

052-39

52

V

PRE—FEASIBILITY STUDY
ON
FORESTRY DEVELOPMENT
IN
TOGIAN ISLANDS OF THE REPUBLIC OF INDONESIA

JULY 1977

108
88
FDD

JAPAN INTERNATIONAL COOPERATION AGENCY

77

JICA LIBRARY



1056385[6]

国際協力事業団	
貸入 月日 52. 9. 12	P210M
登録No. 6189	F43M
	Fp1

国際協力事業団	
受入 月日 '84. 5. 19	108
登録No. 05977	88
	FDD

PREFACE

Up until recently, exploitation of forest resources in South-East Asia has been limited chiefly to species of Dipterocarpaceae, leaving the forests of various other species into oblivion.

The development of those trees in the tropical rain forests which so far have been considered unmarketable is truly a meaningful project because it leads not only to turning the world's forest resources to good account, but also to the socio-economic development of South-East Asian countries.

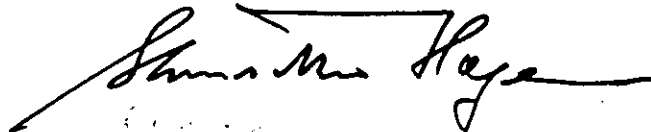
Observing the importance of the project, the Japan International Cooperation Agency despatched in March 1976 its first survey team for the feasibility study of forestry development in the Togian Islands of Central Sulawesi, Indonesia.

Following this, the second feasibility study team, headed by Mr. Tadao Mishina, President of the Japan Federation of Logging Associations, was also sent to Indonesia for a 28-day period from Oct. 8 to Nov. 4, 1976 on mission to study the master plan for the forestry development in the islands.

The forestry development project for which the survey is under way has become the cynosure of the hopes raised among the Indonesian Government authorities concerned as a regional development project to be undertaken by cooperation between Japan and Indonesia on a non-governmental basis, and we are convinced that it will make great steps toward the economic development of both Indonesia and Japan and promotion of mutual understanding and firendship between the two countries.

On behalf of the JICA, I would like to take this opportunity to express my deepest appreciation to the Directorate General of Forestry of the Indonesian Ministry of Agriculture, the Governor of Central Sulawesi Province, many other officers of the Indonesian Government authorities concerned as well as to the officers of the Japanese Ministries and authorities concerned for their great cooperation and assistance extended to the survey team.

July, 1977



Shinsaku Hogen

President

Japan International Cooperation Agency



Courtesy Call on the Directorate General of Forestry
林業総局（計画局）表敬



a village of Lebiti
ルビイティの集落



Courtesy Call on the Administrator of General Sula-
wesi in Pale
バルにて中部スラウェシ州知事表敬



rice paddy around Wakai
ワカイ周辺の水田



Meeting in the Pale Provincial Forestry Office
バル営林局と打合せ



collecting of copra, the main industry in Togian Islands
トギアン諸島の主産業コブラの採取



a primary school in Wakai
ワカイの小学校



forest in Togian Islands
トギアン島の林相



working hut in Coconut forests
ヤシ畑の作業小屋



forest survey
森林調査



a look of shifting cultivation
焼畑の状況

CONTENTS

	Page
I. Purposes and objectives of the survey	1
II. Natural conditions of the Togian Islands	6
III. Master plan for the Togian Islands Forestry Development Project	14
1. Methodology of social development program	15
(1) Land utilization	15
(2) Infrastructures	17
2. Methodology of logging and regeneration	19
(1) Tests and experiments to be made at the time of logging	21
(2) Tests and experiments on an afforestation	22
(3) Methodology of application and processing technology	22

I. PURPOSES AND OBJECTIVES OF THE SURVEY

Covered by the survey are the Togian Islands in Central Sulawesi which measure some 70,000 ha. The Togian Islands lie in Tomini Bay and are about 160 km and 175 km apart respectively from Poso and Gorontalo, the key cities along the Bay.

The Islands, deprived of all the communications, are among the most underprivileged areas in Central Sulawesi.

In order to put new life into the area, it is considered most effective to start with the forestry development to turn rich forest resources to good account and proceed to the development of infrastructures through the resultant increase in the opportunities of employment.

Most of the species standing on the Islands are the trees that have not yet been recognized as marketable.

If these unmarketable trees can be turned to good account, their value will add to Indonesia's already strong position, earning it not only the title of the most richest country in South-East Asia, but also contributing much toward the development of its national economy.

Against this backdrop, Mr. Gobel, Chairman of Indonesian-Japanese Joint Ventures Association and an Indonesian Diet member, visited Japan in 1975 and asked the President of the Japan International Cooperation Agency for Japan's cooperation in the development of the Islands through forestry.

At his request, the Japan International Cooperation Agency despatched in March 1976 the first pre-feasibility study team, headed by Mr. Tadao Mishina, President of the Japan Federation of Logging Associations, for the purpose of investigating the feasibility of the exploitation of tropical rain forests, regeneration of cut-over area, development of infrastructures, and forestry-centered regional development in the Togian Islands.

The findings are as summarized below.

- (1) The regional development of the Islands through forestry development, processing and afforestation concurs with the regional development scheme advocated by the Indonesian Government.
- (2) As regards the species put to basic tests and identified as promising, such as palapi, efforts should be made to put them on market as early as possible through improvement of product quality and strong sales campaign.

At the same time, development tests of other species should be pushed forward.

- (3) As regards the regeneration of cutovers, there remain many problems to be solved. Efforts should therefore be made to solve them, together with promotion of the tests to find out technologies for regeneration.
- (4) The development of infrastructures should be made with due account taken of the livelihood of the local people, in a manner to be conducive to the regional development.
- (5) The Government of Central Sulawesi Province places a strong hope on the development of the Islands, and another survey should be carried out as early as possible to map out a more concrete plan.
- (6) Aerial photographic survey will be effective in making the concrete development plan.

Following what the findings and recommendations of the first survey dictate, the second study team was despatched to Indonesia for 28 days from Oct. 8 to Nov. 4, 1976 for reconnaissance survey, collection of data, exchange of views with the Indonesian counterparts, and aerial photographic survey with a view to mapping out the master plan for the regional development with center around the forestry in the Togian Islands and studying the role and way the logging business should play as the hard core of the forestry development.

The formation and itinerary of the survey team were as follows.

THE MEMBER OF THE SURVEY TEAM

Head:

Tadao Mishina;
President, Japan Federation of Logging Association.

Wood Processing:

Masashi Yagishita;
Chief Director, the Glue & Gluing Laboratory, Wood Technology
Division, Forest Experimental Station, Ministry of Agriculture and
Forestry.

Regional Development:

Fusho Ozawa;
Assistant Director, Planning Department, Forestry Agency.

Cooperation Planning:

Takeo Kuramochi;
Head, Development Division, Forestry Development and Cooperation
Department, J.I.C.A.

Forest Management:

Yasutaka Oshima;
Researcher, Japan Log Importers Association.

Afforestation:

Akira Kinukawa;
Chief, Training Section, Personnel Division, Forestry Agency.

Coordination:

Nobumitsu Miyazaki;
Deputy Head, Development Division, Forestry Development and
Cooperation Department, J.I.C.A.

Itinerary of survey

Date	Route	Activity
1976/Oct. 8(Fri.)	Tokyo Jakarta	
9(Sat.)		Courtesy Call on Japanese Ambassador
10(Sun.)		Collection of Data
11(Mon.)		Courtesy Call on Director General of Forestry
12(Tues.)	Group 1	Group 1 - Courtesy Call on President of Perum Purhutani:
	2	(Mr. Mishina, Mr. Yagishita, Mr. Ozawa, Mr. Kuramochi)
	Group 2. Jakarta Palu	Group 2 - Trip (Mr. Oshima, Mr. Kinukawa, Mr. Miyazaki)
13(Wed.)		Collection of Data
14(Thur.)	Group 1	Meeting with Planning Bureau
	Group 2. Palu Poso	Trip
15(Fri.)	Group 1. Group 2.	Meeting with Planning Bureau Collection of Data
16(Sat.)	Group 1. Group 2. Poso Wakai	Meeting with Planning Bureau Trip
17(Sun.)	Group 1. Group 2.	Collection of Data Field study
1976/Oct. 18(Mon.)	Group 1. Jakarta Pale	Trip
	Group 2.	Field study
1976/Oct. 19(Tues.)	Group .	Courtesy Call on the Administrator of Central Sulawesi and the Director of the Pale Provincial forestry office
	Group 2. Wakai	Field study

Date	Route	Activity
1976/Oct. 20(Wed.)	Group 1. Pale Poso	Trip, Courtesy Call on Governor of the the Commissioner Poso Country and the Chief of the Poso District forest office
	Group 2.	Field study
21(Thur.)	Group 1. Poso Wakai	Trip
	Group 2.	Field study
22(Fri.)		Field study
23(Sat.)		Arrangement of Data
24(Sun.)	(Mr. Yagishita) Wakai Gorontalo	Field study
25(Mon.)	(Mr. Yagishita) Grontalo Jakarta	Field study
26(Tues.)	(Mr. Yagishita) Jakarta Surabaya	Field study
1976/Oct. 27(Wed.)	Wakai Gorontalo	Trip Visit to Plywood Factory, (Mr. Yagishita)
28(Thur.)	(Mr. Yagishita) Surabaya Jakarta	Collection of Data
29(Fri.)	Gorontalo Jakarta	Mr. Yagishita; Trip Collection of Data, (Mr. Yagishita)
30(Sat.)		Exchange of Views on utilization of Non-Commercial Tree Species at the Forest Product Experiment Station
31(Sat.)		Arrangement of Data.
1976/Nov. 1(Mon.)		Arrangement of Data
2(Tues.)		Meeting with the Embassy
3(Wed.)		Courtesy Call on Director General of Forestry
4(Thur.)	Jakarta Tokyo	Trip

II. NATURAL CONDITIONS OF THE TOGIAN ISLANDS

(1) Soil and topographical conditions

Topographically, the Togian Islands are all in their old age. The mountains are comparatively steep, though there are not so high mountains. Except for Una-Una, the volcanic island, all the islands are rolling up and down, presenting complicated patterns. There are small rivers of short length, dismembering the land into small lots and leaving little to form flats up to the mark.

The geology is of the Tertiary or Quarternary.

As regards the soil, soil distribution survey was conducted by reconnaissance, and soil profiles were investigated in Togian and Batudaka where logging is expected to be carried out to start with. Namely, representative soil profiles were set at 6 places for analysis of physical and chemical properties by observation and sampling test.

The soil profile diagrams and analytical data are as shown on the following table.

The bulk of the soils in Togian Island is occupied by latosol.

This is made up of mainly dense, heavy clayey soil in brown to dark brown colour, with less organic substances.

This soil is easy to leach alkali, and is strong in acidity.

On Batudata, latosol is seen at places, together with weathered, soft limestone over a vast expanse. This soil is classed among Rendzina. The colour is black to yellowish brown.

The soil, containing lots of bulky limestones, is basified.

Soil profiles and analytical data

Soil No.	No. 1		No. 2		No. 3		No. 4		No. 5		No. 6	
Place surveyed	Togian Island		Togian Island		Togian Island		Togian Island		Batudata Island		Batudata Island	
Forest description	Primary stand		Primary stand		Primary stand		Secondary stan		Primary stand		Secondary stand	
Terrain	Center of slope		Top of slope		Bottom of slope		Center of slope		Bottom of slope		Center of slope	
Altitude	120 m		150 m		90 m		90 m		60 m		70 m	
Degree of slope	12°		6°		15°		18°		25°		28°	
Name of soil	Latosol		Latosol		Latosol		Latosol		Rendzina		Rendzina	
Soil profile												
Stratigraphic classification	A	B	A	B	A	B	A	B	A	B	A	B
pH value (H ₂ O)	5.6	5.5	5.5	5.4	6.5	6.4	6.5	6.2	7.0	7.2	7.1	7.2
pH value (KCl)	4.7	4.7	4.6	4.6	5.1	4.9	5.2	4.8	7.3	7.5	7.5	7.6
Effective phosphate	Trace	No trace	No trace	No trace	Trace	No trace	Trace	Trace	Trace	No trace	Trace	No trace
Exchangeable lime	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Very rich	Very rich	Very rich	Very rich
Soluble alumina	Much	Much	Much	Much	Fair	Much	Much	Much	Trace	Small	Trace	Trace
Exchangeable magnesium	No trace	No trace	No trace	No trace	Good	Good	Trace	Good	No trace	Trace	Fair	Trace
Exchangeable manganese	Fair to poor	Fair to poor	Fair to poor	Fair to poor	Fair	Trac	Fair	Fair	Fair to poor	Fair to poor	Fair to poor	Fair to poor
Effective potassium	Trace	Trace	Little or no trace	Little or no trace	Trace	No trace	Trace	Trace	Trace	No trace	No trace	No trace
Nitrogen	Trace	Trace	No trace	No trace	Trace	Trace	Trace	Trace	Trace	Trace	Trace	Trace
Salt	Small	Faily much	Small	Trace	Small	Small	Small	Small	Small	Small	Small	Small

(2) Climate

Falling on the equator, the Togian Islands have an almost constant sunlit time of 12 hours throughout the year.

The temperature changes are less throughout the year; the temperature is in the range of 30°C to 35°C in the daytime, and in the range of 25°C to 30°C in the night time.

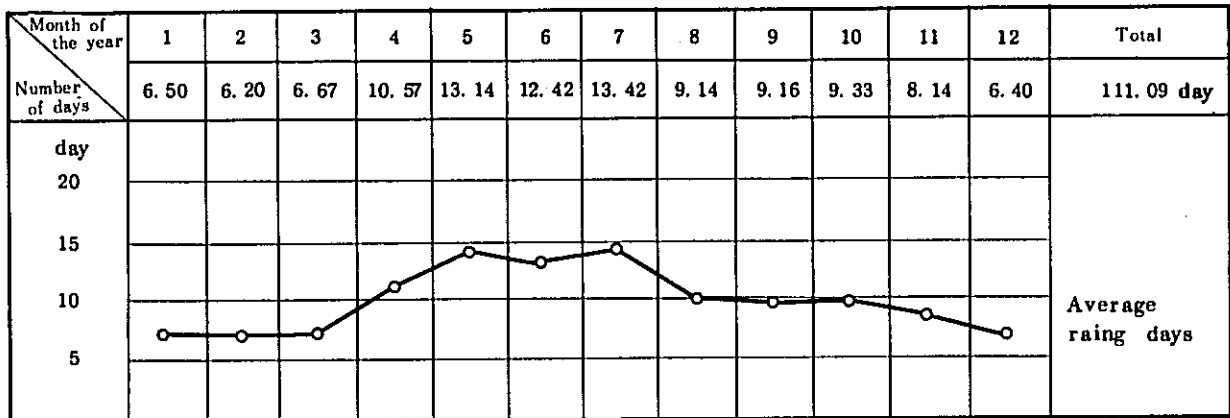
Winds are comparatively calm and comfortable.

There are various data about the rainfalls, and we are at a loss which is accountable. But considering the forest flora in the Togian Islands and the results of interview survey about the rainfalls and taking much account of the recency of the data, the data prepared by the Lembaga Metreologi Dan Geofisika are taken up.

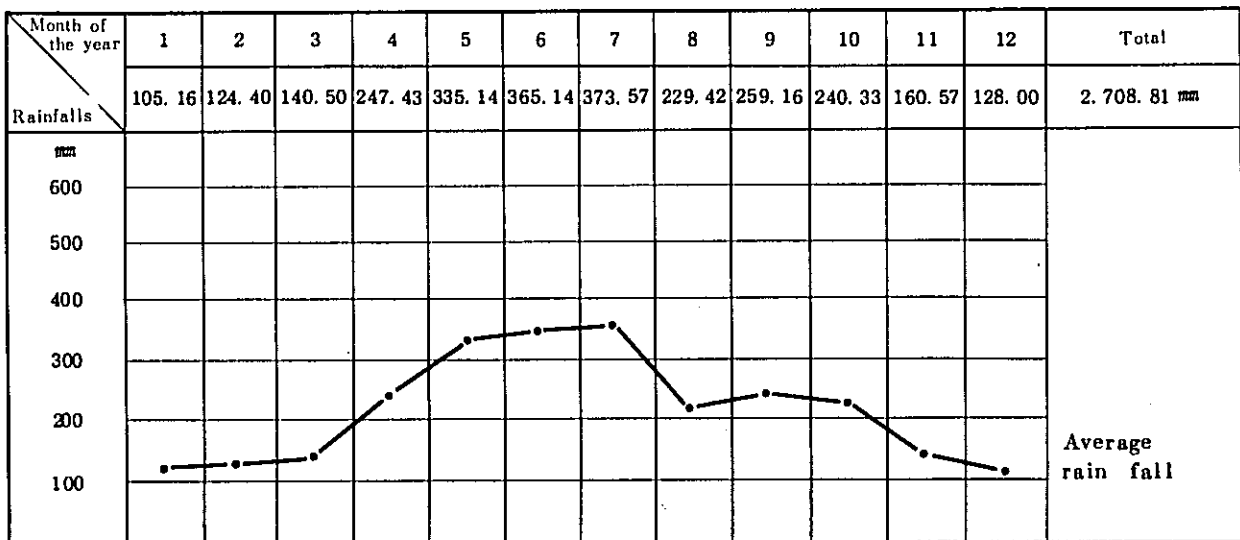
According to the preferred data, the yearly average rainfalls are about 2,700 mm, and the yearly number of raining days is 111. There are no substantial changes in rainfalls in the year, and no pronounced dry season to speak of, either.

REINFALLS AT KEP. TOGIAN
(LEMBAGA METREOLOGI DAN GEOFISIKA DEPARTMEN PERHUBUNGAN)

Monthly number of raining days
(monthly average of 1951 to 1960)



Monthly rainfalls
(monthly average of 1951 to 1960)



(3) Forest conditions

The tropical rain forests in the Togian Islands may be outlined as follows. The primary high-story trees form crowns spottedly, followed by fairly closed secondary high-story trees under the crown of which are small-diameter trees and younglings.

According to the surveys conducted by the Directorate General of Forestry, there are as many as 127 species whose breast height diameter measures 35 cm or more. Flora is diversified.

In the fairly dry hills are prevailing Palapi, Makakata Merah and Siuri as the primary high-story trees. In the lowlands and wetlands, Kume and Tea form the primary high-story stands. As a logging method, the selective cutting will be given precedence. To ensure the regeneration by selective cutting, there should be an ample supply of succeeding trees of useful species. In regard to this prime factor, the survey team conducted an inventory survey of succeeding trees as to species and diameters.

The results are as shown in the following table.

Stand inventory survey

o Survey No. I (Area: 20 m x 50 m; Place surveyed: Togian Island, hilly, fairly dry soil)

(number of young growth)

Item (cm)	Species	Palapi	Makakata	Kume	Tea	Nantu	Siuri	Tawan	Bintangaro	Bakang	Others	Total
Height	100 to 200	25	4	5	1	6	4	9	14	4	-	72
	200 and up	12	2	1	1	1	2	2	3	1	-	25
	5 to 20	2	1	1							46	50
Breast height diameter	20 ~ 50	1		1	1		1		2		15	21
	50 ~ 100	1					1				1	3
	100 and up	1										1
Total		42	7	8	3	7	8	11	19	5	67	172

1
2
1

o Survey No. II (Area: 20 m x 50 m; Place surveyed, Togian Island, fairly wet soil in lowlands)

Item (cm)	Species	Palapi	Makakata	Kume	Tea	Nantu	Siuri	Tawan	Bintangaro	Bakang	Others	Total
Height	100 to 200			4	3	3		3	3		-	16
	200 and up		2	4					1		-	7
Breast height diameter	5 to 20			2	2	2		1			35	42
	20 ~ 50			4							19	23
	50 ~ 100			1							1	2
	100 and up											0
Total		0	2	15	5	5	0	4	4	0	55	90

Notes: 1. For those having breast height diameters of not exceeding 5 cm, the tree height alone was surveyed.

2. Those which have heights of less than 100 cm and those which come under the category of "others" and whose breast height diameters are short of 5 cm were not counted.

In addition, secondary forests of small area, reminiscent of the shifting Cultivation, are found at places.

III. MASTER PLAN FOR THE TOGIAN ISLANDS FORESTRY DEVELOPMENT PROJECT

As already enunciated in the first survey, the forestry development in the Togian Islands is a significant international cooperation project aiming at the development of the Togian Islands through exploitation of unmarketable trees.

The forests in the Togian Islands have no such trees as Meranti of Dipterocarpaceous family that have been recognized as marketable.

This is not limited to the Togian Islands only, but everywhere in Indonesia and other countries. If these unmarketable trees are turned to good account, they will piece out the inventory of the resources in Indonesia, going a long way toward the Indonesian economy and at the same time toward amplifying the source of timber supply for Japan as an importing country.

It is reported by the Forestry Directorate General that there are 127 tree species in the Togian Islands and that those measuring 50 cm and more in diameter amount to 71.44 m³/ha.

Of them, about 40% or 35.87 m³/ha is accounted for by those species which at present are considered likely to be marketable, including Palapi, Kume, Nanto, Dama-dama, Kunari, Bintangoro, Makakata Merah, Tawan, Kayu-China and Siuri (all in vernacular names).

If the remaining 55.57 m³/ha is tamed and harnessed by implementation of the project and comes to be available to the market in sizable quantities, the value of the forests in the Togian Islands will be doubled. Promising in this respect are Tea, Loyo, Ula, Bawan, Makakata, Andolia, Benkele, Polus, Sugimanei, Pia, Bayu, Nane, Bone, Kayu Besi, Lungulo, Bakan, Putat, etc. which amount to about 24 m³/ha in all.

The implementation of the project will also bring about a large socio-economic impact upon the Togian Islands; intercommunity roads (arterial woodland roads) to be constructed in relation to the forestry development project will replace hitherto dugout-dependent traffic with motorized one for more active inter-community trade. At the same time, such utilities as water supply, electricity and telecommunication facilities will become available to the inhabitants and improve their living. With the advance of the project, per capita income level of the inhabitants will be increased, giving an impetus to trade by ships which will in turn will bring about direct and indirect benefits to the development of the Togian Islands.

Taken altogether, the master plan for the project should be supported by the following three in a trinity to promote the development of the Togian Islands.

- (1) Social development programs, such as amplification of agricultural activities, piecing out of social capital, etc.
- (2) Cutting and regeneration programs for developing technologies concerning silvicultural operations of forests consist of unmarketable tree species.
- (3) Harnessing and processing programs for developing application technologies of unmarketable trees.

Now let us discuss the master plan for the forestry development project while digging into the methodology of each of these programs.

1. Methodology of social development program

(1) Land utilization

In discussing the forestry development in the Togian Islands, we must first think of how the social development program as represented by amplification of agriculture should be while making much of the social and natural conditions under which the Islands exist.

Namely, we must first recognize the roles the forestry development project will play, and then study how they should be.

Probably, the only way that can be counted upon for the development of the Togian Islands will be the effective use of the forest resources the Islands have, and the increase in the social capital and inhabitants' income level resulting from the exploitation of forest resources should lead to stable, continued development of the Togian Islands.

In other words, the forestry development project should be regarded as a detonator of the future development of the Togian Islands.

The forestry development should therefore be carried out in a manner that stable farming, commercial and/or industrial activities may be developed in the Togian Islands in the future. To this end, the forests to be cut should be selected after due consideration of the way of land utilization that will make for the development of the Togian Islands.

The status quo of land utilization in the Togian Islands has yet to be clarified statistically. Of the total land area of 70,000 ha, 40,000 ha is accounted for by the forests.

Terrain-wise, 60,300 goes to hills and mountains, 9,600 ha to flats, and 100 ha to lakes and marshes.

The majority of the land is occupied by the forests. Besides, the majority of the forests has been left untapped commercially.

The places where forests once stood but were destroyed by the shifting cultivation of agriculture are left deserted without resuscitation. The land utilization in the Togian Islands remains, so to speak, in a primitive stage.

The first thing to be done in planning the future land utilization in the Togian Islands is to define a geography by use; namely, the area to be preserved as forests for continued yield and supply of timber, the area for agricultural activities, and the area for commercial, industrial and institutional activities should clearly be assigned and laid out.

Wakai of Batudaka Island and Benten of Togian Island are eligible for providing residential, commercial and industrial quarters. Accordingly, the farming operations should also center around Wakai and Benten. Considering the balanced development of the Togian Islands as a whole, however, the purlieus of Kirat Bay of Togian Island and western district of Batudaka, where the construction of palm plantations is under way because of favourable geographical and topographical conditions, should also be set aside for development of agriculture.

Assuming that some 10% or 4,000 ha of the forest land which now measures 40,000 ha is appropriated for farms, residential quarters, commercial and industrial quarters, the area to be maintained as forests becomes 36,000 ha.

What should be borne in mind in making the land utilization plan is the conservation of land; namely, hilly and mountainous areas falling on the water sources of major rivers, and those precious sight-seeing areas around the lakes and marshes should be preserved or sanctuarized in view of land conservation.

For example, Mt. Laruangon, Mt. Munde and others in the upper reaches of Batudaka River in Batudaka Island, and that area in Togian Island which is represented by Mt. Benten, Mt. Vila-Vila and Mt. Tenoloa should be preserved to say the least.

With these mountains and woods excluded, the area left for actual forestry is about 30,000 ha. Then, it is necessary to single out

such sub-areas that offer large-diameter trees, together with small and medium size trees, or agreeable character in such a quantity that permits intensive development.

These sub-areas are destined to serve as strategic points for forestry developments including construction of woodland paths and introduction of regeneration technologies.

For example, the western and eastern districts of Batudaka Island and the western district of Togian Island will be eligible in this respect.

(2) Infrastructures

The implementation of the forestry development project should be pushed forward in keeping with the requirements as dictated by the social development program, including repletion of social capital and improvement of living environments in the Togian Islands.

Namely, the implementation of the forestry development project, should be accompanied, as far as it can permit, by the development of infrastructures; including the construction of road network to engirdle each island, construction of ports, harbours and radio stations for communication with Sulawesi, construction of water supply and electric power facilities, and installation of mosques, schools and other institutions.

o Roads

The roads are one of the most important factors that govern the development of the Togian Islands. They will be constructed keeping pace with the logging work. Particular attention should be given to the construction of arterial roads which will interconnect farmland and communities.

The layout engineering of the routes will be conducted by the third survey. The meterage of the roads is expected to reach about 100 km, though its exact value will be determined upon close examination of routing by making use of topographical maps for the Togian Islands.

o Ports and harbours

When we think of the development of the Togian Islands, we cannot stand clear of the problems of ports and harbours. Namely port and harbour facilities, such as piers, should be constructed to improve trade among Sulawesi and the Togian Islands.

o Telecommunication facilities

At present, the Togian Islands have no telecommunication facilities to speak of. It is therefore necessary to install radio facilities available at least to the public services by the Provincial Government, police and postal offices. For example, Gorontalo, Poso and Wakai will each necessitate an SSB radio station of 10 W class or so.

o Electric power facilities

The electric facilities for the present project should be constructed with emphasis on the construction of towns in and around Wakai which is expected to become the cockpit city of the Togian Islands in the future.

In order to supply electricity to schools, mosques, town halls and other public facilities, a generator of about 80 kw and ancillary equipments will be required.

o Water supply facilities

Like electricity, water supply facilities should be installed to supply public facilities, communal taps and public baths.

Namely, water will have to be pumped and delivered at a rate of about 0.45 m^3 per minute by making use of a 35 HP engine and a six-stage turbine.

o Public institutions, such as schools

With the advance of the project, primary and secondary schools and the mosques will have to be constructed as the workers engaged in the project and their dependents will increase. The construction of such facilities should also be so designed as to piece out the educational facilities of indigigenous communities to a maximum extent.

o Medical facilities

Among others, the medical services are the things the Togian folk are most in need of.

It is therefore recommended to open clinics in keeping with the progress of the project to extend medical services to both inhabitants and project employes.

o Development of farmland

Those forests which are identified as future farmland should be deforested first. Along with logging of such forests, a helping hand should preferably be extended to the felling of small and

medium trees and also to the buildup of farmland itself.

2. Methodology of logging and regeneration

The Directorate General of Forestry has already had expert knowledge about what the forests in the Togian Islands are.

According to the surveys conducted by the Directorate General of Forestry the forests in the Togian Islands are vegetated by no less than 127 tree species, and trees of 50 cm and more in diameter amount to 91.44 m³ per ha.

Of these species, those which are likely to be merchantable on Japanese tropical timber markets some way or other are limited to Palapi, Kume, Nantu, Dama-dama, Kenari, Bintangoro, Makakata Merah, Tawan, Kayu China, and Siuri (all in vernacular names), and all others are not seen on the Japanese markets at all. The logging of these unmarketable species involves ramified problems to be solved in quite a different way from that of Meranti and other tropical species which have already been on market.

Even log scales which are essential to the logging and lumbering have not yet been established. For marketable logs, market prices have been established according to diameter classes, lengths and quality, and it is possible to give an account of logging operations. For unmarketable species, however, we have first to tackle the nebulosity. Although the so-called M.L.H. referred to tropical timber is sure to be put on the Japanese markets, but its uses are limited to packing materials and construction materials because of low quality. If the project concentrates on the development of this type of logs, it will leave no margin of profit.

Lauan, which once had enjoyed a synonym for tropical species, was replaced by Meranti in a few years. Considering this example, it is important for the project to be operated to keep supplying commercially sizable quantity of logs while promoting the development of application technologies.

The development of application technologies and the lumbering methods (lumbering specifications) are two inseparable sides of the logging business. Since the project is to deal with a great number of unmarketable species with unknown factors, its risk is so much.

In addition, the project is also to face various other problems to be solved, including the establishment of know-how about the selection of trees to be cut, control and disposal of down-fall decay and insect depredation, protection of cut trees from cracking, and protection and preservation of promising young growths for sustained yield.

Another problem the project will encounter is how to maintain, supplement and bring up young growth after logging.

Since the species are quite new to us, a new technology is to be developed for the purpose of regeneration.

Not only should all these technologies be developed individually, but at the same time they should be integrated each with the other systematically.

For example, the methods of logging and transportation are governed by the regeneration techniques. Namely, if the regeneration method is determined, the methods of logging and transportation are defined of itself.

As regards Meranti, several large-diameter trees are selected per ha. for cutting.

In the Togian Islands, medium-sized trees of about 50 cm in diameter are standing in groups of two to three or so on somewhat hilly parts in the complicated terrain. For this reason, group selective cutting or similar method will have to be adopted. This inevitably calls for due care for the protection, preservation and culture of promising young growth.

Namely, a composite system of implementation technologies covering both logging and regeneration should be established.

Then, how should we consider the logging project in the Togian Islands? First, the scale of the project should be limited to a minimum as risks are involved.

Then, it will become the mission of the third survey to find that minimum where the strategic minimum scale of project operations and the maximum tolerable risk of commitment are to compromise with each other.

As already discussed in the foregoing, the Togian Islands are blessed with small and medium size succeeding trees which offer high potential of natural regeneration.

According to the Directorate General of Forestry, the number of commercially viable trees having a diameter of 35 to 49 cm is 1,036 per ha, or 35% of the total of commercially viable trees. Also, the plot sampling survey by the Directorate General of Forestry suggests high potential of natural regeneration in that some 55% of plots have promising young growth.

In order to ensure the regeneration, therefore, it will be necessary to allow for some period of trial to search out the logging technologies which permit protection and preservation of young growth.

In view of the fact that the trees to be felled are present in groups, stumpage may be exhausted at some places. For this reason, it will also become necessary to have a try for technologies of artificial supplementation and dispersed small-scale afforestation.

Also, improvement of species for the second growth and development of silvicultural technologies for bare lands (remains of shifting cultivation) should be carried out.

In order to find out a rational system of project implementation for the Togian Islands, the following tests will have to be conducted.

- (1) Tests and experiments to be made at the time of logging
 - # Tests and experiments for bringing up more richer forests
 - o How should the selective cutting be if a given stand consists of comparatively overage trees to form a high-story stratum and many small, medium and young trees in the low-story stratum?
 - * Selection in groups of trees
 - * Care not to cause large cutovers
 - * Care not to damage small and medium trees in logging and transporting
 - * Thinning and killing of ivies by chemicals around succeeding trees
 - * Killing of competing useless trees by chemicals
 - o How to handle the stand where the hig-story stratum is composed of overage trees while the low-story stratum is less with trees of small and medium diameters?
 - * Removal of palms (thinning)
 - * Cutting and killing by chemicals of ivies
 - * Raking of cutovers
 - * Killing by chemicals of useless trees
 - # Tests and experiments for protection and preservation of useful small, medium and young trees
 - o Precedent felling
 - o Half stem longs yarding
 - o Bucking at felling point
 - o Use of sulky and logging arch
 - o Study of the suitable density of tractor roads
 - o Limitation on the length of winch line

All these should be tried and studied for the purpose of establishing the logging methods to meet specific localities.

(2) Tests and experiments on an afforestation

It is natural from the viewpoint of plant ecology that the species to be planted should be the ones to meet the natural conditions of the Tогian Islands. However, they should also be selected from the viewpoint of economy.

Considering the topography, geography, and the scale of bare lands and secondary growth, wholesale afforestation will be hard. Accordingly, emphasis should be placed on selecting species of high commercial value.

In addition to the indigenous, useful species, such as Palapi, introduced, broad-leaved species of high commercial value should also be studied.

In the Tогian Islands, silviculture has not yet been practised.

Even in Central Sulawesi, it is still in the stage of trial, far from implementation.

It is very risky to launch upon afforestation on a large scale from the beginning.

It is therefore recommended to start modestly with a small experimental station where efforts should be made to select suitable species and establish the technologies for nursery, etc.

(3) Methodology of application and processing technology development program

Unlike Dipterocarpaceous species, little is known about the processing of the species growing in the Tогina Islands.

As a consequence, the processing systems which have been practised in Java, Sumatera and Kalimantan, cannot be applied directly without high risks.

It is therefore imperative to study economic and technical feasibility of application and processing based on the results of extensive basic tests and experiments.

Namely, tests to examine adaptability to sawing and plywood-making, pilot plant tests and other various tests and experiments will be necessitated. Some of the properties to be clarified in this course of tests and experiments are itemized below.

o Physical properties:

- air-dried specific gravity,
- oven-dry specific gravity,
- distribution of specific gravity,
- air-dried shrinkage percentage,

shrinkage percentage when green to oven-dry,
average shrinkage percentage,
interlocked grain,
intake rate.

o Chemical Properties:

chemical composition,
ash content,
soluble hot water,
soluble alcohol and benzene,
horo-cellulose, -cellulose, lignin and hexane extract,
ether extract,
aceton extract,
methanol extract,
feature of fiber,
length of fiber,
diameter of fiber,
thickness of cell wall,

o Mechanical Strengths:

Young's modulus in bending parallel to grain,
Young's modulus in compression parallel to grain,
Young's modulus in tension parallel to grain,
Stress at proportional limit in bending parallel to grain,
Stress at proportional limit in compression parallel to grain,
Stress at proportional limit in tension parallel to grain,
Greaking limit in bending parallel to grain,
Breaking limit in compression parallel to grain,
Breaking limit in tension parallel to grain,
Young's modulus in compression across to grain,
Young's modulus in tension across to grain,
Stress at proportional limit in compression across to grain,
Stress at proportional limit in tention across to grain,
Breaking limit in compression across to grain,
Breaking limit in tension across to grain,
Partial compression perpendicular to grain,
Shear parallel to grain,
Absorbed energy in impact bending,
Hardness,
Young's modulus in bending across to grain,

Breaking limit in bending across to grain.

o Fungi Resistance:

Weight diminishing ratio by destructive fungi.

Along with these tests, commercial production tests using a sizable quantity of logs should be conducted. This type of tests will be carried out at sawmills and plywood factories.

The test subjects to be covered are as follows.

o Sawing:

Sawing efficiency and required power in band saw,

Drying speed,

Surface check,

Deformation on the section,

Internal check,

Required drying time,

Cutting resistance by rotating knife,

Life time of tooth edge,

Shearing stress in case of being adhered by resorcinol

formaldehyde resin adhesive glue, phenolic resin adhesive glue,

urea resin adhesive glue, polyvinyl acetate adhesive glue or

casein glue,

Wood failure in case of being adhered by each glue said above,

Demamination rate in case of being adhered by each glue said above.

Drying time and shrinkage percentage in veneer,

Adhesion faculty and wood failure in veneer.

o Paintability:

Curing time of paint

Adhesion strength of paint,

Cracking of point.

In order to examine these, it may be suggested to apply the conventional processing methods to know the characteristics of species from their compatibility to such methods.

Namely, the qualities of the species are appraised with reference to the production standards applied to Lauan, Meranti and other species already put to use.

Those species which can be processed without any hitch, those species which are hard to be processed, and those which come in ratings of processability in between the two extremes will be found. In this way, the species will be classified and rated. In this method of appraisal, the same

processing conditions are applied to all species. Accordingly, some species may happen to agree or disagree with them. Even rejected species may be qualified good if the processing conditions are modified suitably. The results of the appraisal method referred to above should therefore be reckoned by way of reference only.

On the other hand, there is another method the underlying principle of which is that each species has its own properties and hence the best way of processing peculiar to it, and in which the optimum processing standards are established after factor analysis of various selected processing conditions. In this method, the optimum processing methods are singled out of a variety of conditions empirically.

