Suitability of Tapioca and Banana as inter crops in Rubber holdings as compared to those with Leguminous cover crops in Kanyakumari District

By

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Dissertation

Submitted in partial fulfilment of the
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DECLARATION

I hereby declare that this dissertation entitled **Suitability of Tapioca and Banana as Intercrops in Rubber Holdings as Compared to those with Leguminous Cover Crops in Kanyakumari District** is a bonafide record of original work done by me during the course of placement/training and that this dissertation has not formed the basis for award of any degree, diploma, associateship or other similar titles of any other University or society.

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CERTIFICATE

Certified that this dissertation entitled **SUITABILITY OF TAPIOCA AND BANANA AS INTERCROPS IN RUBBER HOLDINGS AS COMPARED TO THOSE WITH LEGUMINOUS COVER CROPS IN KANYAKUMARI DISTRICT** is a record of research work done by **Sri. George C. Varghese** under our guidance and superivision 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 committee of **Sri.George C. Varghese**, a candidate for the post graduate Diploma in Natural Rubber Production, agree that the dissertation entitled **Suitability of Tapioca and Banana as Intercrops in Rubber Holdings as Compared to those with Leguminous Cover Crops in Kanyakumari District** may be submitted by **Sri. George C. Varghese** in partial fulfilment of the requirement of the Diploma.

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Introduction

I. INTRODUCTION

The rubber tree, Hevea brasiliensis (Willd ex-A de Juss) Muell. Arg, which is also known as para rubber tree is the prennial species planted commercially for the exploitation of natural rubber. Rubber Plantation Industry provides the principal raw material required for the rubber goods manufacturing industry, which in turn produce a variety of products indispensable in modern life. Over 30 million people in the world are dependent on natural rubber for their livelihood (Saraswathy Amma et al. 1988). Natural rubber was until recently grown mainly in the states of Kerala and Kanyakumari District of Tamil Nadu. Ninety seven per cent of the rubber plantation in the country are with small holders which cover about 70 per cent of the total rubber growing area. Majority of small holdings are located in the traditional rubber growing tracts of Kerala, and Kanyakumari District of Tamil Nadu.

The Kanyakumari District covers nearly an area of 17500 ha with rubber mainly distributed in three taluks of Kallkulam, Vilavancode and Thovala, numbering 8500 units in small holders sector and less than 30 units in large holders sector (Rubber Board Regional Office, Nagarcoil - Annexure 5).

The gestation period of rubber usually is 7 years, which acts as a disincentive to small growers. Sizable proportion of small holdings are run by family labour and when these units are mono-cropped, they do not provide adequate income to meet their multiple needs. Hence most of the rubber plantations in Kanyakumari District are intercropped with companion crops like banana, ginger, pine-apple, tapioca etc. especially during the first 3-4 year of planting. Due to the inter-cropping habit of growers, especially with tapioca and banana the growers failed to establish leguminous covers.

Tapioca is generally considered to be drought tolerant crop. The greatest attraction of growing tapioca as an intercrop is that it is easy to cultivate and has high demand as food crop, but is often found to prolong the gestation period of rubber mainly by piling competition for sunlight, increasing the exhaustion of fertile soil system, and damaging the root system through rodent attack. Cultivation of Tapioca often results in soil erosion, especially in sloppy areas (Indira, 1988). Even then, intercropping rubber with tapioca is found to be a common practice in Kanyakumari District. Banana is another intercrop extensively grown in the area. Banana protect the young rubber plants as nurse crop during summer. These crops generate additional income during the initiative

period of rubber. No detailed study has been conducted to understand the merits/demerits of intercropping with banana and tapioca as compared to those exclusively established with leguminous cover crops in Kanyakumari District.

The present study is an attempt to find out the effects of intercropping tapioca and banana on the growth performance of rubber and elucidate information for general recommendation in Kanyakumari District.

Review of Literature

II. REVIEW OF LITERATURE

Owing to the long gestation period of rubber, intercropping was found practiced from the early periods of its cultivation. Various attempts have been made to analyse the best suited intercrop for different localities and also to assess the influence of intercrop on the growth and development of the main crop. The available information is reviewed under different heads.

2.1. Intercropping with seasonal and short-term crops

Reports by RRIM (1972) revealed deleterious effect on girth of rubber intercropped with tapioca and banana. Mathew et al. (1978) reported that rubber planted with one crop of dry land paddy followed by Nendran Banana in the interspace showed better rate of growth than the other four experiment plots studied.

Intercropping is permitted by Rubber Board for small rubber holdings in the first three years of planting. It should be planted at least one metre away from rubber plants to avoid direct competition between main crop and the intercrop (Rubber Board, 1980 and 1985). As per the recommendations, any annual crop including tapioca can be

grown in the first year of planting. In the second and third year all annuals except tapioca and paddy can be inter cropped.

Blencowe (1989) noted that rubber trees are themselves strongly competitive for nutrients when planted with tapioca. He has reported that tapioca farmers in Tailand have converted thousand of hectares of cassava to rubber, simply by omitting a cassava row at 8 m interval and intercropping cassava with rubber, with neither crop receiving optional fertilizer, the rubber has nevertheless grown quite well and follow on crops of cassava planted in the third year were overshaded by trees and did not produce a worthwhile yield.

In Indonesia, intercropping with cassava was found to promote leaf diseases (Rigidoporous lignosis) and competed strongly with rubber. In Ivory Coast also, the leaf disease caused by Helminthosporium and collectotrichum were reported to be high in areas intercropped with cassava (Webster and Baulkwill, 1989).

In Malaysia, it is recommended that short term crop like maize or groundnut be planted until the rubber has grown to the stage of third or fourth whirl and then cassava is planted 1.5 to 2 metre away from rubber in order to

compensate the nutrient loss by cassava (Webster and Baulkwill, 1989).

Simon (1992) studied the inter cropping in Rubber Plantations with ginger, plantain and gingely in Taliparamba Taluk and revealed that among the three intercrops, plantain was the best followed by gingelly and ginger.

2.2. Intercropping with perennial crop

Hartely (1977) has reported the poor performance of oil palm while planted with rubber in Indonesia. Rubber and oilpalm when planted together, it was noticed that rubber has overtop the oilpalm and its canopy has spread out and shaded the palms. Competition from nutrient also was fierce. Ultimate result was that oil-palm fruiting and yield seriously suppressed and yield per hectare was poor.

A survey of agro economic condition of small growers in Anakkara Village of Idukki District by Joseph et al. (1978) revealed that the rubber growers preferred one intercrop in their plantation and pepper was found to be the most common one.

Chandrasekhara (1984) has reported the feasibility of pineapple cultivation in rubber plantation of Srilanka and

revealed that the growth of rubber in intercropped plots are better than those of the control plots.

Favourable reports have been made from China, based on a study of intercropping tea in widely spaced rubber. The tea is said to be benefitted from the shade of rubber and came to the production at an early period. A mixed plantation of tea and rubber can be cultivated successfully upto thousand meters and system is likely to find only local importance (Webster and Baulkwill, 1989).

Meegahawatle (1992) reported the introduction of rubber and tea multicropping system in Srilanka. He has stated that wet zone of Srilanka is ideally suited for this crop combination as they together serve two other important issues, namely high soil conservation capability due to good ground cover and reduced period of immaturity. This could be considered as a significant strategic research recommendation for localised adoption.

2.3. **Composite farming in Rubber plantation**

Arope et al. (1985) reports from Malaysia that a cross between local Ewes and imported Dorset Horn rams thrived under rubber estate condition with little supplementary

feeding and Veterinary attention. Weed control cost were reduced by 15-25 per cent and with an inputed value to sales of manure, a return to investment of 15 per cent was achieved.

Webster and Baulkwill (1989) suggested growing of chickens and ducks under the shade of nature rubber trees, but has pointed out that the latter may puddle the surface soil excessively in the rubber plantations.

Composite farming in rubber plantations is reported by Venkataramani (1992). It is found that raising rabbits and cultivation of paddy mushrooms are ideal avenues for small growers in Meghalaya. The rabbit can be reared on covercrops, Pueraria phaseoloides, grown as a variety of residues obtained from inter crops - banana, pineapple and Pueraria phaseoloides during the immature phase of rubber. It is also reported that the intercropping experiments started in the Research Centre, Tura, Meghalaya revealed that rubber plants found in between intercrops grow better.

A study on rubber honey by the Rubber Board (1993) revealed that about 15 bee-hives could be placed in a hectare of rubber plantations, getting 10 kg of honey from each hives.

Materials and Methods

III. MATERIALS AND METHODS

The present study is intended to identify around 100 units of mature rubber, where intercropping such as tapioca, banana and leguminous cover had been planted during immaturity period, and to find the rate of growth, duration of gestation period and probable influence over production in the later period.

3.1. Selection of Estates/holdings

In order to identify the units which had been inter cropped with tapioca, banana and legume covers based on the inspection reports of Rubber Board Field Officers at Kalasekharam and Kuzhithura coming under the Rubber Board Regional Office, Nagercoil were taken as reference, and at random 100 units have been selected. While selecting these units care were taken to see that the units represent all the 22 villages of the rubber growing tract of Thovala, Vilavancodu and Kalkulam Taluks of Kanyakumari District. The list of villages surveyed is given in the annexure 1b.

3.2. Collection of data

The details regarding year of planting, clone, type of planting materials the girth of the plants at the height of 50 inch from ground level between 3rd year and 7th year and

the extent to which the intercrops and the leguminous cover crop were collected from each unit as per a pretested questionnaire appended as annexure 2. The present girth and yield of the rubber trees since inception of tapping were noted in the questionnaire. The details were collected by visiting all the 100 units selected at random (Annexure 3).

3.3. Chemical analysis of soil

Soil sampling at two different depths of 0 to 30 cm and 30 to 60 cm were taken one unit each under the area planted with tapioca, banana and legume. Soil samples were analysed for the available elements following the methods suggested by Jackson (1966). Analysis for organic carbon was done by Walkley and Black method, available P by Bray and Krutz method. Available K was estimated by flame photometric method and available magnesium was analysed by Atomic Absorption Spectrophotometry at Rubber Research Institute of India, Kottayam.

The data thus collected were critically analysed and cast in different tables depicting the distribution of units, size of units and girth pattern of main crop in relation to intercrop, duration of gestation period and productivity of the main crop.

3.4. Yield study

With an attempt to understand the yield performance of the units that have been subjected to intercropping the 3rd year yield from 5 units each from the area planted with tapioca, banana and cover crops were taken as a specimen and is given in Table 6. The year of planting in all the 15 cases ranges from 1979 to 1982. The planting material used were RRII-105, RRIM 600, G.T-1 and PB 86.

Results and Discussion

RESULTS AND DISCUSSION

The traditional area of Kanyakumari region present a different picture in respect of weather condition and rubber production compared to other rubber growing areas. This region is bestowed with moderate and more or less equable distribution of both south west and north east monsoon as seen from the rain fall data in annexure 4. Laterite and lateritic red soils which are encountered in this region are comparatively deep and fertile. This area occasionally has very mild incidence of abnormal leaf fall and severe incidence of powdery mildew diseases.

The present investigation was carried out in hundred different units of three taluks in Kanyakumari District having different intercropping pattern. The performance of main crop to attain tappable girth and duration of gestation period were studied and evaluated under different inter cropping situations. The post nutrition status of the selected area under different companion cropping were also analysed.

4.1. Size and distribution of holdings

The data in the table 1 and chart 1 refer to the 100 units surveyed according to the size of the unit, viz. less than 0.50 ha, 0.50 ha to 1 ha, 1 to 2 ha and above 2 ha.

Table 1. Size and distribution of holdings in units surveyed

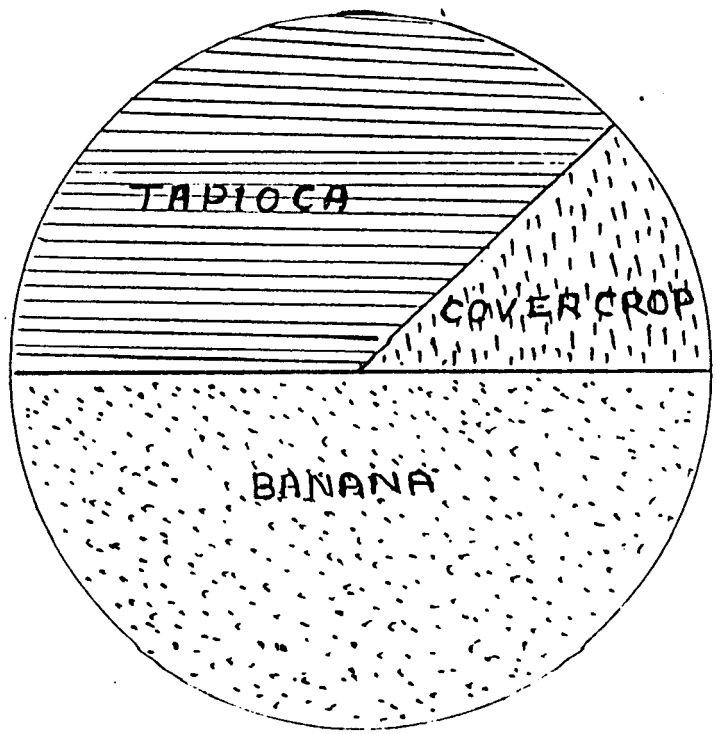
Sl. No.	Slabs (area in ha)	Tapioca	Banana	Cover-crops	Total
1.	0.01 - 0.50	13	13	6	32
2.	0,51 - 1.00	8	20	3	31
3.	1.01 - 2.00	16	12	3	31
4.	2.00 & above	1	5	-	6
	Total	38	50	12	100

The first three categories were identical in quantum consisting as high as 94 percentage of the total units. The units that have more than 2 ha forms only 6 which indicated that majority of holdings in Kanyakumari District are small holdings in nature. This is the case in other traditional areas in Kerala state also, that is the majority of holdings are small holdings. Predominance of small holdings have been reported by different workers. The findings of Joseph (1990) in Mutholi Panchayat of Palai is a classic example.

4.2. Pattern of intercropping

The number of units that have been intercropped with tapioca, banana and cover crops during initial years of gestation period are depicted in Table 2. Out of 100 units

CHART 1. DISTRIBUTION OF AREA UNDER INTERCROP



BANANA = 50 percent

TAPIOCA = 38 Percent

COVER CROP = 12 Percent

Table 2. Distribution of units under tapioca, banana and covercrops

Sl. No.	Units with	Percentage of units surveyed
1.	Tapioca	38
2.	Banana	50
3.	Covercrops	12
	Total	100

surveyed at random, the data revealed that the units intercropped with banana are the highest, forming 50 per cent followed by those with tapioca which accounting to 38 per cent. The units that were planted with cover crops are meagre with 12 per cent. Though the recommendation of the Rubber Board was to establish leguminous cover crops, the growers, especially the small growers did not choose to raise the cover crops. The small growers might have preferred to cultivate tapioca or banana as intercrops in rubber holdings as a subsidiary income source. The small growers are interested to grow suitable intercrops during the immaturity period for a subsistence income were also enlightened by the survey of agro economic conditions of the small growers of Anakkara Village of Idukki District by Joseph et al. 1978 and Simon (1992) in Taliparamba Taluk.

4.3. Planting material used by growers

The data presented in Table 3 gave an idea as regards to the type of planting material used in the 100 units surveyed. The planting material used by the growers were seed at stake planting for field budding, budded stumps and polybag plants. It was observed that the budded stumps were planted in 48 per cent of the unit, and other two types of planting material used were far low. This observation with regard to planting material is in confirmity with the report of Krishnankutty et al. (1985). The seed at stake planting was carried out in order to reduce expenditure on planting material in the initial period of planting as observed by George et al. (1988). The use of poly-bag plants have

Table 3. Type of planting material used by growers in Kanyakumari District.

Planting materials used	Percentage
a. Budded stumps	48
b. Field budding	29
c. Polybag plants	23
Total	100

definite advantage of coming to early bearing (Potty, 1980). The type of planting material will have some influence over the rate of growth of the plants, as pointed out by Krishnankutty et al. (1985). These factors were also taken into account for evaluating the results on the girth pattern of the main crop.

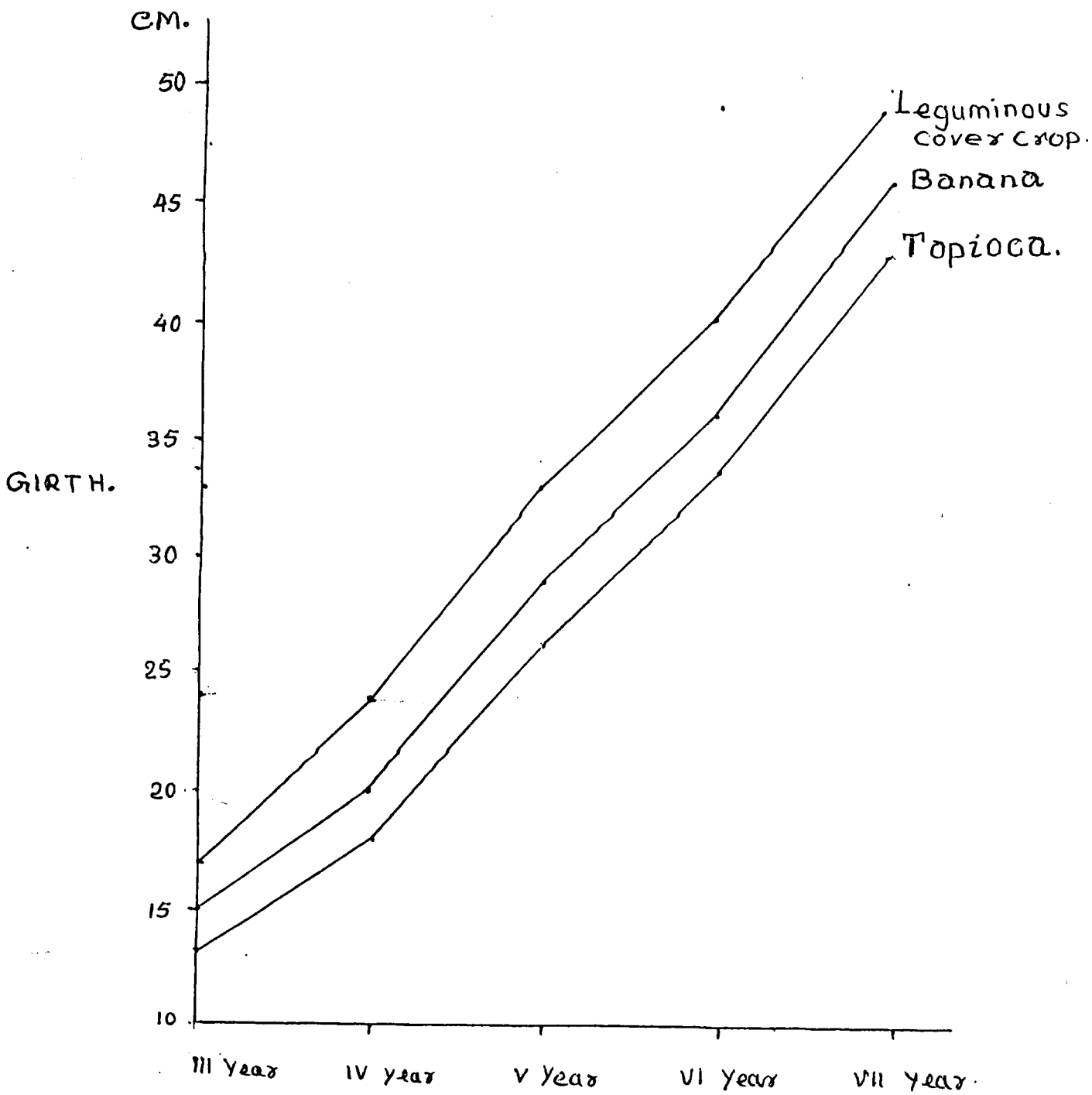
4.4. Effect of intercrops on girth of rubber plants during immaturity period

The data in table 4 and chart 2 reveals the mean girth attained by the main crop rubber intercropped with tapioca, banana and cover crops during the period from 3rd year to 7th year of planting. The rubber planted with legume cover

Table 4. Effect on intercrop on girth of rubber plants during immaturity period.

Sl. No.	Intercrops	No.of units	Girth mean (cm)				
			III year	IV year	V year	VI year	VII year
1.	Tapioca	38	13	18	26	34	43
2.	Banana	50	15	20	29	36	46
3.	Leguminous cover crops	12	17	24	33	40	49

CHART 2. PROGRESS OF GIRTH OF MAJOR CROP DURING GESTATION PERIOD UNDER DIFFERENT INTERCROPS
(Girth in CM)



crops showed higher rate of growth than ~~that~~ the one intercropped with tapioca or banana, and the difference in girth between the plants with leguminous and other two intercrops were pronounced with passage of years. In the 7th year the girth of rubber under legume cover was 49 cms as compared to 43 cms attained by rubber intercropped with tapioca.

As far as banana is concerned, the rate of attaining required girth was not as poor as tapioca. Another reason for choosing banana as intercrop may be due to the fear of soil erosion in the case of tapioca planting. The common observation is that tapioca cultivation attracts immigration of rodents which in turn inflicts upon the root system of rubber also. The shade effect of tapioca in the early stage of rubber plant is also another reason. The superiority of banana over tapioca as intercrop in respect of attainment of girth of rubber has been observed from the early findings of Mathew et al. (1978) who has reported that the growth of rubber plants, 17 months after planting was better in plots intercropped with banana than those with tapioca. This is in confirmity with the present findings.

4.5. Gestation period under different intercropping situations

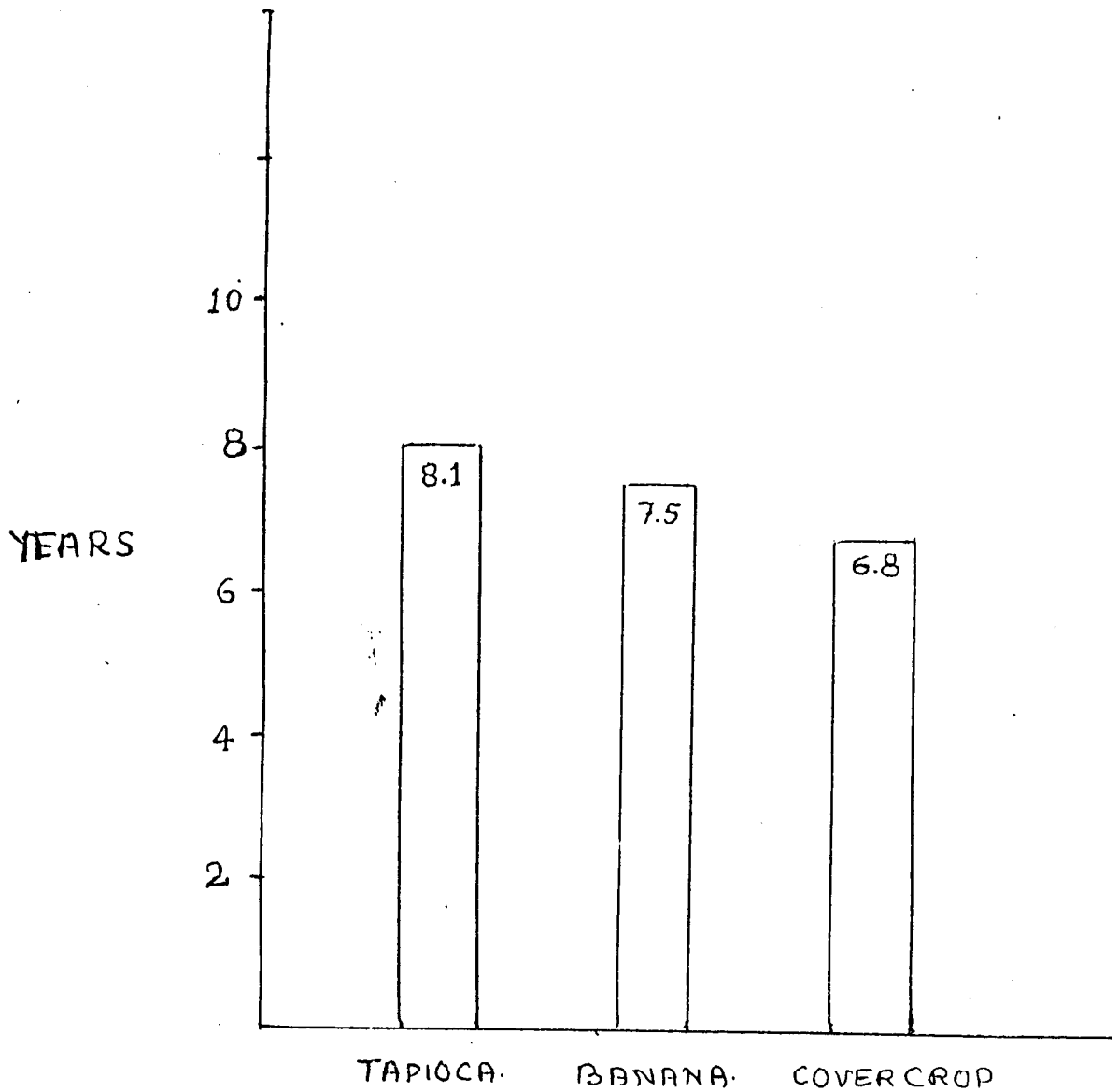
Rubber being a perennial crop it normally take 6 to 7 years duration to attain the required girth for commencement

of tapping. The gestation period may vary depending upon agroclimatic conditions, cultural practices, variety of clone, and type of planting material used. Here there was no possibility for significant variations in agro climatic factors since the units surveyed were located in adjoining Taluks. So the influence of type of planting material used were given due importance (Alexander, 1987). Further, data of mean gestation period under each intercropping situation were given for field budding, budded stumps and polybagged plants (Table 5 and chart 3). The polybagged plants showed shorter duration and field budding plants had longer gestation period (Webster and Boulkwill, 1989). Another notable advantage of polybagged plants was undisturbed root system at the time of planting and uniform establishment (Rubber Board, 1993).

Table 5. Gestation period under different intercropping situation

Sl No.	Type of planting material	Tapioca (mean year)	Banana (mean year)	Covercropped Area (mean year)
1.	Field budding	8.7	8.1	7.6
2.	Budded stumps	8.2	7.5	6.5
3.	Polybagged plants	7.5	6.8	6.4
Mean value		8.1	7.5	6.8

CHART 3. GESTATION PERIOD OF MAJOR CROP WHEN PLANTED WITH INTERCROP



Under different intercropping situation the gestation period of the rubber-tapioca companionship was the longest as compared to the rest of the treatment. The units intercropped with tapioca have taken the mean year of 8.7 years, 8.2 years and 7.5 years in the case of field budding, budded stumps and polybagged plants respectively as compared to mean year of 7.6, 6.5 and 6.4 in the case of cover cropped area. So it is clearly evident that there is an adverse effect over the gestation period in the case of banana and tapioca combinations in the place of leguminous crops.

4.6. Initial yield of the units under study

It can be observed from the Table 6 that there was a close association between the type of clones and yield potential. Krishnankutty et al. (1985) reported the superiority of RRIM 600 and GT 1 and also observed that clone like PB 86, RRIM 623 are moderate yielders. Alexander (1987) also reported higher yields for RRIM 600 and G.T 1 in Kanyakumari District. The observation in the present study also conform the above findings with respect to the performance of these bud grafts in Kanyakumari region. Though there was substantial influence for the cultural practices adopted, the pattern of intercrop ultimately

Table 6. Yield performance on third year of tapping under different intercropped situations

Sl. No.	Intercrop	Year of planting	Area (ha)	Planting material	Total yield on 3rd year of tapping (kg)	Yield/ha (in kg)	Mean yield/ha (in kg)
I.	Tapioca	1981	1.58	RRIM 600,PB 86	1000	636	1011
		1979	1.19	PB 86,RRIM 600	1300	1092	
		1979	0.41	PB 86,RRIM 600&GT1	380	927	
		1982	0.49	GT-1,PB 28/59	600	1224	
		1980	0.68	GT-1	800	1176	
II.	Banana	1980	1.13	PB 86, RRIM 600	926	819	1127
		1982	1.38	RRII 105	1725	1250	
		1979	0.80	RRIM 600, PB 86	900	1125	
		1980	1.05	RRIM 600,RRII 105	1250	1190	
		1980	1.08	PB86,GT1 &RRIM 600	1350	1250	
III.	Cover crops	1982	1.87	RRII 105, GT-1	2430	1299	1404
		1980	0.40	RRII 105 & GT-1	670	1675	
		1982	0.33	RRIM 600,Tjir-1	520	1576	
		1981	0.33	PB 28/59,PB 86	420	1272	
		1981	0.40	PB 86	480	1200	

decided the gestation period of rubber under different cropping system. From the table it was understood that the mean yield per ha of 5 units under cover crop showed 40 per cent increase in yield over that of tapioca area. This is in agreement with the findings of Mathew et al. (1978). The yield performance of the unit planted with banana were also lagging behind than that of cover crop area.

4.7. Nutrient status of plots under study

The nutrient status of soil was analysed from the samples of surface soil and sub soil from 3 units, one each under tapioca, banana and leguminous cover crops and the results are furnished in table 7.

In general, the organic carbon content was low in all the three plots. In all these plots, rubber was planted 10 years ago. However, the carbon content in the leguminous cover crop area was more than the other two areas. It was evident that the recycling of vegetative matter of leguminous cover crops should have influenced the carbon content of the soil. Another significant factor was that nutrient status in respect of P and K are found depleted in the area where tapioca was grown as intercrop. Though there was no reported evidence pertaining to the depletion directly related to tapioca cultivation, the present study

Table 7. Nutrient status of plots under study

Sl. No.	Sample	Depth (in cm)	Area (ha)	Year of planting of rubber	Intercrop	Organic carbon(%)	mg/100gm of soil Av:P	Av:K	Av:Mg
1.	1a	0- 30	0.60	1982	Tapioca	0.535	6.5	4.5	6.18
	1b	30-60				0.446	0.4	4.3	5.99
2.	2a	0- 30	1.21	1976	Banana	0.643	8.00	13.13	5.45
	2b	30-60				0.416	1.20	16.25	3.64
3.	3a	0- 30	2.00	1984	Legume	0.884	7.00	7.6	2.27
	3b	30-60				0.624	3.50	4.8	2.54

stressed the possibility of soil depletion due to tapioca intercropping unless supplemented with adequate nutrition. It was also reported in RRIM (1972) that although intercropping tapioca may be profitable on short term basis, the heavy nutrient depletion and adverse effect on growth of Rubber by tapioca cannot be ignored. The present finding also is in confirmity with this view. The same observation was also reported by Mohankumar et al. (1989). Since correct data pertaining to income from intercrops was not obtained from small holders, these aspects were not discussed here.

Summary and Conclusion

SUMMARY AND CONCLUSIONS

Cultivation of plantation crops by small growers is characterised by intercropping in many cases. The main objective of intercropping is to maximise income from the limited extent of land. This is also true in case of rubber. The average holding size in Kerala or Tamil Nadu is less than 2 hectares. The growers will have to wait for at least 6.5 years to get income from rubber. For full canopy development rubber usually takes four years and interspace could be utilized for intercropping with remunerative crops during the initial three years. In this juncture selection of compatible intercrops, as subsidiary income source to the small growers is an accepted practice.

In Kanyakumari District, the small growers usually adopt tapioca and banana as intercrop with rubber on extensive scale, with out the knowledge how far it would affect the main crop in the long run. Very few small growers prefer planting leguminous cover crop in the very first year mainly due to the economical considerations. So the study was emanate to know the after effect of these intercrops on rubber during gestation period and thereafter.

Growth of rubber plants as evaluated by girth recorded after four years of planting, was better in plots

intercropped with banana, than those with tapioca, but it is far better in the case of area exclusively planted with leguminous cover crops.

From the study it was revealed that planting of leguminous cover crops is more conducive to the growth of the rubber, and their yield performance, than either of the intercrops. Further it revealed that adoption of tapioca as intercrops had adverse influence upon the rate of growth and yield of rubber.

In the case of banana as intercrops, it was found that it is not undesirable as tapioca, though lagging behind leguminous cover, in its advantage over the growth of rubber.

So from the study it could be concluded that

1. The unit intercropped with tapioca seriously affect the rate of growth of rubber which in turn prolong gestation period and affected the yield of rubber. There is ample ground to predict nutrient depletion also during later period.

2. The units intercropped with banana shows a little influence over the rate of growth of the gestation period and also have limited adverse effect over yield

performance. The nutrient depletion was not however very pronounced.

3. The unit intercropped with leguminous covers show better rate of growth during immaturity period, reduce gestation period to a considerable extent, increased the yield and enriched the organic carbon content of the soil.

So it is concluded that it is advisable to establish leguminous covers in rubber plantation from the very beginning and if at all compelled on economical consideration, intercropping with banana is most ideal. However growth of compatible companion annual or perennial crops in the interspace of rubber is one of the feasible means to increase the farm level revenue and generate employment opportunities in small rubber growers holdings.

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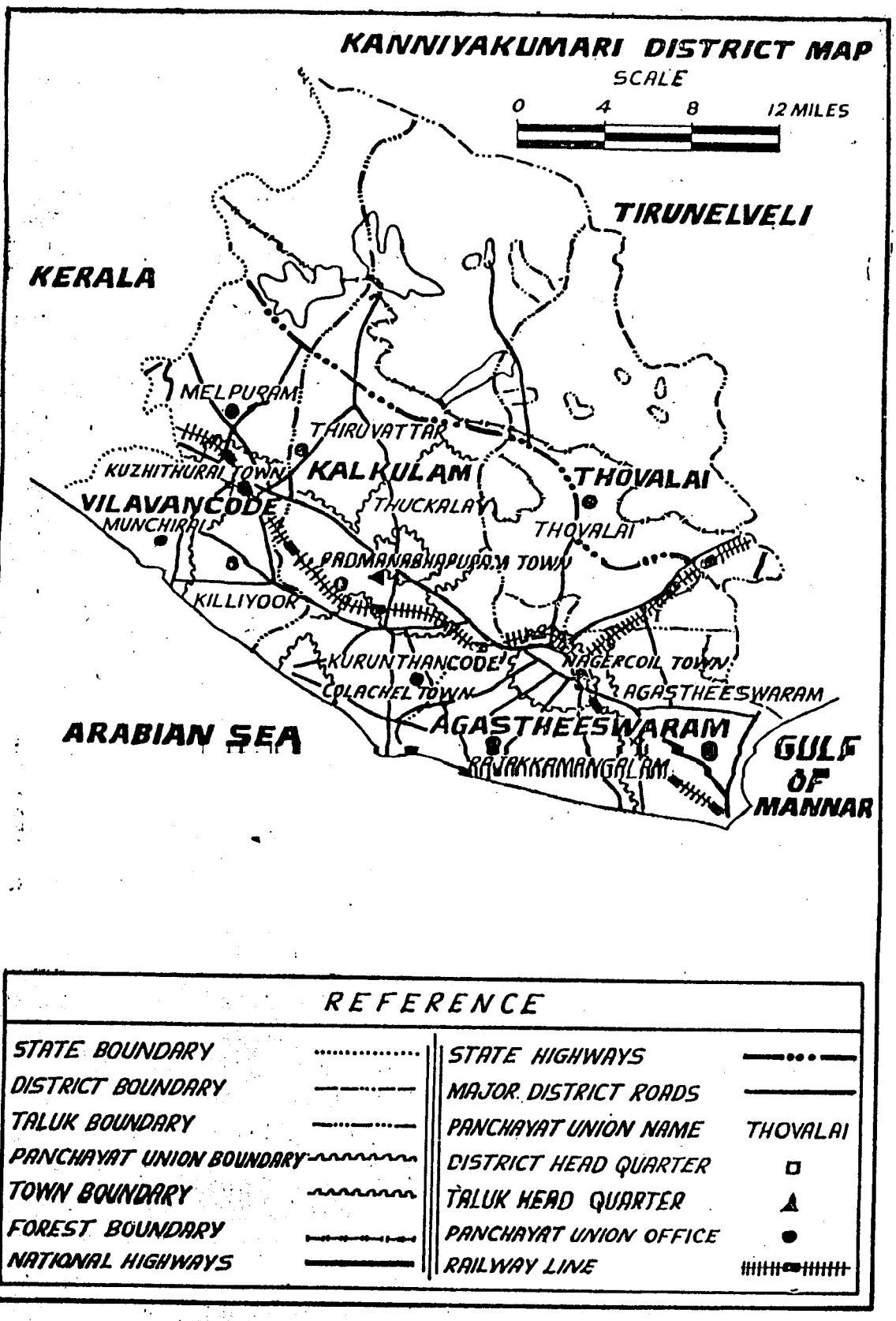
Annexures

ANNEXURE 1 (a). MAP OF KANYAKUMARI DISTRICT



ANNEXURE-1b. VILLAGE WISE DISTRIBUTION OF INTERCROPED AREA.

Sl.No.	Name of Village	No. of units
1.	Mancode	9
2.	Thripparappu	7
3.	Kaliel	10
4.	Anducodu	6
5.	Arumanai	7
6.	Thumbacode	5
7.	Shurlacode	10
8.	Ponmanai	5
9.	Thriuvattar	4
10.	Velimalai	7
11.	Attoor	1
12.	Veeyannoor	2
13.	Kapiara	1
14.	Pacode	1
15.	Mecode	3
16.	Vellamcode	3
17.	Edaicode	6
18.	Aruvikkara	3
19.	Nattalam	1
20.	Kalkulam	1
21.	Keerippara	4
22.	Darsanamcope	4
	TOTAL	100

ANNEXURE 2

(Suitability of tapioca and banana as intercrops in Rubber holdings as compared to those with leguminous cover crops in Kanyakumari District)

1. a. Name and Address of the Estate owner :
   b. Location :
   c. Size of the family (No. of adults) :
   d. Level of education : Illiterate/can read & write/primary/ secondary/above secondary

2. P.D.No./Reg.No. of estate :

3. Type of planting materials with clone :

4. a. Area under immature rubber (ha)

   Ist: 2nd: 3rd: 4th: 5th: 6th: 7th:

   b. Area under mature rubber (ha) :

5. a. Cover cropped or not : Yes/No
   b. If so, year of establishment : I/II/III/IV
   c. Establishment of cover crops : Not established/established well/established at patches/others (specify)
   d. Area under cover crops :

6. Area of inter crop under tapioca/ banana/others

Year	Tapioca	Banana	Others
1st			
2nd			
3rd			
4th			

7. Cropping intensity Dense/Scattered

I yr.	II yr.	IIIyr.	IV yr.

8. Cost of cultivation for the whole period

	Tapioca	Banana (with variety)	Covercrop
a. Cost of seeds/suckers	..	..	..
b. Labour charges	..	..	..
c. Fertiliser cost	..	..	..
d. Cost of cowdung	..	..	..
e. Cost of fungicide/pesticide	..	..	..
f. Expenditure for irrigation	..	..	..
g. Interest on capital	..	..	..
h. Repairing of tools	..	..	..
i. Input family labour	..	..	..
k. Others, if any	..	..	..
l. Yield	..	..	..
m. Value realised	..	..	..
n. Net profit	..	..	..

9. Girth of rubber plant (cm/inch) Ist 2nd 3rd 4th 5th 6th 7th (yr)

10. Whether under tapping : Yes/No

a. Year of commencement of tapping :
b. Present girth measurement :

11. Yield of rubber for the last three years (kg)

1989-90 :
1990-91 :
1991-92 :

12. Average price of rubber realised each year (Rs) :

13. Total return: 89-90 90-91 91-92

14. Overall performance : Poor/average/good

15. a. Terrain of land : Level/gentle slope/ steep

b. Soil conservation work done : Adequate/inadequate/ not done

c. Present status of land (in respect of erosion) : Satisfactory/ unsatisfactory

Place:
Date:

Signature

ANNEXURE - 3. LIST OF GROWERS SELECTED FOR STUDY

Sl.No.	Name and address of growers	Ref.No./Register No:
1.	Sri. S. Genesan, Pandaravilai veedu, Arumani P.O.	PD/NC/101/84A
2.	Smt. K. Seetha, Aruvivilai Puthen veedu, Puliyoorkurchy, Thuckalai	PD_2/NC/A/86/42
3.	Sri. K.V. Krishnan Nair, Ananda Bhavan, Cheruppalloor P.O. Kulasekharam	Kalkalam: 94
4.	Sri. George Thomas, Thadicherril, Devaswasm Board Juction, Trivandrum-3.	Vilavancode:121 (part)
5.	Smt. Y. Ramani Bai, Kuzhinjaivilai veedu, Malaicode, Edaicode P.O.	PD/NC/227/82A
6.	M/s.K.Krishnankutty & Chandrikadevi Narayana vilasam, Arumanai P.O.	PD/NC/227
7.	Sri.P.Narayanankutty, Sreenilayam Bunglow, Thumbacodu, Kulasekharam.	PD/NC/53/84(A)
8.	Sri V. Sundaram Iyer, Rajeswari Estate Bank of Madurai, P.B. No. 19, Thirunelveli	NP/NC/1870/79
9.	Sri. Sukumaran Thampy, E.K.P. Buildings Cheruppaloor, Kulasekharam	Reg. No. Not Known (appied for)
10.	Smt. M. Shchamma Beevi, Sheikamma Illam, Adappuvilai, New Street, Thiruvithamcode	Kalkulam:2716
11.	Smt. Leela Crowther, Mundavilai Estate Mekkemandapam.	Kalkulam:878
12.	Dr. S. Murugesan, Swamiyarmadom, Kattathurai, P.O.	Kalkulam:2595
13.	Sri. S. Christu Das, Christal Bhavan, Eattivilai, Mekkemandapam, P.O.	PD_2/85/86
14.	Sri. Ulahannan, Thoppil,T.C. 3/749 Muttada, Trivandrum 695 025.	PD/NC/26/84A
15.	Sri. K. Leena, Nankakoikal, Arumanai, P.O.	PD_2/NC/A/85/35
16.	Smt. J. Geetha Chella Grace, Kalpagom, Marthanandom, P.O.	Vilavancod-239

17.	Sri. N. Parameswaran Nair, Valiya Veedu, Mangalam.	PD/NC/24/83(A)
18.	Sri. S. Sivachitambaren Pillai, No. 50, Mudaliyar Street, Nagercoil	PD/NC/23/84(A)
19.	Smt. B. Prasanna Kumari, Alummottu Veedu, Perunchani	PD/NC/A/85/1
20.	Sri. M. Selvaraj, Jose Illam, Chemkody.	PD/NC/21/83(A)
21.	Sri. Mathai Devasia, Kokkathumundeckal, Penu, Alancholai	PD_2/NC/A/85/86
22.	M/s M. Rajappen & T. Reginal Velathicalavilia, Cheruppaloor, Kulasekharam.	PD_2/NC/A/85/54
23.	Smt. Vijayakumari & Saroja Vijayabhavan, Viricode P.O., Marthandom	PD_2/NC/A/85/51
24.	Kum. Jayanthi, C/o Kumaraswamy Nadar, Vellinlakathu Veedu, Viricode, Marthandom	PD_2/NC/A/85/46
25.	Master Ganesh, C/o Sri. Kumara Swamy Nadar Vellivilakattu Veedu, Viricode, P.O.	PD_2/NC/A/85/45
26.	Smt. C. Vasanthakumari, Pulimoottu Veedu, Kuzhithurai P.O., Kanyakumari	PD/NC/25-81(A)
27.	Sri. C. Thomas, Merchant, Regi Cottage, Mulagummodu.	PD_2/NC/A/85/141
28.	Sri.Philipose Oommen,Gracyvilasom Bunglow, Kulasekharam.	PD/NC/119/83
29.	Sri. Madhavan Nair, Sreethilakam, Thiruvananthapuram	PD/NC/48/83(A)
30.	Smt. K. Bhagavathee Bai Amma, Bhagavathivilasom Bunglow, Thipparappu	PD/NC/61/81(A)
31.	Sri. T. Muthuswamy, Pearl Villai, Karamana, Trivandrum	PD/NC/50/83(A)
32.	Smt. B. Parimala Devi, Siluvai Cottage, Nagacodu, Vetti. Kulasekharam.	PD/NC/A/193/80
33.	Smt. Padmavathy Thankachy, Lekshmi Bhavan, Arayambacodu	Reg. No. Not known (applied for)

34.	Sri. Mathew Joseph, Rock Valley Estate, Alancholai	Vilavancode:965
35.	Smt. A. Thulasi Bai, Anande Bhavan, Cheruppalloor P.O., Kulasekharam.	PD/NC/33/82(A)
36.	Sri. P. Thankayyan, Anandakuttu, Thevookonam, Kudeppanakunnu	PD/NC/87/83(A)
37.	Sri. Mathew George, Rock Valley Estate, Alamcholai, K.K. Dist.	Vilavancode-40
38.	Sri. A. Rossalaiyan, Viralivihar Puthenveedu, Kuravanconam	PD/NC/190/83A
39.	Smt. S. Stella bai, Christu Bhavan, Perai, Thiruvattur.	NP/NC/116-79(A)
40.	Smt. K. Indira, Chaithanya, TC 29/482 Kaithamukku, Trivandrum.	PD/NC/103/83(A)
41.	Sri. S. Paulos, Peringathottam, Marappady, Arumanai, P.O.	NP/NC/108/79(A)
42.	M/s O. Vellayan & S. Bhagavathy, Kavuvilai, Cheruppalloor P.O., Kulasekharam.	PD/NC/73/83(A)
43.	Sri.M. Ramakrishna Pillai, Thalthyamangalathu veedu, Chirakkara, Anducode P.O.	PD/NC/104/81A
44.	Sri. V. Neelakantan Nair, Vampnathuvilai Veedu, Kollamcode P.O., K.K. Dist.	PD/NC/36/84/A
45.	Sri. V. Santhappen Nair, Krishnavilasom Bunglow, Cheruvathoor P.O.	PD/NC/90/84/A
46.	Sri. V. Rahini, Ayanivilaiputhenveedu, Nallalam P.O., Nallalam	Kal: 2707
47.	Smt. B. Retneswari, Karimparaputhenveedu, Perumchilambu, Velimalai	Kalkulam: 2719
48.	Smt. Annamma Thomas, 33-Water Tank Road, Mayvillai, Nagercoil	Thovalai: 99
49.	Sri. Abdul Salam, TC 27-238-2, Vanchiyoor, Trivandrum-35.	Thovalai: 49
50.	Sri.K.J. Thomas, Mayvillai, 33-Water Tank Road, Nagarcoil	Thovalai: 101

51. Sri. S. Abdul Salam, TC 27/238/2, Soumya, Vanchiyoor, Trivandrum.	Thovalai: 32
52. Sri. V. Sadasivan, Madathuvilakattu Pathenveedu, Kaithakam, Arumanai,P.O. K.K. Dist.	PD/NC/249/81A
53. Sri. R. Raveendranathan Nair, Lakshmi Vilas, Muriyankara, Parasala	PD/NC/130/84A
54. Smt. Nesamma, Alamparaputhen veedu Vettuvilai, Munjalumoodu P.O., K.K. Dist.	PD/NC/209/83(A)
55. Sri.Arjuna panicker, Thanivilaiputhenveedu Devicode, Cheruvaloor P.O.	PD/NC/34/84A
56. Sri. V. Chellayan Nadar, V.C.N. Cottage, Packiapuram, Arumanai	PD_2/NC/A/85/76
57. Smt. A. Ruby Dyna Bai W/o D. Roban, Poovankode, Chenkody	PD/NC/92/81(A)
58. Smt. P.K. Balambika, Allamattu Bunglow, Vendalicode, Kulasekharam	NP/NC/135-79(A)
59. Sri.K.Chandrasekharan Nair Parvatheevilas, Vellancodu Chitharal PO	NP/NC/102/79(A)
60. Smt. Maria Cicily, Kalliyottuvilai, Kattathurai, P.O.	NP/NC/177/79(A)
61. Sri. S. Dennis, Kadambavilai Melpalai P.O., Edaicode	NP/NC/248/79(A)
62. Sri. A. Sathiadas, Kollamvilakom House Malicodu, Edaicode P.O.	PD/NC/171/81(A)
63. Sri. K. Kamalesanan Thampi, Srinivas, Chenkody P.O.	NP/NC/119/79(A)
64. Smt. M. Beatris, Kallukoottam Neyoor, K.K. Dist.	PD/NC/21/81
65. Sri. R. Vijayakumar, Ponnumangalam Kulasekharam	Kal: 2113
66. Sri. P.Narayanankutty, Sreenilayam Bunglow, Thumbacode	PD_2/NC/A/85/72
67. Smt. S. G. Glory Pushpam, Palathilveedu Edaicode, Elanchira, P.O.	Vil: 1512

68.	Sri. V. Balakrishnan, Kuzhimugathuvila Veedu, Vellamcode, Chitharal PO	Vil: 1648
69.	Sri. N. Vasudevan Nair, Santhinilayam Andoor, Vendalicode.	PD/NC/A/43/84(A)
70.	Sri. J. Jebamony, Kalienvilai veedu Kummanoor PO, Kattathurai PO	PD/NC/241/84(A)
71.	Smt. B. Padmavathy Amma, Bhaskarasadanam Thenoor, Kalkulam PO.	PD_2/NC/A/86/70
72.	Smt. N. Sasikala Devi, Lekshmy Vilas Thumbodu, Kulasekharam	PD_2/NC/A/85/137
73.	Sri. Kesavan Nair, Sreeram buildings Cheruppulloor, Kulasekharam	PD/NC/4/83
74.	Sri. M. Subbaiah, Murugan Rubber Estate, Mukkampala	PD/NC/21/83
75.	Sri. C. Salim Jayakumar, Door No. 314, K.P. Road, Nagarcoil-3.	Kal: 2708
76.	Sri. Antony Muthu, Enathuvilai, Veeyanoor PO, KK Dist.	Kal: 2437
77.	Sri. Mohamed Ummer Nazer, Mohamed Ummer (PAH) TC 27/1256, Chirakulam, Tvm-1	PD_2/NC/A/85-237
78.	Sri. S. Rajappen, Cheralvilai Puthen Veedu, Mulagumoodu.	Kal: 2545
79.	Smt. M. Nazema, TC 11/153-3, Kanakanagar, Nanthencode, Trivandrum	PD_2/NC/A/85-240
80.	Smt. Alice Rajam, Asir Cottage Eathuvilai, Mekkemandapam PO	Kal: 2231
81	Sri. K. Ponniah, S.K. Vilasom Bunglow Kaviyellor, Kattathurai	PD/NC/283/80
82.	Smt. Rengitha Bai, Annie Villa, Kuringal Road, Neyoor PO.	Reg: No. Not Known
83.	Sri. S. Premachandran, Syamathavilakattu, Veedu, Pulla, Vendalicode	PD_2/NC/A/86/223
84.	Smt. A. Shaila, TC 31/1488-2, Chayakudi Lane, Pettah, Trivandrum	Thovalai: 32

85.	Sri. S. Dennis Kallamkuzy, Verukilambi, P.O., K.K. Dist.	PD_2/NC/A/85-77
86.	Sri. S. Easwaran Pillai, C/o Padbhanabha Pillai, Kullassery Veedu, Poovangaparambu	PD/NC/209/84(A)
87.	Smt. Joice Lalithabai, Varuvillai House, Kuzhithurai, PO	Vil: 1681
88.	Sri. Sam Mex Jeyachandra, Mundavilai, Verkilambi PO	PD/NC/37/83
89.	Sri. Sam Mex Christopher, Mundailai, Verkilambai PO	PD/NC/38/83(A)
90.	Sri. L. Thomas, Venus House, Manalivilai, Kulasekharam	PD/NC/138/84(A)
91.	Sri. A. Thankayyan, Bose Bhavan, Naduthottam, Pulugal PO	PD/NC/130/81(A)
92.	Sri. N. Gopala Panicker, Thenperathala Thekkeputhen Veedu, Edaicode P.O.	Vil: 1660
93.	Smt. Joyce Bersy Bai, Jayavilasam Bunglow, Cheruvaloor P.O., Edaicode	Vil: 1690
94.	Smt. Maria Thankam, Jose Illam Perinchakonam, Chenkody PO	Kal: 2656
95.	Smt. Sarasa Bai, Jayasadan, B.O.C.Street Marthandom	Vil: 1696
96.	Sri. C. Kumar, Kumara Bhavan Nalloor, Marthandom, KK. Dist.	PD/NC/116/81A
97.	Smt. A. Sugismain, Chodukkavilai Main Cottage, Palliyodi P.O. KK. Dist.	PD/NC/162/81A
98.	Sri. S. Thiravian Achary, Pandarakkattu Vilai, Chitharal P.O., K.K. Dist.	PD/NC/256/80
99.	Sri. KOmalam Thampi, Kuthara Veedu Malaicode, Edaicode PO	PD/NC/15/80A
100	Smt. M. Lekshmi Bai Amma, TC 28/771 Ambujavilasam Road, Trivandrum	PD/NC/318/80A

ANNEXURE 4. DATA ON RAIN FALL AND NUMBER OF WET DAYS IN RESPECT OF KANYAKUMARI DISTRICT

YEAR		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1978	RAINFALL	0.9	—	9.7	11.2	16.1	10.6	17.0	17.2	3.6	23.3	67.5	9.3	186.4
	WET DAYS	1	—	3	4	7	6	7	10	2	18	9	4	71
1979	RAINFALL	—	13.7	2.7	9.9	7.2	39.0	21.1	6.9	23.2	27.6	30.3	6.4	188.0
	WET DAYS	—	6	3	5	7	15	11	9	11	10	14	3	94
1980	RAINFALL	—	—	8.6	18.6	16.8	21.9	6.7	11.1	13.9	14.1	32.8	13.7	158.2
	WET DAYS	—	—	5	10	7	17	9	6	11	10	14	8	97
1981	RAINFALL	2.4	3.6	4.8	19.8	26.7	49.3	14.6	25.0	32.1	46.1	23.3	0.9	248.6
	WET DAYS	1	2	4	12	8	20	11	13	16	18	15	2	122
1982	RAINFALL	—	—	6.9	23.2	35.1	31.7	19.4	8.0	13.9	28.4	22.8	2.8	192.2
	WET DAYS	—	—	4	10	14	21	11	7	2	15	9	1	94
1983	RAINFALL	—	—	—	9.2	19.3	14.6	9.3	19.6	21.5	17.3	28.4	15.4	154.6
	WET DAYS	—	—	—	3	7	9	8	11	11	8	12	10	79
1984	RAINFALL	5.2	10.0	16.8	28.4	3.4	25.9	12.8	1.9	25.9	31.8	21.4	4.5	188.0
	WET DAYS	2	10	10	15	5	19	10	2	9	15	15	1	113
1985	RAINFALL	13.4	0.9	5.0	12.4	24.5	40.0	6.3	2.4	11.2	39.3	21.9	14.7	192.0
	WET DAYS	4	1	4	10	9	25	6	2	7	19	9	4	100
1986	RAINFALL	2.5	15.9	3.7	24.5	17.5	6.5	7.8	22.2	12.3	11.7	22.2	4.0	150.8
	WET DAYS	4	6	2	13	4	7	9	12	10	10	9	2	88
1987	RAINFALL	0.6	—	7.8	18.7	38.0	24.2	2.8	17.0	28.1	46.9	34.5	20.2	238.8
	WET DAYS	2	—	4	11	14	25	4	12	13	23	11	7	126
1988	RAINFALL	—	5.1	12.5	28.9	8.0	34.0	14.9	9.7	33.2	5.8	15.5	4.6	172.2
	WET DAYS	—	4	7	16	5	17	7	9	18	4	14	5	106
1989	RAINFALL	—	—	12.4	16.5	11.5	51.8	27.1	7.8	25.2	28.8	23.6	2.8	207.5
	WET DAYS	—	—	3	8	9	22	14	6	13	21	12	1	109
1990	RAINFALL	0.8	4.6	7.9	9.2	38.7	23.8	14.9	2.1	3.3	46.3	44.7	3.3	199.6
	WET DAYS	3	3	5	8	17	16	12	2	3	21	12	2	104
1991	RAINFALL	4.8	5.4	4.7	17.6	11.1	79.5	30.2	0.5	2.5	44.9	14.5	—	215.7
	WET DAYS	5	3	4	9	14	28	17	2	2	15	7	—	106
1992														
10 years	RAINFALL	2.04	3.95	6.90	16.54	18.26	30.19	13.66	10.09	16.66	27.49	26.89	6.84	179.51
	WET DAYS	1.5	2.3	3.9	8.9	8.5	16.5	9.1	6.9	8.5	13.8	10.8	3.3	93.9

Source: New Ambadi Estate (P) Ltd., Kulasekharam

ANNEXURE-5(a) Area under rubber in the Kanyakumari District.

Sl. No.	Taluk	Regestered area (ha)	Unregestered area (ha)	Total(ha)
1.	Kalkulam	7483.00	1500.00	8983.00
2.	Vilavancodu	5193.00	1000.00	6193.00
3.	Thovala	1409.00	500.00	1909.00
4.	Agesteswaram	NA	NA	NA
Total		14085.00	300.00	17085.00

Source: Rubber Board Regional Office Nagercoil

ANNEXURE-5(b). Per hectare yield of dry rubber in Kanyakumari District

Sl.No.	Year	Yield (kg/ha)
1.	1980-81	1910.40
2.	1981-82	1195.70
3.	1982-83	836.20
4.	1983-84	1613.80
5.	1984-85	1064.00
6.	1985-86	719.70
7.	1986-87	855.40
8.	1987-88	1008.30
9.	1988-89	1122.00
10.	1989-90	1251.10

Source: Arasu Rubber Corporation Ltd. Paraliar Division Nagercoil