ADOPTION OF DROUGHT MANAGEMENT PRACTICES BY RUBBER PLANTERS IN KUNNATHUNADU TALUK OF ERNAKULAM DISTRICT

By

ABDUL RAHIMAN, A. K.

DISSERTATION

Submitted in partial fulfilment of the requirement for the

POST GRADUATE DIPLOMA IN NATURAL RUBBER PRODUCTION

of the Faculty of Agriculture

Kerala Agricultural University

Department of Plantation Crops and Spices

COLLEGE OF HORTICULTURE

KERALA AGRICULTURAL UNIVERSITY

Vellanikkara-Thrissur

1994

DECLARATION

I hereby declare that this dissertation entitled "**Adoption of Drought Management Practices by Rubber Planters in Kunnathunadu Taluk of Ernakulam District**" is a bonafide record of research works done by me during the course of placement/training and that the dissertation have not previously formed the basis for the award to me on any degree, diploma, associateship or other similar title of any other University or Society.

Vellanikkara
11-9-1994

A.K. ABDUL RAHIMAN

ACKNOWLEDGEMENT

I hereby acknowledge with deep sense of gratitude the help rendered by Dr.P.A.Nazeem, Associate Professor, Dept. of Plantation Crops and Spices, College of Horticulture, Vellanikkara, who guided the work, besides being constant source of encouragement.

I take this opportunity to express my sincere thanks to Dr.K.R.Vijayakumar, Dy. Director, Rubber Research Institute of India, Kottayam and Co-chairman of the advisory committee for well founded suggestions offered for the completion of the survey work.

I wish to place with utmost sincerity, my deep sense of gratitude to the committee members namely Dr.E.V.Nybe, Associate Professor, College of Horticulture, Vellanikkara and Dr.P.K.Asokan, Associate Professor, College of Forestry, Vellanikkara for their time to time advise.

I also take this opportunity to express my deep sense of gratefulness to Sri.A.V.Ramabhadran, Development Officer, Rubber Board for his valuable suggestions in completing the study.

My sincere thanks are due to Sri.M.V.Sudhi, Field Officer, Rubber Board, Perumbavoor and Sri.P.V.Geevarghese, Field Officer, Rubber Board, Kolenchery who have rendered great help in selecting the holdings and collecting the data.

A.K. ABDUL RAHIMAN

CERTIFICATE

Certified that the dissertation entitled "**Adoption of Drought Management Practices by Rubber Planters in Kunnathunadu Taluk of Ernakulam District**" is a record of research work done independently by **Sri.A.K.Abdul Rahiman** under our guidance and supervision and that it has not previously formed the basis for the award of any degree or diploma to him.

We the undersigned members of the Advisory Committee of Sri.A.K.Abdul Rahiman, a candidate for the Post Graduate Diploma in Natural Rubber Production, agree that the dissertation entitled "Adoption of Drought Management Practices by Rubber Planters in Kunnathunadu Taluk of Ernakulam District", may be submitted by Sri.A.K.Abdul Rahiman, in partial fulfilment of the requirement of the Diploma.

Dr.P.A.Nazeem
Associate Professor
Dept. of Plantation Crops &
Spices, College of Horticulture
Vellanikkara
(Chairperson)

Dr.K.R.Vijayakumar
Deputy Director
Rubber Research Institute of
India, Kottayam
(Co-chairman)

Dr.E.V.Nybe
Associate Professor
Dept. of Plantation Crops &
Spices, College of Horticulture
Vellanikkara
(Member)

Dr.P.K.Asokan
Associate Professor
College of Forestry
Vellanikkara
(Member)

CONTENTS

LIST OF TABLES

LIST OF PLATES

LIST OF ANNEXURES

INTRODUCTION

Natural rubber is nature's one of the most versatile plant products. This material has multifarious uses and there is hardly any segment of life which does not make use of rubber based materials. Without an adequate supply of natural rubber, the wheels of world industry will come to a grinding halt. There is virtually no commodity that occupies such an uniquely strong and irreplaceable end use requirement positions.

Hevea brasiliensis the major source of natural rubber is a native of Brazil introduced to tropical Asia in 1876 through Kew Garden in U.K. with the seeds brought from Brazil by Sir Henry Wickham. The tree is now grown in the tropical regions of Asia, Africa and America.

Rubber cultivation in India at present is mainly confined to a narrow belt extending from the Kanyakumari district, the South West region of Tamil Nadu in the South to the Coorg District of the Karnataka State in the north and lying in general west of the Western Ghats and parallel to them for approximately 400 Km. The soils in this rubber tract are highly weathered and consist mostly laterite and lateritic types. Red and alluvial soils are also seen in some areas. At present the cultivated area of rubber in India comes to approximately 5 lakhs hectares.

For optimum growth and yield, rubber plants require an evenly distributed rainfall of 2000-3000 mm in an year. In areas

where rainfall is much less it has been observed that the trees become stunted with crooked stems and lower branches. In general, growth of rubber is retarded in regions with a pronounced drought season. Excessive rainfall is also not desirable as it favour soil leaching. It may also cause water logging or high water table and attendant problems if drainage is not adequate. All these reveals the importance of drought management/water management practices in rubber plantations.

Kerala gets plenty of rainfall through the two monsoons, South-West and North-East monsoons. But the pattern and distribution of this rainfall is not ideal for the efficient conservation and utilization of rain water. So a lot of water is being wasted. To overcome this efficient water conservation methods are to be adopted.

Kunnathunadu is a large Taluk of Ernakulam District with an area of 677.72 sq. Kms and the soil is lateritic with sufficient depth. Rubber cultivation in this area on a large scale was begun from 1979 with the introduction of new planting subsidy for rubber by the Rubber Board. Formerly cashew was the major crop in the hills and hillocks of Kunnathunadu Taluk and paddy in the valleys. As in other parts of Kerala, here also the annual rainfall is around 3000 mm; but the pattern of distribution is not ideal for rubber cultivation. Further the rubber plantations are mainly confined to sloppy areas and hence efficient water conservation methods are highly essential for optimum growth and productivity. Moreover there is a long dry spell of nearly six months every year. The farmers in Kunnathunadu Taluk are not traditionally rubber planters and hence require proper

guidance in drought management practices. It is because of these reasons the survey was initiated and conducted in Kunnathunadu Taluk. The objective of the present study was to evaluate the different drought management measures adopted by the rubber growers of Kunnathunadu taluk and to suggest modifications, so as to improve the growth and productivity of rubber in the area.

REVIEW OF LITERATURE

Kerala gets plenty of rainfall every year through the two monsoons - South West and North East Monsoons. But the pattern and distribution of this rainfall is not ideal for the efficient conservation and utilization of rain water. So we loose lot of water by way of surface run off.

A review of previous works either theoretical or empirical would help in the delineation of new problem areas and provide a basis for developing a theoretical frame work for the study of drought management. Though studies in the adoption of dry land technology are available, studies concerned with the adoption of drought management practices are very limited.

Many scientists and scientific institutions have defined drought in various ways.

According to Hoyt (1938) when in an area that is desiccated or defoliates unseasonally or when precipitation is insufficient to meet the needs of established human activities drought condition may be said to prevail.

According to Ramdas (1950) drought is an occassion when the actual rainfall fell short of the normal by more than twice the mean deviation. Landsberg (1958) however differed drastically with all these definitions and said that drought is a biological, rather than

a climatic phenomena and that it should be defined separately for each plant species and soil environment. Linsley *et al.* (1959) defined drought as a "sustained period of time without significant rain fall". Thomas (1962) stated that "drought is a meteorological phenomenon and occurs when precipitation is less than the average and deficiency is great enough and long enough to hurt mankind". Hofman *et al.* (1968) defined a drought year as a year having less than 85 per cent of the normal precipitation, a period of at least 21 days when the precipitation less than 30 per cent of the normal.

The above reviews clearly indicate that drought is a meteorological phenomenon when the rain fall deviates considerably from what is normal which leads to animal and crop losses affecting human survival.

In one of the studies conducted in Kerala Agricultural University it has been observed that considerable quantity of water is lost from eucalyptus plantation intercropped with various annual crops during the rainy season (Gopinath, 1982).

There has been considerable advancement in developing water harvesting technics for micro water sheds. However, the observations given for developing techniques for conserving water in farm land situation are limited. Rainfall infiltration studies under *Cryptomeria japonica* revealed that sites located in heavily littered soils have higher initial infiltration compared to non littered soils (Yadav, 1989). The drop in infiltration rate with time was less in littered soil. There are observations that infiltration capacity of

soil is more under soils where selective felling was adopted compared to those under clear felling system. Studies on litter interception of rainfall [redacted] showed that litter interception ranged in between 7.9 to 11.8 per cent of the gross rainfall. It is also observed that the broad leaved species intercepted greater amount of rain water than the other. These results highlight the importance of trees in increasing the efficiency of rain water conservation in crop fields. Experiments conducted under ICRISAT, Hydrebad demonstrated that trees in the cropping system can enhance the utilisation of rainwater. However, the trees tend to compete with other component crops for moisture and reduced the yield. The importance and possibilities of water harvesting techniques for agroforestry systems have been discussed in detail by many authors.

Of the many factors limiting the crop production, drought stands out as the most important one in crops where water relation is of particular relevance.

Scientific information on the nature and characteristic of the drought would go a long way in planning agricultural and allied activities.

The performance of Hevea tree is known to be greatly influenced by water relations and the cultivation of the crop is mainly confirmed to the humid tropics akin to its place of origin where hardly any stress condition prevail.

The severity of drought can be managed in two different ways

ie., by conserving maximum water during monsoon season and by reducing evapotranspiration during summer season. The drought management practices recommended for rubber include mulching, white washing, cover cropping, contour planting, providing terraces, edakkayyals, trenches, silt pits etc. (Rubber Board recommendations).

MATERIALS AND METHODS

Rubber has become one of the major crops in Kunnathunadu Taluk of Ernakulam District. Present study was intended to identify the different drought management practices adopted by rubber growers of Kunnathunadu Taluk, find out its efficiency so as to popularise the most suited drought management practices for obtaining maximum growth and productivity in the locality.

3.1 Selection of holdings

Survey was conducted in Kunnathunadu Taluk of Ernakulam District. For this 53 small rubber holdings with an area ranging from 0.5 to 5.00 ha were randomisely selected based on the records maintained at the Regional Office of the Rubber Board at Ernakulam. The location of the selected holdings and the details are represented in Annexure I.

3.2 Collection of data

Data were collected from the holdings based on a predesigned questionnaire, the details of which are given in Annexure-II.

3.2.1 Observation

Observations were recorded on the following aspects.

3.2.1.1 General information

Details regarding the holder and holdings were collected and

tabulated. Topography of the land in the surveyed area was studied and classified as Flat, Gentle slope, Medium and Steep based on visual judgement. Level of water table during peak monsoon period and peak drought period were collected. Soil in the surveyed area was classified into four groups based on soil depth and presence of rocky patches and tabulated. Soil with less than one metre depth was catagorised under poor, those with one metre depth under satisfactory and soil with depth more than one metre under good. Data regarding year of planting and planting materials used were collected. The different spacing adopted were also noted.

3.3 Incidence of drought and its management

Latest weather data of the locality was not available. Last published data available for the locality is given in Annexure-III. The influence of drought that occurred in 1983 and 1987 on the rubber planting in the surveyed area was also discussed with the farmers.

The details of drought management practices adopted by the farmers were collected under three heads viz. engineering methods, vegetative methods and other methods.

3.3.1 Engineering methods

Under engineering methods, different types of terracing, trenching and providing silt pits were studied. Farmers of Kunnathunadu Taluk were in the habit of taking terraces wherever necessary. The method of terracing, details of maintenance and repairs done,

edakkayyalas formed etc. were collected. The frequency of taking silt pits, depth of silt pits and its maintenance (desilting etc.) in the locality were observed and recorded.

3.3.2 Vegetative methods

Vegetative methods that can be adopted for soil and water conservation include raising of intercrop and establishment of leguminous cover crop. Details of intercropping and cover cropping; their establishment and management practices were collected.

3.3.3 Other methods

Other methods adopted for drought management include mulching the plant bases and whitewashing the brown stem. Providing fire belts is still another drought management practice. Details regarding adoption of these practices were collected.

RESULTS AND DISCUSSION

4.1 General information of the surveyed area

General information regarding the holding selected is given in Annexure IV. Details regarding topography of the area, size of the holdings, planting materials used, age of plants etc. were collected and presented.

4.1.1 Topography of the area

The terrain of land in Kunnathunadu Taluk was found to vary in different holdings of the surveyed area. Most of the holdings surveyed (48%) are in gentle slope, while about six per cent of the holdings are in steep slope. Flat and level areas were observed in 24 per cent of the holdings (Table 1).

In Kunnathunadu Taluk the forest areas which were ear marked for the collection of mulch for paddy cultivation were brought under rubber cultivation recently and even dry paddy fields were utilized for rubber cultivation and this may be the reason for the presence or more holdings in flat and gentle slope areas.

4.1.2 Depth of soil

The soil depth prescribed for the satisfactory growth of rubber is about one metre. In the surveyed area 66 per cent of the holdings were having soil with satisfactory depth (Table 2). Shallow

Table 1. Topography of land in the surveyed area

Topography	No. of holdings	Percentage
1. Flat	12.5	23.60
2. Gentle slope	25.5	48.10
3. Medium slope	12.0	22.60
4. Steep	3.0	5.70
Total	53.0	100.00

Table 2. Soil depth and presence of rocky patches in the surveyed area

Type of soil	No. of holdings	Percentage
1. Poor (< 1 m)	3	5.67
2. Satisfactory (1 m)	35	66.00
3. Good (> 1 m)	3	5.67
4. Presence of rocky patches (within 1 to 1.5 m)	12	22.64

soil was observed in three units i.e., around six per cent of the total holdings in the surveyed area had poor soil depth as far as rubber cultivation is concerned. It was also observed that about 23 per cent of the holdings had patches of rock in the sub soil. However the rocky patches were rather deep in the soil with little interference in the root zone of rubber. Hence the practice of ascertaining the soil depth at the time of site selection is to be strictly adhered to in Kunnathunadu Taluk. Relatively low percentage of area (6%) were found to have good soil depth in the surveyed area.

4.1.3 Size of the holdings

Out of the 53 holdings surveyed 20 (38%) were within the range of 1 to 1.5 ha (Table 3). Majority of the holdings selected in the surveyed area were of holdings size less than three hectare. Only eight per cent of the holdings were having an area of more than three hectare. In the present study holdings having an area of 0.5 ha and above were only selected for the survey. Others were not considered since the soil conservation and drought management practices adopted in such holdings would not represent the whole area.

4.1.4 Water table

Data on the water table of the locality was collected during peak rain and during peak drought periods. Size of water table during peak rain period in flat area was found to be 11.3 m, in gentle area 10.1 m, in medium are 10.4 m and in steep area it was 8.2 m where as the corresponding data during peak drought period was 3.73, 3.00, 3.75 and 2.00 cm respectively (Table 4).

Table 3. Area-wise distribution of the holdings selected for the survey

Area (in ha)	No. of holdings	Percentage
1. 0 to 0.50	3	5.66
2. 0.51 to 1.00	13	24.50
3. 1.01 to 1.50	20	37.70
4. 1.51 to 2.00	7	13.20
5. 2.01 to 2.50	3	5.66
6. 2.51 to 3.00	3	5.66
7. 3.01 to 3.50	--	--
8. 3.51 to 4.00	--	--
9. 4.01 to 4.50	1	1.88
10. 4.51 to 5.00	3	5.66
Total	53	100.00

Table 4. Water table (Height of water level from bottom of well)

	Flat	Gentle	Medium	Steep
		(metres)		
a) During peak rain	11.30	10.10	10.90	8.20
b) During peak drought	3.73	3.00	3.75	2.00

4.1.5 Planting materials

The farmers in the surveyed area were found to use advanced planting materials in all the holdings. More than 90 per cent of the farmers used polybagged plants and the remaining farmers used budded stumps (Table 5). The benefits of poly bag plants and the additional incentives given for polybagged plants attracted more growers and this resulted in the use of polybagged plants on a large scale. The reduction in the gustation period by one or two years would be another factor which encouraged the use of polybagged plants. The drought induced casuality during early periods of establishment can be considerably reduced by using this planting material.

In about 97 per cent of the holdings surveyed planting was done with RRII 105 and the rest were occupied with P.B. clones (Table 6). The induction of RRII 105, the clone developed by the Rubber Research Institute of India in the first category of approved planting material was a break through in the field of rubber cultivation. The vigorous growth, higher yield potential and resistance to abnormal leaf fall disease were the main factors for its popularity among the planters.

4.1.6 Spacing and planting practices adopted

Data were collected for the different spacings adopted by the rubber planters in Kunnathunadu Taluk. The units surveyed were grouped in to 11, based on the spacing adopted (Table 7). Majority of the farmers (66%) adopted square planting with different spacings

Table 5. Type of planting material used

Category	No. of holdings	Percentage
1. Polybag plants	49	92.45
2. Budded stumps	4	7.55
Total	53	100.00

Table 6. Variety/clones used for planting in the surveyed area

Name of clone/variety	No. of holdings	Percentage
1. RRII 105	51.5	97.20
2. P.B. clones	1.5	2.80
Total	53.0	100.00

Table 7. Distribution of holdings under various spacings adopted in the surveyed area

Spacing (m)	Topography				Total	Percentage
	Flat	Gentle	Medium	Steep		
1. 3.40 x 3.40	--	--	--	--	1.0	1.88
2. 3.70 x 3.70	--	1	--	--	1.0	1.88
3. 4.00 x 3.70	--	--	1	--	1.0	1.88
4. 4.00 x 4.00	3	6	--	2	11.0	20.75
5. 4.28 x 4.00	1	--	1	--	2.0	3.77
6. 4.28 x 4.28	6	10.5	--	--	16.5	31.13
7. 4.57 x 3.70	1	--	--	--	1.0	1.88
8. 4.57 x 4.00	--	--	1	--	1.0	1.88
9. 4.57 x 4.57	1	1	3	--	5.0	9.43
10. 5.14 x 3.70	--	2.5	--	--	2.5	4.21
11. 5.70 x 2.85	0.5	2.5	8	--	11.0	20.70
Total	12.5	23.5	14	3	53.0	100.00

such as 3.4 m^2, 3.7 m^2, 4 m^2, 4.28 m^2 and 4.57m^2. The other common method was the rectangular planting. However it was observed that the planting and spacing were not in accordance with the terrain of the land. Holdings having steep slope were found to adopt square system of planting against the recommended practice of contour planting. Farmers of Kunnathunadu Taluk are to be made more aware of the consequences of defective planting in sloppy area.

None of the farmers in the surveyed locality were found to take substandard pits for planting rubber. Ideal pits were taken for planting in 96 per cent of the holdings while the others took even larger pits for planting (Table 8).

4.1.7 Age of plants

The holdings surveyed were grouped in to 3 based on their age. The age groups were below four year (22.64%), four to seven year (67.92%) and above seven years (9.44%) (Table 9). The drought management practices are more critical during the initial stages of growth. The distribution of holdings according to age group indicate that the population selected for the study could reflect the drought management practices adopted in the area.

4.2 Drought management practices

The drought management practices adopted in the locality are grouped into three as engineering methods, vegetative methods and other methods.

Table 8. Planting practices adopted pit size

Size of pits (cm)	No. of holdings	Percentage
a) 75 x 75 x 75	51	96.20
b) > 75 x 75 x 75	2	3.80
c) < 75 x 75 x 75	Nil	--

Table 9. Distribution of holdings according to age group of plants

Age of plants	No. of units	Percentage
Below 4 years	12	22.64
4 to 7 years	36	67.92
Above 7 years	5	9.44
Total	53	100.00

4.2.1 Engineering methods

Different types of terracing and providing silt pits were the main engineering methods found adopted in the surveyed area as a means of conserving soil and water.

4.2.1.1 Methods of terracing

Methods of terracing found adopted in the surveyed area are presented in Table 10. Terracing was found adopted in more than 90 per cent of the holdings. Individual terraces, contour terrace and continuous terraces were found practiced as a means of soil and water conservation in Kunnathunadu Taluk. Continuous terraces were more popular and in about 58 per cent of the holdings this practice was adopted. Though terracing was a common practice the farmers were found not adhering to the scientific recommendations. Out of the three units having steep terrain, contour terracing was found adopted only in one unit. It was also observed that seven units with gentle terrain have practiced contour terracing, though it was not essential.

Defective terracing was observed in 20 per cent of the holdings. The defects observed were inadequate width inadequate slope and the lack of annual repairs (Plate I). However, it was observed that the defects were rather negligible in areas having steep slope (Table 10). Thus the farmers of Kunnathunadu Taluk are found well aware of soil conservation practices through terracing but they are to be more informed of the scientific practices to be adopted.

Table 10. Engineering methods for drought management adopted in the surveyed area

I. Terracing methods and its maintenance

Particulars	Topography				Total	Percentage
	Flat	Gentle	Medium	Steep		
	(No. of holdings)					
1. Type of terracing						
a) Individual terraces	-	2	1	-	3	6.25
b) Contour terraces	-	7	9	1	17	35.41
c) Continuous terraces	8	16	2	2	28	58.34
2. Maintenance of terraces						
a) No. of units where terracing is adopted	8	25	12	3	48	90.57
b) No. of units where terraces are properly maintained	4	22	9	3	38	79.17
c) No. of units with defective terracing	4	3	3	-	10	20.83
3. Defects in terracing observed						
a) Inadequate width	-	2	1	-	3	6.25
b) Inadequate slope	2	1	1	-	4	8.34
c) Annual repair or maintenance not done	2	-	1	-	3	6.25

Plate 1. A mature rubber holding showing defective maintenance of continuous terraces

4.2.1.2 Providing silt pits

Silt pits were generally provided in between the terraces and also in areas with gentle slope, but where terracing is not done. Silt pits would help to reduce the velocity of run off water, prevent loss of surface soil and also help to conserve rain water. Though it is a recommended practice only very few holdings (4%) in the surveyed area had taken silt pits as a means of conserving soil and water (Table 11). Great difference was also observed for the frequency of providing silt pits. Out of the two units, one had the frequency of 45/ha while in the other, it was 250/ha. Maintenance of silt pits was poor and desilting was not found adopted in any of the units. Shallow depth, improper alignment and high frequency were the other defects observed (Table 11).

4.2.1.3 Fire belts

Young rubber plantations with dried up materials underneath or mature plantations with thick layer of litter following wintering make the holdings highly prone to fire damage during the dry hot weather months. Fire may originate from a neighbouring jungle or due to personnel carelessness or by accident. Just before the commencement of summer, fire belts are to be provided. Out of the 53 holdings surveyed, fire belts were found taken in 11 units. Fire belts were made by clearing strip of three metre width all along the boundary of the holdings. Dry leaves falling on these fire belts were removed at

Table 11. Engineering methods for drought management

2. Details of silt pits provided

Particulars	Tapography				Total	Percentage
	Flat	Gentle	Medium	Steep		
	(No. of units)					
1. No. of units where silt pits taken	-	2	-	-	2	3.77
2. Size of silt pits						
a) 90 x 60 x 45 cm	-	1	-	-	1	50.00
b) 60 x 60 x 25 cm	-	1	-	-	1	50.00
3. Frequency (No./ha)						
a) 250/ha	-	1	-	-	-	50.00
b) 45/ha	-	1	-	-	-	50.00
4. Maintenance of pits						
a) Normal	-	-	-	-	-	-
b) Defective	-	2	-	-	2	100.00
5. Defects observed						
a) Shallow pits	-	2	-	-	2	100.00
b) Lack of desilting	-	2	-	-	2	100.00
c) Improper alignment	-	1	-	-	1	50.00
d) High frequency	-	1	-	-	1	50.00

frequent intervals to avoid fire hazards. Rubber growers in Kunnathunadu Taluk were found not that much cautious about the fire hazards (Table 12).

4.2.2 Vegetative methods

Vegetative methods adopted for drought management include establishment of leguminous cover and raising intercrops.

4.2.2.1 Establishment of cover crop

Different species of plants have been used as cover crops in rubber plantation. These include Pueraria sp., Centrosema sp., Calopogonium sp. and Muccuna sp. Of the 53 holdings surveyed, cover crops were found established in 42 holdings in which 36 holdings had pueraria as the cover crop. In five holdings centrosema was planted and one holding had muccuna (Table 13).

Majority of the rubber growers in Kunnathunadu Taluk had raised cover crop in the available interspace. About 20 per cent of the holdings were not having the cover crop, but this might be because of the practice of intercropping in the immaturity period. Usual practice followed there was to raise the leguminous cover after harvesting the intercrop.

The establishment of leguminous cover was good in 17 units (40%) and it was average in 14 cases. The luxurious growth *Puraria* sp. as a cover crop in the rubber holding of Kunnathunadu taluk is represented in Plate 2. In 11 cases leguminous cover crops had already faded away due to shade effect due to canopy closure (Table 14).

Table 12. Engineering methods for drought management

3. Maintenance of Fire belts

	Terrain of land				Total	Percentage
	Flat	Gentle	Medium	Steep		
1. Number of units surveyed	12	26	12	3	53	
2. No. of units where fire belts have taken	2	6	2	1	11	20.75

Table 13. Vegetative methods for drought management

Particulars	No. of units				Total	Percentage
	Flat	Gentle	Medium	Steep		
I. Cover crop						
a) Pueraria	9.00	15.00	10.0	2.00	36	67.92
b) Centrosema	-	4.00	1.0	-	5	9.43
c) Muccuna	-	-	1.0	-	1	1.90
II. Units without cover crop	3.50	6.50	-	1.00	11	20.75
Total	12.50	25.50	12.0	3.00	53	100.00

Table 14. Status of establishment of cover crop

Particulars	No. of units				Total	Percentage
	Flat	Gentle	Medium	Steep		
I. No. of units where cover crop established	9.00	19.00	12.00	2.00	42.00	79.25
II. Establishment						
a) Good	5	7	4	1	17	40.48
b) Poor	-	-	-	-	-	-
c) Average	4	6	4	-	14	33.33
d) Faded	1	5	4	1	11	26.19

Plate 2. A young rubber holding with luxurious establishment of *Pueraria* sp as ground cover

4.2.2.2 Intercropping

As a part of drought management, intercrops were also found raised along with the main crop. The intercrops raised were plantain, ginger, sesamum, cowpea and pineapple. Plantain was the main intercrop in 6 units (43%). In rubber plantations plantain provide shade to the young rubber plants, thereby giving protection from drought. But cultivating pineapple as intercrop in rubber plantation soil erosion can be checked to a certain extent due to its peculiar planting practice and rooting pattern (Table 15). Some of the intercrop combinations observed were pineapple + cover crop, ginger + cover crop and sesamum + cowpea and cowpea + pineapple.

The intercropping practiced with pineapple, plantain and ginger in Kunnathunadu taluk is represented in plates 3, 4 and 5.

Though the farmers of Kunnathunadu taluk were eager to utilize the interspaces for growing remunerative crops; the practice adopted in many cases were found not scientific. One of the holding intercropped with pineapple represented in plate 3 shows the defective alignment for the intercrop in a sloppy terrain. In this particular case individual terraces were provided for rubber, but the intercrops were grown along the slope instead of aligning it across the slope. Such a practice would rather favour runoff than checking the speed of water flow. High planting density was the defect observed in holding intercropped with plantain (Plate 4).

Defect observed in the holding intercropped with ginger is

Table 15. Intercropping

Particulars	No. of units				Total	Percentage
	Flat	Gentle	Medium	Steep		
I. No. of units intercropped	7.00	6.00	1.00	-	14.00	26.41
II. Type of intercrop						
a) Pineapple	-	2	-	-	2	14.28
b) Pineapple + cover crop	1	-	-	-	1	7.14
c) Plantain	5	-	1	-	6	42.86
d) Ginger	-	1	-	-	1	7.14
e) Ginger + cover crop	1	1	-	-	2	14.28
f) Sesamum + cowpea	-	2	-	-	2	14.28

Plate 3. A new planting of rubber on individual terrace with pineapple as intercrop

Plate 4. A young rubber holding intercropped with plantain

represented in Plate 5. The management was rather good, but for the proper allocation of space for the main crop. The ginger beds were found taken very close to the rubber plants. This would interfere with the root distribution of the main crop during December-January. Thus it is observed that there is an urgent need to make the farmers aware of the scientific practices to be adopted while intercropping rubber in Kunnathunadu taluk.

4.2.3 Other methods

Other drought management practices adopted in the area included white washing the stem and mulching the base of the plants.

4.2.3.1 Whitewashing

Whitewashing is usually practiced in young rubber plants by applying either lime or china clay on the tree trunk during drought period. The luxurient growth of rubber with its trunk whitewashed and the interspaces occupied with cover crop in summer is represented in Plate 6. It is also applied on tapping pannels to avoid sun scorch. In the surveyed area whitewashing was found adopted in 87 per cent of the holdings (Table 16).

4.2.3.2 Mulching

Since the feeding root zone of rubber is very shallow mulching the tree base during summer months would favour the tree growth, especially during the initial years when the canopy is not fully developed. Mulching was practiced in 31 units (58%) in the surveyed area. In Kunnathunadu Taluk mulching was carried out with dry leaves

Table 16. Other methods - Mulching and Whitewashing

	No. of units	Percentage
1. No. of units where mulching is done	31	58.49
2. No. of units where whitewashing is done	46	26.79
3. No. of units where both mulching and whitewashing are done	31	58.49

Plate 5. Ginger maintained as an intercrop in newly established rubber holding

Plate 6. An immature rubber plantation showing whitewashed stem and well established ground cover

and grasses. Both mulching and whitewashing were found adopted in 31 holdings (55%) (Table 16).

In general, the rubber planters of Kunnathunadu Taluk were found aware of the drought management practices. Lining, pitting, planting etc. were carried out as per standard recommendations. General maintenance and growth of plants were also found satisfactory. Though they are adopting the drought management practices, much more refinement is needed in certain aspects. More farmers are to be motivated to adopt scientific drought management practices. This can be effectively achieved by proper extension activities and providing financial assistance. Drought management practices are to be insisted in drought prone areas and areas having steep terrain.

SUMMARY AND CONCLUSION

Rubber is mainly grown as a rainfed crop and thus its productivity greatly depend on the climatic conditions and the nutrient status of the soil, prevailing in the area. Distinct rainy season and dry season are observed in all the rubber growing tracts of India and hence drought management and water conservation practices are of great relevance for this crop. Various management practices are recommended for rubber to conserve the soil moisture and to effectively thrive over the drought conditions.

Kunnathunadu Taluk of Ernakulam District is an area recently brought under rubber cultivation. The rubber growing tracts in this area include wide and varied terrain of land. The farmers in this area are not traditionally rubber growers. The study was made to evaluate the drought management practices adopted by the rubber farmers of Kunnathunadu Taluk. A survey was conducted, selecting 53 rubber holdings having a sizeable area between 0.5 to 5.0 ha and located all over the Taluk. The drought management and moisture conservation practices in the locality were assessed by studying the topography of land, the depth of soil, level of water table and various engineering and vegetative methods adopted for the purpose.

Only very little area (6%) in the surveyed locality had steep terrain where as the others were level or with gentle slope. The soil depth was found to be satisfactory having a depth of 1 m or more in most of the cases (72%). Rocky patches were observed in the

sub soil in 23 per cent of the surveyed units. Though the pitting was ideal, planting practices adopted by the farmers were found to be not in accordance with the terrain of land. Holdings having steep slope were found to adopt square system as against the recommended practice of contour planting. The farmers of Kunnathunadu Taluk are to be made aware of the consequences of defective planting in sloppy areas. The engineering methods adopted for conserving the soil/soil moisture included terracing and pitting. Individual terraces, contour terraces and continuous terraces were found formed in the locality, of which continuous terraces were more popular and were found practiced in 58 per cent of the holdings. Though terracing was common the farmers were found not adhering to the scientific recommendations. It was interesting to note that 7 units with gentle terrain had practiced contour terracing while only 1/3 of the units having steep terrain had practiced the same. Defective terracing was observed in 20 per cent of the holdings, the defects being more pronounced as inadequate width and slope besides lack of annual repair. However, it was observed that the defects were rather low in areas having steep slope.

The practice of providing silt pits so as to make the running water walk was very poor in the surveyed area. Silt pits were observed only in four per cent of the holdings and that too with poor maintenance. Shallow depth, improper alignment, lack of desilting were the defects observed in the locality.

The vegetative methods adopted for drought management included establishment of legume cover and raising of intercrops. Cover crops were observed in 80 per cent of the holdings at various stages

of establishment. *Pueraria* sp. is the common cover crop observed in the locality. Intercrops were found established in 26 per cent of the holdings with plantain being the main intercrop. Others included pineapple, ginger and sesamum.

The other drought management practices included planting of polybagged plants, whitewashing, mulching and providing fire belts. Planting of advanced planting material raised in polybags was done in 92 per cent of the holdings. Whitewashing was found adopted in 87 per cent of the holdings while mulching was practiced in 58 per cent. Fire belts were found provided in 21 per cent of the holdings and the practice adopted in these respects were quite scientific in the surveyed area.

Based on the present study it can be concluded that the farmers are aware of the drought management/moisture conservation practices that are to be adopted in rubber. The farmers are more conscious about the fact at early periods of the growth, as evidenced from the details collected for mulching, whitewashing and cover cropping.

The farmers are yet to be made more aware of the proper methods of terracing, providing silt pits, stone walls, etc. Poor adoption of these practices could be due to the high investment that it requires at initial stages and for its later maintenance. The Rubber Board has to seriously look in to this aspect and can take favourable steps like providing incentives or special subsidy schemes considering the terrain of land and agroclimate prevailing in the locality.

REFERENCES

Alexander, M. S. 1985. *Training needs of small rubber growers* (unpublished). M.Sc.(Ag) Thesis, Tamil Nadu Agricultural University, Coimbatore.

Gopinathan, R. 1982. "Agrotechniques for soil conservation in Taungya System". Ph.D. thesis, Kerala Agricultural University, Vellanikkara.

Hofman, Walter and Hanty. 1968. What is drought? Journal of Soil and Water Conservation of America, Vol.23, No.3

Hoyt, J.C. 1938. Droughts of 1930-1934. US Geol. Survey Water Supply paper No.680, pp.106

Kerala Agricultural University, 1987. Recommendations of the workshop on Drought Management Practices.

Landsberg, H.E. 1958. *Physical Climatology.*

Linsly Jr.R.K., Kohar, M.A. and Pauthus, J.L. 1959. *Applied Hydrology.* M.C.Graw Hill, New York. p.581

Ramadas, L.A. 1950. Rainfall and Agriculture. *Indian Journal for Meteorological Geo-physics* 1(4):262-74

Subrahmaniam. 1967. Eco-climatology of the tropics with special reference to India. *Proc. International Symp. on "Recent advances in Tropical Ecology"*, Varanasi, January 1967, pp.67-86

Thomas, H.E. 1962. Meteorological phenomenon in drought in the South West. *Proceeding paper* 372 A, US Geological Survey, Washington DC.

Tonnehill, J.R. 1977. Droughts, Causes and effects. Princeton University Press, London.

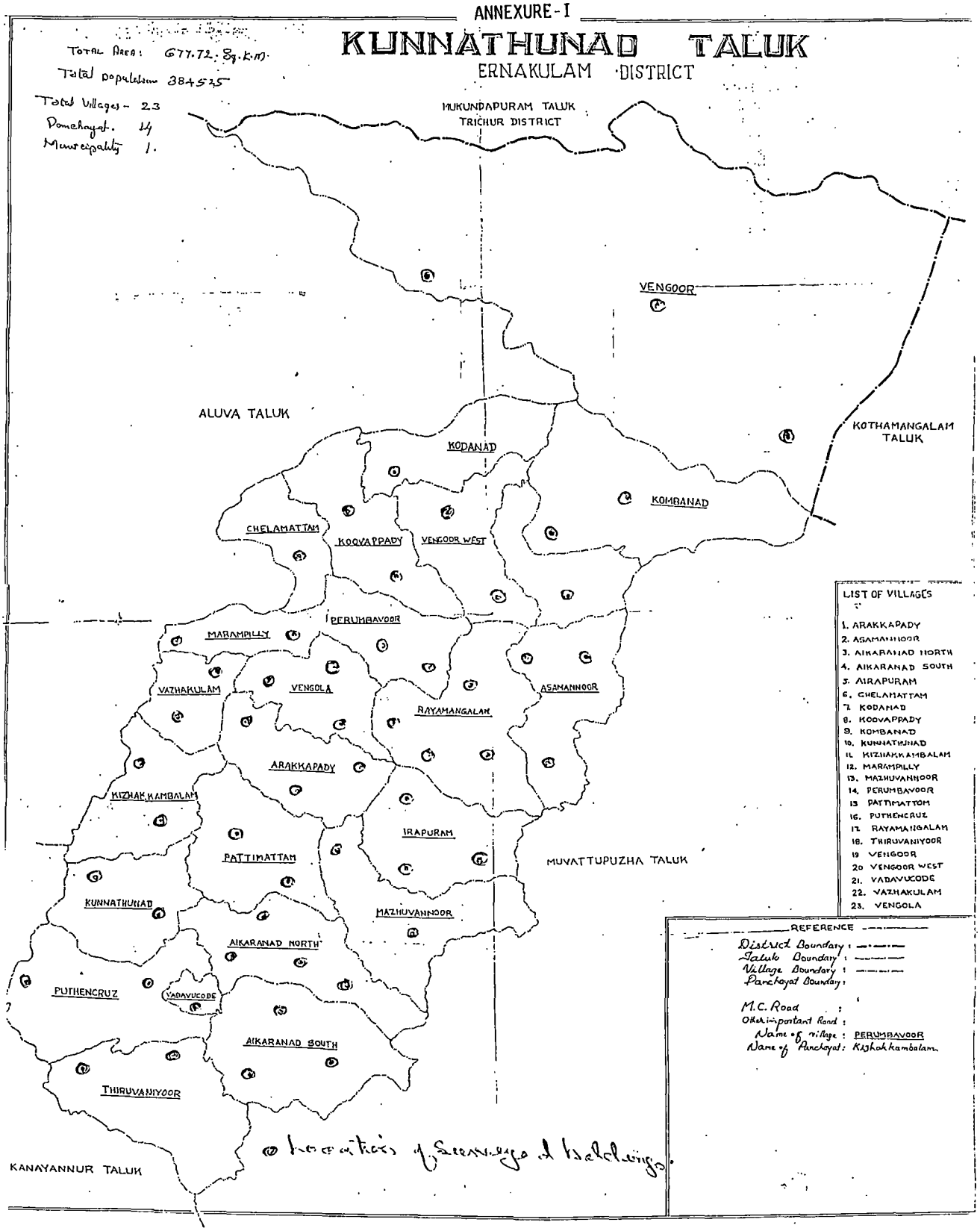
Yadav, U. 1989. Role of raindrops in soil erosion. *J. Soil Water Conser. India*. **9**:180-187

ANNEXURE - I

KUNNATHUNAD TALUK

ERNAKULAM DISTRICT

TOTAL AREA: 677.72 Sq.K.M.
Total population 384525
Total Villages - 23
Panchayat. 14
Municipality 1.



LIST OF VILLAGES

1. ARAKKAPADY
2. ASAMANNOOR
3. AIKARANAD NORTH
4. AIKARANAD SOUTH
5. AIRAPURAM
6. CHELAMATTAM
7. KODANAD
8. KOOVAPPADY
9. KOMBANAD
10. KUNNATHUNAD
11. KIZHAKKAMBALAM
12. MARAMPILLY
13. MAZHUVANNOOR
14. PERUMBAVOOR
15. PATTIMATTOM
16. PUTHENCRUZ
17. RAYAMANGALAM
18. THIRUVANIYOOR
19. VENGOOR
20. VENGOOR WEST
21. VADAVUCODE
22. VAZHAKULAM
23. VENGOLA

REFERENCE

District Boundary :
Taluk Boundary :
Village Boundary :
Panchayat Boundary :

M.C. Road :
Other important Road :
Name of village : PERUMBAVOOR
Name of Panchayat : Kizhakkambalam

ANNEXURE-II

Questionaire for the collection of data of planting/maintenance of small holdings surveyed for studying drought management practices

1. Name and address of the owner :

2.a) Register No./Ref.No. of the estate :

b) Area of the estate :

3. Location of the estate :

4. Details of planting

a) Year/month of planting :

b) Planting material used :

c) Type of planting material used :

d) Spacing adopted :

5. Topography of the land

a) Flat
b) Slope - Gentle - Medium - Steep

6. Soil depth

Poor - Good - Satisfactory - Heterogenius

7. Rock patches :

8.a) Present mean girth :

b) % of casuality :

c) Year of opening for tapping :

9. Status of cultural operation

a) Pit size :

b) Poly bag/Budded stumps :

c) Size of the poly bag plant :

d) Organic manuring in pits :

e) Contour planting adopted or not :

f) Width of contour teraces :

g) Stone wall: Slope - Satisfactory/unsatisfactory

h) Trenches :

i) Ponds provided if any :

j) Present status of contour (Maintenance) :

k) Present status of erosion control : Good/satisfactory/poor

10. Details of intercropping :

11. Details of cover crop : Species/Status of establishment

12. Weeding schedule :

13. Mulching details :

14. Watering/Irrigation

a) If pot watering - quantity/watering and frequency of watering

b) Irrigation - Basin - Drip - Other

c) Quantity/Irrigation/year

d) Frequency

15. Details of silt pits : Present/absent

If present size, number etc.

16. Yield data

a) Latex :

b) drc :

d) Dry rubber :

17. Tapping rest/summer tapping :

18. Weather data of the location :

19. Consequences of drought observed in the area :

20. Level of water table

    During peak rain :

    During peak drought :

21. Fire protection measures :

22. Other details; if any :

Signature

ANNEXURE-III

COCHIN CLIMATOLOGICAL NORMALS

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Maximum temperature	30.6	30.7	31.3	31.4	30.9	29.0	28.1	28.1	28.3	29.2	29.8	30.3
Minimum temperature	23.2	24.3	25.8	26.0	25.7	24.1	23.7	24.0	24.2	24.2	24.1	23.5
Rainfall (mm)	9.6	34.2	50.0	139.5	364.3	755.9	571.9	385.7	234.8	332.7	183.7	36.8
Rainy days	0.6	1.6	2.6	7.5	12.8	25.0	23.9	19.3	14.1	14.3	8.9	2.1

Source: Climatological tables of observations in India (1931-1960) (Indian Meteorological Department) Govt. of India

ANNEXURE-IV
Details of the holding

Sl. No.	Reg.No./ Ref.No.	Name and address	Area (ha)	Year of planting	Planting material	Clone
1	2	3	4	5	6	7
1	KND 906	N.P.Poulose Njattuthalliyil P.O.Kinginimattom	1.31	1989	Poly bag	RRII 105 + PB 311
2	KND 5860	M.G.George Murimattathil P.O.Kolenchery	1.31	1989	,,	RRII 105
3	KND 2016	P.Saju Mathew	1.21	1990	,,	RRII 105
4	KND 196	P.I.Kochukunju Poovelil P.O.Vadeyampadi	2.48	1990	,,	RRII 105
5	PD3/EK/ 66/90A	Mathai Varghese Thengumpillimattathil P.O.Meempara	1.78	1990	,,	RRII 105
6	PD3/EK/ 730/90A	O.K.Issac Cherian Kuzhiyanjal House P.O.Meempara	1.08	1990	,,	RRII 105
7	PD3/EK/ 49/91A	Beena George Chamakkattukalankamari P.O.Kadayiruppu	1.40	1990	,,	RRII 105
8	KND 2462	Thomas P. Paul Peringottu House P.O.Pazhamthottom	0.71	1992	,,	RRII 105
9	KND 225	C.M.Jacob Chettikuzhiyil House P.O.Poothrikka	1.17	1992	,,	RRII 105
10	KND 181 (Part)	Ittan George Thekkakkara P.O.Meempara	0.95	1992	,,	RRII 105

Contd.

Annexure-IV. Continued

1	2	3	4	5	6	7
11	KND 2219	V.M.Kuriakose Vallaramcheril House P.O.Kinginimattom	1.48	1992	Poly bag	RRII 105
12	PD3/EK/ 307/92A	Sabu Abraham Meprath House P.O.Kadayiruppu	0.82	1992	,,	RRII 105
13	KND 1297	Mohan P. Paul Thekkekkara P.O.Meempara	4.47	1992	,,	RRII 105
14	KND 5838	John George Nechoopadam P.O.Kadayiruppu	1.09	1991	,,	RRII 105
15	PD2/EK/ 1083/88	K.P.Mathew Kunnath P.O.Kinginimattom	0.91	1988	,,	RRII 105 + PB 235
16	KND 1124	Chinnamma Babu Poovali P.O.Kinginimattom	1.06	1988	,,	RRII 105
17	KND 633	Sruthi Sara Varghese Naduvile Veettil P.O.Poothrikka	1.21	1988	,,	RRII 105
18	KND 239	O.P.Markose Omplayil P.O.Kolenchery	1.84	1987	,,	RRII 105
19	KND 1041	V.M.Markose Vandanathil P.O.Kolenchery	1.27	1987	,,	RRII 105
20	PD2/EK/ 310/86A	C.P.Thankamma Ananda Bhavan Perumbavoor	2.82	1986	,,	RRII 105
21	KND 727	C.V.Kuriakose Chelettu P.O.Vadayampady	1.35	1986	Budded stumps	RRII 105

Contd.

Annexure-IV. Continued

1	2	3	4	5	6	7
22	KND 2814	V.C.Varkey Airattil Vallikkattil P.O.Kolenchery	1.15	1991	Poly bag	RRII 105
23	KND 2017	Kunjumol Abi Kozhumattathil P.O.Kolenchery	1.39	1991	,,	RRII 105
24	KND 4236	Helany Varghese Kariyamattathil P.O.Kinginimattom	0.93	1989	,,	RRII 105
25	PD2/EK/ 528/89	George Abraham Thekkekkara P.O.Meempara	1.14	1989	,,	RRII 105
26	PD2/EK/ 934/89A	C.T.George Nechoopadom P.O.Kadayiruppu	1.17	1989	,,	RRII 105
27	KND 1195	P.P.Kunjee Mohammed Padathil P.O.Pazhamthottom	1.53	1989	,,	RRII 105
28	PD2/EK/ 107/86A	Dr.Thomas P. Payattuthara P.O.Pazhamthottom	0.71	1986	Budded stumps	RRII 105
29	PD2/EK/ 678/86	Varkey Kuriakose Meppurath P.O.Ezhakkaraanad	0.85	1986	,,	RRII 105
30	KND 5903	P.C.Annamma Mundanchira P.O.Kadamattom	1.05	1986	,,	RRII 105
31	KND 4799	Mercy Jose Mampilly House P.O.Aluva	2.63	1989	Poly bag	RRII 105
32	KND 1427	Sunil Mathew Valath House P.O.Vengola	1.27	1987	,,	RRII 105

Contd.

Annexure-IV.Continued

1	2	3	4	5	6	7
33	KND 5798	Leelamma C6, T.C.C.Colony P.O.Udyogamandal	4.39	1990	,,	RRII 105
34	PD3/EK/ 59/90	M.B.Rajalakshmi Changampadamalika P.O.Vengala	0.61	1990	,,	RRII 105
35	PD3/EK/ 616/90	Joseph Mathew Vimalassery P.O.S.Vazhakulam	2.61	1990	,,	RRII 105 PB 317 & 217
36	KND 217	V.Koruthu Vandanathil House P.O.Vengala Perumbavoor	1.08	1987	,,	RRII 105
37	PD3/EK/ 299/97	Thomas Paul Mookkananachery House P.O.Velyanchirangara	0.50	1991	,,	RRII 105
38	KND 327	Thomas Kattakkayam P.O.Marampally	4.19	1990	,,	RRII 105
39	KND 1982	Raji Paul and Chinnamma Paily Kiluthattil House P.O.Allapra	0.50	1987	,,	RRII 105
40	KND 1023	M.E.Paulose Madathil House P.O.Vengala	1.78	1989	,,	RRII 105
41	KND 893	M.P.Kunju Mukkanamchery P.O.Valanyamchirangara	1.12	1987	,,	RRII 105
42	PD2/EK/ 318/87	Jasmin Moyin Vengala Estate P.O.S.Vahakulam	1.85	1987	,,	RRII 105
43	PD2/EK/ 808/88	O.K.George Okkattu House P.O.Ambalamugal	0.99	1988	,,	RRII 105

Contd.

Annexure-IV. Continued

1	2	3	4	5	6	7
44	KND 167	The Vicar Unnimisiha Church P.O.S.Vazhakulam	2.04	1988	Poly bag	RRII 105
45	KND 5797	Dr.Valsa Thomas L.F.Hospital Ankamaly	4.99	1988	,,	RRII 105
46	KND 64	K.P.P.Padanayar Parayil Akathoottu P.O.S.Vazhakulam	0.63	1985	,,	RRII 105
47	PD3/EK/ 355/91	Johny Paul Vallariyil House P.O.S.Vazhakulam	1.41	1991	,,	RRII 105
48	PD3/EK/ 144/91	A.K.Nafeesa Antholiparambil Edappally	1.61	1991	,,	RRII 105
49	PD3/EK/ 48/91A	Mother Superior Sisters of the Destitute P.O.S.Vazhakulam	2.48	1991	,,	RRII 105
50	PD3/EK/ 55/90A	Saramma Thampy Parakkattu House P.O.W.Vengola	0.64	1990	,,	RRII 105
51	PD3/EK/ 923/89A	Raman Elayathu Peechappilly Illam P.O.Ponjassery	0.74	1989	,,	RRII 105
52	PD2/EK/ 842/88A	K.Balan Mini Bakery Perumbavoor	0.54	1988	,,	RRII 105
53	PD3/EK 346/89A	N.A.Santhosh Nedummath Vengala,P.O.	0.50	1989	,,	RRII 105