STUDIES ON THE CHANGING PATTERN OF MAN-FOREST INTERACTIONS AND ITS IMPLICATIONS ON ECOLOGY AND MANAGEMANT

A case study of the reserved and vested forests in Attappady, Kerala.

KERALA FOREST RESEARCH INSTITUTE
PEECHI, THRISSUR

December 1980

CONTENTS

LIST OF FIGURES

LIST OF PLATES

LIST OF TABLES

Abstract

The study is an attempt to analyze and understand the course and nature on man-forest interactions in Attappady and to determine their implications on ecology and management of the area.

The study area is 740 km^2 in extent, out of which 376 Km^2 is under forests. Much of the remaining area is under various agricultural crops. The area is rugged with elevation ranging from 250 m. to 2, 300 m. Two main rivers Bhavani and Siruvani, with their tributaries determine the drainage pattern. Communications in general is poor excepting for an all weather road from Mannarghat to Coimbatore. Geologically, at least five formations have been described and minerological importance is limited. There is a wide range of variation in rainfall and temperature and at least three rainfall regimes can be recognized.

Nine forest types recognized by Champion and Seth (1968) are encountered in the study area. While the western parts exposed to S.W. monsoon show a moister type of vegetation, those in the east and northeast are dominated by dry deciduous forest and its derivative viz., dry deciduous scrub. Forest management, as such, was unknown in the area till 1933, and

thereafter the reserved forests have continuously been managed under the prescription of Working Plans.

The earliest inhabitants of the area were the tribals viz., Kurumbas, Mudugas and Irulas. The migration from the plains of Coimbatore commenced in 1920 but large scale influx of settlers started only in the late forties when Mannarghat-Coimbatore road was completed.

A household survey covering 276 households revealed interesting information about both the tribals and settlers. Regarding the settlers, their pace and reasons for migration, method of acquisition of land, the extent of land cleared for cultivation, cultivation practices etc. have been fully investigated. Consequent to the large scale influx, the demand of the people on the forests increased and qualitative as well as quantitative estimates for timber, fuelwood, minor forest produce including medicinal plants, have been made. The results point to the conclusion that the forest area is unable to meet even the basic requirements of the people for housing and fuelwood. It is also feared that unless policy options are decided at this stage, the forests may not be even able to meet the demands of minor forest produce and plants of medicinal value.

Vegetational and soil studies have been carried out in sixteen relives representing the evergreen, semi-evergreen, moist deciduous and dry deciduous types of forests. Studies were conducted in undisturbed, partially disturbed and totally disturbed areas and the extent of degradation brought about in physiognomy, floristic composition and on soil by anthropic factors have been analyzed.

CHAPTER I

Introduction

It is often assumed without adequate studies that environmental effects or impacts of any action resulting in changes in the environment must be harmful. The effect may be localized to the area in which the operation is carried out, it may be more pervasive or in extreme cases universal (Poore, 1976). While considering the principles and procedures which should be used in assessing the environmental effect, the impact on areas of human concern has been given paramount importance (ECE/FAO, 1974). The difficulties which attend such an assessment are understandable as many of the effects may take some time to become evident. An action that results in immediate advantages may include in it, seeds of future disadvantages. Moreover, as Poore (2976) has pointed out, the value that society places on various aspects of advantage, may change with the passage of time. Thus, it is important to assess environmental effect by the impact on different groups of people at different periods of time. If this criterion is accepted, the complexity of impact studies becomes evident, even though a number of approaches and guidelines have been suggested for such studies in recent literature (Ward, 1978).

The importance of tropical forests as the habitat of species and genotypes of plants and animals of rare value; as regulator of the quality and quantity of water etc., and its preservation has been discussed in several studies (Richards, 1952; FAO, 1962; Whitmore, 1975). On the other hand, the urgent necessity of management of these forests by conservation, modification or transformation (sensu lato) because of the compulsion of circumstances, has also been advocated (Adeyoju, 1980; King, 1979; King and Chandler, 1978). There is, however, wide consensus that these forests should not be destroyed, whatever be the short term benefits.

To evolve careful management practices, it is essential to clearly understand the safe limits of modification or transformation, consistent with the needs of society and the impact of unlimited interference or disturbance caused by superimposed developmental programmes, unplanned human settlements etc. It is also necessary to take into account the present and projected requirements of inhabitants of the area from the forested land in and around the settlements. Such an assessment at micro level can ensure evolution of management practices to safeguard destruction of forest and consequent adverse effects on environment.

Studies on the structure and functioning of tropical forests under natural and modified conditions have been undertaken to determine and understand the impact of such modification (Edit, 1977; Singh and Misra, 1978). Causes for such modification, possible remedial measures and strategy for management of such areas, have seldom been studied.

In the present study, the effect of unplanned human settlement on vegetation and soil is investigated, tracing the historical sequence of settlement vis a vis modification, transformation and destruction of forest. The present status of managed, partially disturbed and totally disturbed forests of different types viz., evergreen, semi-evergreen, moist deciduous, and dry deciduous, has been investigated to bring out the changes in the structure of almost each of these forest types, caused by unchecked human interference. The changes in soil conditions have also been similarly investigated. A systematic survey has been carried out to determine the nature of dependence of the inhabitants on forest produce (including medicinal plants) and a qualitative as well as quantitative (wherever possible) assessment of requirement of forest produce has been made. It is essential to evolve management strategies to meet the present and future demands of the inhabitants on forest produce from within or around the area, so as to ensure that further damage to whatever forest now exists, is minimal.

Based on the data generated and evaluations made in this study, forest management plans and programmes for social forestry can be drawn up recognizing the ecological implications of man forest interaction.

Attappady in Kerala State offered a typical situation for this study as within a limited extent, it supported a wide spectrum of forest types ranging from wet evergreen to dry deciduous. A portion of the forest received the benefit of protection from the beginning of this century and the rest was exposed to varying degrees of human interference - selective felling to total destruction of vegetal cover. With fundamentally different cultural and social background, the people, who inhabited the area over a period of time had varied perspectives on the forest, ranging from considering it as an abode of unlimited benevolence, to reckoning it as an impediment to progress. A variety of agricultural practices – slash and burn cultivation to modern farming, have been in vogue. Thus Attappady is a veritable microcosm of forest splendour tampered by anthropic blunder.

The methodology adopted for the study was first to reconnoitre the entire area to collect background information about the type and general condition of forests, the inhabitants in make-shift huts within forests, hamlets and

villages, and the impact of current developmental activities. General information on physical features, climate, human population, livestock etc. was gathered from published literature and unpublished primary records maintained in various sources. The description of forest in forest working plans and forest records were critically examined and the forest area was classified in accordance with the classification of Champion and Seth (1968). The delimitation of forest types was based on working plan maps and reconnaissance. Ecological and floristic data were collected by perambulations to supplement available information. The history of forest management was gathered from current and past Forest Working Plans, records in revenue and forest offices. A sample survey of the households was conducted and with a carefully planned questionnaire (Appendix I) basic data covering a wide field, were collected and analyzed to obtain information on the inhabitants, their requirement of major and minor forest produce, their views on planning for a sustained supply of forest produce etc. As regards medicinal plants and local therapeutic practices, very little information was forthcoming through the questionnaire for understandable reasons. Hence contacts had to be established with knowledgeable inhabitants who were repeatedly approached to part with the “secret information”.

To study the effect of human interference on vegetation, sixteen relives were chosen to represent different degrees of disturbance in the major forest types and the permanent vegetation was analyzed to determine the changes in the structure and floristic compositions. Soil samples from the profile as well as surface were taken from all the sixteen relives to study the possible effect on soil, consequent to interference with vegetal cover.

The study has generated useful information to draw up management plans for the area which can sustain an amicable man forest interaction.

CHAPTER II

THE STUDY AREA

Location

Attappady Valley, situated in Palghat District, Kerala State, lies between $10^0$55' and $11^0$14' latitude and $76^0$27' and $76^0$48' E longitude (Fig.I). River Bhavani flows from the north to south and traverses northeastwards. The other important river Siruvani flows from south to northeast. Physiographically, the area is divisible into three regions:

1) The valley proper

2) Nilgiri range along the northern side

3) Vellingiri range on the southern side

The valley region is rugged, the elevation ranging from about 250 to about 1700 meters, particularly in the western portion. Towards east, it is less undulating and gently sloping, merging with the plains of Coimbatore District of Tamil Nadu. The highest peak is Malleswaramalai (1664 m.) and other important peaks are Taikarai (1554 m.), Tokkuppannamalai (1605 m.) and Taimbhagavathimalai (1014 m.). Nilgiri range region is characterized by steep slopes, cliffs and rocky outcrops, elevation ranging from 1600 to about 2300 m. Vellingiri range is also broken but less

unevenly and the gamut of elevation is from about 750 m. to 2100 m.

Boundaries

The area is bounded in the north by Nilgiri District (Tamil Nadu), in the west by Malappuram District (Kerala), in the south by Palghat taluk (Kerala) and in the east by Coimbatore District (Tamil Nadu). The area can be approached by an all weather road, which connects Mannarghat to Coimbatore. Agali is the most important township and the block headquarters. It is about 50 km. From Mannarghat and about 30 km. From Coimbatore.

Area

The geographical area is stated to be 765 km^2 (Kerala Government, 1975; Kerala Government, 1976) and 740 km^2 (India census, 1971). For purposes of this study the area is reckoned as 740 km^2. Although the forested area is said to be 606 km^2 (Kerala Government, 1975) it is limited to 204 km^2 of reserved forests (Venkateswara Ayyar, 1935; Chand Basha, 1977) and 172 km^2 of private forests now vested with the Government (Kerala Government, 1975). Thus the total extent of area classified as forests is 376 km^2 only, which includes area under forest plantations also. Much of the remaining area is under various agricultural crops (Fig. II).

Drainage

The drainage is mainly determined by the course of rivers Bhavani and Siruvani. River Bhavani originates from the Nilgiri range, flows southwards upto Mukkali, from where it takes a sharp turn northeastwards and flows down the hills to Coimbatore District. The tributaries of Bhavani, East and West Varahapallam join Bhavani at Ranganathapuram. River Siruvani which origainates in the Vellingiri range flows through Muthikkulam (where it is impounded by Siruvani dam) and joins river Bhavani at Koodapatty, the Kerala-Tamil Nadu border.

Communication

The principal means of communication is by an all weather road from Mannarghat to Coimbatore which traverses through the valley proper, connecting the three townships, Agali (Attappady I), Pudur (Attappady II) and Sholayur (Attappady III). The Kalkandimala fair weather road connects Chemmannur with Anakatty passing through Kallamala and Ommala. The other fair weather roads are Thavalam-Mulli road, crossing Bhavani and leading to Mettupalayam road; Mukkali-Anavoy road, connecting the Kurumba hamlets and the Kottathara-Pudur road. The road under construction from Mukkali to

Silent Valley passes through Panthanthodu (reserved forest). There are several footpaths between hamlets which also from the connecting links between all weather and fair weather roads. Communication in general is poor and particularly difficult during monsoon.

Geology, Lithology and Soil

Mani (1965) and Lahiri et al (1977) have studies the geology, lithology and minerology of the area (Fig. III) and according to them, the geological formations are as follows:

1.	Partly basement gneisses	a)	Peninsular gneisses
		b)	Magnetite – quartzite
2.	Archean metamorphic complex	c)	Garnet – Sillimanite gneiss
		d)	Calc – granulite
		e)	Pyroxene granulites within the charnockitic rocks
		f)	Charnockitic gneisses and associated migmatic complex
3.	Post Dharwar intrusives	g)	Pink and grey granites and granitic orthogneisses
4.	Later intrusives	h)	Pegmatite and quartz veins
		i)	Dykes and sheets of Gabbro, Dolerite and Basaltic traps
5.	Recent and subrecent	j)	Laterites, alluvium and kanker

a) Peninsular gneisses

Peninsular gneisses occupy the southern part of the valley and megascopically they are greyish-white, coarse to medium grained, massive and foliated. They are seen to be xenoblastic gneissage composed mostly of micropertite (30%), quartz (35%), Sodic plagioclase (20%), pale yellowish green hornblende (6%) and biotite (4%). Within these gneisses, thin lenticular bands of amphibolite are met with (8 in Fig. 3).

Quartz – Biotite Schist

This rock characterizes the shear zone along the Bhavani river. It occurs in a wide zone for about 10 km. Between Kottathara in the north and Varangambadi in the south. Along with its foliation trend, this rock extends from Anakkatty in the east to Tenkara in the west for about 20 km. (2 in Fig. 3).

Megascopically, the rock is medium grained, schistose and greyish white and sections of this reveal large amounts of quartz (55 to 60%), orthoclase (3 to 5%), plagioclase feldspar (3 to 5%) and low grade biotite (20 to 30%).

b) Magnetite – Quartzite

These, along with associated hornblende granulites from a distinctive and useful stratigraphical horizon and occur as numerous massive bands traversing the gneissic and schistose rocks for considerable distances. They are found at the southern foothills of Malleswaramalai and also near Anakkatty (1 in Fig. 3).

It is medium-fine grained, dark brown in colour and banded at places due to parallel arrangement of magnetite and quartz. It consists mainly of a granular aggregate of quartz (55%), Magnetite (35%) and grunerite (10%).

c) Granet – Sillimanite gneiss

Although they are not met with in the study area, they occur very close to it, near, Muthikkulam Reserved Forests. It is pinkish-grey in colour and medium grained and thin sections of rock shows Sillimanite (50%), garnet (3%), oligoclase (2%) and quartz (45%), with lesser amounts of biotite and orthoclase (25 in Fig.3).

d) Calc – granulite

This also occurs close to the study area and is greyish-blue in colour and medium to fine grained. It is composed mainly of calcite (55%), labrodorite (20%), scapolite (10%) and diopside (10%), with lesser amounts of magnetite, apatite and sphene (5 in Fig .3)

e) Pyroxene granulites within the charnockitic rocks

They occur north of the Bhavani river and generally met with in the charnockitic terrain north of Mukkali and also along the southern slopes of the Nilgiri massif (17 in fig. 3.).

The rocks exhibit a typical granoblastic texture composed of quartz (30 to 35%), microperthite (10 to 15%), plagioclase feldspar (10 to 15%), bornblende (2 to 5%), biotite (10%) and iron ore (2%).

f) Charnockitic gneisses and associated migmatite types

They make up the hill slopes of the Nilgiri massif, north of the Bhavani river. They are also seen north of Mullali near Malleswaramalai. The strike of foliation of the charnockites varies from East Northeast to West SouthWest with moderate to steep dips of 50^0 to 75^0 to the south (10 in Fig. 3). The mineral composition is generally 20 to 30% quartz, 20 to 40% microperthite, 20 to 40% plagioclase, 10 to 20% hypersthene, 10 to 15% diopside, about 5% hornblende and 2 to 5% magnetite, apatite an zircon (16 in Fig. 3).

g) Pink and grey granites and granitic ortho-gneisses

These rocky types are common in the vellingiri range and in the valley proper along the eastern side. Their mineral composition are as follows (4,23 & 26 in Fig. 3).

Quartz	(40%)
Microcline	(30%)
Microperthite	(10%)
Feldspar	(15%)

h) Pegmatite and Quartz

These are profuse in the Agali area and contain green coloured beryl. Some of the pegmatites also have muscovite mica (11 in Fig. 3).

i) Gabbro, dolerite and basaltic traps

The shear zone in the valley has been the scene of intensive intrusive activity. Numerous dykes and sheets of basic igneous rocks such as gabbro and basaltic traps are met with in the shear zone, while dykes of fine grained dolerite are seen in the plains near Melattur (9 in Fig. 3). Within the charnockitic gneisses, sheet like bodies of fine to medium grained, dark coloured metagabbro are met with in the following places:

(i) Starting from periamully at the north-eastern corner of the valley, a sill of gabbro stretching East NorthEast-West SouthWest has been traced for a distance of about 20 km. (3 in Fig. 3).

(ii) A small sill is met with just north of Mukkali forest check post North-East to South-West. Besides, a few dykes of gabbro are also met with south of Thuvapatti (3 in Fig. 3).

In fine sections, the rock exhibits gabbroidal texture and is made up mostly of secondary bluish-green hornblende (45%) and plagioclase feldspar (50%).

Basaltic traps

They occur in varying dimensions. From small thin veins traversing the rocks, they vary in size to thick sills and sheets as in the Bhavani river bed north of Mukkali. A sheet of basaltic trap is also met with west of Malleswaramalai (20 in Fig.3).

Under microscope, they were found to contain angite (35%), plagioclase feldspar (55%) and olivine (8%).

Magnetite is an accessory mineral.

Hornblende granulites, amphibolites, chlorite-tremolite schists and hornblende gneisses

The intrusion of the basic igneous rocks and the shearing along the Bhavani river have induced retrograde features resulting in the formation of hornblende granulites, amphibolites, chlorite-tremolite schists and hornblende gneisses along the valley. Numerous bands of these granulites and basic rocks are seen all over the shear zone (6 in Fig.3). They vary from thin intercalcations to long, thick bands and are a conspicuous feature in the valley (7,18 and 19 in Fig.3).

Thin sections of these show, large amount of bluishgreen hornblende (80%), plagioclase feldspar (10%) and quartz (2 to 3%).

The amphibolites are green coloured, medium to coarse grained rocks, carrying 85 to 90% fibrous hornblende with quartz and magnetite in lesser amounts. They occur as conspicuous bands near Narasimukkai (19 in Fig.3). The rock in thin sections exhibits a granoblastic texture with large amounts of quartz (50%), Plagioclase feldspar (10%) and hornblende (25%). Magnetite, epidote and zoisite are the acessory minerals.

Laterites, alluvium and kanker

Extensive capping of reddish brown laterites are seen in the plains near Melattur. The capping is about 9 m. thick (28 in Fig. 3).

The weathering of gneisses, charnockites and schists has given rise to a forruginous loamy to sandy soil. The basic granulites have weathered into a deep red soil.

Thin strips of alluvium are seen in the valley between kakkapadi and kavandikkal (13 in Fig. 3). Nodular kanker occurs as small disseminations along stream beds near Agali and Kottathara (27 in Fig. 3).

Economic minerals

No major mineral deposit has been located in the area. However, pegmatite and quartz carry minerals of minor economic importance like Mica, Beryl, Schelite, Kankar and Laterites (12,15, 21, 22, 24, 27 and 28 in Fig.3). A prominent, deep centred major shear zone has been identified and this zone has an important bearing on the uplift of Nilgiri hill massif to the north (14 in Fig. 3). The association of gabbro, dolerite and basaltic traps, their shearing and conversion to hornblende rocks are features of particular interest in this area.

Soil

No detailed soil survey of the area has been conducted. From information gathered for this study it is seen that the parent material is the Archean crystalline and metamorphic rocks such as garnetiferous gneiss, biotite gneiss, amphibolite, crystalline limestones, and granites under subhumid to semi-arid climate and under evergreen, semi-evergreen, moist deciduous and dry deciduous types of vegetation. Soils under evergreen and semi-evergreen forest are brown to dark yellowish brown, whereas those under moist and dry deciduous forests are dark brown to dark greyish brown in colour. Most of the profiles studied are fairly deep. The surface horizons of these soils have the following general features: loam to sandy loam texture, slightly acid to neutral reaction, fairly high content of organic carbon except in dry deciduous forest area and fairly high cation exchange capacity values.

Climate

There is significant variation in the climate within the area and broadly two regimes can be recognized. The western portion is wet, warm and humid for nearly nine months in a year. The eastern portion is dry and warm almost throughout the year. The influence of these two distinct regimes is reflected in the vegetational distribution.

Rainfall

The area receives rainfall both from southwest and the retreating (northeast) monsoons during June-August and October-December respectively. While the western hilly areas receive the bulk of precipitation during the southwest monsoon, the main quantum of precipitation in the eastern plains is by the retreating monsoon.

The average rainfall for nine stations situated in the study area and adjacent places is given in Table 1 and represented in Fig. IV.

Fig. IV (i) depicts the pattern of rainfall in areas where it is typically of a tropical type with a summer rainfall and a short dry season extending from January to March. Here again the dryness to a great extent is compensated by the presence of dew.

The physiography of the area is such that the Malleswaramalai range forms the line of demarcation between the western and eastern parts. Areas close to this mountainous range also receive the rains by the southwest monsoon but their intensity in less (Fig. IV (ii)). Unlike the former, where the maximum rainfall during July is of the order of 1250 mm here it is only around 760 mm. A tendency towards reduction in the total rainfall is thus noticeable in these areas.

Fig. IV (iii) shows the rainfall pattern in the eastern part. These areas exhibit a tropical dissymmetric regime (Legris and Viart, 1961) where the peak of the rainy season is shifted towards the end of the year and not centred as it is the rule for tropical climates. They receive scanty rainfall during southwest monsoon and the dry season varies from 5 to 7 months. Maximum precipitation occurs during October to November and inter-yearly variability of rainfall is very much conspicuous.

Thus, based on the distributional pattern of rainfall atleast two main regimes can be recognized with a transitory stage.

Chand Basha (1977) has observed a declining trend in the total rainfall in the area and he has attributed it to the probable destruction of private forests during the past.

Table 1

Average monthly and annual rainfall in Attappady and adjacent areas (in mm.)

Month	Elevation from M.S.L.								
	Singa-raparai 710 m (12 yrs)	Meiti-kkal 1005 m (11 yrs)	Silent-valley 990 m (9 yrs)	Nanner-ghat 75 m (16 yrs)	Mukkali 535 m (1 yrs)	Thudu-kki 1220 m (6 yrs)	Pudur 520 m (6 yrs)	Agali 502 m (10 yrs)	Moole-kumbu 610 m (4 yrs)
January	57	32	6	4	5	19	19	6	21
February	16	1	2	7	2	4	3	2	9
March	53	12	13	30	14	12	17	11	22
April	109	82	67	130	59	158	109	58	116
May	285	239	202	236	214	157	94	74	103
June	923	1000	531	468	553	360	47	92	37
July	1268	1176	936	799	422	695	89	133	67
August	780	906	679	406	310	242	46	58	64
September	314	386	319	244	211	156	36	61	29
October	551	417	309	347	249	305	211	171	109
November	241	203	121	131	117	124	177	170	100
December	133	86	45	39	.644	101	90	50	95
Total	4730	4540	3130	2841	2800	2341	938	886	772

Figures in brackets denote the average.

Temperature

Since the figures for the study area are not available those of the adjacent parts like Mannarghat and Coimbatore have been taken into consideration.

It is seen that March, April and May are the hottest months of the year and there is a wide range of variation between the plains and the hills. The mean annual temperature in the plains varies from 21 to 40^0C and in the hills from 10 to 32^0C. The occasional thunderstorms during May considerably reduce the temperature in the western portion.

Population

The population can be broadly categorised as tribals (consisting of Kurumbas, Mudugas and Irulas) and settlers who moved into the area for cultivation, trade and employment. According to Indica Census (1971), the total population is 39, 183 tribals accounting for 16,536. There are about 4000 tribal households distributed in 126 “Oorus” (hamlets).

The details of population as recorded in the censuses of 1951, 1961, 1971 and the estimated figure for 1977 (based on Panchayat records) are as follows:

Table 2

Population

Year	Tribals	Settlers	Total
1951	10,200 (estimated)	1,100 (estimated)	11,353
1961	12,972	8,489	21,461
1971	16,536	22,647	39,183
1977	17,800 (estimated)	40,200 (estimated)	58,000 (estimated)

The original inhabitants of the area were tribals. Settlement in the area are likely to have started from about the beginning of the century and the early settlers were mostly from Tamil Nadu who settled in the eastern plains. After the Second World war, and especially after Independence, more settlers moved from the plains of Tamil Nadu and Kerala. While the increase in population of tribals is due to natural growth only, that of settlers is mostly due to large scale influx into the area. The trend of population growth based on census figures and estimates from Panchayat records is depicted in Fig. V.

Livestock

Livestock, particularly grazing and browsing animals have an important role in determining the nature of interaction in the area. No data prior to 1966 are available. The available information is summarised below.

Table 3

Livestock

Year	Cattle	Goats & Sheep	Poultry
1966	14,727	12,491	21,775
1972	20,598	14,545	26,264
1977	18,185	15,111	31,921

It however, appears that the above figures are underestimates. On the basis of the household survey the following estimated population for 1977 has been worked out.

Cattle	33,000
Sheep & Goat	26,000
Poultry	27,000

Development activities

Being a backward and predominantly tribal area, a special tribal development block was established in 1962 and all development activities were channelised through

this block. From 1962-'63 to 1978-'79 an amount of Rs.204.39 lakhs was spent for implementation of various programmes. The details are summarized below.

Table 4

Expenditure for Development Activities

Sl. No.	Schemes	1962-'63 to 1972-'73	1973-'74 to 1974-'75	1975-'76 to 1978-'79	Total
		Rupees in lakhs			
1.	Community Development	12.10	6.46	6.43	24.99
2.	Tribal Development	...	3.37	43.08	46.45
3.	Agricultural Development	...	...	4.96	4.96
4.	Western ghat Development	...	1.47	126.52	127.99
	Total	12.10	11.30	180.99	204.39

The activities undertaken in the community development programme are as follows

Table 5

Community Development Programmes

Sl. No.	Programmes	I Stage 1962-'68	II Stage 1969-'73	Total	Remarks
		---Rupees in lakhs---			
1.	Agriculture, Animal husbandry and Irrigation	5.80	1.02	6.82	
2.	Transportation (Construction of roads)	2.35	0.29	2.64	New roads were constructed to connect remote villages to Agali, Thavalam etc.
3.	Cultural activities	1.85	0.47	2.32	Development of general education, children park, balavadis etc.
4.	Small scale industries	0.14	...	0.14	Establishment of training centre.
5.	Housing	0.18	...	0.18	Construction of new houses
	Total	10.32	1.78	12.10	

Under community development programmes, an amount of Rs.6.46 lakhs was spent during 1973-'74 to 1975-'76 for supply of sprayers, pumpsets, agricultural implements etc. for construction of houses ad school building. Out of Rs. 180.99 lakhs spent during the period 1975-'76 to 1978-'79, agricultural development, livestock improvement, road construction etc., were given greater emphasis. A cooperative farming society

was established and selected areas in the vested forests have been taken for cultivation of Cardamom, Coffee, Clove, Nutmeg etc. A provision of Rs.260.40 lakhs has been made for development of this area on lines indicated above, for the period 1978-'79 to 1982-'83.

Occupation

Table 6

Educational and Occupational Status (in percentage)

Category	Educational Status					Occupational status	
	Illiterates	Lower Primary school	Upper Primary school	High school	College	Agriculture	Others
1. Settlers							
a) of Kerala origin	38	20	23	16	3	94	6
b) of Tamil Nadu origin	80	8	8	4	...	91	9
2. Tribals							
a) Kurumbas	98	2	...	...	...	100	...
b) Mudugas	95	2	1	2	...	94	6
c) Irulas	92	6	1	1	...	97	3

(Source: Household survey)

The predominant occupation is agriculture which accounts for 91 to 94% among settlers and 94 to 97% among the tribals. Educationally the area is backward except in respect of settlers of Kerala origin, although there are two high schools, three upper primary, 13 lower primary schools and 19 balawadis. The percentage of literates among the settlers of Tamil Nadu origin is 20 and that among tribals 2-8 only.

Miscellaneous

While the tribals mostly depend upon herbal therapy for common ailments (Irulas 8%, Mudugas 75%, Kurumbas 100%), the settlers depend upon modern systems. There are four Government and one private hospitals in the area out of which one at Mukkali is called a tribal hospital.

There are sixteen post offices, three commercial banks, two Farmers' Co-operative banks of which only settlers are members of one of them. Five Library-cum-reading rooms, four cinema houses and ten Girijan Kalasamithis have been established for recreational purposes. There are no industrial establishments except for small oil extraction units based on Lemon grass and Vetiver. A small logging training centre has been established by the Forest Department to train tribals in modern logging methods.

CHAPTER III

THE FOREST

Forest Types

The forests of Attappady, even within the limited geographical area, exhibit considerable variation in floristic composition, structure and physiognomy due to climatic, physiographic and edaphic influences. Its present status is further determined by biotic, particularly anthropic influences. The forests, thus offer, considerable scope for an intensive study of the influences of natural as well as introduced factors.

The following forest types (Fig. VI) can be recognized based on the classification of Champion and Seth (1968).

1. West coast tropical evergreen forest
2. West coast semi-evergreen forest
3. South Indian moist deciduous forest
4. Southern moist mixed deciduous forest
5. Southern tropical dry deciduous forest
6. Southern tropical dry deciduous scrub
7. Southern subtropical broadleaved hill forest
8. Southern montane wet temperate forest
9. Southern montane wet grassland

All these types of forests have been subjected to anthropic influences of varying degrees and their status have been broadly described in the past by Venkateswara Ayyar (1935), van Haeften (1943), Muhammed (1957), Chand Basha (1977) and Zachariah (1980). Intensive field studies were undertaken to determine the extent and nature of anthropic influences and the results have been analyzed elsewhere in this report.

1. **West Coast tropical evergreen forest**

Distribution

It occupies considerable areas in Attappady reserve and in Muthikkulam.

Ecology

It is in its optimum form of development between 750 to about 1100 meters elevation, but under favorable conditions of aspect and humidity descends down to 600m. and below and gradually merges into semi-evergreen forest. Occasionally, it rises to even 1,200 m. or more and then merges with the southern subtropical broadleaved ill forests. It occurs mostly in areas with over 2,000 mm rainfall and a short dry period of three months or less.

Although sufficient meteorological data are not available, it may be stated that the climatic conditions in these areas are:

more rainfall than in the plains due to the relief against monsoon winds;

reduction in the length of the dry season due to convection currents;

night condensation almost throughout the year.

This forest is important source of timber for various wood based industries and for railway sleepers.

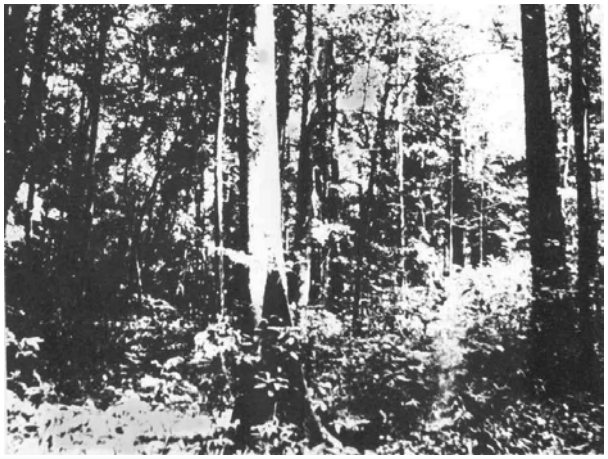


Plate I. West Coast Tropical Evergreen Forest

i. General view

ii. Natural regeneration of Cullenia exarillata

iii. Natural regeneration of Palaquium ellipticum

Physiognomy

It is characterized by the luxuriance of its vegetation and formation of typical tiers. The top canopy has lofty trees of over 40 to 45 m height (PI. I.i). A number of species are often characterized by fluted and flanged trunk (PI. II. ii.), plank buttresses (PI.II.iii.), clean cylindrical bole and spreading crown. A second and third tier is recognized and epiphytes such as Orchids, Ferns, Mosses and Aroids are common. Cauliflory is a conspicuous feature (PI.II.i.). Much variation is noticed in bark features (PI.III). These forests with their multiplicity of species are in a state of biological equilibrium.

Floristics

Its floristic composition is very much complex and the common characteristic species only have been listed.

I tier: The dominant stratum invariably consists of species like Mesua ferrea, Cullenia exarillata, Palaquium ellipticum, Elaeocarpus tuberculatus, Artocarpus heterophyllus, Holigarna arnottiana, Persea macrantha, Calophyllum apetalum, Drypetes elata, Dipterocarpus indicus and Hopea glabra.

II tier: Euphoria longana, Chrysophyllum roxburghii, Aglaia anamallayana, Gomphandra tetrandra, Myristica laurifolia, Polyalthia coffeoides, Garcinia morella and Hydnocarpus laurifolia.

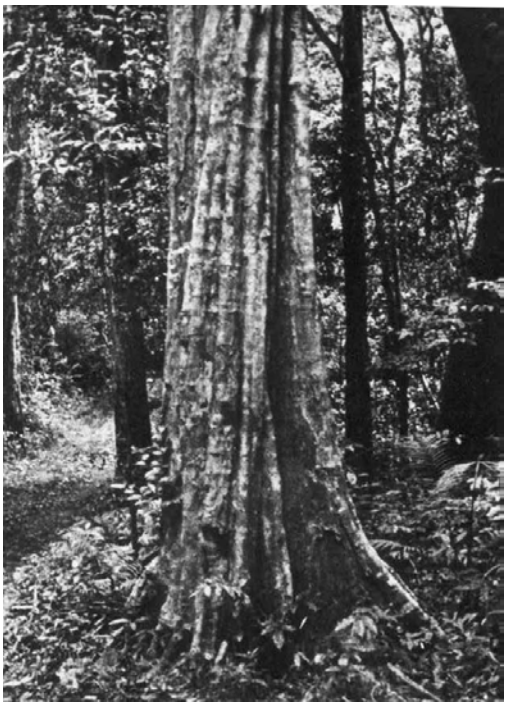
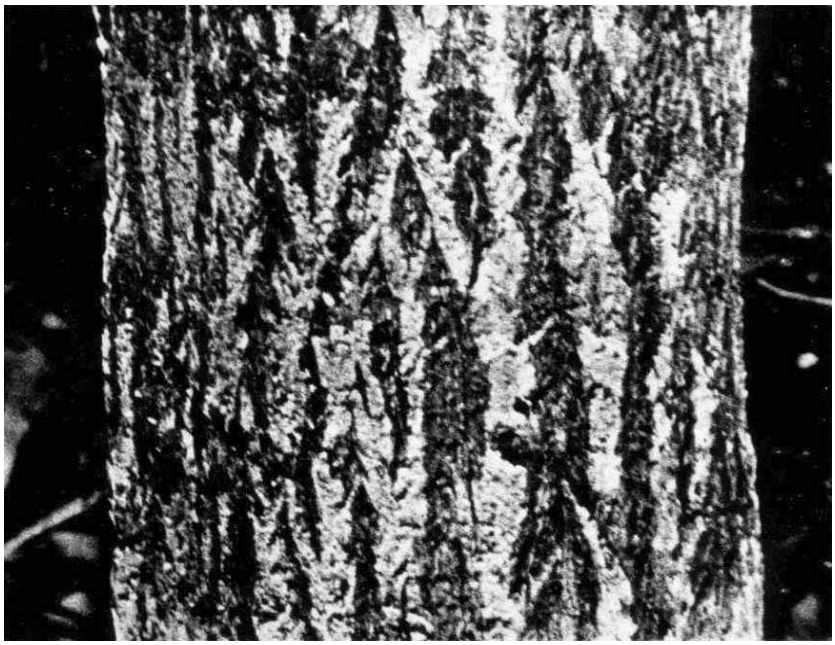


Plate II.Physiognomic features of West Coast Tropical Evergreen Forest

i. Cauliflory (Cullenia exarillata)

ii. Fluted and flanged trunk (Drypets elata)

iii. Plank buttresses (Elaeocarpus tuberculatus)



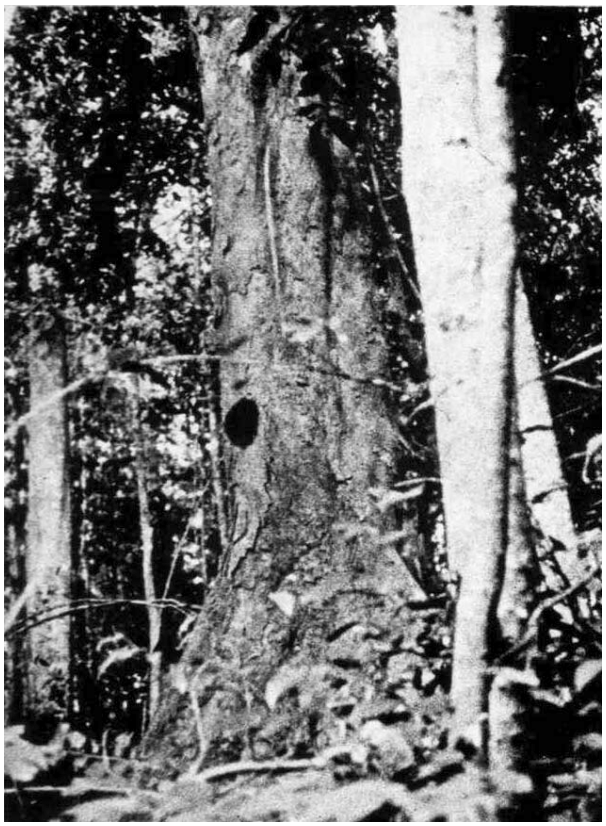


Plate III. Typical bark features of West Coast tropical Evergreen Forest trees

i. Fissured bark (Calophyllum apetalum)

ii. Irregular flakes (Mesua ferrea)

iii. Longitudinal flakes (Persea macrantha)

III tier: Small trees and shrubs. Euonymus angulatus, Jambosa laeta, Jambosa munroii, Cinnamomum zeylanicum, Litsea stocksii, Agrostistachys meeboldii, Vernonia arborea, Goniothalamus cardiopetalus, Turpinia malabarica and Aporusa lindleyana.

Undergrowth: Due to the closed canopy, the ground is devoid of grasses and the herbaceous vegetation is mostly represented by the seedlings of some of the tree species (PI.I.ii. & iii.). However a few species like Laportea crenulata, Apama siliquosa, Costus specious, Psychotria spp., Arisaema spp., Elatostemma spp., Begonia spp and Ophiorrhiza spp are sometimes met with whenever the canopy is broken.

Sparsely distributed are a few monocots like Arenga wightii, Pandanus furcatus and the bamboo Ochlandra travancorica.

Lianas, although characteristic of such forests are few and are represented by Gnetum ula, Smilax zeylanica, Toddalia asiatica, Luvunga eleutherandra, Derris spp., Connarus spp and Senecio spp.

Epiphytes like Lycopodium, Asplenium, Hoya and Pothos are common.

2. **West coast semi-evergreen forest**

It is better termed as semi-deciduous forest which nomenclature is in conformity with Yangambi Conference (1956)

Plate IV. West Coast Semi Evergreen Forest

i. Undisturbed

ii. Partially disturbed

iii. Heavily disturbed

and Unesco (1973). It has been recommended that the term semi-evergreen may be used at the species level and semi-deciduous at the level of vegetation. However, for uniformity, the classification of Champion and Seth (1968) is maintained.

Distribution

This type of forest is found near Chindakki, Havelock's path and in Manthampotti.

Ecology and Physiognomy

It is essentially a transitional forest, from the wet evergreen to moist deciduous and normally occurs between 400 to 900 m. It is also a fairly dense forest but the picture of luxuriance is not found. The characteristic tier formation is absent and the top canopy is uneven being a mixture of evergreen and deciduous species (P. IV). It is often seen along the margin of the wet evergreen forest. Cauliflory is less prevalent and epiphytes and orchids are frequent. Lianas are more abundant.

Floristics

The principal deciduous species are as follows:

Terminalia paniculata, Lagerstroemia microcarpa, Chukrasia tabularis, Radermachera xylocarpa, Toona ciliata, Xylia Xylocarpa, Bombax ceiba and Vitex altissima.

The common evergreen species are Mesua ferrea, Hopea glabra, Mangifera indica, Calophyllum apetalum, Evodia

lunu-ankenda and Bischofia javanica.

Species like (Trema orientalis, Macaranga peltata, Clerodendrum viscosum, Mallotus albus and Leea indica occupy a lower stratum whenever light reaches the floor, due to the deciduous nature of trees and openings caused by interference.

Lianas are frequent and common thorny species like Acacia intsia, Ziziphus xylopyrus, Smilax Zeylanica and Caesalpinia spp are found in abundance.

South Indian moist deciduous forest

Distribution

It is found on both sides of Bhavani river, Anavoy, Thadikkundu and Chindakki.

Ecology

Rainfall is around 2,000 mm and the dry season lasts for four to five months. Because of higher incidence of commercially important species and easy accessibility, the forest is considerably disturbed.

Physiognomy

It is a fairly dense forest (PI.V) with trees attaining a height of about 3-35 m and most of the species are deciduous in the dominant and sub-dominant strata. The forests are leafless during the dry season. Number of species are low and the trees have a cylindrical bole, with a thick and fissured

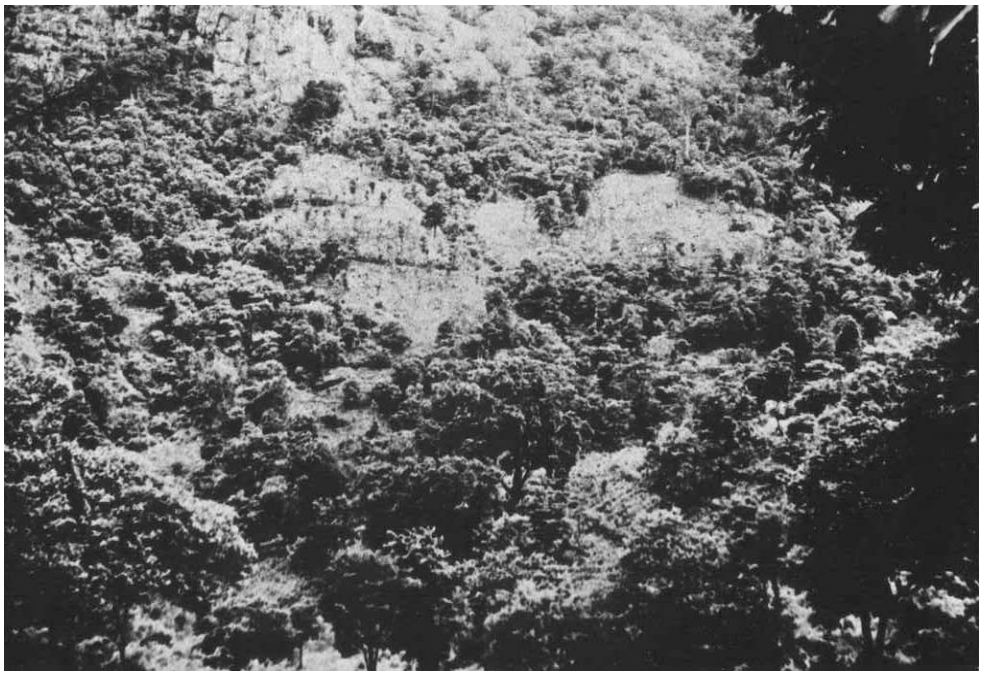


Plate V. South Indian Moist Deciduous Forest

i.& ii. General view with area cleared for forest plantation in the foreground

iii.Partially disturbed for cultivation

bark coming out in flakes. Butteresses are rare. The undergrowth is made up of many small evergreen shrubs. Lianas are quite prevalent and are frequently represented by Spatholobus roxburghii, Entada scandens and a few others.

Bamboo brakes are quite common.

Floristics

I tier: Terminalia paniculata, T. alata, T. bellerica, Lagerstroemia microcarpa, Tectona grandis, Bombax malabaricum, Tetrameles nudiflora, Dillenia pentagyna, Adina cordifolia, Albizia chinensis, Lannea coromandelica, Kydia calycina and Pterocarpus marsupium.

II tier: Wrightia tinctoria, Grewia tiliaefolia, Holarrhena antidysenterica, Mallotus philippinensis and Trema orientalis.

III tier: It essentially consists of shrubs like Helicteres isora, Desmodium spp., Flemingia spp., Strobilanthes spp and Eupatorium odoratum.

Prominent lianas are Spatholobus roxburghii, Entada scandens, Calycopteris floribunda, Combretum sp., Ziziphus Xylopyrus, Acacia intsia and Dioscorea spp.

The ground floor which is seasonal is made up of Acalypha paniculata, Rauvolfia densiflora and Biophytum sensitivum.

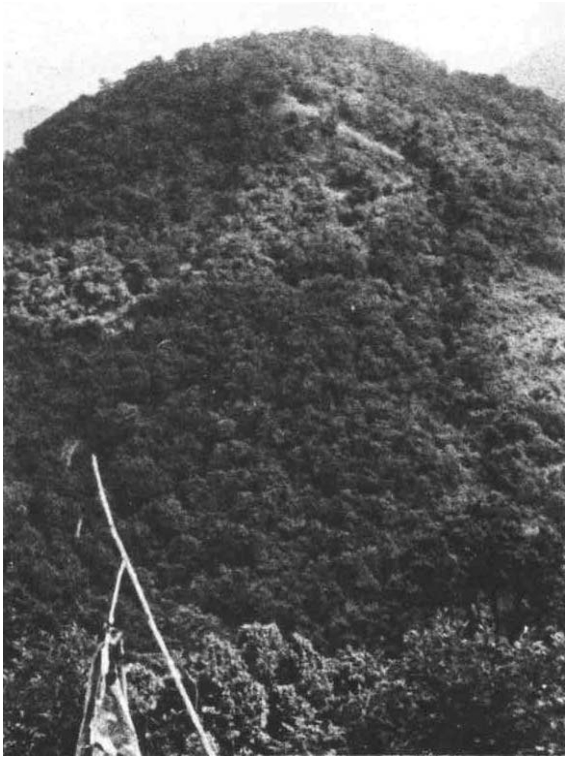


Plate VI. South Indian Moist Deciduous Forest

i. Patches of forest cleared for shifting cultivation

ii. Patches of forest after shifting cultivation and currently under shifting cultivation (Eleusine coracana)

iii. Patches of forest after shifting cultivation and currently under shifting cultivation (cajanus cajan)

Proliferation of bamboos in areas subjected to fellings and colonizers in areas subjected to shifting cultivation are common. Plantations of Teak and softwood species have been raised after clearfelling the forest.

4. **Southern moist mixed deciduous forest**

Distribution

It occurs on poor soil with rocky outcrops and in the study area is encountered in steep slopes along the banks of Bhavani river.

Ecology

Like the former, it occurs in areas where the rainfall is around 2,000 mm. Due to shifting cultivation and consequent extensive damage, it is reduced to a secondary stage. The remnants of the original composition of the forest are some large Teak and Rosewood trees, coppice growth of these species.

Floristics

Predominant arborescent species are:

Lagerstroemia microcarpa, Pterocarpus marsupium, Stereospermum suaveolens, Albizia chinensis, Dalbergia latifolia, Spondias pinnata, Tectona grandis, Xylia xylocarpa, Kydia calycina, Emblica officinalis and Terminalia spp.

The shrubby stratum is made up of Glycosmis cochinchinensis, Solanum torvum, Leea indica and Pouzolzia spp.

Bamboos are sometimes present in pure patches. Lianas are represented as in the previous type. Cycas is common.

5. Southern tropical dry deciduous forest

Distribution

This forest is confined to a major part of north and northeastern region (Mulle, Aralikkonam and Thuva).

Ecology

It occurs in low elevations, i.e. 300-600 m. The rainfall in this area ranges from 1,000 to 1,500 mm and the dry season lasts for about six months. Unlike the other areas described before, the bulk of precipitation is brought about by the retreating monsoon extending from October to December. The decrease in temperature during the nights increases the condensations and results in more humidity. Comparatively, the forest is poor and the frequency of commercially important species is low. The most common species are Albizia amara, Azadirachta indica and Chloroxylon swietenia. This forest is open to grazing and lopping for fodder, green manure and firewood, particularly when it is proximal to villages.

Physiognomy

It is an open forest of about 15 to 20 m height (PI.VI.I) and the dominant trees are Tectona grandis, Anogeissus latifolia and Albizia amara. The lower canopy is also deciduous and during February to may the entire vegetation is devoid

Plate VII. Southern Tropical Dry Deciduous Forest

i. Undisturbed forest along left bank of Bhavani and totally disturbed along the right bank

ii. A closer view of the undisturbed forest

iii. A closer view of totally disturbed forest with secondary growth (Reduced to Southern Tropical Dry Deciduous Scrub)

of foliage. The bark of most of the species is thick, dark and fissured. Thorny and microphyllous lianas are frequent.

Floristics

I tier: It is made up of Sapindus emarginatus, Albizia amara, Vitex altissima, Emblica officinalis, Gyrocarpus jacquinii, Cochlospermum religionsum, Givotia rottlerifomis, Anogeissus latifolia, Grewia tiliaefolia, Tectona grandis, Bridelia retusa, Buchanania lanzan, Cleistanthus collinus, Cassia fistula, Piliostigma racemosa, Crataeva nurvala and Hardwickia binata are sometimes left in areas totally disturbed (P. VIII).

II tier: Comprises of Butea monosperma, Careya arborea and Wrightia tinctoria.

The shrubs are Limonia alata, Premna tomentosa, Lantana camara and Eupotorium odoratum.

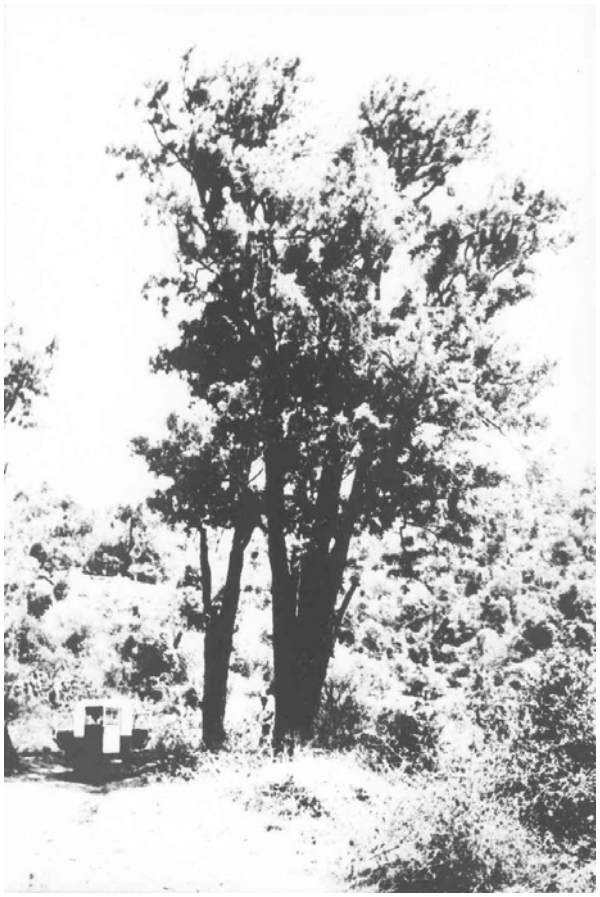
Lianas are represented by Ziziphus oenoplia, Pterolobium hexapetalum, Acacia spp., Ichnocarpus frutescens, Dioscorea pentaphylla and Derris scandens.

Since grazing and fire are frequent, regeneration is almost absent.

6. **Southern tropical dry deciduous scrub**

Distribution

It is found scattered throughout the vested forests and most of them have been already assigned.



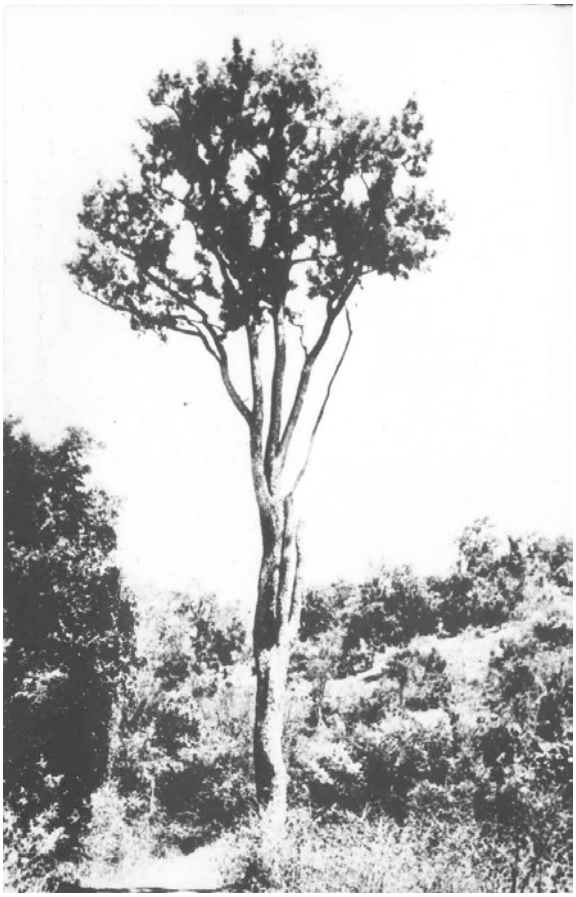


Plate VIII. Southern Tropical Dry Deciduous Forest

i & ii. Hardwickia binata trees left in heavily disturbed areas

Ecology

This type of forest is a derived one from the dry deciduous forest (PI. VII. iii.) due to intensive biotic influences. Only xerophilous species like Euphorbia antiquorum are left.

Physiognomy

This type of forest is subjected to intensive grazing and at best attains a maximum height of about 4 meters. While the periphery of the bushes are covered by armed species, those in the centre are the palatable and non-spiny ones. Some scattered trees emerge here and there. Lianas are common and the grasses cover the denuded areas. This type of forest represents almost the final stage of degradation and the soil is much exposed to erosion.

Floristics

It is poor with the following shrubs dominating:

Euphorbia antiquorum, Euphorbia tirucalli, Dodonaea viscosa, Barleria buxifolia, Calotropis gigantea, Opuntia dillenii, Cassia auriculata and Mundulea suberosa. Occasionally, some of the infiltration species from the previous forest type also occur. They are: Sapindus emarginatus, Albizia amara, Vitex altissima, Emblica officinalis, Gyrocarpus jacquinii, Givotia rottleriformis and Cochlospermum religiosum.

The ground floor consists of ephemerals like Asystasia gangetica, Evolvulus alsinoides, Merrimea spp., Cyperus spp.,

Kyllinga monocephala, Tridax procumbens etc.

Grasses are represented mostly by Perotis latifolia and Chloris barbata.

7. **Southern subtropical broadleaved hill forest**

Distribution

It is usually seen above 1,500 m. and in the study area is confined to 1,500 to 1,900 m in the reserved forests.

Ecology

It is an inferior form of the wet evergreen forests, wind an altitude being the limiting factors. Rainfall is around 5,000 mm and mist is a common feature in the afternoon. Dry season is very short, being less than two months, with a cool temperature throughout the year. It has seldom been worked and better trees are found along river banks and sheltered folds of rocks.

Physiognomy

It is a floristically rich but economically poor forest. Although species like Calophyllum apetalum and Bischofia javanica are common, they are not economically valuable due to their branchy nature. Trees are generally nanic. Heavy festooning with mosses, lichens and ferns are common. The undergrowth is heavy and as the elevation increases the height of the forest decreases.

Floristics

Some of the common species are: Calophyllum apetalum, Mesua ferrea, Gordonia obtusa, Elaeocarpus spp., Syzygium spp., Litsea spp., Cinnamomum spp., Persea macrantha, Bischofia javanica, Myristica spp. And Garcinia spp.

In the shrubby stratum, Strobilanthes forms a thick, impenetrable bush along the periphery. Associated with this are species of Lasianthus, Psychotria andAsparagus.

The ground floor is made up o Chasalia curviflora, Chloranthus brachystachyus, scutellaria violacea and ophiorrhiza spp.

8. **Southern montane wet temperate forest**

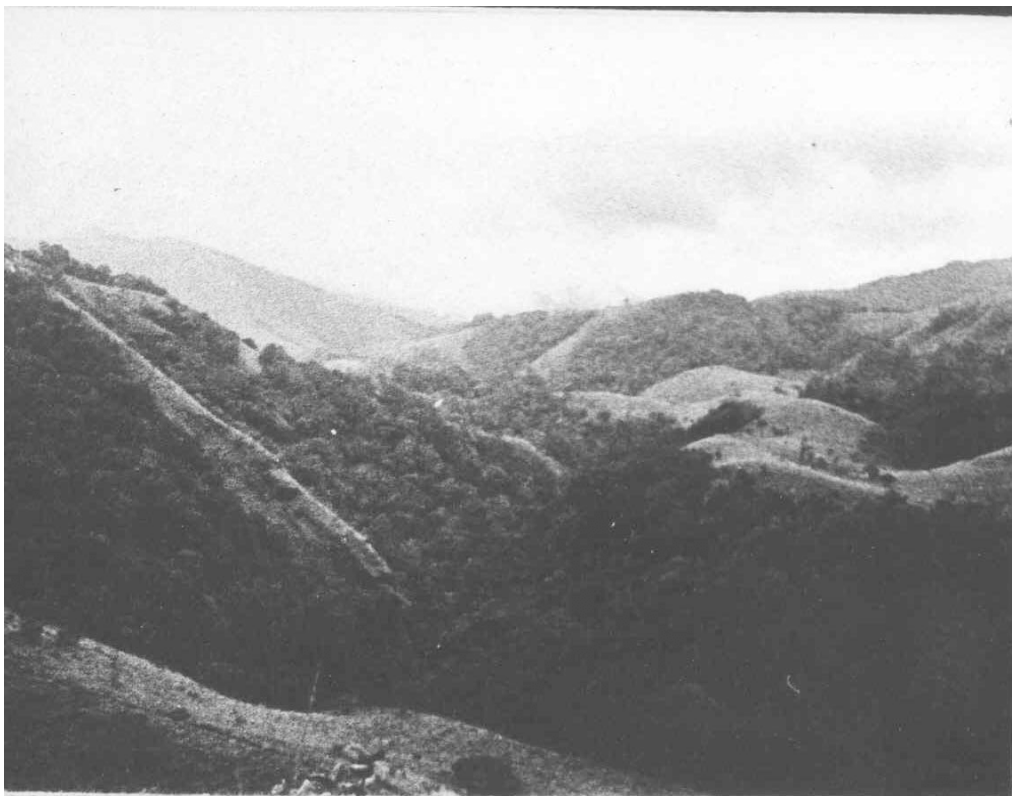
Distribution

This type of forest, which n common parlance is called as 'shola' is distributed all along the northern boundary from 1,900 meters upwards.

Ecology

It is more or less like the former excepting that it is confined to slopes and depressions of the valley sheltered against wind and fire (PI. IX). The moisture content remains high and the soil is deep, black and rich in humus.

This forest has hardly any timber value and its terrain is so difficult that it is not economically feasible for



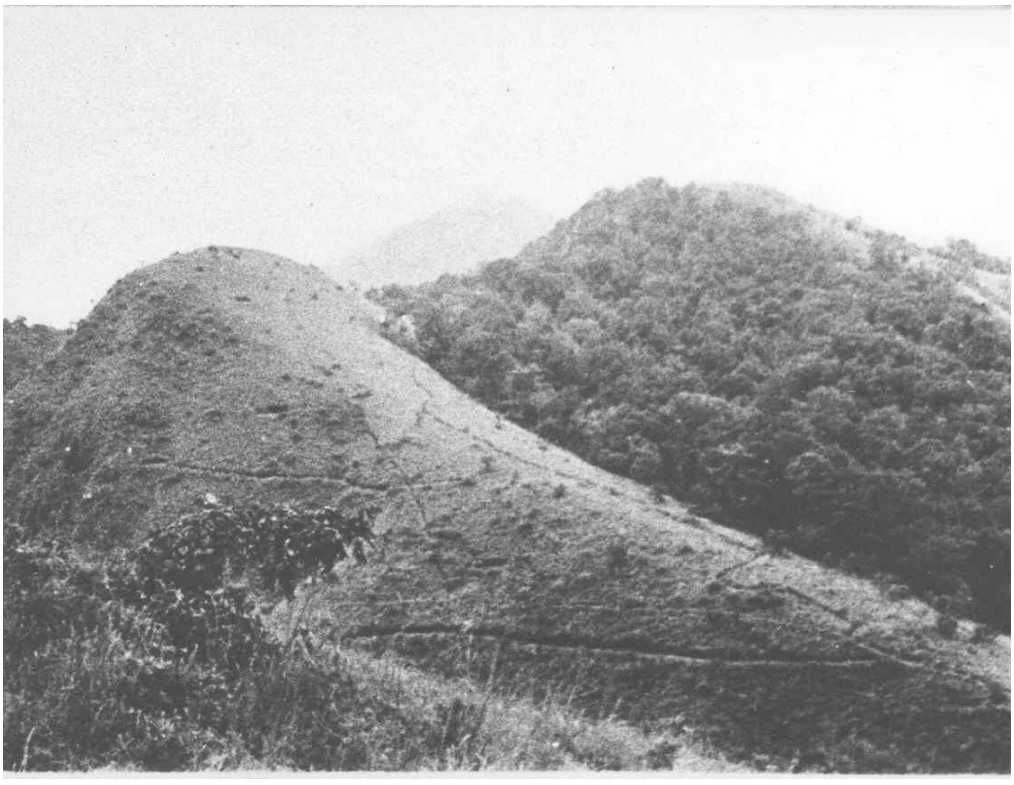


Plate IX. Southern Montane Wet Temperate Forest

i & ii. General View

working.

Physiognomy

It is a dense, closed canopy forest with a rounded crown, short boled and highly branched (Fig. VIII.i). On an average, they reach a height of about 15 to 20 meters and at least two arborescent strata can be recognised. Lichens, mosses and ferns are heavy. The floristic composition is a mixture of species of temperate and tropical stock.

Floristics

I tier: It consists of species like Elaeocarpus munroii, Meliosma arnottiana, Schefflera racemosa, Ternstroemia japonica, Berberis tinctoria, Mahonia leschenaultii, Syzygium spp., Symplocos spp., Litsea spp., Cinnamomum spp and a few other members of Lauraceae.

II tier: Comprises of Rubus ellipticus, Rhodomyrtus tomentosa, Gaultheria fragrantissima and Strobilanthes spp. Along the margins Hypericum spp is commonly encountered. Canes are common.

The ground floor is usually made up of various species of impatiens.

9. **Southern montane wet grasslands**

Distribution

Vast stretches grasslands are seen both below and above 1,500 mm. The low level grasslands are found distributed

along with west coast tropical evergreen forests and occupy considerable areas in the reserved forests, while the high level grasslands are very much restricted in distribution and are mostly confined to the upper reaches of the Nilgiri range.

Ecology

Depending upon whether they are seen along with the wet evergreen forests or with the sholas their ecology also is variable.

Floristics

Low-level grasslands

The grass cover seldom exceeds two meters in height and the commonest grasses are Cymbopogon spp., Themeda spp., Eragrostis spp., Chrysopogon spp., Heteropogon contortus and Tripogon bromoides. Scattered among them are a few deciduous tree species like Emblica officinalis, Wendlandia notoniana, Careya arborea and the palm Phoenix humilis which are all pyroresistant. Immediately after monsoon Pteridium aquilinum is seen.

High level grasslands

They are encountered above 1,500 m elevation and are restricted in distribution to the higher ranges bordering the Nilgiris. Although rainfall is heavy, due to the slopy nature of the terrain the run off is fast. Further, they are directly exposed to wind. These lead to a stunted growth of

the grasses giving them a carpet like appearance. Along with the 'Sholas' and in the ecotone species like Symplocos, Ilex, Macaranga etc. are common.

Typical grasses are Pollinia spp., Arundinella spp. And Eragrostis spp. After the rains ephemerals like Ranunculus, Valeriana, Brunella, Leucas etc. make their appearance.

History of Forest Management

The evolution of forest management in the area has an interesting history. The entire area was under private ownership and even the procedure for reservation of forest had to follow an entirely different course. Normally, as a first step in reservation, notice is issued inviting objections if any, for such reservation and settlement proceedings are taken up thereafter. In Attappady, as was the case in entire Malabar area, instead of claimants rights over forests notified for reservation being the plaintiffs who have to establish their title, the Government was obliged to prove in the first instance that the forest area in question was in the possession of the Government (venkateswara Ayyar 1935). The courts regarded the following propositions as established.

1. No forest in Malabar is at the disposal of the Government unless acquired by escheat, contract of prescription.

2. All forest not belonging to government by escheat or contract must be the absolute property (Janmam) of someone.

Because of the above situation, extensive stretches of forests in this region were under private ownership and proper forest management was unknown. All accessible areas were exposed to uncontrolled depredations and it was only the inaccessible regions which retained their pristine nature. It is described in Madras Forest Gazette (1915) that unscientific forestry, the ravages of timber thief, the destructive ponam cultivation fatal to tree growth, the average janmi's anxiety to turn his trees to money with least possible delay, the timber merchant's greed for removing timber ten times as much as he had paid for, contributed to the slow but steady denudation of forests in accessible areas and the area gradually became almost destitute of timber.

It was in 1790 that part of the area came under government ownership when an area of about 11,900 ha. (which included part of Silent Valley) was acquired by the government under the 'Land Acquisition Act' for about Rs. 1.103 lakhs. In 1882, the Government made its anxiety known to protect the evergreen forests of the valley, as the area was the catchment of the Bhavani and its tributaries. It was, therefore, decided in 1886 that all such areas as were required for the protection of the catchment should be brought under reservation. A detailed inspection of the valley was hence carried out in 1887. The description of the forest in the inspection report of Porter (1887) quoted by Venkateswara Ayyar (1935) explains

the conditions of the forest as it existed then. He described Attappady Block VI (Muthikkulam) as a dense mass of evergreen forest with no deciduous forest and little grassland. The evergreen forests were mentioned as magnificent with finer trees than he had seen in either Nilgiri or Anamalai sholas.

Following the inspection report of porter, further action was initiated and part of the area was brought under reservation in two phases as follows (Muhammed 1957).

TABLE 7

Reservation of Forest

Forest Block	Area in hectare	Date of reservation
I	7,516.80	1st September 1900
II, III and IV	1,166.40	1st September 1900
V	5,329.80	1st September 1912
VI	6,390.90	1st September 1912
Total	: 20,403.90 (204 Km^2)	

Thus it was only in 1900 that a beginning was made to afford protection to part of the forest area and to bring the same under management.

Due to lack of communication, forest block VI (Muthikkulam) has not had much interaction with the habitants in the study area and therefore this block has been excluded from this study. Even after reservation, forest block I to VI

were not brought under effective management and shifting cultivation remained unchecked. Removal of forest produce was also not controlled. It was only in 1933 that the area was brought under a working plan (Venkateswara Ayyar 1935). Since then the reserved forests in the area have been managed under successive working plans as detailed below:

Author of working plan		Year
T.V. Venkateswara Ayyar	..	1933-34 to 1942-43
van Haftein	..	1943-44 to 1957-58
Muhammed	..	1959-60 to 1973-74
Chand Basha	..	1975-76 to 1984-85

In the current working plan (Chand Basha, 1977) following working circles have been constituted.

1. Protection Working Circle
2. Selection Working Circle
3. Plantation Working Circle
4. Bamboo and Reed Working Circle
5. Minor Forest Produce Working Circle

Protection Working Circle (10904 ha.)

Two types of areas are included in this Working Circle i.e. (i) the high level sholas which support forests of low commercial value and forest along steep slopes with poor tree growth (8395 ha.); (ii.) areas under shifting cultivation in the past, which either do not support any forest growth of

Commercial importance or support forest growth not yet ripe for exploitation (2509 ha.).

In this working circle, except controlled grazing, collection of M.F.P (including bamboos, reeds and canes), no other operations are permitted and the forests are to be protected.

Selection Working circle (1536 ha.)

Trees of and above 180 cm girth are to be marked for felling subject to a maximum of 10 trees per hectare (7 of Commercial species and 3 of non commercial species). Fellings are prescribed to be regulated in a thirty year felling cycle based on the assumption that the girth increment varies from 0.9 to 1.123 cm./year. The estimated yield of commercial timber and fuelwood from the circle is as follows.

Year	Timber (m^3)	Fuelwood (Tonne)
1980-81	6100	4000
1981-82	6500	4300
1982-83	5800	3900
1983-84	5500	3700
1984-85	4000	2700

Sleeper Working is not contemplated during the plan period. The selection working is to be on “mel-labhom” basis and the timber would flow for industrial usage.

Plantation Working Circle (500 ha. + management of existing plantation)

Plantation forestry was first introduced in the area as per prescription contained in Venkateswara Ayyar's Working Plan. During the three years, 1934 to 1936, about 12 hectares in Chindakki – forming the lower slopes of Attappady Blocks 1, IV and V which were subjected to heavy shifting cultivation in the past were planted with mixture of hardwood species viz., teak, venga (Pterocarpus marsupium), rosewood and ayani (Artocarpus hirsuta). This was suspended in 1937 as the timber from the area taken up for conversion, could not find market.

Van Haeften prescribed conversion of moist deciduous forests of Panthenthodu and Bhavani Valley into manmade forests. The following were the plantations raised during the plan period.

	Year of formation	Area (ha.)	Species
Chindakki	1947	8.90	Teak, Evodia, Rosewood, Venga
Pottikkal	1951	0.81	Teak
	1952	1.53	"
	1953	1.70	"
	1954	4.09	"
	1955	4.05	"
	1956	3.60	Evodia and Bombax
	1957	9.00	Teak
	1958	4.33	"
	1959	4.13	"
	1960	8.69	"
		50.83	

Artificial regeneration was continued during the period of Muhammed's plan. The details of plantation raised are given below.

Locality	Year of formation	Area in ha.	Species
Pottikkal	1960	19.93	Teak
	1961	16.79	"
	1962	15.79	"
	1963	16.39	"
	1965	16.43	"
	1966	20.52	"
	1967	12.39	"
	1968	18.42	"
Panthenthodu	1962	95.15	Teak and Bombax
	1967	50.39	Eucalyptus grandis (felled in 1976-77)
	1974	1.00	Rosewood
	1975	2.00	"
Thadikkundu	1970	32.31	Teak
	1972	34.00	"
	1973	41.00	"
	1974	23.00	"
	1975	23.00	"

Quality of Plantation

Evaluation of Teak plantations according to All India quality class has been undertaken by Chand Basha for his Working Plan.

Pottikkal	II to II/III
Chindakki	II to II/III
Panthanthodu	II/IV

The current Working Plan has prescribed an additional area of about 600 ha. To be brought under plantations in the moist deciduous forests in Gottiarkandi.

The expected yield from the area is as follows.

	Timber (m^3)	Fuelwood (tonnes)
1977-78	3000	1800
1978-79	1800	900
1979-80	1800	900
1980-81	7900	4900
1981-82	8300	5200
1982-83	7600	4800
1983-84	7300	4600
1984-85	5800	3600

Minor Forest Produce

Bamboo and Reeds Working Circle

The important minor forest produces are cardamom, honey, wax, sheekoy, tamarind, pepper, gallnuts, goosebery etc. Apart from these, medicinal plans (various parts of them) also form valuable items. Even before reservation, the tribals in Attappady were collecting these products for their own use and for offerings to the feudal lords and their agents. When these forests were brought under Working Plans, separate prescriptions for collection and disposal of MFP were incorporated to regularise the procedure for collection.

The extent of area under Bamboo is about 980 ha. Three year felling cycle has been fixed and the system of management

is selection thinning of clumps. The estimated yield is as follows.

Year	Approximate quantity (tonnes)
1977-78	2,500
1980-81	800
1983-84	800

Chand Basha has prescribed that bamboos and reeds should be supplied to the local agricultural population on seigniorage basis for their bonafide uses and for cottage industries. The tribal families living inside the reserve have to be given bamboos and reeds free for their bonafide uses. Bamboos have also to be supplied for industrial use as per terms of an existing agreement.

Apart from 204 km^2 brought under forest management after reservation, the rest of the area remained under private ownership. As a result of reckless exploitation of tree growth and clearance for various purposes only an area of 172 km^2 was available for vesting with the government under the provisions of Kerala Private Forests (Vesting and Assignment) Act (1971). Even in this area, the forest growth has not been left undisturbed.

While it is not possible, at this stage, to trace the historical sequence of destruction of the forest in the area which remained unreserved, it is known that the area was under

the proprietary ownership of the Zamorins of Calicut and for a long time the entire area was covered with dense forests. As accessibility was difficult the area escaped exploitation but the fabulous forest wealth had it attraction, despite inaccessibility and inhospitable conditions. The Zamorins placed the administration of this area under his deputies like Mannarghat Moopil Nayar, Palat and Eralpad Rajah. The deputies deployed mostly the tribals to collect the forest produce for disposal. In return, the tribals were granted the right of occupation of forest area and allowed to cultivate the land on payment of nominal land revenue fixed by the representatives of the Zamorin. In course of time, the representatives of the Zamorin themselves became virtual owners of the land and they were recognized on janmis for all purposes. It is not clear as to how these representatives became the janmis and hereditary ownership passed on to them. After the ownership was appropriated by them, they exercised total control over the area or began to exploit and sell the forest produce and transfer the right of possession of the land for nominal monetory gratification by way of rent. Thus, by the beginning of 20^{th} century, there came into being small land holders. People from other areas were brought in as tenants and workers. In the initial stages, because of inaccessibility, adverse climatic conditions and widespread incidence of malaria not much harm was done to the forests in the early stages. Major recorded leases were in the twenties and afterwards and some of the important lessees

were the following.

TABLE 8

Major lessees

	Lessee	Year	Area (in hectares)
1.	Bhavani Tea and Products Co.	Before 1920	1016
2.	K.M. Mathew	1926	720
3.	Fr. Varghese	1937	590
4.	Balakrishna Panicker	1937	200
5.	K.C. Kunja Ahmed	1946	880
6.	Umadevi Amma	1943	400
7.	Balagopala Panicker	1950	800
8.	Ovathingal Mathai Joseph	1951	400
9.	Parukutty Amma	1951	240
10.	Nair Service Society	1956	440

There was no semblance of management of the forest as the purpose was exploitation and partial or complete clearance for agriculture. Initially, only minor forest products like honey, cardamom etc. were collected for disposal, as timber could not find attractive market due to lack of good communication. Soon after Second World War, the covetous eyes of timber merchants fell on the timber wealth of the area and it is of interest to record that a retired forest officer with good knowledge of the area was the first to undertake large scale exploitation of timber. He obtained a license from Mannarghat Moopil Nair for clearfelling in drier areas and for selection

felling in other areas, on payment of a nominal license fee. The whole of eastern Attappady from Kavandikkal to Tamil Nadu border was worked by him. After clearfelling, the Janmi handed over the area for cultivation on realisation of Rs.2/- per acre as lease amount. Apart from the area leased out to them, the license for timber extraction in the southwestern portion of the area was given to a member of Kalladi family. It must be mentioned to his credit that a Working Plan was prepared by him for the 'management' of the forest under his control (Kunha Ahmed 1960). The so called objects of 'management' were (1) extraction and improvement of the area earmarked for clearfelling, to obtain a sustained yield and revenue, consistent with the avowed principles of preservation of forest growth and soil (2) exploitation of merchantable timber from selection felling areas, consistent with the maintenance of the evergreen character of the forest (3) preservation of forest growth in high altitude, precipitous slopes.

In the clearfelling area, plantation of Teak and Matti (Ailanthus triphysa) was undertaken and bout 100 ha. brought under plantation. In the selection felling area, regeneration operations were undertaken after selective fellings of species for various enduses like plywood, match and railway sleepers.

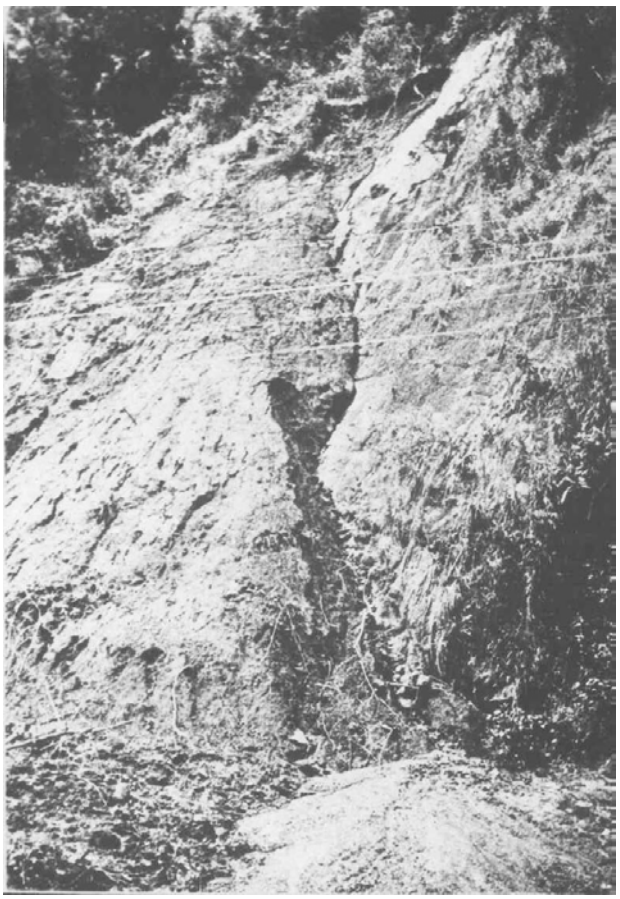
By 1945, conditions in the private forests of Malabar had become bad enough for the government of the Madras Presidency to be worried about the future of these areas. The

government was particularly concerned about the large scale and uncontrolled alienations which were the prelude to the denudation of these tracts. The government was convinced about the need for a comprehensive legislation in this regard, but felt that emergent measures were unavoidable in the meantime. The Madras Preservation of the Private Forests (M.P.P.F) Act, 'an Act to prevent the indiscriminate destruction of private forests and interference with customary and prescriptive rights therein ……' was enacted, pending further legislation, as Act XXVII of 1949 for an initial period of two years. This Act and the Rules made there under provided for the previous permission of the Collector of the concerned district before any sale, mortgage, lease or alienation of private forests took place and for similar prior permission before cutting trees or doing any act likely to denude the forest or diminish its utility as a forest (Madras Government 1949).

As enshrined in the preamble itself, the MPPF Act was intended to be a transitory measure to protect the private forests pending further legislation. For various reasons, further legislation was delayed and with the formation of Kerala State in 1956, changed circumstances and legal questions intervened. The MPPF Act was however extended from time to time, but the implementation of the provisions had many practical difficulties. The implementing authority was the Collector who had to act through the forest department. Penalties envisaged could not often be imposed because

prosecutions were not successful. The areas, being mostly unsurveyed, operative limits of felling permits could not strictly be controlled. The owners naturally had neither interest nor incentive for the proper protection of the areas, as they preferred the easy money obtained by felling the trees. The pernicious system of allowing cultivation on the basis of money receipts (M.R.) opened the flood gates for the land hungry cultivators. The result was that, in general, the objective of maintaining or protecting the forests were not achieved (Kerala Government 1975). The threat to the very existence of forests became pronounced with the influx of settlers from the plains around the sixties. The situation is well documented in the Report of the Vested Forests Committee (Kerala Government 1975).

"Impelled by land hunger, inspired by no desire nobler than that of quick profits and instructed in no agricultural methods more highly evolved than to cut and burn and dig anywhere any everywhere, armies of settlers overran tract after tract of new lands. The owners or their agents issued nominal 'money receipts' which served as licenses to occupy and denude as much areas as each concerned holder of this bit of paper could manage. In less than a decade, between 1960 and 1970, all these accessible and fertile areas had been occupied. During this rapid thrust, the margins of cultivation were extended further into the interior. Even nearly vertical slopes too steeps for ploughing are now being painstakingly and



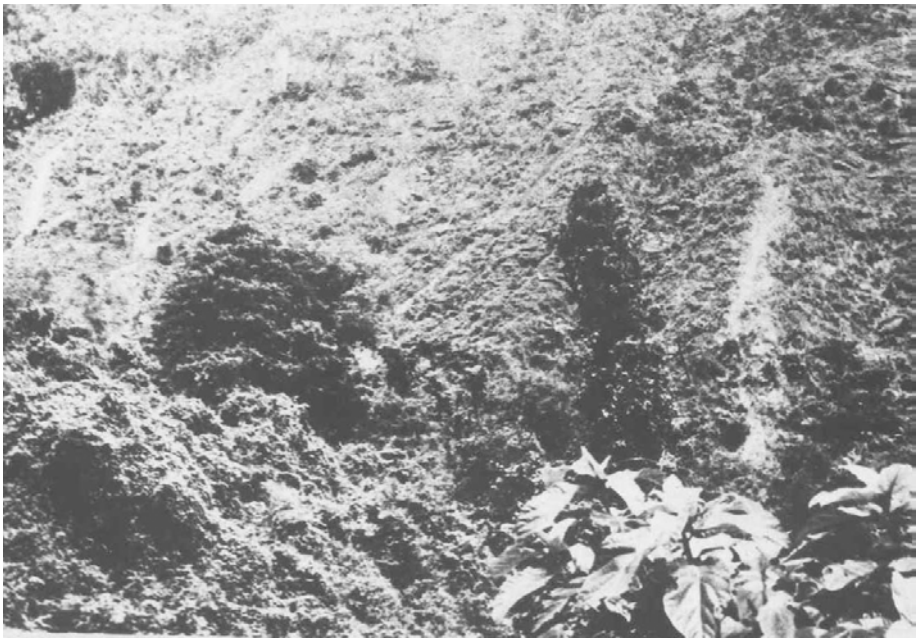


Plate X. Erosion caused by removal of forest cover

i. Gulley erosion

ii. Sheet erosion

pathetically wastefully dug into with hoes and pick-axes to support tapioca for as long as the soil holds out". With and woeful lack of concern, forest cover was cleared resulting in unmitigated erosion of valuable top soil (P1.X).

The process of denudation had reached an alarming stage and most of the accessible tracts had been almost completely deforested. The luxuriant forest of the past had been reduced to scrub or barren land almost beyond the margins of economic cultivation. As stated in the report (Government of Kerala, 1975), the remnants of the once glorious forests in Attappady under private ownership, is a sad commentary on human greed and criminal wastage of nature's bounty.

To halt further denudation of the forest and degradation of the area, the private forests in the State were taken over by the government in 1971 by enactment of the Kerala Private Forests (vesting and Assignment) Act. After a chequered beginning, during which there were large scale fellings throughout the area, the constitutional validity of the Act was established in 1973. The salient features of this Act are summarized below.

The Act empowers Government to reserve some extent of private forests vested with government for purposed directed towards the promotion of agriculture or the welfare of the agricultural population or for purposes ancillary to it. The purposes for which these areas to be reserved includes farm

forestry, shelter belts, agricultural and cattle farms, hydroelectric and irrigation projects, soil and moisture conservation etc.

The remaining area under the vested forests is to be assigned to agriculturists, agricultural laborers, members of Scheduled Castes and Scheduled Tribes or to other weaker and vulnerable sections of society who are willing to take up agriculture as the means of livelihood. The assigning authority has been given powers to direct the assignee to become a member of a joint co-operative farming society which shall follow a prescribed cropping pattern and adopt soil conservation measures.

Under the provisions of this Act and rules made there under, an area of 172.07 sq.km. has been vested with the government and in accordance with the general policy governing with the vesting an area of about 108 Km^2 is to be preserved as forest area and the balance area is to be assigned for cultivation mainly to rehabilitate the tribals. A working plan has recently been prepared (Zachariah, 1980) for the management of the area to be preserved as forest. In this working plan, following working circles have been constituted.

1. Village forestry, fuel and small wood working circle.
2. M.F.P. Working Circle
3. Grazing Working Circle
4. Protection Working Circle

Village forestry, fuel and small wood working circle (17 km^2)

This working circle in Aralikanam and Thuva is constituted mainly to provide small wood and fuel for bonafide domestic requirements by raising plantations of Albizia spp., Acacia leucopholea, Leucaena leucocephala, Cassia siamea and Eucalyptus tereticornis. It is also proposed to take up small scale plantations of Santalum album and Pterocarpus santalinus. In all the plantation areas, existing miscellaneous tree growth will be retained.

M.F.P. Working Circle (9 Km^2)

In the area included under this Working Circle in Mukkalivenga and Aralikonam, apart from collection of MFP, cardamomum and fruit trees like jack, mango, gooseberry etc. will be grown to provide additional source of income to tribals.

Grazing Working Circle (11.50 Km^2)

Regulation of grazing and establishment of improved grazing grounds are envisaged in Aralikonam and Thuva. Emphasis will be given to plantations of fodder trees like Leucaena leucocephala and Derris indica. Legumes and fodder grass will also be grown in suitable areas.

Protection Working Circle (70 Km^2)

The existing tree growth in the area will be protected. There is hardly any exploitable tree growth in the area

and therefore no supply of timber of fuelwood is envisaged.

As an illustration of the present status of tree growth in the vested forests, the enumeration data for Aralikonam is given below.

TABLE 9

Enumeration data for Aralikonam

Species	No. of trees/Hectare
Commercial	
Terminalia bellerica	0.037
Tectona grandis	0.033
Anogeissus latifolia	0.302
Albizia lebbeck	0.219
Grewia tiliaefolia	0.150
Pterocarpus marsupium	0.138
Dalbergia latifolia	0.044
Bridelia retusa	0.043
Bombax malabaricum	0.018
Xylia xylocarpa	0.009
Tamarindus indica	0.001
Mangifera indica	0.001
Non-Commercial	
Ficus sp.	0.148
Pillostigma racemosa	0.140
Strychnos nux-vomica	0.097
Emblica officinalis	0.091
Mimusops elengi	0.060
Careya arborea	0.043
Cleistanthus collinus	0.043
Ficus bengalensis	0.030
Erythrina indica	0.017
Trema orientalis	0.010
Cochlospermum religiosum	0.021
Morinda tinctoria	0.005
Butea monosperma	0.003
Cassia fistula	0.001
Cleistanthus collinus	0.001
Ficus religiose	0.001
Miscellaneous	0.270

It is indicative of the extremely sparse distribution of tree growth and the extent of damage done to the forests. Thus hardly any timber will be available from the vested forest area to meet the local demand. Even in the prescription of the working plan, no annual yield has been prescribed on account of the extremely poor quality of the forest. Timber and other forest produce required for local consumption has therefore to be met from the reserved forest only.

The total expected yield from the forests of the area is presented below:

TABLE 10

Expected yield from the area as estimated in the Working Plans

Year	Timber (cubic metre)	Fuelwood (tonnes)	Bamboos & Reeds (tonnes)
1977-78	3,000	1,800	2,500
1978-79	1,800	900	--
1979-80	1,800	900	--
1980-81	7,900	4,900	800
1981-82	8,300	5,200	--
1982-83	7,600	4,800	--
1983-84	7,300	4,600	800
1984-85	5,800	3,600	--

Timber from the area now available is mainly plywood species and therefore will flow out for industrial use. They will not serve the purpose of meeting local demand in any significant way. As the bamboo area will be worked in a three year cycle, there will not be an even flow of this essential requirement for the local population. Thus, from the systematic extraction operations envisaged, only a small quantity of timber will be available to meet the local demands and it is mostly restricted to timber from the plantation working circle. As regards bamboos, apart from the uneven flow, most of the quantity is earmarked for supply to industrial use. It is only in respect of fuelwood that forestry operations will be able to supply a small portion of the requirement. It is indeed a pathetic situation that in a short span of time, the rich forests of the area have been reduced to a state, where they cannot even meet the local demand.

CHAPTER IV

PEOPLE AND DEMAND ON FOREST PRODUCE

The Kurumbas, Mudugas and Irulas were the early inhabitants of the area (P1.XI). Among them Kurumbas perhaps were the earliest inhabitants who lived in complete harmony with the forest and depended to a large extent on forest produce. From the initial nomadic life, they took up shifting cultivation and organized themselves into hamlets. At present there are 14 hamlets, 9 of which are in reserved forests. The Mudugas moved into the area much before the Irulas and there was close interaction with Kurumbas. The Irulas moved into the area in the 17th century or so as a result of influx of Telugu and Kannada speaking people to Coimbatore. The Irulas occupied the eastern part of the area and gradually pushed the Mudugas westwards. There was constant strife between these two tribes and village names like Santakkadu (field of quarrel) bear testimony to this. All tribes practiced shifting cultivation extensively as the area had immense scope for this.

The people near Tamil Nadu border must have established early contact with the Irulas and the Tamilian population, mainly the Goundas began to migrate to the eastern side in 1920 and thereafter. Although they came mainly for agriculture, they did not, at first settle down

Plate XI. Tribals in the area

i. Kurumba

ii.& iii. Irula

in the area. Instead, they entrusted the growing of agricultural crops to the Irulas and collected the produce. Towards the late thirties however, the Goundas settled down for agriculture by clearance of forests. The Kurumbas and Mudugas who occupied the interior of the areas were however not affected by the settlements Goundas. The isolation of the whole area was gradually broken in the forties when people from the plains of Kerala moved into the area as lessees, mainly to exploit forest wealth and to settle down as agriculturists. It was only after an all weather road from Mannarghat to Malleswarankovil was contructed in 1946 and extended to Coimbatore that the pattern of migration into the area changed. From sporadic incursions into the area, regular migration took place and paved the way for extensive removal of timber and other forest products.

As indicated in Table 2 (chapter II) the area which had predominantly a tribal population in 1951 (about 90%) became a heaven of settlers by 1971, reducing the tribals to a minority within a short span of 20 years. The pace of migration into the area increased from about 800 persons per year from 1951-'61 to over 2000 per year during 1961-'71. This trend continued and the estimated figures for 1977 indicate that the rate of movement reached to about 2400 per year. This trend of movement of settlers is corroborated

by the data obtained by the household survey. These data further indicate the pace of migaration from the two regions viz., Tamil Nadu and Kerala (Table 11).

Table 11

Pace of Migration

Period	Settlers of Kerala origin		Settlers of Tamil Nadu origin	
	No. of households surveyed	Percentage	No. of households surveyed	Percentage
Upto 1951	3	5.0	4	6.0
1951-1961	15	23.0	24	36.0
1961-1971	22	33.0	28	42.0
After 1971	26	39.0	10	16.0
Total	66	100	66	100

(Source: Household survey)

The migrants who settle down in the drier zones in the three villages Agali, Pudur and Sholayur were from the neighbouring areas of Tamil Nadu (mainly from Coimbatore District). The migrant of Kerala origin who came mostly from the plains settled in the high rainfall areas in Agali and Sholayur. Their original cultivation practices determined

the choice of localities for settlement. Data on the place of origin of the migrants of Kerala origin show that about 50% are from Central Travancore area and 29% from the plains of Palghat (Table 12).

Table 12

Place of origin of migrants of Kerala origin

District	No. of house-holds surveyed	Percentage
Kottayam	28	42.0
Palghat	19	29.0
Idukki	7	11.0
Trichur	4	6.0
Ernakulam	4	6.0
Alleppey	2	3.0
Trivandrum	1	1.5
Malappuram	1	1.5
Total	66	100.0

(Source: Household survey)

Enquiries as to the original occupation and reasons for migration revealed the following information (Table 13).

Table 13

Original occupation and reason for migration

Origin	No. of house-holds surve-yed	Original occupation of the migrants		Reason for migration	
		Agri-culture	Unskilled labour	Finan-cial diffi-culty	Cheap availa-bility of land
		percent			
Kerala	66	68.0	32.0	56.0	44.0
Tamil Nadu	66	48.0	52.0	48.0	52.0

(Source: Household survey)

Disposing their possessions at home, the migrants trekked to Attappady in search of land at cheap rates. Fighting against the difficulties of terrain, inhospitable climate, and wild animals, they took to agriculture in the land either bought or encroached. They adopted the crops and cultivation practices with which they were familiar and more of less translated their practices in the new settlements.

The method of acquisition of land (apart from encroachments) by the migrants and the area acquired are summarised in Table 14.

Table 14

Method of acquisition of land and area acquired

Origin	No. of house-holds surve-yed	No. of house-holds who acquir-ed land after migra-tion	House-holds who did not acquire land	Method of acquisition of land		Average area per house-hold (ha)
				From tri-bals	From othe-rs	
		percent				
Kerala	66	92.0	8.0	16.0	84.0	3.36
Tamil Nadu	66	97.0	3.0	50.0	50.0	3.05

(Source: Household Survey)

Cultivation practices

As already mentioned, the area was fully forested till the dawn of the present century, with negligible communication facility and infested with wild animals. The very name of the area (Atta = Leach; Pady = Village) is indicative of the nature of the area. The only inhabitants, viz., the tribes must have at some point of time abandoned the hunting-gathering life and resorted to cultivation. They must have developed a system which was in harmony with their way of life,

long before the area fell under the hegemony of the Janmis. Even though the land became the property of the janmis, they did not interfere with the way of life of the tribes and uncontrolled shifting cultivation continued for a long time. The fact, that the tribes were engaged in this practice is still remembered by the older generation of the tribals. Even till 1917 there was little interference with the practice of shifting cultivation (Venkateswara Ayyar 1935). Irulas who had earlier contacts with traders and farmers from Coimbatore district must have slowly adopted settled cultivation. Moreover, the more fertile tribal lands must have been slowly encroached upon by the traders by exploiting the gullibility of these simple folk. Because of the pressure on land and restriction enforced by the janmis, Irulas and Mudugas had no option but to adopt settled cultivation. The Kurumbas in the interior areas unaffected by this development, continued this practice, and at present it is only this tribe which is practicing shifting cultivation as modified by the restrictions imposed.

Shifting cultivation by Kurumbas

The Kurumbas, now confined to the reserved forests, were the only shifting cultivators when action for reservation was taken in 1900. At that time there was no well defined villages. A village was simply one but divided into compartments to accommodate the families engaged in shifting cultivation. The tendency was just to shift the hut next

year along with their cultivation to places of their choice within the forest (Venkateswara Ayyar 1935). This practice continued till 1917. From this year onwards, definite areas of land, free from assessment were allotted to them for cultivation, the "mooppan" (headman) executing agreements for supplying men at usual rates for carrying the kit of the touring officers and for forest work. In 1921-'22, consequent to the Mopilla rebellion in Malabar, there was slackness in administration and during this period, the Kurumbas cleared forest for cultivation outside the alloted area. Attempts were made to reclothe such cleared areas by directing the tribals to plant species like teak, irul, jack etc. But this did not succeed for want of adequate supervision.

In 1927, a scheme for shifting cultivation on a four year cycle was introduced under which

each village was allotted three blocks of forest near the village site depending upon the number of families;

the lease was to be annual;

of the three blocks in a village, each block was to be cultivated for 2 years and the other two were to lie fallow, the first block was to be cultivated again after 4 years;

the "mooppan" was bound to supply labour at market rates and to assist in forest conservation in return for which the lease would be free from assessment.

The extent of land allotted in each village was as follows:

		Area in hectares
1.	Thadikkundu	42.93
2.	Anavoy	19.44
3.	Murugalai	36.45
4.	Gottiarkandy	18.22
5.	Kurukathikkallu	17.01
6.	Thodukki	50.62
7.	Kadukumanna	36.64
8.	Pottikkal	46.17

During the preparation of the first working plan, it was found that the areas allotted to the tribals were not sufficient, as at the end of four years, the regrowth was not sufficient to bring the land again under cultivation for want of the needed ash from burning of the regrowth (venkateswara Ayyar 1935). It was therefore prescribed that instead of three equal blocks, six such blocks should be given to each village, to make the cycle ten years. This prescription was given effect to in 1933 by allotting more land for cultivation as follows:

		Area in hectares
1.	Thadikkundu	63.18
2.	Anavoy	34.02
3.	Murugala	43.74
4.	Gottiarkandy	24.30
5.	Kurukkathikkallu	38.88
6.	Thodukki	87.48
7.	Kadukumanna	34.02
8.	Pottikkal	72.90

The growth in population of the shifting cultivators and the progressive increase in area cleared for cultivation is summarised below (Chand Basha 1977).

Table 15

Population of tribals and area cleared for cultivation in the reserved forests

Year	Population	Area cleared	Per capita area cleared
		---------hectare---------	
1927	not known	253	...
1933	250	398	1.6
1943	392	447	1.1
1959	517	678	1.3
1976	835	1893	2.3

During the period 1959-76' more land than what the tribals could possibly cultivate, was cleared. Such clearance was not for extraction of timber but perhaps to claim ownership on land. It has now been proposed that the fallow lands in excess of the allotted area, particularly in steep terrain should be assumed and planted with fruit trees (chand Basha, 1977).

The area allotted to each household by the "Moopan" is taken up for cultivation. Small trees, shrubs and herbs are cleared with a small axe (Kunthali). The area is burnt and the soil is worked with a small spade like implement (Kothu). During late April, by which time some premonsoon showers are usual, sowing is undertaken. A religious ceremony is performed and the soil expert (Mannukkaran) initiates the first sowing. An interesting feature is that seeds of Ragi (Eleusine coracana), French millet (Panicum miliaceum), Pigeon pea (Cajanus cajan), Mustard (Brassica juncea), Cheer (Amaranthus s0.) are mixed and broadcast sown. Ragi is harvested after six months, followed by French millet, mustard and cheera. Pigeon pea is harvested in about 9 months. Because of the phasing of the harvest, the tribals are ensured of a continuous source of food. No fertiliser is applied and weeding is seldom carried out. Pests and diseases were unknown in the past, but recently some pest damage has been

noticed. Cultivation in this manner is undertaken successively for two years, the area then abandoned and the next block taken up. Normally the cultivator returns to the first area after ten years. As the tribals use simple implements like kunthali and kothu, vegetation is not excessively disturbed and the disturbance to the soil is minimal. This is evident from the vegetation and soil studies.

During non-harvest seasons, the shifting cultivators sustain themselves by hunting, gathering roots, fruits etc. They also undertake collection of Minor Forest Produce for their own use and for disposal.

Settled cultivation (P1. XII, XIII and XIV)

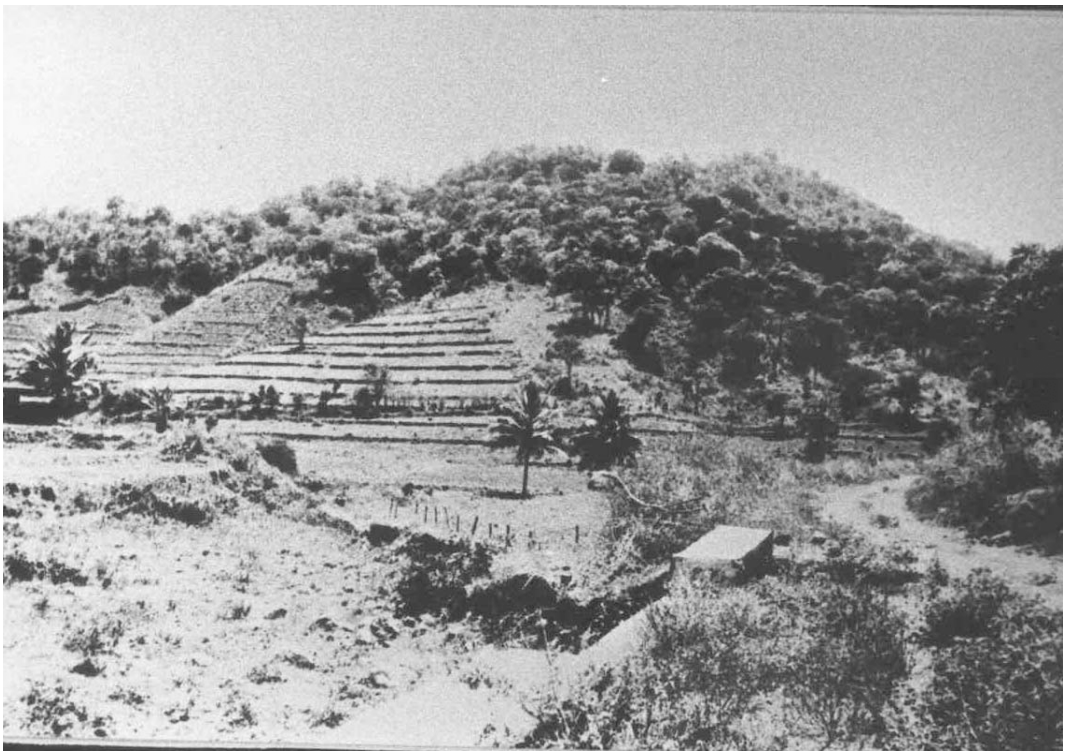
The Mudugas, Irulas and the settlers practice settled cultivation and to a large extent cultivate one crop at a time. About 27,000 ha. have been brought under cultivation under various crops and the distribution in the three villages is as follows:

Agali 16,600 ha.

Pudur 4,300 ha.

Sholayur 6,500 ha.

In Agali 28.3% of the cultivated area is under plantation crops like rubber, cardamom etc. Rice accounts for 7.4% of the area in Agali, 4.7% in Pudur and less than 1.0% in Sholayur. Dryland crops like cotton, pigeon pea,



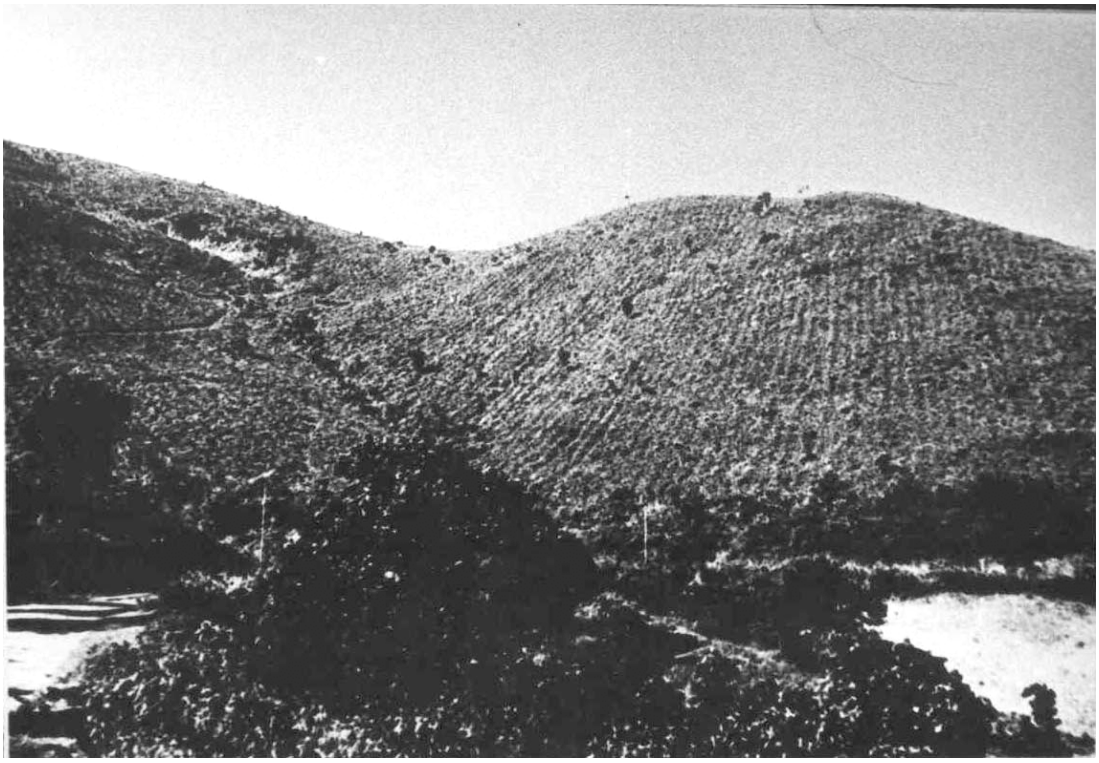


Plate XII. Settled cultivation

i. Rice along hill slopes after terracing

ii. Eucalyptus plantation by the Forest Department

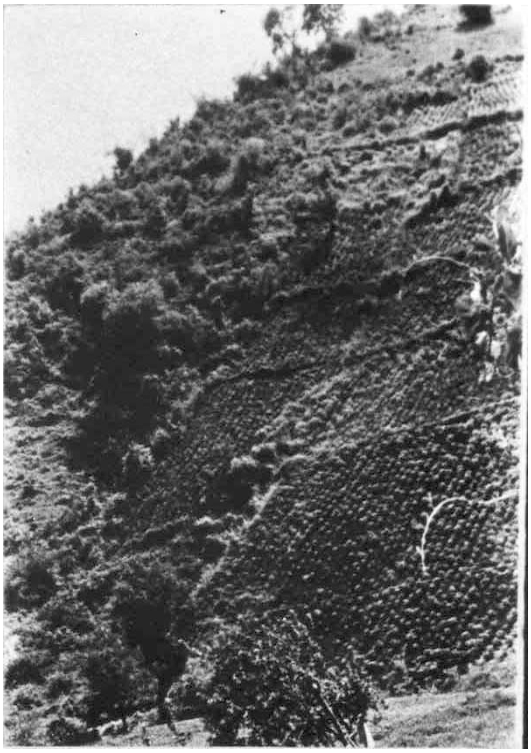
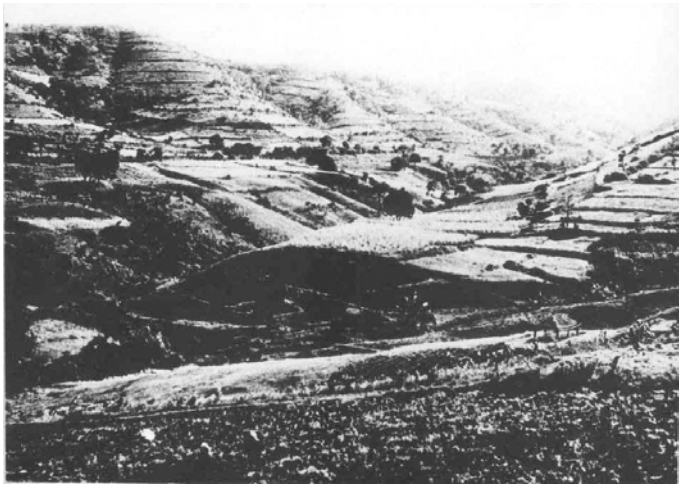


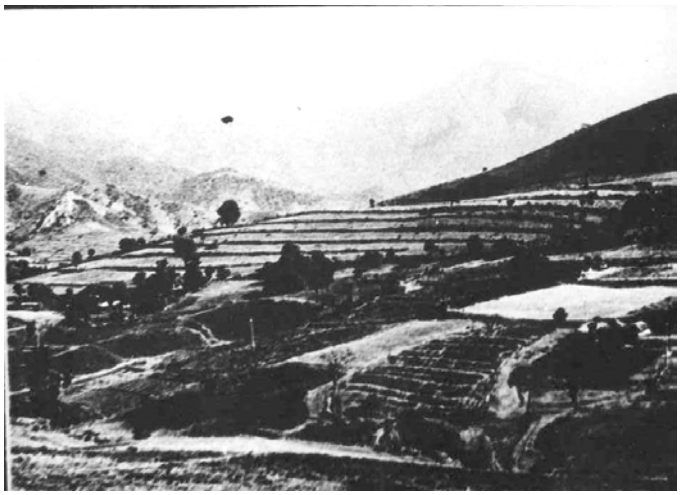
Plate XIII. Settled cultivation

i. Denuded area taken up for cultivation with soil conservation measures

ii. Tobacco in flat area

iii. Tapioca along slopes without soil conservation





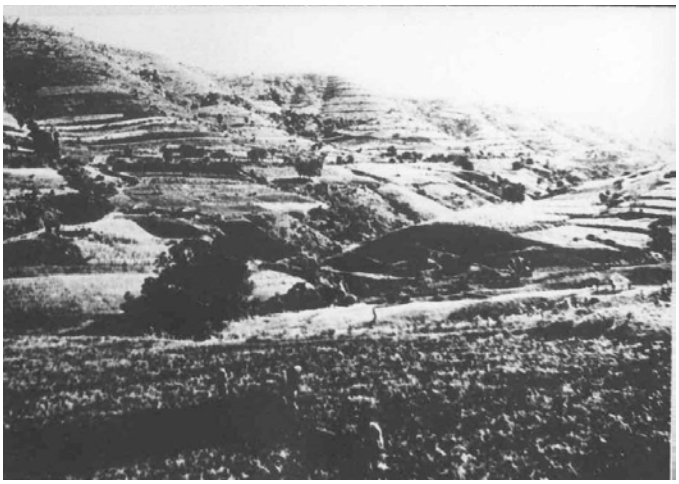


Plate XIV. Settled cultivation

i. Sugarcane along gentle slopes

ii. Rice and Sorghum

ii. Sorghum in slopes and flat lands

blackgram etc. are grown extensively in Pudur and maize is the most common crop in Sholayur. The gross distribution of various crops in the area have been shown in Fig. 2 and the details are tabulated below.

Table 16

Major crops under cultivation

Common name	Botanical name	Percentage of area		
		Agali	Pudur	Sholayur
Sorghum	Sorghum vulgare	4.2	1.9	25.0
Maize	Zea mays	1.2	6.8	9.0
Groundnut	Arachis hypogaea	12.6	...	4.0
Horse gram	Dolichos biflorus	0.3	11.4	6.3
Blackgram	Phaseolus mungo var. radiatus	3.7	11.4	3.1
Cotton	Gossypium herbaceum	3.0	16.7	2.5
Pigeon pea	Cajanus cajan	0.4	19.8	1.9
Ragi	Eleusine coracana	...	...	1.2
French millet	Panicum miliaceum	...	...	1.2
Rice	Oryza sativa	7.4	4.0	0.6
Lemon grass	Cymbopogon flexuosus	3.7	...	0.6
Vetiver	Vetiveria zizenioides	2.2	...	0.6
Tapioca	Manihot esculenta	9.0	...	...
Pepper	Piper nigrum	4.9	...	...
All other crops except plantation crops		19.2	28.0	23.1
Plantation crops				
Cardamom	Elettaria cardamomum	4.5	...	21.0
Rubber	Hevea brasiliensis	17.0	...	...
Coconut	Cocos nucifera	7.0	...	...

(Source: Household survey)

On an average, the Irulas have 2.6 ha. of agricultural land per family and the Mudugas 2.1 ha. Among the settlers, those of Kerala origin have 2.6 ha. per family and those of Tamil Nadu origin 3.4 ha. A small portion of the area is irrigated, the bulk being rainfed (Table 17)

Table 17

Land ownership pattern in the area under settled cultivation

Cultivators	Total No. of house-hold surve-yed	Percent-age of house-holds who own land	Irrigated area		Unirrigated area	
			Average area per house-hold	Per-cen-tage	Average area per house-hold	Per-cen-tage
Mudugas	16	88.0	0.138	6.7	1.945	93.3
Irulas	117	94.0	0.165	6.4	2.420	93.6
Settlers of Kerala origin	66	91.0	0.283	11.0	2.319	89.0
Settlers of Tamil Nadu origin	66	97.0	0.504	14.6	2.945	85.4

(Source: Household survey)

While the main crops of Irulas, Mudugas and settlers of Tamil Nadu origin are ragi and maize, those of settlers from Kerala are rice and tapioca. The details are tabulated below.

Table 18

Crop preference of households

Cultivators	Total No. of house-hold surve-yed	Main crops: No. of households who cultivate			Use of H.Y.V. seeds, chemical fertilisers, pesticides etc.	
		paddy	tapioca	ragi & maize	Yes	No
Mudugas	16	35.7	7.1	78.6	7.1	92.9
Irulas	117	33.0	8.5	100.0	5.7	94.3
Settlers of Kerala origin	66	61.7	68.3	28.3	50.0	50.0
Settlers of Tamil Nadu origin	66	19.4	3.2	95.2	25.8	74.2

(Source: Household survey)

The area is surplus, as far as many agricultural produces like pulses, cereals, millets and vegetables are concerned, as is evident in the three weekly markets ~~and in~~ harvest seasons. Wholesale traders from Mannarghat (Kerala) and Coimbatore (Tamil Nadu) purchase produce, in these markets and transport the same to other places. Some

items like pigeon pea, blackgram, groundnut etc., are not sold in open market and disposed directly by cultivators to the agents of traders. The quantity of agricultural produce disposed in open markets is tabulated below.

Table 19

Agricultural produce disposed in markets

Produce	Quantity sold annually
	----tonne----
Chillies	26
Onion	300
Vegetables	500
Plantain	68
Jaggery (from Sugarcane)	192
Horsegram	260
Sorghum	30
French millet	47
Ragi	42
Italian millet or Foxtail millet or Setaria	47

(Source: Household survey)

Livestock

It has already been indicated that the area has an abundant livestock population and that the number is increasing. All categories of habitants own livestock. While Kurumba households on an average have 9.5 heads, the settlers of Kerala origin have 3.9 heads and the Mudugas 1.7 heads.

Table 20

Distribution of Livestock

Category	Total No. of house-hold: surve-yed	No. of house-holds who own Live-stock (%)	Average No. of Livestock		
			Cattle	Goats & Sheeps	Total
Kurumbas	11	64	3.1	6.4	9.5
Mudugas	16	63	0.7	1.0	1.7
Irulas	117	65	3.0	3.5	6.5
Settlers of Kerala origin	66	68	2.5	1.4	3.9
Settlers of Tamil Nadu origin	66	89	4.7	3.3	8.0

(Source: Household survey)

Grazing area was abundant in early days but with diminution of forest and extension of agriculture, grazing has become a problem now and it will be more acute with the increase in number of livestock. As stall feeding will be impracticable and uneconomic, it is necessary that facilities for grazing are augmented. It is only Kurumbas who do not experience any difficulty in grazing their animals. Majority of Irulas and settlers have reported shortage and difficulty in getting adequate grazing material (Table 21).

Table 21

Patterns of Livestock Feeding

Category	Stall-fed	Grazed	Both	Distance covered for grazing			Availability of grazing material	
				Upto 1 Km	1-3 Kms.	above 3 Kms.	Abundant	Difficult
	percent							
Kurumbas	...	100	...	86	14	...	100	...
Rudugas	...	100	...	50	33	17	67	33
Irulas	3	84	13	24	69	7	41	59
Settlers	14	58	28	44	50	6	46	54

(Source: Household survey)

Requirement of forest produce

Forest produce is an important requirement of the population in the area. While the tribals, particularly the

Kurumbas depend heavily on forest produce for their sustenance; others also have varied demands which have to be met to a large extent from the available forests. The requirement can be classified as:

a) Timber and other materials for construction and maintenance of houses

b) Timber for agricultural implements

c) Fuel wood

d) Minor forest produce like honey, edible tubers, fruits etc. and

e) Medicinal plants

When the population was sparse and their mode of living was simple, the area provided abundant scope for a life of contentment with the forests offering all its bounty. With the infiltration of settlers end destruction of forests, the pattern has changed and the life of tribels in harmony with the forest has been disturbed. The pressure on forest resources has considerably increased and it is necessary to evaluate the requirements of the people in the area to draw meaningful forestry programmes so that a sustainable interaction is maintained between the population and the forest.

a) Timber and other materials for construction and maintenance of houses

A tribel house is a simple structure to protect the family from the inclemencies of weather. During day time

the family is mostly out for work - either agricultural operations, gathering of tubers, fruits etc., or hunting. Years of adaptation to the natural surroundings climate and the easy availability of construction materials have determined the pattern of their dwelling houses. A typical tribal hut has a grass-thatched roof, supported on rafters and reapers made of bamboo or reed. The wall is built of mud, reinforced with split bamboos. The posts are of small roundwood or bamboos (PI. XV). Apart from bamboos and reeds used extensively, small roundwood of Chadachi (Grewia tiliaefolia) is the species of their choice for posts and occasionally for rafters. Teak has been used by Irulas to a small extent. All materials for construction are available in the forests and they are easily renewable. Genarally the hut has two room, one of which is used as living room end the other as kitchen, store etc. In some huts a small.; verandah is also found in the front. Material collected from 107 Irulas, 16 Muduga end 11 Kurumba households spread over 106 hamlets during household survey has revealed valuable quantitative information on the forest produce required for house construction.

With the organization of Tribal Development Block houses of a different pot tern was constructed for the tribals (Pl. XV). These houses have tiled roof, brick/stone walls, beams, rafters, reapers, door and windows of sawn timber.

Plate XV. Tribal dwelling houses

i. Colony of houses constructed by Government

ii. Houses with tiled roof constructed by Government and those with thatched roof constructed by tribals

iii. A typical tribal hut

As regards the houses of settlers, about 40% of them have tiled roofs and the others have roofs thatched with grass supported by bamboos. About 30% have brick walls and the others are of mud reinforced with split bamboo. Chadachi is popular among settlers also for round wood members like posts, rafters etc. Only about 15% have used teak for this purpose. The settlers have made use of timber collected from forest for furniture items like chair, table, cot etc. For this purpose, free use of valuable species like rosewood and teak have been used, apart from Chadachi.

Information pertaining to the types of houses end source of materiel for house construction are summarized below.

Table 22

Types of houses

Category	No. of household surveyed	Wall			Floor		Roof			Source	
		Mud and stone	Mud reinforced by split bamboo	Bricks	Mud	Cement	Tiles	Grass	Others	Forest	Own land
		percent									
Kurumbas	11	...	45.0	55.0	100.0	...	55.0	45.0	...	100.0	...
Muduges	16	19.0	44.0	37.0	100.0	...	38.0	62.0	...	100.0	...
Irulas	117	35.0	46.0	19.0	97.0	3.0	36.0	62.0	2.0	98.0	2.0
Settlers of Kerala origin	66	33.0	24.0	43.0	83.0	17.0	35.0	63.0	2.0	93.0	7.0
Settlers of Tamil Nadu origin	66	36.0	33.0	31.0	68.0	32.0	48.0	47.0	5.0	100.0	...

(Source: Household survey)

Apart from bamboo, Chedachi is most commonly used as timber member for posts, rafters etc. Teak in round is rarely used but wherever sawn timber is utilised, teak is common (Table 23)

Table 23

Construction material for posts, rafters, doors and windows

Category	No. of household surveyed	Timber members: No. of households using: teak	bamboo	chedachi	Others	Source: Forest	Own land
		percent					
Kurumbas	11	...	28.0	72.0	...	100.0	...
Mudugas	16	...	37.0	56.0	7.0	100.0	...
Irulas	117	15.0	30.0	49.0	6.0	100.0	...
Settlers of Kerala origin	66	16.0	31.0	50.0	3.0	97.0	3.0
Settlers of Tamil Nadu origin	66	14.0	36.0	50.0	...	100.0	...

(Source: Household survey)

The estimated requirement of forest produce for construction purposes is as follows:

Table 24

Requirement of Forest Produce for house construction

No. of houses measured	Timber in m^3			Bamboos in tonnes			Thatching grass in Kg.		
	Max.	Min.	Ave.	Max.	Min.	Ave.	Max.	Min.	Ave.
18	1.065	0.06	0.45	2.5	0.2	1.0	750	100	160

(Source: Household survey)

Based on the above data, the annual requirement of forest produce for maintenance of existing houses in the area is given below.

Timber - 600 m^3 (assuming a life of 10 years)

Bamboo - 2500 tonnes (assuming a life of 5 years)

Thatching grass - 2000 tonnes (assuming annual replacement)

For new constructions due to the natural increase in population, about 100 m^3 of timber, about 100 tonnes of bamboos and about 40 tonnes of grass are required annually.

b) Timber for agricultural implements.

Agricultural implements for which timber is required are ploughs, tool handles etc. The choice of species is based on tradition, depending upon the place of origin of the settlers and tribal communities. 88% of the tribals and 66% of the settlers reported that timber for agricultural implements was scarce in the area and about 60% of the settlers purchased their requirement from elsewhere. Replacements were made normally once a year. The total requirement of timber for this purpose is rather small and the special used are Holoptelea integrifolia (Aval), Grewia tiliaefolia (Chadachi), Cleistanthus coliinus (Oduku), Strychnos nux-vomica (Kanjaram), Pterocarpus marsupium (Vengai), Tamarindus indicus (Puli) etc.

c) Fuelwood

Fuelwoods the only source of energy in the area and it will continue to remain the main source for years to come. There is no organized system for collection and distribution of fuelwood and the people mostly depend upon the forest to meet their requirement. While the tribals and settlers of Tamil Nadu origin collect their entire requirement from the forest about 22% of settlers of Kerala origin are able to meet their need from their own land. As the forests are dwindling and availability of fuelwood restricted to forests

in the interior:, 67 to 93% of the settlers and 90% of the : Irulas reported difficulty in meeting this essef1tial requirement. Many of them have to cover distances beyond two kilometers for collection. Even when such scarcity for fuelwood prevails in the area, transportation to outside places by head loads and buses after collection from unrecorded sources is not uncommon. Absence of a proper system to meet the fuelwood requirement is the main reason for destruction of forests resulting in changing their composition and complexion. Information on the source and mode of collection of fuelwood and a qualitative assessment of its availability is summarized below.

Table 25

Source and Mode of collection of fuelwood

Category	No. of household surveyed	Mode of collection		Source		Distance travelled for collection			Supply position of fuelwood	
		Self collection	purchase	Forest	Own land	Upto 1Km.	1-2 Kms.	above 2Kms.	Difficult	Adequate
		percent								
Kurumbas	11	100.0	...	100.0	...	91.0	9.0	...	...	100.0
Mudugas	16	100.0	...	100.0	...	25.0	37.5	37.5	37.5	62.5
Irulas	117	98.5	1.5	100.0	...	18.5	41.5	40.0	90.5	9.5
Settlers of Kerala origin	66	88.0	12.0	77.5	22.5	64.0	19.0	17.0	67.0	33.0
Settlers of Tamil Nadu origin	66	92.4	7.6	100.0	...	34.5	42.5	23.0	93.5	6.5

(Source: Household survey)

The per capita consumption of fuelwood, as per data collected during household survey is 1.2 to 2 Kg. per day. Reckoning the average consumption as 1.7 Kg. the total annual requirement is about 36,000 tones. Apart from fuelwood for domestic consumptions about 18,000 tones are required annually for extraction of Lemon grass and Vetiver oil in small units spread over the area of settlement of the settlers of Kerala origin. Thus the total annual requirement of fuelwood in the area amounts to 54,000 tones.

d) Minor Forest Produce

Cane (mostly Calamus rotang.), Cardamom (Elatteria cardamomum), Pepper *(*Piper nigrum), Soap nut (Sapindus laurifolius), Thanika (Terminalia bellerica) Kadukka (Terminalia chebula), Karukkapatta (Cinnamomum zeylanicum) Nellikkai (Emblica officinalis), Kattumanjal (Curcuma angustifolia), Sheekai *(*Acacia concinna) Inchai (Acacia intsea) are the important minor forest products in the area apart from medicinal plants which are dealt with separately. Honey tubers of Dioscorea spp. etc., are collected for domestic consumption. It is estimated that about 1000 persons (mostly tribals) are engaged in collection of minor forest produces.

e) Medicinal Plants

The area has a rich diversity in plants of medicinal value and the tribals, particularly Kurumbas depend almost entirely on medicinal plants in the region for therapy. The knowledge about medicinal uses of these plants accumulated by these forest dwellers by trial and error is mostly kept secret and passed on from generation to generation by the tribal medicine men. The medicinal uses of these plants are usual 11 not known outside their restricted community or locality. All the tribals were completely dependent on wild medicinal plant for treatment of their ailments, till medical facilities became available to them. At present, Kurumbas depend upon the traditional system of treatment. Gradually, this secret treasure of information is getting lost. It is important that every effort is made for collecting this valuable information before it is completely lost.

The tribals do not easily part with the secret information they possess, unless very intimate contacts are established with them. Very often the informants a local guides accompanying the field staff pass on incorrect information for the sake of monetary gratification. Hence, through establishment of personal contacts repeated queries from time to time with the same informant and personal trials, reliable data have been gathered.

The reported uses of medicinal plants of the area are summerised under different end uses. Wherever possible, the parts of the plant in use and the method of application are also dealt with.

I Abortion

Serial number	Name	Parts used	Mode of administration
1.	Musa paradisiaca (Poovam Pazham)	Ripe Fruit	Mixed with camphor and orally administered twice a day continuously for 3 days.
2.	Saccharum officinarum (Karimbu) and Setaria italica (Thenai)	Stem Fruits	Sugarcane juice is boiled with powdered Setaria italica fruits. The mixture is stirred well and administered thrice a day, for three days.
3.	Emblica officinalis (Nellikkai)	Fruits	The fruits and common salt are mixed by crushing and the mixture orally administered.

II Alexipharmic (antidote to poison and toxicity)

1.	Spatholobus purpureus (Athambu) and Nicotiana tabacum (Pukayilai)	Root tubers Leaves	Both are well mixed and applied externally over the wound.
2.	Vallaris solanacea (Kodippalai)	Root	Paste prepared in water is taken internally as well as applied to the wound as soon as possible after snake bite.

3.	Curcuma angustifolia (Sooppa)	Rhizome	A paste prepared in water is taken orally as well as applied to the wound.
4.	Madhuca longifolia (Iluppai)	Bark	Bark paste applied to the wound and also taken orally.
5.	Euphorbia neriifolia (Ilakkalli)	Milky latex	Applied to the wound.
6.	Gloriosa superba (Menthonni)	Rhizome	Paste applied to the wound.
7.	Commelina sp. ('Pullu')	Leaves	Leaf paste applied locally for scorpion bite.
8.	Solanum nigrum (Chundai)	Leaves	Leaf decoction taken orally to remove the toxic effects of opium.
9.	Ocimum americanum (Kattu thulasi)	Leaves	Leaf juice used to remove bad effects due to alcoholic intoxication.

Anodyne or Analgesic (Headache and other pains)

1.	Lycopersicon lycopersicum (Thakkali)	Leaves	Leaf extract applied on head thrice a day.
2.	Tragia involucrata (Kotithuva)	Root	Root paste applied on the forehead.
3.	Solanum nigrum (Kangu) Amaranthus spinosus (Mullencheera) Eleusine sp.(Pullu) Bidens pilosa	Root	Root paste prepared in water is taken orally in treating body pain.

4.	Glycosmis pentaphylla (Panal) Solanum indicum (Puthirichunda) Ricinus communis (Avanakku)	Root	Root paste of these are mixed and taken for griping pain in stomach.
5.	Aerva lanata (Cheroola)	Root	Root paste applied on forehead for pain.
6.	Baliospermum montanum (Nagadenti)	Shoots	The twigs are used as tooth brush to get relief from tooth ache.
7.	Kydia calycina	Leaves	Leaf paste applied over the body relieves body pain.
IV	Antipyretic		
1.	Zingiber officinale (Inchi)	Rhizome	Rhizome extract is mixed with equal volume of crab extract. Pepper powder is added to it and after sometime it is administered orally.
2.	Melia azadirachta (Veppu) Nicotiana tabacum (Pukayilai) Piper betle (Vethilai) Areca catechu (Pakku)	Leaves	The leaf extracts are mixed in equal proportions and betel nut powder added to the extract and stirred well. This solution is applied all over the body.
3.	Jatropha glandulifera (Kadalavanakku)	Bark	The bark extract is applied all over the body thrice a day.
4.	Solanum verbascifolium (Chundai) Ricinus communis (Avanakku) Cymbopogon flexuosus (Inchippullu)	Leaves	Extracts of tender leaves are mixed in equal proportions and smeared all over the body early in the morning and evening before bath continuously for three days.

5.	Chenopodium ambrosioides (Narakaduchedy)	Leaves	Leaf paste is smeared all over the body for treating very high fever.
6.	Musa paradisiaca (Vazha) Ipomoea bracteata (Koorukil) Chenopodium ambrosioides (Narakaduchedy)	Root	Root paste of these are mixed in equal proportions and applied over the body, especially on head.
7.	Cocculus hirsutus (Garuthakodi)	Leaves	Leaf juice mixed with sugar is taken orally.
8.	Cocculus hirsutus (Garuthakodi)	Root	Root decoction is taken thrice a day.

Antiseptic (for cuts and wounds)

1.	Kalanchoe pinnata (Ilamulachi)	leaves	Leaf paste applied to fresh wounds.
2.	Ageratum conyzoides (Appachedi) Nicotiana tabacum (Pukayilai) Bambusa arundinacea (Mula)	Leaves Leaves epidermal scraping	A paste made by mixing these three with Calcium carbonate (sunnamb) is applied on fresh cuts.
3.	Ricinus communis (Avanakku) and Sesamum indicum (Ellu)	Bark Seed	Bark paste is boiled in gingelly oil and used for deep cuts.
4.	Cleome viscosa (Naivela)	Leaves	Leaf juice used to remove pus from wounds especially from ear.
5.	Ailanthus excelsa (Matti)	Bark	Bark decoction good for healing wounds.
6.	Ageratum conyzoides (Appachedi)	Leaves	Leaf juice used for healing wounds.
7.	Oroxylum indicum (Pathiri)	Bark	Bark paste used in the treatment of wounds of cattle.

VI	Birth Control		
i.	Contraceptive		
	Calamus rotang and other species of Calamus (Chooral)	Ripe fruits and stems	Juice from ripe fruits or stems orally administered for 3 consecutive days once every morning.
ii.	Antifertility		
	Biophytum sensitivum (Mukkutti) and	Leaves	The dried leaves of both mixed and smoked is reported to cause male infertility.
	Nicotiana tabacum (Pukayilai)	Leaves	
VII	Cold and Cough		
1.	Eleusine sp. (Kothukothichedi)	Root	Made into a paste with water and taken orally.
2.	Careya arborea (Pelu)	Calyx	Paste of dried persistent calyx taken orally.
3.	Datura metel (Ummathu)	Leaves	Dried leaves are smoked for relief from cough.
4.	Martynia annua (Garudhakokku)	Leaves	Leaf juice can cure sore throat due to cold.
5.	Achyranthes aspera (Kadaladi)	Whole plant	Decoction for relief from cough.
VIII	Demulcent (for skin diseases)		
1.	Argemone mexicana (Kandankathiri)	Seeds	Oil from seed is used for external application.
2.	Derris indica (Ungu)	Seeds	Oil from seed is used for external application.
3.	Cassia occidentalis (Thakara)	Leaves	Leaf paste applied externally for scabies and other skin diseases.
4.	Alangium salvifolium (Ankolam)	Root	Root paste applied externally.
5.	Plumbago rosea (Chethikoduveli)	Root	Root paste applied externally.
6.	Cyclea peltata (Padavalli) Jasminum angustifolium (Vandakkotiyila)	Leaves	Leaf paste of these are mixed and smeared on the affected parts for itches and dermal affections.

IX	Diabetes		
1.	Gymnema sylvestre (Chackarakkolli)	Leaves	Leaf paste is administered orally.
2.	Coccinia cordifolia (Kovakkai)	Leaves	Leaf juice is administered orally.
X	Dryness of tongue		
1.	Anamirta cocculus (Pechimarunthu)	Root	Root paste is applied on the head before bath in the evening.
2.	Clerodendrum viscosum (Peringalamveru)	Root	Root paste in water applied on head for dryness of tongue consequent to indigestion.
XI	Epilepsy		
	Solanum verbascifolium (Mudippeetha) and Cassia alata (Karimthakara)	Root	Root paste in water taken orally.
XII	Eye diseases		
1.	Leucas aspera (Thumba)	Flowers	Lotion prepared from flowers used in the treatment of sore eyes.
2.	Leonotis nepetaefolia (Mulluthumba, Kattuthumba)	Inflore-scence	The ash obtained by burning inflorescence is mixed with butter and used for treating swollen eye lids.

XIII		Muscular swellings		
	1.	Polygala chinensis	Leaves	Leaf decoction is taken orally.
	2.	Breynia patens (Nithyarcheti)	Leaves	Leaf paste is applied on the swellings.
XIV		Purgative (Cathartic)		
	1.	Amaranthus spinosus (Mullencheera)	Root	Root paste acts as a good purgative.
	2.	Helicteres isora (Idampiri/Valampiri)	Fruits	Decoction is a safe purgative.
		Allium sativum (Vellappoondu)	Bulb	
		Piper nigrum (Kurumulaku)	Fruits	
		Cuminum cyminum (Jeerakom)	Fruits	
	3.	Connarus monocarpus (Bisukattichedi)	Root	Root paste is a good purgative for children.
XV		Stomachic and antidysenteric		
	1.	Dalbergia sissoides (Eatti)	Bark	Bark juice taken orally for dysentery.
	2.	Nicandra physaloides (Muttachedi)	Root	Root paste taken orally for gastric complaints.
	3.	Mangifera indica (Mavu)	Bark	Bark paste is taken orally for dysentery.
	4.	Lantana camara (Poochedi)	Root	Root paste is taken orally in the early steges of dysentery.

	5.	Helecteres isora (Edampiri/Valampiri)	Fruit	Fruit decoction used for treating dysentery in children.
	6.	Helecteres isora (Edampiri/Valampiri)	Root	Root decoction taken orally for griping pain in stomach.
	7.	Rauvolfia serpentina (Amelpori)	Root	Root extract is orally administered for colic pain.
XVI		Tonic		
	1.	Celosia argentea (Kozhicheera)	Root	The roots dried and powdered and administered along with cows milk as a general tonic for children.
	2.	Neptunia oleracea (Nirthottavedi)	Whole plant	The whole plant is dried and powdered. This powder is mixed with milk and given to children as a general tonic.
	3.	Tinospora cordifolia	Stem	Stem decoction is a good tonic.

Raw materials used in Ayurveda are being collected in the area by different agencies and transported to various parts of Kerala, Tamil Nadu and Karnataka. In many cases, the entire plants are uprooted without caring for proper regeneration. This work is carried out by tribals who are not properly educated in the art of collection. Fairly large quantities of the following plants or their parts are regularly transported to places outside the area (Table 26)

Table 26

Medicinal plants marketed in large quantities

Botanical Name	Local Name	Part of the plant
Asparagus racemosus	Sathavari	Root
Boerhaavia diffusa	Thavizhama	Root
Crateva nurvala	Neermathalam	Leaves and Bark
Cyclea peltata	Padakizhangu	Root
Desmodium gangeticum	Moovila	Root
Ficus racemosa	Athi	Bark
Ficus religiosa	Arayal	Bark
Gmelina arborea	Kumizhu	Stem
Hemidesmus indicus	Nannari	Root
Rotula aquatica	Kallurvanchi	Root
Phaseolus trilobus	Kattu Payaru	Root
Piper trioicum	Kattumulaku	Fruit and Root
Derris indica	Ungu	Seed
Sida acuta	Kurunthotti	Root and entire plant
Solanum pubescens	Chunda	Root and Fruit
Nilgirianthus barbatus	Karimkurungi	Root
Trichosanthes cucumerina	Padolam	Whole plant

The unscientific way of collection of these plants from a limited locality will affect their regeneration and may even lead to extermination of some of them in course of time.

Besides these seventeen species which are commercially exploited, there are many more plants of medicinal value found in the area (Appendix II)

Interesting information has also been gathered through discreet enquires with a few Moopans of different tribal hamlets. A popular Moopan claims that he is acclaimed as a physician for curing cases of snake bites with the root of Vallaris solanacea (Kodippalai,). Kirtikar and Basu (1935) and Chopra et al. (1956) state that the milky juice of this plant is good for wounds and sores. The milky latex has been considered good for tooth ache and inflamed gums and the bark for fixing loose teeth, (CSIR 1976).

The tribals make milk cakes by adding the milky white latex of Wrightia tinctoria (palai) to fresh milk. The milk coagulates rapidly and gets converted into a cake- (CSIR 1978), which can be eaten.

The depletion of medicinal plants in the area is due to

i. Unrestricted collection for commercial purposes;

ii. Unscientific method of collection;

iii. Destruction of medicinal plants during conversion for agriculture

It is important that tribals who are involved in the collection of the medicinal plants are given sufficient training in scientific collection. If the species are collected before they flower, some plants should be retained for seed productibn. Collection programme should be planned properly and it is important that an awareness is built up among the people about the need for protection of the medicinal resources of the area.

In the compact area with distinct climatic variations and varied forest types human interference began with the nomadic tribes who depended entirely on the forest for their succour. With the influx of other tribes and settlers, dependence upon forest increased and with the extension of agriculture destruction of accessible tracts commenced at a slow pace in the beginning but with great acceleration after the forties. A stage has reached where the forest area in unable to meet even the basic requirements of the people for housing and fuelwood. Unless policy options are decided at this stage the forest may not even be able to meet the demands of minor forest produces and plants of medicinal value.

CHAPTER V

VEGETAT IONAL CHANGES

To evaluate the various ecological changes in the study area, one of the methods used *was* to conduct a detailed vegetational survey in different types of forests, Within each type of forest, guidance was provided by the degree of disturbance which was qualitatively evaluated, Thus, for most of the forest types, vegetational plots from undisturbed, partially disturbed and totally disturbed areas were chosen both from the reserved as well *as* from the vested forests, Sixteen releves were thus demarcated (Fig.1) and vagetational studies were carried out both before and after the monsoon to evaluate changes in the ground cover. The particulars of the releves are appended below,

Nature of forest	Location of releve	Size of releve (in metres)	Elevation	Remarks
1. Evergreen				
undisturbed	Panthanthodu	50x50 m,	850 m,	Reserved Forest
2. Semi-evergreen				
undisturbed	Kurukkankundu	50x10 m,	760 m,	Vested Forest
partially disturbed	Manthampotti	50x20 m,	450 m.	Vested Forest
3. Moist deciduous				
undisturbed	Pottikkal I1	50x20 m	600 m,	Reserved forest
	Chindakki I1	50x20 m,	650 m,	Vested Forest
partially disturbed	Pottikkal I	50x10 m.	550 m,	Reserved Forest
	Chindakki I	50x10 m,	650 m	Vested forest
	Vandampara	50x10 m,	500 m,	Vested Forest
Partially disturbed (after shifting cultivation)	Thadikkundu	50X20 m	750 m,	Reserved Forest
4. Dry deciduous				
undisturbed	Dhandapaniyur	50x20 m.	575' m,	Reserved Forest (Tamil Nadu)
	Koodappatty	50x20 m	400 m,	"
	Thuva I1	50x10 m.	550 m,	"
partially disturbed	Thuva I	50x10 m,	550 m,	Vested Forest
Totally disturbed (Reduced to Dry deciduous scrub)	Anakkatty	50x10 m.	550 m,	Vested Forest
	Kottathara	50x10 m.	460 m.	"
	Plamaram	50x10 m,	550	"

Methodology

The releves were chosen, based on the visual observation of homogeneity, an indicator of disturbance. This problem was first discussed by Nordhagen (1923 and sutsequently received attention from Kylin (1926,' Romell (1926) Dahl and Hadac **(1949)** and Daubenmire (1968) 。However the frequency histo-grams of Raunkiaer (1934) even now holds good to test the validity of homogeneity where the frequency classes have been divided into five groups viz,,

Class	A	with	1 to 20	frequency	value
"	B	"	21 to 40	"	"
"	C	"	41 to 60	"	"
"	D	"	61 to 80	"	"
"	E	"	81 to 100	"	"

The law of frequency of homogeneitys is expressed as

$$A > B > C \quad \gtreqless \quad D < E$$

According to this, when the frequency classes B, C and D are relatively high the vegetation is not homogenous, In general, higher the class E, greater is the homogeneity, Based on this principle, the releves of Attappady have been cate-gorised as homo or hetrogenous (Table 27), The; frequency histograms for all the relevcs art depicted in Fig,7.

The permanent vegetation was analysed by the list count quadrat method of Oosting (1956). Besides listing of species, actual counting of individual species of over 10 at dbh

has bcen made to evaluate their relative frequency, abundance and density,

Size of the quadrat

Ths requisite size of the quadrat was dctermined by the species : area curve method, This was first enunciatetd by Jaccard (1912, 1928'1 and was later investigated in detail by Brenan .(1921), Du Rietz (1921), un-Blanquet (1932), Pandtya (1953), Poore (1964 and 1968), Werger (1972), Moravec (1973) and Balasubramanyan (1978).

Theoretically, the species ℓ area curve means that with increasing size of the area the curve representing the number of species at first rises very rapidly, then becomes more or less horizontal. This corresponds with Tuxcn's (1970) definition of (a) a strongly curved phases; (b) a slanting straight 1ine and (c: a horizontal linc, Based on this method, thc. size of the quadrate was

TABLE 27

Frequancy Classes end nature of vegetation

Sl. No.	Name of locality	Frequency A 0 - 20	B 21 - 40	C 41 - 60	D 61 - 80	E 01 - 100	Nature of vegetation
1	Panthanthodu	61.76	8.82	14,71	8,82	5,88	Heterogeno us
2	Kurukkankundu	60.00		15,OO	0.00	5.00	Homogenous
3	Manthampotty	83,33	10.00	6,67	0 .00	0 .00	Homogenous
4	Pottikkal I1	79.31	6,90	6.90	3,45	3,45	Homogenous
5	Chindakki I1	41.67	33,33	8,33	0.00	16,67	Homogenous
6	Pottikkal I	69,57	17,39	0.70	4,35	0 .00	Heterogenous
7	Chindakki I	33,33	25,00	8,33	33.33	0.00	Heterogenous
8	Vandarnpara	63.33	0.00	0 .00	16,67	,0.00	Heterogenous
9	Thadikkundu	86,96	0 .00	4.35	0,00	8,70	Homogenous
10	Dhandapaniyur	70,59	23,53	5,86	0.00	0 .00	Homogenous
11	Koodappatty	56.00	36.00	8.00	0.00	0.00	Homogenous
12	Thuva I1	66,67	0 .00	0.00	0,00	33,33	Homogenous
13	Thuva 1	50,00	0,00	50.00	0,00	0.00	Heterogenous
14	Anakatty	0 .00	0.00	0.00	100.00	0.00	Heterogenous
15	Kottathara	75.00	0.00	0.00	25 .00	0.00	Heterogenous
16	Plamaram	80 .00	0.00	0 .00	0 .00	20	Homogenous

From the quadrat data, the density, frequency, abundance, relative density, relative frequency and relative abundance were calculated, It needs to be mentioned here that these terminologies are based on the Anglo-American School as described in Ambasht (1969), Gates *(1949),* Misra (1969), Misra and Puri (1954), Ellenberg and Mueller-Dombois (1974) and Wergcr (1974a and b).

i) Density

It is an expression cf numerical strength and can be calculated as.

$$\text{Density (D)} = \frac{\text{Total number of individuals}}{\text{Total number of quadrats studied}}$$

$$\text{Relative density (R.D)} = \frac{\text{Number of individuals of the species}}{\text{Number of individuals of all species}} \times 100$$

ii) Frequency

It refers to the degree of dispersion of individual species in an area and is usually expressed in terms of percentage occurrence. It is calculated as-

$$\%\text{frequency (\%F)} = \frac{\text{Number of quadrats of occurrence}}{\text{Total number of quadrats studied}}$$

$$\text{Relative frequency (R.F.)} = \frac{\text{Number of occurrence of the species}}{\text{Number of occurrence of all species}} \times$$

Abundance

It is an appreciation of the number of individuals of different species in a community per quadrat in which they

occur and calculated as:

$$\text{Abundance (Ab.)} = \frac{\text{Total number of individuals of a species}}{\text{Total number of quadrats of occurrence}}$$

$$\text{Relative abundance (R.Ab.)} = \frac{\text{Abundance of individual species}}{\text{Abundance of all species}} \times 100$$

Importance Value Index

A mere quantitative value of density, frequency and abundance has its own importance but the total picture of ecological status of a species with respect to the community can be obtained only by synthesizing the percentage values of R.D)„ R„F, and R.Ab. These values when added together give the Importance Value Index (IVI) based on which an association is derived. The different types of associations recorded in the area are in Table 28.

Maturity Index

The Maturity Index (M1) of each locality is worked out to assess the status of the community in relation to its successional stage, This can be profitably employed if two similar types of vegetation are considered using the formula of Pichi Sermolli (1948)。 It is is calculated as:

$$\text{Maturity Index (MI)} = \frac{\text{Total frequency of the community}}{\text{Total number of species present}}$$

Abundance/Frequency Ratio (Ab/F)

The Ab/F ratio has been worked out based on the method of Fracker and Brischle (1944) to the nature of

TABLE 28

Types of Associations

No.	Locality	Vegetation type and status	Type of association
1	Panthanthodu	Evergreen (undisturbed)	Cullenia-Myristica-Palaquium
2	Kurukkankundu	Semi-evergreen (undisturbed)	Mesua-Diospyros-Macaranga
3	Manthampotti	Semi-evergreen (partially disturbed)	Scolopia-Artocarpus-Flacourtia
4	Pottikkal II	Moist deciduous (undisturbed)	Helicteres-Acacia-Schleichera
5	Chindakki II	"	Terminalia-Grewia-Pterocarpus
6	Pottikkal I	Moist deciduous (partially disturbed)	Pavetta-Terminalia-Randia
7	Chindakki	"	Helicteres-Terminalia-Grewia
8	Vandampara	"	Grewia tiliaefolia
9	Thadikkundu	Moist deciduous (Partially disturbed and after shifting cultivation)	Clerodendrum-Dalbergia
10	Koodappatty	Dry deciduous (undisturbed)	Albizia-Euphorbia
11	Dhandapaniyur	"	Albizia-Helicteres
12	Thuva II	"	Euphorbia antiquorum
13	Thuva I	Dry deciduous (Partially disturbed)	Albizia amara
14	Anakkatty	Secondary dry deciduous (Totally disturbed)	Albizia amara
15	Kottathara	"	Euphorbia antiquorum
16	Plamaram	"	Cassia-Tectona

distribution of species, since Ab/F ratio can be used as a measure of contagiousness in any area (Whitford, 1948). Their values are provided in Tables 29 to 44, In most cases the Ab/F value of less than 0,05 are categorised as regular species and those with values 0.05 and more as contagious species,

Rased on the methodologies described , the-: permanent vegetation of different releves were critically analysed and described below,

W'est Coast tropical evergreen forest (Table 29)

The releve chosen at Panthanthodu is situated at an altitude of 850 m, and the existing records show that it has not been much disturbed, Some minor disturbances along the roadsides have taken place recently due to the construction of a road to Silent Valley, As the area receives an annual rainfall of over 4,000 mm, It supports a wet evergreen type of vegetation and the community has an association of Cullenia-Myristica-Palaquium, It consists of 34 species with a minimum of 6 and a maximum of 56 individual species in a quadrat,

Highly frequent species observed are Cullenia exarillata, Myristica dactyloides, Palaquium eillipticum, Agrostistachys meeboldii, Gomphandra tetrandra, Hydnocarpus laurifolia, Holigarna arnottiana, Mesua ferrea and Actinodaphne malabarica,

TABLE 29

Name of the Place: Panthanthodu (Evergreen, undisturbed forest)

No. of quadrats: 25 Size of the Plot: 50 x 50 m.

Name of species	No. of quadrats of occurrence	Total No. of species	(D)	(%F)	(Ab)	(RD)	(RF)	(RAb)	(IVI)	Ab/F
1	2	3	4	5	6	7	8	9	10	11
Cullenia exarillata	25	142	5.68	100	5.68	25.04	10.12	10.15	45.31	0.06
Myristica dactyloides	21	60	2.40	84	2.86	10.58	8.50	5.11	24.19	0.03
Palaquium ellipticum	19	59	2.32	76	3.05	10.41	7.69	5.45	23.55	0.04
Agrostistachys meeboldii	20	47	1.88	80	2.35	8.29	8.10	4.20	20.59	0.03
Gomphandra tetrandra	17	34	1.36	68	2.00	6.00	6.88	3.57	16.45	0.03
Aglaia anamallayana	14	31	1.24	56	2.21	5.47	5.69	3.95	15.09	0.04
Garcinia morella	15	28	1.12	60	1.87	4.94	6.07	3.34	14.37	0.03
Hydnocarpus laurifolia	12	23	0.92	48	1.92	4.06	4.86	3.43	12.35	0.04
Holigarna arnottiana	13	22	0.88	52	1.69	3.88	5.26	3.02	12.16	0.03
Mesua ferrea	12	16	0.64	48	1.33	2.82	4.86	2.38	10.06	0.03
Actinodaphne malabarica	10	14	0.56	40	1.40	2.47	4.05	2.50	9.02	0.04
Euphoria longana	7	11	0.44	28	1.57	1.94	2.83	2.81	7.58	0.06
Memecylon malabaricum	5	9	0.36	20	1.80	1.59	2.02	3.22	6.83	0.09
Diospyros pruriens	4	8	0.32	16	2.00	1.41	1.62	3.57	6.60	0.13
Isonandra stocksii	2	5	0.20	8	2.50	0.88	0.81	4.47	6.16	0.31
Flacourtia indica	4	6	0.24	16	1.50	1.06	1.62	2.68	5.36	0.09
Euonymus indicus	6	6	0.24	24	1.00	1.06	2.43	1.79	5.28	0.04
Knema attenuata	5	6	0.24	20	1.20	1.06	2.02	2.14	5.22	0.06
Cinnamomum macrocarpum	5	6	0.24	20	1.20	1.06	2.02	2.14	5.22	0.06
Artocarpus heterophylla	5	5	0.20	20	1.00	0.88	2.02	1.79	4.69	0.05
Jambosa munroii	1	2	0.08	4	2.00	0.35	0.40	3.57	4.32	0.50
Mallotus philippinensis	3	4	0.16	12	1.33	0.71	1.21	2.38	4.30	0.11
Elaeocarpus tuberculatus	4	4	0.16	16	1.00	0.71	1.62	1.79	4.12	0.06
Persea macrantha	4	4	0.16	16	1.00	0.71	1.62	1.79	4.12	0.06
Calophyllum apetalum	2	3	0.12	8	1.50	0.53	0.81	2.62	4.02	0.19
Croton malabaricus	2	2	0.08	8	1.00	0.35	0.81	1.79	2.95	0.13

Contd....

TABLE 29 (Contd....)

1	2	3	4	5	6	7	8	9	10	11
Cryptocarya lawsonii	2	2	0.08	8	1.00	0.35	0.81	1.79	2.95	0.13
Psychotria nigra	2	2	0.08	8	1.00	0.35	0.81	1.79	2.95	0.13
Dysoxylum malabaricum	1	1	0.04	4	1.00	0.18	0.40	1.79	2.37	0.25
Mangifera indica	1	1	0.04	4	1.00	0.18	0.40	1.79	2.37	0.25
Prunus zeylanica	1	1	0.04	4	1.00	0.18	0.40	1.79	2.37	0.25
Turpinia malabarica	1	1	0.04	4	1.00	0.18	0.40	1.79	2.37	0.25
Evodia lunu-ankenda	1	1	0.04	4	1.00	0.18	0.40	1.79	2.37	0.25
Pavetta sp.	1	1	0.04	4	1.00	0.18	0.40	1.79	2.37	0.25

Maturity Index = 29.06

The highest abundance and density has been recorded in the case of Cullenia exarillata. Species of rare occurrence are Dysoxylum malabaricum, Prunus zeylanica, Turpinia malabarica, Evodia lunu-ankenda and Payetta sp.

Species which show regularity in distribution are Myristica dactyloides, Agrostistachys meeboldii, Palaquium indicum, Gomphandra tetrandra, Aglaia anamallayana, Garcinia morella, Hydnocarpus laurifolia, Holigarna arnottiana, Mesua ferrea and Actinodaphne malabarica with an Ab/F value of 0.05 or less.

Prominant contagious species are Diospyros pruriens, Isonandra stocksii, Jambosa munroii, Mallotus philippinensis, Cryptocarya lawsonii, Calophyllum apetalum, Persea macrantha, Elaeocarpus tuberculatus, Cinnamomum macrocarpum, Euphoria longana, Dysoxylum malabaricum, Turpinia malabarica and a few others.

The comparatively high density, frequency and abundance values of Cullenia exarillata may be explained by their profuse regeneration in the area.

The IVI ranges from 2.37 to 45.31 and the MI is 29.06. The vegetation, but for the frequency class (E) is homogenous.

Regarding the regeneration pattern it is worth noting that Cullenia exarillata, Myristica dactyloides and Palaquium ellipticum regenerate profusely. Others show a lesser capacity.

The ground flora is very sparse and is made up of Apama siliquosa, Chloranthus brachystachyus, Costus speciosus, Calanthe masuca, Elatteria cardamomum, Lasianthus ciliatus and Xyris schoenoides of which excepting Apama siliquosa which is frequent the rest are sparsely distributed.

West Coast semi-evergreen forest (Table 30 & 31)

The area chosen for study were, Kurukkankundu (a relatively undisturbed area) and Manthampotti (a partially disturbed area) both of them in the vested forests. A portion of the area near Manthampotti is presently being prepared for raising cardamomum. While the association at Kurukkankundu is made up of Mesua-Diospyros - Macaranga, at Manthampotti it comprises of Scolopia - Artocarpus - Flacourtia.

The community at Kurukkankundu includes 20 species in all with a minimum of 9 and a maximum of 19 species per quadrat. Species like Mesua ferrea, Canthium dicoccum, Rapanea thwaitesii and Acronychia pedunculata are highly frequent in the area while Calophyllum apetalum, Cullenia exarillata, Elaeocarpus tuberculatus, Holigarna arnottiana, Mallotus philippinensis, Nothapodytes foetida, Palaquium ellipticum and Phoebe cathia are of rare occurrence.

TABLE 30

Name of the Place: Kurukkankundu (Semi-evergreen, undisturbed forest)

No. of quadrats: 5 Size of the Plot: 50 x 10 m.

Name of species	No. of quadrats of occurr-ence	Total No. of species	(D)	(%F)	(Ab)	(RD)	(RF)	(RAb)	(IVI)	Ab/F
1	2	3	4	5	6	7	8	9	10	11
Mesua ferrea	5	16	3.20	100	3.20	25.81	14.71	9.84	50.36	0.03
Diospyros pruriens	2	11	2.20	40	5.50	17.74	5.88	16.91	40.53	0.14
Macaranga peltata	1	4	0.80	20	4.00	6.45	2.94	12.30	21.69	0.20
Canthium dicoccum	3	4	0.80	60	1.33	6.45	8.82	4.09	19.36	0.02
Grewia tiliaefolia	2	4	0.80	40	2.00	6.45	5.88	6.15	18.48	0.05
Rapanea thwaitesii	3	3	0.60	60	1.00	4.84	8.82	3.07	16.73	0.02
Acronychia pedunculata	3	3	0.60	60	1.00	4.84	8.82	3.07	16.73	0.02
Gomphandra tetrandra	2	3	0.60	40	1.50	4.84	3.88	4.61	13.33	0.04
Myristica dactyloides	1	2	0.40	20	2.00	3.23	2.94	6.15	12.32	0.10
Euphoria longana	2	2	0.40	40	1.00	3.23	5.88	3.07	12.18	0.03
Calophyllum apetalum	1	1	0.20	20	1.00	1.61	2.94	3.07	7.62	0.05
Cullenia exarillata	1	1	0.20	20	1.00	1.61	2.94	3.07	7.62	0.05
Elaeocarpus tuberculatus	1	1	0.20	20	1.00	1.61	2.94	3.07	7.62	0.05
Mallotus philippinensis	1	1	0.20	20	1.00	1.61	2.94	3.07	7.62	0.05
Holigarna arnottiana	1	1	0.20	20	1.00	1.61	2.94	3.07	7.62	0.05
Nothapodytes foetida	1	1	0.20	20	1.00	1.61	2.94	3.07	7.62	0.05
Memecylon malabaricum	1	1	0.20	20	1.00	1.61	2.94	3.07	7.62	0.05
Palaquium ellipticum	1	1	0.20	20	1.00	1.61	2.94	3.07	7.62	0.05
Phoebe cathia	1	1	0.20	20	1.00	1.61	2.94	3.07	7.62	0.05
Psychotria nigra	1	1	0.20	20	1.00	1.61	2.94	3.07	7.62	0.05

Maturity Index = 34.00

The species which show regular distribution are Mesua ferrea, Canthium dicoccum, Grewia tiliaefolia, Rapanea thwaitesii and Acronychia pedunculata and those that are contagious are Diospyros pruriens, Myristica dactyloides and Macaranga peltata.

The IVI ranges from 7.62 to 50.36 and the MI value is 34. The vegetation is homogenous and the regeneration status is very poor.

Predominant lianas encountered in this releve are Ancistrocladus heyneanus, Erythropalum populifolium, Smilax zeylanica, Argyreia sp. and Jasminum sp. But for Erythropalum populifolium the rest of them are scarce in the area.

The herbaceous vegetation is feebly represented with Costus speciosus, Elatostemma lineolatum and a species of Zingiberaceae (all of them scarce) and Elettaria cardamomum which is frequent.

A resurvey of the vegetation after the rainy season showed the occurrence of the following species which were not encountered before : Urena lobata, Sida rhomboidea, Tragia involucrata, Clausena willdenovii, Atylosia lineata and Gymnostachyum canescens.

The community at Manthampotti includes 30 species in all with a minimum of 3 and a maximum of 11 species in a quadrat. Most frequent ones are Scolopia crenata, Artocarpus hirsuta, Flacourtia montana, Xanthophyllum flavescens and

Knema attenuata. An increase in the percentage of low frequency class is very much noticeable. The main constituents among them are Goniothalamus cardiopetalus, Olea dioica, Artocarpus heterophyllus, Terminalia alata, Elaeocarpus tuberculatus, Cullenia exarillata, Dillenia pentagyna, Persea macrantha, Canarium strictum and Acronychia pedunculata all of which are contagious in nature.

The IVI ranges from 6.72 to 28.93 and the MI is 16.33. When the MI figure is compared with Kurukkankundu it is obvious that the latter is a more mature community. Likewise, the wide range of IVI at Kurukkankundu suggests an overall quantitative development than at Manthampotti.

The regeneration status like the former is poor.

There is a subtle difference with regard to lianas. Species common to evergreen and deciduous forests are encountered. Those common to the evergreen forest type are Clematis munroii, Connarus sclerocarpus, Cayratia pedata, Rubia cordifolia, Derris sp., Piper sp. and Stephania japonica. Species of deciduous nature are Atylosia albicans, Abrus precatorius, Grewia rhamnifolia, Ichnocarpus frutescens, Daemia extensa, Tylophora indica and Ziziphus rugosa.

TABLE 31

Name of the Place: Manthampotti (Semi-evergreen, partially disturbed forest)

No. of quadrats: 20 Size of the Plot: 50 x 20 m.

Name of species	No. of quadrats of occurrence	Total No. of species	(D)	(%F)	(Ab)	(RD)	(RF)	(RAb)	(IVI)	Ab/F
1	2	3	4	5	6	7	8	9	10	11
Scolopia crenata	5	8	0.80	50	1.60	14.04	10.20	4.69	28.93	0.03
Artocarpus hirsuta	5	6	0.60	50	1.20	10.53	10.20	3.52	24.25	0.02
Flacourtia montana	4	4	0.40	40	1.00	7.02	8.16	2.93	18.11	0.03
Xanthophyllum flavescens	3	4	0.40	30	1.33	7.02	6.12	3.90	17.04	0.04
Knema attenuata	3	3	0.30	30	1.00	5.26	6.12	2.93	14.31	0.03
Clerodendrum infortunatum	1	2	0.20	10	2.00	3.51	2.04	5.86	11.41	0.20
Grewia sp.	1	2	0.20	10	2.00	3.51	2.04	5.86	11.41	0.20
Flacourtia indica	1	2	0.20	10	2.00	3.51	2.04	5.86	11.41	0.20
Madhuca neeriifolia	2	2	0.20	20	1.00	3.51	4.08	2.93	10.52	0.05
Alstonia scholaris	2	2	0.20	20	1.00	3.51	4.08	2.93	10.52	0.05
Holigarna arnottiana	2	2	0.20	20	1.00	3.51	4.08	2.93	10.52	0.05
Cyclostemon malabaricus	2	2	0.20	20	1.00	3.51	4.08	2.93	10.52	0.05
Goniothalamus cardiopetalus	1	1	0.10	10	1.00	1.75	2.04	2.93	6.72	0.10
Nothopodytes foetida	1	1	0.10	10	1.00	1.75	2.04	2.93	6.72	0.10
Litsea stocksii	1	1	0.10	10	1.00	1.75	2.04	2.93	6.72	0.10
Helectres isora	1	1	0.10	10	1.00	1.75	2.04	2.93	6.72	0.10
Canarium strictum	1	1	0.10	10	1.00	1.75	2.04	2.93	6.72	0.10
Memecylon malabaricum	1	1	0.10	10	1.00	1.75	2.04	2.93	6.72	0.10
Terminalia alata	1	1	0.10	10	1.00	1.75	2.04	2.93	6.72	0.10
Phoebe cathia	1	1	0.10	10	1.00	1.75	2.04	2.93	6.72	0.10
Jambosa mundagam	1	1	0.10	10	1.00	1.75	2.04	2.93	6.72	0.10
Ixora sp.	1	1	0.10	10	1.00	1.75	2.04	2.93	6.72	0.10

Contd....

TABLE 31 (Contd....)

1	2	3	4	5	6	7	8	9	10	11
Maesa perrottetiana	1	1	0.10	10	1.00	1.75	2.04	2.93	6.72	0.10
Persea macrantha	1	1	0.10	10	1.00	1.75	2.04	2.93	6.72	0.10
Achronychia pedunculata	1	1	0.10	10	1.00	1.75	2.04	2.93	6.72	0.10
Dillenia pentagyna	1	1	0.10	10	1.00	1.75	2.04	2.93	6.72	0.10
Olea dioica	1	1	0.10	10	1.00	1.75	2.04	2.93	6.72	0.10
Cullenia exarillata	1	1	0.10	10	1.00	1.75	2.04	2.93	6.72	0.10
Elaeocarpus tuberculatus	1	1	0.10	10	1.00	1.75	2.04	2.93	6.72	0.10
Artocarpus heterophyllus	1	1	0.10	10	1.00	1.75	2.04	2.93	6.72	0.10

Maturity Index = 16.33

The herbaceous stratum is represented by Apama siliquosa, Costus speciosus, Chloranthus brachystachys, Calanthe masuca, Elatostemma lineolatum and Hedychium sp.

South Indian Moist deciduous forest (Tables 32 to 37)

In all, six releves were laid out in this forest type viz. Pottikkal II and Chindakki II (representing undisturbed vegetation); Pottikkal I, Chindakki I and Vandampara (representing partially disturbed vegetation) and Thadikkundu (representing partially disturbed vegetation after shifting cultivation.

The various types of associations recorded in these communities are as follows:

a) Pottikkal II:- Helecteres - Acacia - Schleichera
b) Chindakki II:- Terminalia - Grewia - Pterocarpus
c) Pottikkal I:- Pavetta - Terminalia - Randia
d) Chindakki I:- Helicteres - Terminalia - Grewia
e) Vandampara:- Grewia tiliaefolia consociation
f) Thadikkundu:- Clerodendrum - Dalbergia

While the vegetation of Pottikkal I, Pottikkal II and Thadikkundu (which are all under reserved forests) consists of large number of species (23, 29 and 23 species respectively) those of the other three are far less.

The community at Pottikkal II which consists of an association of Helicteres - Acacia - Schleichera is made up of the following species which are highly frequent:

TABLE 32

Name of the Place: Pottikkal II (Moist deciduous, undisturbed forest)

No. of quadrats: 10 Size of the Plot: 50 x 20 m.

Name of species	No. of quadrats of occurr-ence	Total No. of species	(D)	(%F)	(Ab)	(RD)	(RF)	(RAb)	(IVI)	Ab/F
Helicteres isora	9	56	5.60	90	6.22	32.37	13.43	13.92	59.72	0.07
Acacia intsia	8	51	5.10	80	6.38	29.48	11.94	14.28	55.70	0.08
Schleichera oleosa	6	13	1.30	60	2.17	7.51	8.96	4.86	21.33	0.04
Lagerstroemia microcarpa	5	7	0.70	50	1.40	4.05	7.46	3.13	14.64	0.03
Wrightia tinctoria	4	5	0.50	40	1.25	2.89	5.97	2.80	11.66	0.03
Dalbergia latifolia	4	5	0.50	40	1.25	2.89	5.97	2.80	11.66	0.03
Olea dioica	2	4	0.40	20	2.00	2.31	2.99	4.48	9.78	0.10
Terminalia bellerica	2	3	0.30	20	1.50	1.73	2.99	3.36	8.05	0.08
Grewia laevigata	2	3	0.30	20	1.50	1.73	2.99	3.36	8.05	0.08
Erythrina subumbrans	1	2	0.20	10	2.00	1.16	1.49	4.48	7.13	0.20
Randia brandisii	2	2	0.20	20	1.00	1.16	2.99	2.24	6.39	0.05
Sterculia alata	2	2	0.20	20	1.00	1.16	2.99	2.24	6.39	0.05
Pavetta indica	2	2	0.20	20	1.00	1.16	2.99	2.24	6.39	0.05
Clausena indica	2	2	0.20	20	1.00	1.16	2.99	2.24	6.39	0.05
Mallotus philippinensis	2	2	0.20	20	1.00	1.16	2.99	2.24	6.39	0.05
Isonandra sp.	1	1	0.10	10	1.00	0.58	1.49	2.24	4.31	0.10
Terminalia alata	1	1	0.10	10	1.00	0.58	1.49	2.24	4.31	0.10
Grewia tiliaefolia	1	1	0.10	10	1.00	0.58	1.49	2.24	4.31	0.10
Piliostigma racemosa	1	1	0.10	10	1.00	0.58	1.49	2.24	4.31	0.10
Trema orientalis	1	1	0.10	10	1.00	0.58	1.49	2.24	4.31	0.10
Achronychia pedunculata	1	1	0.10	10	1.00	0.58	1.49	2.24	4.31	0.10

Contd....

TABLE 32 (Contd....)

1	2	3	4	5	6	7	8	9	10	11
Ixora sp.	1	1	0.10	10	1.00	0.58	1.49	2.24	4.31	0.10
Toona ciliata	1	1	0.10	10	1.00	0.58	1.49	2.24	4.31	0.10
Terminalia paniculata	1	1	0.10	10	1.00	0.58	1.49	2.24	4.31	0.10
Alstonia scholaris	1	1	0.10	10	1.00	0.58	1.49	2.24	4.31	0.10
Nothopodytes foetida	1	1	0.10	10	1.00	0.58	1.49	2.24	4.31	0.10
Cassia fistula	1	1	0.10	10	1.00	0.58	1.49	2.24	4.31	0.10
Madhuca neerifolia	1	1	0.10	10	1.00	0.58	1.49	2.24	4.31	0.10
Allophylus serratus	1	1	0.10	10	1.00	0.58	1.49	2.24	4.31	0.10

Maturity Index = 23.10

Lagerstroemia microcarpa, Wrightia tinctoria and Dalbergia latifolia which are all characteristic of the moist deciduous forests. Species like Terminalia alata, Grewia tiliaefolia, Piliostigma racemosa, Alstonia scholaris, Allophylus serratus, Madhuca neerifolia, Sterculia alata, Terminalia bellerica, Olea dioica and Mallotus philippinensis are of rare occurrence.

Species which show regular distribution are Dalbergia latifolia, Wrightia tinctoria, Schleichera oleosa and Lagerstroemia microcarpa. Almost all the others show a contagious distribution.

IVI ranges from 4.31 to 59.72 and the MI value is 23.1. The vegetation is homogenous.

Dendrocalamus strictus regrowth was found in abundance.

The lianas are dominated by Spatholobus roxburghii, Clematis gouriana, Ventilago bombaiensis, Atylosia scarabeoides, Cardiospermum helicacabum and Smilax sp.

The ground flora is featured by the presence of Atylosia gangetica, Ophiopogon intermedius, Haplanthus verticillaris, Begonia sp., Rungia sp., Abutilon indicum and Solanum sp.

A resurvey of the vegetation shows the following new entrants:

Oplismenus compositus, Pavonia procumbens, Andrographis paniculata, Desmodium gangeticum, Knoxia corymbosa, Indigofera sp., Justicia simplex, Acanthospermum hispidum, Chrozophora

rottlerii, Trichodesma indicum, Vernonia monosis and Achyranthes bidendata.

The community at Chindakki II consists of 12 species in all with Terminalia paniculata, Grewia tiliaefolia and Piliostigma racemosa showing the highest frequency and regularity in distribution. Species of low frequency values are those of Albizia chinensis, Dalbergia latifolia, Lagerstroemia microcarpa, Mallotus philippinensis, Tectona grandis, Pterocarpus marsupium and Acacia instia. Albizia chinensis alone shows a contagious distribution.

The IVI ranges from 13.33 to 57.46 and the MI value is 43.33. The vegetation is homogenous like the former thus indicating the undisturbed nature of the area.

Lianas are represented by Spatholobus roxburghii and Entada scandens both of them true to moist deciduous forests.

The herbaceous flora is quite rich and prominant among them are Sida carpinifolia, Elatostemma sp., Oplismenus compositus, Abutilon indicum, Desmodium latifolium, Urena lobata, Asparagus racemosus, Polygonum chinense, Panicum sp., Euphorbia sp., Hyptis suaveolens and Knoxia corymbosa.

The resurvey should the presence of following species: Triumfetta rhomboidea, Blainvillea rhomboidea, Justicia simplex, Vernonia cinerea and Rhynchosia suaveolens and the seedlings of Maesa perrottetiana.

TABLE 33

Name of the Place: Chindakki II (Moist deciduous, undisturbed forest)

No. of quadrats: 5 Size of the Plot: 50 x 10 m.

Name of species	No. of quadrats of occurr-ence	Total No. of species	(D)	(%F)	(Ab)	(RD)	(RF)	(RAb)	(IVI)	Ab/F
1	2	3	4	5	6	7	8	9	10	11
Terminalia paniculata	5	9	1.80	100	1.80	26.47	19.23	11.76	57.46	0.02
Grewia tiliaefolia	5	5	1.00	100	1.00	14.71	19.23	6.54	40.48	0.01
Pterocarpus marsupium	2	4	0.80	40	2.00	11.76	7.69	13.07	32.52	0.05
Piliostigma racemosa	3	3	0.60	60	1.00	8.82	11.54	6.54	26.90	0.02
Emblica officinalis	2	3	0.60	40	1.00	8.82	7.69	9.80	26.31	0.04
Albizia chinensis	1	2	0.40	20	2.00	5.88	3.85	13.07	22.80	0.10
Dalbergia latifolia	2	2	0.40	40	1.00	5.88	7.69	6.54	20.11	0.03
Lagerstroemia microcarpa	2	2	0.40	40	1.00	5.88	7.69	6.54	20.11	0.03
Mallotus philippinensis	1	1	0.20	20	1.00	2.94	3.85	6.54	13.33	0.05
Garcinia sp.	1	1	0.20	20	1.00	2.94	3.85	6.54	13.33	0.05
Tectona grandis	1	1	0.20	20	1.00	2.94	3.85	6.54	13.33	0.05
Acacia intsea	1	1	0.20	20	1.00	2.94	3.85	6.54	13.33	0.05

Maturity Index = 43.33

The vegetation at Pottikkal I, showing an association of Pavetta-Terminalia-Randia differs structurally from that of Pottikkal II. This area has been subjected to heavy disturbance and the flora and physiognomy are altered. The highly frequent species are Randia brandisii, Dalbergia latifolia and Schleichera oleosa. It is of interest to note that the species of low frequency class far outweigh in numerical strength. Prominant among them, which are typical of moist deciduous forests are Terminalia bellerica, Grewia tiliaefolia, sterculia alata, Pterocarpus marsupium, Kydia calycina and Celtis tetrandra.

Some of the species like Erythrina subumbrans, Mallotus philippinensis, Piliostigma racemosa, Allophylus serratus and Acronychia pedunculata which are encountered in Pottikkal II are absent here.

Species which show a remarkably regular distribution are Randia brandisii, Dalbergia latifolia and Schleichera oleosa while those that are contagious are Pavetta indica, Terminalia paniculata, Anogeissus latifolia, Olea dioica and Memecylon sp.

The IVI varies from 5.13 to 38.01 and the MI value is 29.57. The vegetation is heterogenous.

Besides the commonest lianas like Spatholobus roxburghii, Ventilago bombaiensis and Bauhinia phoenicea, new records for this place are Cissampelos pareira, Mucuna pruriens and Thunbergia fragrans. These, with the following herbaceous

TABLE 34

Name of the Place: Pottikkal I (Moist deciduous, partially disturbed forest)

No. of quadrats: 5 Size of the Plot: 50 x 10 m.

Name of species	No. of quadrats of occurr-ence	Total No. of species	(D)	(%F)	(Ab)	(RD)	(RF)	(RAb)	(IVI)	Ab/F
1	2	3	4	5	6	7	8	9	10	11
Pavetta indica	1	16	3.20	20	16.00	14.29	2.94	20.78	38.01	0.80
Terminalia paniculata	1	12	2.40	20	12.00	10.71	2.94	15.59	29.24	0.60
Randia brandisii	4	12	2.40	80	3.00	10.71	11.76	3.90	26.37	0.04
Anogeissus latifolia	2	11	2.20	40	5.50	9.82	5.88	7.14	22.84	0.14
Memecylon sp.	2	10	2.00	40	5.00	8.93	5.88	6.49	21.30	0.12
Olea dioica	2	9	1.80	40	4.50	8.04	8.82	5.84	19.76	0.12
Dalbergia latifolia	3	7	1.40	60	2.33	6.25	8.82	3.03	18.10	0.04
Schleichera oleosa	3	5	1.00	60	1.66	4.46	5.88	2.16	15.44	0.03
Isonandra stocksii	2	6	1.20	40	3.00	5.35	2.94	3.90	15.13	0.07
Sarcocephalus missionis	1	4	0.80	20	4.00	3.57	2.94	5.20	11.71	0.20
Cassia fistula	1	4	0.80	20	4.00	3.57	2.94	5.20	11.71	0.20
Terminalia bellerica	1	3	0.60	20	3.00	2.68	2.94	3.90	9.52	0.15
Grewia tiliaefolia	1	3	0.60	20	3.00	2.68	2.94	3.90	9.52	0.15
Sterculia alata	1	1	0.20	20	1.00	0.89	2.94	1.30	5.13	0.05
Alstonia scholaris	1	1	0.20	20	1.00	0.89	2.94	1.30	5.13	0.05
Pterocarpus marsupium	1	1	0.20	20	1.00	0.89	2.94	1.30	5.13	0.05
Kydia calycina	1	1	0.20	20	1.00	0.89	2.94	1.30	5.13	0.05
Cinnamomum sp.	1	1	0.20	20	1.00	0.89	2.94	1.30	5.13	0.05
Celtis tetranda	1	1	0.20	20	1.00	0.89	2.94	1.30	5.13	0.05
Alstonia venenata	1	1	0.20	20	1.00	0.89	2.94	1.30	5.13	0.05
Artocarpus heterophyllus	1	1	0.20	20	1.00	0.89	2.94	1.30	5.13	0.05
Elaeocarpus tuberculatus	1	1	0.20	20	1.00	0.89	2.94	1.30	5.13	0.05
Myristica dactyloides	1	1	0.20	20	1.00	0.89	2.94	1.30	5.13	0.05

Maturity Index = 29.57

species like Achyranthes aspera, Artemesia parviflora, Eupatorium odoratum, Kalanchoe floribunda, Sida rhomboidea, Triumfetta rhomboidea, Trichodesma indicum, Urena lobata and Vernonia cinerea are indicators of disturbance.

The vegetation at Chindakki I resembles very much to that of Chindakki II in respect of the dominant community. Common species to both these localities are Terminalia paniculata, Grewia tiliaefolia, Dalbergia latifolia, Albizia chinensis, Piliostigma racemosa and Emblica officinalis.

Species of high frequency values are represented by Helicteres isora, Terminalia bellerica, Grewia tiliaefolia and Albizia chinensis while those of low frequency values are Piliostigma racemosa, Emblica officinalis, Ficus sp., and Aglaia anamallayana. Excepting Piliostigma racemosa which is contagious in nature the rest of them show a regular distribution. It is of importance to point out here that species like Acacia intsea, Lagerstroemia microcarpa, Mallotus philippinensis and Pterocarpus marsupium which characterised the stabilised community at Chindakki II are absent here.

The IVI ranges from 10.41 to 52.32 and there is no appreciable difference with Chindakki II. Similarly, the MI value which is 48.33 is more or less the same as that Chindakki II and hence both these areas are more or less in the same status regarding their succession. The vegetation is heterogenous.

There is no appreciable difference regarding the lianas and herbs.

The community at Vandampara differs from all the above four in Grewia tiliaefolia forming an unique consociation. This alone shows the high frequency value and uniformly regular in distribution. It is floristically very poor with a total of six species only. Piliostigma racemosa, Acacia intsea, Albizia chinensis, Helicteres isora and Ficus sp. are the other constituents of the area and are of rare occurrence. The range of IVI is very wide, 34.25 to 128.70 and the MI value is 30.0. This high IVI value of Grewia tiliaefolia is not shared by any other species in the moist deciduous forests investigated. Hence, the better adaptation of Grewia tiliaefolia can be exploited, taking into account that perhaps this area is most suitable for this species. The vegetation is heterogenous being a disturbed area.

Compared with the other areas of the moist deciduous forests the lianas pose an enormous complexity. Most of them like Leptadenia reticulata, Mucuna pruriens, Cardiospermum helicacabum, Pachygone ovata, Combretum ovalifolium and Phaseolus trilobus show their affinity to dry deciduous forests. Typical moist deciduous species are found to be absent here.

The vegetation of Thadikkundu comprises most of the deciduous species mentioned in the earlier ones. This area was subjected to shifting cultivation in the past and presently

TABLE 36

Name of the Place: Vandampara (Moist deciduous, partially disturbed forest)

No. of quadrats: 5 Size of Plot: 50 x 10 m.

Name of species	No. of quadrats of occurrence	Total No. of species	(D)	(%F)	(Ab)	(RD)	(RF)	(RAb)	(IVI)	Ab/F
1	2	3	4	5	6	7	8	9	10	11
Grewia tiliaefolia	4	7	1.40	80	1.75	58.33	44.44	25.93	128.70	0.02
Piliostigma racemosa	1	1	0.20	20	1.00	8.33	11.11	14.81	34.25	0.05
Acacia intsea	1	1	0.20	20	1.00	8.33	11.11	14.81	34.25	0.05
Albizia chinensis	1	1	0.20	20	1.00	8.33	11.11	14.81	34.25	0.05
Helectres isora	1	1	0.20	20	1.00	8.33	11.11	14.81	34.25	0.05
Ficus sp.	1	1	0.20	20	1.00	8.33	11.11	14.81	34.25	0.05

Maturity Index = 30.00

left as fallow, with the result the bushy vegetation that has developed is of secondary origin. It is no more than 4 metres in height and characterised by a complex of life forms. Lantana camara, Saccharum spontaneum and Clerodendrum infortunatum occur in abundance. The structure of the vegetation is also considerably altered by the presence of the following species which are heliophilous:

Pithecellobium monadelphum, Buchanania lanzan, Maesa perrottetiana, Morinda citrifolia, Flacourtia indica and Derris indica. A minimum of 6 and a maximum of 30 species were recorded in a quadrat. Among the 23 species recorded only Grewia tiliaefolia shows a regular distribution. Highly frequent species are Clerodendrum infortunatum and Dalbergia latifolia.

Suffice it to say, that these two species form the constituents of the dominant community, yet, they are contagious with regard to their distribution. Species like Buchanania lanzan, Canthium dicoccum, Trema orientalis, Tectona grandis, Piliostigma racemosa, Lagerstroemia microcarpa, Helecteres isora and others are of rare occurrence. The very presence of these species with the constituents of the dominant community suggests that this area must have supported in the past a moist deciduous type of forest.

The IVI has a wider range from 5.04 to 88.61 and the MI is 20.87. The vegetation shows a tendency towards homogeneity although it does not strictly follow Raunkiaer's pattern.

TABLE 37

Name of the Place: **Thadikkundu** (Moist deciduous, after shifting cultivation)

No. of quadrats: 10 Size of Plot: 50 x 20 m.

Name of species	No. of quadrats of occurrence	Total No. of species	(D)	(%F)	(Ab)	(RD)	(RF)	(RAb)	(IVI)	Ab/F
1	2	3	4	5	6	7	8	9	10	11
Clerodendrum infortunatum	10	87	8.70	100	8.70	46.77	20.83	21.01	88.61	0.09
Dalbergia latifolia	9	63	6.30	90	7.00	33.87	18.75	16.91	69.53	0.07
Grewia tiliaefolia	5	6	0.60	50	1.20	3.23	10.42	2.90	16.55	0.02
Gomphandra tetrandra	2	3	0.30	20	1.50	1.61	4.17	3.62	9.40	0.08
Pithecellobium monadelphum	2	3	0.30	20	1.50	1.61	4.17	3.62	9.40	0.08
Maesa perrottetiana	2	3	0.30	20	1.50	1.61	4.17	3.62	9.40	0.08
Artocarpus hirsuta	1	2	0.20	10	2.00	1.08	2.08	4.83	7.99	0.20
Buchanania lanzan	1	2	0.20	10	2.00	1.08	2.08	4.83	7.99	0.20
Canthium dicoccum	1	2	0.20	10	2.00	1.08	2.08	4.83	7.99	0.20
Cinnamomum sp.	2	2	0.20	20	1.00	1.08	4.17	2.42	7.67	0.05
Trema orientalis	1	1	0.10	10	1.00	0.54	2.08	2.42	5.04	0.10
Artocarpus heterophyllus	1	1	0.10	10	1.00	0.54	2.08	2.42	5.04	0.10
Tectona grandis	1	1	0.10	10	1.00	0.54	2.08	2.42	5.04	0.10
Litsea sp.	1	1	0.10	10	1.00	0.54	2.08	2.42	5.04	0.10
Ficus sp.	1	1	0.10	10	1.00	0.54	2.08	2.42	5.04	0.10
Piliostigma racemosa	1	1	0.10	10	1.00	0.54	2.08	2.42	5.04	0.10
Morinda citrifolia	1	1	0.10	10	1.00	0.54	2.08	2.42	5.04	0.10
Mallotus philippinensis	1	1	0.10	10	1.00	0.54	2.08	2.42	5.04	0.10
Derris indica	1	1	0.10	10	1.00	0.54	2.08	2.42	5.04	0.10
Flacourtia indica	1	1	0.10	10	1.00	0.54	2.08	2.42	5.04	0.10
Lagerstromia microcarpa	1	1	0.10	10	1.00	0.54	2.08	2.42	5.04	0.10
Erythrina subumbrans	1	1	0.10	10	1.00	0.54	2.08	2.42	5.04	0.10
Helecteres isora	1	1	0.10	10	1.00	0.54	2.08	2.42	5.04	0.10

Maturity Index = 20.87

The lianas are abundant and represented by Asparagus racemosus, Ichnocarpus frutescens, Jasminum sessiliflorum, Naravelia zeylanica, Stephania wightii, ~~and~~ Similar zeylanica and Clematis gouriana.

Among the herbs Eupatorium odoratum is abundant. Barleria acuminata, Justicia simplex and Vernonia cinerea are other herbs which are fairly distributed.

After the monsoon, the following ephemerals were seen: Andrographis paniculata, Atylosia lineata, Ardisia missionis, Colebrookia oppositifolia, Hibiscus furcatus, Oplismenus compositus, Panicum sp. and Triumfetta rhomboidea.

Southern tropical dry deciduous forest (Tables 38 to 44)

As mentioned earlier, the vested forests at Attappady has been a scene of intensive human activities and the vegetation survey revealed that most of the area were once supporting a dry deciduous type of forest. Presently the dry deciduous forests are only confined to the northern part and a small portion along the east bordering Tamil Nadu. Due to lack of proper communication no releves could be chosen along the northern part and releves were selected in adjacent areas of Tamil Nadu where these forests remain undisturbed. Three areas viz. Dhandapaniyur, Koodappatty and Thuva II were selected which were more or less akin climatically, edaphically and physiographically with the vested forests of the study area.

It is seen from the Tables 38 to 40 that Euphorbia antiquorum and Albizia amara share the dominant status in two out of the three releves. The vegetation at Thuva II is characterised by the consociation of Euphorbia antiquorum while at Dhandapaniyur and Koodapatty Albizia amara shares with Helicteres isora and Euphorbia antiquorum respectively.

The vegetation of Koodapatty and Dhandapaniyur resembles very much in total number of species. The former includes altogether 25 species with a maximum of 18 and a minimum of 5 in a quadrat. Albizia amara and Euphorbia antiquorum forms the typical association. Species of rare occurrence are those of Maytenus emarginataus, Premna tomentosa, Cordia myxa, Lantana camara, Grewia aspera and Ehretia aspera. Diospyres montana, Clausena indica, Streblus asper, Sapindus emarginatus, Piliostigma racemosa, Ziziphus oenoplia and Opilia amentacea are more or less frequent.

Species showing regular distribution are Carmona retusa, Diospyros montana, Clausena indica, Streblus asper, Sapindus emarginatus, Piliostigma racemosa and Ziziplus oenoplia while those of Albizia amara, Naringi crenulata, Grewia aspera, Butea monosperma, Maytenus emarginata etc. are contagious in nature.

The IVI ranges from 5.03 to 24.79 and the MI value is 25.20. Regeneration is absent.

TABLE 38

Name of the Place: Koodappatty (Dry deciduous, undisturbed forest)

No. of quadrats: 10 Size of Plot: 50 x 20 m.

Name of species	No. of quadrats of occurr-ence	Total No. of species	(D)	(%F)	(Ab)	(RD)	(RF)	(RAb)	(IVI)	Ab/F
1	2	3	4	5	6	7	8	9	10	11
Albizia amara	3	11	1.10	30	3.67	11.11	4.76	8.92	24.79	0.12
Euphorbia antiquorum	4	11	1.10	40	2.75	11.11	6.35	6.68	24.14	0.07
Naringi crenulata	1	6	0.60	10	6.00	6.06	1.59	14.58	22.23	0.60
Carmona retusa	6	7	0.70	60	1.17	7.07	9.52	2.84	19.43	0.02
Grewia hirsuta	4	8	0.80	40	2.00	8.08	6.35	4.86	19.29	0.05
Diospyros montana	5	7	0.70	50	1.40	7.07	7.94	3.40	18.38	0.03
Clausena indica	4	5	0.50	40	1.25	5.05	6.35	3.04	14.44	0.03
Streblus asper	4	5	0.50	40	1.25	5.05	6.35	3.04	14.44	0.03
Sapindus emarginatus	4	4	0.40	40	1.00	4.04	6.35	2.43	12.82	0.03
Piliostigma recemosa	4	4	0.40	40	1.00	4.04	6.35	2.43	12.82	0.03
Ziziphus oenoplia	3	4	0.40	30	1.33	4.04	4.76	3.23	12.03	0.04
Opilia amentacea	3	4	0.40	30	1.33	4.04	4.76	3.23	12.03	0.04
Ehretia aspera	1	3	0.30	10	3.00	3.03	1.59	17.29	11.91	0.30
Atalantia monophylla	2	3	0.30	20	1.50	3.03	3.17	3.65	9.85	0.08
Scutia indica	2	3	0.30	20	1.50	3.03	3.17	3.65	9.85	0.08
Azadirachta indica	1	2	0.20	10	2.00	2.02	1.59	4.86	8.47	0.20
Capparis brevispina	2	2	0.20	20	1.00	2.02	3.17	2.43	7.62	0.05
Tarenna asiatica	2	2	0.20	20	1.00	2.02	3.17	2.43	7.62	0.05
Kydia calycina	2	2	0.20	20	1.00	2.02	3.17	2.43	7.62	0.05
Butea monosperma	1	1	0.10	10	1.00	1.01	1.59	2.43	5.03	0.10
Maytenus emarginata	1	1	0.10	10	1.00	1.01	1.59	2.43	5.03	0.10
Premna tomentosa	1	1	0.10	10	1.00	1.01	1.59	2.43	5.03	0.10
Grewia aspera	1	1	0.10	10	1.00	1.01	1.59	2.43	5.03	0.10
Cordia myxa	1	1	0.10	10	1.00	1.01	1.59	2.43	5.03	0.10
Lantana camara	1	1	0.10	10	1.00	1.01	1.59	2.43	5.03	0.10

Maturity Index = 25.20

Lianas are abundant and are principally represented by the following species:

Cardiospermum helicacabum, Cissus quadrangularis, Clitorea ternatea, Combretum ovalifolium, Ichnocarpus frutescens, Leptadaenia reticulata, Jasminum sessiliflorum, Pachygone ovata, Sarcostemma intermedium etc.

During resurvey the following species were encountered: Hibiscus micranthus, Randia malabarica, Walsura trifoliata, Argyreia cuneata, Basella alba, Puppalia lappacea, Notonia grandiflora and Flemingea sp.

The vegetation of Dhandapaniyur includes 17 species with a maximum of 9 and a minimum of 2 per quadrat. Albizia amara is associated with Helicteres isora. The presence of Manilkara hexandra, Crataeva nurvala, Flacourtia indica, Ixora arborea, Maba buxifolia and Phyllanthus polyphllus makes it slightly different in vegetational composition, when compared to Koodapatty. The rarity of Euphorbia antiquorum is striking thus indicating least disturbance to the area. But for, Albizia amara, Cochlospermum religiosum, Piliostigma racemosa and Maba buxifolia the rest of the species are contagious.

TABLE 39

Name of the Place: Dandapaniyur (Dry Deciduous, undisturbed forest)

No. of quadrats: 10 Size of the Plot: 50 x 20 m.

Name of species	No. of quadrats of occurr-ence	Total No. of species	(D)	(%F)	(Ab)	(RD)	(RF)	(RAb)	(IVI)	Ab/F
1	2	3	4	5	6	7	8	9	10	11
Albizia amara	5	6	0.60	50	1.20	15.00	14.71	6.09	35.80	0.02
Helecteres isora	3	4	0.60	40	2.00	15.00	8.82	10.15	33.97	0.07
Cochlospermum religiosum	4	3	0.40	40	1.00	10.00	11.76	5.08	26.84	0.03
Piliostigma recemosa	3	3	0.30	30	1.00	7.50	8.82	5.08	21.40	0.03
Maba buxifolia	3	3	0.30	30	1.00	7.50	8.82	5.08	21.40	0.03
Sapindus emarginatus	2	2	0.30	20	1.50	7.50	5.88	7.61	20.99	0.08
Atalantia monophylla	1	2	0.20	10	2.00	5.00	2.94	10.15	18.09	0.20
Phyllanthus polyphyllus	2	2	0.20	20	1.00	5.00	5.88	5.08	15.96	0.05
Canthium dicoccum	2	2	0.20	20	1.00	5.00	5.88	5.08	15.96	0.05
Naringi crenulata	2	2	0.20	20	1.00	5.00	5.88	5.08	15.96	0.05
Euphorbia antiquorum	1	1	0.10	10	1.00	2.50	2.94	5.08	10.52	0.10
Spondias pinnata	1	1	0.10	10	1.00	2.50	2.94	5.08	10.52	0.10
Flacortia indica	1	1	0.10	10	1.00	2.50	2.94	5.08	10.52	0.10
Maytenus emarginata	1	1	0.10	10	1.00	2.50	2.94	5.08	10.52	0.10
Ixora arborea	1	1	0.10	10	1.00	2.50	2.94	5.08	10.52	0.10
Crataeva nurvala	1	1	0.10	10	1.00	2.50	2.94	5.08	10.52	0.10
Manilkara hexandra	1	1	0.10	10	1.00	2.50	2.94	5.08	10.52	0.10

Maturity Index = 20.00

The IVI varies from 10.52 to 35.80 and the MI is 20. Thus the vegetation of Koodapatty and Dhandapaniyur occupy more or less an equal status in development. Both these areas are typically homogenous.

The vegetation of Thuva II differs a little from Thuva I in the status of the dominant species. Both these areas are adjacent to each other and are separated by the state boundaries only. Thuva I is presently being cleared by the Forest Department of Kerala for raising plantations of Eucalyptus sp. From the vegetational studies, however, it is seen that some disturbances have also taken place at Thuva II although the 'law of frequency' points towards homogeneity. The maximum number of species ranges from 2 to 3. While Thuva II is represented by a consociation of Euphorbia antiquorum Thuva I is featured by Albizia amara both being typical of drier areas. The presence of Atalantia monophylla and Crataeva nurvala at Thuva II indicates that this area has not undergone as much disturbance as Thuva I. This is substantiated by the relatively high MI value exhibited at Thuva II. Species like Euphorbia antiquorum, Albizia amara and Flacourtia indica are regular in distribution while Atlanantia monophylla and Crataeva nurvala tend to be contagious.

Lianas and ephemerals are almost the same as those of Dhandapaniyur and Koodapatty excepting that the following which characterised the stabilized communities are found to be absent:

TABLE 40

Name of the Place: Thuva II (Dry Deciduous, undisturbed forest)

No. of quadrats: 5 Size of Plot: 50 x 10 m.

Name of species	No. of quadrats of occurrence	Total No. of species	(D)	(%F)	(Ab)	(RD)	(RF)	(RAb)	(IVI)	Ab/F
1	2	3	4	5	6	7	8	9	10	11
Euphorbia antiquorum	5	7	1.40	100	1.40	77.78	71.43	41.18	190.39	0.01
Atalantia monophylla	1	1	0.20	20	1.00	11.11	14.29	29.41	54.81	0.05
Crataeva nurvala	1	1	0.20	20	1.00	11.11	14.29	29.41	54.81	0.05

Maturity Index = 46.67

TABLE 41

Name of Place: Thuva I (Dry Deciduous, partially disturbed forest)

No. of quadrats: 5 Size of Plot: 50 x 10 m.

Name of species	No. of quadrats of occurrence	Total No. of species	(D)	(%F)	(Ab)	(RD)	(RF)	(RAb)	(IVI)	Ab/F
1	2	3	4	5	6	7	8	9	10	11
Albizia amara	3	6	1.20	60	2.00	75.00	75.00	50.00	200.00	0.03
Flacourtia indica	1	2	0.40	20	2.00	25.00	25.00	50.00	100.00	0.01

Maturity Index = 40.00

Combretum ovalifolium, Ichnocarpus frutescens, Jasminum sessiliflorum and Pachygone ovata.

Three vegetational plots representing totally disturbed dry deciduous forests (presently reduced to dry deciduous scrubs) were chosen viz. Anakatty, Kottathara and Plamaram, all of which are in the vested forests. As stated in Chapter II these forests are floristically and physiognomically poor and the forest have been derived from the dry deciduous forests due to intensive biotic interference. The total number of species comprising these vegetation types are low, ranging from 1 to 4 (in Anakatty and Kottathara) and invariably either Albizia amara or Euphorbia antiquorum forms the consociation both of which are regular in distribution. Apart from these two species, Mundulea suberosa, Tarenna asiatica and Canthium dicoccum characterise the vegetation at Kottathara. Stumps of the species constituting the dry deciduous forests are present indicating their original composition.

Herbs are poorly represented.

The vegetational studies at Plamaram could not be replicated as during the period of interval the area was cleared and planted with Eucalyptus. In physiognomy it represents the former two but its floristic composition shows a mixture of species of moist and dry deciduous forest types and hence can be considered as an ecotone. Here the community is made up of an association of Cassia fistula and Tectona grandis. The high

TABLE 42

Name of the Place: Anakkatti (Secondary dry deciduous scrub, totally disturbed)

No. of quadrats: 5 Size of Plot: 50 x 10 m.

Name of species	No. of quadrats of occurr-ence	Total No. of species	(D)	(%F)	(Ab)	(RD)	(RF)	(RAb)	(IVI)	Ab/F
1	2	3	4	5	6	7	8	9	10	11
Albizia amara	4	6	12	80	15	100	100	100	300	0.02

Maturity Index = 80

TABLE 43

Name of the Place: Kottathara (Secondary dry deciduous scrub, totally disturbed)

No. of quadrats: 5 Size of Plot: 50 x 10 m.

Name of species	No. of quadrats of occurr-ence	Total No. of species	(D)	(%F)	(Ab)	(RD)	(RF)	(RAb)	(IVI)	Ab/F
1	2	3	4	5	6	7	8	9	10	11
Euphorbia antiquorum	4	7	1.40	80	1.75	70.00	57.14	36.84	163.98	0.01
Mundulea suberosa	1	1	0.20	20	1.00	10.00	14.29	21.05	45.34	0.05
Tarenna asiatica	1	1	0.20	20	1.00	10.00	14.29	21.05	45.34	0.05
Canthium dicoccum	1	1	0.20	20	1.00	10.00	14.29	21.05	45.34	0.05

Maturity Index = 50.00

TABLE 44

Name of the Place: Plamaram (Secondary dry deciduous scrub, totally disturbed)

No. of quadrats: 5 Size of Plot: 50 x 10 m.

Name of species	No. of quadrats of occurrence	Total No. of species	(D)	(%F)	(Ab)	(RD)	(RF)	(RAb)	(IVI)	Ab/F
1	2	3	4	5	6	7	8	9	10	11
Cassia fistula	2	13	2.60	40	6.50	41.94	20.00	43.62	105.56	0.16
Tectona grandis	5	12	2.40	100	2.40	38.71	50.00	16.11	104.82	0.02
Azadirachta indica	1	4	0.80	20	4.00	12.90	10.00	26.85	49.75	0.20
Lagerstroemia microcarpa	1	1	0.20	20	1.00	3.23	10.00	6.71	19.94	0.05
Randia brandisii	1	1	0.20	20	1.00	3.23	10.00	6.71	19.94	0.05

Maturity Index = 40.00

frequency values of Tectona grandis (100%) together with species like Lagerstroemia microcarpa and Randia brandisii (typical of moist deciduous forests) Cassia fistula and Azadirachta indica (typical of dry deciduous forests) leads to the conclusion that this area represent the transition from the moist to dry deciduous type of forests.

The IVI ranges from 19.94 to 105.56 and the MI value is 40. The vegetation surprisingly is homogenous and this can be attributed to the high% frequency of Tectona grandis. Coppices of Terminalia alata, Madhuca indica, Mallotus philippinensis and remnants of Bamboos and Strobilanthus sp. suggest more affinity towards moister type of forest.

Discussion

Climatically, the area shows a significant range of variation in rainfall (Fig.IV) and consequently a wide spectrum of vegetation types is encountered. The western and south western portions exposed to summer rains of high intensity shows a moister type of vegetation viz., evergreen and semi-evergreen interspersed with grasslands. The central part of the valley adjacent to the mountainous ridges also receives southwest monsoon but its intensity is comparatively low. This area supports a moist deciduous type of vegetation. The eastern and the northeastern regions receive the bulk of the precipitation during the retreating monsoon i.e. from October to December. Because of the scanty rainfall and a long dry

season lasting about 5 to 7 months, these areas invariably support a dry deciduous type of vegetation which due to heavy biotic interferences, particularly anthropic, has resulted in a low, thorny, discontinuous scrubby type of vegetation.

Thus, the differences in vegetation in the study area can be attributed mainly to these two factors viz., climatic and biotic (particularly anthropic) and consequently the changes brought about in the structure of the community and floristics as a result of anthropic influences are highlighted below.

1. Structure of the community

It was Raunkiaer (1934 and 1937) who first established the relationship between climate and life forms which is known as 'Biological Spectrum' or 'Phytoclimatic spectrum'. This was subsequently investigated by a number of workers (Ferreira 1940, Bharucha et al. 1941 and 1947, Das and Sarup 1951, van Steenis 1957, Lakshmanachary and Rangaswamy Ayyengar 1970, Siddiqui 1972, Meher-Homji 1974 and Balasubramanyan 1978). The phytoclimate of the earth as defined by Raunkiaer are as follows:

A.	Phanerophytes	-	Climate in the tropics
B.	Therophytes	-	Climate in the deserts
C.	Hemicryptophytes	-	Climate in the greater part of the cold temperate zones.
D.	Chamaephytes	-	Climate in the cold zones

This classification was subjected to further modifications by Ellenberg and Mueller Dombois (1967) and following subdivisions have been recognised under Phanerophytes (woody or herbaceous evergreen perennials that grow taller than 50 cm. or whose shoots do not die back periodically to that height limit):

a.	Megaphanerophytes	-	> 50 m.
b.	Mesophanerophytes	-	5 to 50 m.
c.	Microphanerophytes	-	2 to 5 m.
d.	Nanophanerophytes	-	< 2 m.

It is seen from Figs. VIII to XI that the evergreens almost attain the level of megaphanerophytes while the semi-evergreen, moist deciduous and dry deciduous forests fall under the mesophanerophytic group. It has already been mentioned that the areas occupied by the secondary dry deciduous scrubs are similar to that of the dry deciduous forests climatically, edaphically and physiographically and hence their reduction to the level of microphanerophytes could be attributed only to the biotic factors, especially anthropic. This view is supplemented by the selective exploitation of species like Diospyros montana, Sapindus emarginatus, Piliostigma racemosa, Azadirachta indica, Butea monosperma, Premna tomentosa, Cordia myxa and others, leaving behind only Euphorbia antiquorum and Albizia amara which are of little value.

Thus, from an overall physiognomic point of view the biological spectrum in the study area shows only phanerophytes but variations from mega to microphanerophytes are encountered

due to human action.

If, however, the structure of the community is studied in relation to the disturbance, within each forest type the following interesting points emerge:

a) Wet evergreen forest

The existing records indicate that this type of forest has undergone least disturbance and hence no attempt was made to compare it with the same type of forest in another area. However, this forest type which represents the climax, serves as a baseline to deduce further inferences.

b) Semi-evergreen forest

There is a marked change in the physiognomy and structure of the community. Prominant changes brought about in the physiognomy of the disturbed area are the absence of species like Diospyros pruriens, Mesua ferrea, Palaquium ellipticum, Calophyllum apetalum and Myristica dactyloides which attain almost the level of megaphanerophytes. The removal of these species for various purposes has resulted in an increase of the mesophanerophytes, most of them being heliophilous.

Regarding the community structure it may be mentioned that while the undisturbed area shows an association of Mesua-Diospyros-Macaranga the disturbed one is characterised by Scolopia-Artocarpus-Flacourtia. The undisturbed area also shows a high density value of Mesua ferrea and Diospyros pruriens which are not at all encountered in the disturbed

area. The values of IVI and MI are also striking. While the maximum IVI is 50.36 and MI is 34.00 in the undisturbed area, it is found to be 28.93 and 16.33 respectively in the disturbed area.

c) Moist deciduous forest

Prominant physiognomic change between the undisturbed and partially disturbed forest is not noticeable but, in the partially disturbed forest after shifting cultivation, it is seen that the community on an average is no more than about 4 m. in height and are principally dominated by only two species viz., Clerodendrum infortunatum and Dalbergia latifolia. As already stated some huge trees of Dalbergia latifolia were not affected by the process of shifting cultivation and the high density, frequency and abundance value of this species can be attributed to their profuse regeneration. If freed from human action this type of forest can easily revert to its original status thus indicating minimum disturbance to the vegetation. There is no appreciable difference in the values of IVI and MI in four releves. In one area of partial disturbance, the value of IVI has been boosted by Grewia tiliaefolia and in the partially disturbed area after shifting cultivation by Clerodendrum infortunatum and Dalbergia latifolia. These figures suggest that the moist deciduous forests can be managed without much damage to the vegetation.

d) Dry deciduous forests and secondary dry deciduous scrub

Since the physiognomic change brought about in the life form has already been stressed only the structure of the community is dealt with here. In the undisturbed area, excepting in one site the association is featured by the presence of Albizia amara with either Euphorbia antiquorum or Helicteres isora while in the disturbed area it is either a consociation of Albizia amara or Euphorbia antiquorum. Similarly, the high values of IVI invariably dominated by a single species and MI are also striking, thus pointing to the fact that clearfelling and conversion to agriculture is not advisable in these areas.

2. Floristic Composition

a) Semi-evergreen forest

In the partially disturbed area, the following species which are common in the undisturbed area are found to be conspicuous by their absence: Mesua ferrea, Palaquium ellipticum, Calophyllum apetalum, Myristica dactyloides, Diospyros pruriens and Euphoria longana. They have been replaced by species like Clerodendrum infortunatum, Helecteres isora, Canarium strictum, Terminalia alata, Maesa perrottetiana, Dillenia pentagyna and Olea dioica most of which are heliophilous and fast growing. This may perhaps explain the relatively large number of species encountered in the disturbed area. Furthermore, the presence of species like Terminalia alata, Helectores isora,

Clerodendrum infortunatum, Maesa perrottetiana, Grewia rhamnifolia, Ichnocarpus frutescens and Ziziphus rugosa in the disturbed area indicate that the vegetation in this area is approaching closer to the moist deciduous forests.

b) Moist deciduous forests

The differences are glaring not only between the disturbed and undisturbed areas but also between the reserved and vested forests. While the reserved forests which are under scientific management comprises of about 25 species on an average those under vested forests are very poor being 10 species only. Furthermore, in the undisturbed areas of the vested forests the following species which characterised the reserved forests are either totally absent or with a low frequency value: Terminalia bellerica, T. alata, Alstonia scholaris, Sterculia alata, Lagerstroemia microcarpa and Schleichera oleosa. Similar differences are seen in partially disturbed areas also. Species like Terminalia paniculata, Pterocarpus marsupium, Sterculia alata, Cassia fistula and Anogeissus latifolia are never encountered in the vested forests.

The following species which characterised the undisturbed forests are found to be either absent or with a low percentage frequency in the partially disturbed areas: Lagerstroemia microcarpa, Wrightia tinctoria, Olea dioica, Terminalia alata, Toona ciliata, Tectona grandis, Pterocarpus marsupium and Terminalia paniculata, the last two with a low

percentage frequency value. The partially disturbed area after shifting cultivation has not been much disturbed either in floristic richness or in species diversity. Most of the species common to the undisturbed moist deciduous forests are present excepting by their low frequency value. Given protection this forest can revert to its original status.

c) Dry deciduous forests and their derivatives

A significant difference exists between the undisturbed and totally disturbed area. While the total number of species in the undisturbed area varies from 17 to 25, in the disturbed area, it is either dominated by a single species or at best a maximum of three only. The general tendency is to retain species like Euphorbia antiquorum and Albizia amara which may have no value at all. Species like Diospyros montana, Sapindus emarginatus, Piliostigma racemosa, Butea monosperma, Azadirachta indica, Premna tomentosa, Cordia myxa and others have been heavily exploited and they have been completely removed in the disturbed area.

CHAPTER VI

Soil changes

The area has a range of forest types such as evergreen, semievergreen, moist deciduous and dry deciduous. In addition, the study area presents different degrees of anthropic disturbance to vegetation.

In this study, soils from 16 vegetation plots representing various forest types were studied to evaluate the changes in soil properties in relation to three degrees of disturbance to vegetation viz., undisturbed, partially disturbed and totally disturbed.

Soil samples from the profile as well as surface (0-20 cm.) were taken from 16 vegetation plots representing West Coast Tropical evergreen undisturbed; West Coast semi-evergreen undisturbed and partially disturbed; South Indian moist deciduous undisturbed, partially disturbed and partially disturbed after shifting cultivation; and Southern Tropical dry deciduous undisturbed, partially disturbed and totally disturbed vegetation.

The samples were air-dried, passed through 2-mm. sieve and stored for analyses. The particle-size separates (sand 2.00 to 0.02, silt 0.02 to 0.002, clay 0.002 mm. diameter), p^H in soil-water suspension, organic carbon and cation exchange capacity analyses were done according to methods described in American Society of Agronomy (1965) and Jackson (1958). Soil colour descriptions for air-dried samples are according to the Munsell Colour Chart.

Results

Descriptions of 16 soil profiles and their properties are given in Tables 45-60. Properties of the 16 surface (0-20 cm.) samples are given in Table 61 and Table 62 shows the average properties of these surface samples in relation to disturbance of forest.

1. Rooting depth

Generally evergreen, semi-evergreen and moist deciduous soils have deeper solum than dry deciduous ones. In most cases, rooting depth as evidenced by root distribution is over 100 cm.

2. Particle - size separates

Most of the surface horizons of the profiles as well as the surface samples are loam to sandy loam in texture. There is eluviation of finer separates (silt and clay)

into the lower horizons, thus indicating leaching. The lowest content of sand and highest content of silt and clay are in the evergreen, semi-evergreen and moist deciduous soils. As we go from evergreen to dry deciduous soils, the sand content increases and silt and clay content decreases. Disturbance doesnot seem to have any regular effect on the distribution of particle-size separates in soils under each of the forest type.

3. Soil reaction (p^H)

Most of the surface horizons and surface samples are slightly acid to neutral in reaction. In the profiles, p^H increases or acidity decreases with depth. Evergreen soil is the most acid followed by the slightly acid semi-evergreen and near neutral moist deciduous and dry deciduous soils. As the dryness increases, the soils tend to be less acid and this is expected because of the higher base saturation (principally calcium and magnesium) of drier sites. Disturbance does not seem to have any effect on soil reaction in soils under any of the forest type.

4. Organic carbon

Carbon content decreases with depth in the profiles and this is expected as there will be more litter deposition in the surface horizons. Most of the surface samples of the evergreen, semi-evergreen and moist deciduous soils are rich

in organic carbon, all the values except one being above 2%. The carbon content tends to decrease as we go from evergreen to moist deciduous soil and there is considerable reduction of it (about 50%) in dry deciduous, totally disturbed when compared to evergreen undisturbed. Disturbance does not have any regular effect on carbon content of soil in each of the forest type.

5. Cation exchange capacity (CEC)

The sum of exchangeable bases (principally calcium, magnesium, potassium, sodium) and exchange acidity values give an approximation of CEC in soils of p^H below 7. However, in soils of above p^H 7, presence of carbonates presents the problem of increasing the quantity of exchangeable bases over those in truely exchangeable form, thus artificially increasing CEC values (Table 55).

CEC values are highest in moist deciduous soils and lowest in dry deciduous ones. With disturbance, CEC values does not follow any trend in dry deciduous soils; however in the case of semi-evergreen and moist deciduous soils, it tends to decrease. In the profiles CEC generally decreases with depth.

Table 45

Panthanthodu profile and properties

Hilly, elevation 850 m, well drained, evergreen forest, undisturbed.

0-5	cm	Brown (10 YR 5/3), loam, granular structure, abundant roots.
5-20	cm	Yellowish brown (10 YR 5/4), loam, granular structure, abundant roots.
20-50	cm	Reddish brown (5 YR 5/4), clay loam, blocky structure, few roots.
50-85	cm	Yellowish red (5 YR 4/6), clay loam, massive structure, very few roots.
85-135	cm	Strong brown (7.5 YR 4/6), loam, massive structure, very few roots.
135-150	cm	Strong brown (7.5 YR 5/6), loam, massive structure, no roots.

Depth (cm)	Sand (%)	Silt (%)	Clay (%)	pH in water	Organic carbon (%)	Cation exchange capacity (me/100g)
0-5	75	13	12	4.9	1.76	26
5-20	73	14	13	5.0	1.16	22
20-50	65	12	23	4.9	0.57	18
50-85	66	11	23	5.2	0.49	18
85-135	71	13	16	5.0	0.38	14
135-150	74	11	15	5.1	0.25	12

Table 46

Kurukkankundu profile and properties

Hilly, elevation 760 m, well drained, semi-evergreen forest, no disturbance

0-20	cm	Dark yellowish brown (10 YR 4/4), loam, granular structure, abundant roots.
20-45	cm	Yellowish red (5 YR 5/6), silt loam, granular structure, many to abundant roots.
45-70	cm	Yellowish red (5 YR 5/8), loam, blocky structure, very few roots.
70-100	cm	Yellowish red (5 YR 5/8), loam, blocky structure, very few roots.
100-130	cm	Strong brown (7.5 YR 5/6), loam, massive structure, very few roots.
130-150	cm	Strong brown (7.5 YR 5/6), clay loam, massive structure, no roots.

Depth (cm)	Sand (%)	Silt (%)	Clay (%)	pH in water	Organic carbon (%)	Cation exchange capacity (me/100g)
0-20	74	15	11	6.5	1.69	25
20-45	63	26	11	6.7	0.85	21
45-70	64	20	16	6.7	0.63	18
70-100	66	16	18	6.6	0.64	20
100-130	66	13	21	6.4	0.71	18
130-150	59	14	27	6.6	0.60	19

Table 47

Manthampotti profile and properties

Hilly, elevation 450 m, moderately well drained, semi-evergreen forest, partially disturbed.

0-20	cm	Dark brown (10 YR 4/3), loam, granular structure, abundant roots.
20-70	cm	Reddish yellow (7.5 YR 6/8), clay, blocky structure, very few roots.
70-90	cm	Strong brown (7.5 YR 5/8), clay, massive structure, no roots.

Depth (cm)	Sand (%)	Silt (%)	Clay (%)	p^H in water	Organic carbon (%)	Cation exchange capacity (me/100g)
0-20	73	14	13	6.5	2.34	18
20-70	56	10	34	6.4	1.85	17
70-90	56	10	34	6.1	1.06	16

Table 48

Pottikkal - II profile and properties

Hilly, elevation 600 m, poorly drained, moist deciduous forest, undisturbed.

0-20	cm	Very dark gray (10 YR 3/1), loam, granular structure, abundant roots.
20-50	cm	Dark brown (10 YR 3/3), loam, blocky structure, many to abundant roots.
50-90	cm	Reddish brown (5 YR 4/4), loam, blocky structure, many roots.
90-145	cm	Reddish brown (5 YR 4/4), loam, massive structure, few roots.
145-165	cm	Dark reddish brown (5 YR 3/4), clay loam, massive structure, no roots.

Depth (cm)	Sand (%)	Silt (%)	Clay (%)	p^H in water	Organic carbon (%)	Cation exchange capacity (me/100g)
0-20	74	13	13	6.4	2.34	25
20-50	69	13	18	6.0	0.98	26
50-90	70	12	18	6.5	0.65	14
90-145	68	11	21	5.7	0.51	25
145-165	65	12	23	6.3	0.43	18

Table 49

Chindakki - II profile and properties

Hilly, elevation 650 m, well drained, moist deciduous forest, undisturbed.

0-20	cm	Dark gray (10 YR 4/1), loam, granular structure, abundant roots.
20-45	cm	Very dark grayish brown (10 YR 3/2), loam, granular structure, many roots.
45-73	cm	Dark brown (7.5 YR 4/4), loam, blocky structure, few roots.
73-103	cm	Dark brown (7.5 YR 4/4), loam, blocky structure, very few roots.
103-143	cm	Reddish brown (5 YR 4/4), loam, massive structure, very few roots.
143-163	cm	Dark reddish brown (5 YR 3/4), loam, massive structure, no roots.

Depth (cm)	Sand (%)	Silt (%)	Clay (%)	pH in water	Organic carbon (%)	Cation exchange capacity (me/100g)
0-20	75	12	13	6.1	1.82	24
20-45	72	13	15	6.1	1.39	27
45-73	73	13	14	6.5	1.05	26
73-103	72	12	16	6.0	0.75	24
103-143	70	11	19	5.9	0.53	26
143-163	70	11	19	6.1	0.45	18

Table 50

Pottikkal - I profile and properties

Hilly, elevation 550 m, well drained, moist deciduous forest, partially disturbed.

0-5	cm	Very dark gray (10 YR 3/1), loam, granular structure, abundant roots.
5-40	cm	Very dark grayish brown (10 YR 3/2), loam, granular to blocky structure, abundant roots.
40-55	cm	Dark brown (10 YR 3/3), loam, blocky structure, many to abundant roots.
55-80	cm	Dark brown (7.5 YR 3/4), loam, massive structure, few roots.
80-105	cm	Yellowish red (5 YR 4/6), clay loam, massive structure, very few roots.
105-125	cm	Strong brown (7.5 YR 5/6), clay loam, massive structure, no roots.

Depth (cm)	Sand (%)	Silt (%)	Clay (%)	pH in water	Organic carbon (%)	Cation exchange capacity (me/100g)
0-5	74	14	12	6.0	1.65	35
5-40	73	11	16	5.8	0.66	23
40-55	71	11	18	5.7	0.46	22
55-80	70	11	19	5.6	0.37	20
80-105	62	11	27	5.6	0.25	22
105-125	62	14	24	5.7	0.69	22

Table 51

Chindakki - I profile and properties

Hilly, elevation 650 m, well drained, moist deciduous forest, partially disturbed.

0-20	cm	Very dark grayish brown (10 YR 3/2), loam, granular structure, abundant roots.
20-45	cm	Dark reddish brown (5 YR 3/3), loam, blocky structure, many to abundant roots.
45-75	cm	Reddish brown (5 YR 5/4), clay loam, blocky structure, few roots.
75-90	cm	Yellowish red (5 YR 5/6), clay loam, massive structure, very few roots.
90-140	cm	Reddish brown (5 YR 5/4), clay loam, massive structure, very few roots.
140-160	cm	Yellowish red (5 YR 4/6), clay loam, massive structure, no roots.

Depth (cm)	Sand (%)	Silt (%)	Clay (%)	pH in water	Organic carbon (%)	Cation exchange capacity (me/100g)
0-20	73	14	13	6.0	2.55	30
20-45	69	14	17	6.2	1.39	25
45-70	64	13	23	5.8	0.96	23
70-90	62	11	27	5.5	0.67	23
90-140	63	10	27	5.4	0.65	21
140-160	64	9	27	5.5	0.52	22

Table 52

Vandampara profile and properties

Hilly, elevation 500 m, moderately well drained, moist deciduous forest, partially disturbed.

0-15	cm	Dark grayish brown (10 YR 4/2), loam, granular structure, abundant roots.
15-35	cm	Dark brown (10 YR 4/3), loam, granular structure, many roots.
35-62	cm	Reddish brown (5 YR 4/4), loam, blocky structure, few roots.
62-82	cm	Brown (7.5 YR 5/4), clay loam, blocky structure, very few roots.
82-112	cm	Reddish yellow (7.5 YR 6/6), loam, massive structure, no roots.
112-132	cm	Yellowish brown (10 YR 5/4), sandy loam, massive structure, no roots.

Depth (cm)	Sand (%)	Silt (%)	Clay (%)	p^H in water	Organic carbon (%)	Cation exchange capacity (me/100g)
0-15	74	12	14	6.5	2.29	24
15-35	70	12	18	6.3	0.97	18
35-62	64	17	19	6.3	0.69	18
62-82	68	10	22	6.3	0.42	20
82-112	74	13	13	6.6	0.62	18
112-132	78	9	13	6.5	0.14	17

Table 53

Thadikkundu profile and properties

Hilly, elevation 750 m, poorly drained, moist deciduous forest, partially disturbed after shifting cultivation.

0-20	cm	Dark brown (10 YR 3/3), sandy loam, granular structure, abundant roots.
20-38	cm	Dark brown (7.5 YR 4/4), loam, granular structure, many roots.
38-58	cm	Dark brown (10 YR 3/3), loam, blocky structure, few roots.
58-93	cm	Strong brown (7.5 YR 4/6), loam, blocky structure, few roots.
93-130	cm	Yellowish red (5 YR 5/6), loam, massive structure, very few roots.
130-150	cm	Reddish yellow (5 YR 6/6), loamy sand, massive structure, no roots.

Depth (cm)	Sand (%)	Silt (%)	Clay (%)	p^H in water	Organic carbon (%)	Cation exchange capacity (me/100g)
0-20	78	10	12	5.9	0.27	24
20-38	73	13	14	6.5	0.72	21
38-58	72	12	16	6.4	0.97	21
58-93	70	13	17	6.7	0.41	21
93-130	70	14	16	6.1	0.33	19
130-150	69	20	11	6.2	0.17	19

Table 54

Dhandapaniyur profile and properties

Hilly, elevation 575 m, moderately well drained, dry deciduous forest, undisturbed.

0-15	cm	Dark reddish brown (5 YR 3/3), sandy loam, granular structure, abundant roots.
15-45	cm	Reddish brown (5 YR 4/4), sandy loam, blocky structure, many roots.
45-75	cm	Yellowish red (5 YR 4/6), loamy sand, massive structure, very few roots.
75-102	cm	Yellowish red (5 YR 5/6), loamy sand, massive structure, no roots.
102-122	cm	Yellowish red (5 YR 5/6), loamy sand, massive structure, no roots.

Depth (cm)	Sand (%)	Silt (%)	Clay (%)	p^H in water	Organic carbon (%)	Cation exchange capacity (me/100g)
0-15	84	5	11	6.6	0.17	13
15-45	84	4	12	6.8	0.60	12
45-75	87	4	9	6.9	0.19	10
75-102	87	5	8	6.7	0.14	16
102-122	85	6	9	6.7	0.17	16

Table 55

Koodappatti profile and properties

Hilly, elevation 400 m, well drained, dry deciduous forest, undisturbed.

0-15 cm Dark brown (10 YR 4/3), loamy sand, granular structure, abundant roots.

15-40 cm Dark reddish brown (5 YR 3/4), sandy loam, blocky structure, many roots.

40-78 cm Reddish brown (5 YR 4/4), sandy loam, blocky structure, few roots.

78-120 cm Brown (7.5 YR 5/4), loamy sand, massive structure, very few roots.

120-140 cm Light brown (7.5 YR 6/4), sandy loam, massive structure, no roots.

Depth (cm)	Sand (%)	Silt (%)	Clay (%)	pH in water	Organic carbon (%)	Cation exchange capacity (me/100g)
0-15	87	5	8	7.7	0.58	16
15-40	86	4	10	7.1	0.30	19
40-78	81	8	11	7.4	0.23	23
78-120	78	14	18	8.3	0.21	84
120-140	76	12	12	8.3	0.22	98

Table 56

Thuva - II profile and properties

Hilly, elevation 550 m, well drained, dry deciduous forest, undisturbed.

0-20 cm Dark brown (7.5 YR 4/4), loamy sand, granular structure, abundant roots.

20-50 cm Strong brown (7.5 YR 4/6), loamy sand, blocky structure, few roots.

50-70 cm Brownish yellow (10 YR 6/6), loamy sand, blocky structure, very few roots.

70-110 cm Light gray (10 YR 7/2), sand, single grained structure, no roots.

110-130 cm Very pale brown (10 YR 7/3), sand, single grained structure, no roots.

Depth (cm)	Sand (%)	Silt (%)	Clay (%)	p^H in water	Organic carbon (%)	Cation exchange capacity (me/100g)
0-20	79	11	10	6.0	0.73	12
20-50	80	11	9	6.3	0.49	13
50-70	88	6	6	7.0	0.14	4
70-110	94	2	4	6.7	0.03	1
110-130	94	2	4	6.9	0.13	2

Table 57

Thuva - I profile and properties

Hilly, elevation 550 m, well drained, dry deciduous forest, partially disturbed.

0-20	cm	Dark brown (10 YR 3/3), sandy loam, granular structure, abundant roots.
20-45	cm	Dark brown (7.5 YR 3/4), sandy loam, granular structure, many roots.
45-55	cm	Brown (7.5 YR 5/4), loamy sand, blocky structure, few roots.
55-85	cm	Very pale brown (10 YR 7/4), sand, single grained structure, very few roots.
85-140	cm	Light gray (10 YR 7/2), sand, single grained structure, no roots.
140-160	cm	Very pale brown (10 YR 8/4), sand, single grained structure, no roots.

Depth (cm)	Sand (%)	Silt (%)	Clay (%)	pH in water	Organic carbon (%)	Cation exchange capacity (me/100g)
0-20	80	9	11	6.8	0.90	25
20-45	82	7	11	6.5	0.59	21
45-55	85	6	9	6.9	0.22	22
55-85	90	4	6	6.9	0.04	14
85-140	96	2	2	7.5	0.03	14
140-160	95	2	3	7.2	0.08	16

Table 58

Anakkatti profile and properties

Hilly, elevation 550 m, well drained, dry deciduous forest, (reduced to dry deciduous scrub), totally disturbed.

0-20 cm Dark yellowish brown (10 YR 4/4), sandy loam, granular structure, many roots.

20-70 cm Dark brown (7.5 YR 4/4), loam, granular structure, very few roots.

70-110 cm Reddish brown (5 YR 4/4), sandy loam, massive structure, no roots.

110-140 cm Strong brown (7.5 YR 5/6), sandy loam, massive structure, no roots.

140-160 cm Brown (7.5 YR 5/4), loamy sand, massive structure, no roots.

Depth (cm)	Sand (%)	Silt (%)	Clay (%)	p^H in water	Organic carbon (%)	Cation exchange capacity (me/100g)
0-20	79	8	13	6.2	0.95	7
20-70	74	9	17	6.9	0.61	9
70-110	78	8	14	6.5	0.23	7
110-140	81	7	12	6.5	0.13	5
140-160	84	7	9	6.5	0.12	6

Table 59

Kottathara profile and properties

Hilly, elevation 460 m, well drained, dry deciduous forest, (reduced to dry deciduous scrub) totally disturbed.

0-20	cm	Dark brown (7.5 YR 4/4), loamy sand, granular structure, abundant roots.
20-45	cm	Dark reddish brown (5 YR 3/3), sandy loam, granular to blocky structure, many to abundant roots.
45-65	cm	Strong brown (7.5 YR 5/6), loamy sand, massive structure, few roots.
65-85	cm	Brown (7.5 YR 5/4), loamy sand, massive structure, very few roots.
85-105	cm	Light yellowish brown (10 YR 6/4), loamy sand, massive structure, no roots.

Depth (cm)	Sand (%)	Silt (%)	Clay (%)	pH in water	Organic carbon (%)	Cation exchange capacity (me/100g)
0-20	79	11	10	7.0	1.49	20
20-45	77	11	12	7.1	1.29	28
45-65	80	10	10	7.1	0.82	31
65-85	82	9	9	7.3	0.72	31
85-105	88	7	5	7.8	0.54	28

Table 60

Plamaram profile and properties

Hilly, elevation 550 m, well drained, dry deciduous forest, (reduced to dry deciduous scrub) totally disturbed.

0-5	cm	Very dark grayish brown (10 YR 3/2), sandy loam, granular structure, abundant roots.
5-55	cm	Dark reddish brown (5 YR 3/3), loam, granular to blocky structure, many to abundant roots.
55-80	cm	Reddish brown (5 YR 4/4), loam, blocky structure, few roots.
80-105	cm	Reddish brown (5 YR 4/4), loam, massive structure, very few roots.
105-135	cm	Dark reddish brown (5 YR 3/4), loam, massive structure, very few roots.
135-155	cm	Reddish brown (5 YR 4/4), loam, massive structure, no roots.

Depth (cm)	Sand (%)	Silt (%)	Clay (%)	p^H in water	Organic carbon (%)	Cation exchange capacity (me/100g)
0-5	77	10	13	6.3	1.91	28
5-55	69	14	17	6.6	0.77	28
55-80	69	13	18	5.9	0.96	29
80-105	70	13	17	6.2	0.77	28
105-135	71	13	16	6.6	0.70	25
135-155	75	13	12	6.4	0.53	25

Table 61

Properties of surface samples (0 - 20cm.) in the vegetation plots*

Vegetation plot	Sand (%)	Silt (%)	Clay (%)	pH in water	Organic carbon (%)	Cation exchange capacity (me/100g)
Evergreen: undisturbed						
Panthanthodu	74	13	13	5.4	2.85	23
Semi-evergreen: undisturbed						
Kurukkankundu	69	15	16	6.2	2.58	24
Semi-evergreen: partially disturbed						
Manthampotti	74	13	13	6.1	2.64	18
Moist deciduous: undisturbed						
Pottikkal - II	73	14	13	6.5	2.82	38
Chindakki - II	76	10	14	6.3	1.62	28
Moist deciduous: partially disturbed						
Pottikkal - I	76	12	12	6.4	2.82	31
Chindakki - I	73	12	15	6.2	2.44	25
Vandanpara	72	13	15	6.6	2.07	20
Moist deciduous, after shifting cultivation						
Thadikkundu	74	14	12	6.6	2.29	27
Dry deciduous: undisturbed						
Koodappati	84	7	9	7.3	0.74	24
Dhandapaniyur	82	7	11	6.7	1.21	14
Thuva - II	81	9	10	6.2	1.33	20
Dry deciduous, partially disturbed						
Thuva - I	83	7	10	6.5	1.04	20
Dry deciduous, totally disturbed						
Anakkatti	83	7	10	6.7	1.17	10
Kottathara	78	11	11	6.8	1.49	19
Plamaram	75	10	15	6.4	1.50	24

*Each value is the average of five different sample values.

Table 62

Properties of surface samples (0 - 20cm.) in relation to disturbance of forest

Forest type and degree of disturbance	Sand (%)	Silt (%)	Clay (%)	pH in water	Organic carbon (%)	Cation exchange capacity (me/100)
Evergreen, undisturbed	74	13	13	5.4	2.85	23
Semi-evergreen, undisturbed	69	15	16	6.2	2.58	24
Semi-evergreen, partially disturbed	74	13	13	6.1	2.64	18
Moist deciduous, undisturbed*	74	12	14	6.4	2.22	33
Moist deciduous, partially disturbed**	74	12	14	6.4	2.44	25
Moist deciduous, partially disturbed after shifting cultivation	74	14	12	6.6	2.29	27
Dry deciduous, undisturbed**	82	8	10	6.7	1.09	19
Dry deciduous, partially disturbed	83	7	10	6.5	1.04	20
Dry deciduous, totally disturbed**	79	9	12	6.6	1.39	18

* Average of two plots.

** Average of three plots.

Discussion

As there is no appreciable disturbance in evergreen forest only one plot has been studied. In the semi-evergreen soils, sand content increases, silt plus clay content decreases and CEC decreases with disturbance. There is little change in p^H and organic carbon. The only effect of disturbance seems to be a decrease in CEC in the case of moist deciduous soils. With disturbance, sand content decreases, silt plus clay content increases and organic carbon increases in dry deciduous soils. There is little change in p^H and CEC.

The results do not indicate any definite trend in the changes in properties of these soils due to anthropic disturbance. However, when we study the sequence of evergreen-semi-evergreen-moist deciduous-dry deciduous soils, certain trends are evident. Compared to evergreen, increase of sand, decrease of silt plus clay, decrease of acidity (from p^H 5.4 to 6.7), considerable reduction in organic carbon (from 2.85 to 1.39%) and a tendency for decrease in CEC occur in dry deciduous soils. The data also indicate that moist deciduous soils are quite comparable to evergreen and semi-evergreen soils in all the properties except p^H. It seems the changes in soil properties occur somewhere between the moist deciduous and dry deciduous soils. These changes

in properties of evergreen-semi-evergreen-moist deciduous-dry deciduous soils suggest that dry deciduous and to some extent moist deciduous soils are more resilient to anthropic disturbance than evergreen-semi-evergreen soils. In other words, anthropic disturbance could cause considerable effect in evergreen and semi-evergreen soils.

Thus amongst the forest soils studied, soils under dry deciduous and to some extent moist deciduous forest types are more resilient than those under evergreen and semi-evergreen types. The changes in soil properties in relation to anthropic disturbance of the forest types suggest that evergreen and semi-evergreen areas of Attappady should not be clearfelled or stripped of vegetation for either forestry or agricultural purposes. However, dry deciduous and to some extent moist deciduous areas of Attappady can be developed for forestry or agricultural purposes through scientific soil management practices.

CHAPTER VII

Conclusions and Recommendations

1. Attappady is a relic of earlier vegetal luxuriance distributed in an altitudinal range of 250 to 2,300 m. and three rainfall zones.

2. Private ownership of the forests with little concern for scientific management resulted in over exploitation, denudation and irreversible decline of the vegetation. It was only the area reserved and brought under forest management, which escaped irreversible trend of decline. The present status of the reserved and vested forests serves as an example of the importance of scientific management of forests.

3. Shifting cultivation, as practised in isolated patches in the area, has not resulted in permanent damage to the forest and its ecological impact is inconsequential.

4. Biotic (particularly anthropic) disturbances, over a period of time, have resulted in permanent changes in the vegetation in different types of forests exposed to varying degrees of interference.

5. Soils under dry deciduous and to some extent moist deciduous forests in the area are more resilient and can be developed for forestry or agricultural purposes through scientific soil management practices. Soils under evergreen and semi-evergreen forests are fragile and the vegetal cover needs to be protected.

6. The inhabitants, in one way or the other depend upon forest produce. Even now, there is a shortage of fuelwood and bamboos. The situation will be more difficult as the gap between demand and supply widens. There is likelihood of shortage of timber and thatching material also, in the years to come.

7. Apart from ecological consideration, it is important to reforest the available areas in the moist deciduous and dry deciduous zones by species suitable to meet the local demands. Taking into consideration, the inevitable gestation period, it is necessary to raise plantations of these species now onwards.

8. Though, in accordance with the general policy, the Vested Forests Committee has recommended certain areas to be assigned for agricultural purposes in the area, it is important to consider the ecological factors and the projected requirement of forest produce by the inhabitants,

brought out in the study while formulating a strategy for development of the area.

9. The nature and extent of medicinal plants in the area and the almost total dependence of a section of inhabitants on local therapy need to be recognized. A systematic survey of medicinal plants, their usage and cultivation of those species extensively required locally are points for consideration.

REFERENCES CITED

Adeyoju, S.K. 1980. The future of tropical agroforestry systems. Commonwealth Forestry Review, 59(2):155-161.

Ambasht, R.S. 1969. A Textbook of Plant Ecology. Students and Friends Co., Varanasi, 212p.

American Society of Agronomy. 1965. Methods of Soil Analysis. 2v. American Society of Agronomy, Madison.

Balasubramanyan, K. 1978. Biosystematics of Marakkanam Reserved Forest, Coromandel Coast. Ph. D. Thesis, Annamalai University.

Bharucha, F.R. and Dave, R.N. 1947. The Biological Spectrum of a Grassland Association. J. Univ. Bombay, 12:15-25.

Bharucha, F.R. and Ferreira, D.B. 1941. The biological spectrum of Matheran and Mahabaleshwar flora. J. Indian Bot. Soc., 20(4):195-211.

Braun-Blanquet, J. 1932. Plant Sociologie; the study of plant communities. McGraw-Hill, New York, 438p.

Brenan, W. 1921. Vaxtageografiska studier i Barosunds skargard. Acta Soc. Fauna Flora Fennica, 49:5.

Champion, H.G. and Seth, S.K. 1968. A Revised Survey of the Forest Types of India. Manager of Publications, New Delhi, 404p.

Chandbasha. 1977. A Revised Working Plan for Palghat Forest Division, 1975-'76 to 1984-'85. Government Press, Trivandrum.

Chopra, R.N.; Nayar, S.L. and Chopra, I.C. 1956. Glossary of Indian Medicinal Plants. CSIR., New Delhi.

CSIR. 1976. Wealth of India; Raw Materials, v.10. CSIR., New Delhi.

Dahl, E. and Hadac, E. 1949. Homogeneity of plant communities. Stud. Bot. Czechoslov., 10:159-176.

Das, R.B. and Sarup, S. 1951. The biological spectrum of Indian desert flora. (University of Rajasthan Studies) University of Rajasthan, Jodhpur, pp.36-42.

Daubenmire, R.F. 1968. Plant Communities; A Textbook of Plant Synecology. Harper and Row, New York, 300p.

Du Rietz, G.E. 1921. Zur methodologischen grundlage der moderner pflanzensoziologie. Holzhausen, Wien.

ECE/FAO. 1974. Report on Adhoc Meeting of Experts on Environmental Benefits of Forestry, April, 1-5, 1979, Geneva, FAO., Rome.

Edit. 1977. A Study of Habitat Disruption by Forest Management. Bulletin of the Canadian Society of Environmental Biologists, 34(2):18-31.

Ellenberg, H. and Mueller Dombois, D. 1967. A key to Raunkiaer plant life forms with revised subdivisions. Ber. Geobot. Inst., ETH., Stiftg. Ruhel, Zurich, 37:56-73.

FAO. 1962. Forest Influences. FAO Forestry and Forest Products Studies No.15, FAO., Rome.

Ferreira, D.B. 1940. The Vegetable Life Forms of Central and Southern Deccan in Peninsular India. M.Sc. Thesis, Bombay University.

Fracker, S.B. and Brischle, H.A. 1944. Measuring the local distribution of Ribes. Ecology, 25:283-303.

Gates, F.C. 1949. Field Manual of Plant Ecology. McGraw-Hill, New York.

India, Census. 1961. Village Survey Monographs, Tribal Area (v.7, Kerala, part 6G) Director of Census Operations, Kerala, Trivandrum, 1973.

India, Census. 1971. District Census Handbook; Palghat (Series -9, Kerala) Director of Census Operations, Kerala, Trivandrum, 1973.

Jaccard, P. 1912. The distribution of flora of Alpine zone. New Phytol., 11:37-50.

Jaccard, P. 1928. Die statistische-floristische methods ah grundlage der pflanzensoziologie. In Abderhalden: Hand. Biol. Arbeitsmith, 11:165-202.

Jackson, M.L. 1958. Soil Chemical Analysis. Prentice Hall, Englewood Cliffs.

Kerala Government, Vested Forest Committee. 1975. Report. Trivandrum.

King, K.F.S. 1979. Agroforestry and the utilization of fragile ecosystems. Forest Ecology and Management, 2(3):161-168.

King, K.F.S. and Chandler, M.T. 1978. The Wasted Lands; The Programme of Work of ICRAF., Nairobi.

Kirtikar, K.R. and Basu, B.D. 1935. Indian Medicinal Plants. Periodical Experts, New Delhi. v.4.

Kunhahmmed, K.C. 1960. Working Plan for the Estate Forests of Kalladi Cheriya Kunhahmmed of Mannarghat. (Unpublished)

Kylin, H. 1926. Uber begriffsbuildung und statistik in der pflanzensoziologie. Bot. Notesser, 1926.81-180.

Lahiri, T.C.; Raghavan Nambiar, A. and Reddy, U.S. 1977. Report on the Geochemical Sampling for Precious Metals in Parts of Attappady Area, Palghat District, Kerala State. Progress Report of the GSI for the period 1974-'75 (Unpublished)

Lakshmanachary, A.S. and Rangaswami Ayyengar, K. 1970. Raunkiaer's Biological spectrum of the flora of Annamalainagar. J. Annamalai Univ. Sci., 25:57-60.

Legris, P. and Viart, M. 1961. Bioclimates of South India and Ceylon. Trav. Sech. Sci. Tech. Inst. fr. Pondichery, 3(2):165-178.

Madras Government 1949. Madras Preservation of the Private Forest Act 1949.

Mani, G. 1965. Report on the Systematic Mapping and Mineral Survey of Attappady Valley and Adjacent Hilly Tracts, Palghat District, Kerala State. Progress Report of the GSI for the period 1964-65. (Unpublished)

Meher-Homji, V.M. 1964. Life forms and biological spectra as epharmonic criteria of aridity and humidity in the tropics. J. Indian Bot. Soc., 43(3):424-430.

Misra, R. 1969. Ecology Workbook. Oxford and IBH., Calcutta, 244p.

Misra, R. and Puri, G.S. 1954. Indian Manual of Plant Ecology. English Book Depot, Dehra Dun.

Moravec, J. 1973. The determination of minimal area of phytocoenoses. Folio Geobot. Phytotax., 8:23-47.

Mueller-Dombois, D. and Ellenberg, H. 1974. Aims and Methods of Vegetation Ecology. John Wiley and Sons, New York.

Muhammad, E. 1967. Revised Working Plan for the Palghat Forest Division, 1959-'60 to 1973-'74. Government Press, Trivandrum.

Nordhagen, R. 1923. Om homogenitat, konstans of minimal areal. Nyt. Mag. f. Naturvid, 61:1-51.

Oosting, H.J. 1956. The Study of Plant Communities. W.H. Freeman, San Francisco.

Pandeya, S.C. 1953. Grasslands of Sauger, Madhya Pradesh. Indian For., 78:638-654.

Pichi-Sermolli, R. 1948. An index for establishing the degree of maturity in plant communities. J. Ecol., 36:85-90.

Poore, M.E.D. 1964. Integration in the Plant Community. J. Ecol., 52:143-196.

Poore, M.E.D. 1968. Studies in the Malaysian Rainforest I - The forest on triassic Sediments in Jengka forest reserve. J. Ecol., 56:143-196.

Poore, M.E.D. 1976. The values of tropical moist forest ecosystems and the environmental consequences of their removal. Unasylva, 28(112/113):127-143.

Raunkiaer, C. 1934. The Life Forms of Plants and Statistical Plant Geography. Clarendon Press, Oxford, 632p.

Raunkiaer, C. 1937. Plant Life Forms. Clarendon Press, Oxford, 104p.

Richards, P.W. 1952. The Tropical Rain Forest. Cambridge University Press, Cambridge, 450p.

Rommell, L.G. 1926. Bemerkungen Zum homogenitats problem. Svensk. Bot. Tidskr., 20:441-455.

Siddiqui, M.O. 1972. Biological spectrum of the forests of Gorakhpur. Trop. Ecol., 13(2):234-235.

Singh, K.P. and Misra, R. 1978. Structure and functions of Natural, Modified and Silvicultural Ecosystems of Eastern Uttar Pradesh. Technical Report, Banarus Hindu University, Varanasi.

Tuxen, R. 1970. Einige Boslandes und Typenmerkala in der strükture der pflanzengesellschaflen. In Juxen, R. ed. Gesellschaftmorphologie, Ber. Inst. Symp. Rinteln, 1966. Junk, Den Hagg.

Unesco. 1973. International Classification and Mapping of Vegetation (Ecology and conservation series) Unesco, Paris.

Van Haeften, C.J. 1943. A Revised Working Plan for the Palghat Forest Division, 1943-'44 to 1957-'58.

Van Steenis, C.G.G.J. 1957. Tropical Lowland Vegetation; The Characteristics of its Types and their Relation to Climate, 9th Pac. Sci. Cong. Bangkok.

Venkateswara Ayyar, T.V. 1935. Working Plan for the Ghat forests of Palghat Division. Government Press, Trivandrum.

Ward, V.W. 1978. Biological Environmental Impact Studies; Theory and Methods. Academic Press, New York.

Werger, M.J.A. 1972. Species-area relationship and plot size with samples from South African Vegetation. Bothalia, 10:583-594.

Werger, M.J.A. 1974a. The place of Zurich-Montpellier method in vegetation science. Folio Geobot. Phytotax. Praha., 9:99-109.

Werger, M.J.A. 1974b. On concepts and techniques applied to Zurich-Montpellier method of Vegetation Survey. Bothalia, 11(3):309-323.

Whitford, P.B. 1948. Distribution of woodland plants in relation to succession and clonal growth. Ecology, 30:199-208.

Whitmore, T.C. 1975. Tropical Rain Forests of the Far East. Clarendon Press, Oxford.

Yangambi Conf. 1956. Phytogeography - yangambi (CSA/CCTA Publications 22) CSA., London, 35p.

Zachariah, P.K. First Working Plan for Palghat Special Forest Division, 1980-'81 to 1989-'90. (Unpublished)

APPENDIX II

LIST OF IMPORTANT MEDICINAL PLANTS

I. Roots

Aerva lanata
Alangium salvifolium
Amaranthus spinosus
Anamiita cocculus
Asparagus racemosus
Bidens pilosa
Boerhaavia diffusa
Cassia alata
Celosia argentea
Citrus spp.
Clerodendrum viscosum
Clitoria ternatea
Connarus monocarpus
Cyclea peltata
Cyperus rotundus
Desmodium gangeticum
Eleusine sp.
Glycosmis pentaphylla
Gmelina arborea
Hemidesmus indicus
Ipomoea bracteata
Lantana camara
Musa paradisiaca
Nicandra physaloides
Nilgirianthus barbatus
Pavonia odorata
Plumbago rosea
Plumbago zeylanica
Rauvolfia serpentina

Ricinus communis
Sida acuta
Solanum indicum
Solanum nigrum
Solanum pubescens
Solanum verbascifolium
Spatholobus purpureus
Tragia involucrata
Vallaris solanacea
Vetiveria zizanioides

II. Stem (aerial and subterranean)

Acorus calamus
Allium sativum
Baliospermum montanum
Bambusa arundinacea
Calamus rotang
Coscinium fenestratum
Curcuma angustifolia
Gloriosa superba
Saccharum officinarum
Santalum album
Tinospora cordifolia
Zingiber officinale

III. Leaf

Ageratum conyzoides
Biophytum sensitivum
Breynia patens
Cassia occidentalis
Chenopodium ambrosioides
Cleome viscosa
Coccinia cordifolia
Cocculus hirsutus

Commelina sp.
Crateva nurvala
Cyclea peltata
Cymbopogon flexuosus
Datura metel
Gymnema sylvestre
Indigofera tinctoria
Jasminum angustifolium
Kalanchoe pinnata
Kydia calycina
Lycopersicon lycopersicum
Maesa indica
Martynia annua
Melia azadirachta
Nicotiana tabacum
Ocimum americanum
Piper betle
Polygala chinensis
Pongamia pinnata
Ricinus communis
Solanum nigrum
Solanum verbascifoluim

IV. Bark

Ailanthus excelsa
Alstonia scholaris
Crataeva nurvala
Dalbergia sissoides
Ficus bengalensis
Ficus racemosa
Ficus religiosa
Jatropha glandulifera
Madhuca longifolia
Mangifera indica

Oroxylum indicum
Ricinus communis

V. Latex

Euphorbia neriifolia
Wrightia tinctoria

VI. Flower

Careya arborea
Leonotis nepataefolia

VII. Fruits

Areca catechu
Argemone mexicana
Calamus rotang
Cuminum cyminum
Emblica officinalis
Helicteres isora
Musa paradisiaca
Piper nigrum
Piper trinicum
Pongamia pinnata
Sesamum indicum
Setaria italica
Solanum pubescens
Terminalia bellerica
Terminalia chebula

VIII. Entire Plant

Achyranthes aspera
Andrographis paniculata
Rotula aquatica
Leucas aspera

Neptunia oleracea

Oldenlandia biflora

Phaseolus trilobus

Sida acuta

Trichosanthes cucumerina