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REPORT OF FEASIBILITY SURVEY FOR REFORESTATION PROJECT IN SOLOMON ISLANDS

January 1982

Japan International Cooperation Agency
(JICA)

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PREFACE

It is with great pleasure that I present this report entitled The Report of Feasibility Survey for Reforestation Project in Solomon Islands to the Government of Solomon Islands.

This report embodies the result of a feasibility survey which was carried out from August 3 to 30, 1981 by the Japanese survey team commissioned by the Japan International Cooperation Agency following the request of the Government of Solomon Islands.

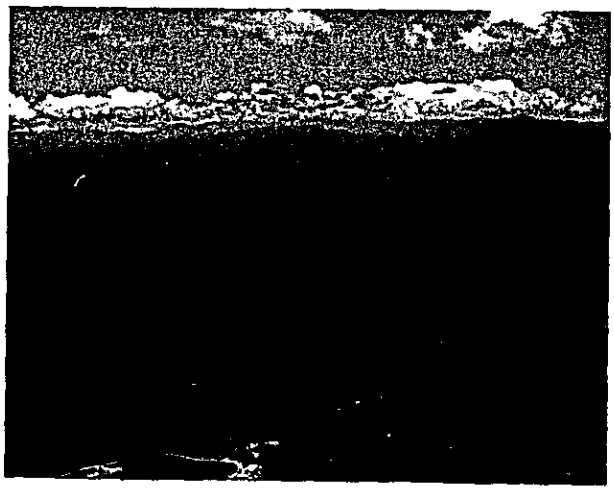
The survey team, headed by Mr. Ryoshiro Tsuji, had a series of discussions with the officials concerned of the Government of Solomon Islands and conducted a wide scope of field surveys and data analyses.

I sincerely hope that this report will be useful as a basic reference for the forestry development in Solomon Islands.

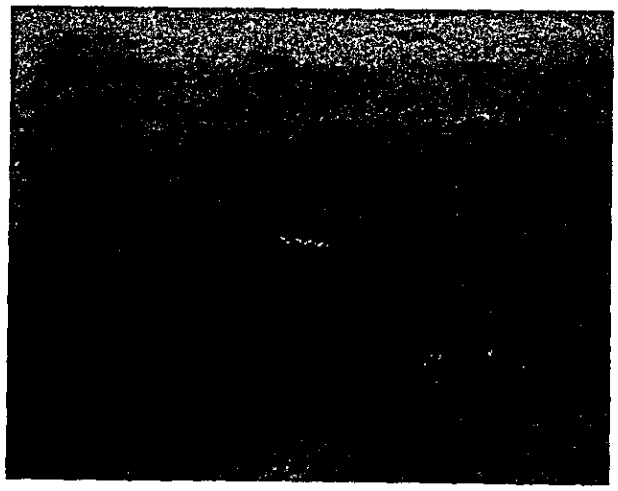
I am particularly pleased to express my appreciations to the officials concerned of the Government of Solomon Islands for their close cooperation extended to the Japanese team.

August , 1981

Keisuke Arita
President
Japan International Cooperation Agency

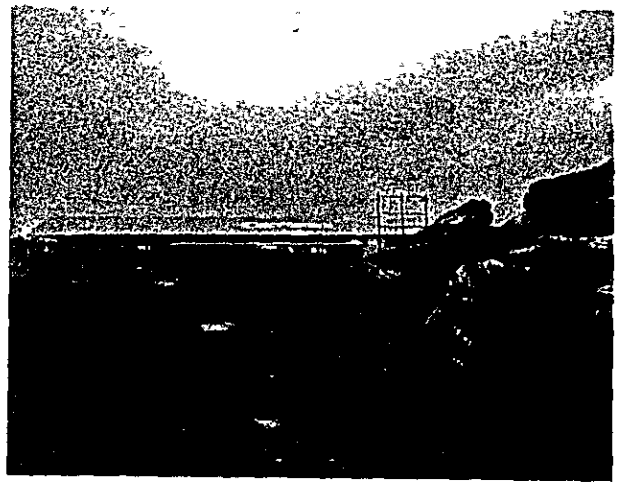


Grass Land Guadalcanal Island



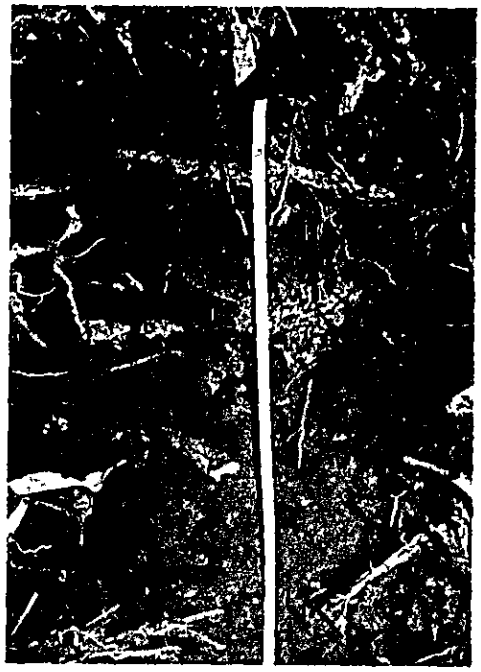
Natural Forest Guadalcanal Island

Caribaea Pine Plantation Guadalcanal Island

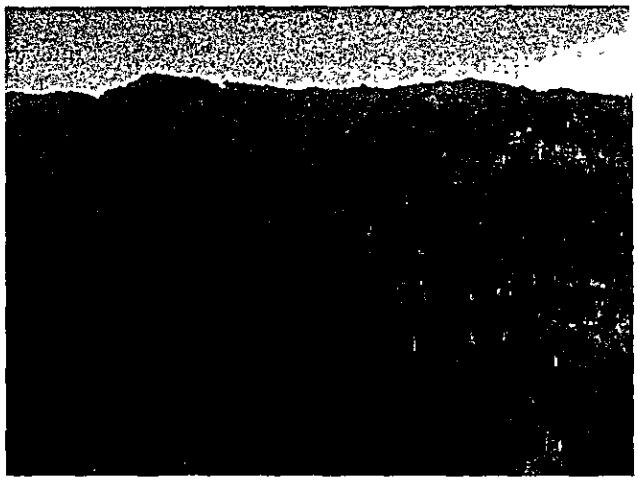


Sawmill Guadalcanal Island

Soil Profile of Grass Land Guadalcanal Island

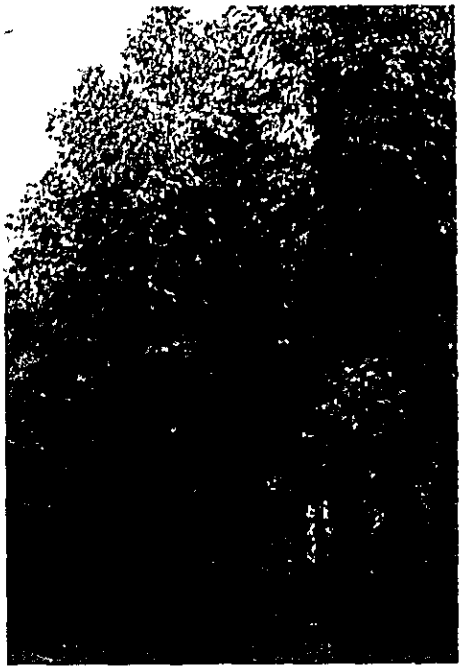


Soil Profile of Natural Forest Guadalcanal Island



Natural Forest · Malaita Island

Broadleaved Plantation after Cutting · Malaita Island



Silvo-pastoral plantation
Kolombangara Island

Nursery Kolombangara Island

Climber : Eucaly Plantation
in Kolombangara Island

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I. Objective and Summary of Survey

1. Background

The territory of the Solomon Islands is mostly covered with forests, and timber constitutes the main natural resource of the country. However, because of a rapid forest exploitation and expanding forest conversion to agricultural land, the economic value of the forests has been declining in recent years. The government of the Solomon Islands was desirous of launching a large-scale re-afforestation project in order to restore its forest resource base for continued timber production that would ensure foreign exchange earnings needed for the country.
As Japan would be the most probable destination of future exports of timber products from the Solomon Islands, the government requested the Japanese government for technical and financial cooperation for the planned re-afforestation project.

Japan International Cooperation Agency (JICA), an executing agency of governmental international cooperation in Japan, carried out a preliminary survey of the project in October 1976 and confirmed economic as well as technical feasibility of the project including chipping operation necessary for the possible export of wood chips.

2. Composition of Survey Team

Assignment	Name	Position
Leader	Mr. Ryoshiro Tsuji	Managing Director, Japan Greening center
Cooperation Planning	Mr. Heihachi Isogai	Senior Press officer, Administration Division, Administration Department, Forestry Agency, Ministry of Agriculture, Forestry and Fisheries
Reforestation	Mr. Ryoji Hayashi	Director, Planning Department, Japan Overseas Afforesting Association
Economic Survey	Mr. Yukitoshi Hino	Permanent Staff Engineer, Japan Overseas Forestry Consultants
Wood Processing	Mr. Seisho Nakamura	Engineer, Japan Overseas Forestry Consultants
Coordination	Mr. Minoru Saito	Forestry Development Div., Forestry and Fisheries Development Cooperation Department, Japan International Cooperation Agency

Table	Date	Day of week	Itinerary	Contents of survey	Accommodation
1	8.3	Mon.	Tokyo—Nandi (Fiji)		On board plane
2	8.4	Tue.		Visit to the Pine Commission. Inspection of tree plantations, a nursery and a sawmill.	Nandi (Fiji)
3	8.5	Wed.	Nandi → Honiara	Visit to and discussion with the Japanese Embassy.	Honiara
4	8.6	Thu.		Visit to the Ministry of Natural Resources and the Forestry Division for consultations.	"
5	8.7	Fri.		Visit to the Governor of the island of Guadalcanal. Consultation with the Central Planning Office. Inspection of the Foxwood timber yard and mill.	"
6	8.8	Sat.		Coastal survey	"
7	8.9	Sun.		Data analysis. Team consultation.	"
8	8.10	Mon.		Inspection of Foxwood felling sites. Survey of sample forest on Mt. Austen.	"
9	8.11	Tue.		Consultation with officials of the Forestry Agency. Aerial survey of forests on Guadalcanal Island.	"
10	8.12	Wed.		Consultation with officials of the Forestry Division.	"
11	8.13	Thu.	Honiara ↔ Auki (Malaita Island)	Aerial survey of forests on Malaita Island. Survey of cutover and reforested land. Inspection of timber mill. Visit to the Governor of the island of Lalaita.	"

Table	Date	Day of week	Itinerary	Contents of survey	Accommodation
12	8.14	Fri.		Survey of grassland and forest soil. Consultation with the Central Planning Office.	Honiara
13	8.15	Sat.		Data analysis.	"
14	8.16	Sun.		Team Consultations.	"
15	8.17	Mon.	Honiara → Viru Harbor (New Georgia Island)	Survey of Kalena cutover and reforested land.	Viru Harbor
16	8.18	Tue.	Viru Harbor → Munda	Survey of Kalena felling sites and shipping port.	Munda
17	8.19	Wed.	Munda → Manigisi (Kolombangara Island)	Survey of experimental reforested land of the Southern Reforestation Association.	Poitete
18	8.20	Thu.	Poitete → Munda	Survey of governmental reforested land and experimental reforested land on Kolombangara Island.	Munda
19	8.21	Fri.	Munda → Honiara	Collection and analysis of data. Team consultations.	Honiara
20	8.22	Sat.		Data analysis.	"
21	8.23	Sun.		Team consultations.	"
22	8.24	Mon.		Consultations with officials of the Forestry Division.	"
23	8.25	Tue.	Honiara → Port Moresby	Report to the Ministry of Natural Resources, the Forestry Division and the Japanese Embassy.	Port Moresby

Table	Date	Day of week	Itinerary	Contents of survey	Accommodation
24	8.26	Wed.		Report to the Japanese Embassy.	Port Moresby
25	8.27	Thu.	Port Moresby → Madan	Survey of JANT nursery and plantation	Madan
26	8.28	Fri.	Madan → Port Moresby	Inspection of JANT chip mill and shipping port.	Port Moresby
27	8.29	Sat.	Port Moresby → Manila		Manila
28	8.30	Sun.	Manila → Tokyo		

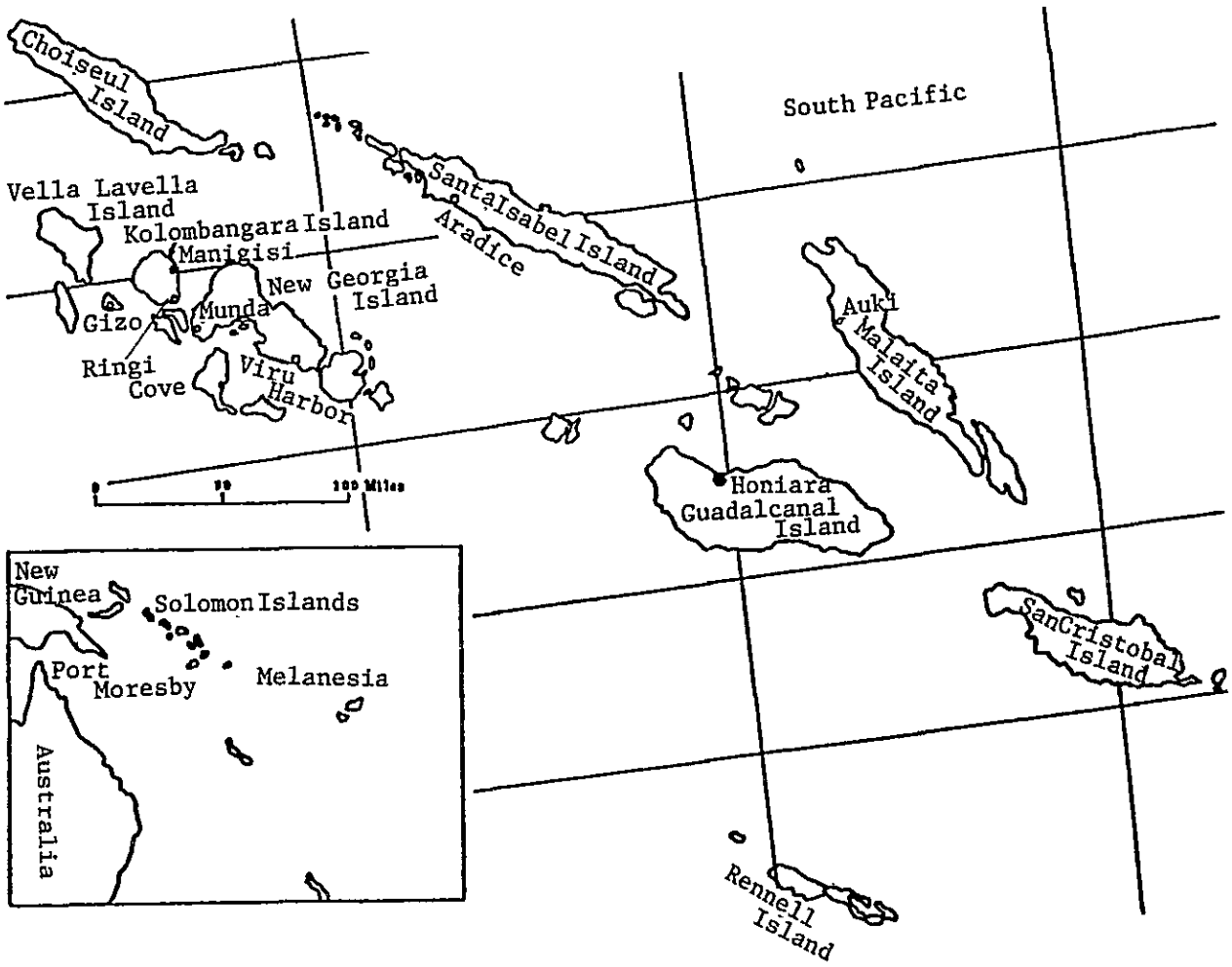


Fig. I-1 Chart of Solomon Islands

II. Reforestation Project

1. Main Ideas of Reforestation

1-1 Basic lines

Together with fishery resources, timber condtitutes an important natural resource in the Solomon Islands, always ranking first or second in total exports. Both resources together make up the lion's share of all exports.

However, timber felling carried out by foreign enterprises which commenced around 1960 was done at such a rapid pace that extensive cut-over areas were left, while regeneration in these areas lagged behind markedly. Because of this adverse situation, the Solomon Islands Government announced a new policy in its Forestry White Paper in 1968, in order to maintain forest resources.

The policy aims at, among others, the strengthening of forest resource base by means of artificial regeneration.

The Government invites overseas funds for the implementation of policy.

The Japanese paper pulp industry had already conducted small-scale reforestation trials and carried out a study on reforestation techniques. In addition, JICA sent a preliminary survey team in October 1976 and studied the feasibility of a possible reforestation project.

On the basis of the above findings, the current JICA Survey Team thought it necessary to concentrate its efforts on the following lines:

(1) To identify tree species for reforestation that are suitable as pulp and paper raw material, fast growing and that could be harvested with the shortest possible rotation.

(2) To determine research programmes and activities such as reforestation techniques, forest protection and forest tree improvement, all of which are to be carried out in line with the reforestation project.

(3) To determine the scale of a reforestation project that would justify an economically viable operation of the processing and transportation of wood chips in the future.

(4) To identify possible project sites meeting the following conditions;

a) Sites proposed for reforestation should have an easy access for harvesting and transport of trees to the processing site that is also the shipping site by large-sized chip carriers.

b) Land of 20,000 to 30,000 ha in area should be made available.

c) Operation could continue all the year round in the transportation of timber for the production of chips.

(5) To ascertain the understanding and cooperation of the Government and the local people concerning the project. The project might include as part of its activities introduction of agroforestry practices for an increased benefit of local inhabitants as and when applicable.

1-2 Conditions to be met for the Reforestation Project

The reforestation project for pulp and paper raw material would be dependent generally on the following conditions:-

(a) Land suitable for reforestation must be secured. It must be conducive to promoting quick growth from the point of view of weather and soil conditions, and should pose no danger of forest fires, cyclones, blight or noxious insects, etc.
The land area must be large enough to accommodate chip mills and large-sized chip carriers.

(b) There should be an assurance that trees planted on suitable lands could be harvested for chip processing. In other words, rights regarding planted trees must be protected and investment rewarded. Although this is usually specified in land lease contracts, reforestation contracts, etc. with landowners and/or the Government, the investors are still concerned over the possible changes in this connection during the contract period. In the Pacific area east of Papua New Guinea, a special land ownership system is still prevalent. Laws based on individual land ownership are not applicable in the countries in this area, nor easily understood by the public. Consequently, utilization of land by enterprises might be often in conflict.

(c) Project partners should be clearly defined. When projects are promoted in developing countries, especially projects entailing the use of land, they are very often subject to restrictive foreign capital laws. Before commencing a project, a joint venture should be established with a reputable organization in the host country, but it is occasionally difficult to find an organization with management capability necessary to carry out the project successfully. Especially if land is utilized, the majority of shares must often be transferred to the organization in the host country.
In case of a joint venture, a Japanese enterprise would offer funds, technology and sales expertise, while the other party acquires the authorization and sanction of the Government, provides guidance concerning local laws, manpower and land, etc. The acquisition of land would be the most important responsibility of the other party in a reforestation project.

(d) The planting site should be located conveniently.
Reforested trees reaching the harvestable time are cut down, brought to the chip mill for processing and chips loaded aboard ships.
It is necessary to ensure ideal shipping locations, accommodate large-sized chip carriers and maintain the smooth operation of chip mills. The success of the project mainly depends upon the site condition of plantations, which would allow reducing the felling and transportation costs, including for example, utilization of existing roads for transport.
To ensure year-round operations is also a crucial factor for the success of the project.

(e) The project must contribute to the development of the host country.
As a reforestation and chip project would cover a very long period, it could not continue if it did not meet the wish of the host country. Where competition for land is high, a low-profit operation such as a reforestation project cannot compete, in the long run, with agriculture or plantations of rubber or oil palm. Chip mills cannot be constructed in areas to be developed as urban districts, for example, and if there is no prospect of lasting benefit to the local population, it is unlikely that the project would succeed. It would be imperative to fulfil all these requirements, for the reforestation project to become a long-term success.

1-3 Scale of Reforestation Project

The scale of the reforestation project would be determined by the yield it expects and the volume of wood chips to be transported in the future.

At present the number of specialized chip carriers is fifty-five, all of which are fully occupied by the operation for individual paper pulp factories. Therefore, the scale of the project would be decided taking into consideration that the carriers can be constructed and operated economically.

Shipping expenses would constitute a considerable part of the total cost of the end product, wood chips. Chip carriers range in size from 1,600,000 cf^3 to 4,000,000 cf^3 storage capacity, with the exception of several very small carriers. The larger the size, the lower the shipping expense per unit. In the case of the Solomon Islands, however, large-sized carriers may not always be expedient in view of the distance to Japan, the number of voyages, the chip stock to be kept in Japan and the Solomon Islands, harbor conditions, etc., and comparatively small carriers might suffice.

As an example, MADANG-Maru class carriers which presently ply between Japan and Papua New Guinea are taken to calculate the cost.

They are of 20,549 tons gross tonnage and 1,775,000 cf^3 in cargo capacity. Each load is about 20,000 m^3 if the compression factor is 200 cf^3/BDU and the volume.weight ratio is 500 kg/m^3. About 2020,000 m^3 x 14 (number of annual voyages) = 280,000 m^3/year would be necessary for the depreciation of chip mills and shipping facility construction costs.

The reforestation of 1,400 ha a year would be necessary if the growth of reforested trees were 200 m^3/ha (figure indicates an actually usable volume) in ten years. 1,400 ha x 11 years = 15,400 ha if the felling is done in the eleventh year, and 15,400 ha ÷ 0.7 = 22,000 ha if we take into account that some of the land may not be suitable for reforestation. In case of conifers, rotation would be longer than ten years.

22,400 ha (1,400 ha x 16 years) is required if the rotation become 15 years, and about 32,000 ha would be needed if the land unsuitable for reforestation were accounted for.

As a result, a land area of at least 20,000 or 30,000 ha would be necessary for a viable project.

2. Institutional and Technical Issues of Reforestation Project

2-1 Institutional Issues

(a) One concerns availability of lands. If the project site falls under the Customary Land system, considerable time would be required to obtain agreement of customary land owners. It would have to start by changing the attitude of the local inhabitants according to the Department of Land and Agriculture and the reports of the Special Committee organized within this Department.

(b) The Solomon Islands Government is planning the reforestation of 20,000 ha on Guadalcanal Isalnd, 10,000 on Malaita Island, and some on Kolombangara Island and in the north of New Georgia Island. There are good prospects to find a solution to use the Customary Land system for reforestation in the near future because these projects are to be implemented on the Customary Lands.

(c) Now that the Government is planning large-scale reforestation, welcoming foreign capital and intending to export forestry products in the future, no substantial problems are foreseen with regard to the foreign capital and investment regulations.

(d) Regarding partners, it would be possible that the Government or the organization in place of the Government and landowners participate in the joint venture, as seen from the experiences of the currently operating joint ventures in other sectors.

(e) It would be necessary to consider the cultivation of agricultural crops by local inhabitants in the form of agroforestry, as and when applicable.
Production of timber required for the daily life of the people would also be considered.

2-2 Technical Issues

(a) On Kolombangara Island, reforestation is already being carried out by the Government in an area of about 6,300 ha.
Levers Pacific Timber Co., Ltd. holds the right to a part of the Government land. It is, therefore, assumed that the remaining land economically suitable for reforestation would be not more than 15,000 ha including Customary Land.

On New Georgia Island, felling by the Kalena Timber Co., Ltd. and Levers Pacific Timber Co.,Ltd. is going on.
Although both have sufficient areas, the Government has already completed the reforestation of 6,000 ha in the harvested areas of the former, and consequently reforestation would follow the plans of these companies in the future.
On Guadalcanal Island, timber harvesting is going on by the Foxwood Timber Co., Ltd., but there should be no problem in finding reforestation areas because the remaining areas are vast. On Malaita Island, the situation is similar to Guadalcanal.

(b) Although line planting is considered expedient under the conditions of the country because of the problem of vines, there is still room for improvement.
Merremia, which grows thick just after planting, causes serious troubles. It may safely be said that the success of artificial planting there would depend upon how well this parasitic plant could be controled. Though very prolific, it does not form tuberous roots and its stems trail on the ground, grows roots everywhere extends and then wind up around trees. After timber harvesting merremia starts to grow drastically (it flourishes in reforested land and the trees wither if the land is left for four weeks or more), quickly covering the ground and reforested trees, retarding the growth and eventually killing them.
Thus, the line planting system should be re-considered and trials made to control the vine with chemicals, employ fire for site preparation.

(c) Repeated large-scale reforestation with short rotation under the humid and hot climate might cause loss of soil fertility and damages to the environment.
Although the Solomon Island line planting system is regarded as effective in reducing the danger, it would be important to develop better reforestation techniques, such as the creation of protective tree zones, and combining short and long rotations.

(d) There is concern over possible damages by blight and noxious insects to Eucalyptus deglupta trees as tree planting proceeds.
On the land reforested with Eucalyptus deglupta in the Solomon Islands, tip dieback is emerging (damages by a kind of sap suckers called coreidae). Though a means has been found to prevent such damage, it is necessary to speed up the development of a more practical prevention method. This is most important because Eucalyptus deglupta appears to be the best for producing pulp.

3. Reforestation Plan

3-1 Selection of Reforestation Site

Viewed from the results of surveys carried out at several areas (presupposing a solution to the Customary Land question), it may be concluded that the natural conditions on each island of the Solomon Islands group are mostly appropriate for starting a reforestation project.
On Guadalcanal Island where the capital Honiara is located, the infrastructure related to reforestation, such as roads, a harbor, electric power generation, etc., is more favourable than other islands. Accordingly, investment in the reforestation project would be more feasible if commenced on Guadalcanal Island.
There is a tract of land suitable for reforestation in zones to the east of Honiara City on the north side of the island, judging from natural conditions such as the topography, geology, etc., and also in the central hill zone where the gentle slopes from 40 to 200 m above sea level are found.
In the absence of land development plans for agriculture, 20,000 ha was chosen as suitable for reforestation (in accordance with the basic lines of reforestation. See I, 1, 1-1.), where soil is deep and inclinations are 20 degrees or less, exclusive of land not suitable for reforestation such as marshy areas alongside rivers. Selection of land was made according to the results of surveys of natural conditions at felling sites, an aerial survey and reference to topographical, geological and soil condition maps, etc. (Fig. II-1 Map of reforestation sites and Table I-1 areas to be reforested).

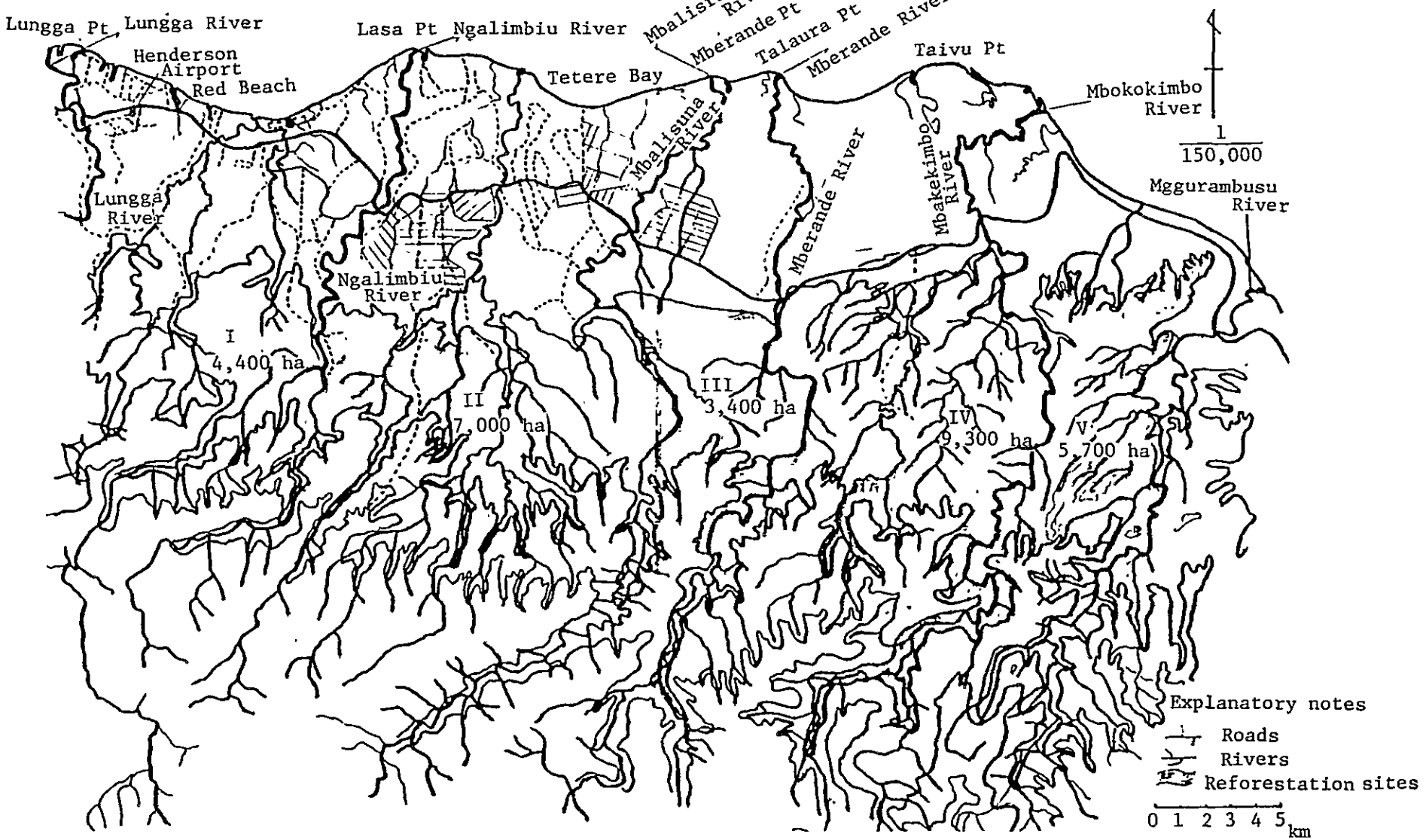


Fig. 3-1 Map of reforestation sites on Guadalcanal Island

Table 3-1 Areas to be Reforested

Unit ha

Zone	Area	Reforestation	Remarks
I	4,400	2,800	Area from 40 to 200 m above sea level between the Lungga River and the Ngalimbiu River.
II	7,000	4,800	Area from 40 to 200 m above sea level between the Ngalimbiu River and the Mbalisuna River.
III	3,400	2,300	Area from 40 to 200 m above sea level between the Mbalisuna River and the Mberanda River.
IV	9,300	6,500	Area from 40 to 200 m above sea level between the Mberanda River and the Mbokokimbo River.
V	5,700	3,600	Area from 40 to 200 m above sea level between the Mbokokimbo River and the Mggurambusu River.
Total	29,800	20,000	

3-2 Forecast of Tree Growth in Reforestation Areas

The history of artificial regeneration in the Solomon Islands started only recently in the middle of the 1960s and total areas planted amount to about 6,400 ha at the end of 1975. Islands where reforestation has been implemented are New Georgia, Santa Isabel, Kolombangara, Gizo and so on. Since then the areas have expanded, and at the end of 1980 reached the level of about 18,300 ha. In these areas, a number of tree species have been planted partially as experiments, but would be early to say that the experiments are producing practical guidelines for a further expanded operation. Thus, tree species must be selected taking into account not only the yield and results of existing plantations but also natural conditions of the proposed sites and the utilization purpose of the produce.

Tree species proposed for the reforestation in Guadalcanal Island comprise quick-growing species which are suitable for pulp. Gmelina arborea, Eucalyptus deglupta, Albizia falcata and Terminalia brassii were chosen from broadleaved trees and Pinus caribaea and Pinus oocalpa from conifers. It would be necessary to reforest partially with other species suitable for general timber, such as Pometia spp. and Callophyllum spp. for domestic demand and also to maintain such resources.

3-3 Reforestation Plan

It would be desirable that the reforestation plan is implemented selecting several places in the different catchments (See I - V of Table II - 1). Even if the operation is hindered temporarily by unavailability of labor or transport problems in some areas, it could continue in other areas. Although concentration of work is unavoidable during the planting season in the reforestation project, the planting area in each year should be evenly allocated over the project period. This will allow a balancing of labor requirements, will stabilize employment and in turn will ensure a smooth implementation of the project. There are many rivers with abundant water, therefore, suitable areas for nurseries could be acquired on the flat land alongside these rivers.

The Reforestation Plan is shown in Table II-2.

Table II-2 Reforestation Plan

Unit ha

Zone	1st year	2nd year	3rd year	4th year	5th year	6th year	7th year	8th year	9th year	10th year	Total
I	400	400	400	400	400	400	400				2,800
II	800	800	800	800	800	800					4,800
III	800	800	700								2,300
IV			100	800	800	800	900	1,000	1,000	1,100	6,500
V								1,000	1,000	900	3,600
Total	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	20,000

Note: Zone I is the site between the Lungga River and the Ngalimbiu River.

Zone II between the Ngalimbiu River and the Mbalisuna River.

Zone III between the Mbalisuna River and the Mberanda River.

Zone IV between the Mberanda River and the Mbokokimbo River.

Zone V between the Mbokokimbo River and the Mggurambusu River.

3-4 Summary of Reforestation Costs

Only the direct costs for reforestation are mentioned excluding the expenses for nurseries (the latter is covered as the cost of seedlings). The cost for facilities, all machinery and equipment directly required for the reforestation has been included, but not the related infrastructure.

The estimated costs for the reforestation project on the above basis are shown in the following Table II-3.

Table II-3 Summary of Reforestation Costs

Unit: 1000 Yen

Item	1st Year	2nd Year	3rd Year	4th Year	5th Year	6th Year	7th Year	8th Year	9th Year	10th year	11th~13th Year	Total
Site Preparation	43,200	43,200	43,200	43,200	43,200	43,200	43,200	43,200	43,200	43,200		432,000
Seedlings	25,920	25,920	25,920	25,920	25,920	25,920	25,920	25,920	25,920	25,920		259,200
Planting	21,600	21,600	21,600	21,600	21,600	21,600	21,600	21,600	21,600	21,600		216,000
Weeding	38,880	77,760	116,640	116,640	116,640	116,640	116,640	116,640	116,640	116,640	116,640	1,166,400
Cutting of vines				12,960	12,960	12,960	12,960	12,960	12,960	12,960	38,880	129,600
Protection and maintenance	108	216	324	432	540	648	756	864	972	1,080	2,592	8,532
Repair of roads	173	346	518	691	864	1,037	1,210	1,382	1,555	1,728	4,147	13,651
Subtotal	129,881	169,042	208,202	221,443	221,724	222,005	222,286	222,566	222,847	223,128	162,259	2,225,383
Construction of roads	35,000	35,000	35,000	35,000	35,000	35,000	35,000	35,000	35,000	35,000		350,000
Maintenance of machinery and equipment, etc.	26,000	13,000	13,000	28,000	15,000	18,000	5,000	5,000	18,000	5,000		146,000
Subtotal	61,000	48,000	48,000	63,000	50,000	53,000	40,000	40,000	53,000	40,000		496,000
Administrative expenses	14,500	14,500	14,500	23,150	23,150	23,150	23,150	23,150	23,150	23,150	21,750	227,300
Subtotal												
Rent	5,700	12,210	19,920	28,740	37,200	45,780	54,000	62,250	70,920	79,230	33,330	449,280
Subtotal												
Total	211,081	243,752	290,622	336,333	332,074	343,935	339,436	347,966	369,917	365,508	217,339	3,397,963

3-5 Yield Estimate

The project would aim at planting of 2,000 ha a year, and expecting a yield of 200 m^3/ha a total of 400,000 m^3 could be harvested in case of broadleaved tree species after 10 years (In case of pinus caribaea, the yield would be 200 m^3/ha after 15 years).

3-6 Cost Estimate

The cost/m^3 of reforested trees is calculated from the estimated cost of the project.

Crowth period 10 years (felled in 11th year)

Yield 200 m^3/ha (utilizable volume)

Interest 3% per year (assumed)

Calculated cost per 1 m^3 is ¥1,117 (¥230 = $1 thus $4.86 per m^3).
No levy, such as a felling tax, royalty, etc., imposed by the Solomon Islands Government is included due to present lack of information on this subject.

III. Logging, Transport and Chip Processing

1. Logging and Transport

Logging sites comprise five project zones, and the operation should be conducted in two to three zones at all times. The supply of raw material to the chip mill must continue avoiding the congestion of the logging roads and disruption of operation by possible natural disasters.

(a) Forest Roads

The project area extends as a belt of 10 km width along the cost of the Northern Guadalcanal. There is a public road running from east to west by the coast. In zones I and II, there is a road running from south to north and connected with the public road.
There are roads constructed by the Foxwood Timber Co.,Ltd., (to be maintained and managed by the Government after completion of the felling operation) in the east. More forest roads would have to be constructed to the south from the public road. One each would be needed in zones I and II and two each in zones III, IV and V, a total of eight roads. The total length would be 64 km estimating each at about 8 km.
Furthermore, in the forests, 5 m/ha would be required as secondary roads and 10 to 40 m/ha as feeder roads, hence approximately 10 km of secondary roads and approximately 50 km of feeder roads would have to be constructed every year for each 2,000 ha to be reforested.
The roads of a width of 6 to 8 m must be constructed on the ridges taking into account the rainy season. Aggregate required could be supplied from rivers which abound in superior quality gravels.
In and outside the forest zones, the roads would have to be constructed on the Customary Land. Therefore, the benefits of the local people would be considered.

(b) Logging

Logging should be done by two-man teams; one worker fells the trees using a chain saw and the other lops off branches. Logs should not be cross-cut at felling sites.
An estimated performance is ten trees an hour per worker, and the norm of one worker would be 16 m^3/day if working hours are five (the utilizable cubic content is 0.33 m^3/tree).
If the number of workdays a year is 250, the performance of a chain saw is 4,000 m^3 per year.

(c) Skidding Operations

Although the topography appears gradual at a first glance, it is finely divided and steep slopes are found here and there. Accordingly, skidding should be done by bulldozers on gentle slopes and by yarders on steep slopes and rugged terrains. In bulldozer skidding zones, the distance between feeder roads should be 250 m if the density is 40 m/ha in order to shorten the skidding distances and increase the efficiency of bulldozers. The average distance between the feeder roads in the cable skidding area should be 1 km if the density is 10 m/ha.
Thus the operational span of yarders should be 500 m.
If the annual number of workdays is approximately 200, the capacity of a bulldozer should be approximately 8,000 m^3/year, and that of a yarder with 250 days/year approximately 7,300 m^3/year.

(d) Transport

The average transport distance is 30 km. Although the weight limit is 15 tons for bridges in Guadalcanal Island, and the Foxwood Timber Co., Ltd. which is conducting the logging at present is using heavy machinery, 11-ton vehicles should be employed for the project because of a small diameter of reforested trees (The efficiency of transport will improve greatly and the cost will be reduced if trailers are used).

(e) Logging and Transport Base

Repair, maintenance and management of equipment are of the highest importance in implementing the logging and transport operation. The project should have its own workshop because repair done outside locally would be inappropriate in both time and cost. It is also important to train not only operators but also mechanics and a workshop manager. Other social facilities including houses for workers would also be provided.

(f) Equipment

As timber harvested from 2,000 ha of reforested land would amount to 400,000 m^3/year many equipment items would be needed including reserves. Both the scale of operation in logging and transport and the fact that the project is implemented in remote areas would require a competent management to ensure a constant flow of timber (Reserves

are calculated here at 20% of the required equipment items).

Table III-1 Equipment Items for Logging and Transport

Item	Description	Number
(Equipment for forest roads)		
Bulldozers	Komatsu D85	10
Bulldozers	Komatsu D65	11
Power shovels	Komatsu D75	2
Pay loaders	Komatsu JH63	2
Dump trucks	Hino K-KF 500D	18
Graders	Komatsu GD37	3
(Logging Equipment)		
Chain saws	For felling and bucking	199
Skidders	Komatsu D45A	30
Yarders		32
Cranes for loading	Mobile cranes with grabs	26
Trucks for transport	Hino K-KS 39D	58

Note: The required equipment items would cost roughly ¥2,300 million at current prices.

(g) Cost Estimate for Logging and Transport

Cost estimates for logging and transport made from the current prices are as follows:

Table III-2 Summary of Logging and Transport Cost per m^3

Volume 400,000 m^3/year

Item	Description	Amount
		Yen
Felling	Chain saw 16 m^3/day or 4,000 m^3/year/machine	418.60
Skidding	Skidding by bulldozer 200 workdays 8,000 m^3/year machine Skidding by yarder 250 workdays 7,300 m^3/year machine The mean value of 50% of each.	1,336.30
Bucking of logs	Chain saw	218.50
Loading	By mobile crane with grab	453.10
Forest Road (including repair)	Construction/year of 6.4 km of forest road, 10 km secondary roads and 50 km feeder roads plus repair.	1,382.30
Transport by truck	Distance 30 km and work of a truck 37.5 m^3/truck/day	1,044.20
Administrative costs	20% of abovementioned costs	968.30
Interest	Interest rate: 10%, calculated repayment for each year	416.30
Total		6,237.60

Note: Unit is per 1 m^3

2. Chip Production

(a) Construction Site

For the convenience of the shipment, the chip mill should be constructed at Koli Point 40 km to the east of Honiara City. Koli Point has the following advantages:-

(i) Although Guadalcanal Island is not particularly blessed with harbors, Koli Point faces the northwest and is not troubled by the constant southeast wind. It is sheltered by the land to the southeast behind it.

(ii) The ocean current runs at approximately 1 knot to the west, and the tide range is between HWM + 0.9 m and LWM -0.06 m.

(iii) Within 200 to 250 m from the shore the water depth reaches 10 m. These are no coral reefs and the sea bottom is sandy; ships can approach the pier safely. The seafront faces the main channel and there is also a large anchorage area.

(iv) Waves would have no great influence, though not many data are available.

(v) Regarding loading facilities for chips, four dolphins are to be installed where there is an ample depth of water and also two anchor dolphins for mooring lines at both sides. A aimple berth is to be located at the dolphins with loading facilities and is to be connected with the land by a pier on which a belt conveyor is to be set up.

(vi) A chip mill is to be constructed behind the above facilities and near the seashore, and is to be connected to the loading facilities by conveyors.

(vii) A road is opened near there up to the Foxwood sawmill 5 km away to the west and can be extended. The present power generating capacity, however, is 4,000 kw/h and insufficient. 20,000-kw/h hydroelectric power at the Lungga River planned as part of the National Development Plan might not be available in time, therefore provision of an independent power generator would be necessary.

(viii) Construction engineers, construction equipment and facilities will not be available locally. Particular attention should be paid to the construction of dolphins. The same is the case for a workshop with ample stock of spare parts for equipment including logging machinery.

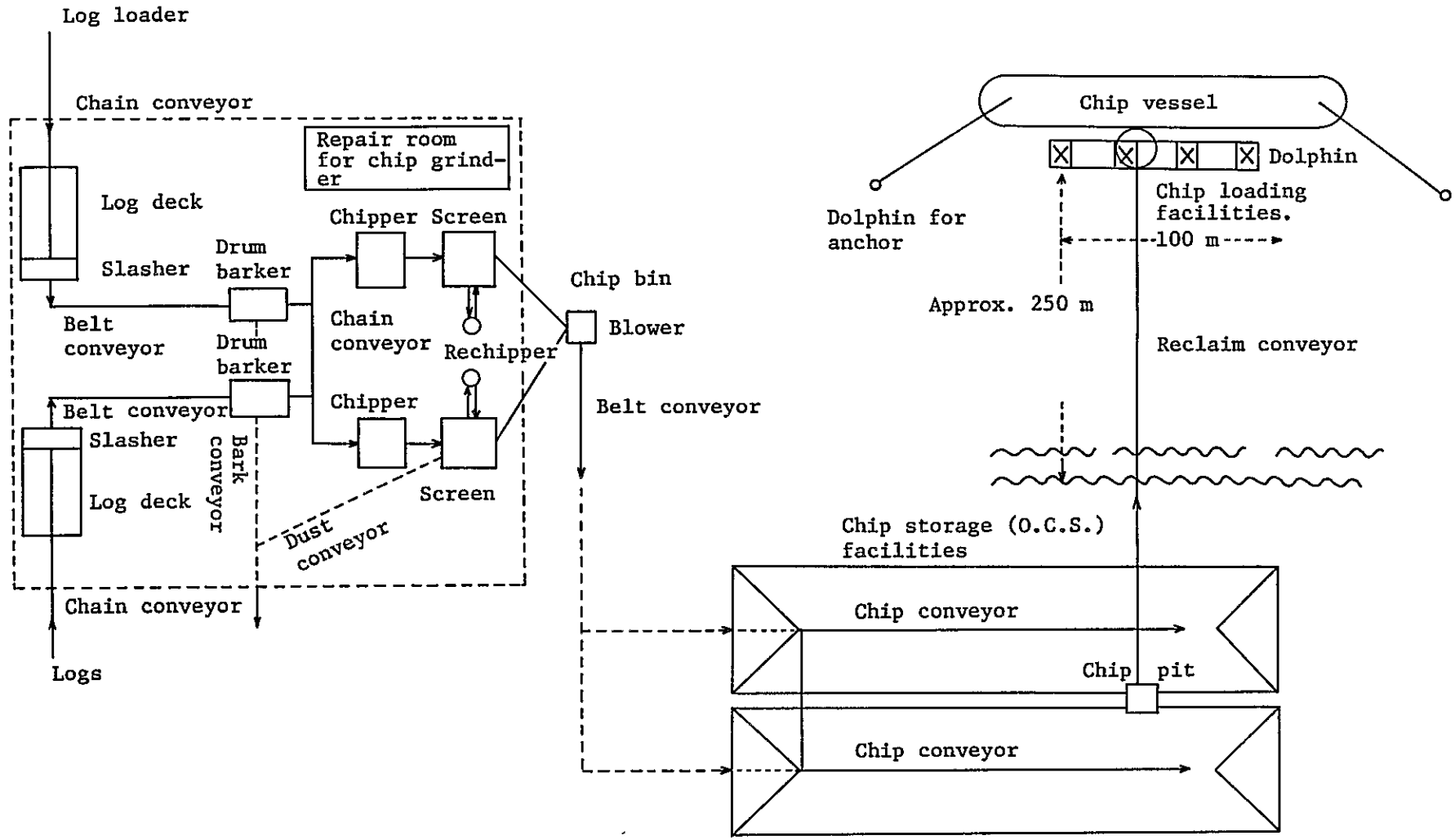
(b) Design of Chip Mill

Annual wood supply:	400,000 m^3/year
Annual chip production:	360,000 m^3/year
Operational period:	300 days/year with two shifts
Daily chip production:	1,200 m^3/day
Wood preparation loss:	10% (slash loss 1%, bark loss 3%, screen dust 5%, decayed wood 1%)
Bark content:	1% 4,000 m^3/year
Log storage:	15 days, 20,000 m^3 (20,000 m^2)
Chip storage:	1.5 months, 45,000 m^3 (23,000 m^2)
Chip space, etc.:	30 m x 100 m (3,000 m^2)
Total area:	(46,000 m^2)
Log size:	ϕ 10 - 40 m (av. 20 cm) x 4 ~ 8 m.

(c) Chipping Process and Corresponding Equipment

Process	Equipment	Loss
Unloading of logs	Log loader	-
Log storage	"	-
Log deck	Chain conveyor	-
Slasher	Belt conveyor	2%
Barking	Drum barker	3%
	Belt conveyor	-
Chipping	Chipper	-
	Belt conveyor	-
Screening	Chip screen	5%
	Belt conveyor	-
Re-chipping	Re-chipper	-
	Belt conveyor	-
Feeding	Feeder	-
	Blower	-
	Chip-dozer	-
Chip storage	"	-
Loading of chips	Chip reclaimer	-
	Belt conveyor	-
	Chip loader	-
Shipment	Vessel	-

Fig. III-1 Flow chart of Chip Mill and Loading Process



(d) Main Equipment and Facilities

Log loader:	Komatsu D 31A JH 63	7
Chip dozer:	Komatsu D 85 D85 D40	3
Crane:	Isuzu TD70 10 ton	1
Log deck:		2
Slasher:		2
Drum barker:	ϕ 5m x ℓ 20m	2
Chipper:	ϕ 3000 x 800 kw	2
Chip screen:	Type KMW	2
Richipper:		1 set
Knife grinder:		1 set
Belt conveyor:		1 set
O.C.S. Conveyor, reclain conveyor:		1 set
Feeder Blower:		1 set
Loading equipment:		1 set
Diesel generator:	2,300 kw	1 set
Electrical equipment:		1 set
Dolphin etc.:		1 set

Current construction costs are as follows.

Table III-3 Summary of construction costs for chip mill

Description	Amount
	Thousand yen
Vehicles	188,600
Machinery	1,174,150
Power generator and electric works	489,900
Site preparation	249,780
Building	224,940
Dolphin	500,020
Total	2,827,390

(e) Chipping Costs

Approximate chipping costs are as follows.

Table III-4 Chipping Cost

Item	Description	Per Chip $1m^3$ (Yen)
	Monthly volume processed: Logs 33,300 m^3, Chips 30,000 m^3	
Labor	Two shifts, 77 man-days	110.40
Oil for generators	2,300 kw	476.10
Oil for vehicles		170.20
Repairs	Vehicles - Same as depreciation, i.e., 3% of costs equipment and facilities x 1/12 months	243.80
Depreciation	Vehicles - 5 years; Other equipment - 10 years, Buildings, dolphins, etc. - 30 years	657.80
Interest	To be 10%, calculated according to number of years of depreciation	427.80
Administrative costs	Estimated at ¥6,900,000 monthly	230.00
Total		2,316.10

(f) Chip Marine Transport Cost

Tonnage calculated at 360,000 m^3 annual chip yield:

360,000 m^3 x 450 kg/m^3 ÷ 1,089 kt/BDU = 149,000 BDU

149,000 ÷ 14 times/year x 200 cf^3/BDU = 2,120,000 cf^3

Vessels with the above-mentioned capacity are Mori Maru (dwt 30,654 and 2,114,000 ft^3) and Grand Zodiac (dwt 30,870 and 2,114,000 ft^3) which are in use for carrying chips from North America to Japan. To calculate the cost of construction, assuming that a new vessel will be built, this would be approximately ¥5,500 million. Shipping charges would be more than ¥70/cf^3, assuming that the price of oil is ¥78,200/kl of heavy oil A and ¥50,600/kl heavy oil C. This is only a rough estimate and if shipping charges are 70/cf^3, shipping cost of 1 m^3 of woodchips would be ¥5,800.

(g) Summary of Gross Production cost for Chips

If the chip production is carried out as above, a rough estimate of chip production cost at current prices would be as follows:-

Table III-5 Summary of Gross Production Cost of Chips

Item	Unit cost per 1 m^3	Estimated annual amount
	Yen	¥1,000
Cost of stumpage at plantation	1,117	($400,000\ m^3$) 446,800
Cost of logging and transport	6,237	($400,000\ m^3$) 2,494,800
Cost of chip processing	2,316	($360,000\ m^3$) 833,760
Freight	5,800	($360,000\ m^3$) 2,088,000
Subtotal	15,470	5,863,360
Import Charges 6%	928	35,180
Total	16,398	5,898,540

Note: This calculation does not include presently unknown in-country charges such as royalties levies, etc. which are to be added to the total.

IV. Possible Cooperation, Related Issues and Recommendations

1. Possible Cooperation

1-1 Technical Issues of the Reforestation Project

Reforestation in the Solomon Islands has been going on since 1967, reaching a total area of 18,310 ha by 1980. Planted areas in Kolombangara Island and New Georgia Island exceed 6,000 ha respectively and occupy about two-thirds of all tree plantations. Guadalcanal possesses only a small trial plantation on a hill in the outskirts of Honiara City. On Malaita Island, the Government started reforestation trial three years ago on the cut over Customary Land.

The main concern in starting a reforestation project is the location of the land in question. As the Solomon Islands are covered by the oceanic climate belt of the tropics, viewed from a broad perspective, both rainfall and temperature for the growth of trees are most favourable, and growth seems to be about ten times as fast as in the temperate zone, though this will deffer by tree species.

There will be no substantial problem concerning the production and supply of seedlings judging from the present situation on Kolombangara and Malaita Islands formerly surveyed.

Line planting has been mainly practiced in those areas, but it is characterized by an extremely small number of trees per ha.

Some issues exist, however. One is the question between tree species and planting sites. The history of reforestation in the Solomon Islands covers only 20 years, but the results in each place have reached a stage which enables a general evaluation. Thus, it is possible to assess the growth of certain tree species under the existing conditions but a systematic analysis must be undertaken to clarify the relation between the tree growth and topography, soil micro-climate, etc. as the future reforestation expands.

There are differences in growth depending on locations where they are planted even in case of the same species, not to say about different species of the same genus, when they are planted in the areas of seemingly the same conditions.

It would be a must for the improvement of the future reforestation to analyze and evaluate experiences being gained.

The other is tending after planting. Generally speaking, it could be said that reforestation owes its success to tending provided that the

healthy seedlings of right species are used, especially in the rainy tropics. As vines grow incredibly fast on the southern slopes in Kolombangara, New Georgia and other islands, removal of these vines is essential to ascertain the growth of trees.

1-2 Issues related to Land Ownership

Customary lands account for 86.7% of all lands in the Solomon Islands. Consequently, when a project is launched, it will have to be operated in compliance with the Customary Land system. According to the revision of the Land Law in 1977, it is specified that no one except the customary land owners can acquire the rights to Customary Land. But, if customary land is changed to transferrable land through the established procedures, foreigners can rent land for a given period. Though this routinely done, it normally takes about five years or more because of many time consuming and difficult procedures involved, e.g., demarcation of boundaries, registration, people's consent.
This would apply if a private Japanese enterprise attempted to launch a project, such as reforestation, in the Solomon Islands.
The main line of action would be to obtain the consent of the people in the area to change their customary land to transferrable land so that the land can be leased. This and other steps will require considerable time and effort which may go beyond the capacity of an enterprise. Future uncertainty, a usual risk of long-term contracts may further be added.
To launch a project on the customary land, an investor must be prepared to undertake long negotiations with the local people and this is the bottleneck of no mean proportion.

1-3 Issues concerning Private Investments

For private investments the profitability of projects must first be examined closely. If a project is unprofitable, no private cooperation will be expected.
The profitability will largely depend upon certain conditions. Private enterprises may easily start their operations if related infrastructure is already developed. Otherwise they will be unable to launch projects.
The conditions through reforestation and chip processing must be thoroughly investigated for the project in question, although

there is a suitable land for constructing a chip mill in the eastern suburb of Honiara on Guadalcanal Island, and the neighboring shore can be utilized for shipment, and an outlook seems promising.
Concerning reforestation projects, the main problem is whether or not an enterprise can bear an investment for about ten years from planting to felling. Recently, Japan's paper pulp industry has been going through a sluggish period, and there seems to be little interest in overseas investments. Therefore, considering the several issues mentioned carlier private reforestation projects in the Solomon Islands appear very difficult, as least for the time being. Even at a later stage, it would be preferrable for the enterprises to acquire felling rights on transferrable lands and carry out an integrated operation to cover logging, reforestation and chip production. If the project is limited to reforestation only, an entire lack of income during the 10 year period might become an unbearable burden.

2. Interim Action

2-1 Technical Investigations

The Solomon Islands Government has conducted reforestation trials in many places since 1958. The scale has been small and the staff in charge of each project is only one or two, and short of examining the results of such trials.
For the purpose of promoting future reforestation, it is necessary to increase the number of researchers and conduct studies on soil, vegetation, seeds, breeding, damage by deseases and insects, etc.
The Forest Service of the Solomon Islands Government needs to be added with more staff who conduct such studies. As it is practically impossible to expect an immediate increase in budget and staff of the Forest Service, a Governmental technical cooperation could be useful in this respect. The cooperation, if envisaged, should include technical investigations described as above and training of local staff in the respective fields.
Suitable land and trees could be selected on the basis of these basic studies and the performance of the existing plantations.
Soil surveys are a matter of special importance because the grasslands on Guadalcanal Island seem to be quite old and lack organic matter and topsoil that must have been washed away continuously by rain.

2-2 Land Ownership

A large part of the land is the customary land, and cumbersome negotiations and procedures will be necessary in order to finalize land leases. Moreover, reforestation of leased land will have to deal with other issues such as respective rights of investors and land owners to the reforested trees. Although the Solomon Islands Government is trying to change customary lands to transferrable lands, the issues may not necessarily be solved by legislation alone.
A systems must be worked out in accordance with the changes in the living condtions of local inhabitants (respective tribal groups in the Solomon Islands), who have been using, and obtaining benefits from the land. It is desirable that the Solomon Islands Government further explore the possibility of amending the land system so that foreign investments can be brought in more smoothly.

2-3 Conclusion and Recommendation

The Solomon Islands offer suitable sites for industrial tree plantations. If logging is combined with reforestation and is carried out with proper techniques, renewal of forest resources would be easy. Despite the fact that an immediate private investment is unlikely, it will take place hopefully in the not too distant future if related issues are resolved.
The Solomon Islands Government is "a small government" in comparison with the resources it has, and lack sufficient means to develop forests and carry out reforestation. The forest development activities being implemented to-date have been initiated by joint ventures. Although a cooperative system of tribes is being conducted on Malaita Island, the Solomon Islands require assistance from other governments and foreign enterprises.
It is recommended that the Government of Japan further strengthen its efforts to assist the Government of Solomon Islands in reforestation related studies and training of staff.
An examination of the land ownership system to resolve the issues related to the customary land and to raise the awareness of the local people should also be carried out. It is certain that the results of these investigations will lead to an early start of the reforestation project and further economic development of the Solomon Islands.