NO.

REPORT OF FOREST INVENTORY ON PLANTATION OF HARD-WOOD IN VITI LEVE, FIJI

March 1981

JAPAN INTERNATIONAL COOPERATION AGENCY

(J.I.C.A.)

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PREFACE

It is with great pleasure that I present this report entitled Report of Forest Inventory on Plantation of Hard-wood in Viti Leve, Fiji to the Government of Fiji.

This report embodies the result of a forest inventory survey which was carried out in Nukurua area, from 6th September to 20th October, 1980 by the Japanese survey team commissioned by the Japan International Cooperation Agency following the request of the Government of Fiji.

The survey team, headed by Mr. Tomohisa Fukumori, had a series of close discussions with the officials concerned of the Government of Fiji and conducted a wide scope of field survey and data analysis.

I sincerely hope that this report will be useful as a basic reference for development of the region.

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

March, 1981

Keisuke Arita

Keisuke Arita
President
Japan International Cooperation Agency

Mahogany
planted year 1966 (14 years old)

Cedamba
planted year 1971 (9 years old)

E. deglupta
planted year 1964 (16 years old)

Maesopsis
planted year 1974 (6 years old)

Cordia ,
planted year 1975 (5 years old)

Kaubula
planted year 1968 (12 years old)

CONTENTS

1. SURVEY OUTLINE

1.1 Purpose

The purpose of the survey was to ascertain, by aerial photograph analysis and field survey, the distribution and resources of hard-wood plantations in Nukurua area, Viti Levu island, Fiji.

1.2 Outline of the survey area

The survey areas are forestry land leased to the Fiji government in Nukurua on the Fijian island of Viti Levu. (See Figures 1-1 and 1-2.)

(i) Location and extent.

Viti Levu is located between latitude South 18° and longitude East 178°. The area is about 13,000 km^2 and this is 70% of the total area of the Fiji islands. The survey area, Nukurua, is located in the south-east part of Viti Levu island and it is about 8,000 ha.

(ii) Topography and geology

The majority of the main islands of Fiji are almost entirely of an ancient volcanic nature, with occasional Cretaceous and Tertiary sedimentary deposits.

Viti Levu island is also of a volcanic nature, and in the centre there is a range of mountains of about 1,000 m altitude running north-south. By this watershed,, it is divided into a wet region in the east and a dry region in the west.

The Nukurua area is located near the coast and its topography is gently undulating. To the south, Viti Levu's largest river, the River Rewa, runs slowly, forming an alluvial plain.

(iii) Climate

The climate is a tropical maritime climate, with high temperature but modified by maritime influence. The predominant wind is the trade wind which tends to be easterly throughout the year; therefore extremely hot weather is not experienced. Hurricanes occur in the period between November and April, sometimes causing considerable damage, but in the long term strong winds is few.

With regard to precipitation, according to the measured value in 1972, it was 4,051 mm at Suva, which is in the wet region, with the largest amount occuring from January to April and from October to December. Even in the month of least precipitation, it was 114 mm.

On the other hand, at Nadi, which is in the dry region, it was only 1.830 mm with the largest amount occuring from Octover to March, while in the period April to September the amounts were very low. In the dry region the dry and wet seasons were clearly separated.

Mountains in the big islands were covered with mist and cloud almost permanently and its annual precipitation reached over 7,620 mm.

The Nukurua area belongs to the wet region and its annual precipitation is generally speaking higher than the Suva area.

Fig. 1-1 Location map of FIJI

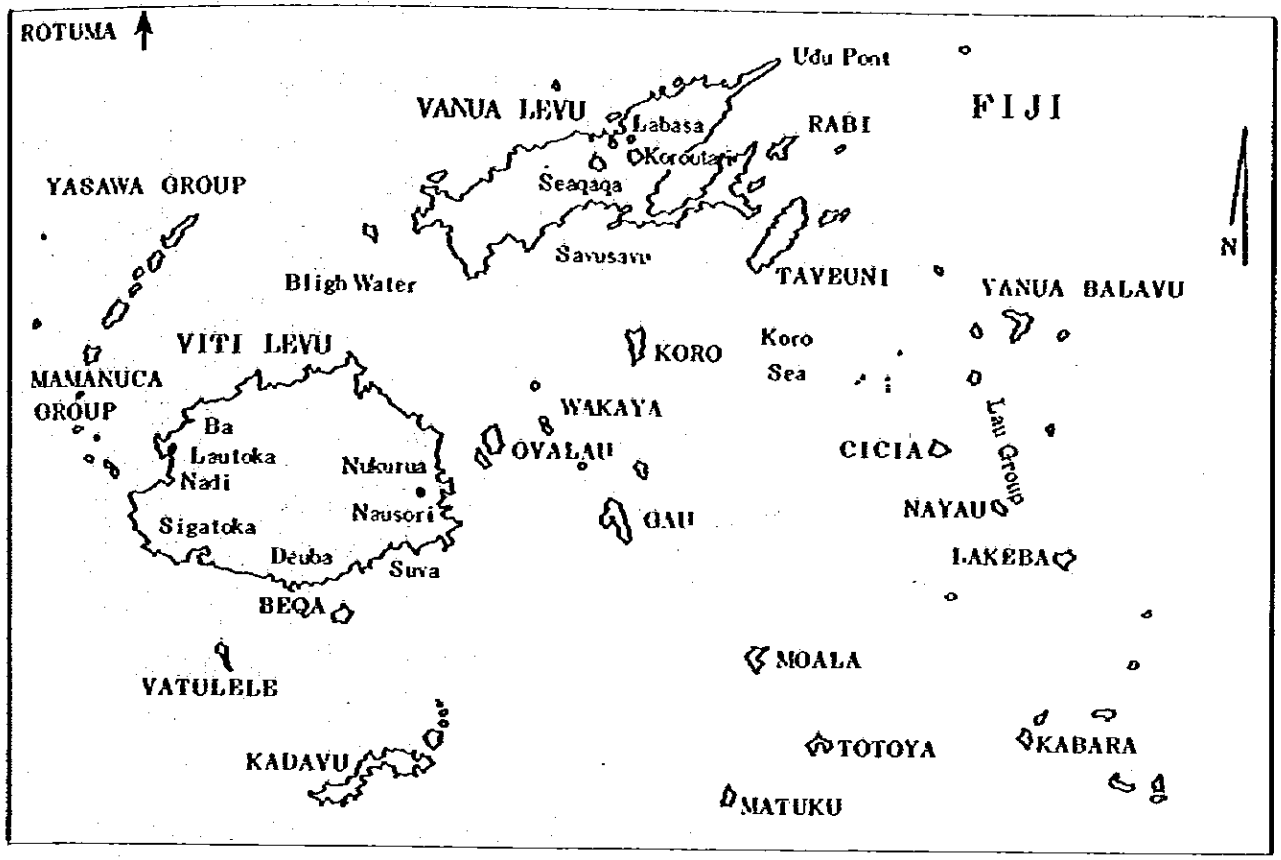
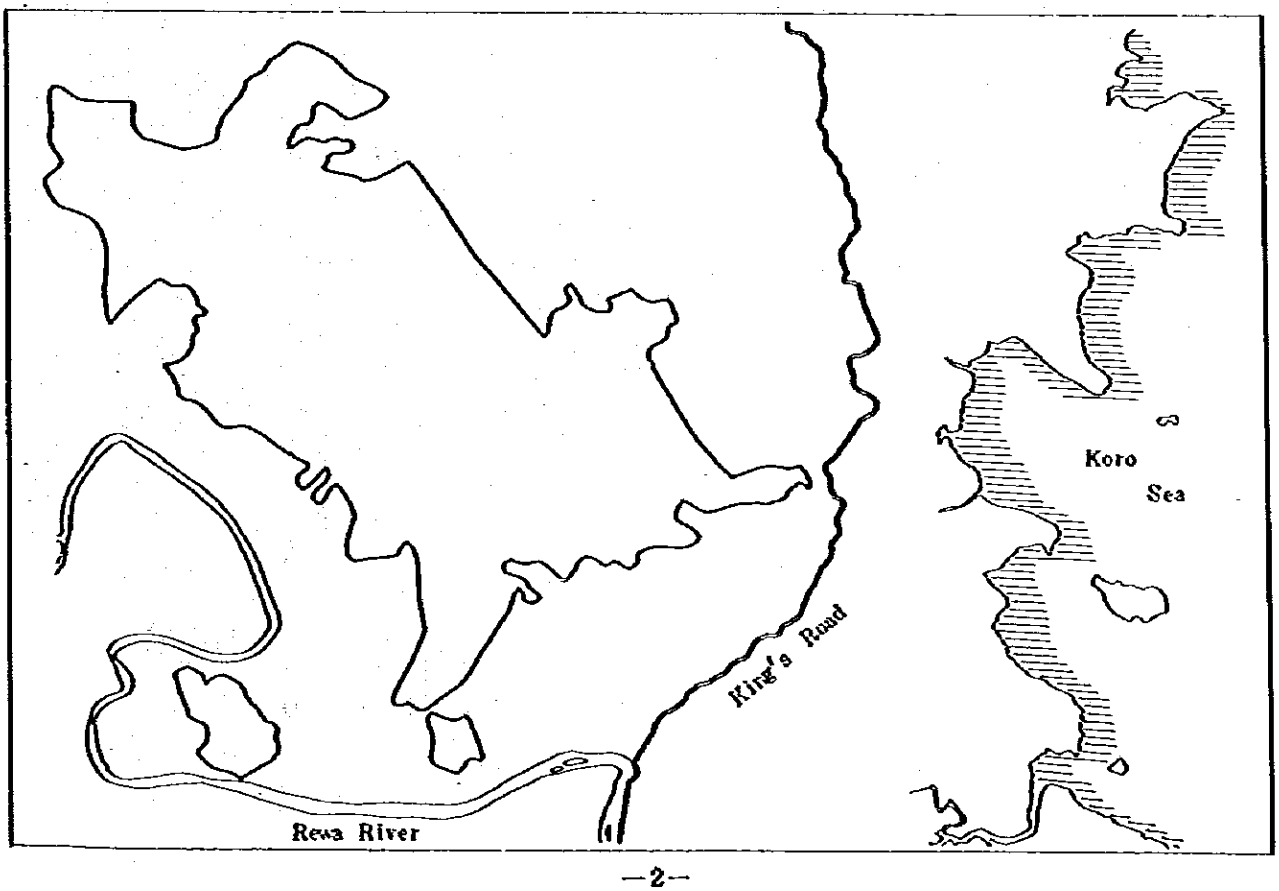


Fig. 1-2 Location map of NUKURUA



1.3 Survey team, and associates in Fiji

The hard-wood survey team for the Nukurua area consisted of the following members:

Overall group

Leader	Tomohisa Fukumori, Adviser, Japan Forestry Technical Association.	
	Hiroshi Watanabe, Technical Department Manager, Japan Forestry Technical Association.	

Survey group

Leader	Kazuo Shishikura	Deputy Manager, Planning Department, Japan Forestry Technical Association.
	Kuniyasu Wakamori	Chief Technical Expert, Japan Forestry Technical Association.
	Michiharu Kondo	Technical Expert, Japan Forestry Technical Association.
	Ryoichi Sato	Engineer, Japan Forestry Technical Association.

Associates in Fiji were as follows:

The Forestry Agency	Conservator of Forests. G.H.D. Williams.
"	Deputy Conservator of Forest. K.T. Yabaki
The Forestry Agency, Senior Assistant Conservator of Forests	A. Oram.
"	Administration Manager J.T. Usumaki

1.4 Summary of planting species of broad leaved trees in the survey

(i) Planting species

Mahogany (Swietenia macrophylla) is the main planting species, and has been planted abundantly in this area. Because of the few technical problems involved in planting this species, and because of the high quality timber produced at the cutting period, afforestation of this species was begun in 1961, reaching 4,900 ha. in 1971.

However, in 1970, damage from Ambrosia beetles was found to be widespread in planted mahogany trees, so that afforestation of mahogany was held back from 1972.

Along with the planting of mahogany, test plantations were made in order to select other planting species. Especially because of the Ambrosia beetle damage and the subsequent hodling back of mahogany planting, the need to select alternative planting species rapidly became great. Test plantations for nearly 200 species were carried out, from which six species including mahongany were chosen as possible future planting species. From 1972, afforestation is being carried out using these six species. The six species are the subjects of this survey.

Common name	Botanical name
Mahogany	Swietenia macrophylla
Cadamba	Anthocephaus Cadamba
Deglupta	Eucalyptus deglupta
Maesopsis	Maesopsis eminii
Cordia	Cordia alliodora
Kauvula	Endospermum macrophyllum

Of the above, only Kauvula is of local origin, the other five being from abroad.

(ii) Regeneration and tending

With regard to the method of afforestation, in the majority of cases this is by line planting. This is a method in which, after extracting the required species from the natural forest, lines are dug 2 – 3 m wide, speced about 10 m (30 36ft) apart, and planting done in lines. At the same time, large unnecessary trees left in the forest are girdled using arsenic, and trees which would have a detrimental effect on the planted trees are cut down. The planting period is from November to April, which is the rainy season. Girdling should be carried out in the six months prior to planting, the most suitable period still being under consideration; generally, though a time three months prior to planting appears to be the most effective. With regard to brush cutting, this is required about four times a year in the lines. Vine cutting in the line is also an important operation. Because the Nukurua is in the wet region, the planting quantities are large with the result that the main problem concerns competition between the planted trees and other vegetation. Therefore, in order to minimise the competition period, planting species with rapid growth in its early stages is considered important. This is the reason that conifers, etc., with their slow growth in the early stages, have not become major planting species in the wet region. This condition of fast growth in the early stage was said to be the prime factor in the selection of presently planting species.

(iii) Characteristics of quality

It is difficult to mention clearly about qualities of the 6 species, because the species in Nukurua have not yielded. So qualities of similar species which arrives on the market are mentioned.

(1) Mahogany.

Swietenia macrophylla KING.

(Meliaceae).

In addition to the above mentioned species, another mahogany is S. mahagoni JACQ which used to have a good reputation for high quality. However, supplies of S. mahagoni are now said to be exhausted, and it is seldom found on the market. Because of the high value timbers of the mahogany group, plantations have been attenpted in tropical areas all over the world. However, of the species, in South East Asia only S. macrophylla plantations are well known, and plantations of S. mahagoni are not well known. Therefore, to obtain the latter in the future will be increasingly difficult.

When naming high value timber species known world-wide, mahogany always appears with teak, walnut and rosewood. Also, as with Philippine mahogany (of the Lauan family), names are often used to artificially boost a timber's value which indicates the status of mahogany.

The species originated in tropical America and it is distributed over the continent in Mexico, Honduras, Guatemala, Nicaragua, Costa Rica, Panama, Colombia, Venezuela, Peru, Bolivia and Brazil. On the other hand, the distribution of S. mahagoni is limited to the West Indian islands of Cuba, Jamaica, Bahama, Puerto Rico, Dominica and Haiti. In comparison with S. mahagoni (air dried specific gravity 0.77 (0.77 – 0.85)), S. macrophylla is lighter in colour and light in weight. Therefore, S. mahagoni, with its dark colour and greater weight may be considered superior.

The colour of the corestock is pink or dark red, with a golden gloss. The grain is a shallow cross grain, while the texture is rather rough. Sometimes, mahoganys occur having irregular grain, which produces beautiful patterns. The line of the vessels are dark in colour and produce distinctive dark stripes visible in longitudinal

sections. The air dried specific gravity is 0.53 (natural stand) and 0.53 (planted stand), and the bulk density is 450 kg/cm^3 (natural stand) and 420 kg/cm^3 (planted stand). A shrinkage percentage of up to 12% may be measured from fresh timber, including a tangential component of 2.5% and a radial component of 1.6%. With regard to strength, the following values have been obtained.

Producing district		Specific Gravity	Water content (%)	Bending strength (kg/cm^2)	Bending Young factor (1.000kg/cm^2)	Compression strength (kg/cm^2)
Natural Tree	Mexico	0.50	10.5	868	109	503
	Nicaragua	0.53	10.7	840	106	—
	Peru	0.59	12.0	868	108	499
	Honduras	0.50	12.0	805	96	432
	Brazil	0.53	11.9	811	99	453
Planted Tree	Honduras	0.50	13.4	722	81	397
	Fiji	0.52	12.0	720	92	439

This wood is easy to dry and bears lumbering and mechanical processing well. It is also a good wood for single plank cutting and drying. The corestock has poor durability when in contact with the ground. The albumum is vulnerable to damage by Powder post beetles (Lyctus. brunneus. Stephens) Those presently growing in Fiji are not much affected by Ambrosia beetle. so in the future, a fairly large quantity of middle sized timber will be produced.

Its uses are, as already mentioned, various, but, because of its beautiful appearance, stability of size, and ease of processing, it is widely used as a high-class material.

(2) Cadamba
Labula
Kalampayan
Kaatoan banghal
Anthocephalus cadamba (ROXB.) MIG.
(=A. chinensis (LAMK.) RICH.)

This is distributed over an area stretching from South East Asia to New Guinea. In the Philippines it is known as Kaatoan banghal, and is grown mainly for pulp timber. It is also one of the typical planting species in tropical Asia. When the second growth has formed, it is a quick growing species, for a pioneer species. Since being imported from Papua New Guinea under the name of Labula, the range of uses for light coloured and light weight timber has widened.

The colour of the corestock is a yellowish white, or a dull light yellow. The grain is a cross grain, and the texture is rough. The air dried specific gravity (water content 12%) is 0.44 (Lubula) and the bulk density is 420kg/m^3 (Kalampayan) and 390 kg/m^3 (Labula), and the shrinkage may be up to 15% including a tangential component of 3.9% and a radial component of 1.0%. With regard to strength (air dried specific gravity 0.44), the bending strength is measured at 659 kg/cm^2, the Bending Young factor is 87 1000kg/cm^2, and the compression strength is 347 kg/cm^2. It is easy to process. Durability is poor when in contact with the ground, and is vulnerable to damage by blue stain fungus.

Some uses require light colour, light weight wood. Generally, this wood is used as lumber, where it will not be visible. Its applications include matchsticks, pulp, plywood, light construction and crates, etc.

(3) Deglupta

Kamerere, Kamarere

Bagras

Eucalyptus deglupta BLUME

Myrtaceae

This species is distributed in New Guinea, Sulawesi and the Philippines. It is known as Bagras in the Philippines, and as Kamerere in Papua New Guinea. Recently it has been planted in the Philippines (Mindanao) and Papua New Guinea for pulp timber. Because it has rapid growth in its early stages, it is considered suitable for afforestation in which the major purpose is to obtain large quantities of wood for lumber at the expense of quality. When this species is used for lumber, unless high technology and experience are available, depending on the use, it is difficult to obtain high quality products, even if the wood has been naturally grown. Furthermore, in the case of planted trees, because of its low specific gravity and because growth stress faults or drying faults become more apparent than in naturally grown wood, some fairly extensive research may be required into the technical developments needed in order to make good use of it as lumber. The colour of the corestock is, in the case of naturally gown wood, dark red, while in the case of planted trees, no dark coloured corestock has been found, due to young tree age, although having relatively large diameters. The texture is somewhat rough, and has a cross grain. Values for air dried specific gravity (water content 12%) are 0.60 (Kamerere, naturally grown), 0.45 (Kamerere, planted), and 0.40 (0.34 – 0.47 Fiji product). Bulk density is 50000 kg/cm^3 (Kamerere, naturally grown), 400 kg/m^3 (Kamerere, planted), and 320 kg/m^3 (270 – 384 kg.m^3 Fiji product). Shrinkage is up to 12% from fresh timber, including a tangential component of 2.9 – 11.1% and a radial component of 1.1 – 3.6%. With regard to strength (air dried specific gravity 0.41), the bending strength is 583 kg/cm^2, the Bending Young factor is 91 $^{1000\ kg/cm^2}$, and the compression strength is 344 kg.cm^2 (planted trees). Durability is low when in contact with the ground, and it is vulnerable to damage by Powder post beetles.

Its applications, in the case of timber from naturally grown trees, include furniture, floor boards, boat building, construction and cabinet-making. In the case of timber from planted trees, it is likely that applications are limited.

(4) Maesopsis

Musizi

Maesopsis eminii ENGL.

Rhamnaceae

This is a species of African origin, and is produced in Liberia, Congo, Tanzania, Kenya, Cameroon, Guinea. It is known as an African market timber, but it is not considered to have any special characteristics.

The corestock is a dark golden colour, and as time passes it becomes darker. It has a golden gloss. The texture is rough, and it has a cross-grain. The air dried specific gravity (water content 12%) is 0.48 and shrinkage is up to 12% from fresh timber, including a tangential component of 4.2%, and a radial component of 2.6%. With regard to strength (water content 12%), the bending strength is 728 kg/cm^2, the Bending Young factor is 100 $^{100\ kg/cm^2}$ and the compression strength is 449 kg/cm^2.

When logs are cut and stored there is a tendency for splitting to occur. Lumbering and mechanical processing is easy. Durability is poor when in contact with the ground.

In Africa it is used for construction, furniture and cabinet making. Its finish is not considered good quality, so it is not used when a high quality finish is required.

(5) Cordia

Laurel

Cordia alliodora (R. & P.) CHAM

Boraginaceae

This species originated in the West Indies, and is distributed from Mexico across the whole of South America. When travelling around Papua New Guinea, carvings of dolphins and sharks in wood can been seen; the wood comes from the nearby Solomon Islands, and most of this wood is of the same type. In Africa, carvings can be found in wood of the same type. This group is divided into two, one being dark in colour and heavy, the othr being light in colour and weight, and this species falls within the latter.

The colour of the corestock is dark gold with a dark greenish appearance. Generally it has dark stripes. Its surface is similar to that of Japanese Chishanoki. The colour and specific gravity varies according to tree age and growing conditions, but generally with older and more slow growing trees a darker colour and heavier harder wood can be expected. The air dried specific gravity is 0.40 – 0.70. The texture is rather rough, with a cross or through grain. Processing is easy, and finish is good.

It is used for construction, furniture, cabinet making, turnery plywood, interior decoration and carving. On the market, it is given the name Siera Walnut, so its use can be expected where a so-called walnut-look interior is required.

(6) Kauvula

Fijian basswood

Endospermum macrophyllum (MUELL. ARG.) PAX et K. HOFFM.

Euphorbiaceae

This type of species is a pioneer species often found on land after forest clearance in South East Asia. Because it has good growth in the early stage, it is often used as a kind of planting species, where pulp timber is the aim. It is often sold on the Japanese market under the name of Gubas (Philippines) or New Guinea basswood (Papua New Guinea). However it is not related to the true basswood group.

In forests, often a gigantic Kauvula tree can be found, which may indicate that the area is a secondary stand.

The corestock is a light yellowish white. It has a through grain, or a light cross grain. The texture is rather rough. The air dried specific gravity (water content 12%) is 0.48 (0.40 – 0.54) and the bulk density is 432 kg/m^3. With regard to strength (air dried specific gravity 0.51), the bending strength is 790 kg/cm^2, the Bending Young factor is 110 ^{100} kg/cm^2, and the compression strength is 442 kg/cm^2.

Artificial drying is easy, presenting no particular problems. Lumbering and mechanical processing is easy, and the finish is good. Piercing is easy and turnery is good. Durability is low when in contact with the ground, and it is vulnerable to damage by Powder post Beetles. As a plywood, finish is good, and a yield percentage is also good. Its uses include moulding, interior construction, furniture,

cabinet making, turnery, floorboards, light construction, matchsticks, crates, boxes and banana crates. The range of application is very wide. In Fiji, it is in very wide use.

Recent production has exceeded 19.6% of the total log production. This indicates that it is an important species.

2. SURVEY OF HARD-WOOD RESOURCES

2.1 Selection of survey method

The following volume survey methods were considered:

(1) Method of every tree measurement.

(2) Method of sample survey.

(3) Method of standard sample plot.

The method of every tree measurement, (1) is a method in which every tree is measured, as the name indicates, and,although it has the greatest accuracy, in a survey covering several thousand hectares it represents both huge expense and effort, and is almost impossible to carry out. Therefore, in a wide survey area, methods (2) and (3) in which sample measurements are made and results estimated for the whole, are used. Method, (2), method of sample survey, generally involves sampling at random, and estimating the total volume. Although it has advantages, such as high efficiency in estimating the total volume and its estimated accuracy can be calculated, it is not suitable for estimations of individual stand volumes. Method, (3), Method of standard sample plot, uses aerial photographs, dividing the forest into various types of stands, and according to the types, standard sample plot surverys are carried out at specific locations, and the volume estimated. Then, using the sample plot results as data, by estmating each stand's volume from aerial photographs, and by calculation, the total volume can be calculated. This is suitable for estimation of individual stand volume. Although the accuracy of the calculated total volume is not estimated statistically, if the individual stand volume estimation is accurate, it is assumed that the calculated total volume is also accurate. The purposes of this survey of hard-wood resources are to estimate the total volume, and to produce a forest inventory note according to compartment, sub-compartment and forest type. Therefore, in this survey, method, (3) was adopted.

2.2 Survey procedure

The survey procedure is shown in the Resource Survey Procedure Flow Chart, Figure 2-1.

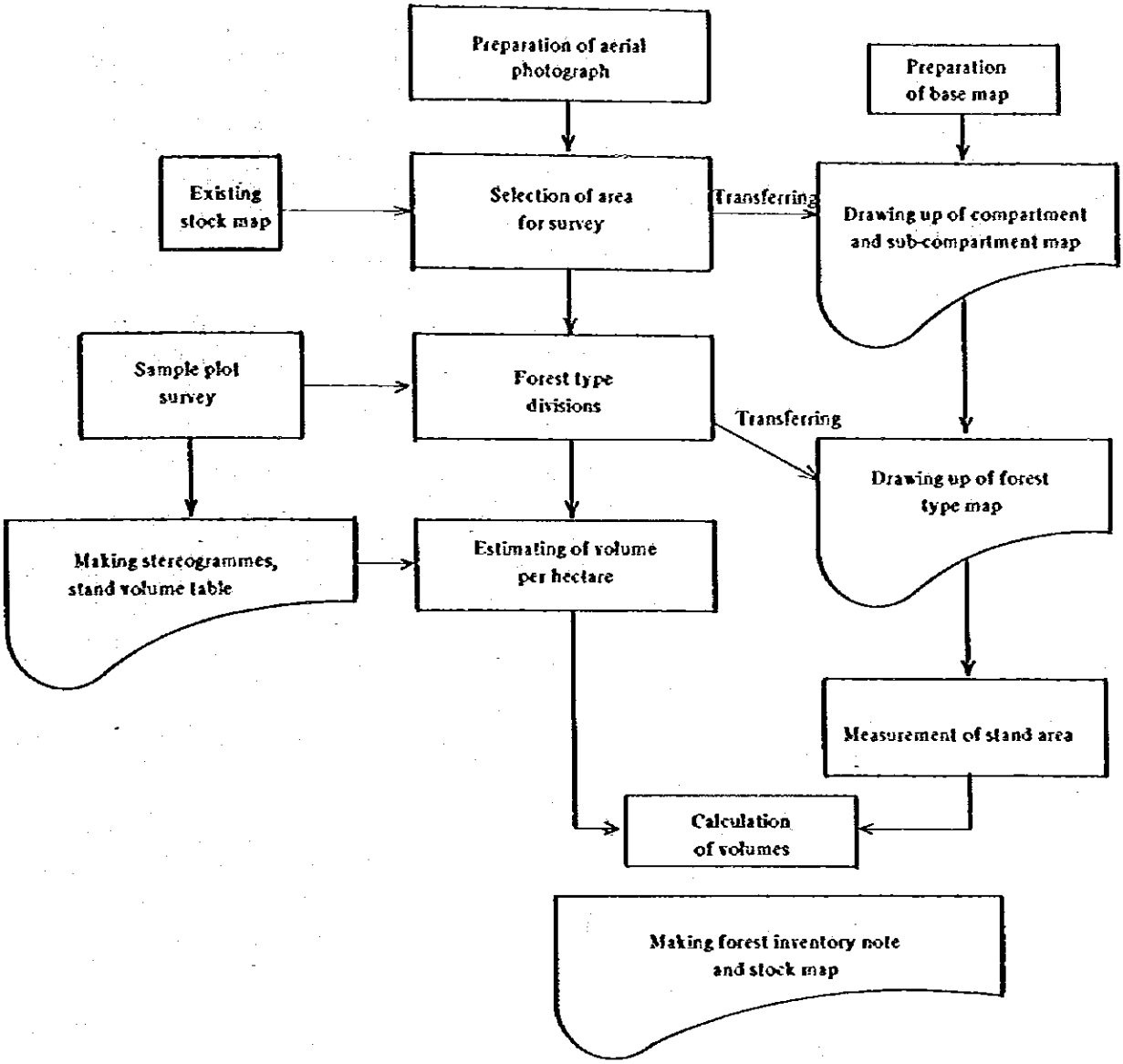
(i) Preparation of aerial photographs.

The most recent aerial photographs covering the whole survey area were prepared. Details of the aerial photographs used are given in Table 2-1.

Table 2-1 Details of Aerial Photographs Used

District Name	VITI LEVU
Flying date	June – July, 1978
Flying altitude	3,100 m
Focal length	152.89 mm
Scale of photograph	1 : 20,000
Scale of photograph used	1 : 10,000
Planned by	Fiji Government

Fig. 2-1 The resource survey procedure flow chart



(ii) Preparation of base map.

A base map was prepared by copying a seperately prepared contour map. (The contour interval was 20 m).

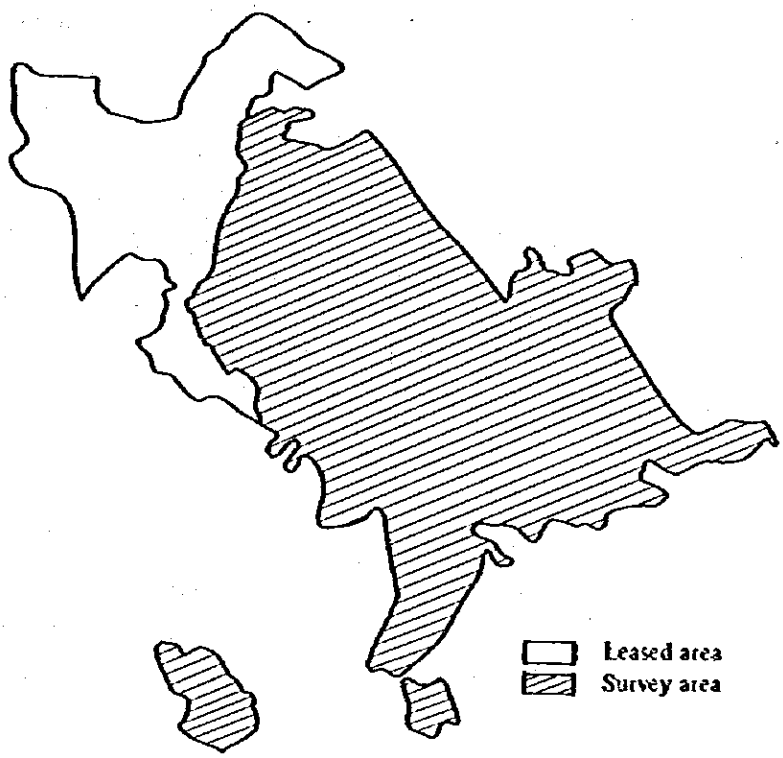
(iii) Selection of areas for survey.

The total area of the Nukurua area leased by the Fiji Government from private owners for the purpose of aforestation of hard-wood is 8242 ha, but, taking into account the two points mentioned below, the resource survey area was limited to the areas afforested up to 1977. The area is 6253 ha.

(1) Areas deeper into the forests are natural forest, not yet being man made.

(2) Because the most recent aerial photographs were taken in June-July 1978, surveys of more recent areas of afforestation was difficult.

Fig. 2-2 Survey Area



(iv) Drawing up of compartments and sub-compartment maps.

Formerly, in Fiji, stock maps showing compartment planting species and planted years were marked with only valley lines.

Based on these stock maps, by field survey and interpretation of aerial photographs, compartment and sub-compartment extents were checked and amended, and by transferring this information onto base maps, compartment and sub-compartment maps were drawn up. With regard to compartments, for the purpose of management, about 100 ha, was chosen for the standard size, and boundaries chosen on the basis of the topography. Division into compartments was made for the whole leased area, and this produced a total of 60 compartments. With regard to sub-compartments, the stands were divided up in the compartments according to species and plantied year.

(v) Drawing up of forest type map, and measurement of areas.

In order to assist the suitable forest working and estimating volume on each stand, on the aerial photographs the sub-compartments were sub-divided into forest types, based on Table 2-2 standard table of dividing Forest Type.

Transferring these forest type divisions onto the sub-compartment map, a map of forest types was made, and at the same time, areas according to forest type were measured, and areas calculated for sub-compartments, compartments and the total.

Table 2-2 Standard of dividing forest type

Item	Contents	Mark
Tree age	Planted year shows tree age Example, p.70 means planted year 1970.	example p. 70
Tree species	Survey 6 species are divided mahogany Cadamba Deglupta Maesopsis Cordia Kaubula	 S. mac A. cad E. deg M. emi C. all E. mac
Average tree height	This is divided to the nearest meter, Planted year 1961 – 1971, this is recorded Merchantable Height. Planted year 1972 – 77, this is recorded Total Height.	example MH_4 TH_{11}
Crown density	0 – 9% 10 – 39% 40 – 69% 70 – 89% 90 – 100%	D_1 D_2 D_3 D_4 D_5

(vi) Sample plot survey.

In order to provide data on which to base the interpretation of aerial photographs, two or three sample plots were established in the area for each species and planted year. The area of the rectangular sample plot was 0.1 ha, and every tree measurement was carried out for diameter and tree height on all planted trees in the plot.

There were 92 sample plots. With regard to the sample plot survey, this is described in section 2.3.

(vii) Making stereogrammes and stand volume table.

Using the results of the sample plot survey, by comparing the plot with its aerial photographs, stereogrammes were made for the purpose of forest type interpretation. At the same time, a stand volume table was drawn up according to planted year and number of trees per hectare. Using these data, estimating of volume per hectare according to forest type was carried out, and the forest type divisions checked. Details are given in section 2.4.

(viii) Calculation of volumes.

By multiplying the area of the forest type by the volume per hectare, the stand volume was calculated. Furthermore, by totalling the volumes per sub-compartment and compartment, the total volume was obtained.

(ix) Making the forest inventory note.

A forest inventory note was made, with area, volume, species and tree height, etc., according to forest type, sub-compartment and compartment. Details are given in section 2.6.

2.3 Sample plot survey

To provide data for volume estimating, smaple plots were established in the survey area and every tree measurement was carried out in these plots.

(i) Distribution of sample plot.

In deciding the location of sample plots, the following points were borne in mind.

(1) At least two survey plots were to be established for each of the six species and each planted year.

(2) At least three survey plots were to be established for each species and each planted year for large planted areas.

(3) Survey plots were also to be established for stands having special characteristics, such as closely planted stands and direct sowing stands.

The results are given in Table 2-3.

In deciding the location of sample plots, careful consideration was given to crown density, topography in order to not lean the distribution of sample plots.

(ii) Size and shape of sample plot.

The size was fixed at 0.1 ha. with a rectangular shape formed by sides of 20 m and 50 m. However, in practice because planting was line planting, and the line spacing varied according to location, the width of the plot was adjusted to accomodate 2~5 lines, and the length adjusted to provide an area of 0.1 ha.

Table 2-3 Distribution of sample plots

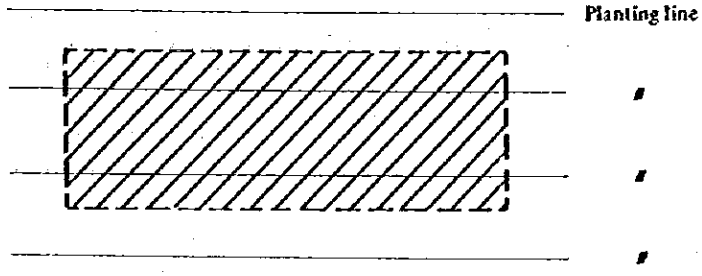
Mahogany		
Planted year	Numbers of sample plots	Note
1961	2 plots	large planted areas
1962	3	
1963	3	
1964	3	
1965	3	
1966	3	
1967	3	
1968	3	
1969	3	
1970	3	
1971	3	
1972	–	No planting
1973	–	
1974	2	
1975	2	
1976	2	
1977	2	
sub-total	40	
1965	2	very close planting
1965	2	close planting
1967	1	direct sowing
1971	1	
sub-total	6	
Total	46	

Except Mahogany			
Species	Planted year	Number of sample plots	Note
Cadamba	1971	2 plots	
	1975	2	
	1976	2	
	1977	2	
Deglupta	1964	2	poor result
	1972	2	
	1973	2	
	1974	–	
	1975	2	
	1976	2	
	1977	2	
Mesopsis	1974	2	
	1975	2	
	1976	2	
Cordia	1971	2	
	1973	2	
	1974	2	
	1975	2	
	1976	2	
	1977	2	
Kaupula	1968	2	
	1975	2	
	1976	2	
	1977	2	

Total number of sample plots according to each species

Species	Number of sample plots
Cadamba	8 plots
Deglupta	12
Maesopsis	6
Cordia	12
Kaubula	8
Sub-total	46
Mahogany	46
Total	92

Fig. 2-3 Example, shape of sample plot



(iii) Items and details measured.

For every tree in the plot, measurements were made for all the items shown on the Inventory Data Sheet, Table 2-4.

(1) Tree species.

With regard to planted trees, only six species, including mahogany, were noted. With regard to natural trees left in the lines, only 41 merchantable species were counted. The names of the 41 merchantable species are given in Table 2-5.

Table 2-4 Inventory Data Sheet

Planted Tree							Natural Tree						
Tree No.	Stem Diameter	Merchantable Height	Total Height	Crown Radius	Form Class	Damaged Tree	Tree No.	Tree Species	Stem Diameter	Merchantable Height	Crown Radius	Form Class	Damaged Tree
0							0						
1							1						
2							2						
3							3						

Table 2-5 Merchantable species of natural trees

1. Dakua (m)	22 Moivi
2. Kauvula	23 Kuasi
3. Kaudamu	24 Mala
4. Damunu	25 Danabi
5. Yasiyasi	26 Amunu
6 Mavota	27 Rosawa
7 Dakua (S)	28 Buabua
8 Buavudi	29 Sa
9 Sacau	30 Koka
10 Rosarosa (Rogi)	31 Sorovulu
11 Yaka	32 Vutu
12 Kaunicina	33 Kauceuti
13 Laubu	34 Vuga
14 Vesi	35 Cevua
15 Ma	36 Sasauira
16 Tivi	37 Kannigai
17 Raintree	38 Dawa
18 Bau	39 Duvula
19 Tabadamu	40 Kaukaro
20 Sorosaro	41 Others
21 Vaivai-ni-veikau	

(2) Stem Diameter Breast Height (D. B. H.)

This measurement was taken to the rounding two centimeters, with a calliper. With regard to planted trees, all trees were measured, but for natural trees, only trees of 10 cm or more were measured, while natural trees of less than 10 cm were not recorded.

(3) Tree Height.

This was measured to the nearest meter by both Blume-Leiss and by eye. In Fiji, tree height is generally recorded as Merchantable Height, and volume tables for mahogany and natural trees are described in Merchantable Volume. Measurement of the Total Height of tall trees was certainly difficult, but for young stands, it is difficult to distinguish between Merchantable and Total Height. The decision on which measurement to use for tree Height was based on the standards shown in Table 2-6.

Table 2-6 The standards of measurement for tree height

Species		Planted Year	
		1961 – 1971	1972 – 1979
Planted tree	Mahogany	Merchantable Height (MH)	Total Height (TH)
	5 species except Mahogany	Merchantable Height (MH) Total Height (TH) is indicated for reference.	Total Height (TH)
Natural tree		Merchantable Height (MH)	

(4) Others.

Supplementary information was collected with regard to crown radius, form class, and damaged trees.

Table 2-7 The volume formula of each species

Species	Marchantable Volume	Total Volume
Mahogany	$MV = 0.053562 + 0.457D^2 \times MH$	Left formula is substituted.
Cadamba	$MV = 0.0301 + 0.4720D^2 \times MH$	$TV = 0.0081 + 0.3764D^2 \times TH$
Deglupta	$MV = 0.0807 + 0.4133D^2 \times MH$	$TV = 0.0146 + 0.3197D^2 \times TH$
Maesopsis	$MV = 0.0185 + 0.4150D^2 \times MH$	$TV = 0.0251 + 0.3034D^2 \times TH$
Cordia	$MV = 0.0129 + 0.4381D^2 \times MH$	$TV = 0.0012 + 0.3079D^2 \times TH$
Kaubula	Following formula is substituted.	Left formula
Natural-tree	$V = 0.101 + 0.4908D^2 \times MH$	

MV is merchantable volume underbark in m^3

TV is total " "

D is d.b.h overbark in metres.

MH is merchantable height above stump in metres

TH is total " " "

The formula used to obtain the single tree volume was the formula derived by the Fiji Government used in thinning trees in plantations and test planted areas. With regard to species for which no formula exists, the formula which seemed most suitable was adopted.

(iv) Results of sample plot survey.

The results of the sample plot survey are given in Table 2-8.

2.4 Making data for interpretation

By using the sample plot survey results as data to estimate volume per hectare for every forest type using aerial photographs, stereogrammes and stand volume table were made.

2.4.1 Making Stereogrammes

Stereogrammes are used to compare survey results and images from aerial photographs for each sample survey plot, and are useful for interpretation of forest types by visual means. Stereogrammes were made for 92 sample plots in this survey (Table 2-9 shows an example).

The aerial photographs used were taken in 1978, so there is a two-year discrepancy with the survey which was carried out in 1980. Therefore it was necessary to back-date the survey data by two years. This adjustment is fairly complicated, and the details are given in section 3.

2.4.2 Making Stand Volume Table

The estimation of volume using stereogrammes is directly related to volume by visual means. Therefore, if the same forest type stand as the stand under interpretation is described in the stereogramme, its volume value can be used as it is. But in the case where the same stand is not in the stereogramme, the volume must be estimated by comparison with similar stands. Thus, there is a possibility of a large error being puted in. 92 stereogrammes were made, based on results from the field survey, but the forest type are very varied, and there is no guarantee that all forest types are covered by the stereogrammes. Therefore, in order to obtain standard of volume estimating of a forest type for which there was no stereogramme, a stand volume table was made.

A stand volume table is a table giving simplified values in which factors such as tree age, which can be obtained from existing data, and factors such as the number of trees and the tree height, which can be measured from aerial photographs, are set out to give independant variables, from which appropriate formulae can be obtained in which stand volume is a dependant variable. The volume can be calculated by using the number of trees and tree height, which can be measured directly from aerial photographs, and is therefore a fairly objective measurement. By detailing the measured values of the factors, the table can be used for any stand.

Normally there are two types of stand volume table. One uses 1~3 factors which can be measured quantitatively, and, by the method of least squares, the volume formula is obtained. This formula is given in the table. The other is a type in which scores are added up according to many factors including those which cannot be measured quantitatively. However, this latter type requires a large amount of data whereas the former type requires relatively little data. Even so, this type required the use of over 30 pieces of data.

With regard to mahogany stands planted before 1971, a highly accurate estimate of volume was required, and a large number of sample plots were surveyed (32 locations).

Table 2-8 Results of sample plot survey

Sample No.	Planted Species	Planted Year	Average D.B.H (m)	Average Height (m)	Volume (m³/ha)	Form Class. (Volume rate%) I	II	III	Basal Area (m²/ha)	Average Crown Radius (m)	Number (living-tree) (/ha)	Plantod-tree Number (/ha)	Number rate of dead-tree (%)	Numrer rate of damaged-tvee (%)	Natural tree Volume (m³/ha)	Remarks
1	Mahogany	19 61	30.81	(M) 9.7	215.7	84	11	5	30.56	3.2	410	550	25	5	0	
2	〃	61	32.27	(M) 7.7	85.6	75	23	2	15.54	3.1	190	410	54	16	4.4	
3	〃	62	33.58	(M) 9.5	62.9	83	17	0	9.74	3.4	110	410	73	0	7.4	
4	〃	62	35.06	(M) 7.6	106.8	20	65	15	21.24	3.1	220	390	44	0	16.4	
5	〃	62	40.98	(M) 6.8	129.1	46	50	4	27.69	4.8	210	540	61	24	0	
6	〃	63	34.62	(M) 6.7	87.2	9	26	65	18.83	4.3	200	450	56	5	0	
7	〃	63	43.63	(M) 6.4	84.4	56	18	28	20.94	5.2	140	410	66	0	0	
8	〃	63	33.90	(M) 5.4	38.1	31	27	42	9.93	3.9	110	400	73	27	0	
9	〃	64	37.49	(M) 7.3	76.1	80	14	6	15.45	4.0	140	510	73	14	0	
10	〃	64	36.58	(M) 9.1	132.8	76	21	3	23.12	3.9	220	450	51	0	0	
11	〃	64	33.87	(M) 8.2	63.5	42	58	0	11.71	3.2	130	410	68	8	6.3	
12	〃	65	25.30	(M)12.5	112.0	62	38	0	13.07	3.2	260	410	37	15	26.8	
13	〃	65	31.93	(M) 9.9	166.5	62	37	1	25.63	3.0	320	650	51	3	0	
14	〃	65	34.51	(M) 8.4	74.9	55	45	0	13.10	3.2	140	450	69	14	0	
15	〃	66	31.00	(M) 8.8	124.6	80	15	5	21.13	3.2	280	370	24	4	12.8	
16	〃	66	34.50	(M) 7.5	84.4	68	30	2	16.83	3.2	180	360	50	0	4.4	
17	〃	66	28.67	(M) 8.1	54.6	91	9	0	9.69	2.9	150	320	53	7	16.7	
18	〃	67	30.60	(M)10.1	89.0	61	35	4	13.24	2.8	180	340	47	6	27.6	
19	〃	67	31.91	(M) 7.6	84.4	8	72	20	15.20	2.8	190	350	46	37	0	
20	〃	67	24.35	(M) 6.8	41.6	68	26	6	7.91	4.1	170	330	48	0	10.1	
21	〃	68	29.25	(M) 6.4	69.3	39	57	4	15.46	2.9	230	400	43	0	1.9	
22	〃	68	22.33	(M) 5.2	33.9	21	51	28	7.44	2.4	190	350	46	16	0	
23	〃	68	21.37	(M) 6.3	23.9	0	83	17	4.30	1.8	120	520	77	8	0	
24	〃	69	21.01	(M) 6.3	33.3	30	60	10	6.58	2.2	190	330	42	11	3.3	
25	〃	69	21.76	(M) 6.0	55.6	58	34	8	10.05	2.3	270	380	29	7	0	
26	〃	69	18.78	(M) 6.7	41.1	73	27	0	6.94	2.5	250	310	19	0	30.4	
27	〃	70	14.88	(M) 5.1	14.9	61	17	22	2.27	2.2	130	270	52	8	0	
28	〃	70	15.68	(M) 5.7	65.4	69	22	9	10.21	2.1	530	650	18	2	15.6	
29	〃	70	14.80	(M) 6.7	29.6	77	13	10	3.95	1.9	230	310	26	4	3.2	
30	〃	71	12.05	(M) 6.8	17.8	53	47	0	1.94	1.4	170	340	50	0	55.3	
31	〃	71	14.32	(M) 8.5	23.3	37	63	0	2.74	1.6	170	350	51	6	13.0	
32	〃	71	14.80	(M) 6.5	25.4	64	30	6	3.43	1.5	200	480	58	0	9.3	

(M), Merchantable
(T), Total

Sample No.	Planted Species	Planted Year	Average D.B.H (cm)	Average Height (m)	Volume (m³/ha)	Form Class (Volume rate %) I	II	III	Basal Area (m²/ha)	Average Crown Radius(m)	Number (living-tree) (/ha)	Planted-tree Number (/ha)	Number rate of dead-tree (%)	Number rate of damaged-tree (%)	Natural tree Volume (m³/ha)	Remarks
33	Mahogany	19 74	12.40	(T) 10.1	28.7	77	21	2	2.66	1.8	220	300	27	0	11.7	
34	〃	74	10.89	(T) 10.5	27.7	54	39	7	2.24	1.9	240	350	31	0	22.3	
35	〃	75	8.88	(T) 9.0	4.3	100	0	0	0.31	0.5	50	260	81	0	26.0	
36	〃	75	8.67	(T) 9.5	29.4	67	28	5	1.89	0.7	320	400	20	3	2.0	
37	〃	76	6.58	(T) 7.4	27.9	84	14	2	0.94	0.6	280	400	30	0	0	
38	〃	76	8.44	(T) 8.6	28.1	88	8	4	1.85	1.1	330	410	20	3	16.1	
39	〃	77	2.52	(T) 2.6	11.2	68	23	9	0.13	0.5	260	330	21	8	43.6	
40	〃	77	1.95	(T) 2.7	11.7	55	36	9	0.09	0.5	290	340	15	0	41.9	
41	〃	65	25.96	(M) 7.1	210.0	46	44	10	35.47	2.7	670	1,130	41	12	0	
42	〃	65	24.07	(M) 7.4	148.9	42	42	16	25.48	2.6	560	840	33	11	0	
43	〃	65	29.59	(M) 8.2	93.2	37	63	0	16.50	2.9	240	580	59	0	14.3	
44	〃	65	26.71	(M) 8.2	95.4	71	25	4	14.58	2.7	260	500	48	4	28.6	
45	〃	67	18.73	(M) 6.9	74.6	53	30	17	12.40	1.7	450	510	12	0	0	
46	〃	71	17.89	(M) 8.8	15.7	50	50	0	2.01	2.2	80	260	69	0	7.5	
47	Cadamba	71	31.65	(T) 22.0	265.8	76	19	5	22.02	3.0	280	410	32	18	0	
〃	〃			(M) 18.5	287.0	77	19	4								
48	〃	71	32.30	(T) 23.5	351.1	67	33	0	27.86	3.2	340	420	19	3	0	
〃	〃			(M) 19.9	377.9	66	34	0								
49	〃	75	15.43	(T) 10.2	27.2	82	18	0	4.86	3.8	260	310	16	8	3.0	
50	〃	75	14.36	(T) 11.4	42.4	93	7	0	6.46	2.9	400	480	17	3	7.5	
51	〃	76	16.04	(T) 10.0	30.1	73	19	8	5.05	4.0	250	340	26	0	0	
52	〃	76	11.65	(T) 8.0	14.8	71	29	0	2.99	3.2	280	310	10	4	8.1	
53	〃	77	13.73	(T) 9.1	31.3	44	49	7	6.06	3.6	410	420	2	0	7.4	
54	〃	77	16.62	(T) 10.5	38.2	73	25	2	6.52	3.7	300	370	19	3	36.2	
55	Deglupta	64	41.12	(T) 27.4	374.8	54	45	1	29.21	3.0	220	390	44	9	0	
〃	〃			(M) 20.3	396.9	58	42	0								
56	〃	64	39.52	(T) 24.0	190.9	73	27	0	17.17	4.5	140	380	63	7	4.8	
〃	〃			(M) 14.9	169.8	75	25	0								
57	〃	72	18.68	(T) 17.4	112.7	69	28	3	13.17	2.4	480	780	38	0	3.2	
58	〃	72	18.51	(T) 19.0	102.3	58	36	6	10.75	2.1	400	760	47	0	3.2	
59	〃	73	24.88	(T) 20.8	163.0	59	33	8	17.50	2.8	360	870	59	0	0	
60	〃	73	21.84	(T) 19.3	91.5	39	48	13	10.12	2.5	270	750	64	0	0	
61	〃	75	9.74	(T) 7.6	7.9	20	67	13	1.27	1.8	170	320	47	0	6.7	
62	〃	75	6.18	(T) 6.3	2.0	35	55	10	0.27	1.4	90	260	65	0	0	

Sample No.	Plantel Species	Planted Year	Average D.B.H (cm)	Average Height (m)	Volume (m³/ha)	Form Class (Volume rate %) I	II	III	Basal Area (m²/ha)	Average Crown Radius (m)	Number (living-tree) (/ha)	Planted-tree Number (/ha)	Number rate of dead-tree (%)	Number rate of dumaged-tree (%)	Natural tree Volume (m³/ha)	Remarks
63	Deglupta	1976	11.94	(T) 8.8	2.7	96	0	4	0.45	3.0	40	390	90	0	0	
64	〃	76	9.34	(T) 6.8	1.5	66	27	7	0.27	2.1	40	320	88	0	0	
65	〃	77	4.37	(T) 4.1	1.8	44	50	6	0.15	0.9	100	310	68	20	0	
66	〃	77	8.37	(T) 7.2	1.8	83	17	0	0.28	2.2	50	310	84	0	0	
67	Macaopsis	74	18.30	(T) 14.3	48.5	61	25	14	7.13	2.7	270	310	13	0	5.1	
68	〃	74	16.32	(T) 11.2	26.1	36	49	15	4.18	2.8	200	290	31	5	0	
69	〃	75	18.61	(T) 10.7	32.0	74	25	1	6.00	3.0	220	350	37	5	225.0	
70	〃	75	16.00	(T) 11.6	32.5	86	14	0	5.44	2.4	270	350	23	4	0	
71	〃	76	10.52	(T) 6.9	17.5	36	35	29	2.96	2.4	340	420	19	3	0	
72	〃	76	9.37	(T) 6.8	14.1	35	37	28	2.07	2.3	300	400	25	17	0	
73	Cordia	71	19.78	(T) 14.6	105.8	39	48	13	15.37	2.5	500	700	29	6	0	
〃	〃			(M) 8.3	92.9	44	47	9								
74	〃	71	18.79	(T) 11.7	88.8	20	67	13	17.46	2.6	630	680	7	0	1.3	
〃	〃			(M) 7.3	85.9	22	69	9								
75	〃	73	17.95	(T) 15.5	55.0	42	43	15	8.34	3.7	330	370	11	3	0	
76	〃	73	23.83	(T) 18.3	41.3	45	52	3	5.35	3.3	120	400	70	8	3.9	
77	〃	74	10.13	(T) 7.5	12.2	43	56	1	2.50	2.3	310	410	24	0	17.7	
78	〃	74	12.09	(T) 10.2	20.7	80	15	5	4.24	2.3	370	400	8	0	24.2	
79	〃	75	11.89	(T) 8.7	10.1	60	37	3	2.56	2.2	230	360	36	0	1.5	
80	〃	75	14.32	(T) 12.1	27.7	77	21	2	5.30	2.5	330	390	15	3	0	
81	〃	76	8.67	(T) 6.0	6.8	28	52	20	1.89	1.8	320	430	26	0	0	
82	〃	76	8.67	(T) 6.0	7.7	67	27	6	2.06	1.9	350	380	8	0	1.4	
83	〃	77	8.88	(T) 7.5	7.2	53	33	14	1.93	2.1	310	320	3	0	3.0	
84	〃	77	8.37	(T) 6.0	5.6	66	30	4	1.75	2.0	320	380	16	3	0	
85	Kaubula	68	20.34	(T) 11.4	107.8	12	59	29	9.75	2.8	300	450	33	3	0	
〃	〃			(M) 6.0	71.5	13	60	27								
86	〃	68	20.27	(T) 10.0	76.5	3	57	40	7.74	2.8	240	390	38	13	0	
〃	〃			(M) 5.9	54.1	4	53	43								
87	〃	75	10.16	(T) 7.3	49.9	39	47	14	2.84	2.1	350	440	20	0	0	
88	〃	75	7.31	(T) 5.7	32.3	41	48	11	1.13	1.7	270	370	27	0	0	
89	〃	76	3.74	(T) 2.7	18.8	40	38	22	0.22	0.6	200	360	44	10	0	
90	〃	76	4.31	(T) 3.9	11.8	27	46	27	0.16	1.2	110	410	73	0	0	
91	〃	77	3.19	(T) 3.2	39.9	10	51	39	0.30	0.8	380	410	7	5	43.1	
92	〃	77	3.74	(T) 3.9	35.3	76	18	6	0.37	0.8	350	390	10	0	0	

Table 2-9

STANDARD INTERPRETATION CARD (STEREO GRAMME)

Planted Species	Forest Age	Crown Density	Filing No.
Mahogany	18	D_2	3

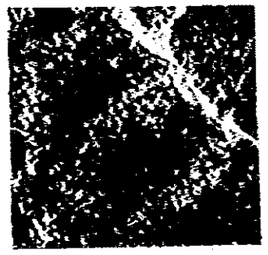
Plot No.		3
Location		Nukurua
Compartment & Sub-Compartment		55 - a - 1
Planned by		JI.C.A. Fiji Government
Enforced by		J.F.T.A.
Surveyed on		September ~ October, 1980
Plot	Size	0.1 ha
	Spacing	25.2 m × 39.2 m 2 lines

Data of Field Survey

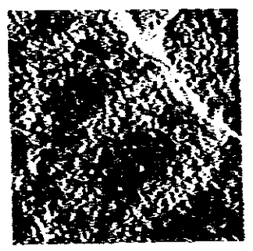
Site Description		Forest Description		
Topography	Flat, Ridge-top, (Valley-bottom), Mid-slope, Irregular	Planted species	Mahogany	
		Age & (Planted Year)	18 (1962)	
Inclination	Flat, (Gentle) Moderate Steep	Average Height	Merchantable	9.5 m
			Total	m
		Average D.B.H.	33.6	cm
Direction	N,(E),S,W,Nothing	Basal Area	9.74	m²/ha
Altitude	50 m	Number of Trees	110	n/ha
Other Remarks		Crown Density	30	%
		Volume	Merchantable	62.9 m³/ha
			Total	m³/ha
		Natural Tree Volume	7.4	m³/ha

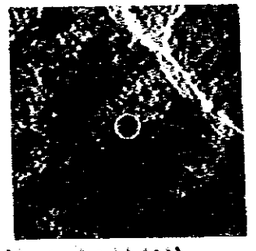
Aerial Photograph Index

District Name	VITI LEVU
Flyng Date	June ~ July, 1978
Scale of Photograph	1 : 20,000
Flyng Altitude	3,100 m
Focal Length	152.89 mm
Course No. & Photo No.	C 39 — 30, 31
Base Length	173 mm

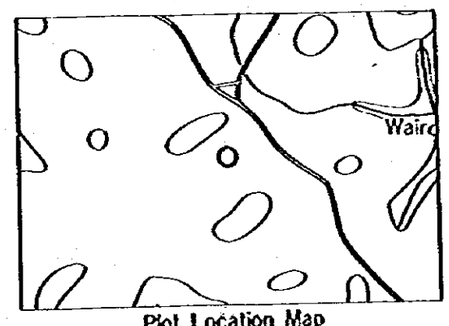


Ground Photo





Stereo Photograph (Scale. 1 : 10,000)



Plot Location Map
(Scale. 1 : 10,000)

With regard to the other five species and younger mahogany stands, the number of sample plots was lower, and some difficulty was experienced in creating the stand volume tables. Also, because of the large number of young stands, accuracy was not so important.

Therefore, a stand volume table was made only for mahogany planted before 1971. There are several factors which are closely related to volume, but of these, tree age and number of trees per hectare were chosen as they could be easily obtained from exiting data and aerial photographs. Using these two factors, calculations were carried out using the method of least squares. Table 2-10 and Figure 2-4 show the accuracy of the volume table and Table 2-11 shows the stand volume table.

Table 2-10 Accuracy of stand volume table

Volume formula	V = −9.1421 + 0.0290 x age x No./ha.	
Correlation coefficient	$\gamma = 0.85$	
Survey plot No.	Measured value	Estimated value
1	215.7	216.8
2	85.6	95.5
3	62.9	48.2
4	106.8	105.7
5	129.1	100.5
6	87.2	89.4
7	84.4	59.8
8	38.1	45.1
9	76.1	55.8
10	132.8	92.9
11	63.5	51.1
12	112.0	103.9
13	166.5	130.0
14	74.9	51.7
15	124.6	104.5
16	84.4	63.9
17	54.6	51.7
18	89.0	58.7
19	84.4	62.5
20	41.6	54.9
21	69.3	70.9
22	33.9	56.9
23	23.9	32.6
24	33.3	51.4
25	55.6	77.0
26	41.1	70.6
27	14.9	28.5
28	65.4	144.5
29	29.6	57.5
30	17.8	35.2
31	23.3	35.2
32	25.4	43.0

Fig. 2-4 Comparison of measured value with estimated value

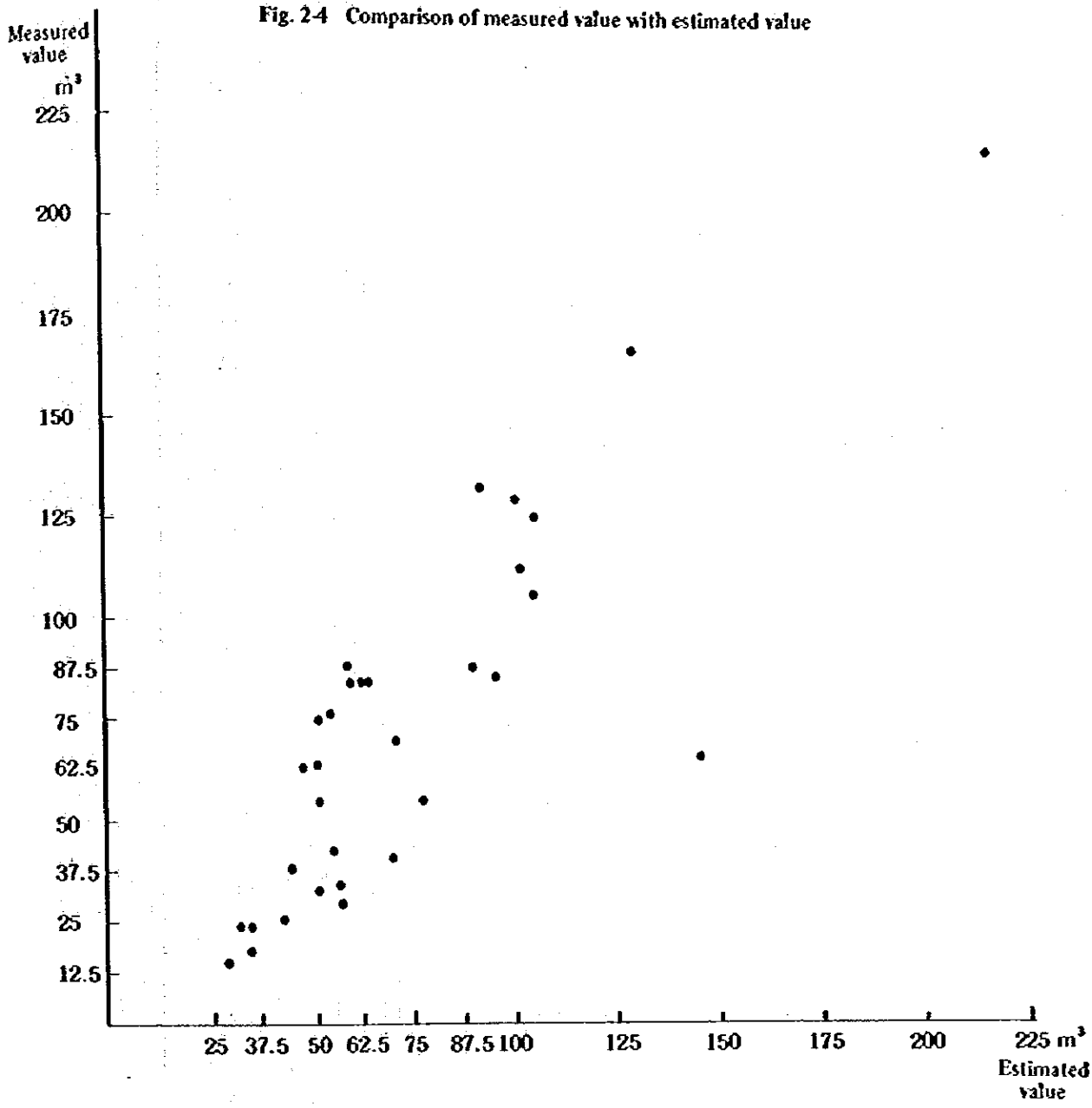


Table 2-11 Stand volume table (Mahogany)

***** STAND VOLUME TABLE (MAHOGANY) *****

V = −9.1421 + .0290 * (AGE) * N

(M↑3/ha)

AGE / N/ha	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
20	−5	−5	−4	−3	−3	−2	−2	−1	−		1	1	2	2	3	4
40	−1		1	2	4	5	6	7	8	9	11	12	13	14	15	16
60	3	5	7	8	10	12	13	15	17	19	20	22	24	26	27	29
80	7	9	12	14	16	19	21	23	26	28	30	33	35	37	40	42
100	11	14	17	20	23	26	29	31	34	37	40	43	46	49	52	55
120	15	19	22	26	29	33	36	40	43	47	50	53	57	60	64	67
140	19	23	27	31	36	40	44	48	52	56	60	64	68	72	76	80
160	23	28	33	37	42	47	51	56	60	65	70	74	79	84	88	93
180	27	33	38	43	48	53	59	64	69	74	80	85	90	95	100	106
200	31	37	43	49	55	60	66	72	78	84	89	95	101	107	113	118
220	36	42	48	55	61	67	74	80	87	93	99	106	112	118	125	131
240	40	47	53	60	67	74	81	88	95	102	109	116	123	130	137	144
260	44	51	59	66	74	81	89	96	104	111	119	127	134	142	149	157
280	48	56	64	72	80	88	96	105	113	121	129	137	145	153	161	169
300	52	60	69	78	87	95	104	113	121	130	139	147	156	165	174	182
320	56	65	74	84	93	102	111	121	130	139	149	158	167	176	186	195
340	60	70	80	89	99	109	119	129	139	149	158	168	178	188	198	208
360	64	74	85	95	106	116	127	137	147	158	168	179	189	200	210	221
380	68	79	90	101	112	123	134	145	156	167	178	189	200	211	222	233
400	72	84	95	107	118	130	142	153	165	176	188	200	211	223	234	246
420	76	88	100	113	125	137	149	161	174	186	198	210	222	234	247	259
440	80	93	106	118	131	144	157	169	182	195	208	221	233	246	259	272
460	84	98	111	124	138	151	164	178	191	204	218	231	244	258	271	284
480	88	102	116	130	144	158	172	186	200	214	227	241	255	269	283	297
500	92	107	121	136	150	165	179	194	208	223	237	252	266	281	295	310
520	96	111	127	142	157	172	187	202	217	232	247	262	277	292	308	323
540	100	116	132	147	163	179	194	210	226	241	257	273	288	304	320	335
560	105	121	137	153	169	186	202	218	234	251	267	283	299	316	332	348
580	109	125	142	159	176	193	210	226	243	260	277	294	310	327	344	361
600	113	130	147	165	182	200	217	234	252	269	287	304	321	339	356	374

2.5 Estimation of volume according to forest type and total volume.

The volume according to forest type is given in a seperate Forest Inventory Note. This section presents;

(1) Area and volume according to species for each compartment.

(2) Area and volume according to tree age of the six species in the plantation.

The total area of the survey area is 6,253 ha. (8,242 ha for the whole Nukurua area) and the total volume is 366.396 m^3.

The area and volume according to species for each compartment is shown in Table 2-12. The area and volume according to tree age of the six species in the plantation are shown in Table 2-13. With regard to the area and volume according to tree age of all six species, they are shown in Table 2-14, and shown diagrammatically in Figure 2-5~6.

As can be seen from the Figure and Table, it is clear that the plantation area of 6~8 years old is extremely small. This is because of damage by Ambrosia beetles, which put the whole mahogany plantation in jeopardy, prompting a change over to plantation with a mixture consisting of six species. This gap should be taken into account in consideration of forest management in the Nukurua area in the future.

Table 2-14 Area and volume according to age of all six species

Age	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	Total
Area (ha)	354.91	201.08	261.01	73.65	38.75	0	499.03	643.86	617.09	530.37	646.84	518.49	360.80	422.06	480.29	104.88	110.89	5,863.91
Volume (m^3)	5,169	4,057	7,641	1,024	1,915	0	9,647	14,361	21,421	22,393	43,364	43,173	34,169	31,109	38,872	7,803	11,627	300,739

Fig. 2-5 Area according to age of all 6 species

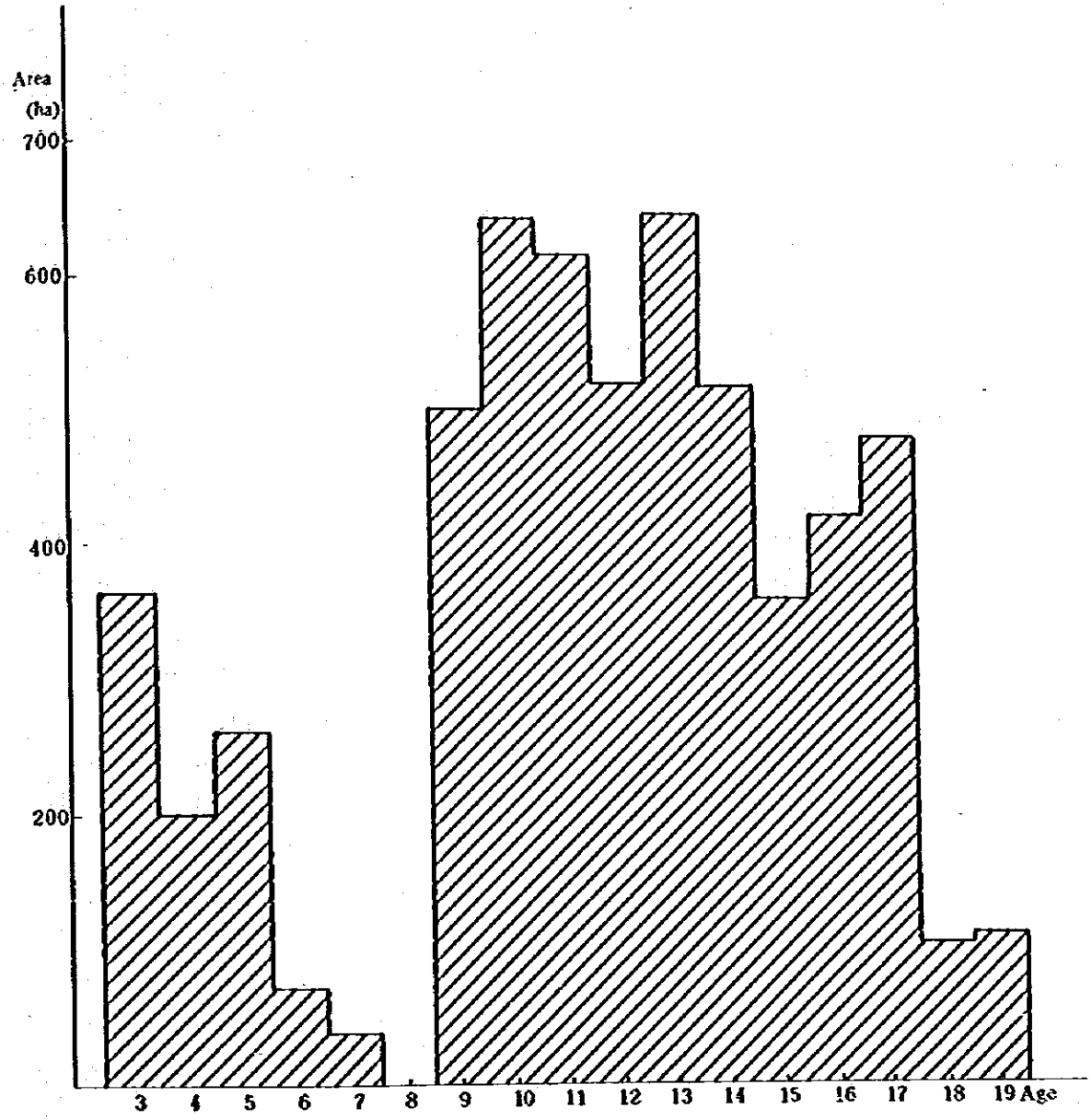


Fig. 2-6 Volume according to age of all 6 species

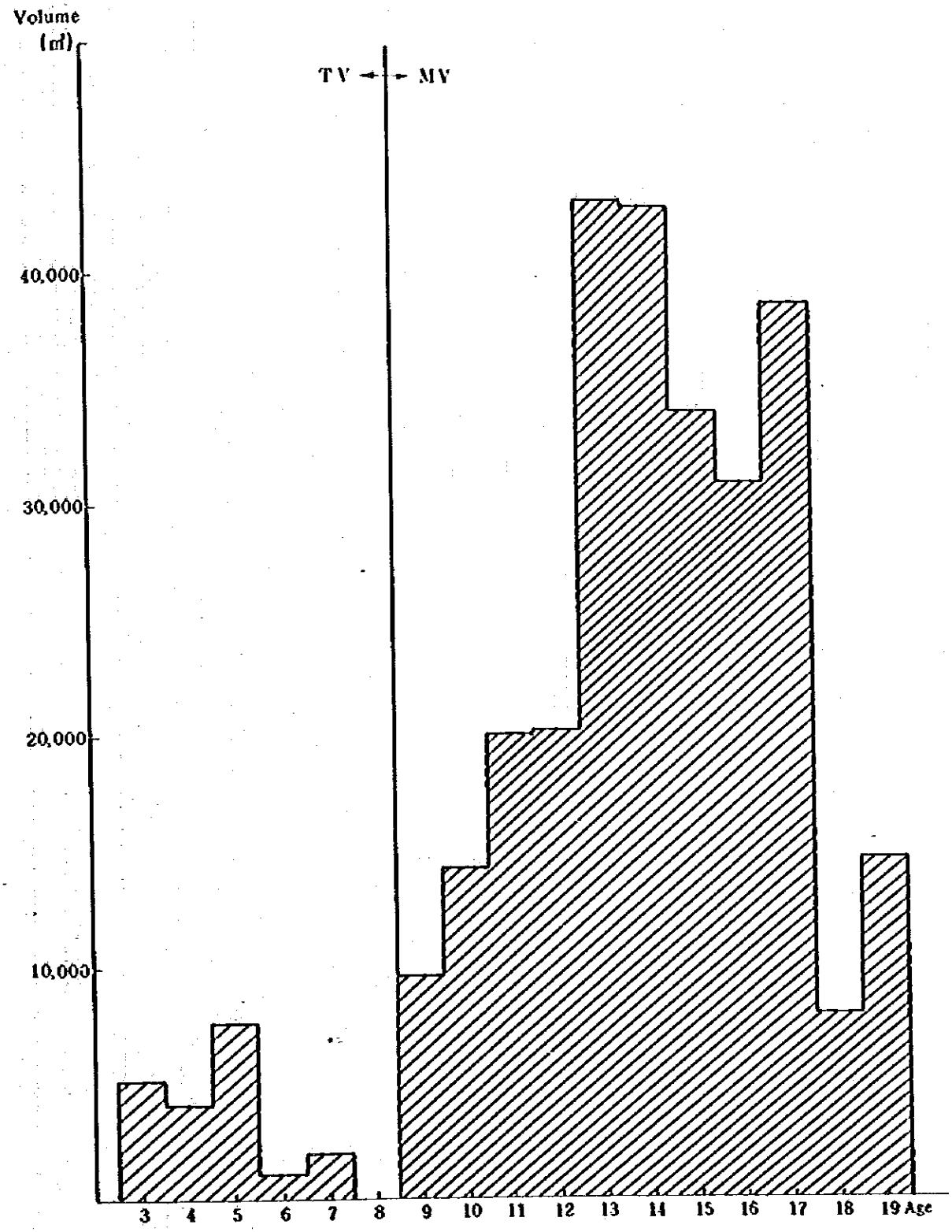


Table 2-12 Area, volume according to compartment and species

No. 1

compartment		Total	out the survey area	In the survey area													
				Mahogany	Cadamba	Degiupta	Maesopsis	Cordia	Kaubula	other planted tree	Natural tree	Grass land	Forest station	Native reserve	Native lease	Research area	Deserted village site
1	Area	87.75	87.75	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	M.volume	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	T.volume	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	Area	107.0	107.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	M.volume	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	T.volume	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	Area	86.13	86.13	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	M.volume	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	T.volume	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	Area	83.5	83.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	M.volume	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	T.volume	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	Area	92.38	92.38	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	M.volume	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	T.volume	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6	Area	87	87	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	M.volume	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	T.volume	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7	Area	117.49	0	0	77.38	5.7	0	19.5	0	12.6	0	0	0	0	0	2.31	0
	M.volume	484	0	0	0	0	0	0	0	0	484	0	0	0	0	0	0
	T.volume	1.743	0	0	1.548	0	0	195	0	0	0	0	0	0	0	0	0
8	Area	81.25	81.25	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	M.volume	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	T.volume	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9	Area	85.5	85.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	M.volume	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	T.volume	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10	Area	113.13	113.13	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	M.volume	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	T.volume	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

compartment		Total	out the survey area	In the survey area													
				Mahogany	Cadamba	Deglupta	Maesopsis	Cordia	Kaubula	other planted tree	Natural tree	Grass land	Forest station	Native reserve	Native lease	Research area	Deserted village site
11	Area	117.13	117.13	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	M.volume	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	T.volume	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12	Area	105.88	105.88	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	M.volume	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	T.volume	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13	Area	157.63	157.63	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	M.volume	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	T.volume	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14	Area	154.75	154.75	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	M.volume	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	T.volume	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15	Area	99.63	99.63	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	M.volume	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	T.volume	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16	Area	89.13	89.13	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	M.volume	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	T.volume	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15.38
17	Area	17.11	0	31.7	7041	40.78	0	7.45	5.38	0	0	0	0	0	0	0	0
	M.volume	1.174	0	0	0	0	0	0	0	0	1.174	0	0	0	0	0	0
	T.volume	2.788	0	317	1.408	880	0	75	108	0	0	0	0	0	0	0	0
18	Area	124.88	0	62.88	0	0	0	0	0	0	15.25	0	0	46.75	0	0	0
	M.volume	3.906	0	1.886	0	0	0	0	0	0	2.020	0	0	0	0	0	0
	T.volume	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
19	Area	126.52	0	126.52	0	0	0	0	0	0	2.114	0	0	0	0	0	0
	M.volume	4993	0	2.879	0	0	0	0	0	0	0	0	0	0	0	0	0
	T.volume	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20	Area	98.64	0	98.64	0	0	0	0	0	0	1.750	0	0	0	0	0	0
	M.volume	3.866	0	2.116	0	0	0	0	0	0	0	0	0	0	0	0	0
	T.volume	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

compartment		Total	out the survey area	In the survey area													
				Mahogany	Cadamba	Deglupta	Maesopsis	Cordia	Kaubula	other planted tree	Natural tree	Grass land	Forest station	Native reserve	Native lease	Research area	Deserted village site
21	Area.	125.58	0	3.38	42.78	40.24	5.15	16.63	0.96	8.91	0	0	0	2.38	0	5.15	0
	M.volume	324	0	0	0	0	0	0	0	0	324	0	0	0	0	0	0
	T.volume	2577	0	68	1759	402	144	166	38	0	0	0	0	0	0	0	0
22	Area	72.18	0	18.27	7.56	5.94	4.6	12.99	4.32	0	0	0	0	0	0	18.5	0
	M.volume	606	0	0	0	0	0	0	0	0	606	0	0	0	0	0	0
	T.volume	1449	0	365	454	59	138	260	173	0	0	0	0	0	0	0	0
23	Area	148.25	148.25	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	M.volume	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	T.volume	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
24	Area	61.88	37.13	9.24	0	10.13	0	5.38	0	0	0	0	0	0	0	0	0
	M.volume	239	0	0	0	0	0	0	0	0	239	0	0	0	0	0	0
	T.volume	146	0	92	0	0	0	54	0	0	0	0	0	0	0	0	0
25	Area	139.44	0	135	15.38	30.06	11.52	53.51	5.67	9.38	0	0	0	0	0	0.42	0
	M.volume	1117	0	0	0	0	0	0	0	0	1117	0	0	0	0	0	0
	T.volume	2121	0	270	615	301	230	535	170	0	0	0	0	0	0	0	0
26	Area	136.88	0	135.88	0	0	0	1.0	0	0	0	0	0	0	0	0	0
	M.volume	6599	0	4599	0	0	0	0	0	0	2000	0	0	0	0	0	0
	T.volume	0	0	0	0	0	0	40	0	0	0	0	0	0	0	0	0
27	Area	152.79	0	152.79	0	0	0	0	0	0	0	0	0	0	0	0	0
	M.volume	5732	0	3602	0	0	0	0	0	0	2130	0	0	0	0	0	0
	T.volume	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
28	Area	159.52	0	159.52	0	0	0	0	0	0	0	0	0	0	0	0	0
	M.volume	5608	0	2933	0	0	0	0	0	0	2675	0	0	0	0	0	0
	T.volume	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
29	Area	157.54	0	157.54	0	0	0	0	0	0	0	0	0	0	0	0	0
	M.volume	5454	0	4441	0	0	0	0	0	0	1013	0	0	0	0	0	0
	T.volume	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30	Area	164.39	0	164.39	0	0	0	0	0	0	0	0	0	0	0	0	0
	M.volume	8772	0	7319	0	0	0	0	0	0	1453	0	0	0	0	0	0
	T.volume	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

compartment		Total	out the survey area	In the survey area													
				Mahogany	Cadamba	Deglupta	Maesopsis	Cordia	Kaubula	other planted tree	Natural tree	Grass land	Forest station	Native reserve	Native lease	Research area	Deserted village site
31	Area	143.81	0	16.63	46.39	42.6	0	36.99	0	1.2	0	0	0	0	0	0	0
	M.volume	494	0	0	0	0	0	0	0	0	494	0	0	0	0	0	0
	T.volume	5,767	0	333	2,783	1,886	0	765	0	0	0	0	0	0	0	0	0
32	Area	148.74	68.38	0	0	31.13	0	49.23	0	0	0	0	0	0	0	0	0
	M.volume	246	0	0	0	0	0	0	0	0	246	0	0	0	0	0	0
	T.volume	492	0	0	0	0	0	492	0	0	0	0	0	0	0	0	0
33	Area	63.5	63.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	M.volume	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	T.volume	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
34	Area	125.88	124.38	0	0	1.5	0	0	0	0	0	0	0	0	0	0	0
	M.volume	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	T.volume	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
35	Area	154.59	0	66.0	9.13	34.76	32	35.08	0	6.42	0	0	0	0	0	0	0
	M.volume	921	0	195	0	0	0	0	0	0	726	0	0	0	0	0	0
	T.volume	2,685	0	1125	548	0	128	884	0	0	0	0	0	0	0	0	0
36	Area	247.26	0	150.01	0	0	0	0	0	0	0	0	0	0	97.25	0	0
	M.volume	11,350	0	9,893	0	0	0	0	0	0	1,457	0	0	0	0	0	0
	T.volume	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
37	Area	131.77	0	131.77	0	0	0	0	0	0	0	0	0	0	0	0	0
	M volume	6,793	0	4,603	0	0	0	0	0	0	2,190	0	0	0	0	0	0
	T.volume	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
38	Area	161.79	0	161.79	0	0	0	0	0	0	0	0	0	0	0	0	0
	M.volume	6,336	0	4,905	0	0	0	0	0	0	1,431	0	0	0	0	0	0
	T.volume	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
39	Area	214.01	0	173.63	0	0	0	0	0	0	40.38	0	0	0	0	0	0
	M.volume	9,289	0	4,158	0	0	0	0	0	0	5,131	0	0	0	0	0	0
	T.volume	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
40	Area	264.14	0	252.64	0	0	0	0	0	0	8.25	0	0	0	3.25	0	0
	M.volume	8,931	0	4,168	0	0	0	0	0	0	4,763	0	0	0	0	0	0
	T.volume	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

compartment		Total	out the survey area	In the survey area													
				Mahogany	Cadamba	Degiupta	Maesopsis	Cordia	Kaubula	other planted tree	Natural tree	Grass land	Forest station	Native reserve	Native lease	Research area	Deserted village site
41	Area	201.52	0	19927	0	0	0	0	0	2.25	0	0	0	0	0	0	0
	M.volume	13,874	0	12,949	0	0	0	0	0	0	925	0	0	0	0	0	0
	T.volume	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
42	Area	154.41	0	144.28	1.5	0	0	5.5	0	3.13	0	0	0	0	0	0	0
	M.volume	8,937	0	6,572	495	0	0	495	0	0	1375	0	0	0	0	0	0
	T.volume	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
43	Area	211.77	0	177.02	0	0	0	0	0	0	31.75	3.0	0	0	0	0	0
	M.volume	14,583	0	10,913	0	0	0	0	0	0	3,670	0	0	0	0	0	0
	T.volume	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
44	Area	157.28	0	146.9	0	10.38	0	0	0	0	0	0	0	0	0	0	0
	M.volume	123.90	0	9,881	0	1.716	0	0	0	0	793	0	0	0	0	0	0
	T.volume	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
45	Area	143.78	0	143.78	0	0	0	0	0	0	0	0	0	0	0	0	0
	M.volume	6256	0	6256	0	0	0	0	0	0	0	0	0	0	0	0	0
	T.volume	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
46	Area	96.14	0	96.14	0	0	0	0	0	0	0	0	0	0	0	0	0
	M.volume	11.732	0	9,317	0	0	0	0	0	0	2,415	0	0	0	0	0	0
	T.volume	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
47	Area	116.89	0	115.89	0	0	0	0	0	0	1	0	0	0	0	0	0
	M.volume	12,458	0	10,315	0	0	0	0	0	0	2,143	0	0	0	0	0	0
	T.volume	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
48	Area	147.04	0	140.03	0	0	0	0	0	0.63	0	0	0	0	6.38	0	0
	M.volume	5.935	0	5,872	0	0	0	0	0	63	0	0	0	0	0	0	0
	T.volume	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
49	Area	160.02	0	131.01	0	1.13	0	0	27.88	0	0	0	0	0	0	0	0
	M.volume	11.792	0	8,889	0	136	0	0	1.673	0	1.094	0	0	0	0	0	0
	T.volume	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
50	Area	217.54	0	212.53	0	0	0	0	0	0	2.13	2.88	0	0	0	0	0
	M.volume	19.556	0	16,971	0	0	0	0	0	0	2.585	0	0	0	0	0	0
	T.volume	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

compartment		Total	out the survey area	In the survey area													
				Mahogany	Cadambe	Deglupta	Maesopsis	Cordia	Kaubula	other planted tree	Natural tree	Grass land	Forest station	Native reserve	Native lease	Research area	Deserted village site
51	Area	180.03	0	172.65	0	0	0	0	0	7.38	0	0	0	0	0	0	0
	M.volume	17,700	0	14,974	0	0	0	0	0	0	2,726	0	0	0	0	0	0
	T.volume	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
52	Area	199.38	0	199.38	0	0	0	0	0	0	0	0	0	0	0	0	0
	M.volume	18,756	0	16,118	0	0	0	0	0	0	2,638	0	0	0	0	0	0
	T.volume	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
53	Area	114.4	0	94.52	0	0	0	0	0	0	3	0	0	0	16.88	0	0
	M.volume	7,492	0	7,054	0	0	0	0	0	0	438	0	0	0	0	0	0
	T.volume	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
54	Area	131.39	0	125.26	0	0	0	0	0	0	0	0	6.13	0	0	0	0
	M.volume	10,464	0	9,650	0	0	0	0	0	0	814	0	0	0	0	0	0
	T.volume	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
55	Area	104.88	0	104.88	0	0	0	0	0	0	0	0	0	0	0	0	0
	M.volume	8,785	0	7,803	0	0	0	0	0	0	982	0	0	0	0	0	0
	T.volume	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
56	Area	151.03	0	147.64	0	0	0	0	0	0	0	3.39	0	0	0	0	0
	M.volume	13583	0	10556	0	0	0	0	0	0	3,027	0	0	0	0	0	0
	T.volume	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
57	Area	88.28	0	88.28	0	0	0	0	0	0	0	0	0	0	0	0	0
	M.volume	5,696	0	5,501	0	0	0	0	0	0	195	0	0	0	0	0	0
	T.volume	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
58	Area	167.13	0	167.13	0	0	0	0	0	0	0	0	0	0	0	0	0
	M.volume	15,001	0	13,335	0	0	0	0	0	0	1,666	0	0	0	0	0	0
	T.volume	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
59	Area	116.77	0	110.89	0	0	0	0	0	0	0	5.88	0	0	0	0	0
	M.volume	15225	0	14,627	0	0	0	0	0	0	598	0	0	0	0	0	0
	T.volume	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
60	Area	222.26	0	222.26	0	0	0	0	0	0	0	0	0	0	0	0	0
	M.volume	23,140	0	21,100	0	0	0	0	0	0	2,040	0	0	0	0	0	0
	T.volume	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	Area	824230	1,989.43	5,026.46	270.53	254.35	24.47	243.26	44.84	51.27	101.76	15.15	6.13	49.13	123.76	26.38	15.38
	M.volume	346,589	0	276,352	495	1,852	0	495	1,736	0	65,661	0	0		0	0	0
	T.volume	19,807	0	2,572	9,115	3,528	640	3,465	489	0	0	0	0		0	0	0

Table 2-13 Area and volume according age of th 6 species

Age	Planted Year	Mahogany		Cadamba		Deglupta		Maesopsis		Cordia		Kaubula	
		Area (ha)	Volume(m^3)	Area (ha)	Volume(m^3)	Area (ha)	Volume(m^3)	Area (ha)	Volume(m^3)	Area (ha)	Volume(m^3)	Area (ha)	Volume(m^3)
3	1977	40.94	409	147.79	2,956	89.24	880			81.56	816	5.38	108
4	1976	13.50	270	55.78	2231	43.42	434	12.57	251	70.14	701	5.67	170
5	1975	77.04	1.542	65.46	3.928	38.92	389	8.70	261	65.61	1.313	5.28	211
6	1974	17.49	351			34.76	0	3.20	128	18.20	545		
7	1973					36.50	1.825			225	90		
8	1972												
Sub- total		148.97	2.572	269.03	9.115	242.84	3.528	24.47	640	237.76	3.465	16.33	489
9	1971	492.03	8.657	1.50	495					5.50	495		
10	1970	643.86	14.361										
11	1969	617.09	21.421										
12	1968	491.86	20.657									28.51	1.736
13	1967	646.84	43.364										
14	1966	518.40	43.173										
15	1965	360.80	34.160										
16	1964	410.55	29.257			11.51	1.852						
17	1963	480.29	38.872										
18	1962	104.88	7.803										
19	1961	110.89	14.627										
Sub- total		4.877.49	276.352	1.50	495	11.51	1.852	0	0	5.50	495	28.51	1.736
Total		5.026.46	278.924	270.53	9.610	254.35	5.380	24.47	640	243.26	3.960	44.84	2225

(Attention) 3–8 years old : T. Volume
9–19 years old: M. Volume

2.8 Making the Forest Inventory Note.

An example of Foredt Inventory Note is shown in Table 2-15. Explanations on the survey items which are in the Forest Inventory Note are given here.

(1) Sub-compartment

Compartments having stands of different species or planted year were divided into sub-compartments. The code for sub-compartments is alphabetical.

e.g: a, b, c....

(2) Forest type

There are some situations in which different tree heights or crown densities occur in the same sub-compartment. In this case, it is divided according to forest type and a number 1, 2, 3.... is added.

(3) Distinction between Merchant (M), Total (T).

With regard to forest type, this is shown as either M or T of the average tree height or volume. With regard to the volume of natural trees, it is always shown as M.

(4) Area

Using the stock map drawn up from this survey, the area was measured according to forest type in hectares to two decimal places.

(5) Species

In the species column, codes according to usage such as native lease, etc, were added.

Codes are as follows

Species or usage	Code
Mahogany	S. mac
Cadamba	A. cad
Deglupta	E. deg
Maesopsis	M. emi
Cordia	C. all
Kauvula	E. mac
Other planting species	Other
Natural trees	Natural tree
Grass land	Grass land
Forest station	Fore station
Native reserve	Nati reserve
Native lease	Nati lease
Research area	Res area
Deserted village site	Des Vil Site

(6) Planted year

The planted year of the planted trees was checked from the stock map.

(7) Average tree height

Average tree height was obtained using the stereogrammes and it was interpreted from the aerial photographs in meters. The same applies to average dominant tree height.

(8) Crown density

Crown density was interpreted to the nearest 5% from the aerial photographs.

(9) Number of trees/ha.

Number of trees/ha was interpreted to the nearest m^3 from the aerial photographs.

(10) Basal area

Basal area was obtained during stereogrammes and is given to the nearest m^2.

(11) Volume/ha

Volume per hectare was estimated from the aerial photographs by using stereogrammes

and the volume table, and is given to the nearest 10 m^3.

(12) Stand volume

By the multiplying the area by the volume per hectare, this was obtained to the nearest m^3.

(13) Natural trees

The merchantable volume per hectare was estimated from the aerial photographs, and, by multiplying the area obtained in (4), stand volume is obtained.

(14) Note

Plantation species except the six main species and the direct sowing plantations were coded as follows:

Name of species, etc.	Code
Opepe	Opepe
Albizzia	Albiz
Alstomia	Alsto
Vaivai	Vaiva
Terminalia pen	T. pen
A. lela	A lel
Terminalia superba	T. sup
Direct sowing area	D. sow

Table 2-15 FOREST INVENTORY NOTE

* * LOCATION NUKURUA * *

* * COMPARTMENT 48 * *

SUB COMP.	FOREST TYPE NO.	MERCHANT OR TOTAL.	AREA (HA)	SPECIES	PLANTED TREE PRANT YEAR	AV. HEIGHT (M)	AV. DOM. HEIGHT (M)	CROWN DENSI (%)	NUM. OF TREES (/HA)	BASAL AREA (M*2 /HA)	VOL. (M*3 /HA)	STAND VOL. (M*3)	NATURAL TREE VOL. (M*3 /HA)	NATURAL TREE STAND VOL. (M*3)	NOTE
A	1	M	32.25	S.MAC	1968	6	9	50	230	15	70	2258	0	0	-
A	2	M	.88	S.MAC	1968	6	8	5	30	1	10	9	0	0	-
A	3	M	17.63	S.MAC	1968	6	8	20	120	4	20	353	0	0	-
A	4	M	72.75	S.MAC	1968	6	8	20	150	6	30	2183	0	0	-
A	5	M	.88	S.MAC	1968	6	8	5	30	1	10	9	0	0	-
A	6	M	1.00	S.MAC	1968	6	8	5	30	1	10	10	0	0	-
A	7	M	11.38	S.MAC	1968	6	9	50	230	15	70	797	0	0	-
A	8	M	.38	S.MAC	1968	6	10	100	600	25	140	53	0	0	-
A	9	M	2.88	S.MAC	1968	6	9	50	230	15	70	202	0	0	-
B	1	M	.63	E.MAC	1968	6	9	100	400	20	100	63	0	0	-
C	1	-	6.38	NATI LEASE		0	0	0	0	0	0	0	0	0	-

TOTAL AREA 147.04

PLANTED TREE

MV 5934.6

SPP. AREA

S.MAC 140.03
A.CAD 0
E.DEG 0
M.EMI 0
C.ALL 0
E.MAC .63
OTHER 0
NATURAL TREE 0
GLASS LAND 0
FORE STATION 0
NATI RESERVE 0
NATI LEASE 6.38
RES.AREA 0
DES.VIL.SITE 0
- 0

TV 0

HA

NATURAL TREE

MV 0

VOL.(M)	VOL.(T)
5871.6	0
0	0
0	0
0	0
0	0
63	0
0	0
0	0
0	0
0	0
0	0
0	0
0	0
0	0
0	0
0	0

3. ADJUSTMENT FOR TIME DISCREPANCY

As mentioned is section 2.4.1, the aerial photographs used to make the stereogrammes were taken two years prior to the survey. Therefore, an adjustment is required to allow for this time discrepancy.

First, regression formulae were prepared for average tree height, average diameter, number of trees, volume, and diameter breast height for each species and tree age, and estimated values were calculated. In the calculations, regression calculations using the following six regression formulae were tried, and after considering the correlation coefficients and the differences between actual and estimated values, the most suitable regression formula was adopted.

Furmula 1. $\log Y = a + b(10/x)$
" 2. $10/Y = a + b(10/x) + C(10/x)^2$
" 3. $1/\log Y = a + b(10/x)$
" 4. $\log Y = a + b \log x$
" 5. $1/SQRT = a + b(10/x)$
" 6. $\log Y = a + b \log x + C(10/x)$

Table 3-1~3-6 and Figures 3-1~3-7 show the regression formulae, regression curves and estimated values according to tree age which were adopted for each species and each stand factor.

In the case of mahogany, with regard to volume and average tree height, the calculations were made for Merchantable (7–19 years old), and Total (1–6 years old).

According to the regression curve, the present values were back dated to values for two years earlier. For example, in the case of volume the following calculation was done:

$$\text{Volume 2 years earlier} = \text{Present volume} \times \frac{\text{Volume from regression formula (2 years earlier)}}{\text{Volume from regression formula (present)}}$$

By this means the present volume for the sample plot was adjusted to a value for two years earlier. With regard to average tree height, etc., the same calculation was done to achieve adjustment, but with regard to the number of trees, a suitable regression formula could not be obtained, so the calculation was made form average diameter and breast height.

With regard to crown density, there was no need for adjustment as this could obviously be interpreted from the aerial photographs, so the interpreted values were used as they stood. Table 3-7 shows each value for both present and two years earlier for the sample plots.

Table 3-1 Estimate value of Merchantable Tree Height and Merchantable Volume for each age, mahogany

Age	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Tree height (m)	5.81	6.10	6.36	6.60	6.83	7.05	7.25	7.45	7.63	7.81	7.98	8.14	8.30	8.46
Volume (m^3/ha)	14.90	19.81	25.46	31.87	39.04	47.00	55.74	65.28	75.61	86.76	98.73	111.52	125.14	139.60

Regression Formula	Correlation coefficient
$\log MH = -0.6278 + 2.1312 \log A$	$r = 0.40$
$\log MV = 0.4630 + 0.3567 \log A$	$r = 0.75$

MH: Merchantable Tree Height
MV: Merchantable Volume
A : Age

Table 3-2 Regression formula and estimate value of age: Total tree height

Age	Estimate value for each species					
	Cadamba	Deglupta	Maesopsis	Cordia	Kaubula	Mahogany
1	3.22	1.86	0.85	2.44	1.27	0.40
2	5.78	3.77	2.47	4.31	2.32	1.51
3	8.12	5.70	4.60	6.01	3.30	3.28
4	10.34	7.63	7.16	7.61	4.24	5.69
5	12.48	9.58	10.09	9.15	5.14	8.72
6	14.54	11.53	13.36	10.62	6.02	12.37
7	16.56	13.49		12.06	6.88	
8	18.52	15.45		13.46	7.73	
9	20.45	17.42		14.82	8.56	
10	22.35	19.39		16.17	9.38	
11	24.21	21.36		17.48	10.19	
12	26.05	23.34		18.78	10.98	
13	27.86	25.32		20.05	11.77	
14	29.65	27.30		21.31	12.55	
15	31.42	29.29		22.56	13.33	
16	33.18	31.28		23.78	14.10	
17	34.91	33.26		25.00	14.86	
18	36.63	35.26		26.20	15.61	
19	38.33	37.25		27.39	16.36	
20	40.02	39.24		28.57	17.11	

Species	Regression formula	γ
Cadamba	$\log TH = 0.5085 + 0.8407 \log A$	0.90
Deglupta	$\log TH = 0.2704 + 1.0172 \log A$	0.90
Maesopsis	$\log TH = -0.0713 + 1.5385 \log A$	0.93
Cordia	$\log TH = 0.3869 + 0.8217 \log A$	0.78
Kaubula	$\log TH = 0.1048 + 0.8672 \log A$	0.90
Mahogany	$\log TH = -0.3982 + 1.9155 \log A$	0.91

(Attention)
Extent of adjustment until bold lines.
Indication for reference under bold lines.

γ : correlation coefficient
TH : Total Tree Height
A : age

Table 3-3 Regression formula and estimate value of age : Average diameter

Age	Estimate value for each species					
	Cadamba	Deglupta	Maesopsis	Cordia	Kaubula	Mahogany
1	5.47	1.79	1.52	3.06	0.80	0.86
2	9.18	3.96	4.03	5.53	2.00	2.14
3	12.42	6.30	7.13	7.82	3.41	3.66
4	15.40	8.76	10.69	10.00	4.99	5.35
5	18.20	11.32	14.64	12.09	6.70	7.18
6	20.85	13.95	18.92	14.13	8.52	9.14
7	23.40	16.64		16.12	10.45	11.20
8	25.85	19.39		18.07	12.46	11.36
9	28.23	22.20		19.98	14.56	15.62
10	30.54	25.05		21.86	16.74	17.95
11	32.79	27.94		23.72	18.99	20.36
12	34.99	30.87		25.55	21.30	22.84
13	37.15	33.83		27.35	23.68	25.39
14	39.27	36.83		29.14	26.11	28.00
15	41.34	39.86		30.91	28.61	30.67
16	43.38	42.92		32.66	31.15	33.40
17	45.39	46.01		34.40	33.75	36.19
18	47.37	49.13		36.12	36.40	39.02
19	49.33	52.27		37.83	39.09	41.91
20	51.25	55.43		39.52	41.84	44.35

Species	Regression formula	γ
Cadamba	$\log D = 0.7373 + 0.7470 \log A$	0.85
Deglupta	$\log D = 0.2526 + 1.1461 \log A$	0.91
Maesopsis	$\log D = 0.1814 + 1.4078 \log A$	0.87
Cordia	$\log D = 0.4856 + 0.8541 \log A$	0.86
Kaubula	$\log D = -0.0977 + 1.3215 \log A$	0.96
Mahogany	$\log D = -0.0674 + 1.3214 \log A$	0.96

(Attention)
Extent of adjustment until bold lines.
Indication for reference under bold lines

γ : Correlation coefficient
D : Average diameter
A : Age

Table 3-4 Regression formula and estimate value of age' Number of trees

Age	Estimate value for each species					
	Cadamba	Deglupta	Maesopsis	Cordia	Kaubula	Mahogany
1	405.22	No suitable estimate value			359.18	583.37
2	311.00				291.13	319.18
3	321.94				271.44	261.06
4	312.82				262.10	236.10
5	307.46				256.65	222.28
6	303.95				253.08	213.52
7	301.46				250.56	207.48
8	299.61				248.69	203.05
9	298.18				247.24	199.68
10	297.04				246.09	197.02
11	296.11				245.15	194.88
12	295.33				244.37	193.10
13	294.68				243.71	191.62
14	294.12				243.15	190.35
15	293.64				242.67	189.26
16	293.22				242.24	188.31
17	292.84				241.87	187.48
18	292.51				241.54	186.74
19	292.22				241.24	186.08
20	291.95				240.97	185.49

Species	Regression formula	γ
Cadamba	$\log N = 2.4578 + 0.0150\ (10/A)$	0.16
Deglupta	No suitable formula (10/A)	
Maesopsis	〃	
Cordia	〃	
Kaubula	$\log N = 2.3728 + 0.0182\ (10/A)$	0.10
Mahogany	$\log N = 2.2421 + 0.0524\ (10/A)$	0.21

(Attention)
Extent of adjustment until bold lines.
Indication for reference under bold lines.

γ: Correlation coefficient
N: Number of trees/ha
A: Age

Table 3-5 Regression formula and estimate value of age: Total Volume

Age	Estimate value for each species					
	Cadamba	Deglupta	Maesopsis	Cordia	Kaubula	Mahogany
1	1.57	0.00	0.98	0.27	8.42	4.23
2	7.37	0.02	4.08	1.59	15.85	9.06
3	18.21	0.76	9.41	4.51	22.95	12.66
4	34.60	4.70	17.02	9.43	29.84	15.33
5	56.91	14.03	26.96	16.70	36.58	17.36
6	85.57	29.11	39.26	26.65	43.21	18.91
7	20.43	49.03	53.94	39.57	49.74	
8	162.35	72.48	71.03	55.73	56.19	
9	211.12	98.24	90.54	75.38	62.56	
10	267.04	125.29	112.50	98.76	68.88	
11	330.29	152.88	136.92	126.10	75.14	
12		180.46	163.81		81.36	
13		207.65	193.18		87.53	
14		234.19	225.06		93.65	
15		259.92	259.44		99.74	
16		284.75	296.35		105.79	
17		308.61	335.78		111.82	
18		331.50	377.76		117.81	
19		353.42	422.28		123.77	
20		374.38	469.37		129.70	

Species	Regression formula	γ
Cadamba	$\log TV = 0.1963 + 2.2303 \log A$	0.85
Deglupta	$\log TV = 3.0487 - 0.9508 (10/A)$	0.91
Maesopsis	$\log TV = -0.0096 + 2.0608 \log A$	0.83
Cordia	$\log TV = -0.5693 + 2.5639 \log A$	0.92
Kaubula	$\log TV = 0.9251 + 0.9130 \log A$	0.71
Mahogany	$\log TV = 0.7509 + 0.7837 \log A$	0.31

(Attention)
Extent of adjustment until bold lines.
Indication for reference under bold lines.

γ: Correlation coefficient
TV: Total Volume (m^3/ha)
A: Age

Table 3-6 Regression formula and estimate value of age: Basal area

Age	Estimate value for each species					
	Cadambe	Deglupta	Maesopsis	Cordia	Kaubula	Mahogany
1	0.78	0.00	0.17	0.16	0.01	0.02
2	2.14	0.00	0.69	0.62	0.08	0.09
3	3.84	0.11	1.56	1.35	0.24	0.26
4	5.83	0.62	2.79	2.36	0.50	0.53
5	8.04	1.72	4.38	3.64	0.90	0.91
6	10.47	3.38	6.32	5.18	1.46	1.44
7	13.09	5.49	8.63	6.98	2.20	2.11
8	15.88	7.90	11.29	9.03	3.13	2.93
9	18.83	10.48		11.35	4.26	3.93
10	21.93	13.14		13.92	5.63	5.10
11	25.17	15.81		16.74	7.24	6.46
12	28.55	18.45			9.11	8.02
13	32.05	21.02			11.25	9.78
14	35.68	23.51			13.68	11.75
15	39.43	25.90			16.41	13.95
16	43.29	28.19			19.46	16.37
17	47.25	30.38			22.83	19.02
18	51.33	32.47			26.55	21.92
19	55.50	34.47			30.62	25.07
20	59.78	36.36			35.06	28.47

Species	Regression formula	γ
Cadamba	$\log BA = -0.1057 + 1.4468 \log A$	0.81
Deglupta	$\log BA = 2.0026 - 0.8840\ 10/A$	0.92
Maesopsis	$\log BA = -0.7686 + 2.0169 \log A$	0.78
Cordia	$\log BA = -0.7927 + 1.9362 \log A$	0.89
Kaubula	$\log BA = -1.8874 + 2.6380 \log A$	0.90
Mahogany	$\log BA = -1.7734 + 2.4810 \log A$	0.92

(Attention)
Extent of adjustment until bold lines.
Indication for reference under bold lines.

γ: Correlation coefficient
Ba: Basal area (m^2/ha)
A: Age

Fig. 3-1 Regression curve of age' Merchantable Tree Height (Mahogany)

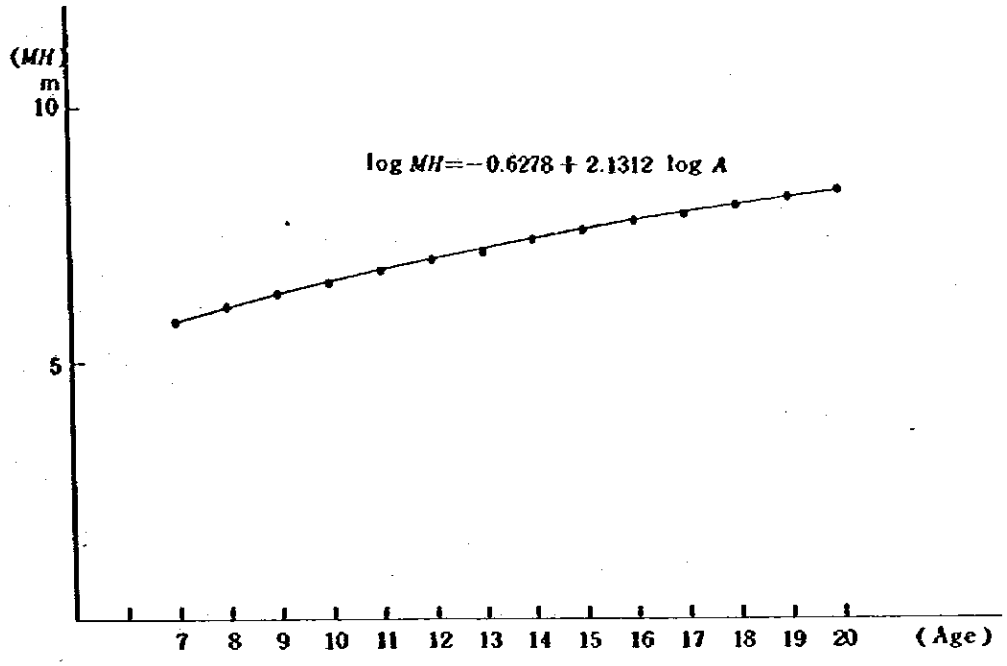


Fig. 3-2 Regression curve of age: Merchantable Volume (Mahogany)

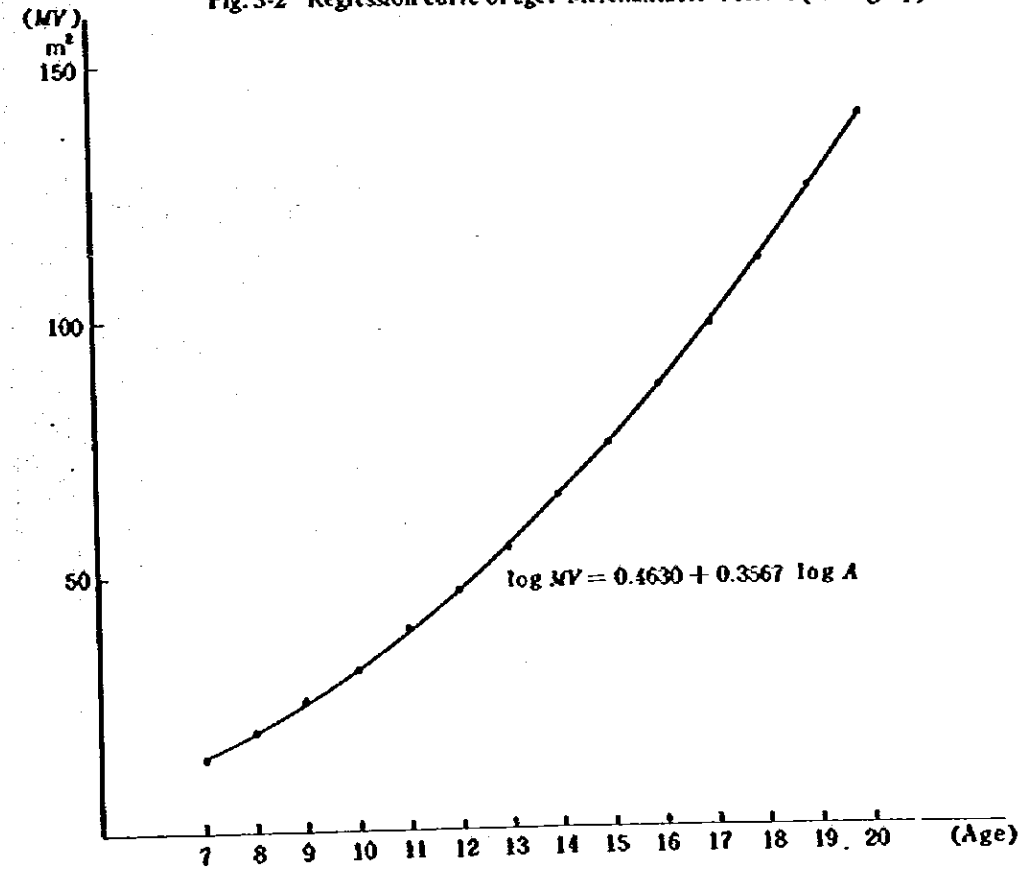


Fig. 3-3 Regression curve of age: Total Tree Height (6 species)

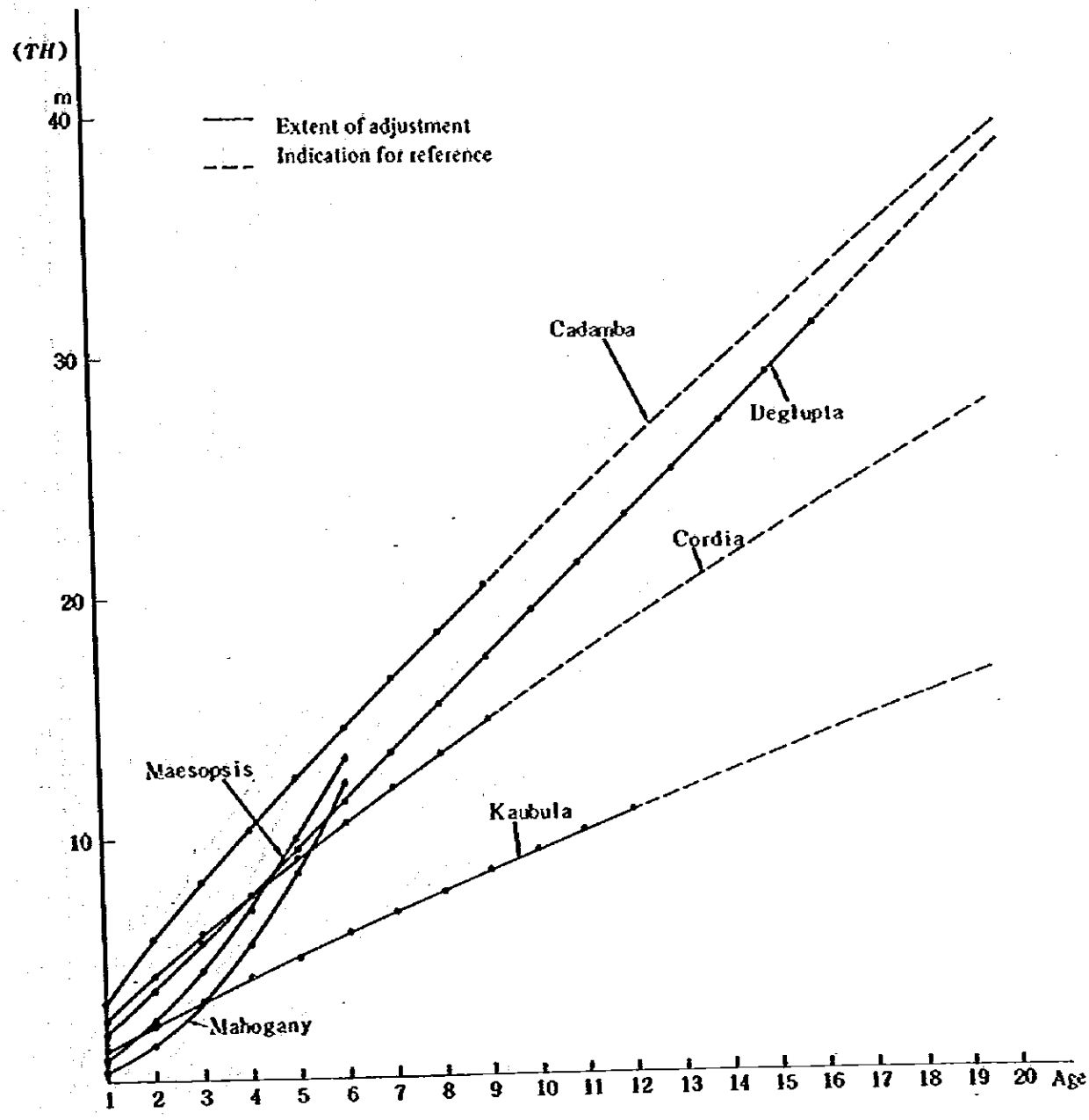
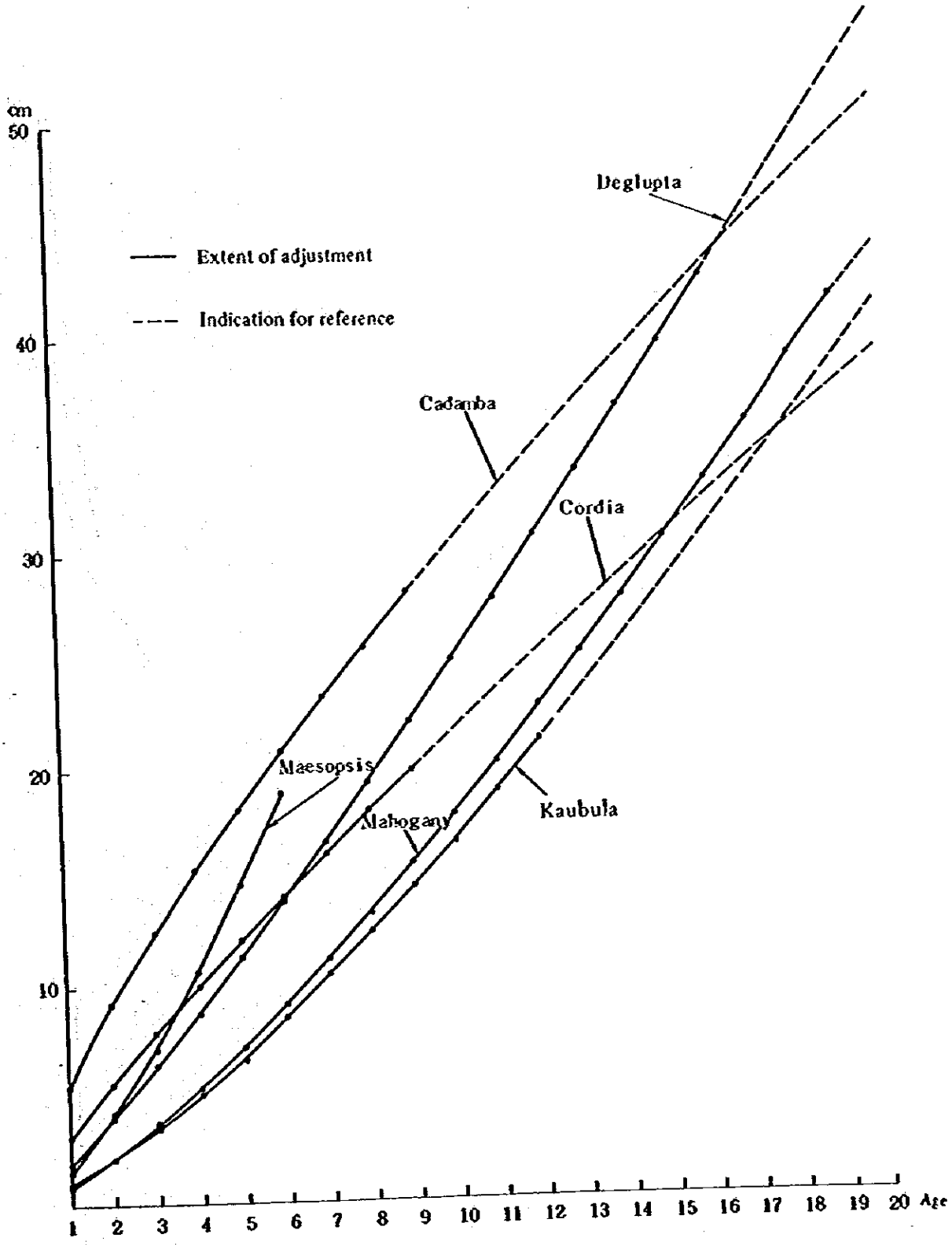


Fig. 3-4 Regression curve of age: Average D.B.H. (6 species)



F'g. 3-5 Regression curve of age: Tree number (only 3 species)

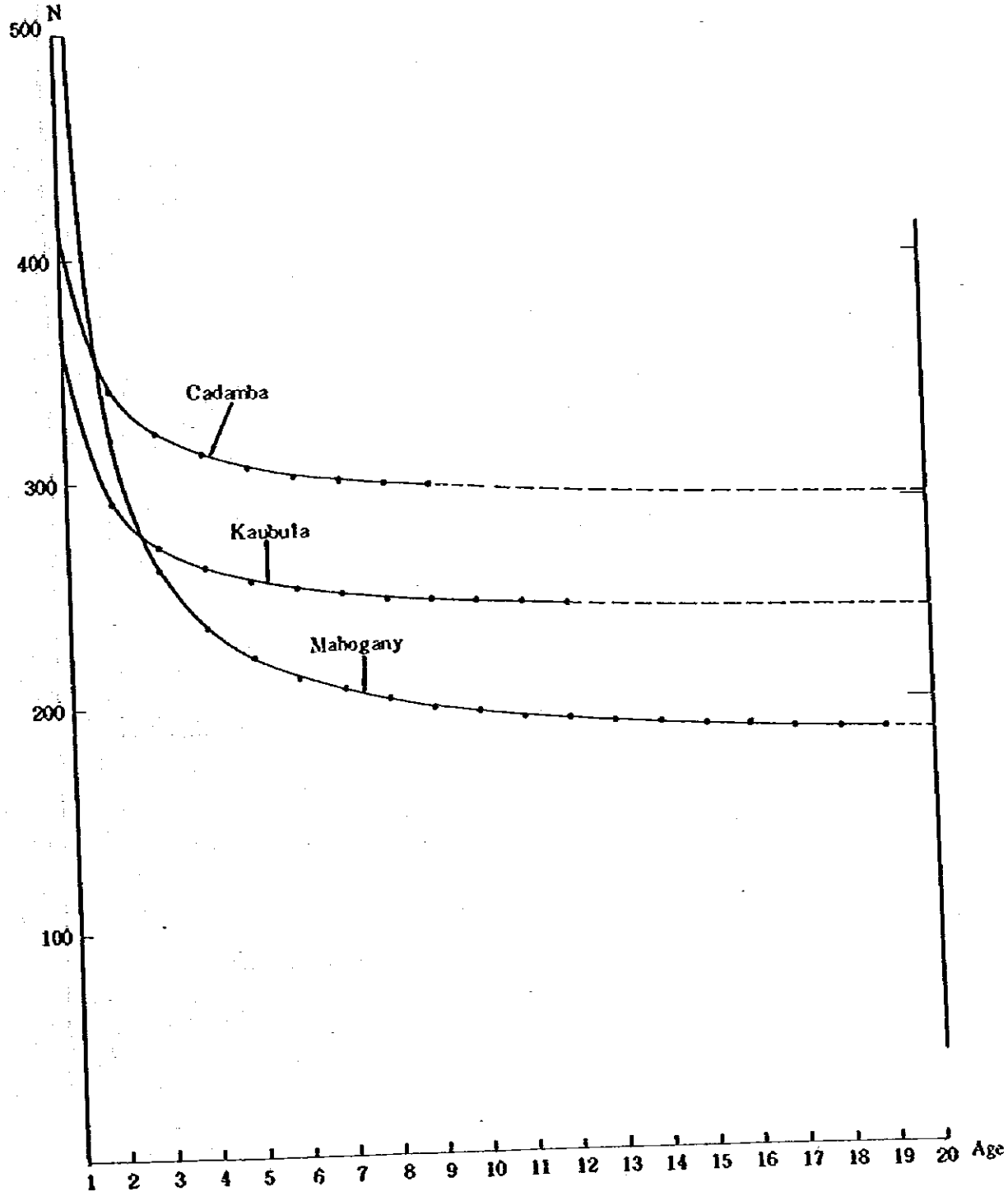


Fig. 3-6 Regression curve of age: Total Volume

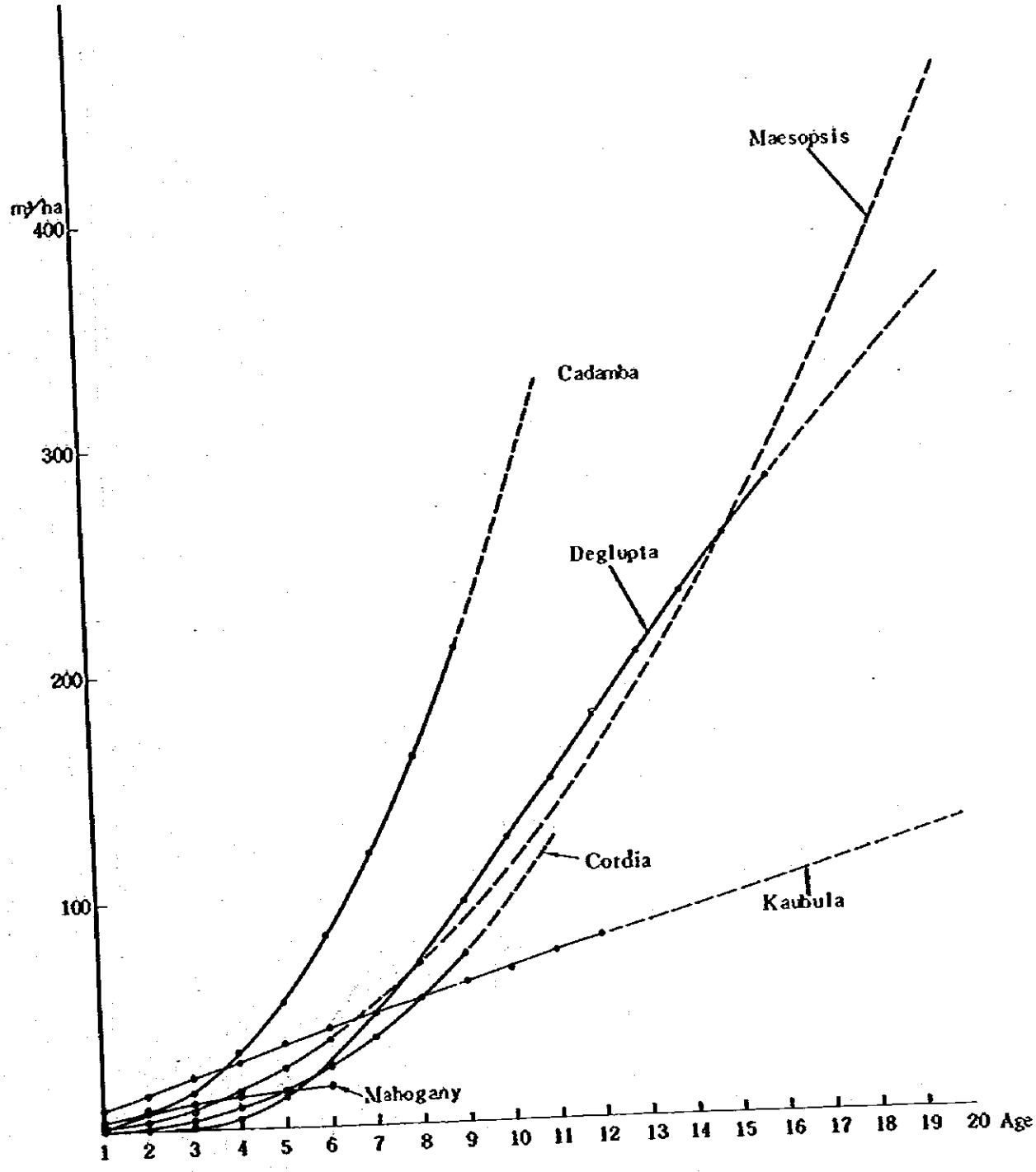


Fig. 3-7 Regression curve of age: Basal area

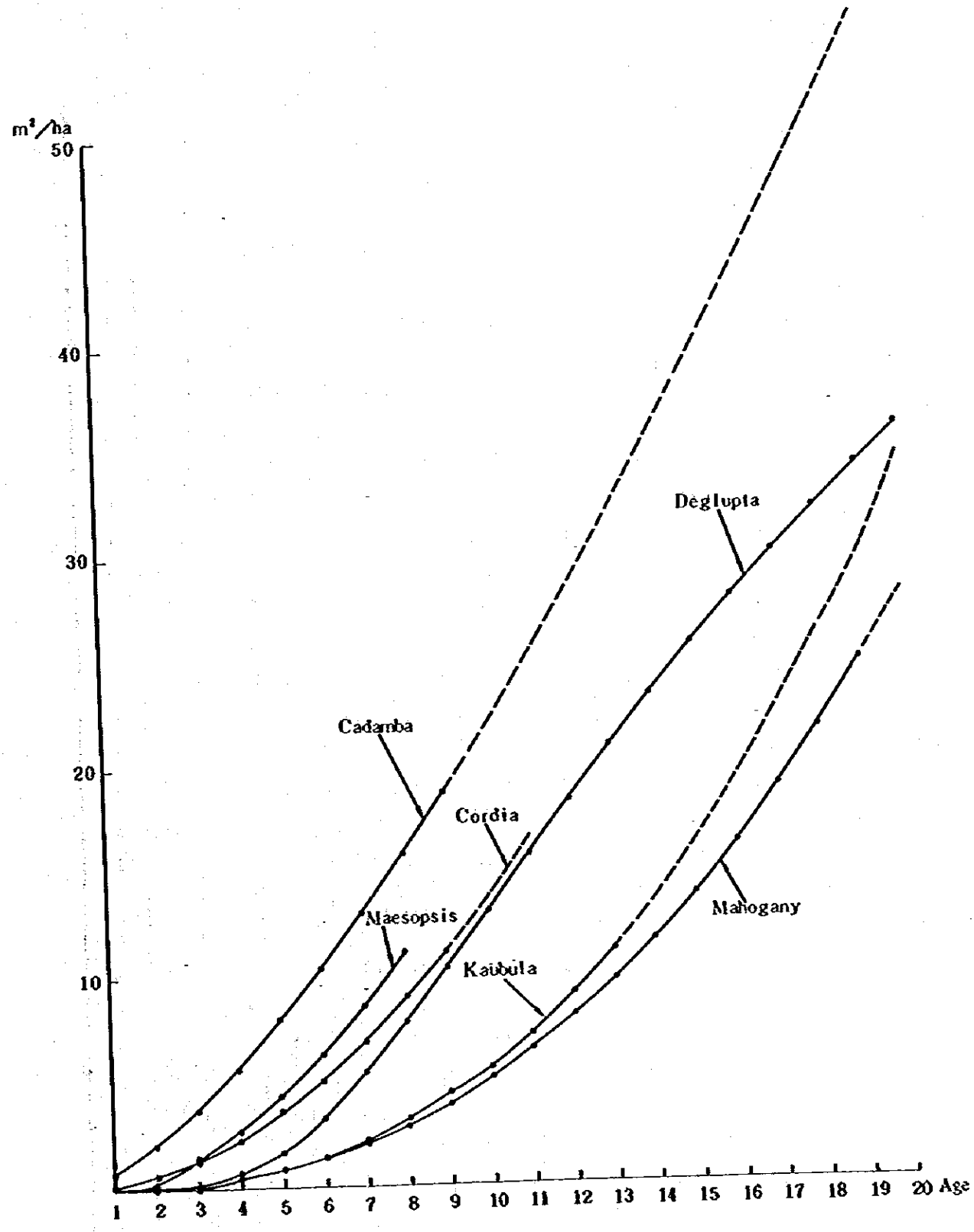


Table 3-7 Each stand value for both present and 2 years earlier for sample plots

Sample plot No.	Species	Ave. height		Ave. diameter		Number		Volume		Basal area	
		2 years earlier	Present	2 years earlier	Present	2 years earlier	present	2 years earlier	Present	2 years earlier	present
1	Mahogany	9.3	9.7	26.60	30.81	424	410	170.2	215.7	23.55	30.56
2	〃	7.4	7.7	27.87	32.27	193	190	67.5	85.6	11.79	15.54
3	〃	9.1	9.5	28.74	33.58	112	110	48.9	62.9	7.27	9.74
4	〃	7.3	7.6	30.01	35.06	224	220	83.1	106.8	15.86	21.24
5	〃	6.5	6.8	35.08	40.98	214	210	100.4	129.1	20.68	27.69
6	〃	6.4	6.7	29.34	34.62	204	200	66.8	87.2	13.81	18.83
7	〃	6.1	6.4	36.98	43.63	143	140	64.6	84.4	15.36	20.94
8	〃	5.2	5.4	28.73	33.90	112	110	29.2	38.1	7.28	9.93
9	〃	7.0	7.3	31.43	37.49	143	140	57.3	76.1	11.09	15.45
10	〃	8.7	9.1	30.67	36.58	225	220	99.9	132.8	16.59	23.12
11	〃	7.8	8.2	28.39	33.87	133	130	47.8	63.5	8.41	11.71
12	〃	11.9	12.5	20.94	25.30	266	260	82.6	112.0	9.16	13.07
13	〃	9.4	9.9	26.43	31.93	328	320	122.7	166.5	17.97	25.63
14	〃	8.0	8.4	28.57	34.51	143	140	55.2	74.9	9.18	13.10
15	〃	8.3	8.8	25.29	31.00	287	280	89.7	124.6	14.42	21.13
16	〃	7.1	7.5	28.14	34.50	185	180	60.8	84.4	11.49	16.83
17	〃	7.6	8.1	22.99	28.67	154	150	38.2	54.6	6.40	9.69
18	〃	9.5	10.1	24.54	30.60	185	180	62.3	89.0	8.75	13.24
19	〃	7.2	7.6	25.59	31.91	195	190	59.1	84.4	10.04	15.20
20	〃	6.4	6.8	19.14	24.35	176	170	28.2	41.6	5.06	7.91
21	〃	6.0	6.4	22.99	29.25	237	230	47.0	69.3	9.83	15.46
22	〃	4.9	5.2	17.55	22.33	196	190	23.0	33.9	4.73	7.44
23	〃	5.9	6.3	16.39	21.37	124	120	15.6	23.9	2.62	4.30
24	〃	5.9	6.3	16.12	21.01	196	190	21.7	33.3	4.00	6.58
25	〃	5.6	6.0	16.69	21.76	279	270	36.3	55.6	6.11	10.06
26	〃	6.2	6.7	14.41	18.78	259	250	26.8	41.1	4.22	6.94
27	〃	4.7	5.1	11.08	14.88	135	130	9.3	14.9	1.30	2.27
28	〃	4.9	5.7	11.67	15.68	549	530	40.7	65.4	5.87	10.21
29	〃	6.2	6.7	11.01	14.80	239	230	18.4	29.6	2.27	3.95
30	〃	6.2	6.8	8.64	12.05	177	170	10.4	17.8	1.04	1.94
31	〃	7.8	8.5	10.27	14.32	178	170	13.6	23.3	1.47	2.74
32	〃	5.9	6.5	10.61	14.80	208	200	14.9	25.4	1.84	3.43
33	〃	4.6	10.1	7.26	12.40	237	220	23.2	28.7	0.98	2.66
34	〃	4.8	10.5	6.37	10.89	257	240	22.4	27.7	0.82	2.24
35	〃	3.4	9.0	4.53	8.88	56	50	3.1	4.3	0.09	0.31

36	Mahogany	3.6	9.5	4.42	8.67	352	320	21.4	29.4	0.54	1.89
37	〃	2.0	7.4	2.63	6.58	295	280	16.5	27.9	0.16	0.94
38	〃	2.3	8.6	3.38	8.44	345	330	16.6	28.1	0.31	1.85
39	〃	0.3	2.6	0.59	2.52	330	260	3.7	11.2	0.01	0.13
40	〃	0.3	2.7	0.46	1.95	340	290	3.9	11.7	0.01	0.09
41	〃	6.7	7.1	21.49	25.96	686	670	154.8	210.0	24.87	35.47
42	〃	7.0	7.4	19.93	24.07	573	560	109.8	148.9	17.86	25.48
43	〃	7.8	8.2	24.50	29.59	246	240	68.7	93.2	11.57	16.50
44	〃	7.8	8.2	22.11	26.71	266	260	70.3	95.4	10.22	14.58
45	〃	6.5	6.9	15.02	18.73	462	450	52.2	74.6	8.19	12.40
46	〃	8.0	8.8	12.83	17.89	84	80	9.2	15.7	1.08	2.01
47	Cadamba	17.8	22.0	26.23	31.65	284	280	151.7	265.8	15.31	22.02
〃	〃	15.0	18.5					163.9	287.0		
48	〃	19.0	23.5	26.77	32.30	343	340	200.4	351.1	19.34	27.86
〃	〃	16.1	19.9					215.7	377.9		
49	〃	5.6	10.2	10.53	15.43	268	260	8.7	27.2	2.32	4.86
50	〃	7.4	11.4	9.80	14.36	410	400	13.6	42.4	3.09	6.46
51	〃	5.6	10.0	9.56	16.04	256	250	6.4	30.1	1.85	5.05
52	〃	4.8	8.0	6.91	11.65	294	280	3.2	14.8	1.10	2.99
53	〃	3.6	9.1	6.05	13.73	435	410	2.7	31.3	1.23	6.06
54	〃	4.2	10.5	7.32	16.62	316	300	3.3	38.2	1.32	6.52
55	Deglupta	23.9	27.4	35.29	41.12	249	220	308.3	374.8	24.36	29.21
〃	〃	17.7	20.3					326.4	396.9		
56	〃	20.9	24.0	33.91	39.52	159	140	157.0	190.9	14.32	17.17
〃	〃	13.0	14.9					139.7	169.8		
57	〃	13.0	17.4	13.44	18.68	480	480	45.3	112.7	5.63	13.17
58	〃	14.2	19.0	13.32	18.51	400	400	41.1	102.3	4.60	10.75
59	〃	14.8	20.8	16.93	24.88	360	360	46.6	163.0	5.48	17.50
60	〃	13.7	19.3	14.85	21.84	270	270	26.2	91.5	3.17	10.12
61	〃	4.5	7.6	5.42	9.74	170	170	0.4	7.9	0.08	1.27
62	〃	3.7	6.3	3.44	6.18	90	90	0.1	2.0	0.02	0.27
63	〃	4.3	8.8	5.40	11.94	40	40	0.0	2.7	0.00	0.45
64	〃	3.4	6.8	4.22	9.34	40	40	0.0	1.5	0.00	0.27
65	〃	1.3	4.1	1.24	4.37	100	100	0.0	1.8	0.00	0.15
66	〃	2.3	7.2	2.38	8.37	50	50	0.0	1.8	0.00	0.28

67	Maesopsis	7.7	14.3	10.33	18.30	290	270	21.0	48.5	3.15	7.13
68	〃	7.4	11.2	9.22	16.32	278	200	11.3	26.1	1.85	4.18
69	〃	6.4	10.7	9.06	15.61	247	220	11.2	32.0	2.14	6.00
70	〃	4.9	11.6	7.79	16.00	305	270	11.3	32.5	1.91	5.44
71	〃	2.4	6.9	3.97	10.52	420	340	4.2	17.5	0.73	2.96
72	〃	2.3	6.8	3.53	9.37	400	300	3.4	14.1	0.51	2.07
73	Cordia	11.9	14.6	16.45	19.78	500	500	55.5	105.8	9.45	15.37
	〃	6.8	8.3					48.8	92.9		
74	〃	9.5	11.7	15.63	18.79	630	630	46.6	88.8	10.74	17.46
	〃	5.9	7.3					45.1	85.9		
75	〃	11.8	15.5	13.46	17.95	330	330	23.2	55.0	4.35	8.34
76	〃	13.9	18.3	17.87	23.83	120	120	17.4	41.3	2.79	5.35
77	〃	5.4	7.5	7.17	10.13	310	310	4.3	12.2	1.14	2.50
78	〃	7.3	10.2	8.56	12.09	370	370	7.3	20.7	1.93	4.24
79	〃	5.7	8.7	7.69	11.89	230	230	2.7	10.1	0.95	2.56
80	〃	7.9	12.1	9.26	14.32	330	330	7.5	27.7	1.97	5.30
81	〃	3.4	6.0	4.79	8.67	320	320	1.1	6.8	0.49	1.89
82	〃	3.4	6.0	4.79	8.67	350	350	1.3	7.7	0.54	2.06
83	〃	3.0	7.5	3.47	8.88	310	310	0.4	7.2	0.23	1.93
84	〃	2.4	6.0	3.28	8.37	320	320	0.3	5.6	0.21	1.75
85	Kaubuta	9.7	11.4	15.99	20.34	300	300	91.3	107.8	6.03	9.75
	〃	5.1	6.0					60.5	71.5		
86	〃	8.5	10.0	15.93	20.27	240	240	64.8	76.5	4.78	7.74
	〃	5.0	5.9					45.8	54.1		
87	〃	4.7	7.3	5.17	10.16	358	350	31.3	49.9	0.76	2.84
88	〃	3.7	5.7	3.72	7.31	279	270	20.3	32.3	0.30	1.13
89	〃	1.5	2.7	1.50	3.74	226	200	10.0	18.8	0.01	0.22
90	〃	2.1	3.9	1.73	4.31	132	110	8.4	11.8	0.03	0.16
91	〃	1.2	3.2	0.75	3.19	380	380	14.6	39.9	0.01	0.30
92	〃	1.5	3.9	0.88	3.74	350	350	13.0	35.3	0.02	0.37

4. OTHERS

We would like to mention here the necessity of right tree on right site, and site index survey.

At present, in Fiji, line planting in which the same species are planted in a line after deciding direction has been followed. Because this method is simple and clear, it is easy to prepare seedlings and the planting method is easy. Also the cultural work is easy. However, it does not seem desirable to plant the same species regardless of the ground factors, such as topography and soil conditions. For example, in the case of mahogany, this species flourishes along ridges and on steep hillsides, whereas in valley-bottoms and low areas growth seems poor. Some areas are left with few trees even if they have been planted. In such places it is obviously more effective to plant species for which the environment is better suited rather than mahogany. It seems to be important to carry out surveys on which trees are suitable for which areas, and to estimate what degree of growth can be expected.