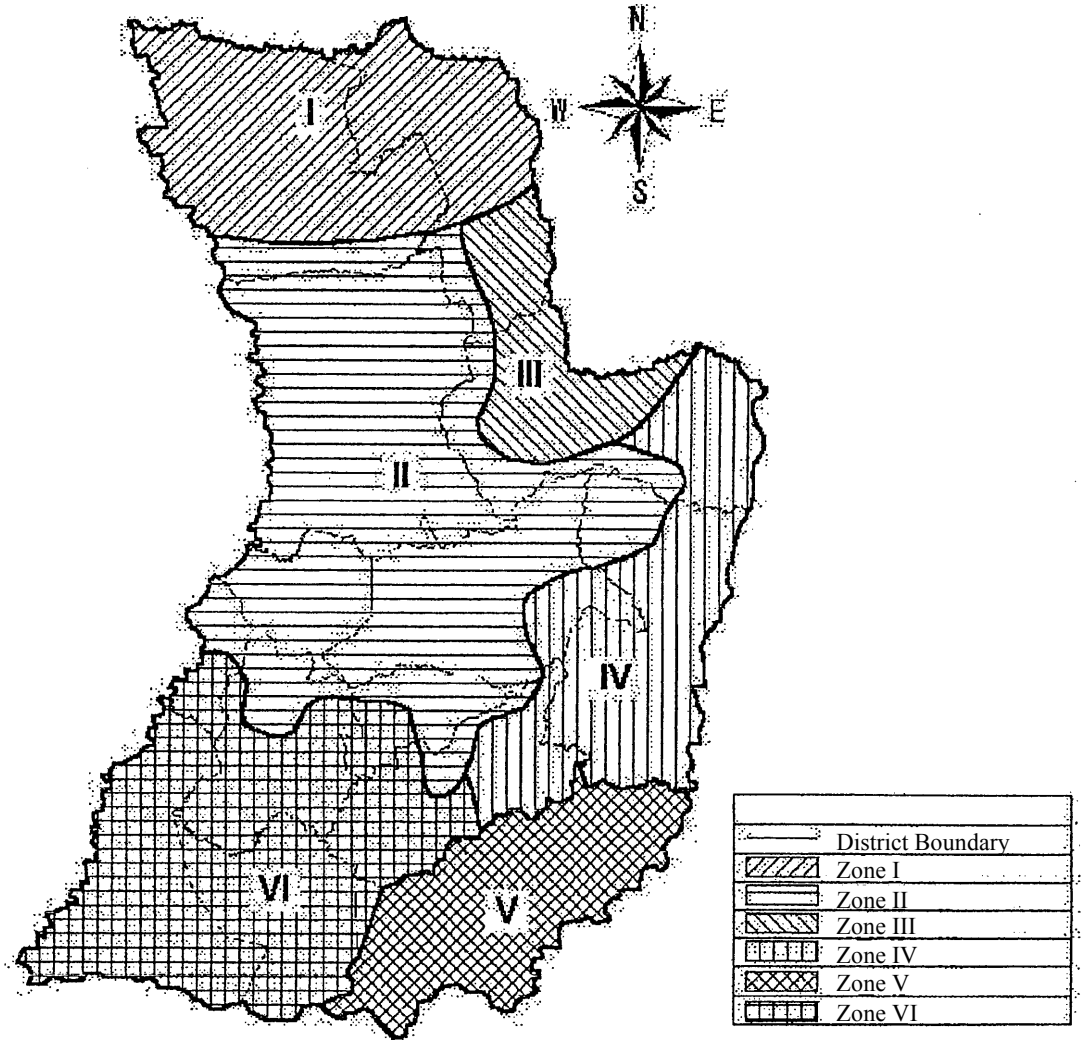


Fig. 5-3 Zoning of Eastern Region Based on Land and Meteorological Conditions

Table 5-4 Adaptability of Main Species to Site Conditions

Conditions \ Species			E. camaldulensis	E. grandis	P. taeda	P. elliottii	M. azedarach	G. robusta
Topo-graphy	Lowland; Dipped Land		○	△	△	△	△	△
	Sloping Land (up to 5%)		○	○	○	○	○	○
Soil	High Salt Content		○	×	×	×	×	×
	Sandy Soil	Wet	○	○	○	○	○	○
		Dry	×	○	○	○	×	×
		Seasonal Flooding	○	×	×	△	×	×
	Clayey Soil	Wet	○	○	○	○	○	○
		Dry	×	○	×	○	×	×
		Seasonal Flooding	○	×	△	△	×	×
Frost			○	○	○	△	×	×

Note : ○ – adaptable; △– less adaptable; × – not adaptable
Sources : 1) Zonificacion potencial para la reforestacion de la Region Oriental, Arno Brune, Ph.D., 1993
2) Training text for Forestry Extension Project in Eastern Region (No. IV).

5.5 Management Method

The main processes of afforestation are outlined in this section.

(1) Survey on Planned Afforestation Site

Prior to planting, a survey is required to establish the location of the planned afforestation site, road conditions, current situation of land use, area, topography, elevation, climate, soil conditions and growth situation at afforestation sites near the planned site, followed by examination of the suitable forest management type, planting species, required quantity and procurement method of seedlings or seeds, required labour force and source of labour.

(2) Selection of Species

For the selection of the species to be planted at the planned afforestation site, the adaptability of the candidate species to the regional and site conditions, including the meteorological and soil conditions described in 5.4, must be examined.

(3) Ant Control

Severe damage can result if the damage caused by leaf-cutting ants (normally two types, i.e. ysau and akeke) is not controlled at afforestation sites in the Eastern Region. The control of ants is, therefore, essential. Thorough observation of the planned site and at least some 100 m beyond the site boundary in all directions must be conducted to check for the existence of ant nests. If any nest is found, the ants should be exterminated using an appropriate insecticide. Routine patrols will also be required to cover the above-mentioned area for at least 3 – 4 years after the completion of planting with a view to conducting further extermination work if necessary.

(4) Ground Clearance

Thorough ground clearance makes subsequent work easier and has a favourable impact on the growth of the planted trees.

1) Weeds will densely grow if there is an inactive period of more than one month after the completion of ground clearance work before planting. The completion of ground clearance work immediately before planting is preferable.

2) In the case of small-scale afforestation (1 – 2 ha) which is mostly likely to be conducted by small-scale land owners, ground clearance work is generally conducted using animal labour and a plough. In the case of larger sites, machinery (disc harrow) is generally used.

3) At a lowland or dipped site where the humidity level is likely to become high, ridges are made for planting. This work is, however, expensive and obstructs various types of mechanised work. Given the facts that the likely planting species at such a site is E. camaldulensis and the expected growth is rather poor, the elimination of these sites from the target afforestation sites is more appropriate.

(5) Planting

1) Planting Season

Table 5-5 outlines the suitable season for the planting of the main species. Planting should be avoided in November and December because of frequent outbreaks of leaf-cutting ants and grasshoppers which eat the young leaves before the seedlings are firmly rooted. In Zone IV and V in Fig. 5-3 which mainly consist of the Itapua District and the Alto Parana District, planting in August and thereafter is preferable to avoid frost damage.

2) Supplementary Planting

If many of the planted seedlings die because of the weather after planting, soil conditions, handling of the seedlings and/or damage due to disease or pest, supplementary planting should be conducted. This work should be conducted after studying the survival situation 20 – 30 days after planting. If more than 20- 30% of the planted seedlings are found to have died, supplementary planting should be conducted to restore the number of seedlings to the 90 – 100% level at the time of the original planting (the actual intensity of supplementary planting and the criterion for such planting vary depending on individual afforesters).

Table 5-5 Planting Season for Main Species

Species	Type of Seedling	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.
Pine	Potted			·····	———	———	———	———	———	———	·····	·····	
	Bare				·····	———	———	·····	———	·····			
Eucalyptus	Potted			·····	———	———	———	———	———	———	———	·····	
	Bare		Not generally used because of the low survival rate.										
Paraiso	Potted			·····	———	———	———	———	———	———	·····		
	Bare				·····	———	———	———	———	·····			
Indigenous Species	Potted			·····	———	———	———	———	———	———	·····		
	Bare				·····	———	———	·····	———	·····			

Note: ——— suitable period ····· tolerable period (depending on the rainfall and temperature)
Source: Training Text for Forestry Extension Project in Eastern Region

(6) Direct Seeding

The species for direct seeding is paraiso for production forests I-1 and II. This method has two advantages comparing to the planting of seedlings, as being described below.

1) One seedling with excellent growth can be selected from some 10 seedlings which have germinated per seeded point.

2) The avoidance of damage to the root system at the time of transplanting acts as a positive factor for growth.

(7) Weeding

1) Weeding is generally conducted using a light weight disc harrow named “Rastra” or grass cutter named “Rotativo” pulled by a tractor. As the disc harrow exposes the soil after weeding, the use of a grass cutter is preferable in summer when there is strong sunshine to restrain the evaporation from forest land. In the case of using a hoe to remove vegetation in a circular area of some 40 – 50 cm in diameter around a planted tree, past experience suggests that this type of weeding must be conducted at least twice after planting to facilitate the growth of the planted tree (further scientific research is required).

Weeding at very small afforestation sites can be manually conducted using a machete.

2) The first weeding should be conducted 3 – 4 months after planting (after final roguing in the case of direct seeding). Thereafter, weeding every 4 – 6 months is generally sufficient depending on the growth situation of the planted trees as well as weeds. Weeding should be conducted approximately four times in three years (there is no general criteria to judge the time to end weeding) and should usually be conducted between September and May.

In the case of Production Forest II, weeding in the second year or up to the third year after planting or the germination of seeds should, in principle, be unnecessary because weeding comprises part of farming. However, it is required to pay attention to weeding around the planted trees.

In the case of Production Forest V, the first weeding should be conducted throughout the afforestation site. From the second weeding onwards, mechanical weeding should only be conducted in areas where the planting distance is 3 m × 3 m while manual weeding around the planted trees should be conducted for all planted trees.

3) Weeding using a herbicide is, in principle, not recommended under the present afforestation plan from the viewpoints of environmental conservation and utilize of the local labour force.

(8) Climber Cutting

Climber cutting is not incorporated in the forest management system as climbers are rare in the Eastern Region.

(9) Pruning

1) Purpose

Pruning is conducted to prevent the appearance of knots on the surface of wood products or to reduce the size of knots on the surface to increase the value of wood products.

2) Criteria for Pruning

Pruning should be conducted in winter when the trees stop growing. The criteria for the timing and intensity are shown in the tables below. In the case of paraiso, bud pruning should constitute the main work and ordinary pruning should be conducted when it is too late to conduct bud pruning. No pruning should be conducted in Production Forests I-2 and IV-2 because of their management object.

① Pine (Production Forests I-1, III and IV-1)

Pruning Order	Stand Age	Target Trees	No. of Target Trees	Pruning Height	Remarks
First	4	Trees not subject to first thinning	530	Approx. 2 m	
Second	9 – 10	Trees not subject to first thinning	530	Approx. 5 m	
Third	14 – 15	Trees not subject to second and third thinning	300	Approx. 8 m	

② Eucalyptus (Production Forests I-1, III and IV-1)

Pruning Order	Stand Age	Target Trees	No. of Target Trees	Pruning Height	Remarks
First	2 – 3	Trees not subject to first thinning	760	Approx. 2 m	
Second	4 – 5	Trees not subject to second thinning	530	Approx. 5 m	
Third	6 – 7	Trees not subject to second thinning	530	Approx. 8 m	

③ Paraiso (Production Forests I-1 and II)

Pruning Order	Stand Age	Target Trees	No. of Target Trees	Pruning Height	Remarks
First	1	All	600	Approx. 1.5m	Pruning is conducted when bud pruning option is unavailable.
Second	2	All	600	Approx. 2 m	
Third	3 – 4	All	600	Approx. 5 m	

④ Eucalyptus (Production Forest V)

Pruning Order	Stand Age	Target Trees	No. of Target Trees	Pruning Height	Remarks
First	2 – 3	Trees not subject to first thinning	550	Approx. 2 m	
Second	4 – 5	Trees not subject to second thinning	330	Approx. 5 m	
Third	7 – 8	Trees not subject to second thinning	330	Approx. 8 m	

(10) Thinning

1) Thinning Methods

Thinning can be classified into qualitative thinning and systematic thinning (line thinning).

① Qualitative Thinning

With this method, the trees subject to thinning are selected in consideration of the situation of competition among the crown in the upper storey trees and the character of individual tree. The standard criteria for the selection of the trees subject to thinning are shown in the table below.

Classification of Trees at Afforestation Site	Character	
	Good	Bad
Obstructing Tree	To be cut after the decision to cut or leave	To be cut
Unobstructing Tree	To be left	To be cut after the decision to cut or leave

Note : Obstructing tree: tree which currently or at the next thinning obstructs a tree(s) which is to be left until the final cutting
Unobstructing tree: tree which does not currently or at the next thinning obstruct a tree(s) which is to be left until the final cutting
Bad tree: damaged tree, tree with a bad character or tree with a poor crown
Good tree: tree with a straight trunk and conical crown with many leaves

② Systematic Thinning (Line Thinning)

With this method, tree lines subject to thinning are mechanically determined at those afforestation sites where the growth situation of the planted trees is uniform for reasons of the positive effect of thinning and work efficiency.

③ Combination Thinning

With this method, qualitative thinning and line thinning are combined. In principle, this method is used under the Master Plan except for Production Forest V.

2) Stand (Tree) Age for Thinning and Thinning Ratio

Table 5-6 shows the criteria for the stand age for thinning and the thinning ratio. Careful attention must be paid to the following points in the selection of the trees to be thinned.

① Qualitative thinning should be adopted where possible. For the first thinning, the central line of each five planted tree lines is selected for thinning while qualitative thinning is conducted for the remaining lines within the scope of the thinning rate except for Production Forest V. Fig. 5-4 illustrates an example of such selection of trees for thinning. In the case of Production Forest V, qualitative thinning is adopted.

② The trees for the second thinning onwards are selected by the qualitative thinning method.

③ As edge trees form a mantle to protect the inner trees from wind, etc., they are excluded from thinning.

④ Grevillea planted on the windward site of Production Forest IV-1 are excluded from thinning.

Table 5-6 Stand Age Subject to Thinning and Thinning Ratio

Forest Management Type	Species	First Thinning		Second Thinning		Third Thinning		Remarks
		Stand Age (yrs)	Thinning Ratio	Stand Age (yrs)	Thinning Ratio	Stand Age (yrs)	Thinning Ratio	
Production Forests I-1, III and IV-1	Pine	10	50%	15	30%	20	20%	The thinning ratio is based on the number of trees to be thinned. Qualitative thinning for Production Forest V
Production Forests I-1 and II	Paraiso	5	50%	8	30%			
Production Forests I-1, III and IV-1	Eucalyptus	4	40%	8	30%			
Production Forests I-2 and IV-2	Eucalyptus	4	40%					
Production Forest V	Eucalyptus	4	30%	8	40%			

3) Thinning Season

Winter is the preferable season for thinning in view of the use of thinned wood (prevention of damage due to pests and mould, etc.) and the better growth of the remaining trees.

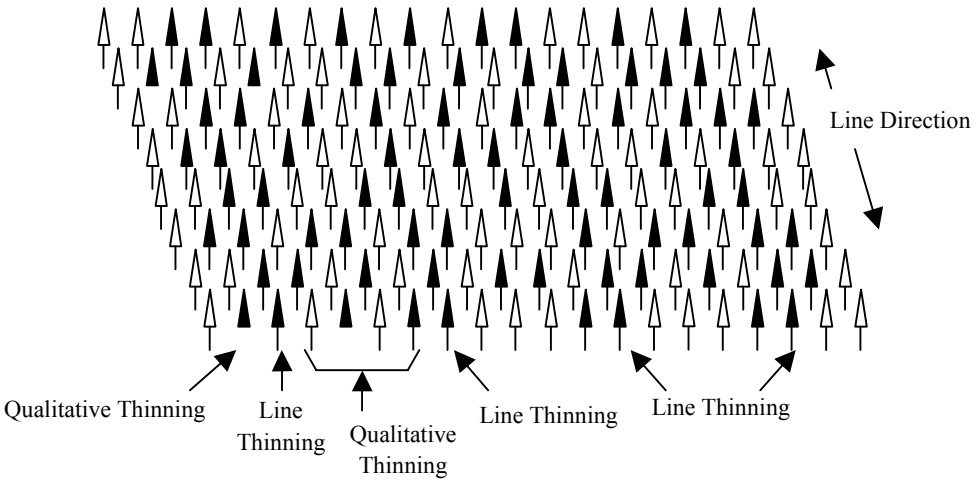


Fig. 5-4 Example of Tree Selection for Thinning

5.6 Forest Protection

(1) Disease and Pest Control Measures

1) Damage by Diseases

At present, the shrinkage and yellowing of the leaves are observed at some parts of afforestation sites of paraiso. There are no other diseases worthy of special mention.

① Present State of Research on Disease Damage to Paraiso

Research on the possible causes of the above-mentioned phenomena has been only conducted on several cases and no reliable control measures have yet been established. Alfred Stauffer of the NUS reports the possible causes and control measures as follows.

a. Possible Causes

i. Phytoplasma, an intermediate microbe between a bacteria and a virus, is transported by insects, damaging the vessels of a tree. The symptoms appear 2 – 3 years later (even though white spots are observed on the stem, their damage is small).

ii. Basdiomycetes, a type of mushroom, may be responsible.

b. Measures to Combat Disease

Even though effective measures have not yet been established, the following actions are recommended.

- Removal of trees suffering from the disease
- Removal of weeds which provide habitat for insects
- Bud pruning from a young age to avoid infection from pruning tools
- Collection of seeds from healthy trees in a group of trees infected by the disease
- Avoidance of damage to the stem or roots during forestry activities
- Application of oil to the cut ends after the pruning of branches of 2.0 – 2.5 cm in diameter
- Avoidance of planting at permanently wet land
- Spraying of clorothanolonil or similar chemicals to prevent round spots appearing on the leaves by Seorspora meliae and Phyllostica azedarachis (both mushroom species) at nurseries

② Tentative Measures to Control Disease of Paraiso

At present, when afforestation using paraiso is planned, the tentative measures listed above should be implemented with a view to preventing an outbreak of the disease in question. It is preferable to restrict the scale of any afforestation site of paraiso to that which adequately allows routine management until a reliable preventive/control measure for the disease is established.

2) Damage by Pests

At present, no significant pest damage to afforestation sites other than the damage by ants described in 5.5-(3) is observed.

3) Control of Diseases and Pests by Afforestation Method

Careful attention should be paid to the combination of the areas planted with different trees as described below to prevent the outbreak or spread of damage by disease or pest at afforestation sites in order to create and preserve healthy forests (stands).

① Avoidance of the creation of a continuous afforestation site of larger than 20 ha with a single exotic species and alternation of sites planted with different species

② Creation of an afforestation belt (some 30 m wide) with an indigenous species within an afforestation site of a single exotic species

③ Combination of the above two methods

Fig. 5-5 shows examples of the above methods.

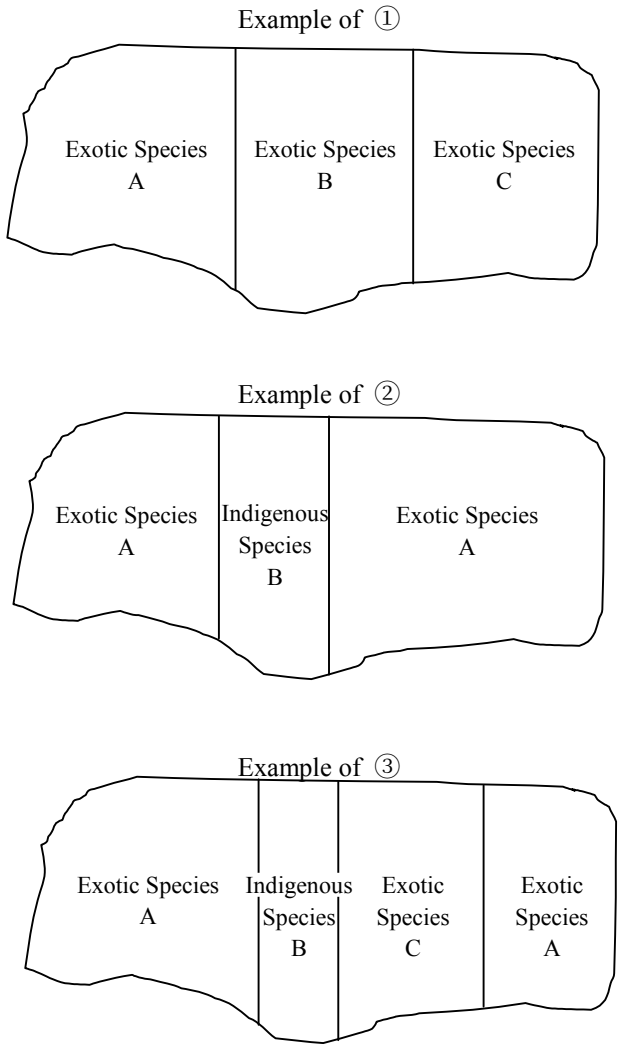


Fig. 5-5 Example of Combination of Areas of Different Species

(2) Forest Fire Control Measures

1) A forest fire is often caused by human action. When there is a risk of forest fire because of the weather conditions, afforestation sites should be patrolled in view of the early detection and extinguishing of any fires.

2) The following points should be taken into careful consideration as general precautions to prevent forest fires.

① At an afforestation site adjacent to a general public road, a treeless belt of approximately 4 m in width should be introduced along the road and this belt

should be ploughed. No combustible items (cut wood, limbs and tops) should be left at the road side of the afforestation site. Further ploughing of the belt should be conducted during the fire risk period.

② A firebreak (approximately 10 m in width) should be established at approximately 100 m intervals at an afforestation site and the vegetation at these firebreaks should be cleared. These firebreaks can prevent the spread of a forest fire, reduce the force of a fire and function as base areas for fire-fighting.

③ The place to report the outbreak of a forest fire should be made known to everyone concerned in advance.

④ A Chinese plough, spades, buckets, jet shooters and chainsaws should be provided as fire-fighting equipment.

⑤ At the beginning of the fire risk period, the fire equipment should be inspected and maintained.

⑥ At an afforestation site adjacent to a place with many passerbys, fire patrols should be conducted during the fire risk period to monitor the use of fire by the public.

⑦ Local residents should be enlightened in regard to fire prevention and control measures.

5.7 Estimation of Yield

(1) Estimation of Yield at Existing Afforestation Sites

As part of the Study, the preparation of empirical yield tables was attempted to estimate the yield at existing afforestation sites. Because of the short history of afforestation, however, few artificial forests have actually be cut in Paraguay. As a result, data on the growth, etc. up to the final cutting age is scarce. The empirical yield tables were prepared in the following manner.

1) P. elliottii and P. taeda

The empirical yield tables obtained from the forestry laboratory (INTA) in Misiones Province in Argentina were used.

2) E. grandis

The empirical yield table for E. grandis was prepared using data supplied by the field survey under the Study, the study report for an afforestation project at Capibary (JICA, 1985), a study report of the JICA-SFN (1995) and the "Evaluacion de

crecimiento de E. camaldulensis, E. grandis y E. saligna en las diferentes corregiones del Paraguay" (Marta A. Jara, 1998).

3) M. azedarach (paraiso)

The empirical yield table for M. azedarach was prepared using data supplied by the field survey under the Study, the study report for an afforestation project at Capibary (JICA, 1985) and a study report by the JICA-SFN (1995).

Table 5-7 through Table 5-12 are empirical yield tables for the existing afforestation sites by species and by forest management method.

In the case of E. camaldulensis, the growth is estimated to be 80% of that of E. grandis based on a general judgement relying on field survey data and existing documents, etc. Accordingly, no empirical yield table for E. camaldulensis has been prepared and the yield is estimated using the table for E. grandis.*

* Reasons to consider the growth of E. camaldulensis as being 80% of that of E. grandis

a. With good site conditions, the growth of E. camaldulensis is inferior to that of E. grandis ("Silvicultura de plantaciones maderables II", Domingo Cozzo).
b. While E. camaldulensis is highly adaptable to various site conditions, the planting of E. grandis is generally believed to be more advantageous at sites with good conditions. Accordingly, it appears likely that E. camaldulensis tends to be planted at sites with poor conditions. Given such a tendency in the selection of planting sites for E. camaldulensis, it is essential not to over-estimate its growth.
c. The survey findings on existing afforestation sites with mixed site conditions indicate that while these two species show a similar performance in terms of diameter growth, the height growth of E. camaldulensis is roughly 20% inferior to that of E. grandis (finding of the field survey for the Study and the earlier-mentioned Marta A. Jara, 1998).
d. Based on the above, it is judged reasonable to assume that the growth of E. camaldulensis is 80% of the growth of E. grandis.

Table 5-7 Estimated Yield of P. taeda (Production Forests I-1, III and IV-1)

Stand Age	No. of Trees/ha	Mean DBH (cm)	Mean Tree Height (m)	Volume/ ha (m^3)	Yield Volume (m^3)		Remarks
					Thinning	Final Cutting	
1	1,110						Planting distance: 3m×3m Thinning First: 10 years old, 50% Second: 15 years old, 30% Third: 20 years old, 20% Final cutting: 25 years old Final mean annual growth: 320m^3 ÷ 25 = 13 m^3/year
10	1,050	16	13	130	40		
15	530	23	17	170	40		
20	370	28	20	190	20		
25	300	32	22	220		220	
Total					100	220	

Note: Effective volume (wood with an end diameter of at least 10 cm): 84 m^3 for thinning and 216 m^3 for final cutting, totalling 300 m^3 (approximately 12 m^3/year)

Table 5-8 Estimated Yield of P. elliottii (Production Forests I-2 and IV-2)

Stand Age	No. of Trees/ha	Mean DBH (cm)	Mean Tree Height (m)	Volume/ ha (m^3)	Yield Volume (m^3)		Remarks
					Thinning	Final Cutting	
1	1,110						Planting distance: 3m×3m Thinning First: 10 years old, 50% Second: 15 years old, 30% Third: 20 years old, 20% Final cutting: 25 years old Final mean annual growth: 445m^3 ÷ 25 = 18 m^3/year
10	1,050	16	12	130	40		
15	530	25	16	215	50		
20	370	31	19	270	35		
25	300	37	21	320		320	
Total					125	320	

Note: Effective volume (wood with an end diameter of at least 10 cm): 112 m^3 for thinning and 318 m^3 for final cutting, totalling 430 m^3 (approximately 17 m^3/year)

Table 5-9 Estimated Yield of E. grandis (Production Forests I-1, III and IV-1)

Stand Age	No. of Trees/ha	Mean DBH (cm)	Mean Tree Height (m)	Volume/ ha (m^3)	Yield Volume (m^3)		Remarks
					Thinning	Final Cutting	
1	1,330						Planting distance: 3m×2.5m Thinning First: 4 years old, 40% Second: 8 years old, 30% Final cutting: 12 years old cf: 0.5 Final mean annual growth: 415m^3 ÷ 12 = 35 m^3/year Figure for 15 years old are for reference purposes only
4	1,260	14	13	126	50		
5	760	16	15	114			
8	760	19	20	215	64		
10	530	22	23	232			
12	530	24	25	300		300	
Total					114	300	
15	530	26	27	380			

Note: Effective volume: thinned wood – 50 m^3×0.6 + 64 m^3×0.7 = 75 m^3; final cutting wood – 300 m^3×0.85 = 255 m^3; total - 330 m^3 (approximately 28 m^3/year)

Table 5-10 Estimated Yield of E. grandis (Production Forests I-2 and IV-2)

Stand Age	No. of Trees/ha	Mean DBH (cm)	Mean Tree Height (m)	Volume/ ha (m^3)	Yield Volume (m^3)		Remarks
					Thinning	Final Cutting	
1	1,330						Planting distance: 3m×2.5m Thinning First: 4 years old, 40% Final cutting: 8 years old cf: 0.5 Final mean annual growth: 265m^3 ÷ 8 = 33 m^3/year Figures for 10 years old are for reference purposes only
4	1,260	14	13	126	50		
5	760	16	15	114			
8	760	19	20	215		215	
Total					50	215	
10	760	22	23	232			

Note: Effective volume: thinned wood – 50 m^3×0.67 = 30 m^3; final cutting wood – 215 m^3×0.85 = 180 m^3; total - 210 m^3 (approximately 26 m^3/year)

Table 5-11 Estimated Yield of M. azedarach (paraiso) (Production Forests I-1 and II)

Stand Age	No. of Trees/ha	Mean DBH (cm)	Mean Tree Height (m)	Volume/ ha (m^3)	Yield Volume (m^3)		Remarks
					Thinning	Final Cutting	
1	630						Planting distance: 4mx4m Thinning First: 5 years old, 50% Second: 8 years old, 30% Final cutting: 12 years old Final mean annual growth: 215m^3 ÷ 12 = 18 m^3/year
5	600	14	9	41	20		
8	300	26	11	87	26		
10	210	32	13	109			
12	210	37	15	169		169	
Total					46	169	

Note: Effective volume (straight stem only): thinned wood – (first) 0, (second) 14 m^3 (6 m straight section; 26 cm in diameter, cf: 0.6); final cutting wood – 81 m^3 (6 m straight section, 37 cm in diameter, cf – 0.6); total – 95 m^3 (approximately 8 m^3/year)

Table 5-12 Estimated Yield of E. grandis (Production Forest V)

Stand Age	No. of Trees/ha	Mean DBH (cm)	Mean Tree Height (m)	Volume/ ha (m^3)	Yield Volume (m^3)		Remarks
					Thinning	Final Cutting	
1	820						Planting distance: 3m×3m + 3m×5m Thinning First: 4 years old, 30% Second: 8 years old, 40% Final cutting: 12 years old cf: 0.5 Final mean annual growth: 329m^3 ÷ 12 = 27 m^3/year
4	780	15	13	90	27		
5	550	17	15	93			
8	550	22	20	209	83		
10	330	24	23	171			
12	330	26	25	219		219	
Total					110	219	

Note: Effective volume: thinned wood – 27 m^3×0.6 + 83 m^3×0.7 = 74 m^3; final cutting wood – 219 m^3×0.85 = 186 m^3; total - 260 m^3 (approximately 22 m^3/year)

(2) Prediction of Growth at Future Afforestation Sites

As good quality seedlings will be used for the planned afforestation work, the growth at the planned afforestation sites is expected to be better than the past performance.

For the present plan, it is estimated that the growth at the new afforestation sites will record a 10% increase on the growth at the existing afforestation sites based on the overall judgement of the factors described in 1) through 4) below.

The estimation results are shown in the expected diameter and growth columns under final cutting in Table 5-2 – Forest Management Method by Forest Management Type.

1) At afforestation sites in Brazil where high quality seedlings are used, the estimated growth is much higher than the growth at the existing afforestation sites in Paraguay (examples in Brazil: 50 m^3/ha/year at 20 year old E. grandis stands and 30 m^3/ha/year at 25 year old P. taeda stands).

2) The Capibary and Cedefo Forestry Centres in Paraguay have afforestation sites using seeds imported from abroad. The survey results on the growth at these sites (Table 5-13) indicate a favourable growth performance.

3) At a private experimental site in Paraguay, growth of 45 m^3/ha/year for 10 year old E. camaldulensis is assumed.

4) Most of the existing afforestation sites have seldom undergone pruning or thinning. Adequate tending is planned for the new afforestation sites.

Table 5-13 Comparison of Growth Between Existing Afforestation Sites and Afforestation Sites Used Imported Seeds

(a) Diameter Growth

Species	Stand Age	Existing Afforestation Site (a)	Afforestation Site Used Imported Seeds (b)	(b)/(a)	Supply Source of Seeds	Remarks
P. elliottii	12	19.6 cm	24.2 cm *1	1.23	Brazil	*1 Capiibary data *2 CEDEFO data (a): Year of measurement – 2000 (b): Year of measurement - 2001
	13	21.4 cm	23.1 cm *1	1.08	Brazil	
	14	23.2 cm	21.4 cm *1	0.92	Brazil	
	Simple Average			(10.7)		
P. taeda	12	18.8 cm	24.2 cm *1	1.32	Brazil	
	14	21.6 cm	28.8 cm *1	1.33	Brazil	
	15	23.0 cm	38.1 cm *2	1.65	Argentina	
	Simple Average			(1.43)		
E. grandis	9	20.5 cm	34.5 cm *2	1.68	Australia	
	12	24.0 cm	30.1 cm *1	1.25	Brazil	
	(Simple Average)			(1.46)		

Note: No thinning was conducted at the Capiibary site. At the CEDEFO site, the distance between the trees is large because of the presence of seed trees, etc.

(b) Height Growth

Species	Stand Age	Existing Afforestation Site (a)	Afforestation Site Used Imported Seeds (b)	(b)/(a)	Supply Source of Seeds	Remarks
P. elliottii	12	13.6 m	15.6 m *1	1.15	Brazil	*1 Capiibary data *2 CEDEFO data (a): Year of measurement – 2000 (b): Year of measurement - 2001
	13	14.4 m	18.3 m *1	1.27	Brazil	
	14	15.2 m	15.9 m *1	1.04	Brazil	
	Simple Average			(1.15)		
P. taeda	12	14.6 m	15.0 m *1	1.03	Brazil	
	14	16.2 m	18.5 m *1	1.14	Brazil	
	15	17.0 m	18.9 m *2	1.11	Argentina	
	Simple Average			(1.09)		
E. grandis	9	21.5 m	33.4 m *2	1.55	Australia	
	12	25.0 m	33.6 m *1	1.34	Brazil	
	(Simple Average)			(1.44)		

5.8 Afforestation Cost

The actual afforestation cost varies depending on the natural and other conditions at each afforestation site and cannot be uniformly determined. Here, the afforestation cost by species and by forest management type at natural grassland (scale of afforestation: 50 – 300 ha) is estimated taking the fact-finding survey results by afforesters into consideration. The results are shown in Table 5-14 and Table 5-15.

Table 5-14 Estimated Afforestation Cost (E. camaldulensis and E. grandis)

(Unit: G'000)

Type of Production Forest / Type of Work	I-1	I-2	III	IV-1	IV-2	V[*1]	Remarks
Preliminary Ant Control	54	54	54	58	58	54	
Ground Clearance	239	239	239	258	258	239	
Planting	650	650	650	697	697	433	Supplementary planting cost included but not fertiliser cost
< Tending >							
Ant Control	206	206	206	221	221	206	For approx. four years
Weeding	873	873	873	944	944	410	3 – 4 times
Pruning	302	0	302	302	0	196	3 times (not at fuelwood production forest)
Sub-Total	1,381	1,079	1,381	1,467	1,165	812	
Total	2,324	2,022	2,324	2,480	2,178	1,538	
Technical Advice Fee	232	202	232	248	218	154	Total × 10%
Grand Total	2,556	2,224	2,556	2,728	2,396	1,692	[*1] Grassland creation cost of G1,080,000 in 12 years is additional required ([*2])
US$	673	585	673	718	631	445	Approx. G3,800/US$ (June, 2001)

Table 5-15 Estimated Afforestation Cost (P. taeda, P. elliottii and M. azedarach)

(Unit: G'000)

Type of Production Forest / Type of Work	P. taeda, P. elliottii			M. azadarach		Remarks
	I-1	III	IV-1	I-1	II[*3]	
Preliminary Ant Control	54	54	58	54	54	
Ground Clearance	239	239	258	239	239	
Planting	547	547	608	364	364	Supplementary planting included but not fertiliser cost
< Tending >						
Ant Control	206	206	221	206	206	For approx. four years
Weeding	873	873	944	1,265	0	3 – 4 times
Pruning	391	391	391	391	446	three times
Sub-Total	1,470	1,470	1,556	1,862	652	
Total	2,310	2,310	2,480	2,519	1,309	
Technical Advice Fee	231	231	248	252	131	Total×10%
Grand Total	2,541	2,541	2,728	2,771	1,440	*[3] Crop cultivation cost of G1,462,000 in three years is additionally required (*[4])
US$	669	669	718	729	379	Approximately G3,800/US$ (June, 2001)

*2 Grassland Creation Cost

① Grassland area: 0.62 ha per 1 ha of afforestation area
② Seeds: brachiaria (4 kg/ha×0.62) – G50,000; calopogonio (4 kg/ha×0.62) – G42,000
③ Seeding work: G43,000
④ Fertiliser: G201,000
⑤ Weeding of grassland: G744,000 (G62,000×12 years)
⑥ Total cost: G1,080,000

* 4

① Crop cultivation area: 0.7 ha per 1 ha of afforestation area
② Crops for cultivation: cassava, maize and beans (French beans)
③ Cultivation period: three years
④ Cultivation area by year
First year : 0.2 ha of cassava, 0.4 ha of maize and 0.1 ha of French beans
Second year : 0.2 ha of cassava, 0.4 ha of maize and 0.1 ha of French beans
Third year (onwards) : 0.4 ha of maize and 0.3 ha of French beans
⑤ Cultivation cost
First year : G466,000 (excluding ploughing cost)
Second year : G500,000
Third year : G496,000
⑥ Total cost: G1,462,000

The afforestation cost will increase or decrease depending on planting at farm land, need to electric fence, density of ants and scale of the planned afforestation, etc. Table 5-16 outlines the possible changes of the afforestation cost because of such conditions.

Table 5-16 Estimation of Changes of Afforestation Cost
(Compared to Afforestation Cost of 50 – 300 ha)

Cost Item	Factor	Cost Change		Remarks
		Increase	Decrease	
Ground Clearance	Farm land		○	Approx. 50%
	Shrub land	○		Approx. 40%
Ant Control	Dense ant population	○		Approx. 20%
	No ants		○	Approx. 100%
General	Stock farm fencing (electric)	○		G110,000/100m
Engineer Remuneration	Scale of work: 20 – 50 ha	○		Approx. 6%
	Scale of work: 300 ha <		○	Approx. 3%
Total Cost	Scale of work: 20 – 50 ha (mechanical work)	○		Approx. 10%
	Scale of work: 300 ha < (mechanical work)		○	Approx. 5%
Others	Land conditions	○		Drainage facilities

5.9 Production of Seedlings

(1) Seedling Production Capacity

The required number of seedlings to meet the average annual work volume is 13.8 million for Phase 1, 41.4 million for Phase 2 and 55.2 million for Phase 3 based on an approximate planting density of 1,200 seedlings/ha and a supplementary planting rate of 15%.

Because of the reasons described below, the required number of seedlings for Phase 1 should be fully supplied by private and SFN nurseries and the supply of seedlings required for Phase 2 and Phase 3 is also considered to be feasible on the grounds of the further expansion of private nurseries.

① The document requesting the Government of Japan's assistance for the project (Solicitud de Estudio de Factibilidad al Gobierno de Japon Relacionado al "Proyecto de Conservacion y Recuperation de Bosque, 1998") plans the production of 48 million seedlings to cover the maximum annual planting area of 40,000 ha (14.4 million seedlings by the Forestry Techniques Extension Centre, three forestry centres and nurseries for forestry extension of the SNF and the remainder by private nurseries).

② According to the Afforesters Association of Paraguay, some private nurseries have a potential annual production capacity of 6 million seedlings or even 11 million seedlings.

③ The number of seedlings, including those for supplementary planting, required for the largest annual planting area of some 12,000 ha in the past is estimated to be approximately 16.5 million.

④ As seedling production techniques are fairly diffused, the period required for the production of seedlings is relatively short. Moreover, relatively simple nursery facilities should be sufficient to produce the required seedlings.

⑤ Excellent seeds can be imported from foreign countries.

(2) Reliable Supply of High Quality Seeds

1) There should not be any major problems in regard to the seedling production and supply system for the present plan because of (i) the spread of seedling production techniques over a wide area and (ii) the short production period. The most important point for the future production of seedlings is the production of high quality seedlings capable of producing high quality as well as high productivity afforestation sites. For this purpose, the supply of excellent seeds must be secured.

2) In Paraguay, there are not many seed collecting forests which product excellent seeds with a proven history. Neither is there a systematic supply system for excellent seeds. Given this situation, it is believed to be more advantageous if seeds of such exotic species as eucalyptus, pine and paraiso are imported from a foreign country with a well-established seed supply system unless seeds can be obtained from mother trees which have grown excellent seeds with a proven history in the Eastern Region.

In the case of seeds of indigenous species, their supply from excellent natural trees in Paraguay is aimed at.

3) Research on breeding is a future task through cooperation between the public sector and the private sector.

(3) Production Method of Seedlings for Planting

In principle, the seedlings for planting will be potted seedlings.

(4) Guidance on and Extension of Seedling Production Techniques

The effective utilisation of the facilities and staff of the nurseries, seed collecting forests and Forestry Technique Extension Centers of the SFN is hoped for to provide active guidance on and the extension of techniques to produce excellent seedlings in view of the smooth implementation of the planned afforestation plan.

5.10 Estimation of Required Labour Volume

The required labour volume to conduct the planting of 400,000 ha and to produce the necessary seedlings is estimated in the following manner from the viewpoint of the effect of the project on the creation of employment in local communities. The estimated employment volume is approximately 90,000 workers.

(1) Labour Volume Required for Afforestation Work

The volume of labour required for the work processes, from advance ant control to pruning, is estimated using the planting of eucalyptus and pine in Production Forests I-1, III and IV-1 as models. Assuming that some 40 person-days are required to manage one ha of an afforestation site (this figure is used for estimation of the afforestation cost), the total labour volume required is approximately 16 million person-days. If the annual working days are 210 days (excluding Saturdays, Sundays and national holidays in addition to unworkable days, assumed to be 10% of 365 days, due to bad weather), the total number of workers to be employed is approximately 75,000.

(2) Labour Volume Required for Production of Seedlings

The number of workers required to produce 552 million seedlings (400,000 ha x 1,200 seedlings/ha x 1.15) to plant an area of 400,000 ha is approximately 15,000 based on an assumed planting productivity of 35,000 seedlings/person-year (rough estimate given by the SFN).

5.11 Implementation System

The scale of the proposed afforestation plan is by far the largest in the history of Paraguay and its target land is mainly privately-owned farm land and pasture land. It will, therefore, be essential for the state forestry authority to play a central role in the systematic implementation of the plan in close collaboration with related authorities.

The state forestry authority must complete and strengthen its administrative structure and urgently develop the implementation system for the proposed afforestation plan by achieving the necessary conditions.

(1) Clarification of Organizational Status of State Forestry Authority and Strengthening of Its Own Organization

For the promotion of the proposed afforestation plan, the cooperation of all related parties is essential. The forestry administration can only gain the trust and cooperation of related parties through the consistent implementation of forestry policies together with the sound contents of such policies. At present, the status of the SFN in the government's administrative structure is not firmly established, making the implementation of consistent forestry administration difficult.

Local offices of the forestry administration, such as forestry offices and forestry centres, are responsible for supervision of the implementation of forestry administration and also for guidance on and the extension of forestry techniques in wide areas. The staff members of these offices are expected to conduct their duties with rich knowledge of the policies and techniques and with pride in their work from the viewpoint of properly performing their work. In reality, however, they are in need of qualitative improvement and their daily work is hampered by budgetary restrictions on travelling expenses and maintenance cost.

Based on such understanding of the present situation, the supervisory, guidance and extension systems should be strengthened through the following efforts.

① Clarification of the status of the state forestry authority to strengthen its organizational system, including local offices, in addition to improvement of the quality of staff members.

② Securing of the necessary budget to conduct the work while developing an efficient work execution system through the simplification as well as rationalisation of administrative procedures.

(2) Collection of Informations on Afforestation Technologies and Establishment of Research and Experiment System on Forest Tree Breeding

For the successful materialisation of the afforestation plan from a technological point of view, backing by technologies which are appropriate for the local conditions is extremely important. In reality, however, publicly accessible technological information based on the local conditions is scarce, partly because of the absence of independent public laboratories relating to forestry and the forest products industry. In the coming years, it will be essential to build up new technological knowledge corresponding to the local conditions through experience of implementing afforestation work while verifying known technological information.

The present afforestation plan aims at creating high quality and highly productive afforestation sites through the active use of excellent seedlings. However, no public research institute specialising in breeding exists in Paraguay and the research work is only conducted by some private enterprises. As a result, the purchase of most of the excellent seeds which are required from foreign countries is necessary for the time being.

Based on such understanding of the present situation, afforestation technologies/techniques which are suitable for the local conditions should be established through the following efforts.

① Active gathering of the existing technological informations on afforestation and the verification of such technologies through the implementation of afforestation work with a view to systematically developing technological information and data on afforestation which is suitable for Paraguay.

② Development of a national research and experiment system, including the forest tree breeding.

(3) Establishment of Cooperation System of All Related Parties

The implementation of the proposed afforestation plan demands the understanding and cooperation of all related parties because of (i) its unprecedented scale, (ii) the fact that privately-owned farm land and pasture land constitute the bulk of the target sites, (iii) the importance of wood production in collaboration with the wood processing industry and

(iv) the planned substantial loans for a long period of time. From the viewpoint described above, the afforestation plan should be smoothly and steadily implemented with the understanding and cooperation of the related parties through the following efforts.

① The state forest authority should aim at liaisoning its policies with related administrative bodies in the agricultural, stock raising and industrial sectors in order to materialise the afforestation plan.

② In order to contribute to the efficient and effective promotion of afforestation work, the state forestry authority should play a central role in the establishment of such a body as "an afforestation promotion council", the members of which should consist of representatives of industries bodies for afforestation and wood processing businesses, academics, land owners, financial institutions and the press, etc., for the purposes of exchanging opinions on basic matters relating to the promotion of the afforestation plan, clarifying problems and finding solutions.

③ The state forestry authority should conduct extensive public relations activities on the significance and contents of the afforestation plan using various means and opportunities with a view to facilitating the understanding of and cooperation for the afforestation plan among all related parties.

④ Afforestation activities based on the proposed afforestation plan will include loans by financial institutions for afforesters, loans by agricultural cooperatives and others for small-scale landowners and free assistance by the state forestry sector and saw millers for small-scale landowners. The state forestry authority should, therefore, try to establish close collaboration between all of the parties involved.

(4) Development of Various Records Relating to Planning and Implementation of Afforestation Plan

It is extremely important for the departments/divisions of the administrative body responsible for forestry to share information relating to the planning and implementation of the proposed afforestation plan so that the plan can be managed with a common understanding. For this purpose, various forms for the planning and implementation of the plan should be standardised to develop appropriate records.

5.12 Environmental Impacts Assessment

In some cases, an environmental impacts assessment (EIA) is required at the implementation stage of an afforestation project.

5.12.1 Administrative Bodies and Laws Concerning Environmental Impacts Assessment

The SEAM was established in 2000 in accordance with Law No.1561 which was enacted in July, 2000. The SEAM is directly controlled by the President and is responsible for the formulation, adjustment, implementation and supervision of national environmental policies. The organizational structure of the SEAM is shown in Fig. 5-6. Practical work relating to EIA is conducted by the Environmental Impacts Evaluation Bureau of the Directorate General for Quality Control of the Environment and Natural Resources.

The laws and government ordinance related to EIA are Law No.294 (1993), Law No.345 (1994) and Government Ordinance No.14281 (1996) which provides the detailed rules for Law No.294. The EIA system in Paraguay based on these laws and government ordinance is outlined below.

5.12.2 Activities Requiring Environmental Impacts Assessment

Government Ordinance No.14281 sets forth the following activities as activities subject to EIA.

(1) Planning and standards relating to dwelling sites and settlements of people and cities

(2) Development of agriculture, stock raising and forestry

(3) Industrial parks and parks for the service industry

(4) Mining and processing of solid minerals on the ground surface or underground

(5) Prospecting, search and mining and processing of fossil fuels

(6) Construction and operation of pipelines, gasification and/or liquefaction of oil, gas and minerals

(7) Construction and operation of water supply facilities, treatment and disposal of waste water and discharge of industrial effluent to a river or water body

(8) General water utilisation work

(9) Power generation and transmission

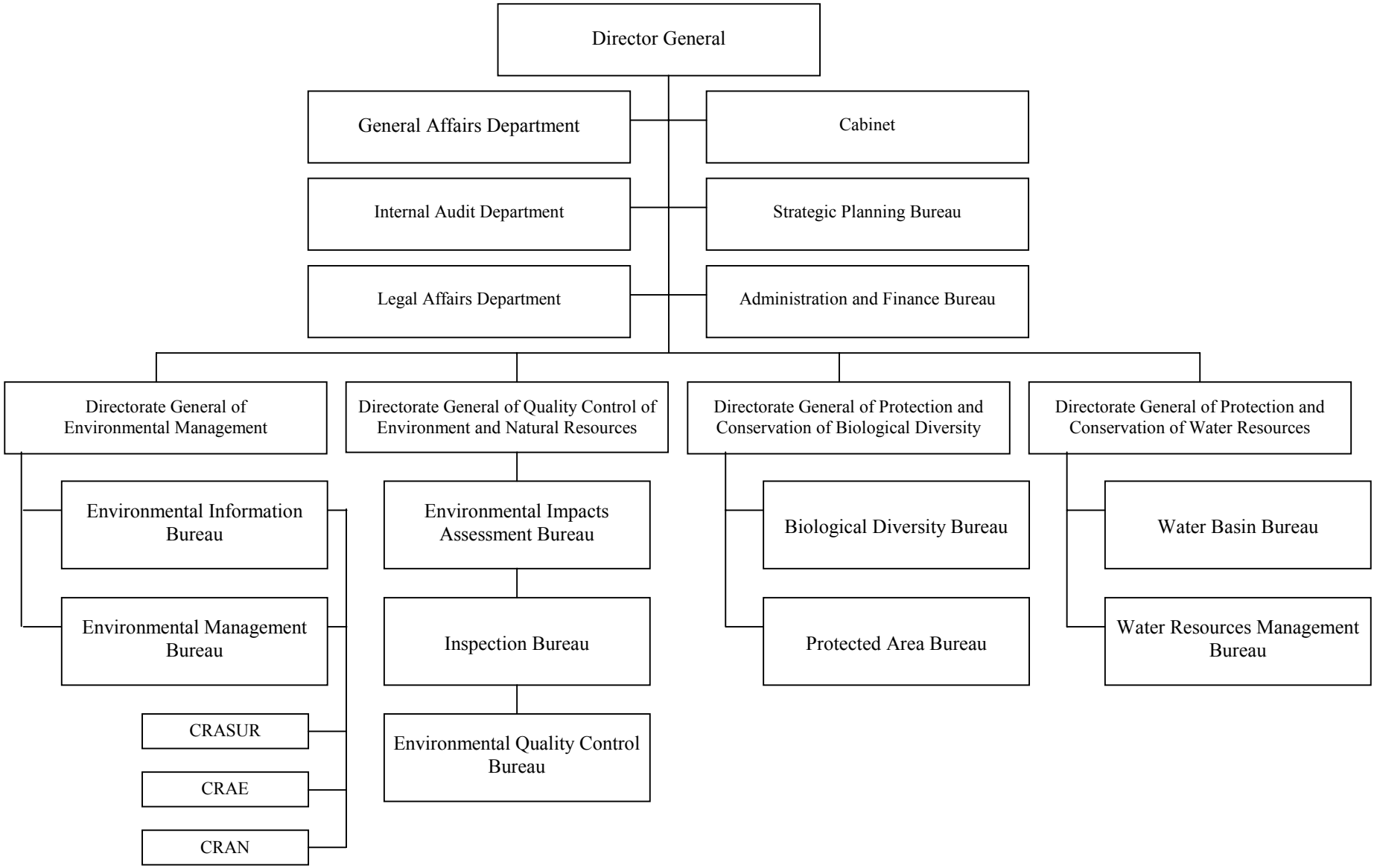


Fig. 5-6 Organizational Structure of the SEAM

(10) Treatment and final disposal of urban solid waste and industrial solid waste

(11) General road work

(12) Construction and operation of ports/harbours

(13) Construction and operation of runways

(14) Construction and operation of warehouses

(15) Machine plant and dissolving activities, etc. which may have external impacts

(16) Archaeology, spelunking and other general search activities

(17) Production, distribution and transportation of hazardous substances

(18) Introduction of exotic animals or plants and commercial fisheries

(19) Work or activities implying the production of atomic energy; use of radioactive materials for industrial, medical, research and other purposes

(20) Whenever an EIA is required because of the natural and socioeconomic characteristics of the target area of activity

Among the listed items, Item (2) – development of agriculture, stock raising and forestry relates to forestry and its detailed contents are given below.

- An EIA is required for the agricultural or stock raising development of an area of 1,000 ha or more. It is also required when the planned development area is less than 1,000 ha if an EIA is deemed to be important because of the implications of the planned development in terms of the present land use or suitability of such development at the planned site or because of the environmental importance of the planned site.
- Forestry development of which the planned use of land exceeds 50 ha. The submission of an EIA report is not required if a project is conducted in line with Article 2 of Law No.536/95 and Article 6 of Government Ordinance No.9425/95.
- The DOA (now changed to the SEAM as a result of administrative reform) can demand the submission of an EIA report in the following cases.
  a) Forestry operation conducted as monoculture using an exotic or indigenous species in an area of 1,000 ha or more.
  b) Existence of a large-scale afforestation site in the same area or the importance of an EIA because of the implications of the planned planting in terms of the present land use or suitability of such development at the planned site or because of the environmental importance of the planned site for planting of less than 1,000 ha.

- Development of vegetable farms exceeding 25 ha in size; stock farms to be judged based on the intensive use of land (number of heads per unit area).

Based on the above provisions, an EIA will be required for the implementation of the Five Year Afforestation Programme when afforestation work using a single species is planned for an area of 1,000 ha or more or when there is a large afforestation site in the area, when the existing land use is very important or when the planned site is very important from the environmental point of view for a planned afforestation area of less than 1,000 ha.

5.12.3 Environmental Impacts Assessment Process

An EIA for forestry activities should be conducted in accordance with the following process.

(1) The project imitator submits a basic environmental questionnaire, certificate of land ownership, certificate of address issued by the municipal authority in the area concerned and letter of interest issued by the district authority to the SEAM.

(2) The SEAM listens to the opinions of individuals and groups who are likely to be affected by the implementation of the project on the environmental impacts.

(3) The SEAM makes a judgement on whether or not an EIA is necessary. (The SEAM makes this judgement within 30 working days of the date of submission of all of the documents. If the SEAM does not make a judgement, an EIA is deemed to be unnecessary.)

In the case of an EIA being judged necessary in (3) above, the following process should be followed.

(1) Should an EIA be judged to be necessary, the SEAM prepares a TOR for the EIA and informs it to the project initiator. The SEAM also provides the project initiator with a list of consultants capable of conducting the EIA.

(2) The project initiator conducts the EIA in accordance with the TOR.

(3) Upon completion of the EIA, the project initiator submits an EIA report and environmental impact records (RIMA; summary of the EIA report) to the SEAM.

(4) Open consultation on the RIMA with the public is publicised for three days in newspapers and on the radio. The RIMA is open to public view for 15 working days after the final day of publicity (if required, public access to the EIA report is also possible).

(5) If necessary, the SEAM organizes a public hearing.

(6) Based on the opinions expressed during the period of public access to the EIA, the SEAM notifies the project initiator of items requiring modification (within 15 working days of the end of the public access period to the EIA).

(7) The project initiator modifies the plan within 15 working days (this may be extended).

(8) The SEAM prepares a declaration of environmental impacts within 90 days of the date of final modification to approve or reject the project.

In the case of an EIA being judged unnecessary in (3) above, the following process should be followed.

(1) If an EIA is judged unnecessary, the SEAM makes a judgement on whether an environmental protection measure(s) or environmental control plan (PCA) is necessary.

(2) If an environmental protection measure is judged to be necessary, the SEAM prepares a TOR for such measure and informs it to the project initiator.

(3) The project initiator formulates the environmental protection measure and submits it to the SEAM.

(4) The SEAM examines the submitted environmental protection measure and issues a certificate of approval if it authorises the submitted measure.

(5) If a PCA is found to be necessary in process (1) above, the SEAM prepares a TOA for the PCA and informs it to the project initiator. The SEAM also provides the project initiator with a list of consultants capable of conducting the PCA.

(6) The project initiator formulates the PCA and submits it to the SEAM.

(7) The SEAM examines the submitted PCA and issues a certificate of approval if it authorises the submitted PCA.

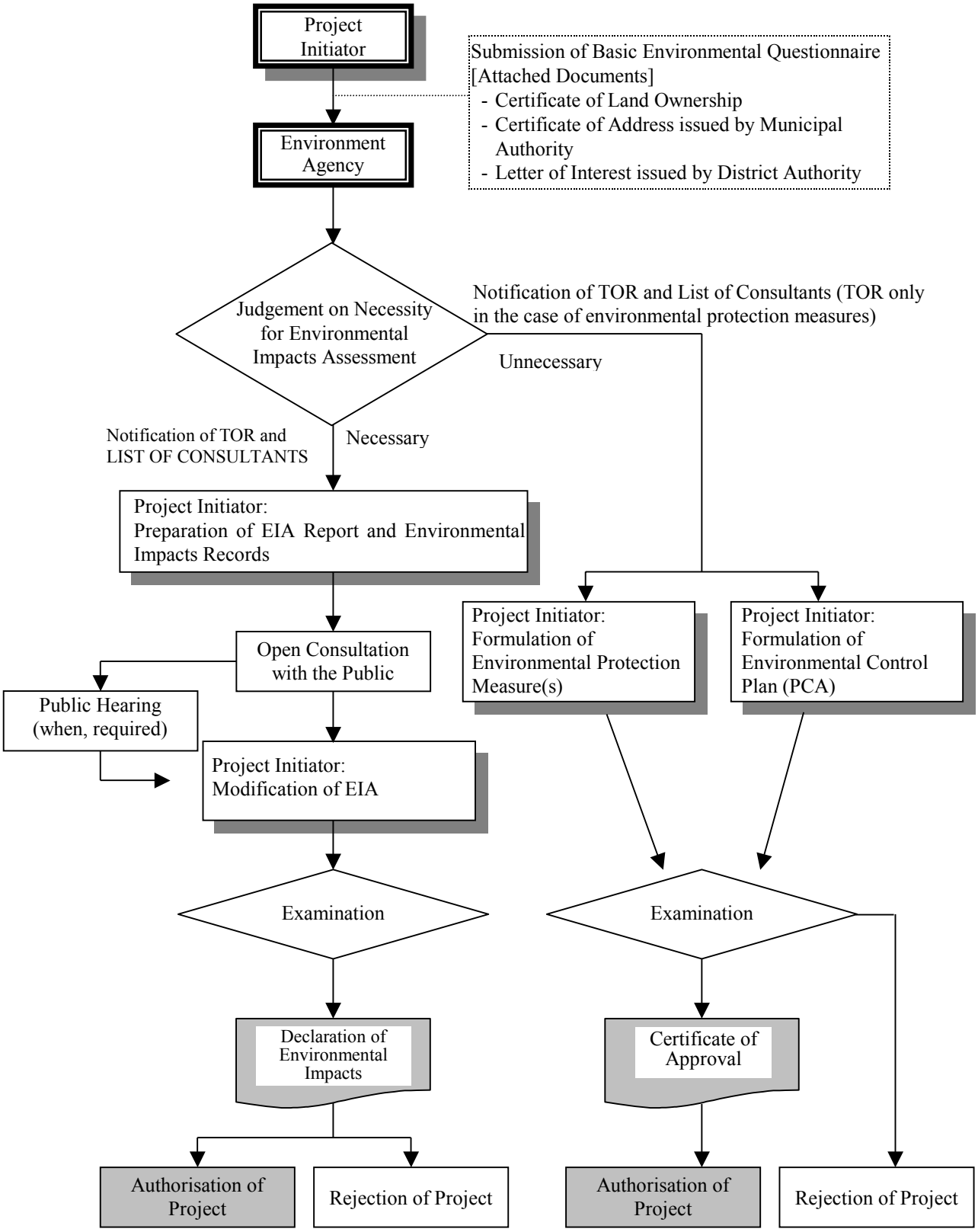


Fig. 5-7 Processes of Environmental Impacts Assessment for Afforestation Project

CHAPTER 6 FIVE YEAR AFFORESTATION PROGRAMME

CHAPTER 6

FIVE YEAR AFFORESTATION PROGRAMME

6.1 Basic Concept of Five Year Afforestation Programme

The basic concept of the Five Year Afforestation Programme is explained below.

(1) The Five Year Afforestation Programme purposes to transform the Afforestation Plan in the Eastern Region (Master Plan) into a concrete project.

(2) The artificial forests to be created are production forests.

(3) The project sites are mainly located in the recommended afforestation areas. The total project area is determined in consideration of the results of the survey on afforestation intentions, the past afforestation results in Paraguay and the capacity to borrow overseas funds, etc. The specific locations of the project sites in the recommended afforestation areas are not determined.

(4) The planting species and forest management methods are those adopted by the Master Plan.

(5) While funding for those wanting to conduct afforestation work is made in the form of a loan, free assistance, etc. is considered for small-scale land owners.

(6) The conditions of a loan for those wanting to conduct afforestation work take the results of the survey on afforestation intentions into consideration.

(7) Financial and economic analyses of the project are conducted to examine the profitability and the financial as well as economic viability of the project.

6.2 Work Plan

6.2.1 Annual Work Volume

In the Five Year Afforestation Programme, the annual work volume, i.e. planting volume, is planned to gradually increase from 5,000 ha each in Year 1 and Year 2 to 10,000 ha in Year 3, 10,000 ha in Year 4 and 20,000 ha in Year 5 to ensure (i) the development of the project implementation system through the planting of 50,000 ha in Phase 1 and (ii) the smooth transition from Phase 1 to Phase 2.

When these planned work volumes are examined from the viewpoint of the planting capacity, they appear to be fully achievable in view of the largest annual planting area of 12,000 ha in the past and the potential capacity of afforestation contractors as already described in 5.2-(2).

6.2.2 Seedling Production Plan

For the formulation of a seedling production plan, calculation of the required quantity of seedlings by estimating the planted area by forest management type and by species is necessary. As the forest management types are prepared for voluntary selection by afforesters, there is no way of knowing which types are actually selected by individual afforesters.

The actual areas covered by each forest management type and species are, therefore, estimated based on certain assumptions described below. (It is believed to be realistic to modify the required number of seedlings by establishing the preferences of afforesters regarding the forest management types and species based on the actual situation of afforestation).

(1) Area Ratio by Forest Management Type

It has been decided not to include Production Forest I-2 (production of fuelwood and pulpwood) and Production Forest IV-2 (production of fuelwood and pulpwood and creation of windbreak forests) in the Five Year Afforestation Plan because of the extremely poor prospect of profitability of producing such types of wood given the current market situation (to be described in 6.4.1 – Financial Analysis). For this decision, such findings of the questionnaire survey as the necessity to create a windbreak forest at farm land and grassland, necessity to protect animals from the harsh weather conditions at pasture land and the expectations regarding agroforestry were also taken into consideration. As a result, the area ratio by forest management type is assumed as shown in Table 6-1.

Table 6-1 Area Ratio by Forest Management Type

Forest Management Type		I-1	II	III	IV-1	V	Total
Ratio (%)		75	10	5	7	3	100
Actual Size in Area of 50,000 ha		ha 37,500	ha 5,000	ha 2,500	ha 3,500	ha 1,500	ha 50,000
Annual Planting Area (ha)	First Year	3,750	500	250	350	150	5,000
	Second Year	3,750	500	250	350	150	5,000
	Third Year	7,500	1,000	500	700	300	10,000
	Fourth Year	7,500	1,000	500	700	300	10,000
	Fifth Year	15,000	2,000	1,000	1,400	600	20,000

(2) Area Ratio by Species for Each Forest Management Type

82% of the people questioned under the questionnaire survey suggested eucalyptus, pine or paraiso as the preferred planting species. The relative ratio of preference among these three species are 61% for eucalyptus, 13% for pine and 26% for paraiso. There is a strong market demand for pine, the price of which is approximately 1.5 times that of eucalyptus. The price of paraiso is approximately four times that of eucalyptus, indicating its extremely good marketability. However, there is a great risk of paraiso being damaged by disease and it is desirable for paraiso to be planted on a scale which permits routine monitoring and management. Based on these points, the anticipated planting area ratios for eucalyptus, pine and paraiso are basically set at 45%, 35% and 20% respectively. The decision on these figures presumes the PR effects of such composition vis-à-vis potential afforesters. The assumed area ratio by species for each forest management type is shown in Table 6-2.

Table 6-2 Area Ratio by Species for Each Forest Management Type

(Unit: %)

Forest Management Type / Species	I-1	II	III	IV-1	V
Eucalyptus	45	-	55	55	100
Pine	35	-	45	45	-
Paraiso	20	100	-	-	-
Total	100	100	100	100	100

(3) Required Quantity of Seedlings

Based on the above assumptions, the quantity of seedlings required for each type of forest management was estimated. The estimated total quantity of seedlings required for five years is approximately 61.9 million, including those for supplementary planting (15%).* By year, 6.19 million each will be required for Year 1 and Year 2, 12.38 million each for Year 3 and Year 4 and 24.76 million for Year 5. The supply of these seedlings should not face any difficulties from the viewpoint of the seedling production capacity because of the reasons described in 5.9-(1).

* Estimation of Required Quantity of Seedlings

Area by Forest Management / Type / Species	I-1	II	III	IV-1	V	Total
	37,500ha	5,000ha	2,500ha	3,500ha	1,500ha	50,000ha
Eucalyptus	(45%) 1330×1.15×37500×0.45=25,810,300	—	(55%) 1330×1.15×2500×0.55=2,103,100	(55%) 1330×1.15×3500×0.55=2,944,300	(100%) 830×1.15×1500×1.00=1,431,800	(No. of Trees) 32,289,500
Pine	(35%) 1110×1.15×37500×0.35=16,754,100	—	(45%) 1110×1.15×2500×0.45=1.436,100	(45%) 1110×1.15×3500×0.45=2,010,500	—	20,200,700
Paraiso	(20%) 630×1.15×37500×0.20=5,433,800	(100%) 630×1.15×5000×1.00=3,622,500	—	—	—	9,056,300
Grevillea	—	—	—	(100%) 90×1.15×3500×1.00=362,250	—	362,250
Total	47,998,200	3,622,500	3,539,200	5,317,050	1,431,800	61,908,750

Note: The percentage figures in brackets show the ratio by species in each forest management type.

6.2.3 Annual Funding Plan

For estimation of the required funding for the afforestation work, natural grassland and farm land are assumed to account for 80% and 20% of the target planting area respectively.* In addition, the above-mentioned area ratio by forest type and by planting species are also assumed.

* These percentage figures are based on the results of the questionnaire survey on afforestation intentions.

① The following figures are estimated regarding the expected afforestation areas of those land owners who "would like to conduct afforestation if some profit can be made from the afforestation site" or who "would like to conduct afforestation regardless of the profitability of the afforestation site".

Farm land : approx. 38,000 ha (approx. 16%)
Natural grassland : approx. 203,000 ha (approx. 84%)
Total : 241,000 ha (100%)

② Based on the above results, it is decided to assume that farm land and natural grassland will constitute 20% and 80% of the target planting area respectively.

Table 6-3 shows the estimated annual cost based on the planned annual afforestation area and the planned work in each year using the unit cost per ha which was calculated by adjusting the afforestation cost for natural grassland (Table 5-15) by the above proportional factor.

The estimated total cost necessary to conduct afforestation work over 50,000 ha in five years is approximately US$26.06 million (based on an exchange rate of G3,800 to US$ 1, June, 2001). The breakdown of this necessary cost is shown in Table 6-4.

The breakdown of the estimated annual cost by forest management type and by planting species is shown in Appendix C-1.

Table 6-3 Annual Funding Requirement

(Unit: US$ '000)

Year	First	Second	Third	Fourth	Fifth	Total
Funding Requirement	3,223	3,221	6,916	5,643	7,778	26,061

The total project cost, which includes the project implementation cost, institutional strengthening cost and consultant cost, etc. (all estimated figures) in addition to the annual cost shown in Table 6-3, is estimated to be US$ 33 million as listed below.

Estimation of Project Cost

Planned afforestation area (ha)	:	50,000
Afforestation cost	:	US$ 26,061,000
Consultant cost	:	US$ 1,800,000
Institutional strengthening cost	:	US$ 1,500,000
Recurrent cost	:	US$ 2,300,000
Other costs	:	US$ 1,339,000
Total project cost	:	US$ 33,000,000

6.2.4 Estimation of Required Labour Volume

When examining the required labour volume for the afforestation of 50,000 ha and the production of the necessary quantity of seedlings in Phase 1, the estimated employment volume is approximately 7,800 workers. The process of reaching this figure is explained below.

a. Required Labour Volume for Afforestation Work

The required labour volume for the work processes from advance ant control to pruning is estimated to be some 1.27 million person-days assuming the forest management types and planting area ratio of each species described in 6.2.2. If the annual working days are 210 days (excluding Saturdays, Sundays, national holidays and unworkable days due to bad weather of 10% of 365 days), the total number of workers to be employed is approximately 6,000 (see Appendix C-2).

b. Required Labour Volume for Production of Seedlings

The total number of workers required to produce some 62 million seedlings to plant an area of 50,000 ha is approximately 1,800 based on the assumed planting productivity of 35,000 seedlings/person-year (rough estimate of the SFN) as mentioned earlier in 5.10.

Table 6-4 Necessary Cost by Forest Management Type and Project Year

Eucalyptus (Production Forest I-1)

Target Afforestation Sites		Necessary Cost per ha of Afforestation Area							Total Unit Price for Five Years (G) ①	Ratio of Species ②	①×② (G)	Distributed Unit Cost (US$)	Actual Afforestation Area (ha)	Cost (US$)	Necessary Cost (US$)					
		Total Cost	First Year	Second Year	Third Year	Fourth Year	Fifth Year	Sixth Year Onwards							First Year Planting	Second Year Planting	Third Year Planting	Fourth Year Planting	Fifth Year Planting	Total
Natural Grassland	80%	2,556,000	1,552,000	638,000	119,000	115,000		132,000												
Farm Land	20%	2,436,000	1,432,000	638,000	119,000	115,000		132,000												
Average		2,532,000	1,528,000	638,000	119,000	115,000		132,000	2,400,000											
Necessary Cost by Year		First Year Planting	1,528,000	638,000	119,000	115,000			2,400,000	0.45	1,080,000	284.21	3750	1,065,788	1,065,788					1,065,788
		Second Year Planting		1,528,000	638,000	119,000	115,000		2,400,000	0.45	1,080,000	284.21	3750	1,065,788		1,065,788				1,065,788
		Third Year Planting			1,528,000	638,000	119,000		2,285,000	0.45	1,028,250	270.59	7500	2,029,425			2,029,425			2,029,425
		Fourth Year Planting				1,528,000	638,000		2,166,000	0.45	974,700	256.50	7500	1,923,750				1,923,750		1,923,750
		Fifth Year Planting					1,528,000		1,528,000	0.45	687,600	180.94	15000	2,714,100					2,714,100	2,714,100
		Total											37500	8,798,851						8,798,851

(For the cost of afforestation at farm land, the ground clearance cost alone is assumed to be 50% of the corresponding cost for grassland while the other costs are the same for the two types of land. The same applies for other forest management types.)

Eucalyptus (Production Forest III)

Target Afforestation Sites		Necessary Cost per ha of Afforestation Area							Total Unit Price for Five Years (G) ①	Ratio of Species ②	①×② (G)	Distributed Unit Cost (US$)	Actual Afforestation Area (ha)	Cost (US$)	Necessary Cost (US$)					
		Total Cost	First Year	Second Year	Third Year	Fourth Year	Fifth Year	Sixth Year Onwards							First Year Planting	Second Year Planting	Third Year Planting	Fourth Year Planting	Fifth Year Planting	Total
Natural Grassland	80%	2,556,000	1,552,000	638,000	119,000	115,000		132,000												
Farm Land	20%	2,436,000	1,432,000	638,000	119,000	115,000		132,000												
Average		2,532,000	1,528,000	638,000	119,000	115,000		132,000	2,400,000											
Necessary Cost by Year		First Year Planting	1,528,000	638,000	119,000	115,000			2,400,000	0.55	1,320,000	347.36	250	86,840	86,840					86,840
		Second Year Planting		1,528,000	638,000	119,000	115,000		2,400,000	0.55	1,320,000	347.36	250	86,840		86,840				86840
		Third Year Planting			1,528,000	638,000	119,000		2,285,000	0.55	1,256,750	330.72	500	165,360			165,360			165360
		Fourth Year Planting				1,528,000	638,000		2,166,000	0.55	1,191,300	311.76	500	155,880				155,880		155880
		Fifth Year Planting					1,528,000		1,528,000	0.55	840,400	221.15	1000	221,150					221,150	221150
		Total											2500	716,070						716,070

Eucalyptus (Production Forest IV-1)

Target Afforestation Sites		Necessary Cost per ha of Afforestation Area							Total Unit Price for Five Years (G) ①	Ratio of Species ②	①×② (G)	Distributed Unit Cost (US$)	Actual Afforestation Area (ha)	Cost (US$)	Necessary Cost (US$)					
		Total Cost	First Year	Second Year	Third Year	Fourth Year	Fifth Year	Sixth Year Onwards							First Year Planting	Second Year Planting	Third Year Planting	Fourth Year Planting	Fifth Year Planting	Total
Natural Grassland	80%	2,728,000	1,668,000	682,000	129,000	117,000		132,000												
Farm Land	20%	2,599,000	1,539,000	682,000	129,000	117,000		132,000												
Average		2,702,000	1,642,000	682,000	129,000	117,000		132,000												
Necessary Cost by Year		First Year Planting	1,642,000	682,000	129,000	117,000			2,570,000	0.55	1,413,500	372.00	350	130,200	130,200					130,200
		Second Year Planting		1,642,000	682,000	129,000	117,000		2,570,000	0.55	1,413,500	372.00	350	130,200		130,200				130200
		Third Year Planting			1,642,000	682,000	129,000		2,453,000	0.55	1,349,150	355.03	700	248,521			248,521			248521
		Fourth Year Planting				1,642,000	682,000		2,324,000	0.55	1,278,200	336.37	700	235,459				235,459		235459
		Fifth Year Planting					1,642,000		1,642,000	0.55	903,100	237.65	1400	332,710					332,710	332,710
		Total											3500	1,077,090						1,077,090

Eucalyptus (Production Forest V)

Target Afforestation Sites		Necessary Cost per ha of Afforestation Area							Total Unit Price for Five Years (G) ①	Ratio of Species ②	①×② (G)	Distributed Unit Cost (US$)	Actual Afforesta-tion Area (ha)	Cost (US$)	Necessary Cost (US$)					
		Total Cost	First Year	Second Year	Third Year	Fourth Year	Fifth Year	Sixth Year Onwards							First Year Planting	Second Year Planting	Third Year Planting	Fourth Year Planting	Fifth Year Planting	Total
Natural Grassland	80%	1,692,000	1,110,000	348,000	73,000	78,000		83,000												
Farm Land	20%	1,572,000	990,000	348,000	73,000	78,000		83,000												
Average		1,668,000	1,086,000	348,000	73,000	78,000		83,000	1,585,000											
Grassland Creation Cost		1,080,000		398,000	62,000	62,000	62,000	496000	584,000											
Total of Afforestation and Grassland Creation Costs		2,748,000	1,086,000	746,000	135,000	140,000	62,000	579,000	2,169,000											
Necessary Cost by Year	First Year Planting	1,086,000	746,000	135,000	140,000	62,000			2,169,000	1.00	2,169,000	570.80	150	85,620	85,620					85620
	Second Year Planting		1,086,000	746,000	135,000	140,000			2,107,000	1.00	2,107,000	554.47	150	83,171		83,171				83171
	Third Year Planting			1,086,000	746,000	135,000			1,967,000	1.00	1,967,000	517.63	300	155,289			155,289			155289
	Fourth Year Planting				1,086,000	746,000			1,832,000	1.00	1,832,000	482.10	300	144,630				144,630		144630
	Fifth Year Planting					1,086,000			1,086,000	1.00	1,086,000	285.78	600	171,468					171468	171468
	Total												1500	640,178						640178

Pine (Production Forest I-1)

Target Afforestation Sites		Necessary Cost per ha of Afforestation Area							Total Unit Price for Five Years (G) ①	Ratio of Species ②	①×② (G)	Distributed Unit Cost (US$)	Actual Afforesta-tion Area (ha)	Cost (US$)	Necessary Cost (US$)					
		Total Cost	First Year	Second Year	Third Year	Fourth Year	Fifth Year	Sixth Year Onwards							First Year Planting	Second Year Planting	Third Year Planting	Fourth Year Planting	Fifth Year Planting	Total
Natural Grassland	80%	2,541,000	1,448,000	563,000	119,000	118,000		293,000												
Farm Land	20%	2,421,000	1,328,000	563,000	119,000	118,000		293,000												
Average		2,517,000	1,424,000	563,000	119,000	118,000		293,000	2,224,000											
Necessary Cost by Year	First Year Planting	1,424,000	563,000	119,000	118,000				2,224,000	0.35	778,400	204.84	3,750	768,150	768,150					768,150
	Second Year Planting		1,424,000	563,000	119,000	118,000			2,224,000	0.35	778,400	204.84	3,750	768,150		768,150				768150
	Third Year Planting			1,424,000	563,000	119,000			2,106,000	0.35	737,100	193.97	7500	1,454,775			1,454,775			1454775
	Fourth Year Planting				1,424,000	563,000			1,987,000	0.35	695,450	183.01	7500	1,372,575				1,372,575		1372575
	Fifth Year Planting					1,424,000			1,424,000	0.35	498,400	131.15	15000	1,967,250					1,967,250	1967250
	Total												37,500	6,330,900						6,330,900

Pine (Production Forest III)

Target Afforestation Sites		Necessary Cost per ha of Afforestation Area							Total Unit Price for Five Years (G) ①	Ratio of Species ②	①×② (G)	Distributed Unit Cost (US$)	Actual Afforesta-tion Area (ha)	Cost (US$)	Necessary Cost (US$)					
		Total Cost	First Year	Second Year	Third Year	Fourth Year	Fifth Year	Sixth Year Onwards							First Year Planting	Second Year Planting	Third Year Planting	Fourth Year Planting	Fifth Year Planting	Total
Natural Grassland	80%	2,541,000	1,448,000	563,000	119,000	118,000		293,000												
Farm Land	20%	2,421,000	1,328,000	563,000	119,000	118,000		293,000												
Average		2,517,000	1,424,000	563,000	119,000	118,000		293,000	2,224,000											
Necessary Cost by Year	First Year Planting	1,424,000	563,000	119,000	118,000				2,224,000	0.45	1,000,800	263.36	250	65,840	65,840					65,840
	Second Year Planting		1,424,000	563,000	119,000	118,000			2,224,000	0.45	1,000,800	263.36	250	65,840		65,840				65840
	Third Year Planting			1,424,000	563,000	119,000			2,106,000	0.45	947,700	249.40	500	124,700			124,700			124700
	Fourth Year Planting				1,424,000	563,000			1,987,000	0.45	894,150	233.90	500	116,950				116,950		116950
	Fifth Year Planting					1,424,000			1,424,000	0.45	640,800	168.60	1000	168,600					168,600	168600
	Total												2500	541,930						541,930

Pine (Production Forest IV-1)

Target Afforestation Sites		Necessary Cost per ha of Afforestation Area							Total Unit Price for Five Years (G) ①	Ratio of Species ②	①×② (G)	Distributed Unit Cost (US$)	Actual Afforestation Area (ha)	Cost (US$)	Necessary Cost (US$)				
		Total Cost	First Year	Second Year	Third Year	Fourth Year	Fifth Year	Sixth Year Onwards							First Year Planting	Second Year Planting	Third Year Planting	Fourth Year Planting	Fifth Year Planting	Total
Natural Grassland	80%	2,728,000	1,579,000	607,000	129,000	120,000		293,000												
Farm Land	20%	2,599,000	1,450,000	607,000	129,000	120,000		293,000												
Average		2,702,000	1,553,000	607,000	129,000	120,000		293,000	2,409,000											
Necessary Cost by Year		First Year Planting	1,553,000	607,000	129,000	120,000			2,409,000	0.45	1,084,050	285.27	350	99,845	99,845					99,845
		Second Year Planting		1,553,000	607,000	129,000	120,000		2,409,000	0.45	1,084,050	285.27	350	99,845		99,845				99845
		Third Year Planting			1,553,000	607,000	129,000		2,289,000	0.45	1,030,050	271.06	700	189,742			189,742			189742
		Fourth Year Planting				1,553,000	607,000		2,160,000	0.45	972,000	255.78	700	179,046				179,046		179046
		Fifth Year Planting					1,553,000		1,553,000	0.45	698,850	183.90	1400	257,460					257,460	257460
		Total											3500	825,937						825,938

Paraiso (Production Forest I-1)

Target Afforestation Sites		Necessary Cost per ha of Afforestation Area							Total Unit Price for Five Years (G) ①	Ratio of Species ②	①×② (G)	Distributed Unit Cost (US$)	Actual Afforestation Area (ha)	Cost (US$)	Necessary Cost (US$)				
		Total Cost	First Year	Second Year	Third Year	Fourth Year	Fifth Year	Sixth Year Onwards							First Year Planting	Second Year Planting	Third Year Planting	Fourth Year Planting	Fifth Year Planting	Total
Natural Grassland	80%	2,771,000	1,533,000	907,000	311,000	20,000														
Farm Land	20%	2,651,000	1,413,000	907,000	311,000	20,000														
Average		2,747,000	1,509,000	907,000	311,000	20,000			2,747,000											
Necessary Cost by Year		First Year Planting	1,509,000	907,000	311,000	20,000			2,747,000	0.20	549,400	144.57	3750	542,138	542,138					542,138
		Second Year Planting		1,509,000	907,000	311,000	20,000		2,747,000	0.20	549,400	144.57	3750	542,138		542,138				542,138
		Third Year Planting			1,509,000	907,000	311,000		2,727,000	0.20	545,400	143.52	7500	1,076,400			1,076,400			1076400
		Fourth Year Planting				1,509,000	907,000		2,416,000	0.20	483,200	127.15	7500	953,625				953,625		953625
		Fifth Year Planting					1,509,000		1,509,000	0.20	301,800	79.42	15000	1,191,300					1,191,300	1191300
		Total											37500	4,305,600						4,305,600

Paraiso (Production Forest II)

Target Afforestation Sites		Necessary Cost per ha of Afforestation Area							Total Unit Price for Five Years (G) ①	Ratio of Species ②	①×② (G)	Distributed Unit Cost (US$)	Actual Afforestation Area (ha)	Cost (US$)	Necessary Cost (US$)				
		Total Cost	First Year	Second Year	Third Year	Fourth Year	Fifth Year	Sixth Year Onwards							First Year Planting	Second Year Planting	Third Year Planting	Fourth Year Planting	Fifth Year Planting	Total
Natural Grassland	80%	1,440,000	991,000	200,000	229,000	20,000														
Farm Land	20%	1,320,000	871,000	200,000	229,000	20,000														
Average		1,416,000	967,000	200,000	229,000	20,000			1,416,000											
Crop Caltivation Cost		1,462,000	466,000	500,000	496,000				1,462,000											
Total of Afforestation and Grassland Cartivation Costs		2,878,000	1,433,000	700,000	725,000	20,000			2,878,000											
Necessary Cost by Year		First Year Planting	1,433,000	700,000	725,000	20,000			2,878,000	1.00	2,878,000	757.36	500	378,680	378,680					378,680
		Second Year Planting		1,433,000	700,000	725,000	20,000		2,878,000	1.00	2,878,000	757.36	500	378,680		378,680				378680
		Third Year Planting			1,433,000	700,000	725,000		2,858,000	1.00	2,858,000	752.11	1000	752,110			752,110			752110
		Fourth Year Planting				1,433,000	700,000		2,133,000	1.00	2,133,000	561.31	1000	561,310				561,310		561310
		Fifth Year Planting					1,433,000		1,433,000	1.00	1,433,000	377.11	2000	754,220					754,220	754220
		Total											5000	2,825,000						2,825,000

(Grand Total)	3,223,101	3,220,652	6,196,322	5,643,225	7,778,258	26,061,557

(US$ 521.23/ha)

6.3 Project Management

6.3.1 Implementation System

The Five Year Afforestation Programme will, in principle, be implemented under the implementation system described in 5.11 with loans for land owners provided by domestic financial institutions, free aid by the SFN for small-scale land owners, free aid by saw millers for small-scale land owners and loans by agricultural cooperatives for small-scale land owners. Meanwhile, the Government of Paraguay will provide loans for domestic financial institutions which in turn will provide loans for land owners, saw millers and agricultural cooperatives. Funds provided by overseas donors are assumed to be the main source of the original funds. The related organizations for the implementation of afforestation work are described below.

(1) Loans by Domestic Financial Institutions for Land Owners

The Government of Paraguay will provide loans for domestic financial institutions which in turn will provide loans for land owners hoping to conduct afforestation work. Under the supervision of the Afforestation Department of the SFN, forestry centres, district forestry offices and district forestry sub-offices will be responsible for consultations on afforestation work, acceptance of applications, examination and approval of the proposed work and site inspection 12 months after planting.

(2) Free Aid by SFN for Small-Scale Land Owners

Under the supervision of the Afforestation Department of the SFN, forestry centres, district forestry offices and district forestry sub-offices will be responsible for consultations on afforestation work, acceptance of applications, examination and approval of the proposed work, free supply of seedlings and ant control equipment and insecticide, technical guidance and site inspection 12 months after planting.

(3) Free Aid by Saw millers for Small-Scale Land Owners (saw millers receiving loans from financial institutions)

The Government of Paraguay will provide loans for domestic financial institutions which in turn will provide loans for saw millers who want to conduct afforestation work. Saw millers will conduct various work to assist small-scale land owners, including consultations on afforestation work, acceptance of applications, examination and approval of the proposed work, free supply of seedlings and ant control equipment and insecticide, technical guidance, site inspection 12 months after planting, reporting to the

SFN, payment of the afforestation cost (each saw miller will decide whether or not payment of the afforestation cost is included in the free aid) and purchase of the harvested wood. In response to a request made by saw millers, forestry centres, district forestry offices and district forestry sub-offices will provide technical guidance for small-scale land owners under the supervision of the Afforestation Department of the SFN.

(4) Loans by Agricultural Cooperatives for Small-Scale Land Owners (agricultural cooperatives receiving loans from financial institutions)

The Government of Paraguay will provide loans for domestic financial institutions which will in turn provide loans for agricultural cooperatives which want to conduct afforestation work. Agricultural cooperatives will conduct various work to assist small-scale land owners, including consultations on afforestation work, acceptance of loan applications, examination and approval of the proposed work, provision of loans, technical guidance, site inspection 12 months after planting and reporting to the SFN. In response to a request made by agricultural cooperatives, forestry centres, district forestry offices and district forestry sub-offices will provide technique guidance for small-scale land owners under the supervision of the Afforestation Department of the SFN.

Extension activities related to afforestation work will be mainly conducted by the Forestry Education, Extension and Investigation Department and the Forestry Techniques Extension Centre of the SFN. Forestry centres, district forestry offices, district forestry sub-offices and nurseries for forestry extension will also be involved as subordinate organizations.

Nine district forestry offices (Amambay, Canindeyu, San Pedro, Concepcion, Caaguazu, Alto Parana, Itapua, Caazapa and Central) will be responsible for the implementation of the Five Year Afforestation Programme and two sub-offices at Curuguaty and Caaguazu will also be involved together with three forestry centres at Alto Parana, Itapua and Capiibary.

The loan conditions of domestic financial institutions for the implementation of the Five Year Afforestation Programme are described below.

Loan amount	:	up to 75% of the required fund
Loan period	:	10 years (maximum of 12 years)
Grace period	:	2 – 3 years
Annual interest rate	:	Guarani-based loan – 20- 30%

Collateral	:	registered real or movable property, including land and house
Guarantee	:	joint and several liability by guarantor with equal or higher creditability than the borrower if real property cannot be provided as collateral. In the case of a group, all other members of the group become sureties liable joint and severally.

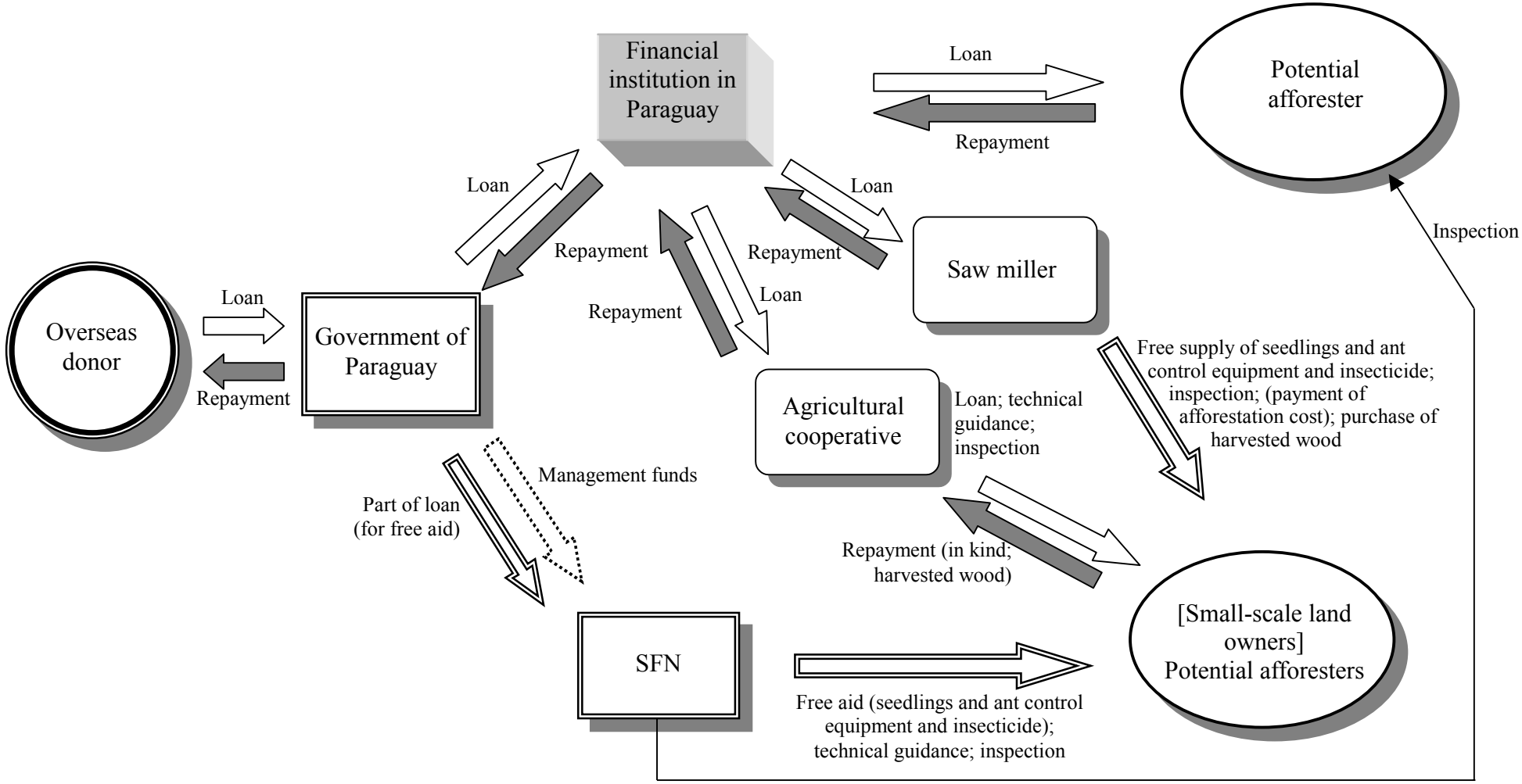


Fig. 6-1 Implementation Mechanism for Afforestation Work Under Five Year Afforestation Programme

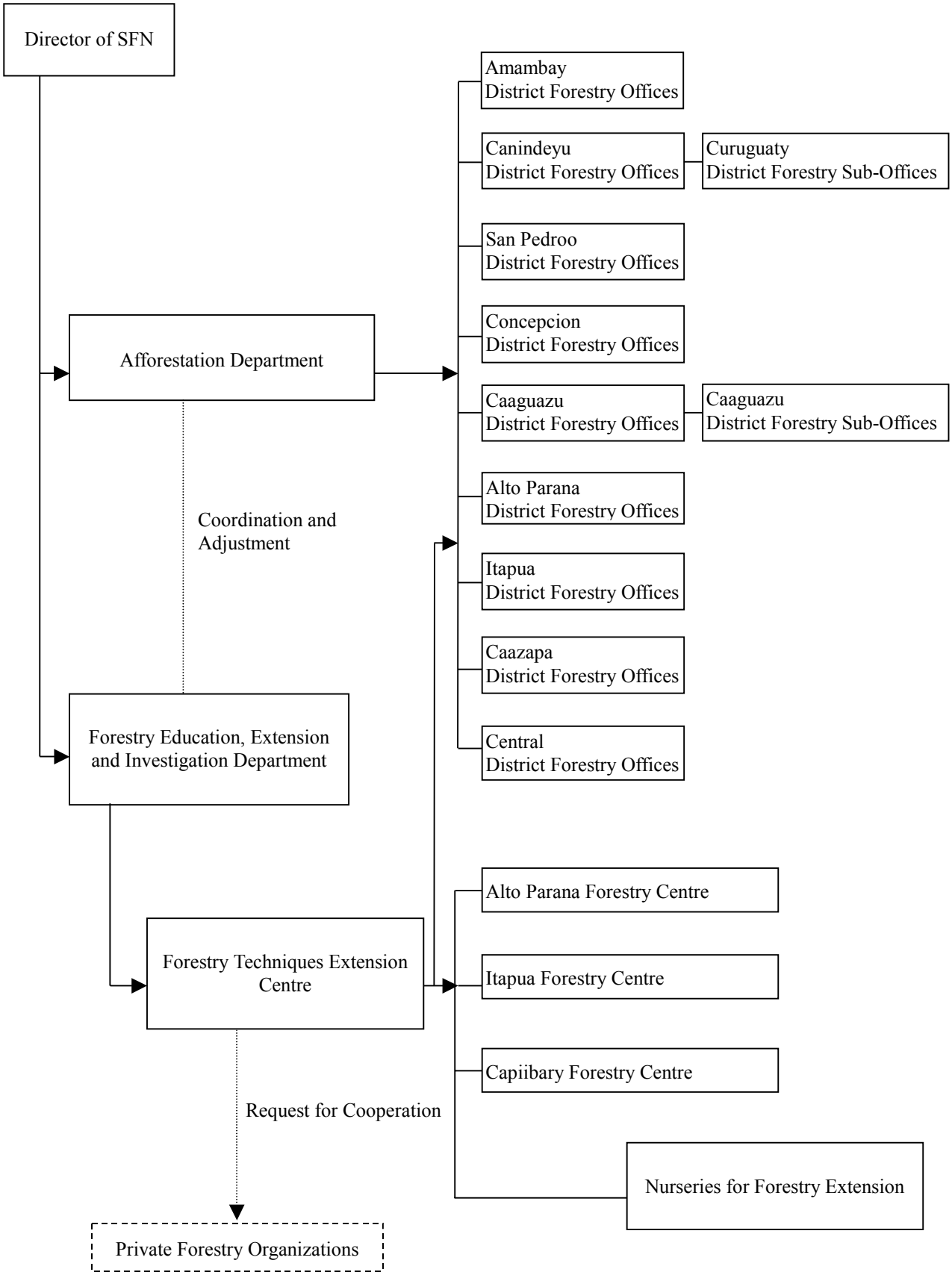


Fig. 6-2 Five Year Afforestation Programme Implementation System at SFN

6.3.2 Application, Approval and Inspection of Afforestation Work

The current Afforestation Promotion Law (Law No.536) sets forth the following application, approval and inspection processes for afforestation work.

① The applicant consults the SFN, the forestry centre, district forestry office and district forestry sub-office on matters relating to application and is introduced to an expert to undergo the application procedure.

② The applicant prepares and submits an application form, management plan, copy of the land register and evaluation notes for the preferred site for forestry to the SFN.

③ The SFN conducts the field verification of the proposed site.

④ The SFN issues a certificate of approved afforestation work and a notification approving the afforestation work (if no reply is received by the SFN within 60 days of the date of application, the said application is deemed to have been approved).

⑤ The applicant commences the afforestation work (within one year of receipt of the certificate of approved afforestation work).

⑥ Upon the completion of planting, the applicant makes a request to the SFN for the verification of completion.

⑦ The SFN conducts a confirmation survey 12 months after planting (a minimum survival rate of 80% is required) and prepares a technical report for the planting verification inspection.

⑧ The SFN issues a certificate of completed planting and first tending work.

The planned Five Year Afforestation Programme will be implemented with loans by domestic financial institutions for land owners, free aid by the SFN for small-scale land owners, free aid by saw millers for small-scale land owners and loans by agricultural cooperatives for small-scale land owners. As the afforestation work conducted with these loans or aid does not aim at receiving a subsidy under the Afforestation Promotion Law, it is not subject to the above processes. As such, the application, approval, inspection and other processes of afforestation work will be simplified as described below compared to the processes currently in force.

(1) Afforestation Work with Loans by Domestic Financial Institutions for Land Owners

① The afforestation work applicant consults the forestry office on matters relating to application.

② The afforestation work applicant submits an application form, management plan, copy of the land register to the forestry office to apply for afforestation work.

③ The forestry office in question examines the application documents and issues a certificate of approval if these documents are found to be appropriate.

④ The afforestation work applicant submits the certificate of approval to a financial institution and concludes a loan agreement with the said financial institution.

⑤ The financial institution provides a loan for the applicant for afforestation work.

⑥ The afforestation work applicant conducts the afforestation work.

⑦ Upon completion of the afforestation work, the afforestation work applicant reports to the forestry office.

⑧ The forestry office conducts an inspection of the site 12 months after planting.

(2) Afforestation Work with Free Aid by SFN for Small-Scale Land Owners

① The afforestation work applicant consults the forestry office on matters relating to application.

② The afforestation work applicant submits an application form for free aid and a copy of the land register to the forestry office.

③ The forestry office in question examines the application documents and supplies seedlings and ant control equipment and insecticide free of charge if these documents are found to be appropriate.

④ The afforestation work applicant conducts the afforestation work.

⑤ The forestry office provides technical guidance and conducts an inspection of the site 12 months after planting.

(3) Afforestation Work with Free Aid by Saw millers for Small-Scale Land Owners (saw millers receive loans from financial institutions)

① The saw miller concludes a loan agreement with a financial institution.

② The afforestation work applicant consults the saw miller on matters relating to application and submits an application.

③ The saw miller provides seedlings and ant control equipment and insecticide free of charge.

④ The afforestation work applicant conducts the afforestation work while the saw miller provides technical guidance.

⑤ The saw miller conducts an inspection of the site 12 months after planting and pays the afforestation cost if the afforestation work is found to be appropriate. (The saw miller in question determines whether or not payment of the afforestation cost is included in the free aid.)

⑥ The saw miller reports to the SFN.

⑦ The saw miller purchases the harvested wood.

(4) Afforestation Work with Loans by Agricultural Cooperatives for Small-Scale Land Owners (agricultural cooperatives receive loans from financial institutions)

① The agricultural cooperative concludes a loan agreement with a financial institution.

② The afforestation work applicant consults the agricultural cooperative on matters relating to application and submits an application.

③ The agricultural cooperative provides a loan for the afforestation work applicant.

④ The afforestation work applicant conducts the afforestation work while the agricultural cooperative provides technical guidance.

⑤ The agricultural cooperative conducts an inspection of the site 12 months after planting and reports to the SFN.

⑥ The afforestation work applicant pays back the loan in kind using the harvested wood.

6.4 Project Evaluation

6.4.1 Financial Analysis

(1) Integration of Management Types

While there are several management types for an afforestation project as pointed out earlier, the following financial analysis primarily focuses on the exclusive wood production type (Production Forest I) for each species. As Production Forest I simply aims at producing wood, the financial analysis tries to verify the profitability of afforestation work alone as a business which is the key issue for an afforestation project.

In principle, the other forest management types represent efforts to add extra work to afforestation work in order to improve the overall productivity of the land with a view to increasing the income even if the production volume of wood is decreased. As a result, the level of profitability of these management types should be slightly higher than that of the exclusive production of wood.

In the case of the wood production and animal protection type (Production Forest III), as the cost and earning levels are the same, it can be integrated in the exclusive wood production type (Production Forest I).

In the case of the wood production and windbreak forest type (Production Forest IV), as the cutting of the windbreak forest is not planned, the overall cost is slightly higher than that of the exclusive wood production type because of the additional cost of creating a windbreak forest. The effects of a windbreak forest can be felt in terms of the increased yield of crops and the qualitative improvement of the beef from cattle grazing on the pasture land. Even though estimation of these effects in financial terms is difficult, it is expected that the economic benefit will exceed the cost of a windbreak forest.

The most important variable in estimation of the profitability is obviously the income from the sale of wood. The main income is generated by final cutting which takes place some 12 – 25 years after the completion of initial planting. There must be a strong probability of the wood produced by final cutting being sold at a reasonable market price to saw millers. If the wood produced by final cutting can only be sold as firewood, raw material for charcoal and/or pulpwood, the financial feasibility of an afforestation project cannot be sustained, resulting in the failure of the project itself. Accordingly, fuelwood and pulpwood production forests (Production Forests I-2 and IV-1) are excluded from the present analysis.

June, 2001 is set as the data reference point. Because of large fluctuations of the local currency (garani), the figures are, in principle, indicated in US$. The price used for both the financial analysis and economic analysis is the constant price which does not include the effect of inflation.

(2) Classification by Scale of Afforestation

Afforesters are classified into two categories, i.e. medium to large and small afforesters, depending on the scale of afforestation work in the recommended afforestation areas. For medium to large afforesters, a model is established for each of pine, eucalyptus and paraiso. In the case of small afforesters, an agroforestry model using paraiso is

established. Firstly, however, the profitability of a production forest alone, excluding farming, is examined.

(3) Profitability of Afforestation Work (Project) by Medium to Large Afforesters

1) Paraiso

The total production cost of paraiso per ha is US$ 720 with thinning and final cutting being conducted in the 8th year and the 12th year respectively. The production volume per ha is 104 tons for timber wood and others and the total income in 12 years is US$ 6,059. It is assumed that cut paraiso is entirely sold at a high price to produce sawn timber or plywood (see Table 4-50 for details of the standing tree prices).

Based on the above preconditions, the financial internal rate of return (FIRR) of a production forest of paraiso wood is calculated to be 23.6%, confirming the high level of profitability of this type of afforestation work (see Appendix D-1 for details).

Note: The main aid organization consider that a FIRR level of 10 – 12% indicates the profitability of a project which is, therefore, acceptable. A FIRR level of more than 20% means fairly high profitability while a FIRR level of more than 30% is deemed to indicate highly profitable operation. In this report, 10% is set as the reference rate of return. Given the continuation of a low interest rate in the international financial market, a project with a FIRR of slightly less than 10% could be acceptable depending on the domestic situation of alternative investment opportunities.

Paraiso (per ha)	8th Year	12th Year	Total
Production Cost			US$ 729
Income	US$ 446	US$ 5,613	US$ 6,059
Production Volume (tons)	15	89	104

Note: While its rate of return is the highest, it must be recognised that paraiso has a high risk of damage by disease.

2) Eucalyptus

The total production cost of eucalyptus per ha is US$ 669 with thinning being conducted in the 4th and 8th years and final cutting being conducted in the 12th year. The production volume per ha is 362 tons, including timber wood and pulpwood and the total income in 12 years is US$ 4,931 (see Table 4-50 for details of the standing tree prices).

Based on the above preconditions, the FIRR of a production forest of eucalyptus wood is calculated to be 21.9%, confirming the high level of profitability of this type of afforestation work together with that of paraiso forest (see Appendix D-2 for details).

Eucalyptus (per ha)	4th Year	8th Year	12th Year	Total
Production Cost				US$ 673
Income	US$ 9	US$ 257	US$ 4,665	US$ 4,931
Production Volume (tons)	33	49	280	362

3) Pine

The total production cost of pine per ha is US$ 669 with thinning being conducted in the 10th, 15th and 20th years and final cutting being conducted in the 25th year. The production volume per ha is 400 tons, including timber wood and fuelwood, and the total income in 25 years is US$ 7,453. In the case of pine, it is again assumed that 75% of the total production volume of pine wood is sold at a high price to produce sawn timber or plywood (see Table 4-50 for details of the standing tree prices).

Based on the above preconditions, the FIRR of a production forest of pine wood is calculated to be 11.6%. Although this rate of return is below that of paraiso and eucalyptus, it is still a well acceptable rate of return (see Appendix D-3 for details).

Pine (ha)	10th Year	15th Year	20th Year	25th Year	Total
Production Cost					US$ 669
Income	US$ 10	US$ 231	US$ 277	US$ 6,934	US$ 7,453
Production Volume (tons)	39	44	26	291	400

(4) Profitability of Small-Scale Afforestation Projects

1) Production Forest

As a contractor afforester is not used for small-scale afforestation work (project), no technical fee is involved. The overall cost is expected to be lower than the cost of medium to large-scale afforestation work. The FIRR of a small-scale production forest of paraiso is 28.5%, confirming a very high rate of return for this type of work (see Appendix D-4 for details).

Paraiso (per ha)	8th Year	12th Year	Total
Production Cost			US$ 729
Income	US$ 446	US$ 5,613	US$ 6,059
Production Volume (tons)	15	89	104

Note: As the cost for small-scale afforesters is lower than that for medium to large-scale afforesters, the rate of return is much higher. However, it must be noted that these figures assume that all produce is sold at a high price to produce sawn timber or plywood and that the risk of damage to pine trees by disease is fairly high.

2) Agroforestry

Agroforestry is to be conducted for some three years after planting at a production forest site referred to above. This incidental production activity improves the productivity of the land, further contributing to enhancement of the high rate of return to be achieved by a production forest alone.

One example of agroforestry is shown in the table below. Here, cassava, maize and French beans are cultivated in the first and second years and cassava and maize are cultivated in the third year (no crop cultivation takes place in the fourth year onwards). With the implementation of such farming activities, the gross and net income will increase by slightly less than US$ 500 and slightly more than US$ 100 respectively in the three year period, making the FIRR increase to 38.5% (see Appendix D-5 for details).

	Planting Area (ha)			Production Cost	Production Volume (kg)			Income
	1st Year	2nd Year	3rd Year	3 Years Total/ha	1st Year	2nd Year	3rd Year	3 Years Total/ha
Cassava	0.2	0.2		US$ 92.42	2,400	2,400		US$ 101.05
Maize	0.4	0.4	0.4	US$ 188.21	800	800	800	US$ 252.63
French Beans	0.1	0.1	0.3	US$ 100.39	100	100	300	US$ 131.58
Total	0.7	0.7	0.7	US$ 381.03	3,300	3,300	1,100	US$ 485.26

(5) Profitability of the Project

When an afforestation project is conducted in accordance with the annual funding plan described in 6.2.3, the project balance will remain in the red until Year 7 because of the afforestation cost in the early years (until Year 15 in the case of pine). As the project produces a profit for the first time in Year 29 when the pine planted in Year 5 is due for

final cutting, the project cycle is set at 29 years. The rate of return for the afforestation work as a whole will be as high as 20.1%.

Next, in order to calculate the rate of return for the entire project, the consultant cost, institutional strengthening cost and incidental cost for project implementation (in five years) are assumed to be 5.5%, 4.5% and 7.0% of the total project cost respectively. With the addition of a contingency of 4.1%, the FIRR still remains as high as 17.1%, indicating the high level of profitability of the project as a whole (see Appendix D-6 for details).

Note: Although the assistance given to small-scale afforesters is, in principle, free, someone has to bear the cost of free inputs from the viewpoint of the entire project. For the present Project, it is assumed that either the government or saw millers and others will bear such cost. As such, all production costs are included in the above calculations regardless of the type of assistance provided for afforestation work.

6.4.2 Economic Analysis

(1) Project Impacts on National Economy

The profitability and rate of return for individual afforesters involved in the afforestation project are discussed in 6.4.1. This section aims at analysing the possible impacts of the afforestation project on the entire national economy.

1) Concept of Opportunity Cost

Under the Five Year Afforestation Programme, it is hoped that new afforestation work will commence at farm land and pasture land in the recommended afforestation areas.

The implementation of afforestation work will produce wood products, contributing to the increased output of the national economy. Meanwhile, the conversion of farm land and pasture land to forests to produce wood products means the loss of the traditional agricultural and livestock outputs from this land from the viewpoint of the national economy. The lost agricultural and livestock outputs due to the conversion of land for afforestation purposes constitute the cost of afforestation for the economy of the country concerned which is recognised as the opportunity cost. While this opportunity cost does not significantly feature in the financial analysis, it is treated as an important variable in the economic analysis.

If the target site for conversion to an afforestation site is waste land or wet land, the economic cost (opportunity cost) of afforestation due to the conversion of land use can be regarded as nil because of the almost no traditional output of such land. In the case of fallow land, the output after the recommencement of cultivation is considered to constitute the opportunity cost.

2) Impacts on Exports

Agricultural products account for approximately two-thirds of Paraguay's total export value and any decrease of the farm land and/or pasture land due to afforestation work is likely to reduce the total export value. For example, the decreased production outputs of such typical export-oriented agricultural and livestock products as soybeans, cotton and beef will immediately reduce the total export value. If crops of which the output is reduced in this manner are imported, the increased import value resulting from afforestation is regarded as the opportunity cost.

3) Uniqueness of Afforestation Project

Wood products are equally important export products as agricultural and livestock products. The increased output of wood products increases the export volume (and value) although the following uniqueness of an afforestation project must be noted.

① Long Production Period

The uniqueness of forestry work lies with the long period before the product can be harvested. In the case of wood for export, it takes at least 10 years for the planted trees to reach the exportable stage. In contrast, only a maximum of several years are required for agricultural and livestock products to be produced and exported.

The likely impact of an afforestation project on exports is a continuous decline of exports (agricultural and livestock products) at an almost constant rate for the first 10 years. The mass production of wood products is only feasible when stands reach their final cutting age, providing the prospect of sizable wood exports.

② Natural Forests and Artificial Forests

Almost the entire wood exported from Paraguay at present is natural wood. As natural wood is not produced by neighbouring countries, the forestry sector in

Paraguay has been able to maintain its advantageous position. The high quality of most natural wood has also been an important contributory factor to the good export performance of natural wood. In contrast, the species to be planted under the Five Year Afforestation Programme have already been planted in neighbouring countries and there is no proven advantage for Paraguay regarding these species. It is, therefore, necessary for the forestry administration and afforesters to make conscious efforts in the coming years to establish the advantageous status of artificial forests in Paraguay. The lack or failure of such efforts will result in a bleak future for wood exports from newly created artificial forests.

4) Target Afforestation Sites

As mentioned earlier, the financial analysis does not consider the opportunity cost. When individual farm or stock farm owners actually examine the possibility of initiating afforestation work, it is believed that they make a rational choice by comparing the expected income from afforestation work with the loss of profit resulting from the conversion of land use. It is, therefore, unlikely that highly productive farm land or stock farms which promise a continuously high rate of return will be converted to afforestation sites involving new business risks.

According to the findings of the survey on afforestation intentions, some two-thirds of those interviewed replied that they would like to conduct afforestation work if the profitability of the afforestation site was generally comparable to that of the existing farming field or stock farm (some multiple replies included). Some 60% of the interviewees were also considering using such marginal land as boundary land, sloping land and river banks, etc. as afforestation sites (the figure is boosted by multiple replies).

Taking such conditions into consideration, it can be inferred that the average productivity of land converted to an afforestation site will not be particularly high.

The extensive stock raising method with a small number of cattle per unit area is widely employed at stock farms raising beef cattle. As this method gradually reduces the fertility of pasture land, some parts of pasture land are said to be left as fallow land in turn.

Also in the case of farming, the introduction of fallow land every few years is said to be inevitable because of the relatively low level of fertiliser input. For the purpose of

the present economic analysis, the problem of declining land productivity is dealt with by the increased input of fertiliser.

(2) Export Route for Each Product

As the agricultural and livestock products produced under each model will be exported, their export prices (FOB Asuncion; average price in 2000) are used as the basis for calculation of the economic value. In the case of cassava and some by-products, the consumption of which is limited in Paraguay, the domestic market price is used as the calculation base.

For the calculation of international prices (border prices), the distribution route of each products, mainly focusing on the export route, must be verified. Such routes are outlined below.

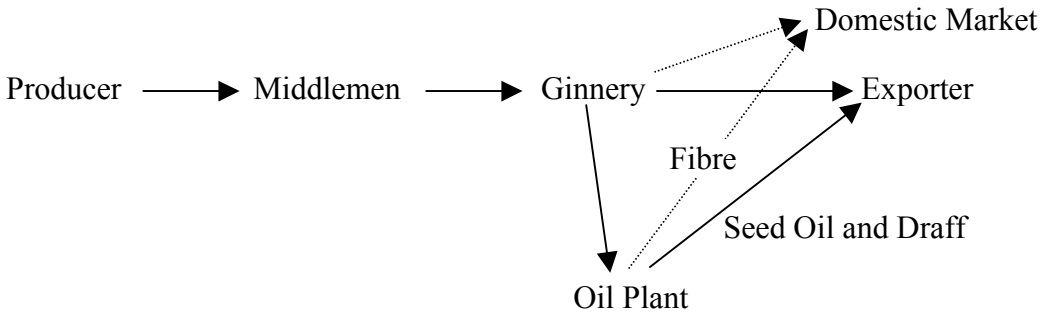
1) Cotton

The middlemen for cotton collect raw cotton from cotton producing farmers, most of which are small-scale farmers, and deliver it to ginneries scattered around the production areas. The purchase price is determined in advance by each ginnery which refers to the international price of raw cotton and other factors.

A ginnery uses a ginning machine to remove the seeds from the raw cotton and to extract the cotton fibres. As seeds account for some 54% of the total weight of raw cotton, the yield of cotton fibre is around 35%. The removed seeds are sold to an oil plant as the raw material for vegetable oil. At such a plant, 1 kg of seeds produces 150 g of vegetable oil (yield: 15%) and 450 g of draff (yield: 45%). The cotton fibre, seed oil and draff are sold to an exporter (who may direct some to domestic consumption).

Raw Cotton (one ton) → Fibre 35% (350 kg)
→ Seeds 54% (540 kg) → Seed Oil 15% (81 kg)
→ Draff 45% (243 kg)

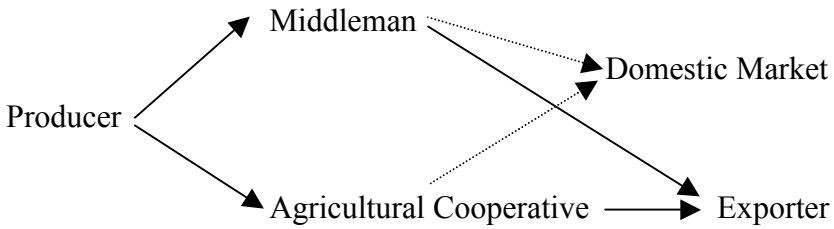
<Distribution Route for Cotton>



2) Soybeans, Wheat and Maize

Soybeans, wheat and maize are collected from producers by middlemen or local agricultural cooperatives which store and ship them to wholesale markets for domestic consumption or exporters (many of which are multi-nationals) for export.

<Distribution Route for Soybeans, Wheat and Maize>



The storage cost (G14/kg) and handling charge (G6/kg) amount to G20/kg. The total weight is reduced by approximately 5% between the producer and exporter due to the removal of foreign matters and cleaning work, etc.

3) Beef

In Paraguay, beef cattle are raised by various methods in terms of the productivity of pasture land, variety, feed and size of capital investment. The most common practice is extensive grazing using natural grassland where one head is raised per 0.5 – 1.5 ha of pasture land.

The yield of the carcass from life cattle at the hands of a slaughterer or cold storage operator is an average of 54% and consists of beef, bone and fat. Internal organs and scrap meat, etc. are obtained from the remaining 46% while the skin is sold to tanners. Standard cattle of 450 kg in weight is cut into two pieces in the following manner.

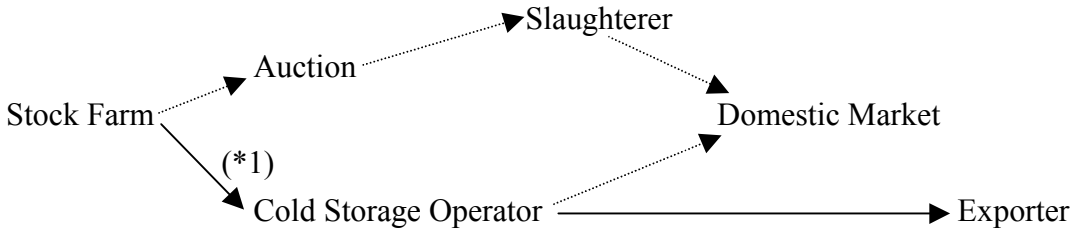
Beef cattle (450 kg)	→	Carcass 54% (243 kg)	→	Beef	73% (177 kg)
			→	Bone	18% (44 kg)
			→	Fat	9% (22 kg)
	→	Others 46% (207 kg)	→	Internal organs	approx. 18% (37 kg)
			→	Skin	approx. 2% (4 kg)
			→	Scrap meat	approx. 9% (18 kg)
			→	Head and tail	approx. 5% (10 kg)
			→	Others	66% (136 kg)

It is assumed that the beef, internal organs and skin are exported while the scrap meat and fat are consumed domestically.

The processing cost of beef cattle by a cold storage operator is estimated to be an average of approximately US$ 290/head.

The standard distribution route for beef is outlined below.

<Distribution Route for Beef>



*1 Some beef cattle for export used to be bought at auction. Today, however, beef cattle is only directly bought from stock farms in view of hygiene considerations.

4) Wood (Planted Trees)

Saw millers and wood processors buying standing trees from afforesters process the wood into timber, wood frames, floor boards and beams, etc. for sale in the domestic as well as export markets.

<Distribution Route for Wood>

The sawing and processing cost is US$ 75/m^3 for standing trees and an additional US$ 10/m^3 (mainly the drying cost) is required to give the wood export quality. The sawing yield is an average of approximately 40% and the remaining 60% is

abandoned and is self-consumed or sold as firewood. The level of earning from the sale of firewood little differs from the transportation cost even though the level of actual earning slightly changes depending on the actual transportation distance. The economic value of this 60% of the original wood is, therefore, considered to be nil. One cubic meter of a standing tree can be converted to one ton in weight although the latter is reduced by drying, etc. Given a sawing yield of 40%, the weight of the processed wood from the original 1 ton of standing tree for each species is as follows.

		Dry Weight		Processed Wood	Yield
Paraiso	→	0.63 tons	→	0.252 tons	25.2%
Pine	→	0.63 tons	→	0.250 tons	25.0%
Eucalyptus	→	0.65 tons	→	0.240 tons	24.0%

Note: The dry weight for pine is the average of two species, as is the dry weight for eucalyptus.

The estimated shares of wood for timber and wood for plywood and their export prices are shown below.

	Share of Wood		Export Price (US$/ton)	
	Timber	Plywood	Timber	Plywood
Paraiso	58%	42%	1,020	930
Pine	61%	39%	694	419
Eucalyptus	79%	21%	400	326

Note: The above export prices are estimated on the basis of the export results of wood products from planted trees in Paraguay using the export prices in Argentina for reference purposes. In the following economic analysis, these relatively high export prices are used as basic data for calculation of the economic value. One important assumption here is that the planted trees are exported in the form of highly value-added furniture, processed wood or plywood products after cutting. As described earlier, while the ratio of processed products in the export of wood products from Paraguay has been steadily increasing, the renewal of processing equipment for wood from natural trees and the introduction of new specialist equipment for wood from planted trees are believed to be necessary to improve the efficiency and quality of the sawing or processing of wood from planted trees. Even if the trend of increased processed wood exports continues in the coming years, there is no guarantee that all of the trees planted under the project will be exported with added value as assumed above. If a sizable quantity of the wood produced from the planted trees is exported in the form of logs or electric poles, the project will be unable to sustain its economic feasibility.

It must be noted that the actual export volume of wood from planted trees, particularly paraiso and eucalyptus, in Paraguay has been quite limited. A significant increase of the wood supply from the planted trees with the full-scale

progress of afforestation work in the future may cause a rapid decline of the export price.

Although the estimated EIRR for each species shows a very high level of feasibility, it must be noted that the high export price level assumed is a major factor for the high EIRR figures. While the EIRR for paraiso is especially high, it must be remembered that this species has a high risk of damage due to disease.

(3) Economic Value and Economic Benefit of Individual Crops

The economic value (or economic price) of the main agricultural and livestock products which is calculated by modifying the export price following the export route described in the previous section is shown below (see Appendix D-6 for details).

(Unit: US$/ton)

	Cotton	Soybeans	Wheat	Maize	Beef
Economic Value per ton	313	125	81	77	321

The estimated economic profit of land which produces various products is shown below. It is impossible to set up an all-inclusive model as the land productivity considerably varies from one place to another in the recommended afforestation areas. The following shows the estimated net economic benefit per ha for each crop mainly on the basis of MAG data and does not necessarily constitute a typical model for the recommended reforestation areas. (see Appendix D-8 for details).

(Unit: US$/ha/year)

	Cotton	Soybeans	Wheat	Maize	Beef
Net Economic Benefit	-49	30	-11	11	9

The above net economic benefit may be considered as the “opportunity cost”.

(4) International Price of Each Product

Each product is, in principle, evaluated based on its average FOB price for export in 2000. As all of the products in question are international commodities, their FOB prices are considerably affected by the situation of the international commodity market. Fig. 6-3 shows the changes of the average annual prices of soybeans, wheat and maize in the international market since 1990. It is clear that the international prices of these commodities reached their peak in 1996 or 1997, followed by a steady decline to the

current level which is lower than the level in the early 1990's. The price of cotton has shown a similar trend of decline from the peak period in 1995 when the average annual price was more than US$ 2,000/ton.

The future prices of export products in Paraguay will depend on the situation of the international commodity market as it is quite difficult to forecast them at present. Here, it is assumed that their real prices will remain at the present level.

(Unit: US$/ton)

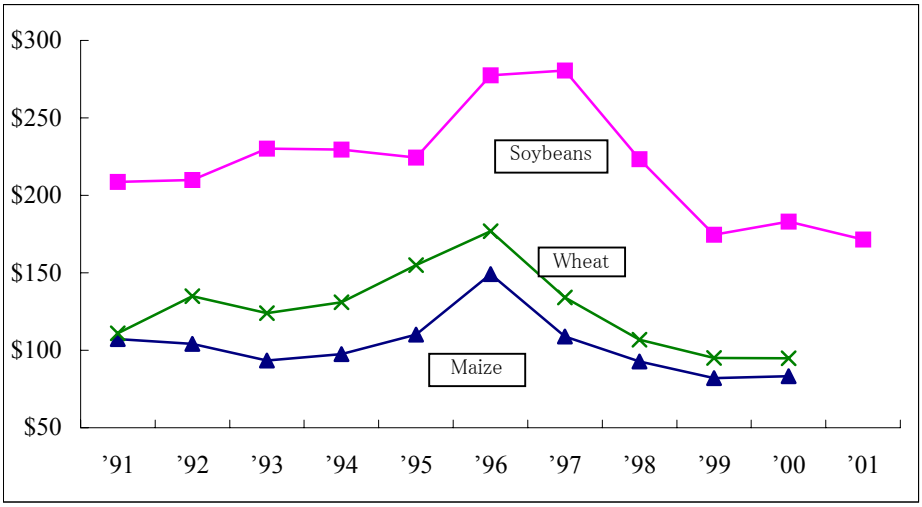


Fig. 6-3 Historical Changes of International Commodity Prices

(5) Conversion of Financial Price to Economic Price

The market prices used for financial analysis are often quite different from the international prices because of the imposition of taxes and levies, granting of a subsidy and/or price control by the government. For economic analysis, the effects of these factors are removed through the following adjustment so that the economic values can be determined based on the international prices.

① Trade Goods

In the case of goods and services subject to international trade, their economic price is the FOB price for goods for export and the CIF price for goods for import. When trade goods are evaluated in terms of the market prices in the financial analysis, their prices are converted to border prices by removing taxes and duties, adding subsidies and taking the domestic handling and transportation costs into consideration.

② Non-Trade Goods

In the case of goods and services which are only traded domestically, their market prices are modified using the standard conversion factor (SCF). In this section, 0.909 calculated in the Report for the Small-Scale Agriculture Improvement Plan for Paraguay (Japan Agricultural Land Development Agency, March, 1997) is used as the SCF.

③ Labour Force

The labour force is a typical example of a service which is not subject to external trading. As the wage level and labour productivity do not match in the case of unskilled workers because of the existing of the minimum wage system, the wages for unskilled workers must be adjusted. For this purpose, 43% which is applied by the World Bank as the shadow wage rate for Paraguay is used as the relevant factor.

(6) Public Benefit Function of Forests

An afforestation project creates a forest which can have various public benefit functions in addition to direct and financial benefits. According to the Forestry Agency of the Ministry of Agriculture, Forestry and Fisheries in Japan, the public benefit functions of forests include the conservation of headwater areas, prevention of erosion, prevention of landslides, promotion of public health, protection of wildlife and conservation of air quality (absorption of CO_2 and supply of O_2). The concrete qualification and price evaluation of these functions involve major technical difficulties and there is no international consent regarding the qualification and evaluation techniques.

For the project considered under the Study, the CO_2 absorption effect among these public benefit functions is recognised as a benefit for the purpose of economic analysis. In recent years, there have been attempts to quantify the CO_2 absorption effect under the concept of "emission trading". The basis for the calculation is the annual biomass formed by afforestation work and the unit evaluation value.

As no international consent has yet been achieved for the unit evaluation value, the idea of alternative cost is used to set an estimated value of approximately US$ 100/ton. It is believed that this figure will fall in the future and a unit value of US$ 10 – 20 is generally suggested.

For the economic evaluation of this particular public benefit function, the following two points must be noted.

① Real Economic Effect

The quantified CO_2 absorption effect is still only a theoretical value as there are only a few concrete examples of emission trading so far in the world. Accordingly, this value does not directly lead to the inflow of foreign currency to Paraguay or increased added-value for the country.

② Relationship with Reforestation After Final Cutting

Debates on the CO_2 absorption effect appear to implicitly assume the semi-permanent existence of created forests and there is no established theory to deal with the present case where reforestation after final cutting is not necessarily guaranteed.

(7) Economic Feasibility of Afforestation Project

The economic feasibility of an afforestation project in Paraguay is examined below, mainly dealing with the medium to large-scale production forest model.

1) Feasibility of Exclusive Afforestation Model

Firstly, the economic feasibility of an exclusive afforestation model is examined for each species without considering the opportunity cost.

① Paraiso

The production cost and economic value of the benefits are outlined in the table below. Because of the high level of the estimated export price, the EIRR is as high as 41.4% (see Appendix D-9 for details).

Note: This EIRR figure must be interpreted taking the notes for the export price described in the previous section into consideration.

Paraiso (per ha)	8th Year	12th Year	Total
Production Cost			US$ 663
Economic Benefits	US$ 2,530	US$ 14,029	US$ 16,559

② Eucalyptus

The production cost and economic value of the benefits are outlined in the table below. Eucalyptus enjoys a high financial rate of return and the EIRR of 18.7% is adequate, indicating its economic feasibility (see Appendix D-10 for details).

While the FIRR of eucalyptus is comparable to that of paraiso, its EIRR is significantly lower than that of paraiso. The main reason for this is the relatively high unit sawing/processing cost for eucalyptus because of its relatively low price per unit weight despite its high productivity.

Note: This EIRR figure must be interpreted taking the notes for the export price described in the previous section into consideration.

Eucalyptus (per ha)	4th Year	8th Year	12th Year	Total
Production Cost				US$ 611
Economic Benefits	US$ 9	US$ 323	US$ 2,929	US$ 3,262

③ Pine

The production cost and economic value of the benefits are outlined in the table below. Although the production period of pine is quite long, its EIRR of 18.5% is excellent (see Appendix D-11 for details).

Note: This EIRR figure must be interpreted taking the notes for the export price described in the previous section into consideration.

Pine (per ha)	10th Year	15th Year	20th Year	25th Year	Total
Production Cost					US$ 608
Economic Benefits	US$ 9	US$ 1,524	US$ 1,729	US$ 14,179	US$ 17,442

2) Addition of Opportunity Cost

The next step is to examine the general impacts of an afforestation project on the actual economy by adding the economic opportunity cost associated with the conversion of land use.

Given the huge diversity in terms of the meteorological conditions, scale of land ownership, types of land use, soil fertility, degree of mechanisation and use of fertiliser/insecticide, etc. in the recommended afforestation areas, the attempted representation of the conditions of such main agricultural crops as soybeans, wheat, maize and cotton and of beef cattle raising may be unable to properly reflect the actual conditions.

In principle, agriculture and stock raising can expect a certain level of harvest each year. Even if such harvest does not materialise in reality, it can still be considered as the exported economic value for the future.

Based on this idea, a change of the economic feasibility for each species is observed by deducting the economic value (opportunity cost) of agricultural and livestock production activities by ha which will be lost due to the commencement of an afforestation project. The table below outlines the subsequent change of the EIRR for each species due to an increase of the opportunity cost (up to 10% which is the lowest acceptable level).

Paraiso		Pine		Eucalyptus	
Base Case		Base Case		Base Case	
EIRR	41.4%	EIRR	18.5%	EIRR	18.7%
Opportunity Cost	EIRR	Opportunity Cost	EIRR	Opportunity Cost	EIRR
US$ 100	33.5%	US$ 100	13.0%	US$ 50	13.1%
US$ 300	23.3%	US$ 180	10.2%	US$ 80	10.3%
US$ 600	14.0%				
US$ 770	10.1%				

In the case of paraiso, feasibility can be maintained with a very high opportunity cost. This means that afforestation using paraiso is feasible even at first class farming land or pasture land.

In the case of pine, although its production period is quite long, the resulting economic benefit is quite high. Accordingly, the feasibility of an afforestation project can be maintained when farming land or pasture land with average productivity is converted.

In the case of eucalyptus, it is difficult to maintain the economic feasibility unless an afforestation site is converted from farming land or pasture land of which the productivity is below average.

However, this table simply compares the expected EIRR of different types of land use and does not actively consider the risk or long production period of an afforestation project as a new business venture. For example, even if the economic feasibility of paraiso is extremely high in the long run, land owners may opt to

continue farming or stock raising with which they can expect a certain production level each year.

3) Public Benefit Functions

As the economic feasibility is confirmed for all three species in the previous section, no special consideration of the public benefit functions of forests is made here. For reference purposes, the CO_2 absorption volume by year, calculated by the Study Team, is given below (see Appendix D-12 for details).

(Unit: tons/year)

Year	1	2	3	4	5	6	7	8	9	10	11	12	13
Pine	0	39	59	79	98	118	138	157	177	136	216	236	255

Year	14	15	16	17	18	19	20	21	22	23	24	25	Ave.
Pine	275	225	306	317	329	341	310	364	376	388	399	0	213

Year	1	2	3	4	5	6	7	8	9	10	11	12	Ave.
Eucalyptus	0	75	112	96	143	193	244	193	287	279	319	0	162
Paraiso	0	27	41	21	68	93	119	102	162	180	229	0	87

CHAPTER 7 RECOMMENDATIONS

CHAPTER 7

RECOMMENDATIONS

Based on the judgement of the present management situation of forests and forestry-related policies and system and also on the availability of various reference materials and data, the following recommendations are made to promote the Afforestation Plan (Master Plan) and to facilitate the implementation of the Five Year Afforestation Programme.

7.1 Promotion of Afforestation Work Using Loan Scheme

The promotion of afforestation work for a total of 400,000 ha under the Afforestation Plan (M/P) and for the more immediate task relating to 50,000 ha under the Five Year Afforestation Programme under the existing afforestation subsidy system is judged to be extremely difficult given the severe fiscal situation of the Government of Paraguay at present.

For the Afforestation Plan (M/P), a loan system which takes the unique characteristics of afforestation work into consideration is proposed based on the understanding that the success of the large-scale afforestation as proposed here requires domestic as well as overseas investment funds for afforestation.

The desirability of introducing a loan system and the preferable loan system should be carefully examined by taking into consideration the national financial condition along with a review of the existing afforestation subsidy system under Law No. 536 for the smooth implementation of the afforestation work under the Afforestation Plan (M/P).

7.2 Clarification of Status of State Forestry Authority in National Administrative Structure and Strengthening of Its Organizations

Even following the establishment of the SEAM in July, 2000, the status of the state forestry authority has still not been totally settled. The submission of a new draft law to separate the SFN from the MAG to establish the National Forestry Institute for the purpose of strengthening of state forestry authority is one example indicating such uncertainty. The status of the state forestry authority must, therefore, be urgently determined together with strengthening of the organization to ensure the implementation of the Master Plan.

7.3 Development of Domestic Regimes to Secure External Funds Required for Implementation of Afforestation Programme

Given the fiscal situation in Paraguay, urgent examination of a method to raise overseas funds to implement the Master Plan is necessary. For this purpose, the necessary domestic regimes must be developed.

① The government-backed afforestation drive must be highly ranked among government policies while ensuring understanding of its importance and urgency on the part of the public.

② The investment environment of the afforestation sector should be improved so that the introduction of overseas investment funds for afforestation can be facilitated using the international framework agreed upon while constantly following the trends of international debates on the CDM of the Kyoto Protocol designed to prevent global warming and other relevant issues.

③ Many government-affiliated financial institutions have expressed their willingness to be involved in a loan scheme for afforestation work. However, the direction for the merger and abolition of these institutions to be conducted by the government based on an agreement with international aid organizations has not yet been clearly established and there is no firm date for such merger or abolition to take place. The government must firmly establish and implement the merger and abolition programme to ensure the early commencement of the afforestation project under the Five Year Afforestation Programme.

④ For the implementation of the afforestation project as planned, the proper provision of the counterpart (C/P) fund is essential. While the C/P fund for the planned project will be mainly provided by the own funds of afforesters, the government must ensure the timely as well as sufficient disbursement of the related budget to provide technical assistance for afforesters without fail.

7.4 Establishment of Effective Measures to Combat Depletion and Degradation of Natural Forests

When the Government of Paraguay plans to make a request for overseas financial assistance for the implementation of the Master Plan, the implementation of effective measures to combat the depletion and degradation of natural forests is necessary.

For this purpose, the laws and regulations relating to the management of natural forests must be reviewed in order to urgently create a nationwide conservation and management system for natural forests and to strengthen the management system while maintaining the conformity of the policies of related government bodies.

7.5 Gathering and Management of Statistical Data and Scientific Data on Forests and Forestry and Establishment of Afforestation Experiment and Research System

In general, statistical data and scientific knowledge on forestry and the forest products industry is extremely inadequate compared to that on agriculture and stock farming. Given the crucial importance of scientific knowledge for the promotion of the Master Plan, the following efforts should be made as soon as possible.

① Strengthening of the system to collect and accumulate statistical data

② Collection and accumulation of technological information on afforestation

③ Development of a national experiment and research system, including the forest tree breeding

7.6 Promotion of Industrial Afforestation Through Collaboration with Wood Industry

For the success of so-called industrial afforestation which is aimed at by the Master Plan, the sustainable production of high quality wood, which is the key to the promotion of the wood industry, should be systematically achieved. At the same time, the wood to be produced from planted trees must be processed into wood products which have strong export competitiveness. For this purpose, the following efforts must be promoted.

① Strengthening of the education, extension and guidance on forestry technology for afforesters

② Development of an information system which is capable of providing information on the locations of afforestation sites and the growth situation for the wood industry side

③ Advancement of the technological standard and improvement of equipment to facilitate the advanced use and to increase the added value of the planted trees

7.7 Effective Promotion of Five Year Afforestation Programme

For the success of the Master Plan, the success of its first stage, i.e. Five Year Afforestation Programme, is essential. For this purpose, the possibility of introducing "core promotion areas for afforestation" where land owners with a strong awareness of and volition to conduct afforestation work are relatively concentrated should be considered instead of implementing afforestation work (projects) evenly throughout the recommended afforestation areas.

APPENDIX

Appendix A-1 Frequency of Wind Velocity by Month

(Unit: %)

District	City	Item		Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual	Location of Observation Station
Concepción	Concepción	Mean Wind Velocity Vmed		2.3	2.2	1.9	2.2	2.5	2.7	3.1	2.9	3.2	2.9	2.5	2.2	2.5	Latitude
		Maximum Wind Velocity Vmax		15.4	13.7	12.3	15.4	15.7	15.4	19.6	14.7	24.5	14.7	17.7	11.8	24.5	23º25' S
		Frequency %	0<V<4 m/seg	6.7	6.3	7.3	6.1	6.4	6.1	6.0	5.7	5.3	6.2	6.4	7.0	76.1	Longitude
			4<V<10 m/seg	1.8	1.6	1.3	1.7	2.0	2.0	2.3	2.1	2.3	2.2	1.8	1.5	22.9	57º18' W
			10<V m/seg	0.0	0.0	0.0	0.0	0.1	0.1	0.2	0.1	0.1	0.1	0.1	0.0	1.0	Elevation (m)
		Total Frequency		8.5	7.9	8.6	8.2	8.5	8.2	8.5	7.9	7.7	8.5	8.3	8.5	100.0	74.0
San Pedro	San Pedro	Mean Wind Velocity Vmed		1.5	1.6	1.2	1.8	1.2	2.3	2.7	2.8	3.5	2.3	2.0	1.9	2.2	Latitude
		Maximum Wind Velocity Vmax		8.2	10.3	15.4	7.2	8.2	12.4	11.3	12.4	12.9	10.3	11.3	19.6	19.6	24º04' S
		Frequency %	0<V<4 m/seg	5.5	4.8	5.7	4.9	5.6	4.7	4.4	8.1	6.7	9.2	9.9	10.2	79.5	Longitude
			4<V<10 m/seg	0.4	0.6	0.1	1.1	0.5	1.0	1.9	3.1	3.5	2.5	1.5	1.5	18.3	57º05' W
			10<V m/seg	0.0	0.2	0.5	0.4	0.3	0.0	0.1	0.2	0.0	0.0	0.0	0.0	2.1	Elevation (m)
		Total Frequency		5.9	5.6	6.3	6.4	6.4	5.7	6.4	11.4	10.2	11.7	11.4	11.7	100.0	80.0
Guairá	Villarrica	Mean Wind Velocity Vmed		2.6	2.6	2.7	3.1	3.2	3.7	4.1	3.8	3.9	3.2	3.1	2.5	3.2	Latitude
		Maximum Wind Velocity Vmax		9.7	9.7	13.0	13.0	13.0	13.0	16.2	13.0	13.0	13.0	13.0	13.0	16.2	25º46' S
		Frequency %	0<V<4 m/seg	5.8	5.8	6.4	5.5	4.9	4.6	4.4	4.5	4.3	5.5	5.5	6.7	63.7	Longitude
			4<V<10 m/seg	2.1	2.0	2.2	2.8	3.0	3.7	4.0	4.0	3.9	3.2	2.8	1.9	35.9	56º26' W
			10<V m/seg	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.4	Elevation (m)
		Total Frequency		7.9	7.8	8.6	8.3	8.0	8.4	8.4	8.5	8.2	8.7	8.3	8.6	100.0	140.0
Caaguazú	Coronel Oviedo	Mean Wind Velocity Vmed		1.3	1.1	1.1	1.4	1.5	1.8	1.9	1.6	1.6	1.5	1.5	1.4	1.5	Latitude
		Maximum Wind Velocity Vmax		6.7	6.7	6.7	29.8	9.3	9.3	9.3	9.3	6.7	18.5	6.7	9.3	29.8	25º28' S
		Frequency %	0<V<4 m/seg	7.7	5.7	6.3	7.3	7.4	6.9	5.5	7.2	6.9	7.1	6.9	5.9	80.9	Longitude
			4<V<10 m/seg	1.4	0.9	1.1	1.5	1.5	2.0	1.7	1.8	2.0	1.9	1.8	1.3	19.1	56º24' W
			10<V m/seg	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Elevation (m)
		Total Frequency		9.1	6.6	7.4	8.8	8.9	8.9	7.2	9.0	8.9	9.0	8.7	7.2	100.0	163.0
Caazapá	Caazapá	Mean Wind Velocity Vmed		0.9	0.8	0.8	0.9	0.9	1.0	1.2	1.1	1.2	1.1	1.0	1.0	1.0	Latitude
		Maximum Wind Velocity Vmax		4.1	4.1	4.1	6.2	7.7	4.1	4.6	6.7	4.1	4.1	7.7	4.1	7.7	26º11' S
		Frequency %	0<V<4 m/seg	5.3	5.4	6.1	5.9	5.8	5.7	5.3	5.2	4.9	5.2	4.7	5.1	64.4	Longitude
			4<V<10 m/seg	3.2	2.3	2.5	2.4	2.7	2.6	3.4	2.7	3.4	3.3	3.6	3.4	35.5	56º22' W
			10<V m/seg	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	Elevation (m)
		Total Frequency		8.5	7.7	8.6	8.3	8.5	8.3	8.7	7.9	8.3	8.5	8.3	8.5	100.0	140.0
Itapúa	Capitán Meza	Mean Wind Velocity Vmed		1.9	1.7	1.8	2.1	2.8	3.4	3.3	3.2	3.3	3.1	3.1	1.8	2.6	Latitude
		Maximum Wind Velocity Vmax		8.2	6.2	10.3	10.3	8.2	15.4	10.3	18.5	15.4	20.6	23.2	7.7	23.2	26º56' S
		Frequency %	0<V<4 m/seg	8.0	7.4	7.9	7.2	6.0	5.3	3.9	5.6	5.0	4.4	3.2	6.3	69.1	Longitude
			4<V<10 m/seg	1.7	1.5	1.9	2.4	3.8	3.7	3.3	3.9	2.9	2.6	1.4	1.1	30.0	55º12' W
			10<V m/seg	0.1	0.0	0.2	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.8	Elevation (m)
		Total Frequency		9.8	8.9	10.0	9.7	9.9	9.1	7.3	9.6	6.9	7.0	4.6	7.4	100.0	248.0
Itapúa	Capitán Miranda	Mean Wind Velocity Vmed		4.6	4.2	4.4	5.0	5.3	5.9	5.7	5.2	5.7	4.8	4.4	4.4	5.0	Latitude
		Maximum Wind Velocity Vmax		15.4	15.4	20.6	18.0	18.0	18.0	18.0	18.0	18.0	18.0	14.4	12.9	20.6	27º17' S
		Frequency %	0<V<4 m/seg	7.3	6.2	7.2	5.9	6.9	4.8	4.2	4.3	3.1	4.5	4.6	5.8	64.7	Longitude
			4<V<10 m/seg	1.1	1.5	1.3	2.2	1.7	3.4	3.6	3.6	4.3	4.0	3.2	2.4	32.3	55º50' W
			10<V m/seg	0.3	0.3	0.3	0.2	0.8	0.5	0.3	0.3	0.1	0.0	0.0	0.0	3.1	Elevation (m)
		Total Frequency		8.7	8.0	8.8	8.3	9.4	8.7	8.1	8.2	7.5	8.5	7.8	8.2	100.0	223.0

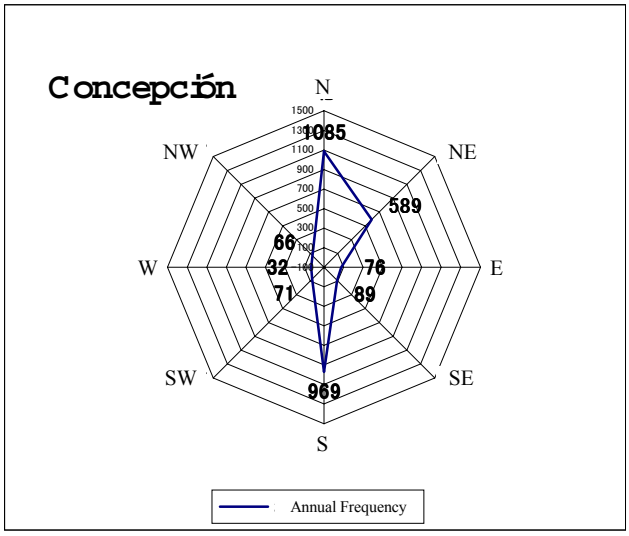
District	City	Item		Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual	Location of Observation Station
Itapúa	Encarnación	Mean Wind Velocity Vmed		2.3	1.7	1.9	2.7	3.0	2.7	3.1	2.8	2.8	3.4	2.9	2.1	2.6	Latitude
		Maximum Wind Velocity Vmax		7.7	7.7	10.3	15.4	9.3	9.3	10.3	18.0	15.4	19.6	8.7	7.7	19.6	27º20' S
		Frequency %	0<V<4 m/seg	3.4	10.0	10.3	5.4	4.7	5.2	5.9	6.3	6.0	5.5	5.1	6.8	74.3	Longitude
			4<V<10 m/seg	1.1	1.4	2.2	2.2	3.5	2.7	2.3	1.8	1.9	2.4	2.4	1.4	24.9	55º50' W
			10<V m/seg	0.2	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.8	Elevation (m)
		Total Frequency		4.7	11.5	12.6	7.7	8.3	7.9	8.2	8.1	7.9	7.9	7.5	8.2	100.0	91.0
Misiones	San Juan Bautista	Mean Wind Velocity Vmed		1.9	1.8	1.8	2.1	2.4	2.5	2.8	2.8	3.0	2.7	2.4	2.0	2.3	Latitude
		Maximum Wind Velocity Vmax		12.4	9.3	13.0	19.0	12.4	10.3	16.2	14.9	16.2	13.0	20.0	17.3	20.0	26º40' S
		Frequency %	0<V<4 m/seg	7.6	7.0	7.7	6.3	6.8	6.3	5.9	5.7	5.0	6.1	6.5	7.2	78.0	Longitude
			4<V<10 m/seg	1.0	0.8	0.9	1.3	1.8	2.0	2.6	2.8	2.6	2.5	1.8	1.2	21.6	57º09' W
			10<V m/seg	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	Elevation (m)
		Total Frequency		8.6	7.8	8.6	7.6	8.6	8.3	8.5	8.5	7.6	8.6	8.3	8.4	100.0	126.0
Paraguarí	Paraguarí	Mean Wind Velocity Vmed		1.9	1.7	1.8	2.1	2.8	3.4	3.3	3.2	3.3	3.1	3.1	1.8	2.6	Latitude
		Maximum Wind Velocity Vmax		8.2	6.2	10.3	10.3	8.2	15.4	10.3	18.5	15.4	20.6	23.2	7.7	23.2	25º46' S
		Frequency %	0<V<4 m/seg	8.0	7.4	7.9	7.2	6.0	5.3	3.9	5.6	4.0	4.4	3.2	6.3	69.1	Longitude
			4<V<10 m/seg	1.7	1.5	1.9	2.4	3.8	3.7	3.3	3.9	2.9	2.6	1.4	1.1	30.0	57º15' W
			10<V m/seg	0.1	0.0	0.2	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.8	Elevation (m)
		Total Frequency		9.8	8.9	10.0	9.7	9.9	9.1	7.3	9.6	6.9	7.0	4.6	7.4	100.0	125.0
Paraguarí	Carapeguá	Mean Wind Velocity Vmed		1.0	0.9	0.9	0.9	1.0	1.1	1.3	1.3	1.3	1.1	1.2	1.1	1.1	Latitude
		Maximum Wind Velocity Vmax		4.1	4.6	7.2	5.1	6.4	4.1	7.2	6.2	7.2	6.2	6.2	11.8	11.8	25º46' S
		Frequency %	0<V<4 m/seg	8.8	8.2	8.8	8.5	8.8	8.5	8.4	8.6	8.4	7.2	6.9	5.9	96.8	Longitude
			4<V<10 m/seg	0.1	0.1	0.3	0.3	0.3	0.2	0.5	0.4	0.2	0.2	0.3	0.1	3.2	57º14' W
			10<V m/seg	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Elevation (m)
		Total Frequency		8.9	8.3	9.1	8.8	9.0	8.7	8.9	9.0	8.6	7.4	7.2	6.0	100.0	116.0
Paraguarí	Quiindy	Mean Wind Velocity Vmed		2.0	2.1	1.7	2.6	1.9	3.4	3.8	4.0	4.8	3.8	3.6	2.7	3.0	Latitude
		Maximum Wind Velocity Vmax		10.3	18.0	8.7	11.3	9.3	10.3	10.3	11.3	12.9	11.3	10.3	11.3	18.0	25º58' S
		Frequency %	0<V<4 m/seg	7.3	6.2	7.2	5.9	6.9	4.8	4.2	4.3	3.1	4.5	4.6	5.8	64.7	Longitude
			4<V<10 m/seg	1.1	1.5	1.3	2.2	1.7	3.4	3.6	3.6	4.3	4.0	3.2	2.4	32.3	57º13' W
			10<V m/seg	0.3	0.3	0.3	0.2	0.8	0.5	0.3	0.3	0.1	0.0	0.0	0.0	3.1	Elevation (m)
		Total Frequency		8.7	8.0	8.8	8.3	9.7	8.7	8.1	8.2	7.5	8.5	7.8	8.2	100.0	181.0
Alto Paraná	Ciudad del Este	Mean Wind Velocity Vmed		1.8	1.6	1.5	1.6	1.6	1.6	1.9	1.8	2.2	2.0	1.9	1.7	1.8	Latitude
		Maximum Wind Velocity Vmax		12.9	12.9	10.3	12.9	13.4	12.9	15.4	12.9	12.9	15.4	20.6	10.3	20.6	25º32' S
		Frequency %	0<V<4 m/seg	7.3	6.7	7.5	7.1	7.2	7.0	6.9	6.0	6.4	6.9	6.9	7.3	84.2	Longitude
			4<V<10 m/seg	1.2	1.0	0.9	1.1	1.2	1.2	1.5	1.6	1.8	1.6	1.3	1.2	15.6	54º36' W
			10<V m/seg	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	Elevation (m)
		Total Frequency		8.5	7.7	8.4	8.2	8.4	8.2	8.4	8.6	8.2	8.5	8.2	8.5	100.0	196.0
Central	San Lorenzo	Mean Wind Velocity Vmed		2.3	1.7	1.9	2.7	3.0	2.7	3.1	2.8	2.8	3.4	2.9	2.1	2.6	Latitude
		Maximum Wind Velocity Vmax		7.7	7.7	10.3	15.4	9.3	9.3	10.3	18.0	15.4	19.6	8.7	7.7	19.6	25º21' S
		Frequency %	0<V<4 m/seg	3.4	10.0	10.3	5.4	4.7	5.2	5.9	6.3	6.0	5.5	5.1	6.8	74.3	Longitude
			4<V<10 m/seg	1.1	1.4	2.2	2.2	3.5	2.7	2.3	1.8	1.9	2.4	2.4	1.4	24.9	57º34' W
			10<V m/seg	0.2	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.8	Elevation (m)
		Total Frequency		4.7	11.5	12.6	7.7	8.3	7.9	8.2	8.1	7.9	7.9	7.5	8.2	100.0	125.0

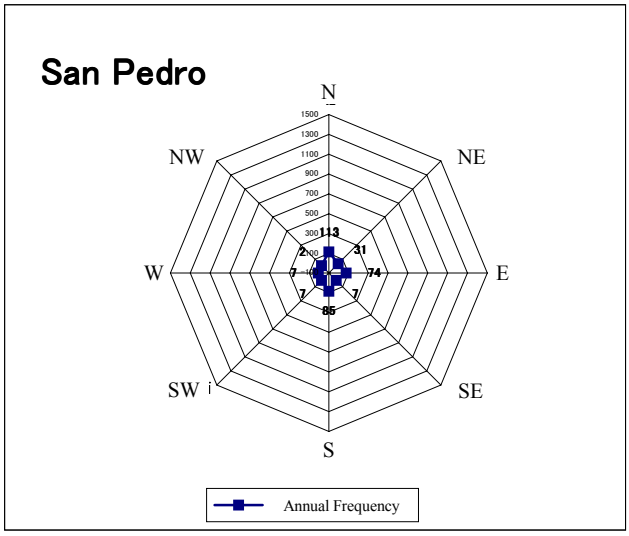
District	City	Item		Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual	Location of Observation Station
Central	Asunción	Mean Wind Velocity Vmed		3.0	2.8	2.7	3.0	3.2	3.3	3.8	3.6	4.0	3.8	3.3	2.8	3.3	Latitude
		Maximum Wind Velocity Vmax		22.1	18.3	15.4	16.6	14.4	12.9	14.4	22.1	22.1	22.1	19.4	18.0	22.1	25º15' S
		Frequency %	0<V<4 m/seg	6.1	5.8	6.4	5.8	5.7	5.2	4.4	4.7	4.3	4.6	4.9	5.9	63.9	Longitude
			4<V<10 m/seg	2.7	2.2	2.3	2.8	2.1	3.2	3.5	3.1	3.4	3.5	2.8	2.2	34.5	57º31' W
			10<V m/seg	0.1	0.0	0.0	0.1	0.1	0.1	0.2	0.1	0.2	0.1	0.2	0.0	1.5	Elevation (m)
		Total Frequency		8.9	8.0	8.7	8.7	8.9	8.5	8.1	7.9	7.9	8.2	7.9	8.1	100.0	101.0
Ñeembucú	Pilar	Mean Wind Velocity Vmed		2.1	2.1	1.9	2.2	2.3	2.3	2.8	2.5	2.8	2.7	2.4	2.1	2.3	Latitude
		Maximum Wind Velocity Vmax		9.6	14.3	15.4	15.4	12.8	12.8	12.8	15.9	12.8	12.8	15.9	12.8	15.9	26º51' S
		Frequency %	0<V<4 m/seg	7.1	6.5	6.5	6.6	6.6	6.3	5.8	6.5	5.3	6.1	6.5	7.1	77.1	Longitude
			4<V<10 m/seg	1.6	1.4	1.2	1.7	2.0	2.0	2.7	2.1	2.1	2.4	1.9	1.5	22.3	58º19' W
			10<V m/seg	0.0	0.0	0.0	0.1	0.0	0.1	0.1	0.1	0.0	0.1	0.0	0.0	0.5	Elevation (m)
		Total Frequency		8.7	7.9	7.7	8.4	8.6	8.4	8.6	8.7	7.4	8.6	8.4	8.6	100.0	56.0
Ñeembucú	Itá Corá	Mean Wind Velocity Vmed		2.4	2.7	2.5	2.9	3.1	3.2	3.7	3.0	3.3	3.7	3.0	2.2	3.0	Latitude
		Maximum Wind Velocity Vmax		12.9	15.4	12.9	15.4	15.4	13.4	15.4	12.9	15.4	18.0	15.4	15.4	18.0	27º13' S
		Frequency %	0<V<4 m/seg	6.4	5.4	6.3	5.6	5.4	5.2	4.7	5.6	4.0	4.8	5.3	6.7	65.5	Longitude
			4<V<10 m/seg	2.1	2.3	2.3	2.3	3.0	2.9	3.2	2.7	2.5	3.5	2.6	1.6	31.0	58º17' W
			10<V m/seg	0.1	0.1	0.2	0.4	0.3	0.3	0.5	0.3	0.2	0.4	0.3	0.2	3.5	Elevation (m)
		Total Frequency		8.6	7.8	8.8	8.3	8.7	8.4	8.4	8.6	6.7	8.7	8.2	8.5	100.0	55.0
Amambay	Pedro Juan Caballero	Mean Wind Velocity Vmed		3.0	3.3	3.2	3.6	3.9	4.4	4.4	4.1	4.7	3.9	3.6	3.4	3.8	Latitude
		Maximum Wind Velocity Vmax		12.9	15.4	15.4	20.6	15.4	44.2	20.6	18.0	18.0	18.0	15.4	15.4	44.2	23º35' S
		Frequency %	0<V<4 m/seg	5.3	4.7	4.7	4.7	4.7	4.0	3.7	3.8	3.6	4.3	4.8	4.8	53.3	Longitude
			4<V<10 m/seg	3.3	3.0	3.0	3.6	3.7	3.9	3.6	3.7	4.1	4.1	3.5	2.9	42.3	55º44' W
			10<V m/seg	0.1	0.2	0.2	0.4	0.4	0.4	0.5	0.5	0.7	0.3	0.3	0.2	4.4	Elevation (m)
		Total Frequency		8.8	7.9	7.9	8.7	8.8	8.3	7.8	8.0	8.4	8.7	8.6	7.9	100.0	652.0
Canindeyú	Salto del Guairá	Mean Wind Velocity Vmed		3.1	2.7	2.6	2.4	2.3	2.4	2.8	2.6	3.1	3.0	3.0	3.1	2.8	Latitude
		Maximum Wind Velocity Vmax		13.9	12.9	12.4	14.4	15.4	15.4	15.4	14.4	14.4	12.9	12.9	11.3	15.4	24º03' S
		Frequency %	0<V<4 m/seg	5.0	5.0	5.9	5.7	5.8	5.6	5.4	6.3	4.9	5.3	5.1	5.9	66.0	Longitude
			4<V<10 m/seg	3.2	2.3	2.3	2.3	2.2	2.3	2.7	3.0	2.9	2.8	2.9	3.5	32.3	54º19' W
			10<V m/seg	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.1	0.2	1.7	Elevation (m)
		Total Frequency		8.3	7.4	8.3	8.1	8.1	8.0	8.3	9.5	8.0	8.3	8.1	9.6	100.0	265.0

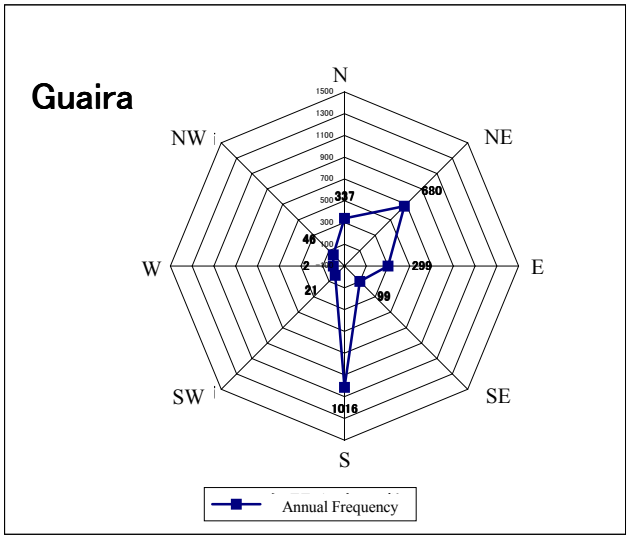
Note : Observation period: 1966 – 1996

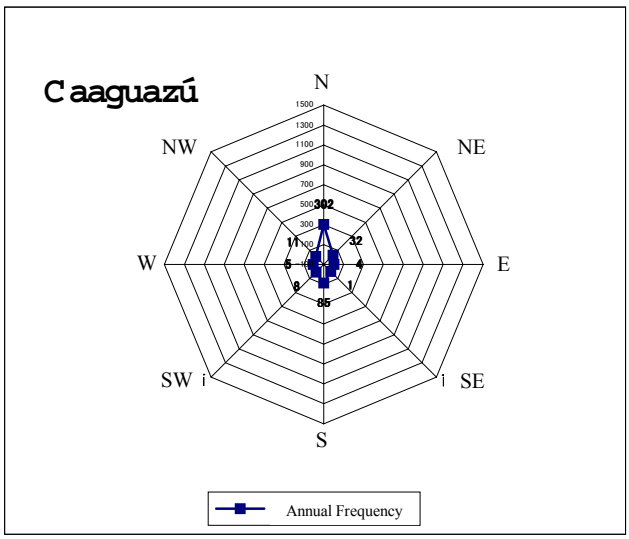
Source : FONDO ARGENTINO DE COOPERACION HORIZONTAL, INSTITUTO NACIONAL DE TECNOLOGIA Y NORMALIZACION, DIRECCION NACIONAL DE AERONAUTICA CIVIL: EL RECURSO EOLICO EN PARAGUAY

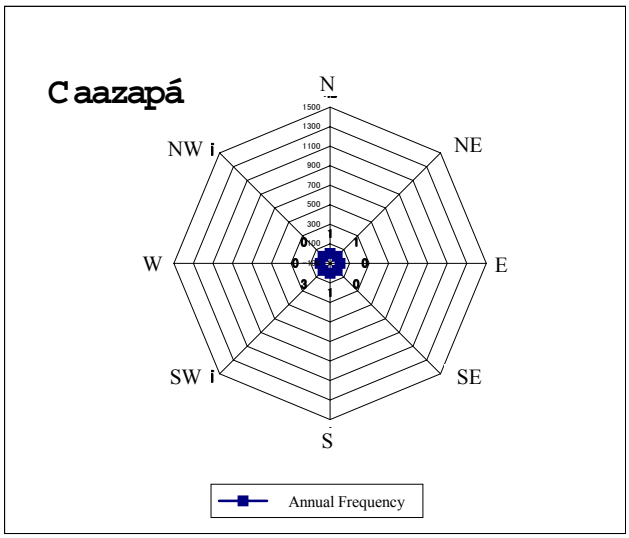
Appendix A-2 Annual Frequency of Wind Velocity of 5 m/s or Stronger by Wind Direction (1)

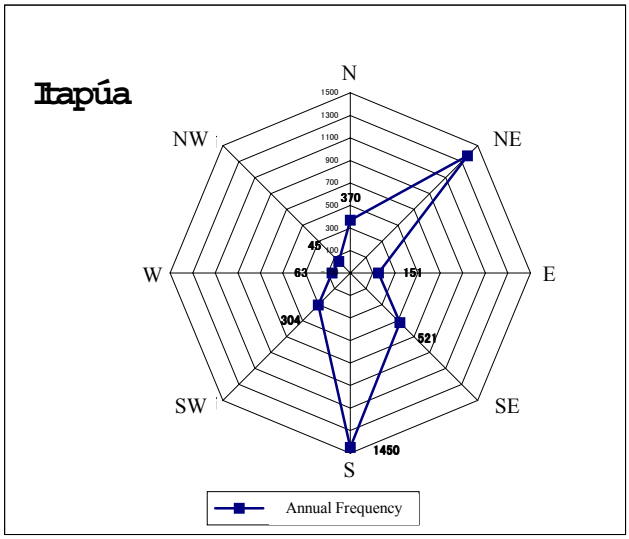








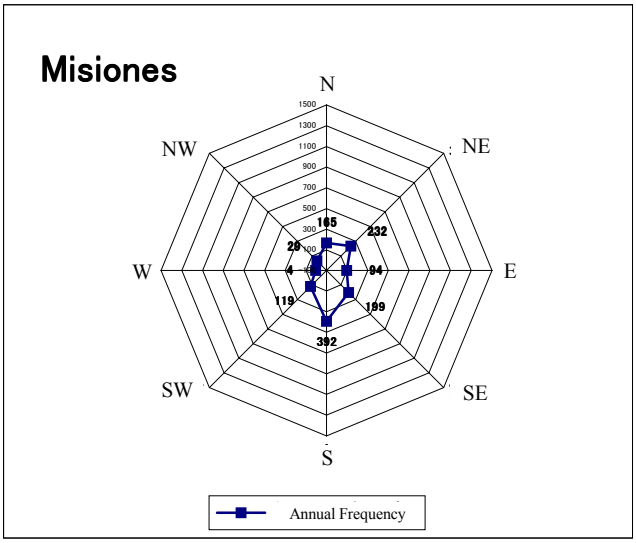


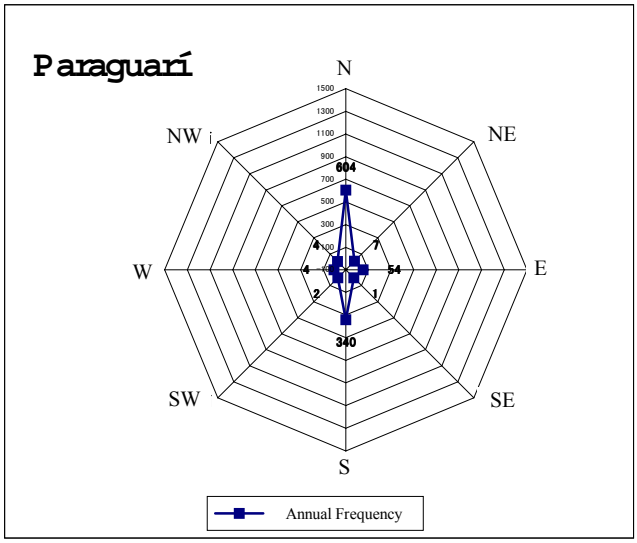


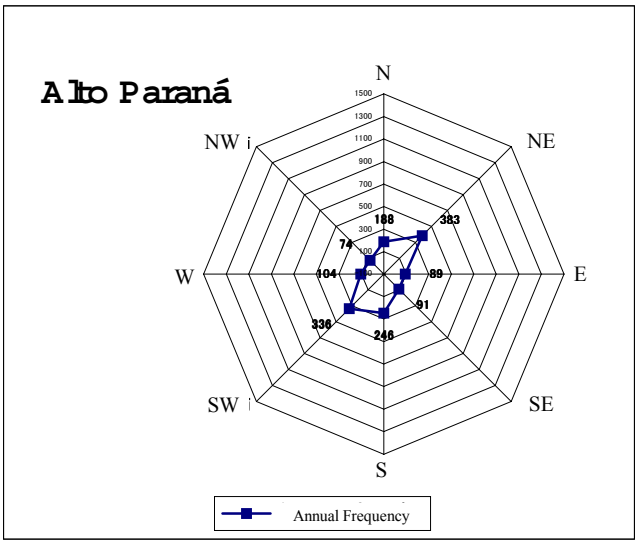
Note : Observation period: 1966 – 1996

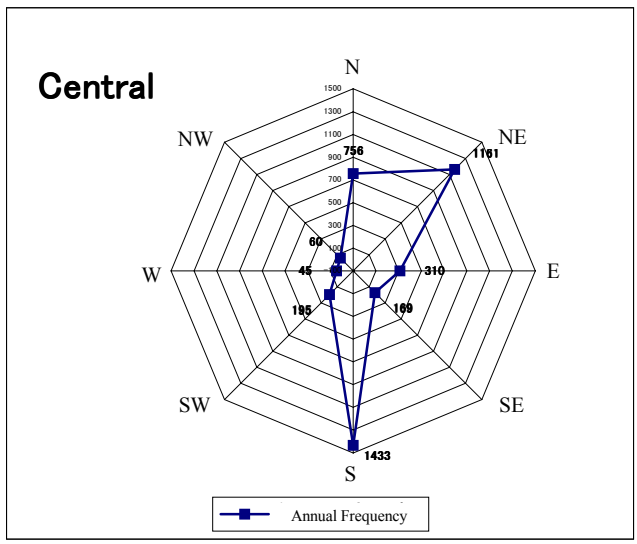
Source: FONDO ARGENTINO DE COOPERACION HORIZONTAL, INSTITUTO NACIONAL DE TECNOLOGIA Y NORMALIZACION, DIRECCION NACIONAL DE AERONAUTICA CIVIL: EL RECURSO EOLICO EN PARAGUAY

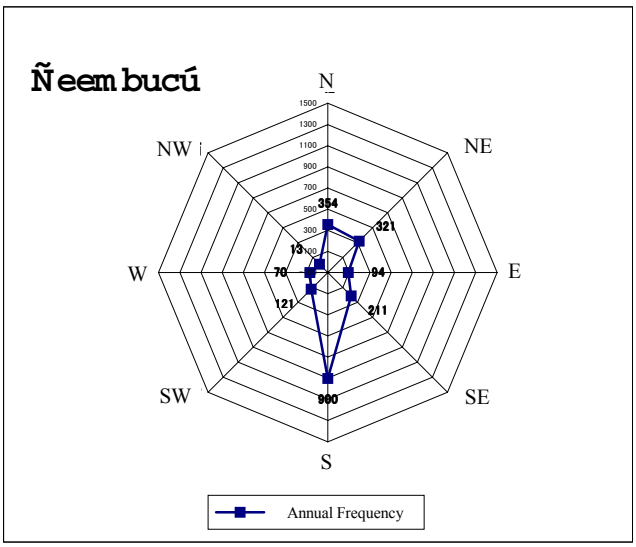
Appendix A-2 Annual Frequency of Wind Velocity of 5 m/s or Stronger by Wind Direction (2)

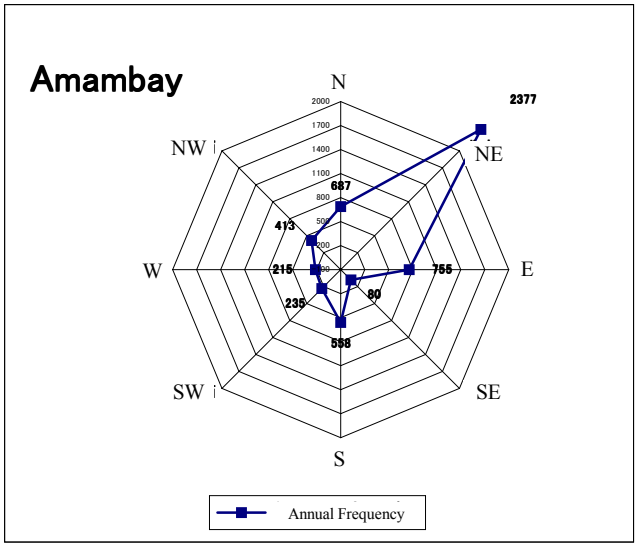




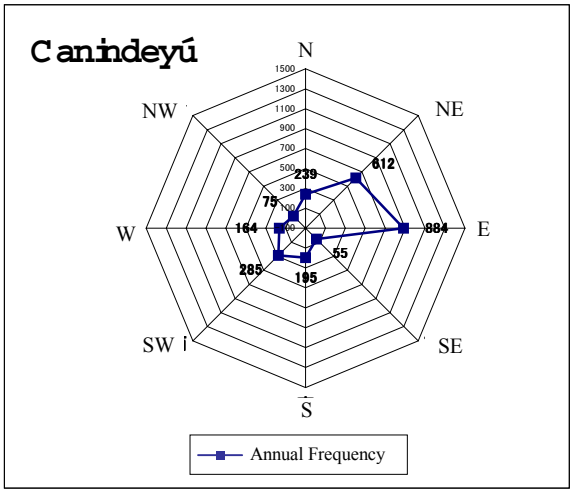








Appendix A-2 Annual Frequency of Wind Velocity of 5 m/s or Stronger by Wind Direction (3)



Appendix B-1 Distribution of Questionnaire Respondents by City: Findings of Survey on Afforestation Intentions

(Unit: persons)

District	City	Scale of Land Ownership									Type of Management			
		～20ha	20～100ha	100～200ha	200～500ha	500～1,000ha	1,000～5,000ha	5,000～10,000 ha	10,000 ha～	Total	Mainly Agricul-ture	Mixed	Mainly Stock Raising	Total
CONCEPCION	Horqueta	3	11	2	2	3	5	0	0	26	3	3	20	26
SAN PEDRO	San Pedro	4	13	1	2	1	6	0	0	27	1	1	25	27
	San Estanislao	4	15	2	0	0	3	1	1	26	3	6	17	26
CORDILLERA	Mbocayaty del Yhaguy	6	12	3	2	3	3	0	0	29	0	3	26	29
	Tobatí	4	11	2	3	1	5	0	0	26	4	4	18	26
GUAIRA	Independencia	4	6	6	2	2	3	0	0	23	4	6	13	23
	Mbocayaty	7	9	3	1	1	5	0	0	26	7	5	14	26
CAAGUAZU	Coronel Oviedo	4	13	0	5	0	5	0	0	27	4	5	18	27
	Yhú	4	12	3	2	0	5	0	0	26	6	6	14	26
	Dr. J. Eulogio Estigarribia	4	12	1	3	1	5	0	0	26	10	9	7	26
CAAZAPA	Abaí	4	15	2	1	0	0	1	0	23	5	7	11	23
	Yuty	4	7	4	4	3	2	0	1	25	4	1	20	25
ITAPUA	Encarnación	4	12	3	2	0	0	0	0	21	15	6	0	21
	San Pedro del Paraná	5	10	3	4	0	5	0	0	27	1	8	18	27
	San Rafael del Paraná	4	11	2	3	1	2	0	0	23	19	3	1	23
PARAGUARI	Carapeguá	4	13	3	2	0	1	0	0	23	0	4	19	23
	Ybytymi	4	17	1	2	0	3	0	1	28	7	8	13	28
ALTO PARANA	Hernandarias	4	7	4	6	2	4	0	0	27	21	5	1	27
	Itakyry	4	11	3	5	0	5	0	0	28	5	11	12	28
CENTRAL	Guarambaré	4	7	2	3	1	0	0	0	17	8	1	8	17
	Ypacarai	5	12	3	1	0	0	0	0	21	0	5	16	21
AMAMBAY	Pedro J. Caballero	4	11	5	0	1	4	2	0	27	2	3	22	27
CANINDEYU	Curuguaty	4	10	1	5	3	5	0	0	28	3	7	18	28
	Francisco C. Alvarez	5	9	1	7	2	3	1	0	28	18	5	5	28
TOTAL		103	266	60	67	25	79	5	3	608	150	122	336	608

Appendix B-2 Willingness and Purpose of Afforestation (Number of Replies): Findings of Survey on Afforestation Intentions

Item	Scale of Land Ownership									Type of Management			
	≦20ha	20＜≦100ha	100＜≦200ha	200＜≦500ha	500＜≦1,000ha	1,000≦5,000ha	5,000＜≦10,000ha	10,000ha＜	Total	Mainly Agricul-ture	Mixed	Mainly Stock Raising	Total
2.3-a Willingness to conduct afforestation work on own land													
1) Would like to conduct afforestation work regardless of profitability	24	62	17	17	11	14	1	0	146	34	23	89	146
2) Would like to conduct afforestation work if such work produces even a small profit from the planted sites	37	98	26	27	8	27	1	2	226	53	46	127	226
3) Would like to conduct afforestation work if the profit from the planted sites is similar to that of the existing farming or stock farming	13	26	3	5	1	8	0	0	56	25	9	22	56
4) Would like to conduct afforestation work if the profit from the planted sites exceeds that of the existing farming or stock farming	18	39	12	10	5	16	3	1	104	25	27	52	104
5) Not interested in afforestation work	11	38	6	6	0	13	2	0	76	13	16	47	76
Total	103	263	64	65	25	78	7	3	608	150	121	337	608
2.3-b Purpose of afforestation for those answering 1) above (multiple choice)													
To prevent soil erosion at farming fields or stock farm	1	1	2	1	1	0	1	0	7	2	2	3	7
To create a windbreak forest to protect farming fields or stock farm	0	2	1	2	1	3	0	0	9	2	1	6	9
To maintain the health of the animals raised at a stock farm	1	3	1	0	2	3	0	0	10	1	1	8	10
To secure work for surplus home labour	0	0	1	4	1	1	0	0	7	0	0	7	7
To leave forests as assets	7	32	5	8	3	5	0	1	61	10	11	40	61
Others	1	2	0	1	0	0	0	0	4	0	1	3	4
Total	10	40	10	16	8	12	1	1	98	15	16	67	98
2.3-c Purpose of afforestation for those answering 2) above (multiple choice)													
To earn income from afforestation at currently unprofitable farming fields	13	19	5	3	1	1	0	0	42	17	11	14	42
To earn income from afforestation at currently unprofitable pasture land	7	32	10	11	3	4	0	2	69	6	8	55	69
Expectation of the positive effects of a forest for soil conservation, windbreaking and animal health and also to earn income from afforestation sites at the expense of some farming fields and/or pasture land	0	5	1	6	1	6	0	0	19	3	3	13	19
To produce and sell high quality timber wood and firewood at the expense of some farming fields and/or pasture land	8	24	5	10	1	9	2	0	59	19	13	27	59
To conduct agroforestry	1	8	2	1	0	1	0	0	13	7	3	3	13
Others	0	3	2	1	1	4	0	0	11	2	0	9	11
Total	29	91	25	32	7	25	2	2	213	54	38	121	213

Item	Scale of Land Ownership									Type of Management			
	≦20ha	20＜≦100ha	100＜≦200ha	200＜≦500ha	500＜≦1,000ha	1,000≦5,000ha	5,000＜≦10,000ha	10,000ha＜	Total	Mainly Agricul-ture	Mixed	Mainly Stock Raising	Total
2.3-d Purpose of afforestation for those answering 3) above (multiple choice)													
Expectation of the positive effects of a forest for soil conservation, windbreaking and animal health and to earn income from afforestation sites at the expense of some existing farming fields and/or pasture land to create forests	0	2	0	2	1	2	0	0	7	2	2	3	7
To produce and sell high quality timber wood and firewood at the expense of some existing farming fields and/or pasture land	8	17	1	4	3	2	0	0	35	16	6	13	35
To conduct agroforestry	4	3	0	1	1	0	0	0	9	5	2	2	9
Others	0	1	1	2	0	3	0	0	7	1	0	6	7
Total	12	23	2	9	5	7	0	0	58	24	10	24	58
2.3-e Purpose of afforestation for those answering 4) above (multiple choice)													
To increase the income from the managed land as a whole by converting some existing farming fields and/or pasture land to afforestation sites	2	10	0	3	1	6	0	1	23	6	6	11	23
To produce and sell high quality timber wood and fuelwood by converting some existing farming fields and pasture land	13	24	11	6	5	5	0	0	64	22	12	30	64
To conduct agroforestry	2	5	0	0	3	2	0	0	12	4	4	4	12
Others	1	1	0	0	1	1	1	0	5	1	1	3	5
Total	18	40	11	9	10	14	1	1	104	33	23	48	104
2.3-f Reasons for no interest in afforestation work for those answering 5) above (multiple choice)													
Satisfied with the management of the existing farming fields and/or stock farm	5	16	1	2	1	3	1	1	30	7	6	17	30
Satisfied with existing forests	3	10	1	2	0	5	2	0	23	6	7	10	23
Others	2	8	5	1	0	0	0	0	16	4	0	12	16
Total	10	34	7	5	1	8	3	1	69	17	13	39	69

Appendix B-3 Preferred Sites for Afforestation

Item	Scale of Land Ownership									Type of Management			
	≦20ha	20＜≦100ha	100＜≦200ha	200＜≦500ha	500＜≦1,000ha	1,000≦5,000ha	5,000＜≦10,000ha	10,000ha＜	Total	Mainly Agricul-ture	Mixed	Mainly Stock Raising	Total
2.4-a Farming field (multiple choice)													
Any suitable site for planting	24	53	8	6	5	4	1	0	101	40	31	30	101
Boundary site	11	8	4	3	1	2	1	0	30	17	5	8	30
Boundary between farming fields and pasture land	3	3	0	1	1	0	0	0	8	6	1	1	8
Sloping land	9	20	5	10	3	4	2	0	53	31	15	7	53
Very windy site	17	16	2	7	0	0	2	0	44	24	14	6	44
Site with relatively low productivity	2	4	1	1	1	1	0	0	10	8	1	1	10
Along a river or seasonally flooded site	4	10	5	5	3	4	0	0	31	21	5	5	31
Others	2	0	0	0	1	1	0	0	4	3	1	0	4
Total	72	114	25	33	15	16	6	0	281	150	73	58	281
2.4-b Pasture land (multiple choice)													
Any suitable site for planting	17	73	13	14	8	25	0	0	150	11	29	110	150
Boundary site	7	20	10	9	3	7	1	0	57	5	6	46	57
Boundary between farming fields and pasture land	0	6	0	3	0	3	1	1	14	4	2	8	14
Sloping land	5	13	7	11	4	9	1	1	51	10	10	31	51
Very windy site	2	11	4	4	1	14	1	0	37	8	6	23	37
Site with relatively low productivity	1	5	0	2	1	1	0	0	10	1	1	8	10
Along a river or seasonally flooded site	2	14	6	8	6	12	0	0	48	11	13	24	48
Others	1	8	4	2	2	9	0	2	28	1	3	24	28
Total	35	150	44	53	25	80	4	4	395	51	70	274	395
2.4-c Shrub land (multiple choice)													
Any suitable site for planting	3	8	4	1	1	2	0	0	19	4	1	14	19
Boundary site	1	2	1	2	0	0	0	0	6	0	1	5	6
Boundary between farming fields and pasture land	2	2	0	0	1	1	0	2	8	0	2	6	8
Along a river	1	4	2	2	0	0	0	0	9	1	3	5	9
Others	2	0	1	1	1	0	0	0	5	1	2	2	5
Total	9	16	8	6	3	3	0	2	47	6	9	32	47

Appendix B-4 Proportion of Target Area for Afforestation (Average of Replies)

Scale of Land Ownership	No. of Replies	Planting at Farming Field	Planting at Pasture Land	Planting at Shrub Land
		Target Proportion (%)	Target Proportion (%)	Target Proportion (%)
≦20ha	103	15.0	10.7	3.5
20＜≦100ha	266	11.6	11.4	3.6
100＜≦200ha	60	6.9	12.8	4.1
200＜≦500ha	67	4.1	9.7	2.1
500＜≦1,000ha	25	3.7	7.3	6.0
1,000＜ ≦5,000ha	79	1.9	12.5	0.9
5,000＜ ≦10,000ha	5	0.0	8.2	0.0
10,000ha＜	3	0.0	32.7	8.3

Appendix B-5 Preferred Species for Planting and Cutting Period: Findings of Survey on Afforestation Intentions

Preferred Species for Planting		Scale of Land Ownership									Type of Management			
		≦20ha	20＜≦100ha	100＜≦200ha	200＜≦500ha	500＜≦1,000ha	1,000＜≦5,000ha	5,000＜≦10,000ha	10,000ha＜	Total	Mainly Agricul-ture	Mixed	Mainly Stock Raising	Total
Eucalyptus	No. of Replies	52	153	44	47	15	47	3	3	364	99	68	197	364
	Preferred Cutting Period (average of replies) (yrs)	8	9	10	10	10	8	15	13	9	10	10	9	9
Pine	No. of Replies	13	36	8	8	5	7	2	0	79	19	17	43	79
	Preferred Cutting Period (average of replies) (yrs)	12	12	12	14	9	8	15	0	11	13	12	10	11
Paraiso gigante	No. of Replies	28	62	18	22	10	13	1	1	155	38	37	80	155
	Preferred Cutting Period (average of replies) (yrs)	10	11	11	11	11	10	10	15	11	10	11	11	11
Toona	No. of Replies	2	4	1	4	2	1	0	0	14	8	2	4	14
	Preferred Cutting Period (average of replies) (yrs)	10	10	10	11	11	15	0	0	11	11	10	11	11
Pawlownia	No. of Replies	3	2	1	0	0	1	0	0	7	4	1	2	7
	Preferred Cutting Period (average of replies) (yrs)	7	8	10	0	0	18	0	0	9	8	5	14	9
Lapacho	No. of Replies	19	49	8	9	6	17	0	0	108	34	15	59	108
	Preferred Cutting Period (average of replies) (yrs)	19	16	19	22	28	15	0	0	18	22	17	16	18
Others	No. of Replies	29	60	18	9	10	21	2	0	149	42	26	81	149
	Preferred Cutting Period (average of replies) (yrs)	12	14	15	18	14	18	45	0	15	19	13	13	15

Appendix B-6 Method of Raising Afforestation Funds, Expected Minimum Ratio of Loan in Required Funds and Preferred Loan Period: Findings of Survey on Afforestation Intentions

Item	Scale of Land Ownership									Type of Management			
	≦20ha	20＜≦100ha	100＜≦200ha	200＜≦500ha	500＜≦1,000ha	1,000≦5,000ha	5,000＜≦10,000ha	10,000ha＜	Total	Mainly Agricul-ture	Mixed	Mainly Stock Raising	Total
Method of Raising Afforestation Funds (Number of Replies)													
Entirely own funds	14	26	11	7	4	12	0	0	74	17	13	44	74
Own funds and a loan	11	29	9	4	4	6	2	0	65	10	18	37	65
Own funds and a subsidy	13	25	6	8	1	11	0	0	64	8	10	46	64
Own funds, a loan and a subsidy	1	15	3	3	0	6	0	1	29	4	4	21	29
Entirely a loan	25	59	9	12	9	9	1	1	125	27	21	77	125
A subsidy and a loan	28	71	18	23	7	19	1	1	168	70	37	61	168
Total	92	225	56	57	25	63	4	3	525	136	103	286	525
Expected Minimum Ratio of Loan in Required Funds (Average of Replies; %)													
Those relying on own funds and a loan	40	37	54	57	29	44	31	0	41	45	37	42	41
Those relying on own funds, a loan and a subsidy	30	27	15	39	0	31	0	30	28	27	35	27	28
Those relying on a loan and a subsidy	28	35	40	45	46	44	50	30	37	38	34	38	37
Preferred Loan Period (Average of Replies; Years)													
Those relying on own funds and a loan	15	10	14	4	6	9	13	0	11	17	10	9	11
Those relying on own funds, a loan and a subsidy	5	4	5	5	0	19	0	20	8	5	9	8	8
Those relying entirely on a loan	15	14	10	13	16	13	10	20	14	12	10	16	14
Those relying on a loan and a subsidy	8	8	9	11	9	11	10	20	9	9	9	9	9

Appendix B-7 Preferred Loan or Subsidy Conditions (Average of Replies): Findings of Survey on Afforestation Intentions

Item	Scale of Land Ownership									Type of Management			
	≦20ha	20＜≦100ha	100＜≦200ha	200＜≦500ha	500＜≦1,000ha	1,000≦5,000ha	5,000＜≦10,000ha	10,000ha＜	Total	Mainly Agricul-ture	Mixed	Mainly Stock Raising	Total
Preferred Loan Conditions													
Maximum interest rate for a garani loan													
Those relying on own funds and a loan	13	11	9	11	11	9	14	-	11	12	10	11	11
Those relying on own funds, a loan and a subsidy	14	14	11	9	-	11	-	15	13	15	17	12	13
Those relying entirely on a loan	12	11	14	10	7	10	-	4	11	12	12	10	11
Those relying on a loan and a subsidy	10	10	10	10	11	14	19	10	11	11	10	11	11
Maximum interest rate for a US dollar loan													
Those relying on own funds and a loan	-	2	-	-	-	-	-	-	2	-	2	3	2
Those relying on own funds, a loan and a subsidy													
Those relying entirely on a loan	-	4	3	5	-	1	-	-	3	5	3	2	3
Those relying on a loan and a subsidy	3	4	4	3	4	3	1	-	3	4	3	3	3
Grace period (years)													
Those relying on own funds and a loan	3	3	4	3	3	3	4	-	3	4	4	3	3
Those relying on own funds, a loan and a subsidy	2	2	3	2	-	4	-	15	3	3	5	2	3
Those relying entirely on a loan	5	4	4	6	5	6	3	5	5	4	4	5	5
Those relying on a loan and a subsidy	4	4	4	6	5	4	5	2	4	5	5	4	4
Preferred Subsidy Conditions													
Minimum subsidy rate (%) for required funds													
Those relying on own funds and a subsidy	72	58	67	67	75	68	-	-	65	75	60	64	65
Those relying on own funds, a loan and a subsidy	75	73	75	67	-	67	-	60	71	74	71	71	71
Those relying on a loan and a subsidy	71	63	64	59	61	67	50	70	64	62	67	65	64

Appendix B-8 Preferred Loan Sources and Reasons (Number of Replies): Findings of Survey on Afforestation Intentions

Item	Scale of Land Ownership									Type of Management			
	≦20ha	20＜≦100ha	100＜≦200ha	200＜≦500ha	500＜≦1,000ha	1,000≦5,000ha	5,000＜≦10,000ha	10,000ha＜	Total	Mainly Agricul-ture	Mixed	Mainly Stock Raising	Total
Preferred Loan Source													
Government institution	20	47	9	13	4	16	0	0	109	37	16	56	109
Private institution	20	45	14	16	8	12	3	2	120	39	26	55	120
Semi-governmental institution	23	62	19	16	4	19	2	0	145	52	37	56	145
Others	1	4	2	3	0	1	0	0	11	3	2	6	11
Reason(s) for Preference for Government Institution (Multiple Choice)													
High level of reliability	6	23	3	4	3	3	0	0	42	16	9	17	42
High level of transparency	0	2	0	0	0	1	0	0	3	0	1	2	3
Rich funds	4	1	0	2	0	2	0	0	9	2	3	4	9
Good service	0	0	1	1	0	0	0	0	2	0	1	1	2
Well-established organization	2	0	1	2	0	0	0	0	5	2	0	3	5
Low interest rate	9	25	4	5	3	11	0	0	57	10	5	42	57
Large flexibility	5	11	2	2	2	6	0	0	28	15	5	8	28
Others	0	0	0	1	0	0	0	0	1	1	0	0	1
Reason(s) for Preference for Private Institution (Multiple Choice)													
High level of reliability	17	34	10	11	6	10	3	2	93	34	17	42	93
High level of transparency	7	14	4	3	4	8	0	1	41	15	6	20	41
Rich funds	3	3	0	1	0	0	0	1	8	3	3	2	8
Good service	3	8	4	1	3	4	0	1	24	6	4	14	24
Well-established organization	1	6	1	2	0	0	0	1	11	6	2	3	11
Low interest rate	4	10	0	1	0	1	0	1	17	5	4	8	17
Large flexibility	5	4	1	3	2	0	0	0	15	10	3	2	15
Others	0	0	0	0	0	0	0	0	0	0	0	0	0

Item	Scale of Land Ownership									Type of Management			
	≦20ha	20＜≦100ha	100＜≦200ha	200＜≦500ha	500＜≦1,000ha	1,000≦5,000ha	5,000＜≦10,000ha	10,000ha＜	Total	Mainly Agricul-ture	Mixed	Mainly Stock Raising	Total
Reason(s) for Preference for Semi-Governmental Institution (Multiple Choice)													
High level of reliability	12	47	14	12	5	15	2	0	107	36	27	44	107
High level of transparency	8	26	6	2	2	8	0	0	52	14	13	25	52
Rich funds	4	3	2	3	1	2	0	0	15	4	3	8	15
Good service	4	14	6	1	1	5	0	0	31	11	5	15	31
Well-established organization	2	7	4	0	0	5	0	0	18	6	4	8	18
Low interest rate	4	11	3	1	0	3	0	0	22	4	7	11	22
Large flexibility	2	11	3	2	1	4	0	0	23	10	5	8	23
Others	0	0	0	0	0	0	0	0	0	0	0	0	0
Reason(s) for Preference for Other Institutions (Multiple Choice)													
High level of reliability	0	2	1	1	0	0	0	0	4	0	1	3	4
High level of transparency	0	2	0	0	0	0	0	0	2	0	0	2	2
Rich funds	0	1	0	0	0	0	0	0	1	0	0	1	1
Good service	0	1	0	0	0	0	0	0	1	0	0	1	1
Well-established organization	1	1	0	0	0	0	0	0	2	0	0	2	2
Low interest rate	0	2	1	0	0	0	0	0	3	0	0	3	3
Large flexibility	0	1	0	0	0	0	0	0	1	0	0	1	1
Others	0	0	1	1	0	1	0	0	3	0	0	3	3

Appendix C-1 Necessary Cost by Forest Management Type and by Planting Tree Species

Eucalyptus (Production Forests I-1 and III)

Type of Work		Total Cost	Timing of Spending (Year)						Remarks
			1st	2nd	3rd	4th	5th	6th onwards	
Ant Control		54,000	54,000						The timing of spending is based on the assumption that both the fiscal year in Paraguay and planting start in July.
Ground Clearance		239,000	239,000						
Planting	Seedlings	460,000	460,000						
	Others	190,000	190,000						
	Sub-Total	650,000	650,000						
Tending	Ant Control	206,000	80,000	62,000	44,000	20,000			
	Weeding	873,000	297,000	501,000	75,000				
	Pruning	302,000		75,000		95,000		132,000	
	Sub-Total	1,381,000	377,000	638,000	119,000	115,000		132,000	
Total		2,324,000	1,320,000	638,000	119,000	115,000		132,000	
Technical Fee		232,000	232,000						
Grand Total		2,556,000	1,552,000	638,000	119,000	115,000		132,000	

Eucalyptus (Production Forest IV-1)

Type of Work		Total Cost	Timing of Spending (Year)						Remarks
			1st	2nd	3rd	4th	5th	6th onwards	
Ant Control		58,000	58,000						The timing of spending is based on the assumption that both the fiscal year in Paraguay and planting start in July.
Ground Clearance		258,000	258,000						
Planting	Seedlings	492,000	492,000						
	Others	205,000	205,000						
	Sub-Total	697,000	697,000						
Tending	Ant Control	221,000	86,000	65,000	48,000	22,000			
	Weeding	944,000	321,000	542,000	81,000				
	Pruning	302,000		75,000		95,000		132,000	
	Sub-Total	1,467,000	407,000	682,000	129,000	117,000		132,000	
Total		2,480,000	1,420,000	682,000	129,000	117,000		132,000	
Technical Fee		248,000	248,000						
Grand Total		2,728,000	1,668,000	682,000	129,000	117,000		132,000	

Eucalyptus (Production Forest V)

Type of Work		Total Cost	Timing of Spending (Year)						Remarks
			1st	2nd	3rd	4th	5th	6th onwards	
Ant Control		54,000	54,000						The timing of spending is based on the assumption that both the fiscal year in Paraguay and planting start in July.
Ground Clearance		239,000	239,000						
Planting	Seedlings	288,000	288,000						
	Others	145,000	145,000						
	Sub-Total	433,000	433,000						
Tending	Ant Control	206,000	80,000	62,000	44,000	20,000			
	Weeding	410,000	150,000	231,000					
	Pruning	196,000		55,000		58,000		83,000	
	Sub-Total	812,000	230,000	348,000	73,000	78,000		83,000	
Total		1,538,000	956,000	348,000	73,000	78,000		83000	
Technical Fee		154,000	154,000						
Grand Total		1,692,000	1,110,000	348,000	73,000	78,000		83,000	
Grassland Creation Cost	Seeds	92,000		92,000					
	Fertiliser	201,000		201,000					
	Sowing	43,000		43,000					
	Weeding	744,000		62,000	62,000	62,000	62,000	496,000	
	Total	1,080,000		398,000	62,000	62,000	62,000	496,000	
Total of Afforestation and Grassland Creation Costs		2,772,000	1,110,000	746,000	135,000	140,000	62,000	579,000	

Pine (Production Forests I-1 and III)

Type of Work		Total Cost	Timing of Spending (Year)						Remarks
			1st	2nd	3rd	4th	5th	6th onwards	
Ant Control		54,000	54,000						The timing of spending is based on the assumption that both the fiscal year in Paraguay and planting start in July.
Ground Clearance		239,000	239,000						
Planting	Seedlings	357,000	357,000						
	Others	190,000	190,000						
	Sub-Total	547,000	547,000						
Tending	Ant Control	206,000	80,000	62,000	44,000	20,000			
	Weeding	873,000	297,000	501,000	75,000				
	Pruning	391,000				98,000		293,000	
	Sub-Total	1,470,000	377,000	563,000	119,000	118,000		293,000	
Total		2,310,000	1,217,000	563,000	119,000	118,000		293,000	
Technical Fee		231,000	231,000						
Grand Total		2,541,000	1,448,000	563,000	119,000	118,000		293,000	

Pine (Production Forest IV-1)

Type of Work		Total Cost	Timing of Spending (Year)						Remarks
			1st	2nd	3rd	4th	5th	6th onwards	
Ant Control		58,000	58,000						The timing of spending is based on the assumption that both the fiscal year in Paraguay and planting start in July.
Ground Clearance		258,000	258,000						
Planting	Seedlings	389,000	389,000						
	Others	219,000	219,000						
	Sub-Total	608,000	608,000						
Tending	Ant Control	221,000	86,000	65,000	48,000	22,000			
	Weeding	944,000	321,000	542,000	81,000				
	Pruning	391,000				98,000		293,000	
	Sub-Total	1,556,000	407,000	607,000	129,000	120,000		293,000	
Total		2,480,000	1,331,000	607,000	129,000	120,000		293,000	
Technical Fee		248,000	248,000						
Grand Total		2,728,000	1,579,000	607,000	129,000	120,000		293,000	

Paraiso (Production Forest I-1)

Type of Work		Total Cost	Timing of Spending (Year)						Remarks
			1st	2nd	3rd	4th	5th	6th onwards	
Ant Control		54,000	54,000						The timing of spending is based on the assumption that both the fiscal year in Paraguay and planting start in July.
Ground Clearance		239,000	239,000						
Planting	Seedlings	230,000	230,000						
	Others	134,000	134,000						
	Sub-Total	364,000	364,000						
Tending	Ant Control	206,000	80,000	62,000	44,000	20,000			
	Weeding	1,265,000	446,000	725,000	94,000				
	Pruning	391,000	98000	120,000	173000				
	Sub-Total	1,862,000	624,000	907,000	311,000	20,000			
Total		2,519,000	1,281,000	907,000	311,000	20,000			
Technical Fee		252,000	252,000						
Grand Total		2,771,000	1,533,000	907,000	311,000	20,000			

Paraiso (Production Forest II)

Type of Work		Total Cost	Timing of Spending (Year)						Remarks
			1st	2nd	3rd	4th	5th	6th onwards	
Ant Control		54,000	54,000						The timing of spending is based on the assumption that both the fiscal year in Paraguay and planting start in July.
Ground Clearance		239,000	239,000						
Planting	Seedlings	230,000	230,000						
	Others	134,000	134,000						
	Sub-Total	364,000	364,000						
Tending	Ant Control	206,000	80,000	62,000	44,000	20,000			
	Weeding								
	Pruning	446,000	123,000	138,000	185,000				
	Sub-Total	652,000	203,000	200,000	229,000	20,000			
Total		1,309,000	860,000	200,000	229,000	20,000			
Technical Fee		131,000	131,000						
Grand Total		1,440,000	991,000	200,000	229,000	20,000			
Crop Planting		1,462,000	466,000	500,000	496,000				
Total of Afforestation and Crop Planting Costs		2,902,000	1,457,000	700,000	725,000	20,000			

Appendix C-2 Estimation of Required Amount of Labour for Five Year Afforestation Programme

Type of Work	Species	Production Forest I-1					Production Forest Ⅱ					Production Forest Ⅲ					Production Forest Ⅳ－1					Production Forest V					Required Total Amount of Labour (persons) ⑤	Estimated Implementation Rate in 5 Years (%)⑥	Required Amount of Labour in 5 Years (persons) ⑤×⑥
		Required Labour per ha ① (persons)	Ratio by Species ②	③ ①×②	Subject Area of 5 Year Programme ④	Require Amount of Labour (Persons) ③×④	Required Labour per ha ① (persons)	Ratio by Species ②	③ ①×②	Subject Area of 5 Year Programme ④	Require Amount of Labour (Persons) ③×④	Required Labour per ha ① (persons)	Ratio by Species ②	③ ①×②	Subject Area of 5 Year Programme ④	Require Amount of Labour (Persons) ③×④	Required Labour per ha ① (persons)	Ratio by Species ②	③ ①×②	Subject Area of 5 Year Programme ④	Require Amount of Labour (Persons) ③×④	Required Labour per ha ① (persons)	Ratio by Species ②	③ ①×②	Subject Area of 5 Year Programme ④	Require Amount of Labour (Persons) ③×④			
1. Advance Ant Control	Eucalyptus	1.4	0.45	0.63			—	—	—	—	—	1.4	0.55	0.77			1.4	0.55	0.77			1.4	1.00	1.4					
	Pine	1.4	0.35	0.49			—	—	—	—	—	1.4	0.45	0.63			1.4	0.45	0.63			—	—	—					
	Paraiso	1.5	0.20	0.30			1.5	1.00	1.50		7,500	—	—	—			—	—	—			—	—	—					
	Total		1.00	1.42	37,500	53,250		1.00	1.50	5,000	7,500		1.00	1.40	2500	3,500		1.00	1.40	3,500	4,900		1.00	1.4	1,500	2,100	71,250	100	71,250
2. Ground Clearance	Eucalyptus	0.9	0.45	0.40			—	—	—			0.9	0.55	0.495			1.00	0.55	0.55			0.9	1.00	0.9					
	Pine	0.9	0.35	0.32			—	—	—			0.9	0.45	0.405			1.00	0.45	0.45			—	—	—					
	Paraiso	0.9	0.20	0.18			0.9	1.00	0.9			—	—	—			—	—	—			—	—	—					
	Total		1.00	0.90	37,500	33,750		1.00	0.9	5,000	4,500		1.00	0.90	2500	2,250		1.00	1.00	3,500	3,500	0.9	1.00	0.9	1,500	1,350	45,350	100	45,350
3. Indication of Planting Positions	Eucalyptus	3.00	0.45	1.35			—	—	—			3.00	0.55				3.2	0.55				2.1	1.00	2.1					
	Pine	3.00	0.35	1.05			—	—	—			3.00	0.45				3.2	0.45				—	—						
	Paraiso	2.10	0.20	0.42			2.1	1.00	2.1				—				—	—				—	—						
	Total		1.00	2.82	37,500	105,750		1.00	2.1	5,000	10,500		1.00	3.00	2500	7,500		1.00	3.2	3,500	11,200		1.00	2.1	1,500	3,150	138,100	100	138,100
4. Planting (Including Supplementary Planting)	Eucalyptus	4.60	0.45	2.07								4.6	0.55	2.53			5.0	0.55	2.75			3.7	1.00	3.7					
	Pine	4.60	0.35	1.61								4.6	0.45	2.07			5.5	0.45	2.475			—	—						
	Paraiso	3.20	0.20	0.64			3.20	1.00	3.20			—	—				—	—				—	—						
	Total		1.00	4.32	37,500	162,000		1.00	3.20	5,000	16,000		1.00	4.6	2500	11,500		1.00	5.2	3,500	18,200		1.00	3.7	1,500	5,550	213,250	100	213,250
5. Tending (Ant Control)	Eucalyptus	6.00	0.45	2.70			—	—				6.00	0.55	3.3			6.5	0.55	3.575			6.00	1.00						
	Pine	6.00	0.35	2.10			—	—				6.00	0.45	2.7			6.5	0.45	2.925			—	—						
	Paraiso	6.00	0.20	1.20			6.00	1.00	6.00			—	—				—	—	—			—	—						
	Total		1.00	6.00	37,500	225,000		1.00	6.00	5,000	30,000		1.00	6.0	2500	15,000		1.00	6.5	3,500	22,750		1.00	6.00	1,500	9,000	301,750	55	165,960
6. Tending (Weeding)	Eucalyptus	11.10	0.45	5.00			—				—	11.10	0.55	6.105			11.9	0.55	6.545			7.1	1.00	7.1					
	Pine	11.10	0.35	3.89			—				—	11.10	0.45	4.995			11.9	0.45	5.355			—	—						
	Paraiso	34.70	0.20	6.94			—				—	—	—				—	—	—			—	—						
	Total		1.00	15.83	37,500	593,625	—				—		1.00	11.10	2500	27,750		1.00	11.9	3,500	41,650		1.00	7.10	1,500	10,650	673,675	66	444,620
7. Tending (Pruning)	Eucalyptus	12.10	0.45	5.45				—				12.10	0.55	6.655			12.10	0.55	6.655			7.8	1.00	7.8					
	Pine	15.60	0.35	5.46				—				15.60	0.45	7.02			15.60	0.45	7.02			—	—						
	Paraiso	15.60	0.20	3.12			17.8	1.00				—	—				—	—				—	—						
	Total		1.00	14.03	37,500	526,125		1.00	17.8	5,000	89,000		1.00	13.68	2500	34,188		1.00	13.68	3,500	47,880		1.00	7.8	1,500	11,700	708,893	27	191,400
Total						1,699,500					157,500					101,688					150,080					43,500	2,152,268		1,269,930
	Eucalyptus	39.1					—					39.1					41.1					29.0							
	Pine	42.6					—					42.6					45.1					—							
	Paraiso	64.0					31.5					—					—					—							

Appendix D-1 Financial Analysis (Paraiso)

Production Cost

		Year	1	2	3	4	5	6	7	8	9	10	11	12
Ant Control		$14.21	$14.21											
Ground Clearance		$62.89	$62.89											
Planting	Seedlings	$60.53	$60.53											
	Others	$35.26	$35.26											
Tending	Ant Control	$68.68	$27.63	$21.05	$14.74	$5.26								
	Weeding	$318.42	$110.79	$182.89	$24.74	$0.00								
	Pruning	$102.89	$25.79	$31.58	$0.00	$45.53								
Total		$662.89	$337.11	$235.53	$39.47	$50.79								
Technical Fee		$66.32	$66.32											
Grand Total		$729.21	$403.42	$235.53	$39.47	$50.79								

Income

		Year	8	12
Cutting and Hauling Cost + Transportation Cost			$10.24	$9.24
Wood Price (Delivery Price to Sawmill)	Timber Wood		$40.00	$55.00
	Plywood Wood			$90.00
Producer Price	Timber Wood		$29.76	$45.76
	Plywood Wood			$80.76

		Year	8	12	Total
Harvest (M+)	Timber Wood		15	45	60
	Plywood Wood			44	44
	Total		15	89	104
Income	Timber Wood		$446.40	$2,059.20	$2,505.60
	Plywood Wood			$3,553.44	$3,553.44
	Total		$446.40	$5,612.64	$6,059.04

Year	1	2	3	4	5	6	7	8	9	10	11	12
Production Cost	$403.42	$235.53	$39.47	$50.79	0	0	0	0	0	0	0	0
Income from Wood Sales								$446.40				$5,612.64
Net Cash Flow	($403.42)	($235.53)	($39.47)	($50.79)	0	0	0	$446.40	0	0	0	$5,612.64

FIRR: 23.6%

Appendix D-2 Financial Analysis (Eucalyptus)

Production Cost

		Year	1	2	3	4	5	6	7	8	9	10	11	12
Ant Control		$14.21	$14.21											
Ground Clearance		$62.89	$62.89											
Planting	Seedlings	$121.05	$121.05											
	Others	$50.00	$50.00											
Tending	Ant Control	$68.68	$27.63	$21.05	$14.74	$5.26								
	Weeding	$215.26	$71.58	$123.95	$19.74									
	Pruning	$79.47		$19.74	$0.00	$25.00		$34.74						
Total		$611.58	$347.37	$164.74	$34.47	$30.26		$34.74						
Technical Fee		$61.05	$61.05											
Grand Total		$672.63	$408.42	$164.74	$34.47	$30.26		$34.74						

Income

		Year	4	8	12		Year	4	8	12	Total
Cutting and Hauling Cost + Transportation Cost			$10.74	$10.24	$9.24		Pulpwood	33	29	28	90
Wood Price (Delivery to Plants)	Pulpwood		$11.00	$11.00	$11.00	Harvest (Mt)	Timber Wood		20	196	216
	Timber Wood			$22.00	$24.00		Plywood Wood			56	56
	Plywood Wood				$40.00		Total	33	49	280	362
Producer Price	Pulpwood		$0.26	$0.76	$1.76		Pulpwood	$8.58	$22.04	$49.28	$79.90
	Timber Wood			$11.76	$14.76	Income	Timber Wood		$235.20	$2,892.96	$3,128.16
	Plywood Wood				$30.76		Plywood Wood			$1,722.56	$1,722.56
							Total	$8.58	$257.24	$4,664.80	$4,930.62

Year	1	2	3	4	5	6	7	8	9	10	11	12
Production Cost	$408.42	$164.74	$34.47	$30.26	0	$34.74	0	0	0	0	0	0
Income from Wood Sales				$8.58				$257.24				$4,664.80
Net Cash Flow	($408.42)	($164.74)	($34.47)	($21.68)	0	($34.74)	0	$257.24	0	0	0	$4,664.80

FIRR: 21.9%

Appendix D-3 Financial Analysis (Pine)

Production Cost

		Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Ant Control		$14.21	$14.21																								
Ground Clearance		$62.89	$62.89																								
Planting	Seedlings	$93.95	$93.95																								
	Others	$50.00	$50.00																								
Tending	Ant Control	$68.68	$27.63	$21.05	$14.74	$5.26																					
	Weeding	$215.26	$71.58	$123.95	$19.74																						
	Pruning	$102.89				$25.79					$31.58					$45.53											
		$607.89	$320.26	$145.00	$34.47	$31.05					$31.58					$45.53											
Technical Fee		$60.79	$60.79																								
Grand Total		$668.68	$381.05	$145.00	$34.47	$31.05					$31.58					$45.53											

Income

		Year	10	15	20	25
Cutting and Hauling Cost + Transportation Cost				$10.24	$10.24	$9.24
Wood Price (Delivery to Plants)	Firewood		$11.00	$11.00	$11.00	$11.00
	Timber Wood			$22.00	$24.00	$24.00
	Plywood Wood					$50.00
Producer Price	Firewood		$0.26	$0.76	$0.76	$1.76
	Timber Wood			$11.76	$13.76	$14.76
	Plywood Wood					$40.76

		Year	10	15	20	25	Total
Harvest (Mt)	Firewood		39	26	3	29	97
	Timber Wood			18	20	146	184
	Plywood Wood				3	116	119
	Total		39	44	26	291	400
Income	Firewood		$10.14	$19.76	$2.28	$51.04	$83.22
	Timber Wood			$211.68	$275.20	$2,154.96	$2,641.84
	Plywood Wood					$4,728.16	$4,728.16
	Total		$10.14	$231.44	$277.48	$6,934.16	$7,453.22

Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Production Cost	$381.05	$145.00	$34.47	$31.05	0	0	0	0	$31.58	0	0	0	0	$45.53	0	0	0	0	0	0	0	0	0	0	0
Income from Wood Sales										$10.14					$231.44					$277.48					$6,934.16
Net Cash Flow	($381.05)	($145.00)	($34.47)	($31.05)	0	0	0	0	($31.58)	$10.14	0	0	0	($45.53)	$231.44	0	0	0	0	$277.48	0	0	0	0	$6,934.16

FIRR: 11.6%

Appendix D-4 Small-Scale Afforestation (Paraiso)

Small-Scale Afforestation with Paraiso (1-2 ha) Production Forest I-1 (per~ha)

Production Cost

		Year	1	2	3	4
Ant Control		$14.21	$14.21			
Ground Clearance		$50.26	$50.26			
Planting	Seedlings	$60.53	$60.53			
	Others	$28.42	$28.42			
Tending	Ant Control	$54.21	$21.05	$16.32	$11.58	$5.26
	Weeding	$183.95	$62.63	$66.05	$39.47	$15.79
	Pruning	$117.37	$32.37	$36.32	$48.68	
Grand Total		$508.95	$269.47	$118.68	$99.74	$21.05

Income

		Year	8	12
Cutting and Hauling Cost + Transportation Cost			$10.24	$9.24
Wood Price (Delivery Price to Sawmill)	Timber Wood		$40.00	$55.00
	Plywood Wood			$90.00
Producer Price	Timber Wood			
	Plywood Wood		$29.76	$45.76
				$80.76

		Year	8	12	Total
Harvest (M+)	Timber Wood		15	45	60
	Plywood Wood			44	44
	Total		15	89	104
Income	Timber Wood		$446.40	$2,059.20	$2,505.60
	Plywood Wood			$3,553.44	$3,553.44
	Total		$446.40	$5,612.64	$6,059.04

Year	1	2	3	4	5	6	7	8	9	10	11	12
Production Cost	$269.47	$118.68	$99.74	$21.05	0	0	0	0	0	0	0	0
Income from Wood Sales								$446.40				$5,612.64
Net Cash Flow	($269.47)	($118.68)	($99.74)	($21.05)	0	0	0	$446.40	0	0	0	$5,612.64

FIRR: 28.5%

Appendix D-5 Small-Scale Afforestation: Agroforestry

Cultivation Cost and Income

Crop	Unit Cost ($/ha)	Planting Area (ha)			Cost ($)		
		Year 1	Year 2	Year 3	Year 1	Year 2	Year 3
Cassava	$231.05	0.2	0.2		$46.21	$46.21	
Maize	$156.84	0.4	0.4	0.4	$62.74	$62.74	$62.74
French Bean	$200.79	0.1	0.1	0.3	$20.08	$20.08	$60.24
Total		0.7	0.7	0.7	$129.03	$129.03	$122.97

Crop	Yield (kg/ha)	Unit Price ($/kg)	Production Volume(kg)			Income($)		
			Year1	Year 2	Yeaar 3	Year 1	Year 2	Year 3
Cassava	12,000	$0.02	2,400	2,400		$50.53	$50.53	
Maize	2,000	$0.11	800	800	800	$84.21	$84.21	$84.21
French Bean	1,000	$0.26	100	100	300	$26.32	$26.32	$78.95
Total						$161.05	$161.05	$163.16

Total Production Cost

Year	1	2	3	4	Total
Afforestation Cost	$206.84	$52.63	$60.26	$5.26	$325.00
Crops Cultivation Cost	$129.03	$129.03	$122.97		$381.03
Total	$335.87	$181.66	$183.24	$5.26	$706.03

Total Income

Year	1	2	3			8	12	Total
Forest Products						$446.40	$5,612.64	$6,059.04
Farming Products	$161.05	$161.05	$163.16					$485.26
Total	$161.05	$161.05	$163.16			$446.40	$5,612.64	$6,544.30

Year	1	2	3	4	5	6	7	8	9	10	11	12
Production Cost	$335.87	$181.66	$183.24	$5.26	0	0	0	0	0	0	0	0
Income from Wood Sales	$161.05	$161.05	$163.16					$446.40				$5,612.64
Net Cash Flow	($174.82)	($20.61)	($20.08)	($5.26)	0	0	0	$446.40	0	0	0	$5,612.64

FIRR: 38.5%

Appendix D-6 Profitability of the Entire Project

Production Cost

Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Consultant Cost	$180	$360	$360	$450	$450										
Institutional Strengthening Cost	$225	$375	$450	$450	$0										
Reccurent Cost	$345	$345	$460	$575	$575	$575	$575	$345	$345	$345	$345	$345	$173	$173	$173
Other Costs	$201	$201	$268	$335	$335										
Sub-Total	$951	$1,281	$1,538	$1,810	$1,360	$575	$575	$345	$345	$345	$345	$345	$173	$173	$173
Afforestation Cash Flow															
Paraiso	-$303	-$479	-$811	-$1,026	-$1,661	-$842	-$195	$182	$335	$670	$670	$5,549	$4,209	$8,419	$8,419
Agro-forestry	-$87	-$98	-$195	-$208	-$393	-$67	-$45	$213	$223	$446	$446	$3,699	$2,806	$5,613	$5,613
Eucalyptus	-$885	-$1,242	-$2,202	-$2,606	-$4,452	-$1,747	-$468	$219	$407	$814	$1,115	$12,341	$10,111	$20,222	$20,222
Pine	-$603	-$832	-$1,490	-$1,769	-$3,029	-$1,125	-$317	-$197	-$50	-$34	-$84	-$68	-$168	-$8	$294
Sub-Total	-$1,878	-$2,652	-$4,699	-$5,609	-$9,535	-$3,781	-$1,025	$418	$915	$1,896	$2,147	$21,521	$16,959	$34,246	$34,548
Total Cash Flow	-$2,829	-$3,933	-$6,237	-$7,419	-$10,894	-$4,356	-$1,600	$73	$570	$1,551	$1,802	$21,176	$16,786	$34,073	$34,375

Year	16	17	18	19	20	21	22	23	24	25	26	27	28	29
Consultant Cost														
Institutional Strengthening Cost														
Reccurent Cost	$173	$173	$173	$173	$173	$86	$86	$86	$86	$86	$86	$86	$86	$86
Other Costs														
Sub-Total	$173	$173	$173	$173	$173	$86	$86	$86	$86	$86	$86	$86	$86	$86
Afforestation Cash Flow														
Paraiso	$16,838													
Agro-forestry	$11,225													
Eucalyptus	$40,444													
Pine	$222	$588	$444	$1,465	$439	$439	$878	$878	$1,756	$10,973	$10,973	$21,947	$21,947	$43,893
Sub-Total	$68,729	$588	$444	$1,465	$439	$439	$878	$878	$1,756	$10,973	$10,973	$21,947	$21,947	$43,893
Total Cash Flow	$68,556	$415	$271	$1,292	$266	$353	$792	$792	$1,670	$10,887	$10,887	$21,861	$21,861	$43,807

FIRR of Entire Afforestation Work 20.1%
FIRR of Entire Project 17.1%

Appendix D-7a Economic Price (Cotton, Soybeans, Wheat, Maize)

Economic Price of Cotton

	Cotton Fibre (US$/ton)		Cotton Seed Oil (US$/ton)		Draff (US$/ton)	
Export Price (FOB Asuncion; Average in 2000)		$1,132.98		$320.46		$83.93
Adjustment of 2001 Price	101.3%	$1,147.14	101.3%	$324.47	101.3%	$84.98
Price Adjustment Based on Quality (10%)	90%	$1,032.43	100%	$324.47	100%	$84.98
	Fibre					
Conversion to Price per Ton of Raw Cotton	Yield	US$/ton (raw cotton)	Yield	US$/ton (raw cotton)	Yield	US$/ton (raw cotton)
			54%		54%	
Conversion to Price per Ton of Raw Cotton	35%	$361.35	15%	$26.28	45%	$20.65
Customs Clearance Cost, Exporter's Commission and Transportation Cost		$18.07		$1.31		$1.03
Manufacturing/Processing Cost		$54.20		$6.57		$8.26
Transportation Cost		$5.42		$0.39		$0.31
Subtotal		$77.69		$8.28		$9.60
		Cotton Fibre		Seed Oil		Draff
Total Economic Price of Cotton/Ton		$283.66		$18.00		$11.05
Loco Price $312.71						

Economic Price of Soybeans

			(US$/ton)
Export Price (FOB Asuncion; Average in 2000)			$159.22
Adjustment of 2001 Price	101.3%		$161.21
Price Adjustment Based on Quality (10%)	100%		$161.21
Customs Clearance Cost, Exporter's Commission and Transportation Cost		$16.12	
Transportation Cost (150km×120Gs/ton)	18000	$5.17	
			$139.92
Ullage	-5%	$7.00	
Storage Cost (20000Gs/ton)	20000	$5.74	
Transportation Cost (150km×120Gs/ton)	6,000	$1.72	
		$35.74	
Loco Price			$125.47

Economic Price of Wheat

			(US$/ton)
Export Price (FOB Asuncion; Average in 2000)			$108.02
Adjustment of 2001 Price	101.25%		$109.37
Price Adjustment Based on Quality (10%)	100%		$109.37
Customs Clearance Cost, Exporter's Commission and Transportation Cost		$10.94	
Transportation Cost (150km×120Gs/ton)	18000	$5.17	
			$93.27
Ullage	-5%	$4.66	
Storage Cost (20000Gs/ton)	20000	$5.74	
Transportation Cost (150km×120Gs/ton)	6,000	$1.72	
		$28.23	
Loco Price			$81.14

Economic Price of Maize

			(US$/ton)
Export Price (FOB Asuncion; Average in 2000)			$102.97
Adjustment of 2001 Price	101.25%		$104.26
Price Adjustment Based on Quality (10%)	100%		$104.26
Customs Clearance Cost, Exporter's Commission and Transportation Cost		$10.43	
Transportation Cost (150km×120Gs/ton)	18000	$5.17	
			88.67
Ullage	-5%	$4.43	
Storage Cost (20000Gs/ton)	20000	$5.74	
Transportation Cost (150km×120Gs/ton)	6,000	$1.72	
		$27.49	
Loco Price			$76.77

Appendix D-7b Economic Price (Beef)

Economic Price of Beef

	Total	Beef		Bone		Fat		Internal Organs		Skin		Scraps		Head and Tail	
			US$/kg		US$/kg		US$/kg		US$/kg		US$/kg		US$/kg		US$/kg
Export Price															
(FOB Asuncion; Average in year 2000)			$1.81		$0.18		$0.29		$0.72		$2.82		$0.14		$0.67
Adjustment to 2001 Price		101.3%	$1.83	101.3%	$0.18	101.3%	$0.29	101.3%	$0.73	101.3%	$2.86	101.3%	$0.14	101.3%	$0.68
Weight Adjustment (+10%)			1.1												
SCF 0.909			$2.01												
		450 kg		450 kg		450 kg		450 kg		450 kg		450 kg		450 kg	
Conversion to the Unit of 450kg of Raw Beef		yield	$/450kg	yield	$/450kg	yield	$/450kg	yield	$/450kg	yield	$/450kg	yield	$/450kg	yield	$/450kg
	$432.37	39%	$356.92	10%	$8.04	5%	$6.35	8%	$27.23	0.92%	$11.83	35%	$21.64	0.12%	$0.35
	97.8%														
Customs Cost, Exporter Fee, Exportation Cost, etc.	$10.81	2.5%	$8.92	2.5%	$0.20	2.5%	$0.16	2.5%	$0.68	2.5%	$0.30	2.5%	$0.54	2.5%	$0.01
Butchering and Cold Storage Cost $290.00	$263.61														
	$157.95														
Processing Cost	$7.19					20%	$1.27			50.0%	$5.92				
Transportation Cost	$6.49	1.5%	$5.35	1.5%	$0.12	1.5%	$0.10	1.5%	$0.41	1.5%	$0.18	1.5%	$0.32	1.5%	$0.01
			$14.28		$0.32		$1.53		$1.09		$6.39		$0.87		$0.01
Total Economic Price per 450kg of Beef	$144.27														

Total Economic Price one ton of Beef

Appendix D-8a Net Economic Benefit (Cotton, Soybean)

Cotton Production Model (ha)

	Financial Price	Factor	Economic Price
Direct Costs			
Labour	$232.46	0.670	$155.63
Others	$87.53	0.909	$79.57
Seeds	$16.14	0.909	$14.67
Chemicals	$11.24	0.851	$9.57
Indirect Costs			
Management Cost	$112.68	0.909	$102.42
Production Cost Total	$460.05		$361.86
Economic Benefit	$460.05		
Yield (kg/ha)	1,000		1,000
Cotton Price (US$/ton)	$186.54		$312.71
Income	$186.54		$312.71
Net Economic Benefit	-$273.51		-$49.15

Personnel Cost Adjustment		Factor: 0.6695
Fertiliser, Insecticide and Herbicide	IVA 10%	Treatment/Transportation 8%
	1.18	Factor 0.85

Soybean Production Model (ha)

	Financial Price	Factor	Economic Price
Direct Costs			
Labour	$45.62	0.670	$30.54
Others	$9.47	0.909	$8.61
Seeds	$32.63	0.909	$29.66
Chemicals	$139.07	0.800	$111.25
Indirect Costs			
Management Cost	$4.54	0.909	$4.12
Others	$109.59	0.909	$99.61
Production Cost Total	$340.91		$283.81
Economic Benefit			
Yield (kg/ha)	2,500		$2,500
Soybean Price (US$/ton)	$120.35		$125.47
Income	$300.88		$313.66
Net Economic Benefit	-$40.04		$29.86

Personnel Cost Adjustment		Factor: 0.6695
50% of the insecticide and herbicide spraying work is manually conducted while a machine is used for the remainder.		
Fertiliser, Insecticide and Herbicide	IVA 10%	Treatment/Transportation 15%
	1.25	Factor 0.80

Appendix D-8b Net Economic Benefit (Wheat, Maize)

Wheat Production Model (ha)

	Financial Price	Factor	Economic Price
Direct Costs			
Labour	$8.44	0.670	$5.65
Others	$38.03	0.909	$34.57
Seeds	$23.53	0.909	$21.39
Chemicals	$75.03	0.851	$63.86
Indirect Costs			
Others	$2.90	0.909	$2.64
Management Cost	$99.90	0.909	$90.81
Production Cost Total	$247.82		$218.90
Income			
Yield	2,300kg/ha		2,300
Wheat Price	$77.00US$/mt		$90.07
Income	$177.10		$207.15
Net Income	-$70.72		-$11.75

Personnel Cost Adjustment		Factor: 0.6695
Fertiliser, Insecticide and Herbicide	IVA 10%	Treatment/Transportation 8%
	1.18	Factor 0.85

Maize Production Model (ha)

	Financial Price	Factor	Economic Price
Direct Costs			
Labour	$18.83	0.909	$17.11
Others	$58.11	0.909	$52.83
Seeds	$40.18	0.909	$36.52
Chemicals	$88.17	0.800	$70.53
Indirect Costs			
Others	$4.11	0.909	$3.73
Management Cost	$91.42	0.909	$83.10
Production Cost Total	$300.81		$263.83
Income			
Yield	5,000kg/ha		5,000
Maize Price	$52.63US$/mt		$55.00
Income	$263.16		$275.00
Net Income	$263.16		$11.17

Personnel Cost Adjustment		Factor: 0.6695
Fertiliser, Insecticide and Herbicide	IVA 10%	Treatment/Transportation 15%
	1.25	Factor 0.80

Appendix D-8c Net Economic Benefit (Beef)

Beef Production Model (ha)

			Financial Price	Factor	Economic Price
Production Cost					
Labour	35760	35,760	$10.26	0.670	$6.87
Drugs, etc.		48,039	$13.79	0.851	$11.73
Others		400,000	$114.79	0.909	$104.35
	Sub-Total		$138.84		$122.95
Indirect Costs					
Management Cost		48,000	$13.78	0.909	$12.52
Land Tax (US$0.70/ha)			$0.70	0	$0.00
	Sub-Total		$14.48		$12.52
	TotalProduction Cost	48,000	$153.32		$135.47
Economic Benefit					
	Beef Price				$144.27
	Income				$144.27
Net Economic Benefit					$8.80

US$1 = G 3484.5

Personnel Cost Adjustment		Factor: 0.6695
Vaccination and Nutrients,etc	IVA 10%	Treatment/Transportation 8%
	1.18	Factor 0.85

Appendix D-9 Economic Analysis (Paraiso)

Year	1	2	3	4	5
Economic Production Cost	$662.85	$366.71	$214.09	$35.88	$46.17

Economic Benefit

Economic Price	Timber Wood	$1,006.58	$1,006.58
	Plywood Wood		$918.08
(1)Miscellaneous Cost		$10.24	$9.24
(2)Sawing/Processing Cost		$337.30	$337.30
(1)+(2)		$347.54	$346.54
Economic Cost		$315.92	$315.01
Producer Economic Cost	Timber Wood	$690.66	$691.57
	Plywood Wood		$603.08

		Year 8	Year 12	Total
Harvesting (Mt)	Timber Wood	15	45	60
	Plywood Wood		44	44
	Total	15	89	104

Yield	25.2%	Year 8	Year 12	Total
Conversion to Products (Mt)	Timber Wood	3.78	11.34	15.12
	Plywood Wood		11.09	11.09
	Total	3.78	22.43	26.21

		Year 8	Year 12	Total
Economic Benefit	Timber Wood	$2,610.70	$7,842.40	$10,453.10
	Plywood Wood		$6,686.93	$6,686.93
	Total	$2,610.70	$14,529.33	$17,140.03

Year	1	2	3	4	5	6	7	8	9	10	11	12
Production Cost	$366.71	$214.09	$35.88	$46.17	0	0	0	0	0	0	0	0
Income from Wood Sales								$2,610.70				$14,529.33
Net Cash Flow	($366.71)	($214.09)	($35.88)	($46.17)	0	0	0	$2,610.70	0	0	0	$14,529.33

Appendix D-10 Economic Analysis (Eucalyptus I-1,III)

	Total Cost	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
Economic Production Cost	$579.85	$371.25	$149.75	$31.34	$27.51		$31.58

Economic Benefit

Income		Year 4	Year 8	Year 12
Harvest (Mt)	Pulpwood	33	29	28
	Timber Wood		20	196
	Plywood			56
	Total	33	49	280
		Year 4	Year 8	Year 12
Economic Price	Pulpwood	$0.26	$0.76	$1.76
	Timber Wood		$394.88	$394.88
	Plywood Wood			$322.06
(1) Miscellaneous Cost		$10.74	$10.24	$9.24
(2) Sawing/Processing Cost			$354.17	$354.17
(1) + (2)			$364.41	$363.41
Economic Cost			$331.25	$330.34

Yield	24.0%	Year 4	Year 8	Year 12	Total
Conversion to Products (Mt)	Firewood	39.00	26.00	3.00	68.0
	Timber Wood		4.80	47.04	51.84
	Plywood			13.44	13.44
	Total	39.0	30.80	63.48	133.28
Producer Economic Price	Pulpwood	$0.24	$0.69	$1.60	0.909
	Timber Wood		$63.63	$64.54	
	Plywood Wood			-$8.28	
		Year 4	Year 8	Year 12	Total
Economic Benefit	Firewood	$9.22	$17.96	$4.80	$31.98
	Timber Wood		$305.42	$3,035.88	$3,341.30
	Plywood Wood			-$111.24	-$111.24
	Total	$9.22	$323.38	$2,929.45	$3,262.05

Year	1	2	3	4	5	6	7	8	9	10	11	12
Production Cost	$371.25	$149.75	$31.34	$27.51	0	$31.58	0	0	0	0	0	0
Income from Wood Sales				$9.22				$323.38				$2,929.45
Net Cash Flow	($371.25)	($149.75)	($31.34)	($18.29)	0	($31.58)	0	$323.38	0	0	0	$2,929.45

Eucalyptus EIRR: 18.7%

Appendix D-11 Economic Analysis (Pine)

		Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Year 13	Year 14
Production Cost	$607.83	$346.38	$131.81	$31.34	$28.23					$28.71					$41.38

Economic Benefit

Income		Year 10	Year 15	Year 20	Year 25
Harvest (Mt)	Firewood	39	26	3	29
	Timber Wood		18	20	146
	Plywood			3	116
	Total	39	44	26	291
Economic Price	Firewood	$0.26	$0.76	$0.76	$1.76
	Timber Wood		$685.00	$685.00	$685.00
	Plywoo			$413.97	$413.97
(1) Miscellaneous Cost		$10.74	$10.24	$9.24	$9.24
(2) Sawing/Processing Cost			$340.00	$340.00	$340.00
(1) + (2)			$350.24	$349.24	$349.24
Economic Cost			$318.37	$317.46	$317.46

Yield	25.0%	Year 10	Year 15	Year 20	Year 25	Total
Conversion to Products (Mt)	Firewood	39.0	26.0	3.0	29.0	97.0
	Timber Wood		4.50	5.00	36.50	46.00
	Plywood			0.75	29.00	29.75
	Total	39	30.50	8.75	94.50	172.75
Producer Economic Price	Firewood	$0.24	$0.69	$0.69	$1.60	0.909
	Timber Wood		$366.63	$367.54	$367.54	
	Plywood Wood		$96.51	$96.51		
	Total	$0.24	$367.32	$464.74	$465.65	

		Year 10	Year 15	Year 20	Year 25	Total
Economic Benefit	Firewood	$9.22	$17.96	$2.07	$46.40	$75.65
	Timber Wood		$1,649.84	$1,837.70	$13,415.22	$16,902.77
	Plywood			$72.38	$2,798.73	$2,871.11
	Total	$9.22	$1,667.80	$1,912.16	$16,260.35	$19,849.53

Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Production Cost	$346.38	$131.81	$31.34	$28.23	0	0	0	0	$28.71	0	0	0	0	$41.38	0	0	0	0	0	0	0	0	0	0	0
Income from Wood Sales										$9.22					$1,667.80					$1,912.16					$16,260.35
Net Cash Flow	($346.38)	($131.81)	($31.34)	($28.23)	0	0	0	0	($28.71)	$9.22	0	0	0	($41.38)	$1,667.80	0	0	0	0	$1,912.16	0	0	0	0	$16,260.35

Pine EIRR: 18.5%

Appendix D-12 Estimation of Carbon Fixation Amount

Production Forests I-1, III and IV-1

Species: Pinus taeda

Stand Age	Standing Tree Volume m^3/ha	Thinning Volume m^3/ha	Final Cutting Volume m^3/ha	Remaining Standing Tree Volume After Final Cutting m^3/ha	Carbon Fixation Amount ton/ha	CO_2 Equivalent ton/ha
1				0	0	0
2	29			29	10	36
3	43			43	15	55
4	57			57	20	73
5	72			72	25	91
6	86			86	30	109
7	100			100	35	128
8	114			114	40	146
9	129			129	45	164
10	143	44		99	34	126
11	152			152	53	194
12	161			161	56	205
13	169			169	59	216
14	178			178	62	227
15	187	44		143	50	182
16	191			191	67	244
17	196			196	68	250
18	200			200	70	255
19	205			205	71	261
20	209	22		187	65	239
21	215			215	75	275
22	221			221	77	283
23	228			228	79	290
24	234			234	81	298
25	240		240	0	0	0
						174

Note: The conditions to estimate the carbon fixation amount are as follows:
Specific gravity of air-dried wood: 0.58
Ratio of air-dried weight of roots, limbs and tops to stem: 0.2
Carbon fixation factor: 0.5

Production Forests I-1, III and IV-1

Species: Pinus elliottii

Stand Age	Standing Tree Volume m^3/ha	Thinning Volume m^3/ha	Final Cutting Volume m^3/ha	Remaining Standing Tree Volume After Final Cutting m^3/ha	Carbon Fixation Amount ton/ha	CO_2 Equivalent ton/ha	Average
1				0	0	0	0
2	29			29	11	42	39
3	43			43	17	63	59
4	57			57	23	84	79
5	72			72	29	105	98
6	86			86	34	126	118
7	100			100	40	148	138
8	114			114	46	169	157
9	129			129	52	190	177
10	143	44		99	40	146	136
11	162			162	65	238	216
12	181			181	73	266	236
13	199			199	80	294	255
14	218			218	88	322	275
15	237	55		182	73	268	225
16	249			249	100	367	306
17	261			261	105	385	317
18	273			273	110	402	329
19	285			285	115	420	341
20	297	38		259	104	382	310
21	308			308	124	453	364
22	318			318	128	469	376
23	329			329	132	485	388
24	339			339	136	500	399
25	350		350	0	0	0	0
						253	213

Note: The conditions to estimate the carbon fixation amount are as follows:
Specific gravity of air-dried wood: 0.67
Ratio of air-dried weight of roots, limbs and tops to stem: 0.2
Carbon fixation factor: 0.5

Production Forests I-1, III and IV-1

Species: Eucalyptus grandis

Stand Age	Standing Tree Volume m^3/ha	Thinning Volume m^3/ha	Final Cutting Volume m^3/ha	Remaining Standing Tree Volume After Final Cutting m^3/ha	Carbon Fixation Amount ton/ha	CO_2 Equivalent ton/ha
1				0	0	0
2	70			70	24	88
3	104			104	36	131
4	139	55		84	29	106
5	125			125	43	158
6	162			162	56	205
7	200			200	69	252
8	237	70		167	57	210
9	246			246	85	310
10	255			255	88	321
11	293			293	101	369
12	330		330	0	0	0
						179

Note: The conditions to estimate the carbon fixation amount are as follows:
Specific gravity of air-dried wood: 0.55
Ratio of air-dried weight of roots, limbs and tops to stem: 0.25
Carbon fixation factor: 0.5

Production Forests I-1 and II

Species: Melia azedarach

Stand Age	Standing Tree Volume m^3/ha	Thinning Volume m^3/ha	Final Cutting Volume m^3/ha	Remaining Standing Tree Volume After Final Cutting m^3/ha	Carbon Fixation Amount ton/ha	CO_2 Equivalent ton/ha
1				0	0	0
2	18			18	7	27
3	27			27	11	41
4	36	22		14	6	21
5	45			45	18	68
6	62			62	25	93
7	79			79	32	119
8	96	28		68	28	102
9	108			108	44	162
10	120			120	49	180
11	153			153	62	229
12	185		185	0	0	0
						179

Production Forests V

Species: Eucalyptus grandis

Stand Age	Standing Tree Volume m^3/ha	Thinning Volume m^3/ha	Final Cutting Volume m^3/ha	Remaining Standing Tree Volume After Final Cutting m^3/ha	Carbon Fixation Amount ton/ha	CO_2 Equivalent ton/ha	Average
1				0	0	0	0
2	50			50	17	62	75
3	74			74	26	94	112
4	99	30		69	24	87	96
5	102			102	35	129	143
6	145			145	50	182	193
7	187			187	64	236	244
8	230	91		139	48	175	193
9	209			209	72	263	287
10	188			188	65	237	279
11	214			214	74	270	319
12	240		240	0	0	0	0
						145	162

Note: The conditions to estimate the carbon fixation amount are as follows:
Specific gravity of air-dried wood: 0.55
Ratio of air-dried weight of roots, limbs and tops to stem: 0.25
Carbon fixation factor: 0.5

Note: The conditions to estimate the carbon fixation amount are as follows:
Specific gravity of air-dried wood: 0.63
Ratio of air-dried weight of roots, limbs and tops to stem: 0.3
Carbon fixation factor: 0.5

Appendix E Area by Land Cover Classification in the Eastern Region

Original Information				Analysis Results (ha)													
Code No.	City	District	Area (ha)	High Forest (Dense-Medium)	High Forest (Sparse)	Low Forest	Bamboo Forest	Artificial Forest	Dry Farmland	Paddy Field	Non-Flooded or Seasonally Flooded Natural Grassland	Permanently Flooded Natural Grassland	Artificial Grassland	Urban Area/ Settlement	Shrub Land	Water Body	Others (Cloud/ Cloud Shadow)	Total
101	CONCEPCION	CONCEPCION	962,616.2	4,808.9	58,460.1	252,857.1	1,943.4	0.0	15,618.1	0.0	548,834.2	24,640.9	50,915.4	950.8	17.3	3,569.9	0.0	962,616.2
102	BELEN	CONCEPCION	18,673.2	5.8	526.5	2,223.8	12.9	0.0	7,163.2	0.0	6,120.4	881.7	1,626.8	43.2	0.0	69.0	0.0	18,673.2
103	HORQUETA	CONCEPCION	283,578.4	5,136.9	40,531.6	54,569.3	3,196.5	0.0	33,388.1	0.0	82,224.2	11,372.8	52,175.2	151.3	180.1	652.6	0.0	283,578.4
104	LORETO	CONCEPCION	81,350.3	198.9	3,601.3	8,949.3	93.7	0.0	12,181.6	0.0	44,741.9	7,199.8	3,806.0	70.6	10.1	497.2	0.0	81,350.3
105	SAN CARLOS	CONCEPCION	164,270.7	2.9	662.8	68,294.5	1.4	0.0	0.0	0.0	91,849.8	2,286.5	279.5	17.3	0.0	527.3	348.7	164,270.7
106	SAN LAZARO	CONCEPCION	108,100.2	0.0	51.9	28,901.5	0.0	0.0	0.0	0.0	73,144.3	1,926.9	0.0	190.2	0.0	1,111.2	2,774.3	108,100.2
107	YBY YAU	CONCEPCION	219,227.1	3,447.5	28,885.1	36,977.2	1,063.2	0.0	14,008.9	0.0	71,851.1	197.4	62,164.2	47.5	371.7	213.2	0.0	219,227.1
201	SAN PEDRO DEL YCUAMANDYYU	SAN PEDRO	314,283.7	4,944.0	31,246.9	41,801.7	2,467.7	0.0	19,546.8	0.0	101,107.5	50,481.0	58,713.7	463.9	1,424.7	2,085.9	0.0	314,283.7
202	ANTEQUERA	SAN PEDRO	46,827.3	57.6	1,479.2	6,177.5	14.4	0.0	0.0	0.0	28,464.8	8,435.9	714.4	53.3	427.8	1,002.5	0.0	46,827.3
203	CHORE	SAN PEDRO	100,170.0	1,933.3	10,300.4	11,899.4	1,027.2	0.0	24,850.5	0.0	19,981.3	8,862.6	19,619.7	0.0	495.6	1,200.0	0.0	100,170.0
204	ELIZARDO AQUINO	SAN PEDRO	81,053.0	1,524.8	7,758.0	7,043.8	656.6	0.0	20,264.7	0.0	23,603.7	8,830.7	10,737.1	61.9	151.2	420.4	0.0	81,053.0
205	ITACURUBI DEL ROSARIO	SAN PEDRO	91,336.0	567.9	3,250.1	4,293.5	171.5	0.0	8,823.4	0.0	33,065.6	26,643.3	11,582.0	47.6	0.0	2,891.2	0.0	91,336.0
206	LIMA	SAN PEDRO	65,869.5	1,437.9	6,395.8	11,667.7	657.0	0.0	2,427.8	0.0	24,169.6	10,061.2	7,061.4	40.3	96.5	1,854.3	0.0	65,869.5
207	NUEVA GERMANIA	SAN PEDRO	223,078.1	27,371.7	33,462.9	19,842.6	8,067.9	0.0	16,694.7	0.0	53,593.7	19,148.2	34,086.8	20.2	9,108.1	1,681.3	0.0	223,078.1
208	SAN ESTANISLAO	SAN PEDRO	404,919.1	37,706.6	63,642.0	45,648.2	5,215.6	765.1	56,505.9	0.0	79,971.8	17,591.9	92,763.0	361.6	2,939.2	1,808.2	0.0	404,919.1
209	SAN PABLO	SAN PEDRO	32,016.0	57.6	1,449.4	3,208.4	5.8	0.0	3,129.2	0.0	8,945.7	13,386.2	679.4	0.0	87.8	1,066.6	0.0	32,016.0
210	TACUATI	SAN PEDRO	227,106	16,244.1	51,334.3	38,088.3	5,839.2	0.0	10,451.0	0.0	37,258.4	9,861.7	55,758.7	0.0	1,776.4	494.2	0.0	227,106.3
211	UNION	SAN PEDRO	59,312.0	1,022.3	4,809.2	5,450.0	620.6	0.0	2,545.7	0.0	30,841.0	6,679.7	6,326.9	106.6	36.0	874.0	0.0	59,312.0
212	25 DE DICIEMBRE	SAN PEDRO	91,061.7	446.5	3,147.0	5,327.5	182.9	2.9	3,260.7	0.0	37,105.4	33,861.9	3,484.0	14.4	0.0	4,228.6	0.0	91,061.7
213	VILLA DEL ROSARIO	SAN PEDRO	191,966.1	95.1	1,430.4	5,870.0	23.0	10.1	13,216.5	0.0	82,672.9	76,491.7	4,879.0	142.6	636.7	6,498.1	0.0	191,966.1
214	ISIDORO RESQUIN	SAN PEDRO	107,078.8	12,247.4	17,900.7	13,578.6	1,847.0	0.0	5,996.2	0.0	17,288.4	10,995.4	25,674.8	0.0	416.4	1,133.8	0.0	107,078.8
215	YATAITY DEL NORTE	SAN PEDRO	34,259.2	1,199.8	3,644.1	5,049.9	329.8	0.0	10,775.4	0.0	9,804.6	0.0	3,212.0	0.0	154.1	89.3	0.0	34,259.2
301	CAACUPE	CORDILLERA	13,710.2	11.5	408.7	1,754.3	23.0	0.0	2,325.6	0.0	8,954.0	0.0	27.3	205.8	0.0	0.0	0.0	13,710.2
302	ALTOS	CORDILLERA	12,665.5	0.0	121.0	927.9	0.0	0.0	1,773.7	0.0	9,452.3	181.6	23.1	181.6	1.4	2.9	0.0	12,665.5
303	ARROYOS Y ESTEROS	CORDILLERA	51,707.8	23.0	568.9	3,040.2	7.2	30.2	9,006.8	0.0	26,873.6	9,626.1	511.3	27.4	74.9	1,918.3	0.0	51,707.8
304	ATYRA	CORDILLERA	15,066.3	5.8	180.0	1,042.7	5.8	0.0	2,189.2	0.0	8,580.9	2,955.4	11.5	85.0	0.0	10.1	0.0	15,066.3
305	CARAGUATAY	CORDILLERA	55,454.6	159.8	1,288.9	2,906.1	86.4	0.0	4,634.2	0.0	23,865.0	20,650.8	1,170.8	47.5	0.0	645.2	0.0	55,454.6
306	EMBOSCADA	CORDILLERA	18,938.2	13.0	218.9	2,209.0	0.0	0.0	2,122.6	0.0	11,910.7	1,954.2	28.8	83.5	37.4	360.0	0.0	18,938.2
307	EUSEBIO AYALA	CORDILLERA	27,513.2	36.0	1,044.1	2,893.2	97.9	0.0	3,414.5	0.0	17,889.0	1,288.9	699.9	135.4	0.0	14.4	0.0	27,513.2
308	ISLA PUCU	CORDILLERA	10,625.3	14.4	370.3	926.4	66.3	0.0	2,826.7	0.0	5,659.1	54.7	662.7	41.8	0.0	2.9	0.0	10,625.3
309	ITACURUBI DE LA CORDILLERA	CORDILLERA	11,135.3	51.9	504.2	1,171.2	57.6	73.5	1,266.2	0.0	6,895.8	13.0	1,014.1	67.7	0.0	20.2	0.0	11,135.3
310	JUAN DE MENA	CORDILLERA	98,385.3	1,465.7	4,355.3	4,389.9	397.8	17.3	2,467.3	0.0	21,730.5	54,884.0	2,533.6	25.9	59.1	6,058.8	0.0	98,385.3
311	LOMA GRANDE	CORDILLERA	9,230.5	0.0	24.5	363.3	0.0	0.0	506.0	0.0	5,320.9	2,974.0	15.9	0.0	4.3	21.6	0.0	9,230.5
312	MBOCAYATY	CORDILLERA	28,233.1	63.4	955.1	2,012.5	54.7	0.0	2,933.1	0.0	12,240.9	8,558.7	422.1	21.6	0.0	971.0	0.0	28,233.1
313	NUEVA COLOMBIA	CORDILLERA	8,420.3	1.4	66.3	591.3	0.0	0.0	1,378.6	0.0	6,130.3	227.8	10.1	0.0	0.0	14.4	0.0	8,420.3
314	PIRIBEBUY	CORDILLERA	20,559.9	20.2	631.2	2,196.2	53.3	0.0	4,647.5	0.0	12,389.0	0.0	308.4	288.2	0.0	25.9	0.0	20,559.9
315	PRIMERO DE MARZO	CORDILLERA	7,693.1	0.0	67.8	456.1	1.4	0.0	2,092.9	0.0	2,196.8	2,553.3	17.3	21.7	116.9	168.9	0.0	7,693.1
316	SAN BERNARDINO	CORDILLERA	12,245.5	40.3	479.4	1,730.4	0.0	0.0	640.6	0.0	5,381.3	1,209.3	53.3	391.6	149.7	2,169.5	0.0	12,245.5
317	SANTA ELENA	CORDILLERA	11,279.8	15.8	234.8	606.3	4.3	0.0	1,641.9	0.0	7,634.6	772.0	302.4	30.2	0.0	37.4	0.0	11,279.8
318	TOBATI	CORDILLERA	26,295.7	10.1	361.6	1,564.7	18.7	33.1	2,995.4	0.0	16,364.4	4,624.9	4.3	306.9	0.0	11.5	0.0	26,295.7
319	VALENZUELA	CORDILLERA	18,868.5	93.7	795.4	1,531.7	43.2	0.0	2,858.7	0.0	11,733.2	737.7	1,017.3	33.1	0.0	24.5	0.0	18,868.5
320	SAN JOSE OBRERO	CORDILLERA	20,083.7	36.0	429.3	1,306.7	31.7	0.0	1,384.5	0.0	4,005.2	12,028.6	80.7	0.0	60.5	720.4	0.0	20,083.7
401	VILLARRICA	GUAIRA	32,401.6	489.8	2,251.7	3,387.0	44.7	0.0	3,134.8	0.0	21,608.3	280.9	7.2	1,148.2	0.0	49.0	0.0	32,401.6
402	BORJA	GUAIRA	44,009.6	1,668.5	3,357.1	5,911.7	40.3	28.8	5,214.3	99.4	19,677.2	6,233.0	527.3	38.9	0.0	1,213.2	0.0	44,009.6
403	MARICIO J. TROCHE	GUAIRA	17,303.5	1,233.9	2,122.7	2,237.7	191.3	0.0	3,129.4	0.0	7,914.0	102.1	230.1	67.6	0.0	74.8	0.0	17,303.5
404	CORONEL MARTINEZ	GUAIRA	18,879.3	51.9	753.5	1,414.8	34.6	152.7	2,403.1	0.0	9,550.6	3,503.8	103.7	82.1	0.0	828.4	0.0	18,879.3
405	FELIX PEREZ CARDOZO	GUAIRA	11,116.8	10.1	293.8	760.4	15.8	0.0	1,270.2	0.0	7,260.0	1,420.0	0.0	2.9	0.0	83.5	0.0	11,116.8
406	GRAL. EUGENIO GARAY	GUAIRA	28,012.4	2,611.2	4,056.5	6,102.0	433.3	0.0	1,793.6	0.0	12,486.1	397.3	67.7	7.2	0.0	57.6	0.0	28,012.4

Original Information				Analysis Results (ha)														
Code No.	City	District	Area (ha)	High Forest (Dense-Medium)	High Forest (Sparse)	Low Forest	Bamboo Forest	Artificial Forest	Dry Farmland	Paddy Field	Non-Flooded or Seasonally Flooded Natural Grassland	Permanently Flooded Natural Grassland	Artificial Grassland	Urban Area/ Settlement	Shrub Land	Water Body	Others (Cloud/ Cloud Shadow)	Total
407	COL. INDEPENDENCIA	GUAIRA	113,715.0	10,676.9	14,521.1	17,414.4	909.2	0.0	23,849.3	0.0	42,695.9	566.3	2,783.8	4.3	0.0	293.9	0.0	113,715.0
408	ITAPE	GUAIRA	16,188.1	157.1	863.1	1,481.2	23.1	0.0	2,412.0	0.0	9,596.1	1,455.3	33.1	49.0	0.0	118.2	0.0	16,188.1
409	ITURBE	GUAIRA	25,258.0	165.6	1,189.5	2,429.5	44.6	0.0	1,846.2	0.0	13,384.3	4,827.2	59.0	89.3	0.0	1,222.6	0.0	25,258.0
410	JOSE FASSARDI	GUAIRA	10,858.0	855.3	1,374.6	2,152.0	79.3	57.7	1,404.8	0.0	4,149.6	0.0	752.9	27.4	0.0	4.3	0.0	10,858.0
411	MBOCAYATY	GUAIRA	20,317.9	272.4	1,238.1	2,003.4	60.5	0.0	2,053.8	2.9	13,552.5	703.4	285.4	53.3	0.0	92.2	0.0	20,317.9
412	NATALICIO TALAVERA	GUAIRA	6,188.6	25.9	308.2	747.5	14.4	0.0	1,309.1	7.2	3,185.7	1.4	557.4	27.4	0.0	4.3	0.0	6,188.6
413	NUMI	GUAIRA	9,494.8	338.4	949.0	1,613.0	0.0	0.0	547.3	0.0	6,011.1	0.0	0.0	36.0	0.0	0.0	0.0	9,494.8
414	SAN SALVADOR	GUAIRA	14,616.3	138.4	837.4	1,383.7	64.9	0.0	812.9	0.0	11,209.1	95.1	0.0	43.2	0.0	31.7	0.0	14,616.3
415	YATAITY	GUAIRA	8,766.5	43.2	303.6	628.8	30.2	0.0	605.7	0.0	4,906.3	1,959.6	0.0	50.4	0.0	238.8	0.0	8,766.5
416	DR. BOTTRELL	GUAIRA	7,037.4	69.2	402.4	618.8	26.0	0.0	429.8	0.0	3,689.6	1,505.9	43.3	4.3	0.0	248.1	0.0	7,037.4
501	CORONEL OVIEDO	CAAGUAZU	87,930.9	1,221.7	5,715.2	7,961.2	989.8	63.4	10,956.4	0.0	46,127.9	10,309.6	922.0	1,194.3	0.0	2,469.3	0.0	87,930.9
502	CAAGUAZU	CAAGUAZU	98,020.8	4,358.8	9,626.5	10,292.0	1,899.9	0.0	17,958.0	0.0	42,859.0	322.7	4,645.4	1,526.9	828.3	155.6	3,547.8	98,020.8
503	CARAYAO	CAAGUAZU	93,543.9	6,760.2	17,118.8	10,571.7	5,999.6	0.0	4,850.1	0.0	30,258.9	6,292.1	11,319.4	49.0	0.0	324.1	0.0	93,543.9
504	DR. CECILIIO BAEZ	CAAGUAZU	14,918.3	715.8	2,712.0	2,930.9	298.1	0.0	1,451.8	0.0	5,520.5	0.0	1,250.1	37.4	0.0	1.4	0.0	14,918.3
505	SANTA ROSA DEL MBUTUY	CAAGUAZU	30,606.6	1,377.8	3,199.6	4,202.7	484.3	30.3	6,742.2	0.0	10,145.0	0.0	4,253.2	34.6	95.1	41.8	0.0	30,606.6
506	JUAN MANUEL FRUTOS	CAAGUAZU	55,932.7	1,177.4	2,330.2	3,156.0	172.9	0.0	13,562.0	0.0	26,634.1	1,034.7	4,026.4	47.6	1,088.0	219.0	2,484.4	55,932.7
507	REPATRIACION	CAAGUAZU	86,071.0	5,634.1	7,715.7	7,571.6	1,035.8	0.0	20,943.0	0.0	36,169.7	1,992.3	4,177.6	24.5	0.0	786.5	20.2	86,071.0
508	NUEVA LONDRES	CAAGUAZU	21,999.4	34.6	753.9	1,850.8	67.7	0.0	1,385.2	0.0	16,663.2	1,092.6	64.9	15.9	0.0	70.6	0.0	21,999.4
509	SAN JOAUIN	CAAGUAZU	40,482.6	3,405.7	3,935.6	4,101.3	960.5	0.0	3,788.8	0.0	17,636.2	0.0	6,553.6	83.5	1.4	15.8	0.0	40,482.6
510	SAN JOSE DE LOS ARROYOS	CAAGUAZU	49,516.8	194.5	1,841.6	3,072.3	96.5	14.4	5,987.5	0.0	29,731.4	7,046.7	171.5	193.1	0.0	1,167.2	0.0	49,516.8
511	YHU	CAAGUAZU	256,123.9	31,861.7	33,810.8	24,612.6	5,220.7	429.3	23,670.5	0.0	92,463.3	5,406.6	36,815.9	90.8	414.9	1,326.8	0.0	256,123.9
512	J.E. ESTIGARRIBIA	CAAGUAZU	63,745.9	1,372.6	4,662.1	3,937.7	301.0	0.0	22,581.8	0.0	24,193.5	568.9	1,382.6	33.1	0.0	4,712.5	0.0	63,745.9
513	R.I.3 CORRALES	CAAGUAZU	28,545.0	1,381.4	4,350.1	4,551.8	652.5	0.0	3,704.8	0.0	12,704.6	0.0	1,186.9	5.8	0.0	7.2	0.0	28,545.0
514	RAUL OVIEDO	CAAGUAZU	142,124.2	11,822.7	14,138.5	11,177.5	3,007.2	0.0	24,824.9	0.0	39,264.4	2,458.4	15,960.4	10.1	2,023.5	17,436.6	0.0	142,124.2
515	JOSE D. OCAMPOS	CAAGUAZU	14,413.8	286.9	1,026.7	1,179.5	44.7	0.0	4,023.1	0.0	6,576.8	301.4	17.3	0.0	0.0	951.7	5.8	14,413.8
516	MARISCAL LOPEZ	CAAGUAZU	117,470.1	16,369.5	12,435.6	7,633.0	2,978.9	1.4	18,857.2	0.0	25,058.4	8,092.5	15,630.5	40.3	206.0	10,166.8	0.0	117,470.1
517	LA PASTORA	CAAGUAZU	18,833.8	116.7	795.3	1,871.6	80.7	0.0	2,511.3	0.0	9,729.6	2,668.3	932.2	11.5	0.0	116.7	0.0	18,833.8
518	3 DE FEBRERO	CAAGUAZU	17,594.2	546.4	1,467.5	2,022.5	138.4	0.0	2,747.6	0.0	9,505.6	11.5	1,131.6	17.3	0.0	5.8	0.0	17,594.2
519	SIMON BOLIVAR	CAAGUAZU	35,542.4	1,056.0	3,584.3	4,640.3	329.9	118.1	1,939.1	0.0	15,564.8	1,192.9	7,030.4	0.0	4.3	82.1	0.0	35,542.4
601	CAAZAPA	CAAZAPA	85,331.4	1,664.3	5,598.2	7,125.6	2,298.3	0.0	5,727.9	0.0	50,288.4	11,527.8	11.5	217.6	0.0	871.8	0.0	85,331.4
602	ABAI	CAAZAPA	202,953.6	29,578.7	23,750.0	22,963.4	2,645.0	0.0	42,570.1	0.0	56,018.2	2,492.3	21,724.4	272.3	0.0	939.3	0.0	202,953.6
603	BUENA VISTA	CAAZAPA	13,297.0	425.1	1,472.8	1,246.6	814.2	0.0	1,422.4	0.0	7,819.4	31.7	1.4	47.6	0.0	15.9	0.0	13,297.0
604	DR. MOISES BERTONI	CAAZAPA	69,111.5	311.3	1,315.8	2,601.3	98.0	273.8	1,174.5	0.0	37,805.5	20,715.0	157.1	31.7	0.0	4,627.5	0.0	69,111.5
605	GRAL. HIGINIO MORINIGO	CAAZAPA	29,806.4	2,067.0	2,618.7	4,319.8	108.0	0.0	1,414.5	0.0	16,749.1	1,362.6	741.8	63.4	0.0	361.5	0.0	29,806.4
606	MACIEL	CAAZAPA	40,472.5	128.1	954.6	2,148.2	100.8	0.0	1,568.0	0.0	26,066.9	7,680.1	56.2	38.9	0.0	1,730.7	0.0	40,472.5
607	SAN JUAN NEPOMUCENO	CAAZAPA	100,557.2	10,488.9	14,433.2	12,786.6	2,516.7	1,260.5	4,555.1	0.0	50,787.8	1,540.0	1,601.9	151.3	0.0	435.1	0.0	100,557.2
608	TAVAI	CAAZAPA	136,177.9	34,140.3	23,035.3	13,524.7	2,078.4	0.0	23,899.5	0.0	36,066.0	0.0	3,253.7	14.4	0.0	165.6	0.0	136,177.9
609	FULGENCIO YEGROS	CAAZAPA	95,164.6	1,680.8	2,709.2	4,692.6	167.1	0.0	1,976.1	0.0	48,151.2	27,413.5	290.9	37.4	0.0	8,045.6	0.0	95,164.6
610	YUTY	CAAZAPA	183,509.5	9,519.8	13,881.4	15,513.4	1,482.2	0.0	6,745.5	2,516.4	92,857.4	35,158.0	986.7	115.2	0.0	4,733.3	0.0	183,509.5
701	ENCARNACION	ITAPUA	24,262.6	653.4	1,612.5	2,048.1	10.1	0.0	7,501.5	0.0	11,730.3	0.0	0.0	705.3	0.0	1.4	0.0	24,262.6
702	BELLA VISTA	ITAPUA	27,670.0	2,841.4	2,825.5	1,728.5	37.5	13.0	9,652.9	0.0	10,006.1	141.3	0.0	99.5	0.0	324.4	0.0	27,670.0
703	CAMBYRETA	ITAPUA	21,499.9	492.3	2,540.7	2,746.5	0.0	0.0	3,901.0	0.0	10,901.1	27.3	0.0	709.7	0.0	181.4	0.0	21,499.9
704	CAPITAN MEZA	ITAPUA	76,848.9	6,500.6	6,834.9	5,081.5	193.1	31.7	31,412.4	0.0	26,365.5	41.8	0.0	18.7	0.0	368.8	0.0	76,848.9
705	CAPITAN MIRANDA	ITAPUA	17,956.2	522.8	1,181.0	1,084.5	4.3	44.6	7,317.6	0.0	7,591.2	0.0	0.0	208.8	0.0	1.4	0.0	17,956.2
706	NUEVA ALBORADA	ITAPUA	19,730.9	1,027.8	2,268.9	1,765.8	4.3	0.0	6,620.7	0.0	7,514.4	108.1	0.0	14.4	0.0	406.5	0.0	19,730.9
707	CARMEN DEL PARANA	ITAPUA	21,721.3	687.3	1,537.1	1,537.1	7.2	7.2	5,892.6	84.8	11,729.2	11.5	30.2	93.5	0.0	103.5	0.0	21,721.3
708	CORONEL BOGADO	ITAPUA	47,909.0	1,038.4	2,582.2	3,865.4	210.3	0.0	2,965.3	567.4	32,694.9	2,386.4	51.8	318.3	0.0	1,228.5	0.0	47,909.0
709	CARLOS A. LOPEZ	ITAPUA	79,360.3	10,874.1	10,233.3	7,841.3	617.8	0.0	26,787.0	0.0	22,678.5	64.8	0.0	87.8	0.0	175.7	0.0	79,360.3
710	NATALIO	ITAPUA	32,064.4	1,722.0	2,760.1	2,416.0	69.1	0.0	11,527.1	0.0	13,200.1	142.5	0.0	92.1	0.0	135.3	0.0	32,064.4
711	FRAM	ITAPUA	32,160.3	523.2	1,515.0	1,650.5	8.6	0.0	14,064.3	0.0	14,287.7	0.0	37.5	67.7	0.0	5.8	0.0	32,160.3
712	GENERAL ARTIGAS	ITAPUA	142,561.0	1,017.1	3,701.2	6,209.5	203.1	0.0	4,508.0	3,583.0	62,995.0	52,868.2	528.7	149.8	0.0	6,797.3	0.0	142,561.0

Original Information				Analysis Results (ha)														
Code No.	City	District	Area (ha)	High Forest (Dense-Medium)	High Forest (Sparse)	Low Forest	Bamboo Forest	Artificial Forest	Dry Farmland	Paddy Field	Non-Flooded or Seasonally Flooded Natural Grassland	Permanently Flooded Natural Grassland	Artificial Grassland	Urban Area/ Settlement	Shrub Land	Water Body	Others (Cloud/ Cloud Shadow)	Total
713	GENERAL DELGADO	ITAPUA	44,826.0	233.5	818.6	1,847.7	77.8	180.2	2,373.8	1,066.5	28,126.2	7,608.4	46.1	25.9	0.0	2,421.3	0.0	44,826.0
714	HOHENAU	ITAPUA	26,050.3	796.7	2,028.6	2,044.4	18.7	20.2	9,556.5	0.0	10,778.3	15.8	344.3	269.4	63.4	113.8	0.0	26,050.3
715	JESUS	ITAPUA	12,808.7	198.8	834.1	747.7	10.1	0.0	4,801.6	0.0	5,115.7	0.0	991.2	105.2	0.0	4.3	0.0	12,808.7
716	LEANDRO OVIEDO	ITAPUA	12,705.3	142.6	821.2	1,499.7	73.5	0.0	935.0	1.4	8,440.9	710.3	5.8	23.1	0.0	51.9	0.0	12,705.3
717	OBLIGADO	ITAPUA	37,848.0	2,954.3	3,400.8	2,748.3	37.5	34.6	14,676.3	0.0	13,594.5	37.5	0.0	200.2	0.0	164.2	0.0	37,848.0
718	MAYOR OTAÑO	ITAPUA	26,599.7	3,085.2	4,875.0	3,256.7	87.9	0.0	6,968.8	0.0	6,879.4	122.5	1,072.1	155.6	0.0	96.5	0.0	26,599.7
719	SAN COSME Y DAMIAN	ITAPUA	72,457.5	1,087.5	2,800.2	5,123.7	275.1	0.0	2,447.3	652.5	36,329.6	19,119.1	1,390.0	34.6	0.0	3,197.8	0.0	72,457.5
720	SAN PEDRO DEL PARANA	ITAPUA	138,737.1	8,135.3	12,663.9	16,244.7	615.0	0.0	9,055.7	67.7	80,464.6	9,266.0	218.9	67.7	0.0	1,937.3	0.0	138,737.1
721	SAN RAFAEL DEL PARANA	ITAPUA	141,849.6	16,937.3	15,771.5	11,056.2	732.1	0.0	52,235.8	0.0	44,468.2	318.5	0.0	8.6	0.0	321.4	0.0	141,849.6
722	TRINIDAD	ITAPUA	21,073.9	1,633.0	3,280.4	2,394.1	44.6	5.8	3,824.3	0.0	9,239.9	0.0	0.0	122.3	359.7	169.8	0.0	21,073.9
723	EDELIRA	ITAPUA	68,583.4	6,404.5	5,041.5	4,290.8	272.3	0.0	26,481.0	0.0	25,887.4	0.0	0.0	113.8	0.0	92.2	0.0	68,583.4
724	TOMAS ROMERO P.	ITAPUA	63,161.2	4,815.7	5,322.6	4,209.4	230.4	0.0	23,626.2	0.0	24,743.7	0.0	0.0	105.1	0.0	108.0	0.0	63,161.2
725	ALTO VERA	ITAPUA	121,382.2	33,680.4	17,854.4	15,696.3	129.7	0.0	19,975.1	0.0	32,530.7	436.5	922.0	15.8	0.0	141.2	0.0	121,382.2
726	LA PAZ	ITAPUA	22,790.7	694.9	1,600.2	1,376.8	5.8	0.0	11,362.9	0.0	7,724.2	0.0	0.0	25.9	0.0	0.0	0.0	22,790.7
727	YATYTAY	ITAPUA	28,067.7	1,124.7	1,816.0	1,784.3	90.7	0.0	11,348.1	0.0	11,480.6	195.9	0.0	70.6	0.0	157.0	0.0	28,067.7
728	SAN JUAN DEL PARANA	ITAPUA	6,416.4	187.2	524.1	619.2	0.0	0.0	1,198.0	0.0	3,857.6	7.2	0.0	0.0	0.0	23.0	0.0	6,416.4
729	PIRAPO	ITAPUA	67,560.6	6,814.1	7,943.3	4,737.2	207.4	172.8	31,027.1	0.0	16,433.9	51.9	0.0	76.3	0.0	96.5	0.0	67,560.6
801	SAN JUAN BAUTISTA	MISIONES	216,104.8	66.3	1,047.2	2,797.4	70.6	0.0	1,841.0	677.0	100,087.2	104,219.9	779.3	181.5	0.0	4,337.3	0.0	216,104.8
802	AYOLAS	MISIONES	71,884.9	1,268.9	3,181.7	3,769.3	335.6	0.0	0.0	0.0	22,348.0	26,990.2	0.0	122.4	0.0	13,868.8	0.0	71,884.9
803	SAN IGNACIO	MISIONES	153,311.6	760.7	2,675.4	3,912.9	181.5	74.9	2,332.5	106.6	73,596.5	55,471.1	778.0	201.7	0.0	13,219.8	0.0	153,311.6
804	SAN MIGUEL	MISIONES	57,151.6	70.6	494.2	1,219.0	37.5	0.0	1,080.7	366.0	41,150.5	10,739.0	40.3	53.3	0.0	1,900.5	0.0	57,151.6
805	SAN PATRICIO	MISIONES	6,422.9	25.9	111.0	227.7	7.2	0.0	276.7	0.0	5,020.8	191.7	469.8	60.5	0.0	31.7	0.0	6,422.9
806	SANTA MARIA	MISIONES	37,052.2	86.5	737.7	1,328.5	64.8	0.0	2,731.9	3,704.5	23,134.8	4,949.4	2.9	100.9	0.0	210.4	0.0	37,052.2
807	SANTA ROSA	MISIONES	83,687.9	849.7	2,554.8	4,641.5	198.7	46.1	5,136.9	1,841.9	45,131.7	21,836.4	155.5	159.9	0.0	1,134.8	0.0	83,687.9
808	SANTIAGO	MISIONES	85,895.1	422.1	1,261.9	2,868.1	158.5	0.0	231.9	0.0	51,562.7	21,876.1	38.9	54.7	0.0	7,420.2	0.0	85,895.1
809	VILLA FLORIDA	MISIONES	27,422.2	0.0	0.0	132.6	0.0	28.8	524.5	0.0	14,830.0	10,543.2	15.9	80.7	0.0	1,266.6	0.0	27,422.2
810	YABEBYRY	MISIONES	64,022.1	296.8	1,341.4	1,275.1	38.9	0.0	0.0	468.3	10,381.2	30,823.8	0.0	37.5	0.0	19,359.1	0.0	64,022.1
901	PARAGUARI	PARAGUARI	45,965.9	89.4	1,263.9	3,503.5	108.1	0.0	1,562.2	8.6	35,572.3	154.2	3,430.0	141.2	0.0	132.6	0.0	45,965.9
902	ACAHAY	PARAGUARI	32,658.5	177.1	1,565.3	2,933.3	40.3	0.0	4,521.7	0.0	23,089.5	0.0	201.6	95.0	0.0	34.6	0.0	32,658.5
903	CAAPUCU	PARAGUARI	246,888.7	252.1	3,463.0	7,796.0	171.4	0.0	776.4	0.0	107,912.8	116,102.1	110.9	59.1	0.0	10,244.9	0.0	246,888.7
904	CABALLERO	PARAGUARI	23,759.2	276.9	2,033.2	3,245.9	197.5	0.0	1,566.0	0.0	15,165.1	1,137.7	51.9	38.9	0.0	46.1	0.0	23,759.2
905	CARAPEGUA	PARAGUARI	48,012.0	17.3	473.9	1,971.8	20.2	0.0	7,138.3	7.2	30,045.3	8,037.1	74.9	126.7	17.3	82.1	0.0	48,012.0
906	ESCOBAR	PARAGUARI	28,717.0	210.1	1,981.7	3,515.9	166.9	0.0	2,347.3	0.0	19,431.5	0.0	1,004.5	43.2	0.0	15.8	0.0	28,717.0
907	LA COLMENA	PARAGUARI	10,657.3	872.9	1,415.9	1,953.1	0.0	0.0	1,584.4	0.0	4,612.0	0.0	146.9	72.0	0.0	0.0	0.0	10,657.3
908	MBUYAPEY	PARAGUARI	92,514.0	2,214.1	6,184.1	7,809.0	144.1	0.0	2,264.5	301.1	44,789.8	23,091.4	3,081.3	155.6	0.0	2,479.1	0.0	92,514.0
909	PIRAYU	PARAGUARI	17,590.2	69.2	553.2	1,795.0	27.4	0.0	1,204.4	0.0	12,450.0	680.0	638.2	135.4	7.2	30.3	0.0	17,590.2
910	QUIINDY	PARAGUARI	62,521.1	79.3	1,320.1	4,371.2	36.0	0.0	3,520.9	0.0	45,321.7	7,572.1	41.8	116.7	0.0	141.2	0.0	62,521.1
911	QUYQUYHO	PARAGUARI	59,350.7	93.7	801.1	1,698.8	44.7	0.0	1,711.8	0.0	37,228.5	13,811.0	3,337.1	23.1	0.0	600.9	0.0	59,350.7
912	SAN ROQUE GONZALEZ	PARAGUARI	21,401.0	24.5	495.6	1,214.4	5.8	0.0	3,487.6	0.0	12,125.2	3,634.5	8.6	116.7	0.0	288.1	0.0	21,401.0
913	SAPUCAI	PARAGUARI	19,389.6	226.2	1,619.3	2,634.9	211.8	0.0	809.6	0.0	11,968.9	0.0	1,849.8	33.1	0.0	36.0	0.0	19,389.6
914	TEBICUARYMI	PARAGUARI	14,825.8	1,092.2	1,765.1	2,549.0	0.0	185.9	1,102.3	0.0	7,023.1	791.1	167.1	10.1	0.0	139.8	0.0	14,825.8
915	YAGUARON	PARAGUARI	23,594.5	11.5	175.6	950.0	0.0	73.4	2,851.4	7.2	17,187.8	382.9	1,717.2	145.4	0.0	92.1	0.0	23,594.5
916	YBYCUI	PARAGUARI	81,246.8	2,487.6	7,242.4	9,022.8	13.0	0.0	6,764.2	0.0	46,725.7	5,002.6	3,762.4	122.4	0.0	103.7	0.0	81,246.8
917	YBYTYMI	PARAGUARI	40,756.8	662.4	2,661.2	3,824.8	53.3	155.5	2,705.9	0.0	26,543.3	3,404.3	443.5	25.9	0.0	276.5	0.0	40,756.8
1001	CIUDAD DEL ESTE	ALTO PARANA	8,646.0	4.3	99.5	163.0	2.9	0.0	419.7	0.0	1,064.3	144.2	119.7	6,238.9	0.0	389.4	0.0	8,646.0
1002	PRESIDENTE FRANCO	ALTO PARANA	11,665.6	590.5	1,277.5	816.6	5.8	0.0	3,676.8	0.0	3,167.0	115.2	28.8	1,806.0	0.0	181.5	0.0	11,665.6
1003	DOMINGO M. IRALA	ALTO PARANA	41,047.0	3,383.5	5,124.9	3,619.7	15.8	0.0	17,751.5	0.0	10,957.1	28.8	23.0	27.4	0.0	115.2	0.0	41,047.0
1004	MALLORQUIN	ALTO PARANA	25,988.1	516.7	2,199.4	2,190.7	23.0	0.0	5,272.5	0.0	13,097.0	1,780.5	164.1	313.8	0.0	430.4	0.0	25,988.1
1005	HERNANDARIAS	ALTO PARANA	116,698.6	8,165.1	8,349.5	5,619.6	1,293.6	2,904.2	40,152.8	0.0	21,630.1	1,637.9	23,203.2	1,807.9	0.0	1,934.7	0.0	116,698.6
1006	ITAKYRY	ALTO PARANA	199,054.5	32,039.4	32,161.9	16,431.1	7,202.6	0.0	37,128.4	0.0	36,070.8	11,654.8	23,895.9	113.8	1,658.4	697.4	0.0	199,054.5
1007	JAN E.OLEARY	ALTO PARANA	23,015.3	819.3	2,408.9	2,193.0	11.5	0.0	4,720.0	0.0	9,866.2	704.1	106.6	40.3	0.0	2,145.4	0.0	23,015.3

Original Information				Analysis Results (ha)														
Code No.	City	District	Area (ha)	High Forest (Dense-Medium)	High Forest (Sparse)	Low Forest	Bamboo Forest	Artificial Forest	Dry Farmland	Paddy Field	Non-Flooded or Seasonally Flooded Natural Grassland	Permanently Flooded Natural Grassland	Artificial Grassland	Urban Area/ Settlement	Shrub Land	Water Body	Others (Cloud/ Cloud Shadow)	Total
1008	NACUNDAY	ALTO PARANA	128,473.6	14,184.9	19,947.6	12,368.2	103.7	0.0	50,479.8	0.0	30,069.8	472.5	295.3	110.9	0.0	440.8	0.0	128,473.6
1009	YGUAZU	ALTO PARANA	83,366.0	4,288.9	6,744.7	5,842.5	660.1	49.0	21,698.3	0.0	19,778.6	1,960.0	4,577.2	422.3	0.0	17,344.5	0.0	83,366.0
1010	LOS CEDRALES	ALTO PARANA	41,116.2	1,005.7	3,337.0	3,056.1	4.3	0.0	19,213.8	0.0	13,912.9	0.0	92.2	102.3	204.6	187.3	0.0	41,116.2
1011	MINGA GUAZU	ALTO PARANA	54,721.3	802.2	4,588.3	4,778.4	223.2	0.0	12,032.4	0.0	23,259.8	891.5	4,526.4	1,394.1	159.9	882.8	1,182.4	54,721.3
1012	SAN CRISTOBAL	ALTO PARANA	103,288.5	12,327.4	16,168.0	9,582.1	229.1	0.0	29,135.3	0.0	26,985.1	2,595.5	5,901.4	0.0	0.0	364.6	0.0	103,288.5
1013	SANTA RITA	ALTO PARANA	63,682.8	2,611.4	5,306.4	7,111.2	7.2	0.0	29,421.5	0.0	17,894.1	0.0	1,014.0	283.8	0.0	33.1	0.0	63,682.8
1014	NARANJAL	ALTO PARANA	80,718.5	2,795.2	6,914.6	7,218.6	54.8	208.9	37,960.3	0.0	25,260.7	0.0	152.7	86.5	0.0	66.3	0.0	80,718.5
1015	SANTA ROSA	ALTO PARANA	96,792.5	3,994.0	11,335.3	9,591.1	40.3	0.0	36,339.3	0.0	30,713.4	2,029.4	1,945.9	167.1	139.7	496.9	0.0	96,792.5
1016	MINGA PORA	ALTO PARANA	87,096.1	6,077.8	8,616.1	5,001.7	234.8	0.0	49,845.6	0.0	12,126.8	472.5	4,030.7	66.3	387.5	236.3	0.0	87,096.1
1017	MBARACAYU	ALTO PARANA	103,005.5	10,651.1	8,952.3	4,681.5	332.8	20.2	54,571.1	0.0	17,942.1	177.2	4,576.3	95.1	0.0	1,005.7	0.0	103,005.5
1018	SAN ALBERTO	ALTO PARANA	96,042.2	12,266.8	10,439.5	4,805.1	295.2	0.0	45,241.3	0.0	14,458.4	403.2	5,068.6	171.4	0.0	2,892.8	0.0	96,042.2
1101	AREGUA	CENTRAL	10,813.5	5.8	111.0	939.8	0.0	0.0	446.8	0.0	4,449.6	1,664.8	648.6	118.2	0.0	2,428.8	0.0	10,813.5
1102	CAPIATA	CENTRAL	7,840.2	0.0	20.1	146.6	0.0	0.0	140.8	0.0	3,316.5	41.7	1,010.2	3,154.2	0.0	10.1	0.0	7,840.2
1103	FERNANDO DE LA MORA	CENTRAL	2,086.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2,086.4	0.0	0.0	0.0	2,086.4
1104	GUARAMBARE	CENTRAL	3,010.3	0.0	2.9	57.8	0.0	0.0	290.3	0.0	2,263.5	15.9	257.1	82.3	18.8	21.7	0.0	3,010.3
1105	ITA	CENTRAL	18,544.2	7.2	86.4	608.8	0.0	0.0	2,109.9	0.0	13,272.4	312.3	1,699.7	371.3	40.3	36.0	0.0	18,544.2
1106	ITAUGUA	CENTRAL	11,368.6	4.3	85.1	604.1	0.0	0.0	413.8	0.0	7,503.1	184.6	1,433.1	223.5	0.0	917.0	0.0	11,368.6
1107	LAMBARE	CENTRAL	2,350.3	0.0	0.0	10.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2,340.2	0.0	0.0	0.0	2,350.3
1108	LIMPIO	CENTRAL	9,285.0	2.9	47.6	434.0	0.0	0.0	536.4	0.0	5,988.6	517.7	1,403.1	212.0	1.4	141.3	0.0	9,285.0
1109	LUQUE	CENTRAL	15,053.1	0.0	46.1	707.8	0.0	0.0	572.3	0.0	8,065.7	1,221.0	1,519.4	2,870.2	0.0	50.5	0.0	15,053.1
1110	MARIANO R. ALONSO	CENTRAL	3,712.6	0.0	0.0	106.4	0.0	0.0	153.9	0.0	1,141.7	17.3	209.9	2,067.7	0.0	15.8	0.0	3,712.6
1111	NUEVA ITALIA	CENTRAL	36,757.4	4.3	125.3	570.4	0.0	0.0	3,125.7	0.0	5,526.8	25,507.9	836.9	180.0	51.9	828.2	0.0	36,757.4
1112	NEMBY	CENTRAL	2,951.1	0.0	2.9	15.9	0.0	0.0	17.3	0.0	245.1	2.9	56.2	2,610.9	0.0	0.0	0.0	2,951.1
1113	SAN ANTONIO	CENTRAL	1,810.7	0.0	0.0	10.1	0.0	0.0	1.4	0.0	98.2	4.3	14.4	1,676.4	0.0	5.8	0.0	1,810.7
1114	SAN LORENZO	CENTRAL	5,639.3	0.0	0.0	8.7	0.0	0.0	17.3	0.0	178.8	1.4	23.1	5,410.0	0.0	0.0	0.0	5,639.3
1115	VILLA ELISA	CENTRAL	1,915.8	0.0	0.0	7.2	0.0	0.0	0.0	0.0	4.3	2.9	0.0	1,901.4	0.0	0.0	0.0	1,915.8
1116	VILLETA	CENTRAL	84,265.9	4.3	171.5	6,978.1	0.0	0.0	2,400.0	0.0	18,888.8	52,082.6	1,519.3	178.7	345.9	1,696.6	0.0	84,265.9
1117	YPACARAI	CENTRAL	10,600.8	5.8	125.4	775.6	2.9	77.9	801.6	0.0	7,101.8	706.4	281.1	171.6	0.0	550.7	0.0	10,600.8
1118	YPANE	CENTRAL	4,771.9	0.0	11.5	207.5	0.0	0.0	183.0	0.0	3,686.7	14.4	609.6	13.0	5.8	40.4	0.0	4,771.9
1119	J. A. SALDIVAR	CENTRAL	3,519.9	0.0	4.3	76.3	0.0	0.0	221.8	0.0	2,628.4	8.6	488.2	51.8	36.0	4.3	0.0	3,519.9
1120	ASUNCION	CENTRAL	11,289.8	0.0	0.0	1.4	0.0	0.0	28.8	0.0	744.0	95.0	47.5	9,909.7	0.0	463.4	0.0	11,289.8
1201	PILAR	NEEMBUCU	32,842.6	14.4	122.3	739.5	0.0	381.3	0.0	0.0	9,099.8	20,793.5	0.0	728.0	0.0	963.9	0.0	32,842.6
1202	ALBERDI	NEEMBUCU	9,911.1	0.0	5.8	933.8	0.0	0.0	7.2	0.0	3,908.0	4,800.1	0.0	0.0	1.4	254.7	0.0	9,911.1
1203	CERRITO	NEEMBUCU	50,759.3	275.1	1,399.7	2,834.0	70.6	0.0	0.0	0.0	13,640.3	24,589.1	0.0	334.1	0.0	7,616.5	0.0	50,759.3
1204	DESMOCHADOS	NEEMBUCU	28,590.8	28.8	184.3	760.4	0.0	0.0	0.0	0.0	7,006.2	19,958.7	0.0	73.4	0.0	578.9	0.0	28,590.8
1205	GRAL. JOSE E. DIAZ	NEEMBUCU	27,138.2	5.8	60.5	471.2	0.0	0.0	0.0	0.0	7,733.0	17,301.6	0.0	27.4	0.0	1,538.8	0.0	27,138.2
1206	GUAZU CUA	NEEMBUCU	119,733.2	54.8	501.4	1,716.1	2.9	0.0	0.0	0.0	18,533.9	88,332.3	0.0	15.8	0.0	10,576.0	0.0	119,733.2
1207	HUMAITA	NEEMBUCU	33,889.4	8.7	285.5	1,757.5	0.0	0.0	0.0	0.0	8,505.2	20,485.0	0.0	0.0	0.0	2,847.5	0.0	33,889.4
1208	ISLA UMBU	NEEMBUCU	45,791.6	11.5	167.2	1,412.7	0.0	0.0	0.0	0.0	14,032.3	25,399.1	0.0	18.7	0.0	4,750.0	0.0	45,791.6
1209	LAURELES	NEEMBUCU	91,214.0	119.6	1,054.9	1,825.8	14.4	0.0	0.0	0.0	23,839.6	52,352.7	0.0	15.9	0.0	11,991.2	0.0	91,214.0
1210	MAYOR J. J. MARTINEZ	NEEMBUCU	26,961.4	7.3	103.1	493.7	0.0	0.0	0.0	0.0	7,767.4	16,339.2	0.0	23.2	0.0	2,227.5	0.0	26,961.4
1211	PASO DE PATRIA	NEEMBUCU	15,493.4	2.9	75.5	500.7	0.0	0.0	0.0	0.0	3,230.8	8,294.6	0.0	50.8	0.0	3,338.2	0.0	15,493.4
1212	SAN JUAN B. DE NEEM.	NEEMBUCU	141,483.0	51.9	608.0	2,338.4	0.0	103.7	0.0	0.0	59,061.0	75,680.5	0.0	8.6	0.0	3,630.8	0.0	141,483.0
1213	TACUARAS	NEEMBUCU	133,947.3	44.6	564.5	2,507.3	5.8	2.9	0.0	0.0	36,589.6	90,898.7	262.1	15.8	0.0	3,056.0	0.0	133,947.3
1214	VILLA FRANCA	NEEMBUCU	151,987.1	2.9	43.2	6,207.3	0.0	0.0	13.0	0.0	37,710.8	102,275.2	0.0	20.2	0.0	5,714.5	0.0	151,987.1
1215	VILLA OLIVA	NEEMBUCU	157,989.0	5.8	109.5	8,833.9	0.0	0.0	56.2	0.0	17,601.5	126,040.7	0.0	76.3	0.0	5,265.2	0.0	157,989.0
1216	VILLALBIN	NEEMBUCU	39,656.7	5.8	125.4	389.1	0.0	0.0	0.0	0.0	9,074.4	27,592.1	0.0	59.1	0.0	2,410.9	0.0	39,656.7
1301	PEDRO J. CABALLERO	AMAMBAY	526,869.8	9,801.5	57,102.0	78,981.4	1,457.8	30.6	21,444.6	0.0	160,227.6	0.0	190,653.6	1,338.1	5,467.7	364.8	0.0	526,869.8
1302	BELLA VISTA	AMAMBAY	367,834.8	1,012.7	22,920.5	71,422.1	1,118.3	0.0	1,406.2	0.0	228,350.0	2,565.0	36,590.6	76.7	1,331.0	1,041.6	0.0	367,834.8
1303	CAPITAN BADO	AMAMBAY	362,101.1	18,671.3	52,858.9	50,107.6	4,779.4	0.0	21,790.0	0.0	92,828.9	4,952.9	99,579.6	103.5	16,055.7	373.3	0.0	362,101.1
1401	SALTO DEL GUAIRA	CANINDEYU	164,318.4	14,973.4	13,969.5	12,450.6	969.2	166.4	47,906.0	0.0	20,703.3	1,199.2	38,770.9	335.6	0.0	12,874.4	0.0	164,318.4

Original Information				Analysis Results (ha)													
Code No.	City	District	Area (ha)	High Forest (Dense-Medium)	High Forest (Sparse)	Low Forest	Bamboo Forest	Artificial Forest	Dry Farmland	Paddy Field	Non-Flooded or Seasonally Flooded Natural Grassland	Permanently Flooded Natural Grassland	Artificial Grassland	Urban Area/ Settlement	Shrub Land	Water Body	Others (Cloud/ Cloud Shadow)	Total
1402	CORPUS CHRISTY	CANINDEYU	183,358.9	15,270.2	21,397.0	15,268.7	6,073.4	0.0	52,077.4	0.0	29,463.1	1,046.9	39,364.5	69.3	3,194.1	134.3	0.0	183,358.9
1403	CURUGUATY	CANINDEYU	415,430.6	59,185.7	81,041.0	54,637.7	14,106.4	37.5	41,495.1	0.0	56,578.2	7,092.1	86,001.0	308.3	14,053.1	894.6	0.0	415,430.6
1404	IGATIMI	CANINDEYU	189,224.8	34,121.7	50,298.1	34,258.5	12,721.1	0.0	10,678.7	0.0	24,602.5	651.0	15,470.7	46.1	6,174.7	201.6	0.0	189,224.8
1405	ITANARA	CANINDEYU	90,870.6	7,640.8	13,233.3	14,908.8	1,529.6	0.0	1,551.7	0.0	22,965.2	950.5	25,931.6	11.8	2,067.5	79.6	0.0	90,870.6
1406	YPEJHU	CANINDEYU	95,717.2	16,126.1	19,818.4	17,695.9	3,267.5	0.0	1,963.8	0.0	16,242.2	2,604.6	16,577.3	67.6	1,178.8	174.9	0.0	95,717.2
1407	GRAL. F. CABALLERO A	CANINDEYU	365,543.8	44,955.3	36,764.2	22,023.1	1,986.9	184.4	170,181.9	0.0	40,823.0	3,357.1	42,082.3	355.9	2,109.4	720.4	0.0	365,543.8
TOTAL			15,610,357	789,513	1,347,921	1,689,311	138,922	8,604	1,970,922	16,138	5,707,842	2,073,040	1,377,975	70,472	78,627	330,707	10,363	15,610,357