National
Agricultural
Research
Project

STATUS REPORT

Region of Problem Areas

(SPECIAL REGION)

Kerala
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Vellanikkara
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English

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FOREWORD

The genesis of the first Agricultural University in India in the year 1960 was an important land mark in the history of agricultural development in the Country. This paved the way for the development of a strong agricultural education and research system in the country. The activities of the Agricultural Universities are by and large concentrated around urban and sub-urban areas. In a country like ours with a wide range of agro-climatic and edaphic conditions, the Agricultural Universities are, therefore finding it extremely difficult to tackle the location specific problems of all the agro-climatic zones constituting their area of jurisdiction. The introduction of the National Agricultural Research Project (NARP) during late seventees in India was mainly to bridge this gap and this project marks another important land mark in the annals of agricultural development in India. The strengthening of the regional research capabilities of different agro-climatic zones by providing scientific manpower and necessary infrastructural facilities will definitely go a long way in finding out solutions to location specific problems and also to disseminate the research findings to the extension machinery without any time lag.

I am sure, that if the NARP is implemented in a proper manner, the agricultural productivity could be increased substantially. The net income of our farmers can thus be stepped up, besides generating employment potential in the agricultural sector.

The eligibility of Kerala Agricultural University to participate in the NARP was approved by the PFC in May, 1980. The Anand Rao Committee after reviewing research work, had submitted their report in September, 1980. Based on the recommendations, the Kerala Agricultural University submitted its draft proposal. So far, six sub-projects (Directorate, Northern, Central, Southern, Special and High Range Regions) with a total financial outlay of Rs. 489.01 lakhs for a span of five years have been sanctioned.

A status report is prepared for each region as a basic document giving all the valuable information on the agricultural sector. The report has been prepared making use of the statistics available and based on the outcome of group discussions of the cultivators and of the District Seminars conducted by Kerala Agricultural University. The information gathered from the workshops, both the monthly workshops of the T & V

system and the NARP Regional workshops conducted once in six months were also made use in the preparations of the Status report. The regional workshops are attended by all Heads of the University Departments, representatives of the State Department of Agriculture and Scientists from CPCRI, CTCRI etc., and these are therefore the proper bodies for giving shape to problems of the regions and to suggest the possible solutions.

It goes without saying that the problems so far identified and the work undertaken thereon cannot be exhaustive as fresh problems arise from time to time and sometimes the solutions once worked out require further refinement. The present attempt may, therefore, be considered as a first attempt. I hope that it will be possible gradually to further refine the status paper by identification of more problems and by working out solutions to these.

The status paper was prepared by the scientists and the Assoc. Directors of the concerned regions. Although there are limitations and shortcomings, the officers responsible for the preparation and printing of this status paper are to be congratulated for this pioneering work.

I sincerely hope that this material would be of immense utility to the research workers in the State and to the extension personnel of the Department of Agriculture and the personnel in other Agricultural Universities.

P. C. S. NAIR
Director of Research

24th April, 1984.

CONTENTS

CHAPTER 1

The State and its Agricultural characteristics

1.1 Delineation of the area

Kerala is one of the smallest states in India with an area of 38,863 km^2. The State lies as a long narrow coastal strip of land between the Arabian Sea in the West and the Western Ghats in the East. It is broadest in the middle; but not more than 120 km, tapering down to 30 km at northern and southern extremities. It is located between 8°18' and 12°48' North latitudes and between 74°52' and 77°22' East longitudes. This small state which covers only about 1.18 per cent of the total area of India, however, supports a population of 25,453,680 which is 3.71 per cent of the total population of the Country. This has reflected in a population density of 655 persons per km^2 of land, the highest among the states of the Indian Union.

Nearly 82 percent of the population of Kerala live in villages. The population engaged in Agriculture including live stock farming, fishing and forestry is 55 per cent. This includes cultivators, landless labourers and fishermen.

1.2 Physiography

The land mass of Kerala can be distinguished into three broad natural physiographic divisions, namely high land, mid land and low land, each running parallel in North-South orientation. The mountainous land (elevation from 1000 to 2500 metres above MSL) along the Western Ghats with jutting rock having loamy soils which support vegetation constitute the high land. The low land, bordering the Arabian Sea, is a strip of land running along the coast with sandy to sandy loam soils and almost level topography. Sandwitched between the low land and the highland is the midland, situated at elevations of around 100 metres above MSL. The region is characterised by undulating terrain and soils of lateritic nature.

1.3 Climate

According to Thornthwaite's climatic classification based on the moisture regime, the high land and the mid land fall under perhumid (A) climatic type. The low land falls under humid (B-B4) type, except the southern most pockets of the State and the eastern part of the Palghat region, which come under moist sub humid (C2) climatic type. The State as a whole experiences megathermal (A) climate on the basis of

Thornthwaite's thermal regime which shows that the vegetative growth is not inhibited due to temperature; but governed by rainfall alone.

1.3.1 March of the monsoon

The mean date of onset of the South-West monsoon varies from May 25th to June 1st over the State.

1.3.2 Rainfall

The mean annual rainfall of the State is 2963mm (Fig.1). The highest (5883.8mm) is recorded at Neriamangalam (Ernakulam) and the lowest (651.3mm) at Chinnar (Idukki). The mean annual rainfall in the low lands increases from 1479 mm at Parassala in the South to 3562 mm at Hosdurg in the North. Relatively uniform distribution of rainfall is seen in the southern region due to the influence of both the South-West and North-East monsoons. June is the rainest month in the South (Alleppey, Quilon and Trivandrum) while July is the rainest in the North (Cannanore, Kozhikode, Wynad and Malappuram). Though tne annual rainfall of the northern region is more, the effective rainfall is only 40% (Cannanore) about 56% of which concentrates in June-July. About 80% of the annual rainfall is effective in the southern region (Trivandrum) due to its uniform distribution. The mean annual number of rainy days over the State is 126, with the minimum (45 days) at Chinnar and the maximum (172 days) at Neriamangalam.

1.3.3 Surface air temperature

Being a coastal state, the mean annual air temperature is uniform and records around 27°C. March, April and May are the summer months. Temperature during these months varies between 29°C and 31°C. The daily maximum may shoot upto 40°C during the summer and minimum may come down to less than 16°C in the winter. Since the temperatures are uniform throughout the year and not very high, the plant growth is not inhibited due to temperature.

1.3.4 Cloudiness and humidity

Cloudy and overcast skies are seen during the South-West monsoon. Moderate cloudy to cloudy skies are observed during October and November. During the rest of the year, clear or partly cloudy skies are seen. The mean monthly relative humidity varies between 85% and 95% during June-September and is about 70% in January over different parts of Kerala.

1.3.5 Surface winds

During August, northwesterly winds are observed over the State and the mean wind speed is 10 to 15 km ph. Easterly winds are observed in December over the northern and central regions of the state and the mean wind speed varies between 10 and 15 km ph. Northeasterly winds

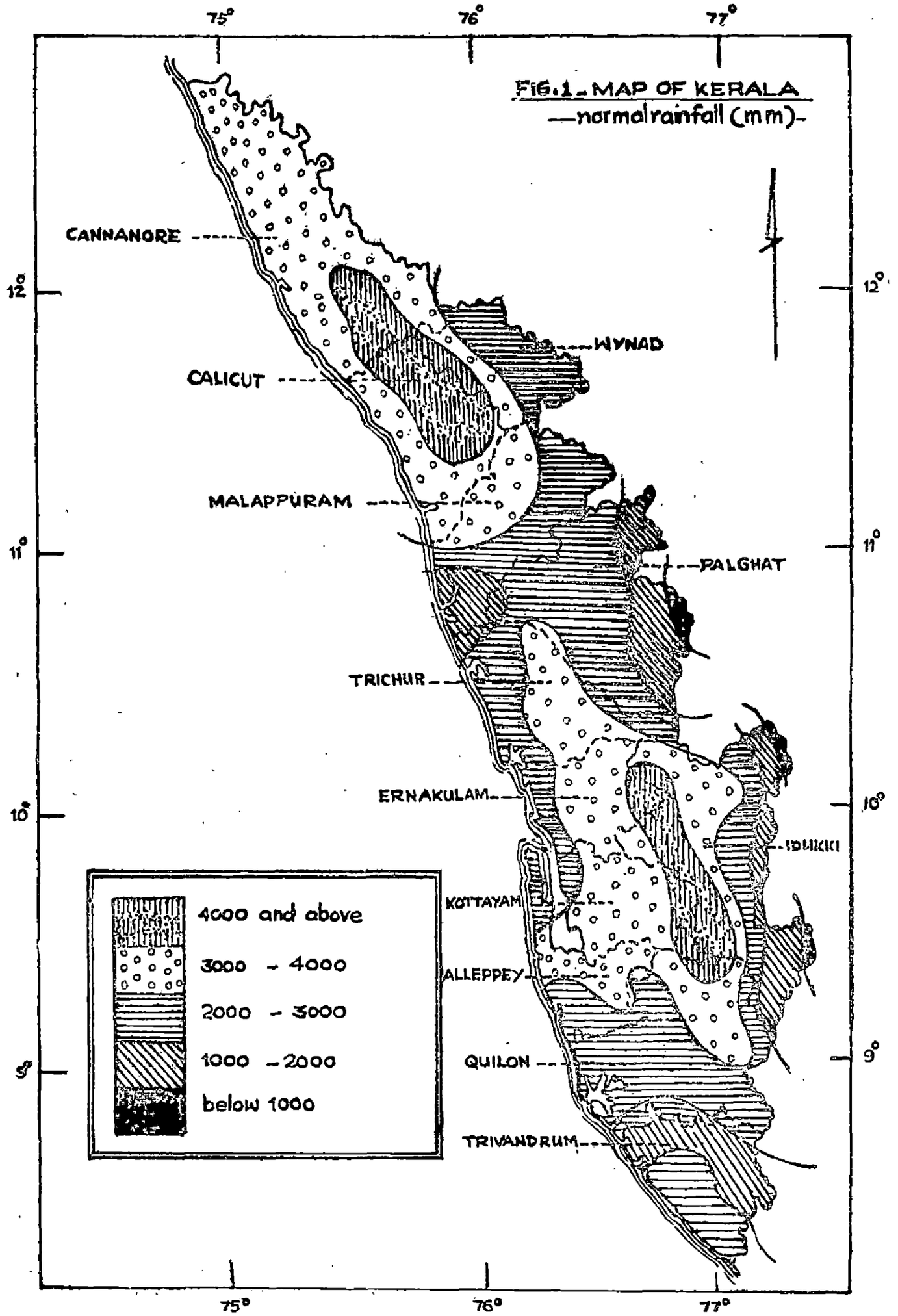


FIG. 1 - MAP OF KERALA
—normal rainfall (mm)—

are observed over the southern region during October-November and wind speed is 5 to 10 km ph. During April, Westerly winds are observed over the central region (Palghat) and the mean wind speed is 5 to 10km ph.

1.3.6 Potential evapotranspiration

On the basis of Thornthwaite's formula, the annual potential evapotranspiration varies from less than 1700 mm in the South to around 1730 mm in the North. Palghat experiences 1744 mm. Based on open pan evaporimeter data, the mean daily evaporation is 4.8 mm at Kasaragod, 4.3 mm at Trivandrum and 5.8 mm at Ollukkara and Pattambi.

1.3.7 Sunshine

The mean daily bright sunshine hours of the northern region are 6.8, maximum being from January to March (9.83 hours) and minimum from June to August (2.89 hours).

1.3.8 Special weather phenomena

Depression storms, which are not uncommon during October and November in the Arabian Sea, cause rain over the entire state. Heavy winds are blown during October and November (Mundakan season) over the Central region through the Palghat gap of the Western Ghats. Thunder phenomenon is seen frequently during the pre-monsoon period (April-May).

1.3.9 Climate and plant growth

From the above climatic analysis, the following conclusion may be drawn from the agricultural production point of view:

Humid and megathermal climate of the State never inhibit plant growth due to want of temperatures. The uniform distribution of rainfall, moderate winds and low potential evapotranspiration towards the southern region promote comparatively better growth and production of perennial crops under rainfed conditions.

1.4 Soils

Climate, topography and vegetation appear to be the dominant factors involved in the process of soil formation. On the basis of the morphological features and physicochemical properties, the soils of the State have been classified into red loam, laterite, coastal alluvium riverine alluvium, greyish Onattukara, brown hydromorphic, hydromorphic saline, acid saline, black soil and forest loam (Fig. 2).

The important features of these soils are detailed below:

1.4.1 Red loams

Red loams of Kerala are localised in occurrence and are found mostly in the southern parts of Trivandrum district. These soils occur in catenary sequence along with laterites and are found mainly as deposits by colluviation in foothills and small hillocks. The rapid permeability of the surface

soils also has been responsible for the characteristic development of these loamy soils which are very deep and homogenous without much expression of horizons. The soils have red colour which has been attributed to the presence of haematite. These soils are essentially kaolinitic in nature, acidic in reaction, highly porous and friable. They are low in organic matter content as well as in all the essential plant nutrients.

1.4.2 Laterites

Laterites of Kerala are typical weathering products of gneissic and granitic rocks, developed under humid tropical conditions. Heavy rainfall and high temperature prevalent in the state are conducive to the process of laterisation. *In situ* laterites have been formed by the leaching of bases and silica from the original parent rock with concurrent accumulation of oxides of iron and aluminium. The surface soil, which is reddish brown to yellowish red, is mostly gravelly loam to gravelly clay loam in texture. The profiles have well developed B horizon with abundant ferruginous and quartz gravels. The content of coarse fragments varies widely from 20–75 per cent. The plinthite is characterised by a compact vesicular mass below the B horizon, composed essentially of a mixture of hydrated oxides of iron and aluminium. The plinthite includes quarriable type which can be cut into blocks and also nonquarriable type which breaks into irregular lumps. In Calicut, Malappuram and Cannanore districts, extensive stretches of indurated laterites with hard surface crust are of common occurrence. Laterites are in general poor in available nitrogen, phosphorus and potassium and are low in bases. The organic matter content also is low. They are generally acidic with the pH ranging from 5.0 – 6.2. These soils are well drained and respond well to management practices. They cover a major portion of mid land and mid-upland regions and are the most extensive of the soil groups found in Kerala.

1.4.3 Coastal alluvium

These soils are seen in the coastal tracts along the West and have been developed from recent marine deposits. They show incipient development. The texture is dominated by sand fraction. They are excessively drained with very rapid permeability. The A horizon is usually thin and the surface textures observed are loamy sand and sandy loam. The water table is high in the low-lying areas. Profiles in these areas show mottling in lower layers. Those soils are of low fertility level. The low content of organic matter and clay has resulted in low cation exchange capacity of the soil.

1.4.4 Riverine alluvium

These soils occur mostly along the banks of rivers and their tributaries. They show wide variation in their physicochemical properties depending obviously on the nature of the alluvium that is deposited and the characteristics of the catchment area through which the river flows.

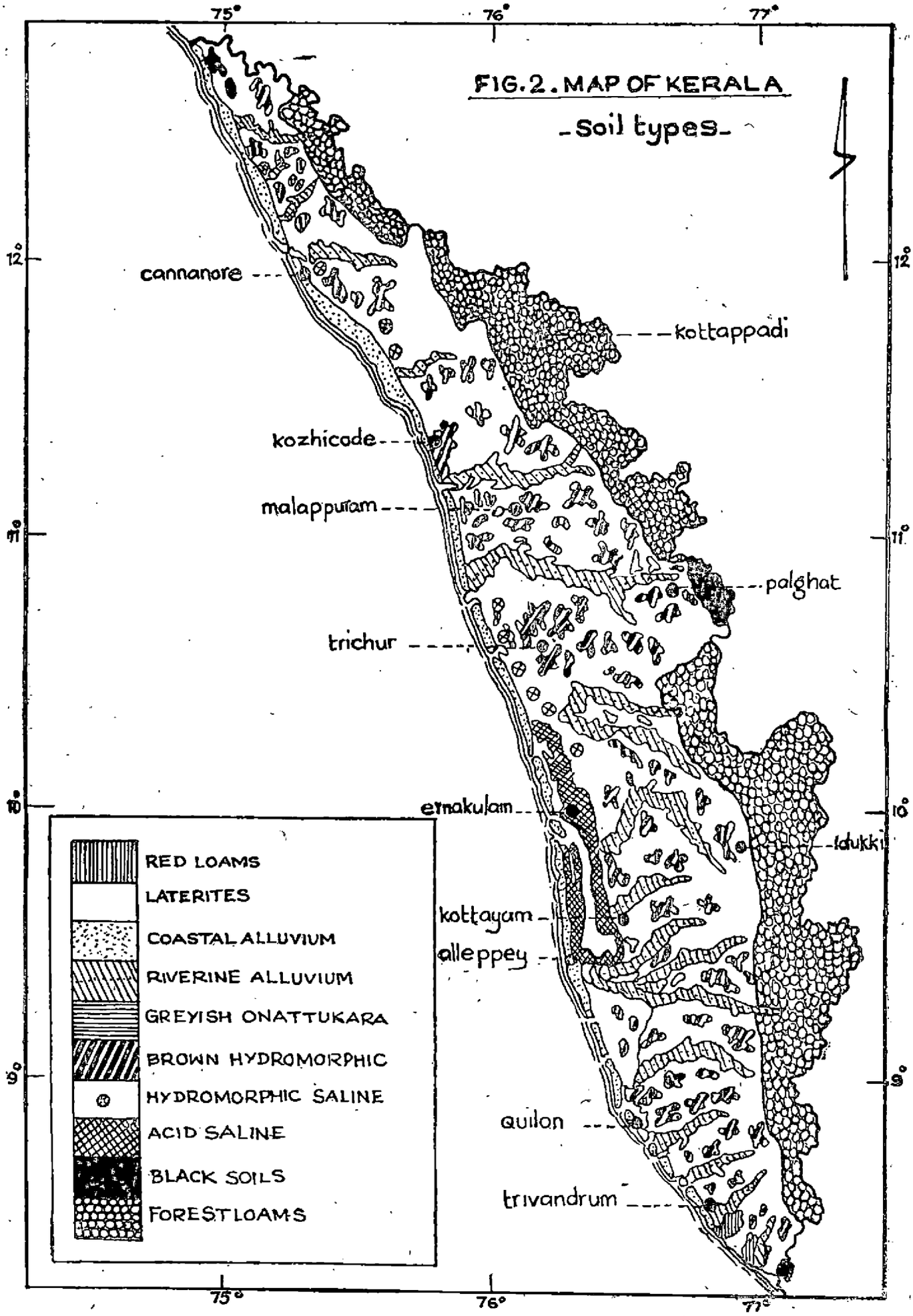


FIG. 2. MAP OF KERALA
-Soil types-
75°
76°
77°
12°
11°
10°
9°
cannanore
kottappadi
kozhicode
malappuram
palghat
trichur
ernakulam
idukki
kottayam
alleppey
quilon
trivandrum
RED LOAMS
LATERITES
COASTAL ALLUVIUM
RIVERINE ALLUVIUM
GREYISH ONATTUKARA
BROWN HYDROMORPHIC
HYDROMORPHIC SALINE
ACID SALINE
BLACK SOILS
FOREST LOAMS

Horizon differentiation is not well expressed. They are very deep soils with surface texture ranging from sandy loam to clay loam. They are moderately supplied with organic matter, nitrogen and potassium.

1.4.5 Greyish Onattukara

These soils are confined to Onattukara region comprising of Karunagapally, Karthikappally and Mavelikkara taluks of Quilon and Alleppey districts. They occur as marine deposits extending to the interior upto the lateritic belt. The soils are in general coarse textured with immature profiles. In low-lying areas, the water table is high and drainage is a problem. These soils are excessively drained with very rapid permeability. These soils are acidic and are extremely deficient in all the major plant nutrients.

1.4.6 Brown hydromorphic

Hydromorphic soils, as a group, occur extensively in the State. These soils are mostly confined to valley bottoms of undulating topography in the midland and in low-lying areas of coastal strip. They have been formed as a result of transportation and sedimentation of material from adjoining hill slopes and also through deposition by rivers. They exhibit wide variation in physico-chemical properties and morphological features. The development of the soil profiles has occurred under impeded drainage conditions. These soils therefore exhibit characteristic hydromorphic features like grey horizons mottling streaks, hardpans, organic matter depositions, iron and manganese concretions etc. Drainage is the major problem. They are moderately supplied with organic matter, nitrogen and potassium and are deficient in lime and phosphate. Acidity is a problem in some areas.

1.4.7 Hydromorphic saline

The saline soils are usually met with in the coastal tracts of the districts of Ernakulam, Alleppey, Trichur and Cannanore. The origin, genesis and development of these soils have been under peculiar physiographic conditions. They are therefore not comparable with the saline soils occurring in other parts of the country. The net work of backwaters and estuaries bordering the coast serve as inlet of tidal waters to flow into these areas, causing salinity. Wide fluctuations in the intensity of salinity have been observed. During rainy season, the fields are flooded and most of the salt is leached out, leaving the area almost free of salts. Electrical conductivity of the soil during this season ranges from 0.1 to 2.0 mmhos/cm. Maximum accumulation of toxic salts is observed during the summer months from March to April when electrical conductivity rises to the range of 10 to 15mmhos/cm. These soils are in general brownish, deep and imperfectly drained. The profiles show wide variation in texture, as is common in most of the alluvial soils. Being developed in areas with

relatively high ground water table, these soils show aquic properties. In some areas, undecomposed organic matter is observed in lower layers, causing problems of acidity.

1.4.8 Acid saline

The Kuttanad region covering about 875 sq. km is an unique agricultural area in the World. A good portion of this area lies below the sea level and is submerged for major part of the year. The area is susceptible to seasonal ingress of saline water as a result of tidal inflow from the sea. During the monsoons, the rivers and rivulets pour fresh water into the area. As the North East monsoon recedes. sea water again enters the Vembanad lake and the whole area becomes saline. Hence, the soils of Kuttanad area are faced with the serious problems of hydrology, floods, acidity and salinity. Soils of Kuttanad form the typical water-logged soils and are entirely different from normal well drained soils in their morphological, chemical and physical characteristics. They can be grouped into three categories viz,. *kayal soils, karappadam soils* and *kari soils.*

i) Kayal soils

The Kayal soils are found in the reclaimed lake beds in Kottayam and Alleppey districts. They are very deep, poorly drained, dark brown alluvial soils having silty loam to silty clay–loam surface texture. The sub soils show the presence of lime shells. The clay content usually decreases with depth. These soils are slightly acidic, medium in organic matter and poor in total and available nutrients; but are fairly rich in calcium. They are seriously affected by salinity. A whitish colour on the surface is often observed due to accumulation of salts.

ii) Karappadam soils

Karappadam soils occur along the inland waterways and rivers, and are distributed over a large part of upper Kuttanad. They are river borne alluvial soils occurring in nearly level or flat lands lying one to two meters below the sea level. Soils are very deep, poorly drained and dark grey with clay loam surface texture, followed by slaty clay sub soils. These soils are characterised by high acidity, high salt content and fair amount of decaying organic matter. They are generally poor in available nutrients, particularly phosphorus. They are also highly deficient in lime.

iii) Kari soils

The kari soils resemble peat soils. They occur in patches in the districts of Alleppey, Kottayam and Ernakulam. They exhibit characteristics of once submerged forest area. These are black, poorly drained, heavy textured soils distributed in flat areas lying one to two meters below the sea level. They remain submerged for nearly six months in an year. During the summer, the water table is 1.0 to 1.5 m below the ground level. The profile exhibits typical aquic characteristics. Decomposed

organic matter is often observed in the lower layers. These soils are highly acidic in reaction, the pH approaching 3.0 during the summer months. Accumulation of salts to toxic level often affects the crop growth and yield in this region.

1.4.9 Black soils

Black soils of the State are restricted in their occurrence to Palghat district. They are found to occur in patches and are considered as extensions of the black cotton soils observed in the adjacent Coimbatore district. These soils are dark, low in organic matter, calcareous, moderately alkaline, high in clay content and cation exchange capacity and hence exhibit characteristic cracking during the dry periods. They are usually located in gently sloping to nearly level lands. Levels of potassium and calcium are moderate, while the soil is low in nitrogen and phosphorus.

1.4.10 Forest loams

As the name indicates, these soils are the products of weathering of crystalline rocks under forest cover. They are restricted in occurrence to the eastern parts of the State. They have immature profiles with shallow soils followed by gneissic parent material in various stages of weathering. In areas with lesser canopy cover, signs of laterisation have been observed in the profiles. These soils in general show wide variation in depth. They are dark reddish brown to black with loam to silty loam texture. In denuded areas, leaching and deposition of humus in lower layers is observed. The B horizon usually contains gneissic gravels and boulders. These soils are generally acidic with the pH ranging from 5.5–6.3. They are rich in nitrogen, but poor in bases because of heavy leaching.

1.5 General soil fertility ratings for Kerala soils

For the purpose of giving fertilizer recommendations based on soil test values, the soils of the State are grouped into ten fertility classes numbering from class 0 to class 9. A soil with 10 kg of Bray No. 1 extractable (available) phosphorus per hectare is considered to be "average" in phosphorus status and will therefore require 100% of the general fertilizer recommendation for phosphorus. The potassium status of the soil will be considered as "average" when the soil retains 115 kg of available (1 N neutral ammonium acetate extractable) potassium per hectare. The average fertility values for total nitrogen are 0.03 per cent (organic carbon 0.3%) for sandy soils and 0.05 per cent (organic carbon 0.5%) for clayey/loamy soils. The details of the soil fertility classes and the recommendation of N,P and K for each class as percentage to general recommendation currently followed by the soil testing laboratories of the State are given in Table 1.1.

Table 1.1— Fertilizer recommendation based on soil test values

Soil fertility class	% Organic C		Recommendation of N, as % to general recommendation	Available P, kg/ha.	Exchangeable K,kg/ha.	Recommendation of P & K, as % to general recommendation
	Sandy	Clayey/ loamy				
0	0.00–0.10	0.00–0.16	128	0.0–3.0	0–35	128
1	0.11-0.20	0.17–0.33	117	3.1-6.5	36–75	117
2	0.21–0.30	0.34-0.50	106	6.6-10.0	76–115	106
3	0.31–0.45	0.51-0.75	97	10.1–13.5	116-155	94
4	0.46–0.60	0.76-1.00	91	13.6-17.0	156–195	83
5	0.61–0.75	1.01-1.25	84	17.1–20.5	196-235	71
6	0.76-0.90	1.26-1.50	78	20.6-24.0	236-275	60
7	0.91-1.10	1.51-1.83	71	24.1–27-5	276-315	48
8	1.11-1.30	1.84-2.16	63	27-6-31.0	316-355	37
9	1.31-1.50	2.17-2.50	54	31.1–34.5	356-395	25

1.6 Irrigation

1.6.1 Area under irrigation

In Kerala, a total area of 6,51,747 hectares enjoys the benefit of irrigation, which works out to 21.52 per cent of the total cropped area. It may be noted that about 90 per cent of the total irrigation water is diverted for growing food crops. This includes about 80 percent on rice and 10 percent on other food crops.

1.6.2 Irrigation potential

A number of irrigation projects have been taken up in Kerala after independence. Among these, thirteen have been completed. Irrigation water has been made available to about 80,000 ha. in the central and southern regions. Seven projects are under various stages of completion. Four more irrigation projects are under consideration. It is anticipated that about 2.0 lakh hectares will benefit from these irrigation projects, when completed (Table 2). (See Page 9)

1.7 Socio-economic characteristics

Kerala supports a population of 25,453,680 according to 1981 census, which work out to 3.71 per cent of the national population. The population density of Kerala is 655 persons per km² as against the national average of 221. The district of Trivandrum has the highest density of 1578 persons per km, followed by Alleppey district with 1137. There are 1268 villages and 88 towns in the State. The number of occupied residential houses is 34,18,244 and the number of occupied residential house–

Table 2— Irrigation projects

Projects	Net area irrigated [ha]	Ultimate benefit expected (ha)
Completed		
Neyyar I & II	7782	—
Chalakudy I & II	14553	—
Peechi	17256	—
Vazhani	2194	—
Pothundy	5468	—
Cheerakuzhi	929	—
Mangalam	3307	—
Gayathri I & II	5001	—
Walayar	3754	—
Malampuzha	19748	—
Total	79992	
Continuing		
Kallada	—	52610
Pamba	—	17800
Periyar Valley	—	32800
Chitturpuzha	—	17300
Kanhirapuzha	—	9720
Kuttiadi	—	14600
Pazhassi	—	16200
New Schemes	—	
Muvattupuzha	—	17400
Chimoni	—	13000
Attappady	—	4300
Karapuzha	—	4650
Total		200380

holds is 35,43,129. Kerala leads all other states in India in literacy with 69.17 per cent, the national average being 36.17 per cent. The total number of workers is reported as 62.2 lakhs, out of which 34.5 lakhs are either cultivators, agricultural labourers or those attending to livestock farming, forestry, fishing, plantation management or other activities related to Agriculture. This indicates the pre-dominance of agricultural workers in the State.

1.8 Land use and farming systems

1.8.1 Land tenure system

The high density of population in Kerala has curtailed the per capita land cultivated to less than 0.10 hectare. The holdings continue

to be fragmented and sub-divided as a result of pressure of population and laws of inheritance. Most of the holdings have ceased to be economically viable units The total number of operational holdings is 28, 22,781 of which 15,17,640 are below 0.04 hectare. The total number of holdings having an extent of more than 50 hectares is only 426.

1.8.2 Land use and cropping pattern

The pressure of population on land is so heavy in the State, that as much as 90 per cent of the cultivable area is already under cultivation (Table 1.3).

Table 1.3—Classification of area (1978-'79)

	Area (lakh ha)
Total geographical area	38.85
Forest	10.82
Land put to non-agricultural use	2.60
Barren & uncultivable land	0.75
Permanent pastures & grazing land	0.06
Land under miscellaneous tree crops	0.66
Cultivable waste lands	1.23
Fallow other than current fallow	0.27
Current fallow	0.42
Net area sown	22.04
Area sown more than once	6 82
Total cropped area	28.86

Out of the geographical area of 38.85 lakh hectares in the State, 24.65 lakhs hectares are cultivable land. The remaining area comprises of forest (10.82 lakh) and area put to non-agricultural uses. The increase in land put to non-agricultural uses and a downward trend in the area of permanent pastures and other grazing lands, have been the disturbing patterns.

The suitability of land and climate for a number of crops tempted the farmers to cultivate a host of crops in the same land as mixed stands. This has resulted in an intensive cultivation of dry land in the State. The overall intensity of cropping in Kerala is fairly high. The ratio between the gross cropped area and net area sown is 1.33 in Kerala. At the national level, it is only 1.18. But this parameter in the context of Kerala is deceptive because nearly 60 per cent of the net area sown is under perennial crops. If this factor is discounted for and the intensity of field crops alone is considered, then the ratio rises to 1.50.

1.8.3 Major Crops

A wide variety of crops is cultivated in Kerala. They include plantation crops like coconut, arecanut, cashew, pepper, coffee, tea, rubber. annual crops like rice, tapioca, pulses, sesamum, cotton, groundnut, ragi, tobacco and fruit crops like mango, banana, pineapple etc. The major crops are rice and tapioca as food crops; coconut, groundnut, and sesamum as oil seeds and cowpea, blackgram and redgram as pulses. The major crops grown, their annual production and average yield are presented in Table 1.4.

Table 1.4—Area, production & productivity of the major crops (1978-'79)

Crops	Area (lakh ha)	Production (lakh t)	Average yield (kg/ha)
Rice	7.70	12.73	1592
Tapioca	2 73	40.44	14787
Banana & other plantains	0 53	6.60	12367
Coconut	6.61	3211(*)	4860(**)
Arecanut	0.62	10919(*)	175217(**)
Pepper	1.07	0.26	247
Rubber	2.14	1.24	579
Ginger	0.13	0.33	2589
Cardamom	0.55	0.03	53
Tea	0 36	0.47	1202
Coffee	0.53	0.28	525
Cashew	1.37	0.84	617
Cocoa	0.13	0.02	153

(*) million nuts (**) nuts

1.8.4 Farming systems

Agriculture in Kerala has certain distinguishing features in the systems and practices of crop production. This is due to the varied soil, land and physiographic conditions and climatological factors. The main features of the farming systems are (i) The homestead system of cultivation with a combination of perennial and annual crops and or mixed farming of crops–livestock, crop-livestock-fish. (ii) Rice cultivation of extensive nature in areas of utmost adverse conditions viz. lands lying below the sea level and subjected to inundation by sea water and extreme salinity as witnessed in *Kuttanad, Kole* and *Pokkali* lands of the State.

The cropping systems can be largely grouped into three major groups.

1.8.5 Coconut based farming systems

Farming system with coconut as the pivotal crop is in vogue in uplands and hill slopes of the midlands. This cropping system includes a number of intercrops like pepper, arecanut, cocoa, banana, turmeric, ginger, small tubers, fodder and in some areas upland rice, pulses and oil seeds. The selection of annual crops is made depending on the age of the coconut palms so as to make the best use of the sunshine for maximum out-turn from unit area.

1.8.6 Rice based farming systems

The rice based cropping systems are prevalent in the low lands. A single crop or two crops of paddy are grown depending on the availability of water as in the central region or after dewatering of impounded water as in the *Kayal* lands. Annual crops like vegetables, pulses and oil seeds are grown in rice fallows or as summer crop. Fish farming or prawn culture is often practised, after the rice crop, in the areas of sea water inundation.

1.8.7 Homestead farming systems

Homestead farming system has been in vogue in the State as the agro-climatic conditions of Kerala favour the raising of a wide variety of crops. The pressure on land and fragmentation of holdings also encouraged the homestead system of farming in Kerala. The farmers choose their crop combinations and livestock-fish farming according to the conditions available in the tracts.

1.9 Research organisation

1.9.1 Organisational set up

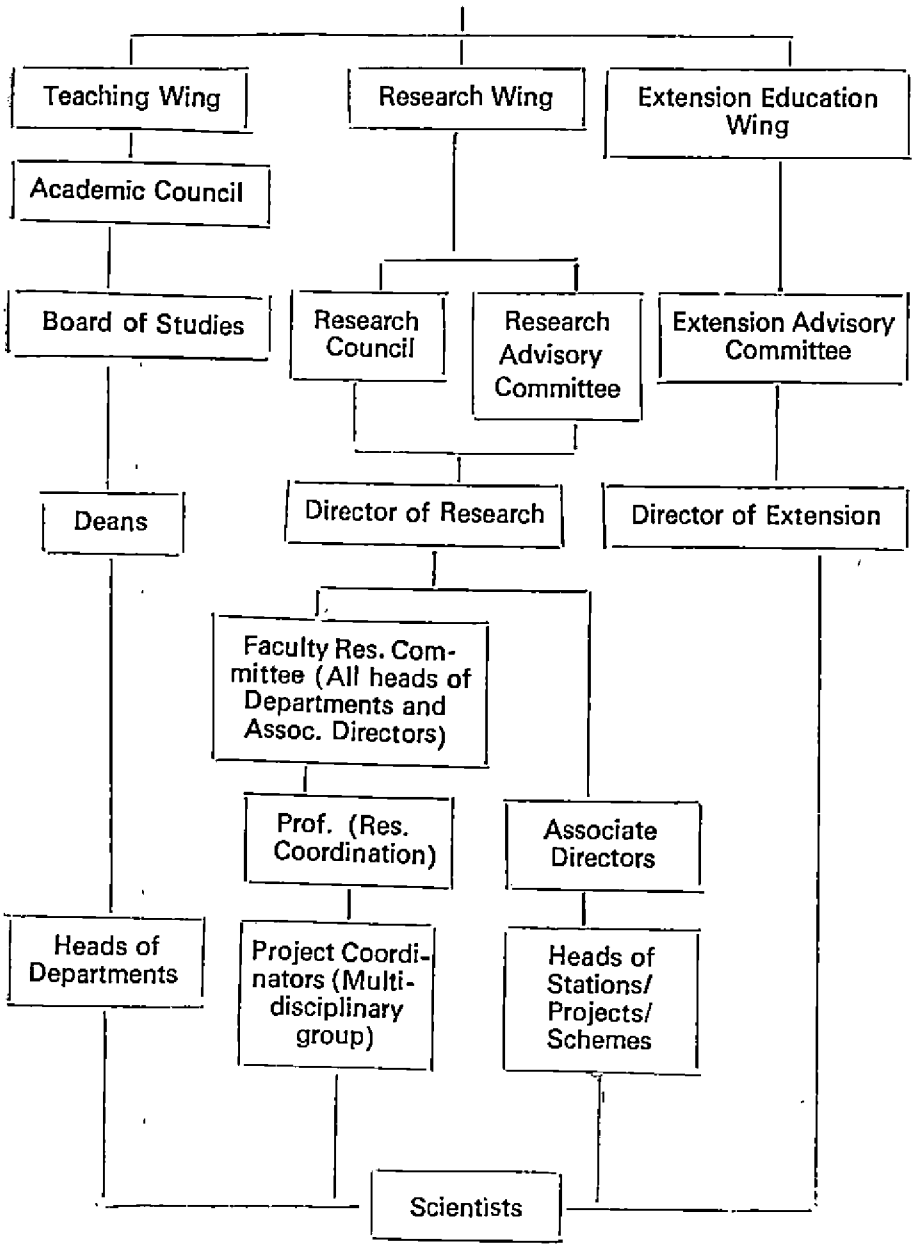
The organisational set-up of the Research Wing of the University is schematically presented in page 13.

Research, Teaching and Extension Education have been integrated in this University. The constituent Colleges and Research Institutions of the University through which the research activities are being carried out are indicated in Fig. 3.

The Director of Research will take action to provide necessary funds and facilities for the implementation of the projects. The overall technical and administrative control of the research is vested with the Director of Research. The primary responsibility for the implementation of the project is vested with the Project Leader.

The University has at present 31 Project Co-ordination Groups, 17 in the Faculty of Agriculture, 7 in the Faculty of Vety. & Animal Sciences and 7 in the Faculty of Fisheries. (Page 14)

RESEARCH ADMINISTRATION



PROJECT CO-ORDINATION GROUPS

Agriculture	Veterinary & Animal Sciences	Fisheries
Rice*		
Coconut, arecanut, oil palm Cashew	Cattle & buffaloes*	Aquaculture
Fruits & Floriculture Spices	Goat	Fishery Biology
Cocoa & beverage crops	Poultry & ducks	Fish processing technology
Vegetable & tuber crops		
Pulses & Oil seeds	Pig & other animals	
Essential oil & medicinal plants	Artificial insemination & animal reproduction	Fishery Hydrography
Sugarcane, jute & mesta		Fishing Technology
Fodder crops		
Crop pests, disease & weeds		
Soils & Agronomy*	Animal diseases	Fishery Engineering
Farm Economics & Extension		
Soil conservation & farm mechanisation	Miscellaneous	Management studies
Cropping patterns & farming systems		
Post-harvest technology & nutrition		

* Full time Project Coordinators are available

It has already been possible for these Project Coordination Groups to prepare status papers for each of their groups identifying the research gaps and the efforts needed to bridge these gaps. These status papers are periodically revised or updated and serve as the background papers for further discussions and major policy decisions on the strengthening or reorientation of research efforts and stresses in various areas.

1.9.2 Formulation and approval of research programmes

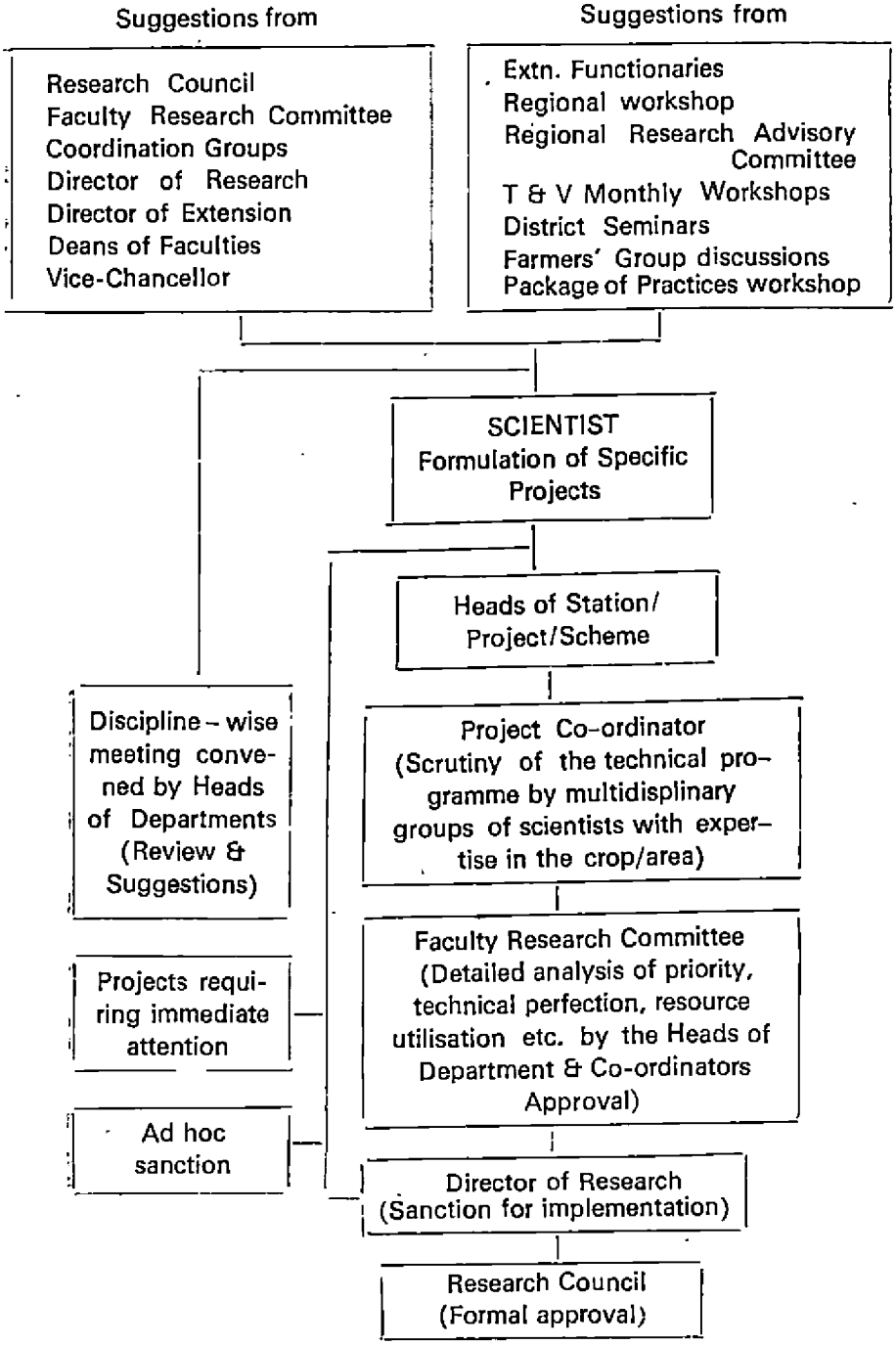
The various steps involved in the formulation and approval of research programmes are schematically presented on page 15.

1.9.3 Implementation of research programmes & monitoring the progress

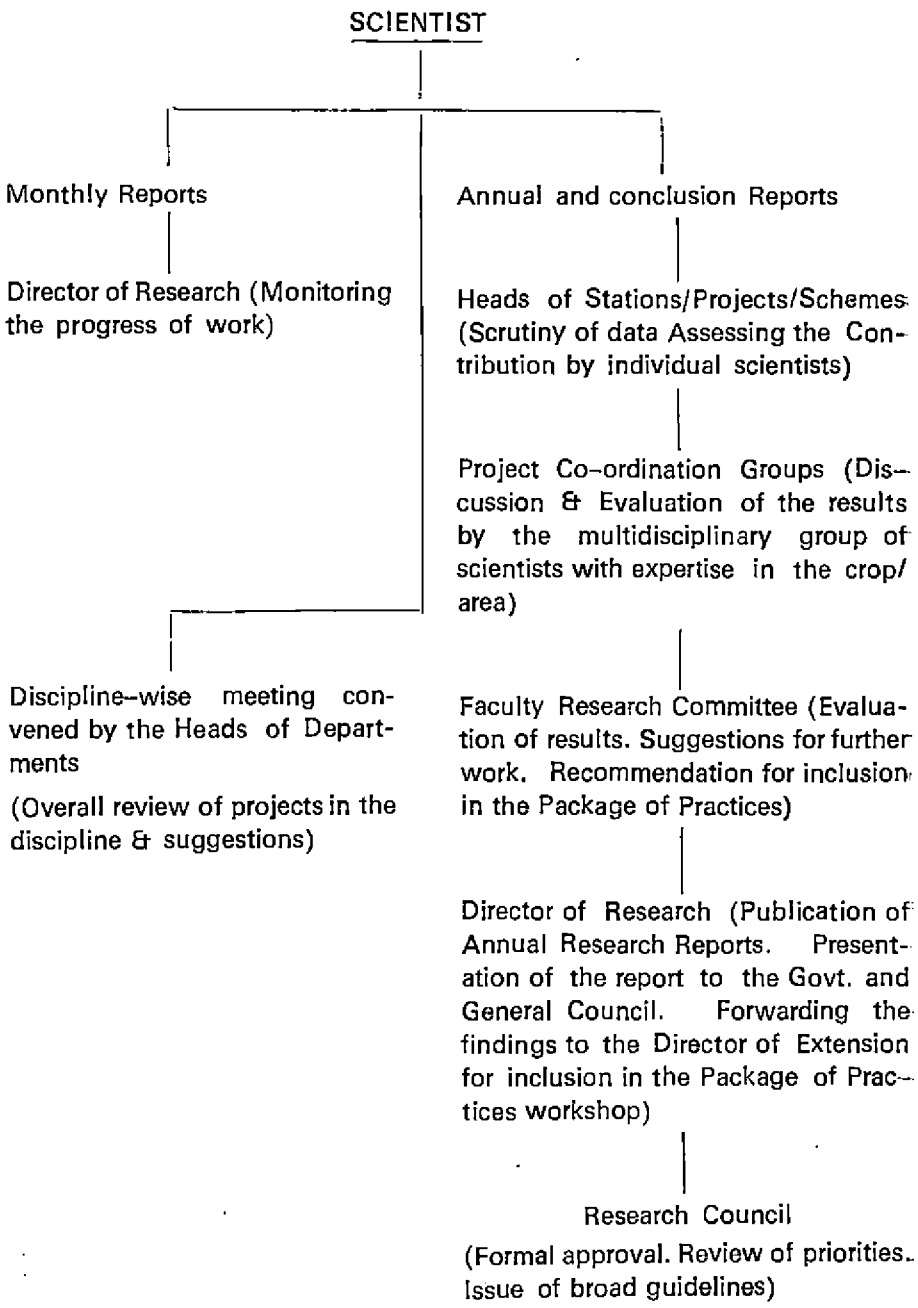
Besides undertaking its own research projects, the University is participating in 33 ICAR Coordinated Research Projects (26 Agriculture, 5 Veterinary & Animal Sciences and 2 Fishery).

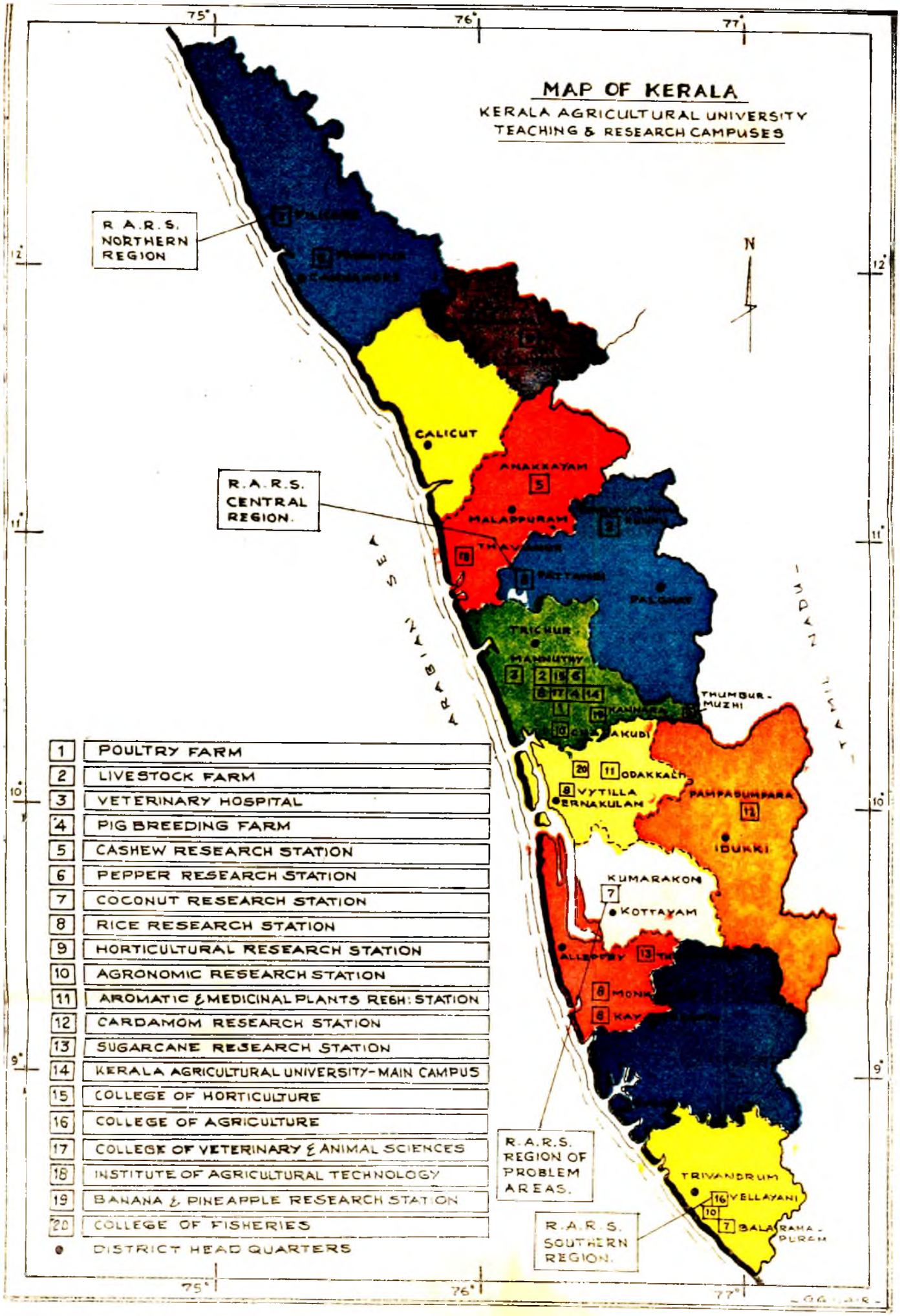
The procedure adopted for monitoring the progress and evaluating the research results is presented on page 16.

FORMULATION & APPROVAL OF RESEARCH PROJECTS



MONITORING THE PROGRESS AND EVALUATION OF THE RESULTS





The Pathanamthitta District was formed on 1-11-1983 by delineating the taluks of Ranni, Kozhencherry, Thiruvalla, Pathanamthitta, Mallappalli and Pathanapuram from the Alleppey and Quilon districts.

Staff specifically borne on research budget

The total sanctioned strength of research staff in the Research Wing of the Kerala Agricultural University (as on 1.4 .82) is as follows:

	ADR Prof. (RC)	Profe-ssors	Assoc. Prof.	Asst. Prof.	Jr. Asst. Prof.	Total
Agriculture	7	17	81	123	90	318
Veterinary & Animal Sciences	2	4	6	16	19	47
Fishery	—	—	2	3	6	11
Total	9	21	89	142	115	376

The teaching staff in the Colleges are also implementing research programmes. The staff as on 1.4.82 is as follows:

Institution	Professor	Associate Professor	Assistant Professor	Junior Asst. Prof.	Total
College of Agriculture	9	30	39	35	113
College of Horticulture	11	18	32	29	90
College of Vety. & Animal Sciences	23	36	41	31	131
College of Fisheries	3	8	10	8	29
Institute of Agricultural Technology	—	1	6	12	19
Total	46	93	128	115	382

1.10 NARP—Scope, objectives, recommendations

1.10.1. Scope

The National Agricultural Research Project (NARP) has been formulated by the Indian Council of Agricultural Research (ICAR) for strengthening the regional research capability of the State Agricultural Universities (SAU). Assistance for the project is being provided by the International Development Association (IDA); an affiliate of the International Bank for Re-construction and Development (IBRD) and the agreements in this respect were signed in December, 1978. The project is being administered by the ICAR through a Project Funding Committee (PFC).

1.10.2. Objective and approach

The main objective of the NARP is to improve the regional research capabilities of the SAUs permanently. This strengthening is considered to be an important means of finding solutions to the location-specific problems in the different agro-climatic zones in the service area. For this purpose, intensification of research efforts is promoted in respect of (i) food-grains (cereals and millets), pulses and oil seeds, particularly those that are grown under rainfed conditions, (ii) farming systems involving crop-livestock and crop-fish production systems; (iii) agronomic practices; (iv) soil and water conservation techniques and (v) land use patterns for more efficient use of natural resources and ecological potential. These objectives are achieved through rationalisation of the research programmes and the research set-up of the University as well as by strengthening the capability of the SAU to undertake research on location-specific problems. The main approach for this would comprise of: (i) Development of at least one main station in each selected agroclimatic zone in the service area of the University supported by sub-stations wherever it is necessary, by providing resources for staff, equipment and infrastructure needed for the on-going research as well as to pursue new applied research problems. (ii) Provision of resource including infrastructure for verification of research results both at the main station as well as the sub-stations. (iii) provision of resources to initiate, strengthen and accelerate basic research on topics which are crucial for the long-term agricultural development of the State.

1.10.3. Recommendations

Taking into consideration the topography, climate, soils, sea water intrusion, land use pattern and the recommendations of the 'Committee on Agro-climatic Zones and Cropping Patterns' constituted by the Government of Kerala in 1974, the Research Review Committee recommended that Kerala State may be divided for purposes of research and development into five agro-climatic regions viz., Northern Region, Central Region, Southern Region, High Ranges and Region with Problem Areas which include *Onattukara, Kuttanad, Pokkali* and Kole areas (Fig. 4). It has been recommended that each region consisting of two or three zones may have a single multidisciplinary research station. Based on the detailed research needs of each agro-climatic region, the Committee recommended a three tier system for carrying out research as well as verification functions as indicated below:

AGRICULTURAL RESEARCH STATIONS

Regional Station	Sub-Station/ Special Station	Lead function(s)	Verification function(s)
1	2	3	4
Northern Region			
Pilicode/Nileshwar		Coconut	Rice, Tubers Pulses
	Panniyur	Pepper	

1	2	3	4
	Anakkayam**	Cashew	
	Tavanur		Rice, Coconut
Central Region			
Pattambi		Rice, Pulses, Groundnut	Coconut
	Eruthiampathy		Rice, Groundnut, Pulses, Rice Groundnut, Tuber
	Mannuthy		Rice, Groundnut, Tuber
	Chalakudy	Water Management	
	Kannara**	Banana & Pineapple	
	Odakkali**	Medicinal & Aromatic Plants	
Region of Problem Areas			
Kumarakom		Coconut diseases, Crop-livestock-fish farming	Rice in Kayal lands
	Moncompu	Rice in *Kayal* lands	
	Kayamkulam	Oil seeds	Rice in Onattukara
	Vyttila	Crop–fishery systems	Rice in Pokkali
	Kole		Rice in *Kole* areas
	Thiruvalla**	Sugarcane	
Southern Region			
Vellayani		Tubers	Rice, Homestead Farming
	Kottarakkara	Homestead Farming	
	Karamana**		Rice, Agro-techniques
	Balaramapuram**		Coconut
High range Region			
Ambalavayal		Citrus, Hort. crops, Tribal area Devt.	Rice in High Ranges
	Pampadumpara	Cardamom, Tribal area development	

** Not covered under NARP

1.10.3 1. Regional Research Stations

These will have lead function for the State and responsibility for ensuring coordination of research in their influence area. Pilicode in the Northern Region, Ambalavayal in the High Ranges, Pattambi in the Central Region, Kumarakom in the Region of Problem Areas and the campus at Vellayani in the Southern Region have been recommended to serve this need.

1.10.3.2. Special Stations

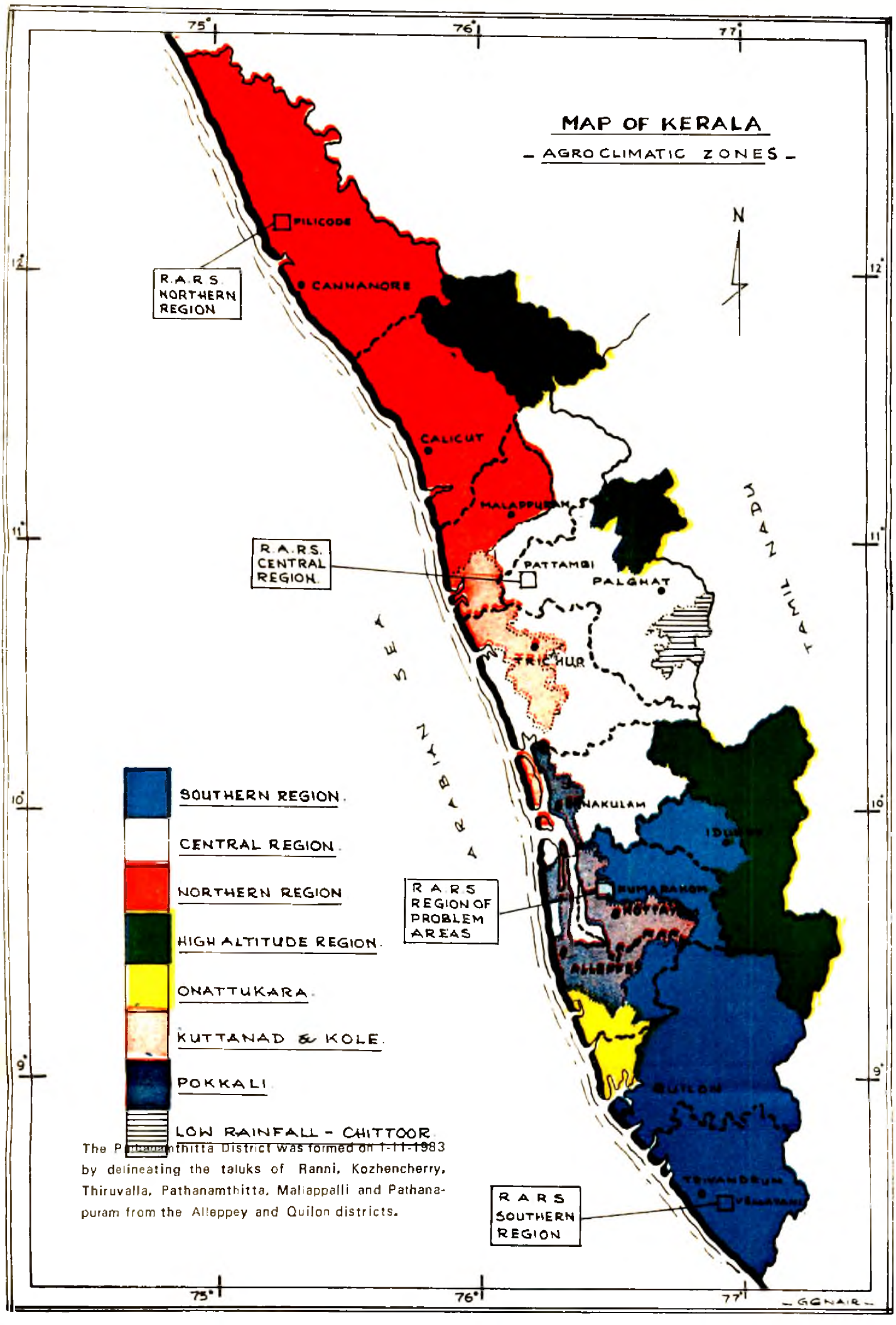
Sub-Stations will have lead functions in respect of particular crop (s) / programme (s) that could not be covered at the Regional Station due to locational reasons and due to variations in soil and climate.

The following seven special stations have been recommended:

Region	*Name of Station*	*Lead function*
Northern	Panniyur	Pepper
Central	Chalakudy	Water management
Southern	Kottarakkara	Homestead farming
Problem Areas	Kayamkulam	Problems connected with *Onattukara*
	Moncompu	Rice in *Kuttanad* area
	Vyttila	Rice and fisheries in *Pokkali* area
High Ranges	Pampadumpara	Cardamom, Tribal area development

1.10.3.3. Sub-station

Four sub-stations have been recommended at Tavanur, Mannuthy Eruthiampathy and Kole area to serve as verification centres in the Northern Central and Problem Areas.


MAP OF KERALA
– AGRO CLIMATIC ZONES –
N
75°
76°
77°
12°
11°
10°
9°
PILICODE
CANNANORE
CALICUT
MALAPPURAM
PATTAMBI
PALGHAT
TRICHUR
ERNAKULAM
IDUKKI
KOTTAYAM
ALLEPPEY
QUILON
TRIVANDRUM
R.A.R.S. NORTHERN REGION
R.A.R.S. CENTRAL REGION.
R A R S REGION OF PROBLEM AREAS
R A R S SOUTHERN REGION
ARABIAN SEA
TAMIL NADU
SOUTHERN REGION.
CENTRAL REGION.
NORTHERN REGION
HIGH ALTITUDE REGION.
ONATTUKARA.
KUTTANAD & KOLE.
POKKALI
LOW RAINFALL - CHITTOOR.
The Pathanamthitta District was formed on 1-11-1983 by delineating the taluks of Ranni, Kozhencherry, Thiruvalla, Pathanamthitta, Mallappalli and Pathanapuram from the Alleppey and Quilon districts.
– GGNAIR –

1.10.3.4. Sub-Projects

Based on the recommendations of the Research Review Committee, sub-projects have been sanctioned till 81-82.

Region	Name of the station	Outlay proposed by the Res. Rev. Comte. (Rs. in lakhs)	Outlay sanctioned (Rs. in lakhs) ICAR	KAU	Total
Northern	Pilicode Panniyur Tavanur	86.98	83.98	23.45	110.43
Central	Pattambi	70.00			
	Mannuthy	20.00	84.46	1.75	82.21
	Eruthiampathy	20.00			
	Chalakudy (Water management)	40.00	21.72	8.34	30.06
Southern	Vellayani	70.00			
	Kottarakara	40.00	81.77	13.94	95.71
	Kumarakom	40.00			
	Moncompu	40.00			
Special	Kayamkulam	40.00	113.91	4.50	118.41
	Vyttila	20.00			
	Kole	—			
High Range	Ambalavayal	20.00	33.37	3.99	37.36
	Pampadumpara	—			
	Strengthening Directorate of Research	10.83	10.83	—	10.83
		Grand total			489.01

The share of the State Government towards the NARP projects is about 10% of the total investment. This amount is required for land acquisition, station maintenance and basic cultivation costs.

1.10.3.5. Programme formulation and research co-ordination

The Committee noted that Heads of the Divisions of the University are not effectively involved in programme planning and technical evaluation of the projects. It therefore recommended the following additional step in the programme formulation procedure existing at the moment in the University. The projects prepared by a Scientist relating to a particular discipline may be discussed at the disclipine committee headed by the Professor of the department before it is submitted to

the Crop-Co-ordination Group. The following chart indicates the various steps in the formulation of programmes:

Scientist
↓
Discipline-wise meeting
↓
Crop Co-ordination Group
↓
Faculty Research Committee
↓
Research Council

The Committee noted the detailed procedure evolved for monitoring and evaluation of the work done under the individual projects as well as under the Research Stations of the University. It suggested in addition, that there should be a five yearly evaluation of research projects by a committee which should include outside experts also. The Committee noted that the University is proposing to have full time Project Co-ordinators for different crops disciplines. It was felt that a full time Project Co-ordinator gets drawn away from active research and after some time may fail to provide the necessary leadership in the field. Secondly, the creation of desk oriented jobs will tend to increase the existing tendency to crowd around the main campuses of the University. In view of the above, the Committee recommended that the University may consider full time Project Co-ordinators only when necessary. Even in cases where a full time Project Co-ordinator is considered essential, he/she should be allocated to the main station which deals with the crop (s) he/she coordinates.

The Committee recommended that the University may invite the National Project Co-ordinators of the All India Co-ordinated Projects in which they participate to the meetings of the FRC. This would provide effective co-ordination both at the State and National level.

The University is implementing almost 1000 projects at the moment. It is almost impossible for the FRC to go through the reports of all the projects in a detailed manner. The Committee therefore recommended that a group of projects (dealing with the same crop or with similar subjects) may be referred to a Scientist of capability within the University for detailed study. This would facilitate an indepth study of the research programmes and critical analysis of research result that become available.

With the strengthening of the regional research capability through programmes like NARP the Committee felt that there is need for reorientation of the Programmes of the Central Institutes located in the

State to avoid duplication. The Central Institutes should restrict their programmes to basic research and applied research when there is no university station to meet necessary location specific demands of an area near its establishment. While some duplication would be welcome, arrangements need to be made to ensure that duplications are minimised. The Committee recommended that the Directors of the Central Institutes may be invited to the Faculty Research Committee meetings whenever the projects concerning their area of work are discussed. The Directors of the ICAR Institutes should also request the Director of Research or the Professor assisting him to join their annual reviews as well as programme planning discussions.

The Committee recommended a detailed procedure for formulation of programmes for the Regional Research Stations with the active involvement of the development functionaries.

The Committee suggested that the KAU take up the revision of pay scales in the University. The present pay scales which are not equal to that of UGC not only fail to attract talent from outside, but also result in the University losing some of its bright Scientists.

The Committee was of the view that the staff strength at the different stations has to be improved to give a better proportion between the campus and the outlying stations. The University may consider incentives to retain the staff at the not-so-well-developed Regional Stations.

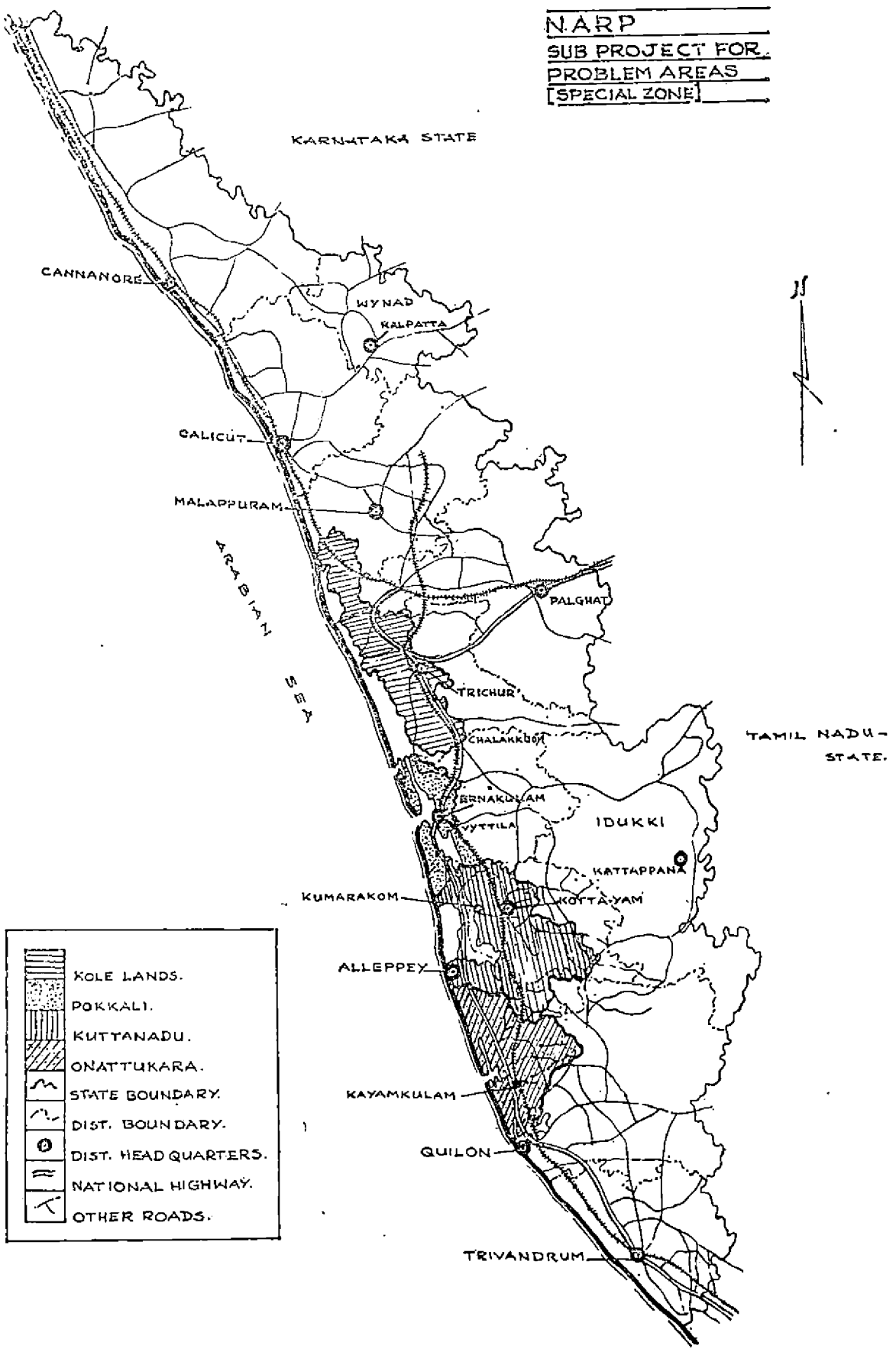
1.10.3.6. Extension

The expenditure of the University on Agricultural Extension comes to around 2% of the total budget. The Research Review Committee noted that the Extension Education programmes need further strengthening. It has been recommended to have a unit of Extension Staff at each of the Regional Stations. The strength should be decided keeping in view the programme of work and the likely outflow of the technology. The Extension team at each station should be headed by a person at the level of either a Professor or an Associate Professor. He should be assisted by Subject Matter Specialists in disciplines depending upon the requirements of the Regional Stations. This team should have a specialist in Extension Education who can impart to the Subject Matter Specialists, the communication skills and also assist in the maintenance of a good information centre.

The extension unit at each Regional Station should be administered by the Associate Director. But the various specialists working in it should maintain intimate links with the respective Heads of the

Departments. More funds need to be allocated for prvoiding increased audio-visual support.

The Committee recommended that the University take advantage of the possibility of bringing the latest technology to the door of the farmer through correspondence courses which are feasible due to the high literacy rate in the State.


N.A.R.P
SUB PROJECT FOR
PROBLEM AREAS
[SPECIAL ZONE]
KARNATAKA STATE
CANNANORE
WYNAD
KALPATTA
CALICUT
MALAPPURAM
ARABIAN SEA
PALGHAT
TRICHUR
CHALAKKUDY
TAMIL NADU-
STATE.
ERNAKULAM
VYTTILA
IDUKKI
KATTAPPANA
KUMARAKOM
KOTTAYAM
ALLEPPEY
KAYAMKULAM
QUILON
TRIVANDRUM
KOLE LANDS.
POKKALI.
KUTTANADU.
ONATTUKARA.
STATE BOUNDARY.
DIST. BOUNDARY.
DIST. HEAD QUARTERS.
NATIONAL HIGHWAY.
OTHER ROADS.

CHAPTER 2

General Agricultural features of the region

2.1. Delineation of the zone

The special zone of problem areas consists of Onattukara, Kuttanad, Pokkali and Kole lands. Details of each of the regions are furnished below:

2.1.1. Onattukara

The Onattukara region falls into Quilon and Alleppey Districts of Kerala. In Quilon District it is located at Karunagapally Taluk and in Alleppey District it falls into Mavelikkara and Karthikappally Taluks. It is bounded on the Southern side by Neendakara Azhi and Ashtamudi Lake, in the Northern side by Tottappally Pozhi and upper Kuttanad region, on the Eastern side by midland laterite belt and on the Western side by the Arabian Sea. The total geographical area of this agricultural region is estimated to about 725.7 km². In olden days Onattukara region was considered to be the rice grannery of erstwhile Travancore. But recently due to various reasons it became a problem area with low level of production and productivity.

The influence area of Onattukara-region is given in Table 2.1.

Table 2.1: Onattukara region

District	Taluk	Block	Villages
Alleppey	Mavelikkara	Mavelikkara	Chettikulangara, Mavelikkara Muncipal area.
		Bharanikavu	Bharanikavu Vallikkunnam Thamarakulam Chunakkara
		Pandalam	Palamel Nooranad Pandalam Thekkekara Pandalam Thumpamon
	Karthikappally	Muthukulam	Pathiyoor Kandalloor Muthukulam Arattupuzha

			Kayamkulam Muncipal area.
		Haripad	Chingoli
			Karthikappally
			Thrikunnapuzha
Quilon	Karunagappally	Ochira	Ochira
			Krishnapuram
			Clappana
			Devikulangara
			K. S. Puram
		Karunagappaly	Karunagappally
			Thazhava
			Thodiyoor
			Mynagappally
			Alappad
		Chavara	Chavara
			Panmana
			Thevalakkara
			Thekkumbhagam

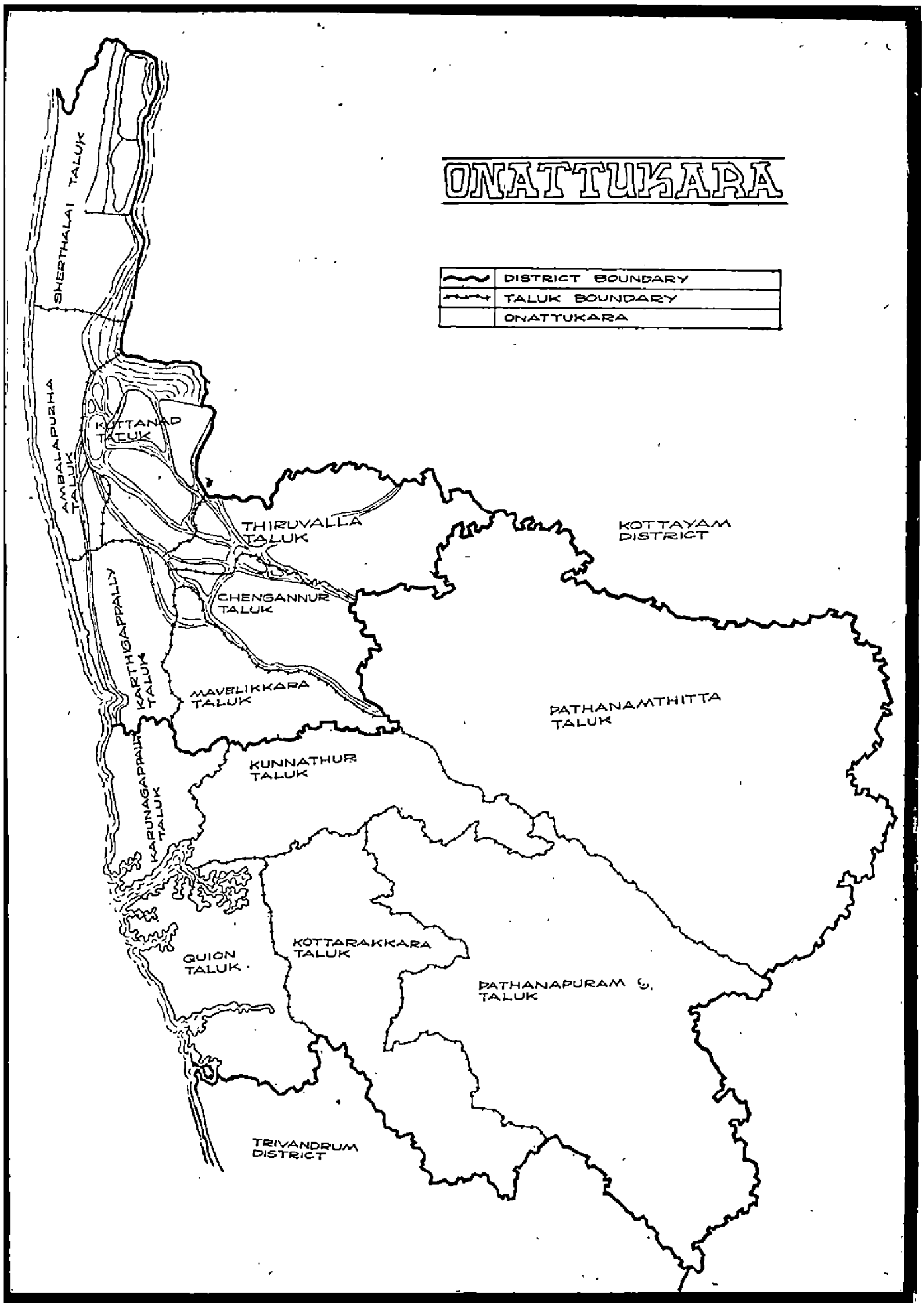
Population

According to 1971 Census, the total population of Onattukara region is estimated to 9,74,947, out of which 7,45,340 (77%) purely depend upon agriculture for their livelihood. More than six lakhs people are small cultivators and agricultural labourers. Medium cultivators having an area of 2 to 3 acres accounts to 1,31,470 and cultivators having an area of more than 3 acres accounts to only 9960. The per capita land available in Onattukara region was only 33 cents. The population of the respective Taluks in Onattukara region corresponding to 1971 and 1981 census are furnished in Table 2.2.

Table 2.2: Total Population of Onattukara region
(Taluk wise distribution 1971–1981)

Taluk	1971			1981			Growth rate
	Total	Male	Female	Total	Male	Female	
Karuna–gapally	321164	160707	160457	377181	187818	189353	17.44
Karthika–pally	330506	160710	169790	364357	175500	188857	10.24
Maveli-kara	323277	158202	165075	352894	169756	183138	9.16
Total	974947			1094432			

Source: 1. District hand book of Census 1971.
2. Bureau of Economics and Statistics.


ONATTUKARA
DISTRICT BOUNDARY
TALUK BOUNDARY
ONATTUKARA
SHERTHALAI TALUK
AMBALAPUZHA TALUK
KUTTANAD TALUK
THIRUVALLA TALUK
KOTTAYAM DISTRICT
CHENGANNUR TALUK
KARTHIGAPPALLY TALUK
MAVELIKKARA TALUK
PATHANAMTHITTA TALUK
KUNNATHUR TALUK
KARUNAGAPPALLY TALUK
QUION TALUK
KOTTARAKKARA TALUK
PATHANAPURAM TALUK
TRIVANDRUM DISTRICT

In Onattukara region the population increased by 12.28 per cent during the past one decade. Comparing the different taluks, Karunagappally taluk has exhibited the highest increase of 17.44% while Mavelikkare taluk recorded the least with 9.16%.

Density of population

The density of population in Onattukara region as per 1981 Census is found to be 1493/km^2 This is more than double the rate of the State average (549/km^2). But in 1971 the density in Onattukara region was 1374/km^2, Karunagappally taluk has exhibted the maximum density with Mavelikkara the minimum. The details are furnished below:

Table 2.3: Density of Population in Onattukara region (Taluk wise 1981)

Taluk	Density/km^2
Karunagappally	1780
Karthikappally	1622
Mavelikkara	1241

Source: Bureau of Economics and Statistics.

Literacy

The literacy in Onattukara region as per 1981 Census is 74.4% which is very high when compared to the State average of 69.1%. Among the different taluks, Mavelikkara ranks first in literacy followed by Karthikappally and then Karunagappally. The details are given in the following Table

Table 2.4: Literacy rate in Onattukara region, Taluk wise 1981

TaluK	Literacy rate
Karthikappally	74.48
Karunagappally	71.45
Mavelikkara	77.37

Source: Bureau of Economics and Statistics.

Sex ratio

As in other parts of the State in Onattukara region also females out number the males. According to 1981 Census the sex ratio is found to be more in Mavelikkara followed by Karthikappally and then Karunagappally. In Mavelikkara and Karthikappally Taluks the ratio exceeds the State average of 1034 (Table 2.5).

Table 2.5: Sex ratio in Onattukara region (Taluk wise, 1981)

Taluk	Sex ratio
Karthikappally	1076
Karunagappally	1008
Mavelikkara	1079

Source: Bureau of Economics and Statistics

2.1.2 *Kuttanad*

The Kuttanad region represents low-lying lands measuring about 25 km. east-west and 60 km. north-south of the west coast of Kerala State. It lies between latitudes 9°8' and 9°52' N and longtitude 76°19' and 76°44' E. It is separated from the Arabian sea by a narrow strip of land. Alleppey Municipality is located on the western fringe and Kottayam and Changanacherry Municipalities on the eastern side.

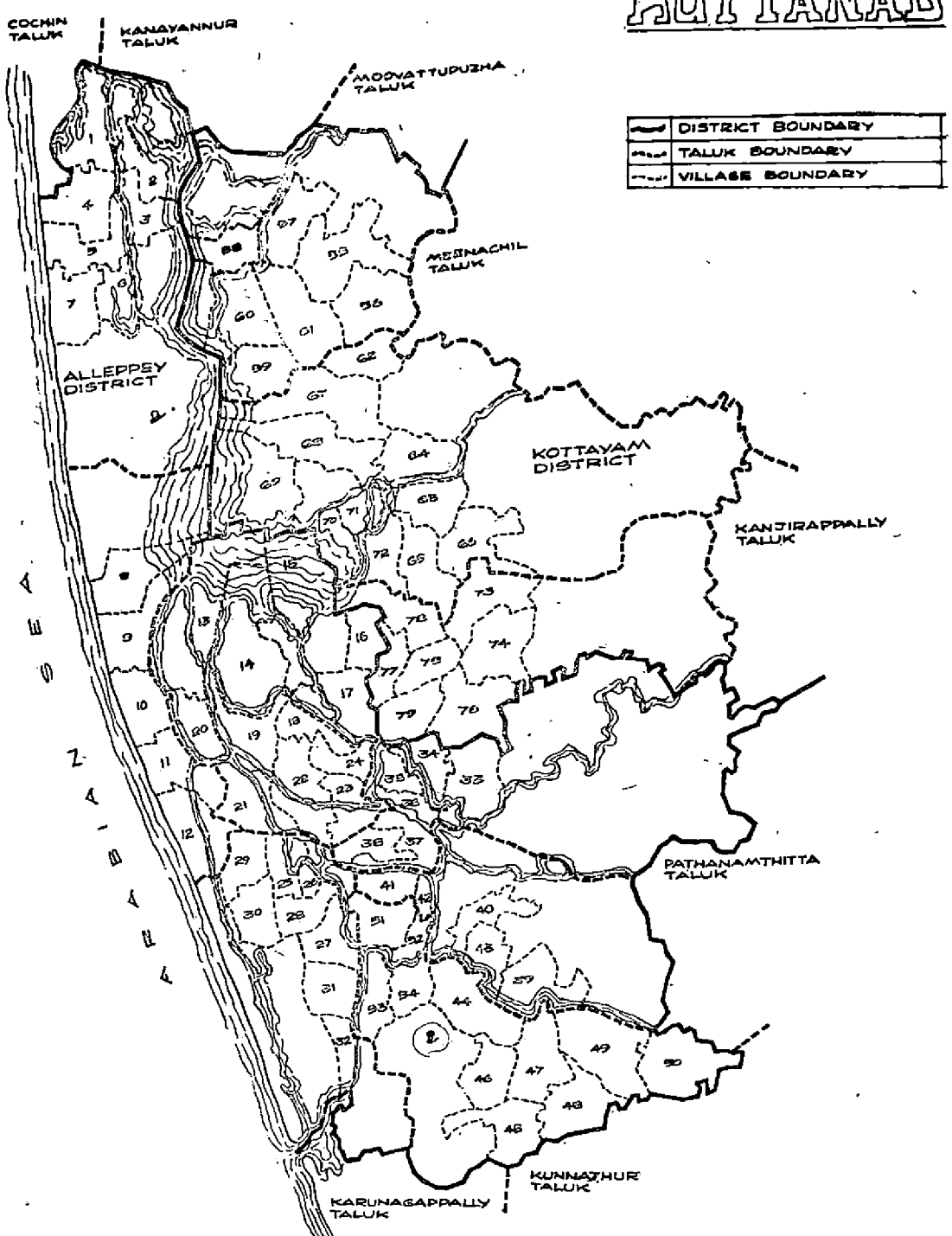
The Kuttanad region falls into two districts of Alleppey and Kottayam. In Alleppey district, the region comprises the revenue taluks of Kuttanad, Ambalapuzha and parts of Karthikappally, Shertallai, Mavelikkara, Chengannur and Thiruvalla. In Kottayam district it consists of certain patrs of Changanacherry, Kottayam and Vaikom taluks.

The different villages, blocks and taluks falling into this region are furnished in Table 2.6.

Table 2.6: Administrative divisions of Kuttanad Region

District	Taluk	Block	Villages
Alleppey	Ambalapuzha	Ambalapuzha	Ambalapuzha Alleppey Punnapra, Purakkad.
	Karthikappally	Harippad	Harippad. Cheruthana, Karuvatta, Kumarapuram, Pallippad. Veeyapuram.
	Kuttanad	Champakulam	Champakulam Nedumudi, Thakazhi, Kozhimukku, Thalavadi.
		Veliyanad	Nilamperur Veliyanad Muttar Ramankary, Pulinkunnu. Chennamkari.
	Shertallai	Pattanakkad	Vayalar West Vayalar East Thuravur North, Thuravur South.
		Thaikkatussery	Aroor Panavally Thaikkattussery.

KUTTANAD



ALLEPPEY DISTRICT						KOTTAYAM DISTRICT	
1	AROOR	18	RAMANKARY	38	KIZHAKKUMBHAGOM	55	KADUTHURUTY
2	PANAVALLY	19	CHAMPAKULAM	39	VENMONY	56	MANJOOR
3	THAIKKATTUSSERI	20	NEDUMUDY	40	PULIYOOR	57	VADAYAR
4	THURAVUR VADAKKU	21	THAKAZHY	41	KURATTISSERI	58	NADUVILLA
5	THURAVUR THEKKU	22	KOZHIMUKKU	42	MANNAR	59	VETCHOOR
6	VAYALAR KIZHAKKU	23	THALAVADY	43	CHERIANAD	60	THALAYAZHAM
7	VAYALAR MEKKU	24	MUTTAR	44	THAZHAKARA	61	KALLARA
8	ARYAD SOUTH	25	CHERUTHANA	45	THAMARAKULAM	62	ONAMTHURUTHU
9	ALLEPPEY	26	VEEYAPURAM	46	CHUNAKARA	63	VIJAYAPURAM
10	PUNNAPRA	27	PALLIPAD	47	NOORNAD	64	PERUMPAIKAD
11	AMBALAPUZHA	28	HARIPAD	48	PALAMEL	65	PANACHIKAD
12	PRAKKAD	29	KARUVATTA	49	THONNELLUR	66	PUTHUPPALLY
13	KAINAKARY	30	KUMARAPURAM	50	PANDALAM SOUTH	67	KAIPUZHA
14	PULINKUNNU	31	CHEPAD	51	TRIPERUMTHURA	68	AIMANAM
15	CHENNAMKARY	32	PATHIYOOR	52	CHENNITHALA	69	KUMARAKOM
16	NEERAMPEROOR	33	THIRUVALLA	53	KUNNAMANGALAM	70	THIRUVARPU
17	VELIANAD	34	KAVUMBHAGOM	54	MAVELIKKARA	71	KOTTAYAM
		35	PERINGARA			72	NATTAKOM
		36	NEDUMPURAM			73	VAKATHANAM
		37	KAPAPRA			74	MADAPPALLY
						75	VAZHAPPALLY EAST
						76	THRIKKODITHANAM
						77	VAZHAPPALLY WEST
						78	KUDICHY
						79	CHANGANACHERRY

	Chengannur	Chengannur	Cheriyanad Venmoni Puliyur Kuruttissery
	Mavelikkara	Bharanikkav	Kannamangalam
		Mavelikkara	Thazhakkara, Chennithala, Thripparumthura Chunakkara, Mavelikkara
		Pandalam	Pandalam South, Thovallur
	Thriuvalla	Pulikeezhu	Kizhakumbhagam Kadapra, Peringara, Nedumpuram, Kavumbhagam, Thiruvalla.
Kottayam	Kottayam	Pallom	Kumarakom, Panachikkadu, Nattakom. Puthupally, Thiruvarpu, Vijayapuram, Kottayam
		Ettumanur	Aimanom, Kaipuzha, Onamthuruthu, Perumpaikadu
	Vaikom	Vaikom	Naduvila, Thalayazham, Kallara, Vechoor, Manjoor, Vadayar, Kaduthuruthy.
	Changanacherry	Vazhoor & Madappally	Kurichi, Vazhapally west, Vazhapally East, Changanacherry, Trikkodithanam, Vakathanam.

Source: Report on Kuttanad Development Project.

Population

Though the land area is small, Kuttanad region is densely populated. According to 1971 Census the population in this region was 1.69

million. The density of population in this region during 1971 was 1128 per km². It is very high when compared to the state average. So, it can be seen that Kuttanad, having only 4.2% of the total area of the state supports 8% of its population.

The literacy rate in Kuttanad is also found to be high. In 1971 it was 72% against the state average of 60%. Out of the total population, about 30% form the actual labour force.

Pattern of land holding.

The rice fields in Kuttanad region are divided into contiguous blocks called 'Padasekharam'. The area of each padasekharam ranges from a few hectares to above 1000 ha, owned by serveral cultivators. The pattern of agricultural holdings in Kuttanad region is given in Table 2.7.

Table 2.7: Pattern of land holdings in Kuttanad Region as in June 1973

Pattern of holdings	Alleppey Dist.		Kottayam Dist.		Total	
	No. of culti-vators	Extent of holding (ha)	No. of culti-vators	Extent of holding (ha)	No. of culti-vators	Extent of holding (ha)
Below 0.42 ha	10112	4166	6464	2556	16576	6722
Between 0.42 ha. and 1 ha.	7723	6667	4460	3981	12183	10648
Between 1 ha. and 2 ha.	6203	9841	4957	7182	11160	17021
Between 2 ha. and 4 ha	3816	8396	1215	3503	5031	12199
Between 4 ha. and 6 ha.	10113	4312	238	1072	1251	5384
Above 6 ha.	201	4333	141	1323	342	5656
Total	29068	38015	17475	19617	46543	57632

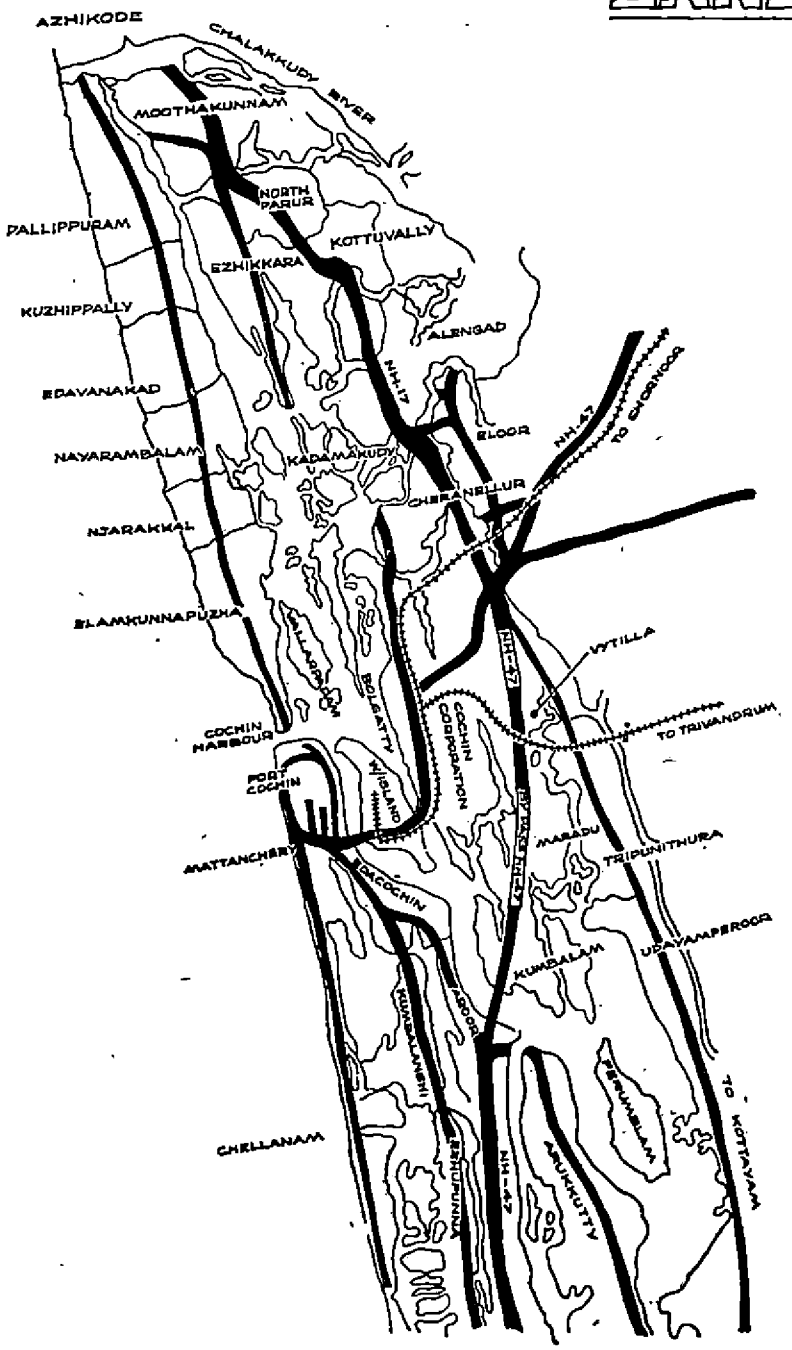
Source: Report on Kuttanad Development Project, Kerala, 1974

Out of 46543 cultivators of Kuttanad region, nearly 40,000 (86%) are having holdings less than 2 ha. About 62% of total cultivators are having holdings of less than 1 ha.

2.1.3 Pokkali

The Pokkali type of cultivation is a unique feature of Ernakulam District in the State. The pokkali lands comprise of the marshy areas of Ernakulam District where salt water incursion is the problem. The total area of Pokkali region is estimated to about 22,000 acres. Though only one crop is being taken during the first crop season, it yields a substantial production of 20,000 tons annually. During the second and third crop seasons the entire region may be submerged and during this period the cultivators get actively engaged in fish and prawn culturing business. This is considered to be more profitable when compared to paddy cultivation.

POKKALI LANDS



Hence, in Pokkali region though cultivators are taking only one crop financially they are not losing. The paddy fields of pokkali lands mostly lie on the mean sea level. The Pokkali region lies between the Northern side of Thannirmukkam bund and the Southern side of Ernamakkal bund. These two are considered to be salt water barrier bunds. Some pokkali lands also exists in certain areas of Cannanore and Alleppey Districts. In Cannanore District these areas extend to about 4,000 to 5000 acres and are saline in nature. It is known by the name Kaipad. In Alleppey District the pokkali lands lie in limited areas of Thaikkattussery and Pattanakkad blocks. The different villages, blocks and taluks falling into Pokkali region are given in Table 2.8.

Table-2.8: Details of Pokkali region

District	Taluk	Block	Villages
Ernakulam	Kanayannur	Edappally	Kadamakudy, Cheranallur, Edappally.
		Vyttila	Marad, Kumbalam, Vyttila.
	Cochin	palluruthy	Palluruthy, Kumbalangy, Chellanam
		Vypeen	Kuzhuppally, Pallippuram, Edavanakkad, Elamkunnapuzha, Nayarambalam.
	Parur	Parur	Vadakkekara, Chennamangalam, Puthenvelikkara, Aiyroor, Ezhickara, Kattuvally, Alangad, Kadumgattur, Varapuzha.
Alleppey	Shertallai	Thaikkattussery	Chemmanom, Pallippuram.
		Pattanakkad	Vyalar West, Vyalar South, Thuravur North, Thuravur South, Aroor.

Population

Though the land area is very small, the area is densely populated. As per the 1971 Census, the total population of Pokkali blocks in

Ernakulam and Alleppey districts are estimated to be 6,93,337, out of which 3,30,190 are males and 3,63,167 females. The details are given in Table 2.9.

Table 2.9: Population of Pokkali region—block wise distribution (1971)

Block	No. of holdings	Total	Male	Female
Edappally	13771	833724	42717	40657
Palluruthy	7011	44514	21900	22614
Parur	17561	112783	55526	57257
Vypeen	23682	154659	76348	78811
Vytilla	6514	41453	20647	20806
Pattanakkad	25746	180920	75189	75731
Thaikattussery	12864	75634	37863	37771

Source : Hand book of census 1971.

Note:– The data pertain to the entire block region, and hence the same may not represent the Pokkali area since the total block area is not covered by pokkali region alone.

Separate data on literacy, sex ratio and density of population are not available for pokkali region. Hence, the data pertaining to the district are considered for this purpose. The literacy rate of Ernakulam district as per the 1971 census is found to be 65.29. The density of population was estimated to 729 km^2 with a sex ratio of 983.

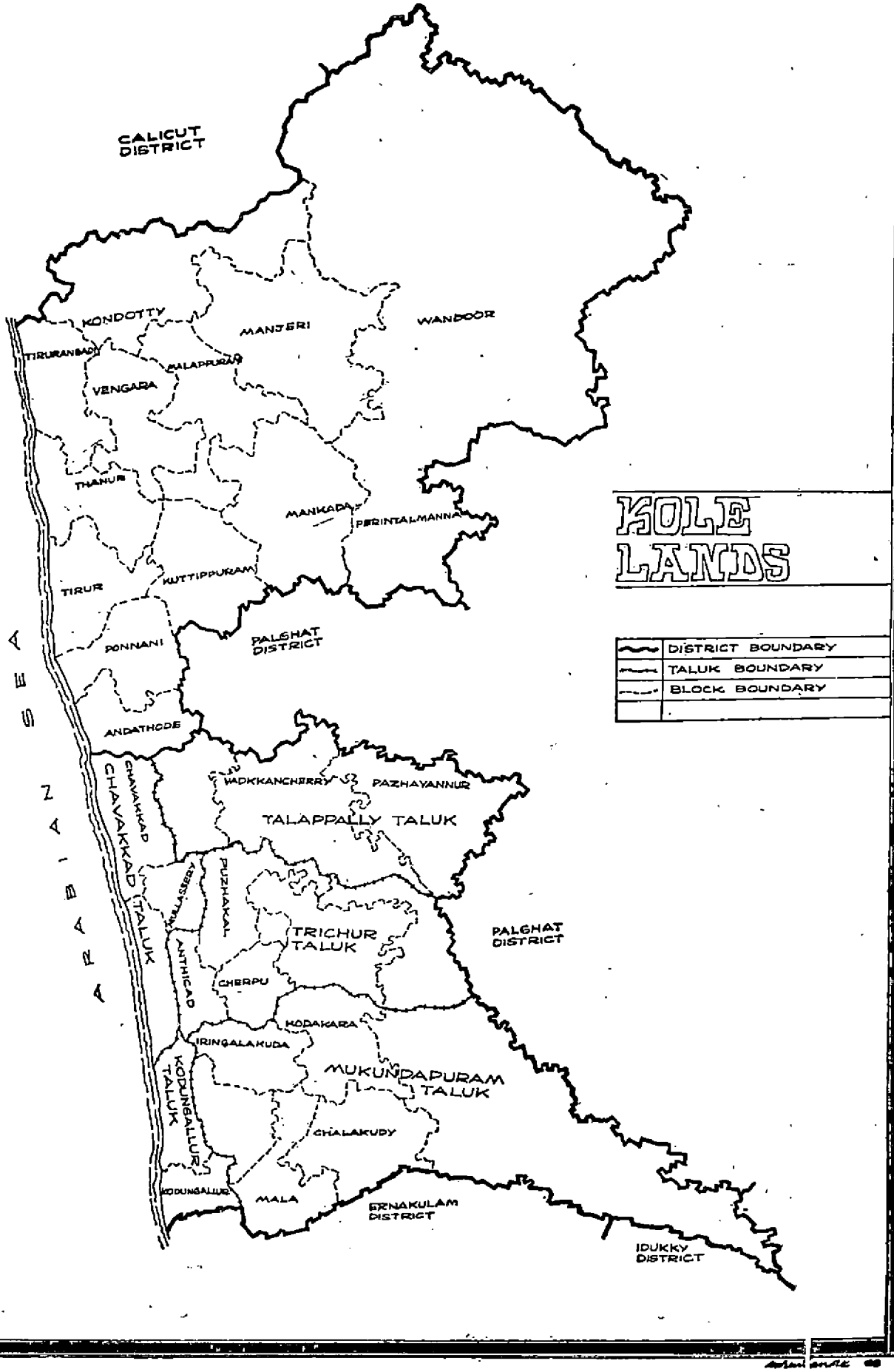
The data regarding the pattern of size of holdings in Pokkali region is not available and hence could not be incorporated.

2.1.4 Kole Region

The name Kole Cultivation is peculiar to the type of cultivation carried out during December to April, in about 11,000 ha. of Karuvannur and Keecheri basins. The Kole region lies in Trichur and Malappuram Districts extending partly along Trichur, Chowghat, Mukundapuram and Ponnani taluks. The area lies between 10°20′ and 10°35′ north latitude and 76°06′ and 76°11′ east longitude. The Kole area forms a substantial portion of the area under paddy cultivation in Trichur and Malappuram Districts. The different taluks, blocks and villages falling into the Kole region are furnished in Table 2.10.

Table 2.10: Administrative division of Kole region

District	Taluk	Block	Villages
Trichur	Trichur	Puzhakkal	Puzhakkal, Puranattukara, Chittilappally, Adat, Manakody, Vetathur, Erava, Parakkad, Thangallur. Avannur, Choorassery, Velapaya, Pattazhi, Aranattukara, Ayyanthol, Poonkunnam, Raiparambu, Anjoor,


CALICUT DISTRICT
KONDOTTY
MANJERI
WANDOOR
TIRURANGADI
MALAPPURAM
VENGARA
THANUR
MANKADA
PERINTALMANNA
TIRUR
KUTTIPPURAM
PONNANI
PALGHAT DISTRICT
ARABIAN SEA
ANDATHODE
CHAVAKKAD
CHAVAKKAD TALUK
VADAKKANCHERRY
PAZHAYANNUR
TALAPPALLY TALUK
PUZHAKKAL
WADAKKANCHERRY
TRICHUR TALUK
PALGHAT DISTRICT
ANTHICAD
CHERPU
KODAKARA
IRINGALAKUDA
MUKUNDAPURAM TALUK
KODUNGALLUR TALUK
CHALAKUDY
KODUNGALLUR
MALA
ERNAKULAM DISTRICT
IDUKKY DISTRICT
KOLE LANDS
DISTRICT BOUNDARY
TALUK BOUNDARY
BLOCK BOUNDARY

			Peramangalam, Killannur, Tholur, Edakolattur, Chalakkal.
		Cherpu	Cheeyaram, Kanimangalam, Koorkancherry, Ollur, Edakkunny, Avinassery. Vallachira, Arattupuzha, Kodannur, Venginissery, Palissery, Pallipuram. Paralam, Chevoor, Oorakom, Cherpu.
		Anthikad	Padiyam. Anthikkal, Chazhoor, Inchamudi, Karamukku, Vadakumuri, Kizhuppillikkara, Pullur, Alappad, Karumpilav, Manalur, Kizhakumuri, Thaniyam.
	Mukunda-puram	Irinja-lakuda	Karalam, Kattur, Pullur, Anandapuram Muriyad, Nellayi, Parappukara, Thottipal, Parathissery, Irinjalakuda, Madaikonam.
	Chowghat	Mulla-ssery	Elavally, Pavaratty, Vengidangu, Mullassery.
	Thalap-pally	Chovv-annur	Anjoor, Arthat, Chiranallur, Choondal, Eranallur, Chovvannur, Chemnanthatta, Kanippayyur, Kadavallur, Perumpilavu, Karikkad, Alur, Pazhachi, Kuttakambad, Mangad, Porkulam, Akathiyur.
Mala-ppuram	Ponnani	Ponnani	Thavanur, Vattamkulam, Maemcheri, Edappal, Ezhuvathiruthi.
		Anda-thode	Perumpadappa, Nanamukka, Alankad, Marancheri

Source: District Hand Book of Census, 1971.

Like other parts of the State, Kole region is also densely populated. The demographic features of different taluks falling into the Kole region are furnished in Table 2.11.

Table 2.11: Demographic features of Kole region (Taluk wise distribution 1971)

Taluk	Population in lakhs	Density	Sex ratio	Literacy
Trichur district				
Thalappally	4.04	609	1101	56.28
Trichur	5.88	926	1049	66.35
Chowghat	4.33	1426	1162	59.11
Mukundapuram	5.50	449	1051	62.57
Malappuram Dist.				
Ponnani	2.14	1073	1081	45.59

Source: District Hand Book of Census, 1971.

in Kole region Chowghat taluk is most densely populated. The taluk having the maximum literacy is found to be Trichur followed by Mukundapuram. In Malappuram District the literacy is found to be comparatively low. The literacy in all taluks except Ponnani is more than the State average.

Size of the holdings and Land use pattern.

The size of holdings in Kole region is not known separately. Hence, the size of the holdings in Trichur and Malappuram Districts in general is considered to represent the Kole region. The details are given in Table 2.12.

Table 2.12: Size of agricultural holdings in Kole region (Trichur and Malappuram district)

Size of the holding	No. of holdings	
	Number	Percentage
Trichur District		
Less than 1 ha.	1,39,100	75.4
1 ha. — 2 ha	22,000	11.9
2 ha. — 4 ha.	15,3000	8.3
4 ha. — 6 ha.	3,600	2.0
6 ha. — 8 ha.	1,700	0.9
8 ha. —10 ha.	1,500	0.8
(More than 10 ha.)	1,200	0.7
Malappuram District		
Less than 1 ha	10,962	
1 ha. —2 ha.	2,967	
2 ha. —4 ha.	1,373	
4 ha. —6 ha.	292	
More than 6 ha.	158	

Source : Planning Office, Malappuram and Trichur Districts Hand Book of Census, 1971.

Occupational Distribution.

The data on occupational distribution exclusively for Kole region is not available. Hence, a block wise description pertaining to the different blocks in the region is attempted to.

The total number of households present in different blocks are furnished below;

Table 2.13: Number of households in Kole region block wise distribution, 1971.

Sl. No.	Name of block	No. of house holds
1	Irinjalakuda	17008
2	Cherpu	25982
3	Chowghat	20470
4	Mullassery	13023
5	Anthikad	16831
6	Vellangallur	16734
7	Puzhakkal	224432
8	Chovvannur	23941
9	Ponnani	19892
10	Andathode	13408

Source : District Hand Book of Census, 1971.

2.2. Climate

2.2.1. Onattukara region

Generally in Onattukara region a hot humid tropical climate is experienced. On an average the region receives an annual rainfall of 2600 mm which spreads over eight months form April to November. The average maximum and minimum temperature in this region is 30°C and 25°C respectively. The altitude of this area is about 3.5 m above mean sea level. The distribution of rainfall and temperature in this region for the year 1981 is furnished in the following table. The data are collected from the Rice Research Station, Kayamkulam.

Table 2.14: Temperature and rainfall in Onattukara region for the year 1980 and 1981

Month	1980			1981		
	Temperature °C		Rain fall mm	Temperature °C		Rain fall mm
	Maximum	Minimum		Maximum	Minimum	
January	31.2	28.6	—	30.0	28.0	21.0
February	31.4	29.2	2.0	31.2	29.0	2.0
March	32.2	31.9	15.0	32.0	30.0	3.0
April	34.8	34.1	117.4	32.0	29.5	52.6
May	32.6	31.9	151.2	32.9	29.5	129.4
June	32.1	30.1	363.8	28.4	27.5	761.2
July	29 4	28.2	506.8	29.0	27.0	264.0
August	31.2	29.4	93.2	28.8	26.6	320.6
September	30.0	28.0	39.4	29.8	27.0	375.2
October	31.1	29.2	323.4	30.5	27.4	219.2
November	30.3	29.5	121.0	30.6	27.3	101.8
December	31.2	29.0	62.2	30.8	27.3	—
Total			1790.4			2750.0

The Onattukara region is blessed with both North East and South West Monsoons. Maximum rain is received during South West Monsoon. The North East Monsoon is less intensive and occurs from September to November. March and April months are hottest and November-December comparatively cooler.

2.2.2 Kuttanad Region

In general a humid tropical climate with an oppressive hot summer and plentiful rainfall is experienced in Kuttanad region. The hot season from March to May is followed with South-West monsoon from June to August followed by the North-East monsoon in October-November. There is very little rain in January–February. The average annual rainfall in this region is 2350 mm. The maximum and minimum temperature of the region are 36°C and 21°C respectively. The humidity is also very high in this region. The meteorological data on monthly rainfall, maximum and minimum temperature collected from Rice Research Station, Moncompu are furnished in Table 2.15

Table 2.15: Monthly rainfall and temperature of Kuttanad Region for 1981

Month	Rainfall (mm)	Temperature °C	
		Maximum	Minimum
January	6.4	34.58	22.14
February	4.4	34.78	23.43
March	35.81	36.23	23.93
April	106.5	35.9	23.30
May	25.1	34.9	26.10
June	1037.3	29.8	24.80
July	425.4	30.4	24.50
August	489.1	31.0	25.20
September	490.1	31.3	25.80
October	291.8	33.6	25.60
November	206.9	32.0	24.96
December	9.9	34.48	23.45
Total	3128.71		

Evapotranspiration

Studies on Pan-evaporation losses conducted at the Rice Research Station, Moncompu near Alleppey and at Thanneermukkom have shown that the readings of pan-evaporation losses at Moncompu is lower than at Thanneermukkom on account of higher humidity at Moncompu. The average monthly rate of evaporation losses at Moncompu and Thanneermukkom region during January to March are given below:

Table 2.16: Pan-evaporation at Moncompu and Thanneermukkom

	Evaporation in cm.		
	January	February	March
Moncompu	6.22	6 59	9.29
Thanneermukkom	15.4	13.9	21.2
Average	10.81	10.25	15.25

2.2.3 Pokkali region

In Pokkali region a humid tropical climate with plentiful rainfall is experienced. The average rainfall in Pokkali region is about 3,000 mm per year. The maximum rainfall is noticed in the months of July and August. Forty per cent of the total rainfall is contributed by these two months. The humidity is comparatively high in this region. The data on rainfall and temperature for the year 1981 collected from the Coconut Farm Vyttila are given in Table 2.17.

Table 2.17: Monthly rainfall and temperature of Pokkali region for 1981

Month	Rainfall (mm)	Temperature°C	
		Maximum	Minimum
January	6.8	24.7	23.4
February	0.2	26.0	25.2
March	26.4	27.6	25.0
April	195.8	29.2	27.3
May	88.9	29.2	27.0
June	1078.3	27.0	26.0
July	439.1	30.0	27.0
August	449.3	27.0	26.0
September	507.8	26.0	25.0
October	749.0	27.0	25.0
November	171.5	27.0	26.0
December	13.0	28.0	26.0
Total	3726.1	—	—

2.2.4. Kole region

The Kole region is generally having a moderate climate. Extremes of hot and cold are not felt. The minimum temperature comes down to 17°C and the maximum rarely goes above 38°C. Due to high percentage of humidity, the atmosphere is always damp along the coastal region and it progressively becomes drier towards the western ghats. The rainfall is fairly heavy. The average annual rainfall is about 2,960 mm. The area is well blessed with the two monsoons. The Southwest monsoon extends from June to September and North East Monsoon, September to November. During the period of December to April generally there will not be any rain.

Since there is no full fledged meteorological Station functioning in the region, the data collected from the College of Horticulture, Vellanikkara, Trichur District, is used to give a true representation.

2.3. Soils and Cropping pattern

2.3.1. Onattukara region

2.3.1.1. Soils

Onattukara region is mainy located on the coastal belt and it consists of recent sediments of sand, coastal alluvium, loam etc. Surface consists of mostly well graded sand with little or no fines. On the fringes of back water and low level areas the soil is slightly plastic. In general the soil of Onattukara region is predominently sandy and porous. It also includes very deep coarse textured coastal alluvial soil that are typically light coloured throughout the profile. The structure and texture are mostly uniform throughout the profile clearly revealing the immature condition. The water table is at 10' to 15' in the case of uplands and 3' to 6' in low lands, during summer.

The soil survey department of the State has not conducted any detailed study on Onattukara region. However, the following studies were taken up by them.

1. A soil survey of Krishnapuram Village of Karunagappally taluk conducted in May 1975.

2. A soil survey of the district Agrl. Farm, Mavelikkara conducted in April, 1977.

3. A soil survey of the command area of Kallada Irrigation Project covering 66 revenue villages of Kunnathur, Kottarakkara, Pathanapuram, Quilon, Pathanamthitta, Karunagapally and Mavelikkara taluks of Alleppey and Quilon Districts.

Since separate studies on Onattukkara region are not available, the studies conducted at Krishnapuram Village of Karunagapally taluk is used to generalise for the entire Onattukara region. The results are shown below

Table 2.18: Analytical results of the soil of Onattukara region

Depth (cm)	Gravel	Coarse sand	Fine sand	Silt	Clay
0—17	—	60.00	23.10	5.0	10.0
17—99	0.427	62.30	22.40	5.0	9.0
99—150	0.735	68.20	17.40	4.0	9.0

Organic matter	Nitrogen	P_2O_5	K_2O	CaO	pH
1.003	0.070	0.050	0.114	0.043	6.2
0.250	0.015	0.053	0.117	0.045	6.3
0.270	0.019	0.017	0.087	0.020	7.0

Source: Soil Survey Department, Kerala.

Soil samples collected from Kayamkulam, a typical location of Onattukara region gave the following analytical results. Though in general the soil in Onattukara region is sandy loam some tracts are found to be having laterite belts. These areas include parts of Mynagapally and Thazhava Panchayats of Karunagapally taluk and Eastern parts of Thekkekara Panchayat of Mavelikkara taluk. The average pH in Onattukara region is about 5.6. The water holding capacity of the soil is very low. It is very poor in organic matter content. The nitrogen, phosphorus and potash content is also comparatively low.

Table 2.19: Analytical results of sandy soil of Kayamkulam Area

Depth (cm)	*Description*
0—22	Brownish grey sand
23—45	Light grey sand
45—67	Light grey sand

Mechanical composition of surface soil

Organic matter	0.5 per cent
Coarse sand	67.6 ,,
Fine sand	18.2 ,,
Silt	3.3 ,,
Clay	10.4 ,,

Chemical composition

Character	Depth (cm)		
	0—23	23—45	45—67
pH	5.5	6.8	6.8
N per cent	0.04	—	—
P_2O_5 ,,	0.02	—	—
K_2O ,,	0.05	—	—
CaO ,,	Trace	Trace	Trace

2.3.1.2 Topography

The Onattukara region is having a plain and levelled topography lying at 3.05m. above mean sea level. A special category of land called 'Tharas' also exists in Onattukara region, These lands are located at a level higher than the wet land paddy fields and lower than the up lands. The total area under tharas is estimated to about 5000 ha.

In Onattukara region more than 8000 ha. of land is saline marshes due to the inundation of salt water. These areas are located on the coastal side of Karthikappally and Karunagappally taluks.

2.3.1.3 Land use Pattern

The total geographical area of Onattukara region is estimated to be 724.7 km², consisting of 41 panchayats and two municipal areas. The land use pattern of Onattukara region in general is given in table 2.20

Table 2.20: Land use pattern of Onattukara region

Category	Area
Total geographical area (km^2)	724.7
Area under Forest	Nil
Net cropped area (ha)	68340
Area under wet land (ha)	28340
Area under dry land (ha)	35000
Area under 'Thara' lands (ha)	5000
Total irrigated area (km^2)	152.00
Cultivable waste ,,	8.6
Area not available for Cultivation (km^2)	129.24

Onattukara region is mainly an agricultural area. Practically there are no forest lands in these areas.

2.3.1.4 Irrigation

The Onattukara region is blessed with both the South–west and North-east monsoons. However, it is noticed that the distribution of rain is uneven and untimely in several years. The common methods of irrigation followed in the tract are by using pumpsets and by manual labour. With the commissioning of the Pamba-Kallada irrigation Projects it is estimated that about 20,000 ha. of land in Alleppey and Quilon districts could be brought under assured irrigation.

2.3.1.5 Crops and Cropping Pattern

The important crops grown in Onattukara region are rice, coconut, arecanut, tapioca, gingelly, pulses, banana and vegetables. Recently, there is a trend among cultivators to convert the paddy areas into coconut gardens. In wet lands generally farmers use to take two crops of paddy followed by a crop of gingelly or groundnut or pulses. Short duration varieties of rice (90-110 days) such as 'Kochuvithu, Ptb-23, Thriveni and Jyothi are cultivated in the first crop (Virippu) season. The first crop season extends from April to August in Onattukara region. During the Second crop (Mundakan) season medium and long duration varieties of 120–175 day duration such as 'Chamba' are grown. High yielding varieties such as Jyothi, Thriveni, Culture–28 and Jaya are being cultivated along with the local strains like 'Kochuvithu' and Ptb.23 during the first crop season. In the second crop season more than 70% of the area is covered by local strains. Sesamum is grown during the third crop season. Some improved strains of sesamum like Kayamkulam–1 and Kayamkulam–2 are used by the cultivators in large scale. In garden lands a coconut based cropping pattern mixed with a variety of crops like tapioca, yam, banana, arecanut, cocoa and fruit trees are practiced. This is mostly like the homestead garden which is considered to be the speciality of Kerala State.

In the area of saline marshes noticed on the coastal areas of Karthikappally and Karunagappally taluks only one crop during the second crop season using the local strain 'Orumundakan' is taken. In the first crop season these lands are mostly left fallow.

The utilisation of land in Onattukara region growing different crops is furnished below.

Table 2,21: Utilisation of land under different crops

Types of land	Crops	Season	Area (in ha.)
Wet land	Virippu (rice)	April–August	26480
	Mundakan (,,)	August–December	28340
	Summer (gingelly)	January–April	10980
Dry land	Coconut gardens (coconut, arecanut, fruit trees etc.)	Throughout the year	35000
'Thara'	Banana, tapioca, pulses etc	September-June	5000
Coastal saline marshes	Rice	August–December	8174

Source: Rice Research Station, Kayamkulam.

The area, production and productivity of rice grown in Onattukara region falling into the different taluks are furnished in table 2.22.

Tabie 2.22: Taluk level estimates of area, production and productivity of Rice in Onattukara region, 1979-80

Taluk	Area (ha.)			Production (T)			Productivity (Kg/ha.)		
	Autumn	Winter	Summer	Autumn	Winter	Summer	Autumn	Winter	Summer
Karunagappally	4003	4542	308	4066	5297	235	1546	1775	1162
Karthikappally	3436	4359	3482	5946	5976	7067	2634	2086	3089
Mavelikkara	3148	5329	2681	7458	7006	7338	2235	2001	4166

Source: Bureau of Economics and Statistics.

2.3.1.6 Contraints limiting production

The main constraints limiting production in Onattukara region are severe drought during summer, lack of drainage during rainy season, poor soil structure and nutritional status, infestation of pest and disease to annual and perennial crops and weed menace due to salvinia infestation in paddy fields, canals and other water ways. The detailed analysis of constraints under different farming situations are described in chapter 3.

2.3.2 *Kuttanad*

The whole of Kuttanad area practically lies 1—2.5 metres below the sea level and is submerged under water for the major part of the year. It was in the past, periodically inundated by saline water of tidal inflow from the sea. With the construction of Thanneermukkom barrier the salt water inundation is restricted. During the periods of the South-west monsoon (June-August) and the North-East monsoon (Oct.-Nov.) the rivers and riverlets pour fresh water into the area.

2.3.2.1 Soil

Soils of Kuttanad area is grouped into three categories viz., (1) Kayal soils (2) Karapadam soils and (3) Kari soils.

Kayal soils

These are found in the reclaimed lake beds in Kottayam and Alleppey districts and they occupy an area of 8000ha. The land is situated 2-3 meters below sea level. The soils are slightly acidic to neutral in reaction, poor in total and available plant nutrients, but are fairly rich in calcium.

The Kayal soils are light grey in colour. Lime shell deposits of lacustrine origin are commonly observed in the surface and sub-surface layers in these soils. The texture is silty clay loam with fairly good drainage. The profile description of a typical soil of this type is given in Table 2.23.

Table 2.23: Profile description of Kayal Soil (Vechoor Kayal)

Sample No.	Depth in cm	Description of morphological features	pH of air dry soil in distilled water 1:2.5 soil water suspension
1	0—25	Light Grey Brown 10 Y R 6/2 Silty clay not very plastic. Well drained. Not very hard on drying. Natural deposits of lime shell in abundance. Boundary not clear.	6.7
	25—50	Grey brown 10 YR 5/2. Clayey, soft slightly plastic. Yellowish red incrustations. Limeshell deposits in plenty. Boundary somewhat clear.	6.4
	50—80	Light grey 10 YR 6/1. Silty clay. Boundary somewhat clear. High water-table, not very sticky and plastic becomes harder on drying.	6.6
	below 80	As the profile pit was flooded further observation was impossible.	6.6

Karapadam soils

These soils cover an area of about 41000 ha. They are river borne alluvial soils. The soils are characterised by high acidity and high salt content. The profile description of two representative samples of Karapadam soils are given in Table No. 2.24 and 2.25.

Table 2.24: Profile description of Karapadam soils (Kidangara)

Sample No.	Depth cm	Description of morphological features	pH of air dry soil in distilled water 1:2.5 soil water suspension
1	0—20	Very dark grey 10 YR 3/1 clayey, very sticky and plastic when moist. Turns very hard on drying. Small pieces of decaying plant materials. Yellowish brown mottlings. Boundary not very distinct.	3.4
	20—50	Dark grey 10 YR 4/1 sticky and plastic. becomes hard on drying. Decaying plant remains in high quantities. Odour of hydrogen sulphide in small degrees. Horizon differentiation not easy.	3.0
	50—90	Dark grey, 10 YR 4/1 clayey, sticky and plastic yellowish brown spots and white incrustations. Decomposing plant materials very few. Horizon differentiation some what clear.	3.2
	90—120	Light grey 10 YR 6/1, Silty clay, soft and not very sticky, but plastic. White incrustations. Decaying plant materials are very few. High water table.	4.0
	below 120	Because of high water table further observation was difficult.	4.0

Table 2.25: Profile description and composition of Karapadam soils (alluvial—Moncompu)

1 Alluvial Soil: Location: Moncompu, Alleppey Dt.

Depth		Description
0—23 cm	:	Dark brown clay
23—45 cm	:	Blackish clay with lime shells sparcely present.
Below 45 cm	:	Blackish clay with lime shells and occasionally with wood fossils.

Mechanical composition of surface soil

Organic matter	:	5.4%
Coarse sand	:	8.5%
Fine sand	:	34.9%
Silt	:	20.6%
Clay	:	30.6%

Chemical Composition

	pH	N%	P_2O_5%	K_2O%	CaO%
0—23 cm	5.2	0.29	0.12	0.17	0.14
23—45 cm	4.5	0.31	0.13	0.21	0.41
Below45 cm	5.0	0.33	0.13	0.27	0.44

Karapadam soils are very dark grey to black in colour. Yellow Brown spots, mottlings and streaks are found in almost all the layers of Karapadam soils. Clayey nature of karapadam soils accounts for their poor drainage.

Kari soils

These are peat soils found in large isolated patches in some parts of Kuttanad viz., Thottapally, Ambalapuzha, Vaikom etc. covering an area of about 20000 ha. They exhibit characteristics of the submerged forest area but are not silted up. The soils are characterised by deep black colour, heavy texture, poor aeration, bad drainage and low contents of available plant nutrient. They are also affected by saline incursion with consequent accumulation of soluble salt. They are also highly acidic in reaction. In these soils, free sulphuric acid is formed by the oxidation of sulphur compound present in the wood fossils found under the soil. Large amounts of woody matter at various stages of decomposition are seen embedded in these soils.

The profile description of kari soil (Mundar and Vechoor) are given in Table No. 2.26 and 2.27.

Table 2.26: The profile description of Kari soil (Mundar)

Sample No.	Depth in cm	Description of morphological features	pH of air dry soil in distilled water 1:2.5 soil water suspension
1	0-30	Black 10 YR 2/1, Clayey, soft and sticky, poor drainage, plastic when wet, but becomes hard on drying. Decomposing plant residues in plenty. Odour of hydrogen sulphide persists. Yellowish brown streaks. Horizon differentiation somewhat clear.	3.2

30–75	Black 2/1 silty clay soft, sticky and plastic when wet, hardens on drying, yellowish brown incrustations. Partially humified plant residues in large quantities. Odour of marsh gas and hydrogen sulphide persists, Boundary clear.	2.5
75-100	Dark grey 10 YR 4/1 Clayey, very sticky soft and plastic when moist but becomes too hard on drying. Smaller quantities of decomposing plant materials. Odour of hydrogen sulphide in slight degree. High water table.	3.4
Below 100	The pit was flooded and the observation obstructed.	3.5

Table 2.27: The profile description and composition of Kari soils (Vechoor)

Depth	Description
0-24 cm	Black, clay loam, poorly drained with undecomposed plant residues and roots present in abundance.
24–75 cm	Very dark grey, sandy clay loam, decomposed plant residues and a few roots present, occurrence of lime shells.
Below 75 cm	Dark grey clay, very poorly drained, lime shells present in abundance.

Mechanical composition of surface soil

Organic matter	:	17.4%
Coarse sand	:	1.9%
Fine sand	:	21.2%
Silt	:	22.5%
Clay	:	37.0%

Chemical composition

	pH	N%	P_2O_5%	K_2O%	CaO%
0–24 cm	3·7	0.62	0.19	0.23	0.63
25–72 cm	6.7	0.40	0.50	0.19	1.33
Below 73 cm	7.1	0.29	0.26	0.35	3.41

A study conducted by the soil survey department of Kerala State has classified the soils of Kuttanad into 15 series. The series are as follows, (1) Karuvatta series, (2) Pallippad series, (3) Mannar series (4) Vechoor series (5) Changanacherry series, (6) Champakulam series, (7) Ramenkari series, (8) Edathua series, (9) Purakkad series, (10) Manjoor series, (11) Thottappally series, (12) Ambalapuzha series, (13) Thakazhi series, (14) Muthur series and (15) Kurichi series.

The profile description and analytical status of Ambalapuzha series as given by the soil survey department is presented below:

Table 2.28: Analytical data of soil related to Ambalapuzha series

Horizon	Depth	Organic Carbon%	pH 1:2.5 H_2O moist soil	pH 1:2.5 H_2O dry soil	E C. 1:2.5 of dry soil	E.C.1:2.5 of moist soil
1	0–17	4.95	6.4	3.7	3.8	0.9
2	17–30	7.00	6.6	2.9	7.5	1.0
3	30–43	8.72	3.1	2.3	14.0	3.6
4	43–60	8.66	4.2	2.4	14.0	2.9

Besides this, an analysis conducted by the Rice Research Station, Moncompu on the soils of Champakulam region which represents a typical Kuttanad area is also given below.

Table 2.29: Analytical status of soil of Champakulam block area

a) Mechanical composition

Organic matter	Coarse sand	Fine sand	Silt	Clay	Textured class
5.4	8.5	34.9	20.6	30.6	Silty clay

b) Chemical composition

Horizon	Depth (cm)	pH	N	P_2O_5	K_2O	CaO	MgO	R_2O_3	C E C
1	0–23	5.1	0.07	0.11	0.05	0.01	0.09	20.2	12.6
2	23-45	5.3	0.06	0.06	0.08	0.14	0.07	21.8	11.0
3	45-50	5.2	0.08	0.06	0.10	0.17	0.03	21.3	11.3

Source: Rice Research Station, Moncompu

2.3.2.2. Topography

Broadly Kuttanad has an area af 875 km², out of which 295 km² are garden lands scattered in different parts lying 1 to 2m above water level. The garden land is mainly utilised for coconut cultivation and for residential purposes. The rest of the area is below water level. The paddy fields are at depths 0.5 to 2m below mean sea level.

2.3.2.3 Land capability

It is estimated that an area of about 52,000 ha in Kuttanad region can be converted into double crop lands if salt water intrusion in this area is prevented. This is partially achieved by the construction of Thanneermukkam bund and a good percentage of single crop fields has been converted into double cropped lands. Similarly, adequate protection from floods and other natural hazards has to be given in

this area. For this purpose, the Kuttanad Development Project undertakes the construction of permanent bunds in the project area at a total length of 2000 km. around the rice fields. This permanent bund will also facilitate the planting of about 3 lakh coconut seedlings additionally.

2.3.2.4 Irrigation

The paddy fields in Kuttanad region are naturally below the water level. During the cropping season the excess water in the field is pumped out and the cultivation is done. As the water level outside the rice field remains at a high level than inside, periodical irrigation in the rice fields is carried out by letting in water through the sluices located in outer bunds. Except when the fields are required to be kept dry, the soil is normally saturated with water and there is no loss on account of percolation. There is no canal irrigation system in Kuttanad region. The water losses in Kuttanad region occur only through evapo-transpiration.

The rivers Achancoil, Pamba, Manimala and Meenachil discharge their water into Kuttanad region from the East and the South. These rivers after flowing through a network of channels and canals, join the Vembanad lake draining an area of nearly 5,000 km^2 in the upper hilly regions. The catchment area of these rivers has an annual average rainfall varying from 280 to 380 cm. Nearly 60-70% rainfall occurs during south-west monsoon causing floods in Kuttanad and as a result, the low lands get submerged for some period during the season. The north-east monsoon also causes flood at a lesser level. The average rainfall in the catchment areas of the main rivers discharging water into Kuttanad region is furnished in the following Table.

Table 2.30: Average rainfall in the catchment areas of rivers which discharge into Kuttanad

River	Average rainfall (cm)	Catchment area km^2
Achancoil	306	1155
Meenachil	315	1181
Manimala	358	803
Pamba	324	1976

Source: Report on Kuttanad Development Project, 1974.

2.3.2.5 Crops and Cropping Pattern

The main crops grown in Kuttanad region are Rice and Coconut. Though Kuttanad is known as the rice bowl of Kerala State, the cultivation is always found to be a gamble with nature. Formerly only one crop during Punja season was taken from November-February. At present with construction of Thanneermukkom barrier and the outer

bunds of Kuttanad Development Project, farmers are taking an additional crop also. In Kuttanad region cultivation is being done using mostly high-yielding varieties. In up lands, coconut forms the main crop mixed with cocoa and banana.

2.3.2.6 Main constraints limiting production

The main problems of Kuttanad region are the high acidity of the soil, ingress of salinity, high incidence of pest and diseases and the menace of many types of weeds, mainly *Salvinia*. Occasional flooding of the fields in this region is also another problem.

2.3.3. Pokkali

2.3.3.1. Soils

Pokkali soils are the low lying acid saline marshes found near the mouth of streams and rivers situated near the Arabian sea. They are subjected to tidal waves and periodical inundation by saline water and in their natural state are overgrown with mangrove and other salt loving vegetation. These soils are river borne alluvium loam to clay in texture. They are highly acidic and fairly rich in Nitrogen. The high conductivity and high acidity of these soils may be due to the combined effect of large amounts of sulphuric and hydrochloric acid and sulphates and chlorides of sodium. Being highly saline and acidic, no regular cultivation of any kind is done in these soils except for rice grown in mounds, on the fringes of the swamp. The origin, genesis and development of these soils are under peculiar environmental conditions such as trough like situations, alternate flooding with saline and fresh water and high acid reaction of soil.

An average analytical sketch of pokkali soil done in the Department of Agriculture Chemistry, College of Agri., Vellayani is furnished below:

pH	:	3.4 —6.4
Organic matter	:	2.39%
Total Potash	:	0.05 —0.63%
Total P_2O_5	:	0.03 —0.22%
Total N_2	:	0.067%
C/N ratio	:	20.75
Organic carbon	:	1.39%
Aluminium oxide	:	1.38 —5.73%
Iron oxide	:	0.29 —13.8%
Water holding capacity	:	33.6
Pore space	:	40%
Coarse sand	:	28%
Fine sand	:	19.1%
Silt	:	13.7%
Clay	:	36.2%

2.3.3.2 Topography

The Pokkali region falls into the coastal belt and they lie on mean sea level.

2.3.3.3 Land capability

In Pokkali region only one crop is being taken in virippu season. During the rest of the year the land is under water and during this period people undertake fishing and prawn culture which is considered to be a more remunerative enterprise. During this period, the fields will be completely under salt water. If by the execution of some suitable projects, the salt water entry to this region is prevented, attempts can be made to take a subsequent crop. But, it is understood that the people in this region show a special interest in fishing activity, since it is more profitable.

2.3.3.4 Irrigation

In Pokkali region, the question of irrigation does not arise in first crop season, since the crop entirely depends on rainfall. The area is benefited by Vembanad and Cranganur lakes. These backwaters are used for navigation purposes, and coir making. Inland fishing is found to be very popular in this region.

2.3.3.5 Crops and Cropping pattern

The main crops grown in Pokkali regions are rice in the wet lands and coconut in uplands. In the entire rice area they take only one paddy crop in Virippu season and in the rest of the year, people are engaged in fishing activity.

With the commencement of the south-west monsoon rains, the salinity accumulated in the fields due to salt water incursion gets washed off. Seeds are sown in mounds after the salinity is washed out. The mounds are made after dewatering the land during March-April months. The local varieties of seed commonly used for pokkali cultivation are pokkali, Chettupokkali, Chettuvirippu, Eravappandi and Orkaima. These seeds are considered to be tolerant to salinity and are long duration varieties. Besides, the Rice Research Station, Vytilla has released an improved strain under the name Vytilla-I to suit the pokkali conditions. The duration of this variety is comparatively lesser and the yield is more.

Due to the continuous rain of south-west monsoon, the salinity in the mounds gets washed off. The upper portion of the mounds are levelled and germinated seeds sown on the mounds The water level in the fields should be regulated to suit the growth of the seedlings in the mounds. After 30-40 days of growth the seedlings are spread into the field by using a 'Mammatti'. During this period the water level should be minimum. The level of water is increased after the seedlings are established well in the soil. The different agricultural operations required for pokkali cultivation are minimum when compared to the other types of cultivation. But it is proved that the supply of 20 kg Nitrogen

and 40 kg of P_2O_5 at the time of scattering the seedlings into the field and also the application of lime @ 1000 kg/ha. will increase the yield substantially. During September–October the crop gets ready for harvest. Only the ear heads are harvested. The average yield of pokkali is found to be about 1500 kg/ha. After harvest the entire fields are filled with water. During this season either fish culture or prawn culture is done in these fields.

Coconut is the main crop of uplands. The entire area is covered with the complex disease of coconut. Intercropping with cocoa is introduced in certain areas. Spices and other perennial crops are also raised in the low lands and uplands.

The constraints limiting production in this area are floods during monsoons and acidity and salinity due to salt water. In addition, the salvinia menace is also common.

2.3.4 Kole Region

2.3.4.1 Soil.

The Kole area lies continuously along the coastal strips of Trichur and Malappuram Districts. These are reclaimed lake beds. Acidity, salinity, poor drainage and presence of toxic salts are the characteristics of the soil.

The soil in general is clayey sand. The flood water deposits silt and organic matter every year. In the low lying fields the percentage, of silt is more, while in the higher paddy fields it is comparatively less. The garden lands surrounding the fields have laterite soils with traces of silt and clay. It is also found that there is hard and porous laterite 0.5 to 1.0 cm below the surface.

The Kole region represents peidmont type deposit of valley fills the thickness of which may vary from 10–15 m only. The valley fill material is mainly of fine to coarser elastic including scree and talus materials formed of gravel and sand of laterite composition. Some portion of Kole land exhibit a lucastrine environment containing black carbonaceous clay with lot of vegetable matter and at places even with timber embedded in the sediments.

The eastern side of the Kole region is characterised by low-lying laterite hills. Since Kole area is a deposition basin, the laterite soils from the eastern hills are eroded and brought down and deposited in this basin during the rainy season. Similarly, since the area remains submerged for considerable time the finer elastic including the clay portions leached from the weathered rock are brought down as suspended impurities and these get deposited in the form of clay in course of time. This may contain organic matter too. Thus, the soil of Kole land include secondary, laterite and clay. The western extremities of Kole area are characterised by sandy soil.

A detailed soil survey report of the entire Kole area is not

available. But for the command area of the Chimmoni-Mupli Project in the Kole areas a survey has been conducted by the soil survey department of the State covering three taluks of Trichur, Mukundapuram and Chowghat consisting of a total number of 86 Villages. The department has divided the entire region into different series having different soil types like Chentharappinni series, Maraikkal series, Ayyanthole series, Konchira series and Anthikkad series.

2.3.4.2 Topography

The Kole areas are low-lying. Most of the areas lie below MSL. The special features of these fields are that these fields have a central narrow strip extending for a long distance with many pockets running inth the garden lands on either sides. Along the boundaries lie the higher paddy fields. The canals running through the fields have bed level below the field level. Towards the ends of their length the canals are very shallow. This prevents easy flow of water and lifting becomes essential to feed the higher paddy fields towards the end pockets.

2.3.4.3 Land capability

At present in Kole region, only one crop during the summer season (puncha) is taken. During the rest of the year the entire region gets flooded and submerged under water. Hence, dewatering by erecting proper bunds becomes a must in this region during the puncha crop season. The objective of taking multiple cropping in this region could be achieved by constructing permanent bunds along the drainage channels to store and prevent water from the channels entering into the fields and by providing a system of drainage to maintain the water at the desired level. With this objective in mind the Kerala Land Development Corporation has undertaken a project for the development of the entire Kole region and the same is in progress.

The Kole region is also subjected to salt water ingression. The fields are linked with sea with a system of drainage channels and back-waters. Hence, during summer, in Puncha season, when the fields are under the crop the water level in backwaters goes down and as a result the salt water from the sea enters the Kole area through the backwater system. Hence, prevention of salt water entry in the Kole areas is very essential by providing regulators at certain strategic points.

2.3.4.4 Irrigation

The puncha crop is very often subjected to drought, and irrigation during summer is essential. The Karuvannur river and its tributory and the Karumali river flow along the northern side of the region. There are canals receiving water from these rivers to irrigate the Kole fields. Nedumthodu, Parayathodu and other small intake canals serve the Mooriyad Kayal while Neeroli thodu irrigates the Chemmanda Kayal and the main canal from Nandi sluice on the southern bank of Karuvannur river irrigates the Karalam fields.

There are three main irrigation projects in the region. Peechi irrigation Project, Vazhani Irrigation Project and Chalakkudi Irrigation Project. Of these, Peechi Irrigation Project is designed to supply water to Kole fields. The ayacut of Peechi Irrigation Project consists of 10400 ha, of double crop lands and 8000 ha of Kole lands. It is a project in Karuvannur river.

2.3.4.5 Crops and Cropping Pattern

Kole lands being submergible areas, only one crop in summer season (puncha) is taken from the entire area. However, in some areas, a second crop (Mundakan) is also attempted to with great difficulties. It is practically impossible to take the virippu crop since the entire region will be under water during the period.

Puncha crop is taken during summer months of January-May. After the recession of North-east monsoon, the bunds along the drainage channels are repaired. The excess water from the fields is pumped out into the drainage channels for preparatory tillage. Preliminary operations are completed by November-December and sowing done in early January.

The uplands around the paddy fields are steep slopes. These slopes are terraced and put under perennials like arecanut and coconut or annuals like banana.

The slopes then merge into plateau lands which are more or less levelled and in these areas annual and seasonal crops are grown. Certain portions of these land are terraced and rice is also attempted to during rainy season. Dry lands of Kole region adjoining to the coastal belt are covered with coconut and arecanut. Provision of summer irrigation will enhance the production, of these crops to a great extent. The soil is best suited for growing banana and similar crops if irrigation is provided.

2.3.4.6 Production and Productivity

Kole areas are located over Trichur, Mukundapuram and Chowghat taluks of Trichur District and Ponnani taluk of Malappuram district. The average yield per ha. from puncha crop varied from 2000 to 3000 Kg/ha. This is very high when compared to the State average which indicates that the Kole lands are relatively fertile. Due to the intensity of risk involved in paddy cultivation in Kole areas, cultivators generally do not give sufficient dose of fertilizers and manures. Hence, stabilisation of crop by proper fertilizer and pesticide application will almost double the production.

2.3.4.7 The constraints limiting production in kole region

The main constrains limiting production in these region are, submergence and lack of drainage, floods in the Karuvannur and Keecheri rivers, salt water ingression during summer and the toxicity and salinity developed in the paddy fields.

CHAPTER 3

Specific farming situations

Based on the soil, climate, irrigation facilities and cropping patterns the following specific farming situations were identified.

3.1 Onattukara

3.1.1 Farming situations—Low lands

3.1.1.1 The whole of Onattukara except the coastal salinity affected areas, the uplands and the "Thara Lands". It covers an area of 28340 ha. The area is distributed over Quilon and Alleppey Districts.

3.1.1.2 Soil Type

Sandy to sandy loam. Very porous, poor water holding capacity, very poor in organic matter and available plant nutrients. Acidic in reaction with an average pH of 5.6.

3.1.1.3 Rainfall

On an average, the Onattukara region receives an annual rainfall of 2600 mm, which spreads over eight months from April to November.

3.1.1.4. Irrigation

Nil. One irrigation project namely, the Kallada Irrigation Project is nearing completion.

3.1.1.5 Cropping pattern

A very intensive cropping pattern of two rice crops and a sesamum crop is followed in this region.

Crop				*Season*
1st Crop Paddy	—	(Virippu)	—	April–May to August–September
2nd Crop Paddy	—	(Mundakan)	—	September-October to December–January
3rd Crop	—	(Sesamum)	—	January-April

During the 3rd crop season, instead of sesamum, pulses like cowpea, blackgram, green gram, groundnut and vegetables are also grown in a smaller scale.

The rice crops fully depend on the two monsoons while the 3rd crop sesamum or pulse is raised by making use of the residual moisture.

3.1.1.6. Constraints limiting production

Problems	Existing practice	Suggested solutions
1	2	3
1) Untimely and irregular pre-monsoon showers and the monsoon which delay the time of sowing of 1st crop.	The ideal time for 1st crop sowing in Onattukara is the last week of April and 1st week of May. But unfortunately due to the monsoon being irregular and untimely cultivators are forced to postpone this, to the second fortnight of May. Because of this irregular and untimely monsoon very often the seeds fail to germinate and as a result the crop fails. Flood damage during the later stage of 1st crop and earlier stages of 2nd crop also results.	1) Project to evolve a suitable cropping pattern exploring the possibilities of transplanting 1st crop. 2) Project to study the possibility of adjusting sowing time to utilise the irrigation water potential from Kallada project, after it is commissioned.
2) Lack of moisture for the 3rd crop and hence the failure of sesamum or other substitute crops.	During the third crop season of January to April sesamum or other substitute crops like pulses, groundnut etc. are taken by making use of the residual moisture from the previous monsoon. Sometimes this residual moisture status of the soil becomes very meagre and as a result the 3rd crop fails.	The possibility of tapping the ground water potential to the maximum to help the summer crop should be explored, since the yield potential can be increased substantially due to timely irrigation.
3) Very poor organic matter content of the soil which leads to poor water holding capacity and other physical conditions of soil.	At present the cultivators give little quantity of cowdung and green leaf. But this is not enough to meet the requirement.	1) Trial using different green manure plants like cowpea, daincha, sesbania. sunhemp etc. to study their comparative efficiency and identify the best ones to suit the cropping pattern of the region.

		2) Besides this the economic feasibility of adding organic matter in the form of Farm yard manure/compost/ Green leaf/cakes or similar organic matter will also be investigated. 3) The scope for adding soil amendments and conditioners for improving the soil conditions will also be undertaken.
4) Severe incidence of pests/ diseases of paddy		
i) Molecricket damage in dry sown crop (1st crop season).	Problem severe in 90% of the area. Initial stand of the crop is affected causing 20% of yield losses. In severely affected areas resowing has to be resorted to. Soil application of BHC is practiced to control this pest.	Adequate control not obtained. Further chemicals are to be screened. Method of application—soil, seed treatment etc. are to be perfected. Possibilities of using deterents are to be explored. Use of light traps for collecting adults is to be tested. Projects to be formulated on these lines.
ii) Mealy bug attack at the tillering stage of the 1st crop season.	Problem is severe if dryspell continues in April/May. Severe stunting, yellowing and wilting of plants in patches. Losses vary from 5 to 50%. No control measures are adopted at present.	Suitable chemicals are to be screened. Biology of the insect has to be studied. Parasites and predators are to be identified and biological control attempted. Projects are to be formulated on these lines.

1	2	3
iii) Rice gall midge incidence in the second crop season nursery when rainfall is heavy.	This is being controlled by spraying systemic insecticides/applying granules.	As the pest multiplies on alternate hosts (weeds), control may be directed to locate these hosts and eradicate them. Use of micronutrients to induce tolerance has to be looked into.
iv) Rice stem borer	Incidence of white earhead are very common but damage is severe in the second crop season. At present this is controlled by chemical control measures.	Tolerant varieties are to be evolved.
v) Rice leaf roller	The damage in post flowering stage is severe in both the seasons. This is being controlled by using contact insecticides.	Application of chemicals at this stage is difficult. Use of a systemic chemical has to be worked out. Resistance has to be induced. Possible use of neem oil has to be investigated. (Project started).
vi) Rice case worms	Due to the stagnation of water during rainy seasons damage occurs. It is found in both the seasons. Chemical control though possible is difficult due to rains.	Alternate hosts of the insects are to be identified. Use of spreading oils has to be perfected.
5) Problem of salvinia infestation in paddy fields.	Salvinia is a very serious menace in the entire paddy fields of the region. Due to the presence of this weed agricultural operation becomes very difficult. Control of this weed is a very serious felt problem. At present it is removed by mechanical means.	1) Identification of a suitable weed killer through testing the different herbicides available in the market will be conducted. 2) The possibility of controlling this weed biologically will be explored.

		3) Feasibility of soil incorporation and converting it in the composed/ organic matter are to be investigated. 4) Utilisation as animal feed/industrial product/biogas
6) Problem of weeds other than Salvinia.	These weeds are very severe in the dry sown crop. Perennial weeds like *Ischaemum* are real threats in 80% of the area. Occurrence of *Striga* is also reported. Hand weeding is the only practice now followed. The cost and availability of labour are limiting factors.	Use of pre and post emergent herbicides are to be tested in the situations and economics worked out. Two projects are in progress.
7) Lack of proper technology for manuring the first crop dry sown paddy	- The 1st crop paddy in Onattukara region is sown under dry conditions. Standardised manurial schedules are not available for the dry sown crop. Cultivators use, wood ash, cowdung and fertilizers not according to the scientific recommendations but to their will and pleasure. Hence, the manurial schedule for the dry sown crop has to be standardised.	Manurial experiments to determine the optimum dose of nitrogen, phosphorus and potash fertilizers are to be undertaken.
8) Problem of incidence of disease.		
i) Sheath blight	Fungus disease causing severe damage to the paddy crop at all stages of the growth. It is prevalent throughout the rice growing regions of the tract. Losses upto 50 to 60%. Spraying Hinosan 500ml/ha.	Spraying with fungicides is done at a later stage of incidence of the disease. Hence early spraying in the prophylatic manner is recommended, in endemic areas. All the existing vari-

1	2	3
	or Bavistin 250 g/ha is recommended for control.	eties are susceptible to this disease. Resistant and tolerant varieties have to be evolved. Projects are in progress to study the effect of prophylactic spraying to find out the most suitable fungicide to control the disease and to work out an economic spray schedule are in progress. The projects are 1) Scheme for the control of sheath blight by prophylatic spraying. 2) Adaptive trial for the control of sheath blight. 3) Economic spray schedule for the control of sheath blight. 4) Evaluation of herbicides for the control of sheath blight. 5) Screening varieties for sheath blight resistance.
9) Lack of suitable varieties for a sound cropping pattern.	The cultivators are not variety conscious. They use different varieties both local as well as high yielding. Hence suitable varieties for the different seasons are to be identified.	Varietal trials using different high yielding varieties and identify the most suitable one to the region for different seasons are to be undertaken.

10) Lack of knowledge on organic re-cycling and utilisation of Bio-fertilizers.	Soils of Onattukara being very coarse, the response to the application of organic matter is very high. But the application of organic matter in heavy doses becomes difficult due to various reasons. Azolla, and Blue green Algae are coming up excellently well during certain periods especially during the harvesting stage of the first crop paddy and the initial stages of second crop. However, the knowledge about their utilization is very meagre	Adaptive trials and demonstration trials may be conducted in the farmers fields. The possibility of multiplying and incorporating these bio-fertilizers in large scale required investigation.
11) Iron toxicity in soils	Iron toxicity has been noticed in certain fields of Onattukara which are being controlled by the application of lime and frequent washings.	Varieties tolerant to iron toxicity have to be screened out. Also the management practices reducing the ill effects may also be investigated. All the above problems will be tackled at the existing Rice Research Station, Kayamkulam.

3.1.2 Farming situation—Salinity affected low lands

3.1.2.1 Area

About 8000 ha. of lands in Onattukara situated on the coastal sides of Karthikappally and Karunagappally taluks. These areas and subject to salt water incursion.

3.1.2.2 Soil type

Sandy to sandy loam. Very porous, poor water holding capacity, very poor in organic matter and available plant nutrients. Acid in reaction with an average pH of 5.6.

3.1.2.3 Rainfall

On an average, the region receives an annual rainfall of 2600 mm, which spreads over eight months from April to November.

3.1.2.4 Irrigation : Nil

3.1.2.5 Cropping pattern

Only one crop of Rice is taken during the second crop season (October–January). During the remaining period some of the fields will be utilised for prawn culture. Generally long duration salt resistant varieties of paddy are grown.

3.1.2.6 Constraints limiting production

Problems	Existing practice	Suggested solutions
1	2	3
1) Problem of salinity due to salt water incursion	About 8000 ha of land in Onattukara region is saline affected. In this area only one crop during the second crop season is taken, using the variety 'Orumundakan'.	Evolution of suitable varieties resistant to salinity.
2) Lack of suitable crop varieties	The common variety of paddy used in this region is 'Orumundakan', a local variety which can withstand the salt water conditions to a certain extent. But the yield of this variety is not appreciable. Hence a suitable variety is to be screened out.	Screening of a suitable variety resistant to salinity suited to the region.
3) Lack of standardisation of cultural methods.	Due to the existing limitations in this region the cultivators are not in a position to adopt systematic cultural practices which in turn affects the production. Hence standardisation of different cultural practices is very essential.	Research project to standardise the cultural practices in salinity affected Onattukara region will be undertaken. As the KAU is not having a research Station in this type of situation, the trials will be taken up in cultivators fields by the R.R.S. Kayamkulam.

3.1.3. Farming situation—'Thara' fields

3.1.3.1. Area

These lands are scattered in small bits throughout the Onattukara region. These lands are at a level higher than the wet lands and lower than the up lands. The total area under 'Tharas' is estimated to about 5000 ha.

3.1.3.2. Soil type

Sandy to sandy loam. Very porous, poor water holding capacity, very poor in organic matter and available plant nutrients. Acid in reaction with an average pH of 5.6.

3.1.3.3. Rainfall

On an average, the region receives an annual rainfall of 2600mm, spreading over eight months from April to November.

3.1.3.4. Irrigation : Nil

3.1.3.5. Cropping pattern

The common crops grown in this type of lands are short duration Tapioca, Pulses, Vegetables, Sweet potato and similar seasonal crops. these lands are utilised as nurseries for the second crop rice.

3.1.3.6 Constraints limiting production

Problems	Existing practice	Suggested solutions
1) Lack of suitable cropping pattern and suitable varieties.	'Thara' land are a special category of lands extending about 5000 ha. in Onattukara regions. It lies at a level below the up lands and above the wet lands. The common crops grown in these lands are tapioca, banana, pulses, vegetables etc. No definite cropping pattern is followed in these region.	As this land is mostly utilized as a nursery for paddy it is felt necessary to identify short duration varieties of tapioca suited to this are. The possibility of growing vegetable in this area is also to be explored. This will be taken up in the farmers field as the KAU does not have a station to represent this type of situation, works will be attended to by the staff of RRS, Kayamkulam.

3.1.4. Farming situation—uplands

3.1.4.1 Area

About 35000 ha distributed throughout the region.

3.1.4.2. Soil type

Sandy to sandy loam, porous, poor water holding capacity, very poor in organic matter and available plant nutrients. Acid in reaction with an average pH of 5.6.

3.1.4.3. Rainfall

About 2600 mm rainfall is received annually in this area.

3.1.4.4. Irrigation

No regular irrigation system is available. Coconut and other crops are being irrigated either by using pumpsets or by manual labour (Pot watering)

3.1.4.5. Cropping pattern

A coconut based cropping system is prevalent in this region. Mixed cropping is also practiced. The main intercrops grown in coconut gardens are Tapioca, Banana, Cocoa, Pulses, Clove, Nutmeg, Fodder, Vegetables, Minor tubers etc.

3.1.4.6. Constraints limiting production

Problems	Existing practice	Suggested solutions
1	2	3
1) Problem of incidence and spread of coconut disease (Root wilt)	(Root) wilt is a very serious menace found in this region. As a result of this infection the production may go down to an extent of about 80%. An inter-disciplinary co-ordination and multi-disciplinary approach is envisaged in the investigation undertaking the studies both under field and laboratory conditions. The participating disciplines are Agronomy, Agrl. Chemistry, Plant Pathology, Nematology and Entomology. Field studies will be conducted in four centres in the root wilt disease affected areas viz., Kumarakom, Moncompu, Vytilla and Kayamkulam. Apart from the research stations, field trials also will be laid out in the cultivators field adjacent to this station. For laboratory studies a field station will be established at Kumarakom to undertake ordinary analytical works. Studies requiring sophisticated instruments will be undertaken in	Research projects in the following lines are in progress. 1) Response of disease and apparently healthy coconut palms to fertilizer levels and organic manuring. 2) Root studies of apparently healthy and affected palms under different management practices. 3) Effect of intercropping fodder legumes and grasses in coconut gardens on the incidence and intensity of root (wilt) disease. 4) Effect of micro nutrients on the yield and disease intensity of root (wilt) affected palms. 5) Integrated control of root (wilt) disease in young palms. 6) Root excavation studies in diseased and apparently healthy palms in diseased and apparently healthy palms in different soil types.

1	2	3
	the College of Horticulture, Vellanikkara and College of Agriculture, Vellayani.	7) Microflora studies in rhizosphere and rhizoplane of healthy and diseased palms in different locations. 8) Effect of intercropping pattern on the arthropod fauna occurring in the rhizosphere of diseased coconut palms. 9) Plant parasitic nematodes associated with coconut root (wilt) disease affected palms in Kerala.
2) Lack of suitable varieties of annual intercrops in coconut gardens.	In this area a coconut based cropping pattern is followed. The common intercrops grown are Tapioca, Banana, Pulses, Vegetables etc. A most profitable crop combination should be identified for this region.	A research project to identify the most profitable crop combination will be undertaken.
3) Lack of proper manurial schedule for the coconut based cropping system.	The common practice of cultivators in this area is to apply organic manures like cowdung, ash green leaf etc. and inorganic straight and complex fertilizers without any standardisation.	A research project to standardise the manurial schedule suited to this situation may be undertaken.

4)	Problem of lesser net income from individual holding.	Farmers are not getting reasonably higher returns from their land. This is mainly due to the lack of oredit facilities and timely input supply, in addition to the improper manurial application and poor management.	Research project to identify the most profitable crop combination considering mixed cropping, relay cropping and mixed farming techniques will be undertaken. Simultaneously projects to standardise manurial schedules also will be taken up. The source of getting sufficient credit to the cultivators will be identified. This will be handled by the RRS, Kayamkulam.

3.2 Kuttanad

3.2.1 Farming situation—Kuttanad Karapadams

3.2.1.1 Area

This area lies along the inland water ways and rivers and are spread over a large part of upper Kuttanad in the districts of Alleppey and Kottayam. The area is estimated to about 41000 ha.

3.2.1.2 Soil type

The soils are riverborne alluvial soils. The fields lie about 1 to 2 metres below mean sea level. The soils are characterised by high acidity, high salt content and fair amount of decomposing organic matter.

3.2.1.3 Rainfall

At an average the Kuttanad region receives an annual rainfall of 2350 mm. The maximum rainfall is noticed during the month of June and the minimum in January-February. During the rainy season this area will be flooded.

3.2.1.4 Irrigation: Nil.

3.2.1.5 Cropping pattern

Usually in this area till recently only one crop of rice was taken. But at present in majority of areas farmers are taking two crops as shown below.

Season	Period	Crop	Remarks
Puncha	September-October to February-March.	Paddy	Main crop
Additional crop	April-May to August-September		Addl. crop

3.2.1.6 Constraints limiting production

Problems	Existing practice	Suggested solutions
1	2	3
1) Problem of weed infestation in the wet direct sown rice fields.	Grasses, sedges and similar broad leaved weeds form the main constraints in these areas. Among these the grassy weed *Echnochloa* is the most important. These weeds are being controlled by hand weeding and spraying with 2, 4-D.	Herbicides are to be screened and popularised. The pre-emergent herbicide though effective in weed control cannot be applied here in the direct sown crop due to phytotoxicity. The proper management technique and doses are to be formulated. The research projects are in progress. Biological control also to be intensified
2) Problem of salvinia infestation	Salvinia is a problem not only in paddy fields but also in the rivers and canals of Kuttanad region which hinder the transport and communication and drinking water systems. At present it is controlled or removed by mechanical means.	1) Possibilities of controlling the weed chemically using different weedicides are to be explored. 2) The scope of converting the weed into compost is to be studied. 3) Utilizing the weeds for bio-gas production is to be attempted. 4) The possible natural enemies to are be tested. 5) Proper machinary is to be designed for the mechanical removal of salvinia.
3) Lack of standardised tillage practice.	Generally in this area, after taking a crop, the field is ploughed ones, water is let in and then left as such till the next season is	An experiment to test the effects of different tillage operations like ploughing, harrowing etc. immediately after

1	2	3
	arrived. When season comes water is drained out, field is levelled and made ready for cultivation. In this situation it is better to ascertain whether the first ploughing after the harvest is essential and whether ploughing the field after draining out water will enhance production.	the harvest of the previous crop or immediately before sowing or transplanting has to be laid out.
4) Problem of nutrient losses due to frequent washing.	During the cropping seasons water from the paddy fields will be pumped out and later it is let into the fields through wooden sluices installed at convenient points. This leads to heavy nutrient losses. The extent of such loss should be ascertained and proper remedial measures undertaken.	A research project to study the extent of nutrient losses due to frequent washing at different seasons will be undertaken. The nutrients will include major, minor and trace elements:
5) The problem of acidity	The acidity is a common problem in this area. The pH of soil is about 5.6. The extent of acidity under various situations should be studied and suitable remedial measures found out.	A research project to assess the extent of acidity in Kuttanad soils at different regions under different cropping seasons and to develop appropriate measures to correct it will be undertaken.
6) Problem of incidence of pests		
i) Brown plant hopper.	The problem is acute in 95% of the area since 1973. Every year crop losses are reported ranging from 10 to 100% in certain pockets. The problem is severe only in summer crop. At present we have	1) The process of evolving suitable resistant varieties is to be intensified and continued, as the resistance may breakdown or resistant bio-types may occur. Projects are in progress.

	only a high cost technology to control this pest. Tolerant varieties are also grown. Water management practices are undertaken.	2) Newer chemicals are to be tested continuously. 3) Possibility of utilizing natural enemies is to be explored. (Projects in progress) 4) The low cost technology has to be worked out. 5) Bio-type studies are in progress. Question of developing insecticide resistance by the insects has to be studied in detail (Work started) Resurgence due to chemicals also has to be studied (Projects started).
ii) Leaf roller	The damage is found to be severe in post flowering stage. It is being cont-rolled by treating with contact insecticides.	Application of chemicals during the post flowering stage will be difficult. Hence use of systemic insecticides has to be worked out. Resistance has to be induced. Possible use of Neem oil has to be investigated.
iii) Rice case worm	The incidence is mainly due to the stagnation of water during rains and the damage occurs in both the seasons. The chemical control of this pest is very difficult due to rains.	Alternate hosts of the insect are to be identified. The use of spreading oils has to be perfected.
iv) Rice stem borer	The severe damage is noticed in early sown crop during puncha season. Only chemical control is practiced against this pest.	1) Evolving tolerant varieties. 2) Brood emergence and population fluctuations are to be worked out (Project in progress)

1	2	3
		3) Attraction to light trap to be studied in detail. 4) The species composition has to be studied.
v) Leafthrips	The thrips damage the seedlings in late sown puncha crop (December sowing). The problem is severe in 10% of the area. This is being controlled by spraying contact insecticides.	Seed treatments with some systemic chemicals are to be perfected for recommendation. The cost benefit ratios are to be worked out.
vi) Earhead cut worm	The problem of this pest occurs in certain years during puncha season as the crop approaches the harvesting stage. The loss due to this pest amounts to about 10 to 30%. This pest is being controlled by dusting chemicals at present.	Suitable chemicals are to be screened out. A pathogen already recorded for the area has to be further tested and utilized.
vii) Gallmidge	The problem is noted in both the seasons. It is being controlled by spraying systemic insecticides or applying granules.	As the pest multiplies on alternate hosts (weeds) control may be directed to locate these hosts and irradicate them. Use of micronutrients to induce tolerance has to be looked away.
viii) Rice bug	The problem of rice bug is found to be severe in the additional crop season (rainy season). The damage due to this pest extends to 10 to 15%. It is being controlled by using chemicals.	1) Alternate hosts of the insects are to be located and irradicated. 2) Further chemicals are to be tested. 3) Use of deterents are to be tried.

7) Problem of incidence of diseases		
i) Sheath blight	It is a fungul disease causing severe damage to the crop at all stages of growth. It is prevalent throughout the rice growing regions of the tract. The loss due to this disease is estimated to 50 to 60%. It is being controlled by spraying Hinosan @ 500 ml/ha or Bavistin 250 g/ha.	1) A prophylatic way of spraying may be recommended in endemic areas. 2) Resistant or tolerant varieties are to be evolved. 3) An economic spray schedule for the control is to be worked out. The following projects are in progress. 1) Scheme for the control of sheath blight by prophylatic spraying. 2) Adaptive trial for the control of sheath blight. 3) Economic spray schedule for the control of sheath blight. 4) Evolution of herbicides for the control of sheath blight. 5) Screening varieties for sheath blight resistance.
ii) Blast	A fungal infection causing heavy damage both in local as well as in high yielding varieties. The leaf blast is not severe. But the neck blast is dangerous causing about 100% loss. Generally the infection brings out 10 to 30% loss in production. It is being controlled by spraying Hinosan 500 ml/ha or Bavistin 250 gm/ha.	Use of susceptible varieties have to be discontinued. Effect of new fungicides and their combinations to control the disease is to be taken up as a project. Evolution of tolerant or resistant varieties are to be attempted.

1	2	3
iii) Blight disease	Now experienced as a severe problem in this locality. Hence the effect of new fungicides is being tried for the control of the disease.	Screening varieties against this disease is also attempted.
iv) Sheath rot	A fungal disease gaining importance during recent years. The loss due to this disease is estimated to 10 to 20%. The effect of spraying with different fungicides is being tried.	Projects on chemical control of sheath rot disease of rice.
v) Stack burn	Fungal disease causing about 5 to 10% loss.	Project on chemical control of stack–burn disease.
vi) Leaf scald	A fungal disease recently noted in this region.	A project for the assessment of loss due to this disease and chemical control is in progress.
vii) Bacterial Leaf Blight	A severe disease causing about 30 to 40% loss. The attack is severe in the additional crop season. (May to August). At present it is controlled by spraying with Agrimycin@ 750 gm/ha.	Screening varieties against this disease is to be attempted.
8) Problem of pollution of river water due to the application of plant protection chemicals.	Massive quantities of pesticides are being used in the area against a variety of pests and diseases. The drinking water system is linked with irrigation and drainage channels and hence the problem. It is a problem in atleast 60% of the total area.	Detailed studies to find out the residual effects of pesticides in river water at different points are to be taken up in a systematic manner. At the same time tolerant limits are to be prescribed for different chemicals.

		At present no action is found taken against this problem.	Safer chemicals are to be found out and recommended. A multi disciplinary approach is very essential in this case.
9)	Lack of proper machinery for collection and utilization of Salvinia.	At present it is being removed by manual labour, which is a labour consuming process incurring heavy expenditure. Hence a very effective machinery capable of collecting this weed at a minimum cost is to be designed.	The Engineering division attached to NARP will design the suitable machinery for the purpose. Research also will be undertaken to study the feasibility of using Salvinia for paper, fibre board etc.
10)	Problem of Rodents in rice field	Rats damage rice crop from tillering to the harvesting stage in both seasons. Infestation is found to be severe in the additional crop season (Rainy crop). At present the rats are being controlled by poison baiting and trapping.	As the rats developed shyness to all conventional methods newer technology are to be generated and developed.

3.2.2 Farming situation—Kuttanad—Kayal lands

3.2.2.1 Area

These areas are found in the reclaimed lake beds of Kottayam and Alleppey districts and occupy an area of about 8000ha. The land is situated 2 to 3 metres below sea level.

3.2.2.2 Soil type

Silty clay loam, the soils are slightly acidic to neutral in reaction, poor in plant nutrients and fairly rich in calcium.

3.2.2.3 Rainfall

The annual average rainfall in this area is about 2350 mm. Maximum rainfall is noticed during the month of June and the minimum in January–February.

3.2.2.4 Irrigation : Nil

3.2.2.5 Cropping pattern

In this situation only one crop of paddy in puncha season is taken. During the rest of the year the fields will be under submerged condition. The crop is raised during September–October to February–March.

3.2.2.6. Constraints limiting production

Problems	Existing practise	Suggested solutions
1	2	3
1) Problem of salinity in the region	In this area only one crop is taken during puncha season. During the rest of the year the field will be under submerged conditions. Salt water enters into the fields as the fields are at a lower level. At present the cropping period is so adjusted that the crop is harvested before the salt water inundation.	The new cultures and other varieties evolved elsewhere will be screened for the salinity affected areas and most suitable ones will be selected.
2) Problem of weed infestation in the wet direct sown rice fields.	Grasses, sedges and similar broadleaved weeds form the main constraints in these areas. Among these the grassy weed *Echnochloa* is the most important. These weeds are being controlled by hand weeding and spraying with 2, 4-D.	Herbicides are to be screened and popularised. The pre-emergent herbicide though effective in weed control cannot be applied here in the direct sown crop due to phytotoxicity. The proper management technique and doses are to be formulated. The research projects are in progress. Biological control also to be intensified.
3) Problem of salvinia infestation.	Salvinia is a problem not only in paddy fields but also in the rivers and canals of Kuttanad region which hinder the	1) Possibilities of controlling the weed chemically using different weedicides are to be explored.

1	2	3
	transport and communication and drinking water systems. At present it is controlled or removed by mechanical means.	2) The scope of converting the weed into compost needs to be studied. 3) Utilizing the weeds for bio-gas production is to be attempted. 4) The possible natural enemies are to be tested. 5) Proper machinery is to be designed for the mechanical removal of salvinia.
4) Lack of standardised tillage practice	Generally in this area, after taking a crop, the field is ploughed once, water is let in and left as such till the next season is arrived. When season comes water is drained out, field is levelled and made ready for cultivation. In this situation, it is better to ascertain whether the first ploughing after the harvest is essential and whether ploughing the field after draining out water will enhance production.	An experiment to test the effects of different tillage operations like ploughing harrowing etc. immediately after the harvest of the previous crop or immediately before sowing or transplanting has to be laid out.
5) Problem of nutrient losses due to frequent washing.	During the cropping seasons water from the paddy fields will be pumped out and later it is let into the fields through wooden sluices installed at convenient points. This leads to heavy nutrient losses. The extent of such loss should be ascertained and proper remedial measures are to be undertaken.	A research project to study the extent of nutrient losses due to frequent washing at different seasons will be undertaken. The nutrients will include major, minor and trace elements.

6) Problem of acidity	The acidity is a common problem in this area. The pH of the soils is about 5–6. The extent of acidity under various situations should be studied and suitable remedial measures are to be found out.	A research project will be undertaken to assess the extent of acidity in Kuttanad soils at different regions under different cropping seasons and to develop appropriate measures to correct it.
7) Problem of incidence of pests i) Brown plant hopper	The problem is acute in 95% of the area since 1973. Every year crop losses are reported ranging from 10 to 100% in certain pockets. The problem is severe only in summer crop. At present we have only a high cost technology to control this pest. Tolerant varieties are also grown. Water management practices are also undertaken.	1) The process of evolving suitable resistant varieties is to be intensified and continued, as the resistance may breakdown or resistant bio-types may occur. Projects are in progress. 2) Newer chemicals are to be tested continuously 3) Possibility of utilizing natural enemies is to be explored (Projects in progress). 4) The low cost technology has to be worked out. 5) Bio-type studies are in progress. Question of developing insecticide resistance by the insects has to be studied in detail (Work started). Resurgence due to chemicals also has to be studied (Projects started).

1	2	3
ii) Leaf roller	The damage is found to be severe in post flowering stage. It is being controlled by treating the contact insecticides.	Application of chemicals during the post flowering stage will be difficult. Hence use of systemic insecticides has to be worked out. Resistance has to be induced. Possible use of Neem oil has to be investigated.
iii) Rice case worm	The incidence is mainly due to the stagnation of water during rains and the damage occurs in both the seasons. The chemical control of this pest is very difficult due to rains.	Alternate hosts of the insect are to be identified. The use of spreading oils has to be perfected.
iv) Rice stem borer	The severe damage is noticed in early sown crop during puncha season. Only chemical control is practiced against this pest.	1) Evolving tolerant varieties. 2) Brood emergence and population fluctuations are to be worked out (Project in progress) 3) Attraction to light trap has to be studied in detail. 4) The species composition has to be studied.
v) Leafthrips	The thrips damage the seedlings in late sown puncha crop (December sowing). The problem is severe in 10% of the area. This is being controlled by spraying contact insecticides.	Seed treatments with some systemic chemicals are to be perfected for recommendation. The cost benefit ratios are to be worked out.

vi) Earhead cut worm	The problem of this pest occurs in certain years during puncha season as the crop approaches the harvesting stage. The loss due to this pest amounts to about 10 to 30%. This pest is being controlled by dusting chemicals at present.	Suitable chemicals are to be screened out. A pathogen already recorded for the area has to be further tested and utilized.
vii) Gallmidge	The problem is noted in both the seasons. It is being controlled by spraying systemic insecticides or applying granules.	As the pest multiplies on alternate hosts (weeds) control may be directed to locate these hosts and irradicate them. Use of micronutrients to induce tolerance has to be looked away.
viii) Rice bug	The problem of rice bug is found to be severe in the additional crop season (rainy season). The damage due to this pest extends to 10 to 15%. It is being controlled by using chemicals.	1) Alternate hosts of the insects are to be located and irradicated. 2) Further chemicals are to be tested. 3) Use of deterents are to be tried.
8) Problem of incidence of diseases		
i) Sheath blight	It is a fungus disease causing severe damage to the crop at all stages of growth. It is prevalent throughout the rice growing regions of the tract. The loss due to this disease is estimated to 50 to 60%. It is being controlled by spraying Hinosan @ 500 ml/ha or Bavistin 250 g/ha.	1) A prophylactic way of spraying may be recommended in endemic areas. 2) Resistant or tolerant varieties are to be evolved. 3) An economic spray schedule for the control is to be worked out. The following projects are in progress. 1) Scheme for the control of sheath blight by prophylactic spraying.

1	2	3
		2) Adaptive trial for the control of sheath blight. 3) Economic spray schedule for the control of sheath blight. 4) Evaluation of herbicides for the control of sheath blight. 5) Screening varieties for sheath blight resistance.
ii) Blast	A fungal infection causing heavy damage both in local and high yielding varieties. The leaf blast is not severe. But the neck blast is dangerous causing about 100% loss. Generally the infection brings out 10 to 30% loss in production. It is being controlled by spraying Hinosan 500 ml/ha or Bavistin 250 gm/ha.	Use of susceptible varieties have to be discontinued. Effect of new fungicides and their combinations to control the disease is to be taken up as a project. Evolution of tolerant or resistant varieties are to be attempted.
iii) Blight disease	Now experienced as a severe problem in this locality. Hence the effect of new fungicides is being tried for the control of the disease.	Screening varieties against this disease is also attempted.
iv) Sheath rot	A fungal disease gaining importance during recent years. The loss due to this disease is estimated to 10 to 20%. The effect of spraying with different fungicides is being tried.	Project on chemical control of sheath rot disease of rice.

v)	Stack burn	Fungal disease causing about 5 to 10% loss.	Projects on chemical control of stack burn disease.
vi)	Leaf scald	A fungal disease recently noted in this region	A project for the assessment of loss due to this disease and chemical control is in progress.
vii)	Bacterial Leaf Blight	A severe disease causing about 30 to 40% loss. The attack is severe in the additional crop season (May to August). At present it is controlled by spraying with Agrimycin @ 750 gm/ha.	Screening varieties against this disease has to be attempted.
9)	Problem of pollution of river water due to the application of plant protection chemicals.	Massive quantities of pesticides are being used in the area against a variety of pests and diseases. The drinking water system is linked with irrigation and drainage channels and hence the problem. It is a problem in atleast 60% of the total area. At present no action is found taken against this problem.	Detailed studies to find out the residual effects of pesticides in river water at different points are to be taken up in a systematic manner. At the same time tolerant limits are to be prescribed for different chemicals. Safer chemicals are to be found out and recommended. A multi disciplinary approach is very essential in this case.
10)	Lack of proper machinery for collection and utilization of salvinia.	At present it is being removed by manual labour which is a labour consuming process incurring heavy expenditure. Hence a very effective machinery capable of collecting this weed at a minimum cost is to be designed.	The Engineering division attached to N. A. R. P. will design the suitable machinery for the purpose. Research also will be undertaken to study the feasibility of using salvinia for paper, fibre, board etc.

1	2	3
11) Problem of Rodents in rice fields.	Rats damage rice crop from tillering to the harvest stage in both seasons. Infestation is found to be severe in the additional crop season (Rainy crop). At present the rats are being controlled by poison baiting and trapping.	As the rats developed shyness to all conventional methods newer technology are to be generated and developed.

3.2.3 Farming situation—Kuttanad—Kari lands

3.2.3.1 Area

These are found in large isolated patches in Ambalapuzha, Shertallai, Vaikom and Kunnathunad taluks of Alleppey and Kottayam districts, covering an area of about 20,000 ha.

3.2.3.2 Soil type

These are peaty soils, clayey in texture. They exhibit charcteristics of submerged forest area, but are not silted up. Deep black in colour, heavy in texture, poor in aeration and drainage, low in available plant nutrients but rich in organic matter. In the soil free sulphuric acid is formed by the oxidation of sulphur compounds present in the wood fossils found under the soil. Large amount of woody matter at various stages of decomposition occur embedded in these soils.

3.2.3.3. Rainfall

At an average the Kuttanad region receives an annual rainfall of 2350 mm. The maximum rainfall is noticed during the month of June and the minimum in January–February.

3.2.3.4 Irrigation : Nil

3.2.3.5 Cropping pattern

Only one crop during the puncha season is being taken. During the rest of the year the fields will be under submerged condition.

3.2.3.6 Constraints limiting production

Problems	Existing practice	Suggested solutions
1	2	3
1) Problem of acidity in the soil	From this area only one crop is being taken during the puncha season. During the rest of the period the fields will be under submerged conditions. The soil will be acidic The extent of acidity should be assessed and control measures evolved.	A research project to study the extent of acidity in the soil during the cropping season and evolve suitable technology to correct it should be taken up. Suitable liming materials, their dose and time of application in these fields may have to be decided. Research projects have already been approved for this purpose.
2) Problem of weed infestation in the wet direct sown rice fields	Grasses sedges and similar broadleaved weeds form the main constraints in these areas. Among these the grassy weed *Echnochloa* is the most important. These weeds are being controlled by hand weeding and spraying with 2,4-D.	Herbicides are to be screened and popularised. The pre-emergent herbicide though effective in weed control cannot be applied here in the direct sown crop due to phytotoxicity. The proper management technique and doses are to be formulated. The research projects are in progress. Biological control also to be intensified.
3) Problem of Salvinia infestation.	Salvinia is a problem not only in paddy fields but also in the rivers and canals of Kuttanad region which hinder the trans-	1) Possibilities of controlling the weed chemically using different weedicides are to be explored.

	port and communication and drinking water systems. At present it is controlled or removed by mechanical means.	2) The scope of converting the weed into compost has to be studied. 3) Utilizing the weeds for bio-gas production is to be attempted. 4) The possible natural enemies are to be tested. 5) Proper machinery is to be designed for the mechanical removal of Salvinia.
4) Lack of standardised tillage practice.	Generally in this area after taking a crop the field is ploughed once, water is let in and left as such till the next season is arrived. When season comes water is drained out, field is levelled and made ready for cultivation. In this situation, it is better to ascertain whether the first ploughing after the harvest is essential and whether ploughing the field after draining out water will enhance production.	An experiment to test the effects of different tillage operations like ploughing, harrowing etc. immediately after the harvest of the previous crop on immediately before sowing or transplanting has to be laid out.
5) Problem of nutrient losses due to frequent washing	During the cropping seasons water from the paddy fields will be pumped out and later it is let into the fields through wooden sluices installed at convenient points. This leads to heavy nutrient losses. The extent of such loss should be ascertained and proper remedial measures undertaken.	A research project to study the extent of nutrient losses due to frequent washing at different seasons will be undertaken. The nutrients will include major, minor and trace elements.

1	2	3
6) The problem of acidity	The acidity is a common problem in this area. The pH of the soil is about 5-6. The extent of acidity under various situations should be studied and suitable remedial measures found out.	A research project to assess the extent of acidity in Kuttanad soils at different regions under different cropping seasons and to develop appropriate measures to correct it will be undertaken.
7) Problem of incidence of pests		
i) Brown plant hopper	The problem is acute in 95% of the area since 1973. Every year crop losses are reported ranging from 10 to 100% in certain pockets. The problem is severe only in summer crop. At present we have only a high cost technology to control this pest. Tolerant varieties are also grown. Water management practices have also been undertaken.	1) The process of evolving suitable resistant varieties is to be intensified and continued as the resistance may breakdown or resistant bio-types may occur. Projects are in progress. 2) Newer chemicals are to be tested continuously. 3) Possibility of utilizing natural enemies is to be explored. (Projects in progress) 4) The low cost technology has to be worked out. 5) Bio-type studies are in progress. Question of developing insecticide resistance by the insects has to be studied in detail (Work started) Resurgence due to chemicals also has to be studied (Projects started).

ii) Leaf roller	The damage is found to be severe in post flowering stage. It is being controlled by treating the contact insecticides.	Application of chemicals during the post flowering stage will be difficult. Hence use of systemic insecticides has to be worked out. Resistance has to be induced. Possible use of Neem oil has to be investigated.
iii) Rice case worm	The incidence is mainly due to the stagnation of water during rains and the damage occurs in both the seasons. The chemical control of this pest is very difficult due to rains.	Alternate hosts of the insect are to be identified. The use of spreading oils has to be perfected.
iv) Rice stem borer	Severe damage is noticed in early sown crop during puncha season. Only chemical control is practiced against this pest.	1) Evolving tolerant varieties. 2) Brood emergence and population fluctuations are to be worked out. (Project in progress) 3) Attraction to light trap to be studied in detail. 4) The species composition has to be studied.
v) Leafthrips	The thrips damage the seedlings in late sown puncha crop (December sowing). The problem is severe in 10% of the area. This is being controlled by spraying contact insecticides.	Seed treatments with some systemic chemicals are to be perfected for recommendation. The cost benefit ratios are to be worked out.
vi) Earhead cut worm	The problem of this pest in certain years during puncha season as the crop appro-	Suitable chemicals are to be screened out. A pathogen already recorded for

1	2	3
	aches the harvesting stage. The loss due to this pest amounts to about 10 to 30%. This pest is being controlled by dusting chemicals at present.	the area has to be further tested and utilized.
vii) Gallmidge	The problem is noted in both the seasons. It is being controlled by spraying systemic insecticides or applying granules.	As the pest multiplies on alternate hosts (weeds) control may be directed to locate these hosts and irradicate them. Use of micronutrients to induce tolerance has to be looked away.
viii) Rice bug	The problem of rice bug is found to be severe in the additional crop season (rainy season). The damage due to this pest extends to 10 to 15%. It is being controlled by using chemicals.	1) Alternate hosts of the insects are to be located and irradicated. 2) Further chemicals are to be tested. 3) Use of deterents are to be tried.
8) Problem of incidence of diseases.		
i) Sheath blight	It is a fungus disease causing severe damage to the crop at all stages of growth. It is prevalent throughout the rice growing regions of the tract. The loss due to this disease is estimated to 50 to 60%. It is being controlled by spraying Hinosan @ 500 ml/ha or Bavistin 250 g/ha.	1) A prophylactic way of spraying may be recommended in endemic areas. 2) Resistant or tolerant varieties are to be evolved. 3) An economic spray schedule for the control is to be worked out. The following projects are in progress. 1) Scheme for the control of sheath blight by prophylactic spraying.

			2) Adaptive trial for the control of sheath blight. 3) Economic spray schedule for the control of sheath blight. 4) Evolution of herbicides for the control of sheath blight. 5) Screening varieties for sheath blight resistance.
ii)	Blast	A fungal infection causing heavy damage both in local and high yielding varieties.The leaf blast is not severe. But the neck blast is dangerous causing about 100% loss. Generally the infection brings out 10 to 30% loss in production. It is being controlled by spraying Hinosan 500 ml/ha or Bavistin 250 gm/ha.	Use of susceptible varieties have to be discontinued. Effect of new fungicides and their combinations to control the disease is to be taken up as a project. Evolution of tolerant or resistant varieties are to be attempted.
iii)	Blight disease	Now experienced as a severe problem in this locality. Hence the effect of new fungicides is being tried for the control of the disease.	Screening varieties against this disease is also attempted.
iv)	Sheath rot	A fungal disease gaining importance during recent years. The loss due to this disease is estimated to 10 to 20%. The effect of spraying with different fungicides is being tried.	Project on chemical control of sheath rot disease of rice.

1	2	3
v) Stack burn	Fungal disease causing about 5 to 10% loss.	Projects on chemical control of stack burn disease.
vi) Leaf scald	A fungal disease recently noted in this region	A project for the assessment of loss due to this disease and chemical control is in progress.
vii) Bacterial leaf blight	A severe disease causing about 30 to 40% loss. The attack is severe in the additional crop season (May to August). At present it is controlled by spraying with Agrimycin @ 750 g/ha.	Screening varieties against this disease to be attempted.
9 Problem of pollution of river water due to the application of plan protection chemicals.	Massive quantities of pesticides are being used in the area against a variety of pests and diseases. The drinking water system is linked with irrigation and drainage channels and hence the problem. It is a problem in atleast 60% of the total area. At present no action is found taken against this problem.	Detailed studies to find out the residual effects of pesticides in river water at different points are to be taken up in a systematic manner. At the same time tolerant limits are to be prescribed for different chemicals. Safer chemicals are to be found out and recommended. A multi disciplinary approach is very essential in this case.
10) Lack of proper machinery for collection and utilization of Salvinia.	At present it is being removed by manual labour which is a labour consuming process incurring heavy expenditure. Hence a very	The Engineering division attached to N. A. R. P. will design the suitable machinery for the purpose. Research

		effective machinery capable of collecting this weed at a minimum cost is to be designed.	also will be undertaken to study the feasibility of using Salvinia for paper, fibre board etc.
11)	Problem of Rodents in rice fields.	Rats damage rice crop from tillering to the harvest stage in both seasons. Infestation is found to be severe in the additional crop season (Rainy crop). At present the rats are being controlled by poison baiting and trapping.	As the rats developed shyness to all conventional methods newer technology are to be generated and developed.

3.2.4 Farming situation—Kuttanad Uplands

3.2.4.1 Area

It includes the upland area of the entire Kuttanad region in Kottayam and Alleppey Districts.

3.2.4.2 Soil Type

Alluvial clay loam.

3.2.4.3 Rainfall

The annual average rainfall in this area is about 2350 mm. Maximum rainfall is noticed during the month of June and the minimum in January-February.

3.2.4.4 Irrigation : Nil

3.2.4.5 Cropping pattern

Coconut based cropping pattern is followed. The common inter-crops grown are vegetables, cocoa and banana.

3.2.4.6 Constraints limiting production

Problems	Existing practice	Suggested solutions
1) Problem of raising fodder crops in coconut gardens	In the upland region a coconut based cropping pattern is followed. The common intercrops grown are banana, cocoa, vegetables etc. Hence the possibility of growing fodder crops should be explored.	From a preliminary study it was found that Hybrid Napier appeared to be the most suitable fodder grass in these areas. However, the possibility of growing leguminous fodder crops has to be taken up.
2) Lack of knowledge on the suitable intercrops to be grown in coconut garden.	In this region it is a felt need to find out a suitable crop combination giving the maximum net returns to the cultivators.	A research project to identify a most profitable cropping pattern will be taken up.
3) Lack of knowledge in the integrated farm development with coconut-cattle, coconut-fish, coconut-pig farming.	Combinations of different types of enterprises as stated in the problem will yield better results. Hence this should be attempted.	A research project to identify the most profitable enterprise combination will be taken up.
4) Lack of standardised agronomic techniques for vegetables, banana and tapioca.	Though tapioca, vegetables and banana are grown as intercrops. it was not based on standardised agronomic practices.	A research project will be undertaken to standardise the cultural practices to be followed against the intercrops viz., tapioca, banana, vegetables etc.

3.2.5 Farming situation involving fish and prawn culture—Kuttanad

Fish and prawn culture are being undertaken in the intervening canals of coconut gardens, paddy fields and other waterways, throughout Kuttanad. Identification of suitable varieties of fish and prawn, standardisation of their cultural practices, testing the feasibility of undertaking paddy-cum fish culture in low lands etc. need immediate attention and solution.

3.2.5.1 Constraints limiting production

Problems	Existing practices	Suggested solutions
1	2	3
1) Problem of fish and prawn culturing in the water ways of Kuttanad region.	Fish and prawn culture are undertaken in the canals of coconut garden, paddy fields and other water ways throughout Kuttanad. Identification of suitable varieties of fish and prawn, standardisation of their cultural practices, testing the feasibility of undertaking paddy cum fish culture in low lands etc. needs immediate attention.	Research projects to identify suitable varieties suited to the area and to study the feasibility of undertaking paddy cum fish culture in low lands will be taken up.

Note: The problems in the Kuttanad region will be handled by the existing RARS, Kumarakom, the RRS, Moncompu in their own fields as well as in cultivators fields whereever necessary.

3.3 Pokkali

3.3.1 Farming Situation—Pokkali paddy fields

3.3.1.1 Area

The Pokkali region is located in Ernakulam and Alleppey district of the State. In Ernakulam district it is distributed over Edappally, Vyttila, Palluruthy, and Vypeen blocks of Kanayannor, Cochin and Paravur Taluks. In Alleppey district, the area is scattered over Thaikkattussery and Pattanakkad blocks of Shertallai Taluk. The total area under Pokkali is estimated to about 10000 ha.

3.3.1.2 Soil type

The soil is river borne alluvium, loam to clay in texture. They are highly acidic and fairly rich in nitrogen. Conductivity is also high. These soils are subjected to periodical inundation of salt water and are highly acidic in reaction.

3.3.1.3 Rainfall

The annual average rainfall in Pokkali region is found to be 3000 mm. The maximum rainfall is noticed in July and August (about 40%).

3.3.1.4 Irrigation: Nil

3.3.1.5 Cropping pattern

Only one crop of paddy is taken during the 1st crop virippu season. During the rest of the period the fields are submerged and people are engaged in fishing activity. Long duration and salt resistant varieties are grown. The crop is sown in raised mounds and seedlings are spread subsequently.

3.3.1.6 Constraints limiting production

Problems	Existing practice	Suggested solutions
1	2	3
1) Lack of knowledge on the utilisation, time and method of application of fertilizers to Pokkali crop.	The cultivators in this region are not having the scientific knowhow on the time and method of application of fertilizers. This is mainly due to the peculiar system of Pokkali cultivation. Hence it is very essential to standardise the fertilizer schedule suited to pokkali region.	A research project to work out an optimum fertilizer schedule including straight and complex fertilizers, and also to fix the exact time and method of application will be taken up.
2) Lack of suitable varieties to suit the farming situation.	Generally from Pokkali region only one crop of paddy during the virippu season is taken. During the rest of the period the fields are under submerged condition and subjected to salt water inundation. Because of this salt water incursion the ordinary varieties used in other regions will not come up here. The varieties used in this region are 'Cheetupokali, Chettivirippu, Eravappandi and Orkaima'. These seeds are long duration varieties and tolerant to salinity But the yield is very low. Hence it is a felt need to evolve some promising high yielding varieties suited to the local conditions.	A research project is in progress to evolve saline resistant, short duration and high yielding variety suited to the area.

1	2	3
3) Problem due to tidal effects on soil properties	The soils are salt affected and showed high couductivity ranging from 4 2 to 14 mm. hos/cm. Though the conductivity is high, the soil is very often found to be acidic and the pH values ranged from 3.5 to 6.8. During summer months the fluctuations in the magnitude of salinity are very high.	The very high fluctuations in the pH values and conductivity of the soils are supposed to be due to the tidal effects as these fields are adjacent to lakes. Thus a detailed research projects to find out the tidal effect on the physico-chemical properties of Pokkali soil is to be started. The project has been prepared.
4) Problem associated with the application of fertilizers and insecticides to paddy crop and its ill effects on the subsequent prawn culture.	In Pokkali region prawn culture is considered to be a very important activity rather, than paddy cultivation. Indiscriminate use of fertilizers and insecticides in the fields are found to be harmful against the fish culture. Hence it is very essential to develop some technology against this.	Already an experiment has been started to study effects of application of pesticides on the control of rice pests and on fish and prawn culture in Pokkali fields. A similar project to study the effect of fertilizer application on prawn culture will be taken up.
5) Lack of standardised cultural methods and problems of high cost of cultivation.	No standard cultural practices are followed in this region. This is due to the peculiar system of cultivation. Seeds are sown in raised mounds after washing out the salinity. The seedlings are scattered into the entire field with soil. Hence for	Marking mounds or raised beds have to be tested for their comparative efficiences in this region in relation to the low yield and very high cost of cultivation especially labour. Similarly the possibility of increasing

	getting more production, the cultural practices needs standardisation. Further the yield from these fields are very poor, whereas the cost of cultivation is high.	income from these lands by way of prawn culture also need investigation.
6) Difficulties associated with germination of seeds.	A special method is adopted for sprouting seeds of pokkali varieties and keeping them viable for 3 to 4 weeks. About 7–10 kg seeds are tightly packed in country baskets made of plated coconut leaves. The inner side of the basket is lined with banana leaves or teak leaves. Then it is immersed in water for 12–15 hrs. taken out and kept in shade. The seeds start to sprout within 3 to 4 days and their further growth is arrested and they remain as such for about another 30 days. Before sowing, it is taken out and again immersed in water for 6 hrs and then sown. Deterioration of sprouted seeds is a common phenomenon in this case.	It is suggested to study the physico-chemical factors associated with prevention of deterioration of sprouted seeds in the baskets. Under these projects, laboratory study will be conducted with different varieties for 5 storage periods. The pressure, temperature and air inside the basket will be studied at weekly intervals.
7) Problem of pest infestation. Stem borer	It is a major pest in this region. Use of chemicals is difficult due to the peculiar farming system and the resultant toxicity to the fish fauna which is very important.	Chemicals safer to the fish fauna are to be screened and located. Use of indigenous plant products for insect control has to be further investigated

1	2	3
	Hence at present no measures are being taken to control the pest.	Egg parasites of the insects to be searched and work on this line intensified. Possibility of utilising some other fish species for the control of stem borer can also be investigated. Additional use of plant nutrients like Silica, Potash etc. to induce field tolerance to the pest is worth investigating. A plant protection strategy for Rice cum fish culture has to be evolved.

3.3.2 Farming situation—Uplands in Pokkali Region

3.3.2.1 Area

It constitutes the entire upland region of Pokkali area coming under C1 farming situation.

3.3.2.2. Soil type

The soil in upland region is found to be more porous when compared to the low level fields. The structure, texture and the composition are almost the same as in the C1 farming situation.

3.3.2.3. Rainfall

The annual average rainfall is about 3000 mm. The maximum rainfall is noticed in July–August (about 40%).

3.3.2.4. Irrigation

No separate irrigation system is functioning in this area. The crops grown in uplands are irrigated by using pump sets or by manual labour (Pot watering).

3 3.2.5. Cropping pattern

A coconut based cropping system is practiced in this region. Coconut is mixed with other crops like arecanut, tapioca, banana, cocoa, clove, nutmeg etc.

3.3.2.5. Constraints limiting production

Problems	Existing practice	Suggested solutions
1) Lack of suitable varieties of intercrops suited to pokkali region.	The common intercrops grown in pokkali uplands are arecanut, tapioca, banana, cocoa, pulses, clove, nutmeg etc. The varieties of intercrops grown are not high yielding. An ideal cropping pattern suited to this region, giving the maximum net returns should be evolved.	A research project should be taken up to develop an ideal cropping pattern suited to the area.
2) Lack of proper manurial schedule suited to the area for coconuts.	The present manurial recommendation for coconut palms in this area is a general one based on experiments conducted in other parts of the State. Considering the peculiar nature of soil conditions in this area, a specific manurial recommendation has to be developed.	A manurial experiment has already been started in this region.

Note: The RRS, Vyttila will take up the above problems in its own fields as well as in cultivators' fields.

3.4 Kole

3.4.1 Farming situation—Low fields of Kole areas

3.4.1.1. Area

The Kole region lies in Trichur and Malappuram districts extending partly along Trichur, Chowghat, Mukundapuram and Ponnani Taluks. The total area under Kole is estimated to about 11000 ha.

3.4.1.2 Soil type

The soil in general is clayey sand containing sufficient quantity of organic matter and silt. The flood water deposits silt and organic matter every year.

3.4.1.3 Rainfall

The average annual rainfall in Kole region is estimated to about 1960 mm. The area is well blessed with two monsoons. The South West monsoon extends from June to September and North-East monsoon September to November.

3.4.1.4 Irrigation

Some parts of Kole area is benefitted by Peechi irrigation Project.

3.4.1.5 Cropping pattern

Generally from Kole region only one crop during summer (Puncha Crop) is taken. However, in some areas a second crop (Mundakan) is also attempted to. During the first crop season the entire area will be under water.

3.4.1.6 Constraints limiting production

Problems	Existing practice	Suggested solutions
1	2	3
1) Problem of submergents, flood and lack of drainage.	At present in Kole region only one crop during puncha season is taken. During the rest of the year the entire area gets flooded and submerged under water. Hence before raising the puncha crop, dewatering after erecting permanent bunds becomes essential. Any improvement in the cropping system in Kole region could be achieved by constructing permanent bunds along with drainage channels to store and prevent water from the channels entering into the fields and by providing a system of drainage to maintain the water at the desired level.	This problem is being tackled by Kerala Land Development Corporation. A project for constructing permanent bunds in Kole region is in progress.
2) Lack of irrigation in summer crop season.	During summer season water scarcity is a problem in this area. The entire area does not fall into the Command area of Peechi Irrigation Project.	Drought tolerant varieties evolved elsewhere can be tested here and suitable one selected.
3) Lack of suitable short duration varieties for the Kole region.	At present few farmers grow some of the varieties recommended for other regions while others follow the local varieties. Hence to select the most suitable variety for this region is a felt need.	To select the most suitable varieties/ cultures a trial with varieties Rohini, Triveni, Annapoorna, Jyothi, Culture 1907, MO-5, Culture 1537-2, Culture 47-41, MN-23332-2 and Culture 10-1-1 can be taken up.

4)	Lack of suitable varietal combination for double crop Kole lands.	Suitable varieties to suit the situation are lacking.	To find out the most suitable varietal combination for double crop Kole lands an investigation using the different combinations of short duration and medium duration varieties of paddy will be taken up and the varieties for first and second crop seasons decided.
5)	Problems of low germination of seeds.	Direct sowing is commonly practiced in kole lands. Broadcasting to seeds in flooded conditions results in poor germination for want of oxygen. It has been found that calcium peroxide can supply the required oxygen to the germinating seeds.	To find out the effect of sowing non-coated and calcium peroxide coated seeds as compared to farmers practice an experiment will be conducted in the Kole lands.
6)	Problems of weed infestation.	Direct sowing is the common practice followed in Kole land and hence weed growth is a common problem. Hand weeding is very expensive and hence the possibility of herbicidal control is to be tested.	An experiment using six herbicides in two doses and their combinations along with handweeding and unweeded control has been formulated and is in progress.
7)	Possibility of combined application of carbofuran and urea.	The present system is to apply urea and carbofuran separately. Trials conducted at C.R.R.I. revealed that inhibiting action of insecticide on nitrification may have beneficial effect in reducing the loss of nitrogen in flooded soil and hence increased yields.	An experiment namely 'Evaluation of joint application of Carbofuran and urea applied by broadcasting and placement methods' has been prepared and approved. The experiment is in progress.

8)	Fertilizer requirement of rice in kole land.	At present there is no specific recommendation of fertilizer dose to the Kole land paddy. Farmers adopt their own doses and methods.	An experiment to study the different levels of nitrogen, phosphorus and potash has been prepared and approved. The experiment is in progress.

3.4.2 Farming Situation—Uplands in Kole region

3.4.2.1 Area

It includes the upland area of entire Kole region in Trichur and Malappuram Districts.

3.4.2.2 Soil type

The upland region is mostly laterite with lesser amount of silt and clay.

3.4.2.3 Rainfall

Annual average rainfall in this region is about 2960 mm. The South West monsoon extends from June to September and North-East monsoon from September to November.

3.4.2.4 Irrigation

The area is benefitted to a certain extent by Peechi irrigation project. Irrigation using pumpsets and post watering is also practiced.

3.4.2.5 Cropping pattern

A coconut based cropping pattern is followed in this region. Mixed cropping pattern forms the main practice. The inter crops grown are banana, cocoa, tapioca, pulses, vegetables etc.

3.4.2.6. Constraints limiting production

Problems	Existing practice	Suggested solutions
1	2	3
1) Lack of suitable varieties of intercrop suited to Kole region.	The common intercrop grown in this region are arecanut, banana, cocoa, pulses, clove, nutmeg etc. The varieties are local and not promising. Hence a suitable cropping pattern giving the maximum net returns should be identified.	A research project may be taken up to develop the suitable and most profitable cropping pattern for this region.
2) Lack of proper manurial schedule suited to the area.	At present the cultivators are using fertilizers not based on the recommendations of package of practices. Considering the peculiar nature of soil conditions in this area a specific manurial schedule has to be developed, for which investigations has to be initiated.	A manurial trial to work out a proper manurial schedule suited to this region may be taken up.

Note:- The above problems will be tackled by the Kole Research Unit attached to the Agrl. Res. Station, Mannuthy, Trichur.

CHAPTER 4

EXTENSION

4.1 Linkage between Agrl. Research and Extension

The Zonal Research Advisory Committee consists of the Associate Director of Research, Crop experts from the University, Heads of departments, Senior Scientists of Regional and Sub Stations, Senior Officers of the Department of Agriculture of the region and representatives of progressive farmers. This committee is responsible for identifying the research gap, fixing priorities and reviewing the progress of research.

Agricultural Research and Extension are interdependent. The research findings generated in the research stations are conveyed to the actual cultivators through the medium of extension. Similarly research also requires feed back from extension based on which further research work is to be undertaken.

In Kerala State, the linkage between Research and extension is effectively developed through the important strategies of 'T' and 'V' Programme and I.R.D.P. The different agencies involved into this programme are the Department of Agriculture having State level, regional level, district level and circle level Office headquarters with the Director of Agriculture, Joint Directors, Deputy Directors, District Agrl. Officers, subject Matter Specialists, Principal Agrl. Officers and Circle Officers as heads of Offices. The district level D.R.D.A's and other Block and Village level extension officers are also involved into this system. The research findings recommended by the various research stations of the Agricultural University are being conveyed to the farmers through a network of such extension agencies scattered throughout the State.

In the problem areas of the special zone falling into six districts of the State the 'T' & 'V' programme is effectively functioning. This programme is being executed through a net work of officials viz., J. D. A., Principal information Officers, Sub divisional Agrl. Officers, Subject matter Specialists, Circle Officers, Junior Agrl. Officers and Village level workers. Similarly the entire research programmes related to different crops, livestock and fisheries are taken care of by the six research stations located at different places in the region. They are:

1. R. A. R. S., Kumarakom
2. R. R. S., Moncompu
3. R. R. S., Vyttila
4. R. R. S., Kayamkulam
5. Research Station and Instructional Farm, Mannuthy.
6. C. P. C. R. I., Kayamkulam (ICAR Institute).

The institutions governed by the Department of Agriculture falling into the problem areas which undertake the extension activities are listed below.

Developmental Agency	*Headquarters*	*Jurisdiction*
1	2	3
Joint Director of Agriculture	Alleppey	Entire Alleppey District (Onattukara & Kuttanad)
'T' and 'V' Sub–Division & Circle Offices	Alleppey, Mavelikkara and Chengannur	–do–
Subject Matter Specialists. Subject matter Specialists Deputy Director of Agriculture	Kottayam, Trichur Quilon, Ernakulam Trichur and Malappuram	Jurisdiction of the respective districts.

The important activities built in the N. A. R. P. system through which a strong linkage between research and extension is developed, are the following.

1. Zonal workshops.
2. Organisation of Field days (Kisan Melas).
3. Testing of Technology by conducting trials in cultivators fields.
4. Feed back through departmental experts.
5. Monthly workshops of extension and research staff.

Officials of the developmental programmes like N. R. E. P., D.R.D.P. etc. are participating in the workshops organised by the University and in turn the University staff members are also participating in their programmes.

Experts from Research Stations under this Projects are functioning as resource personnels to the 'T' & 'V' Programme. They actively participate in the monthly workshops regularly.

The N. A. R. P. Programmes are also being undertaken in collaboration with the sister institutions like C.P.C.R.I., Kayamkulam, C.T.C.R.I. Trivandrum, Rubber Research Institute, Kottayam; C.F.T.R.I. Unit, Trichur.

For promoting and strengthening the linkages between research and extension, periodical meetings of Research and Extension staff are being organised as monthly workshops, seasonal zonal workshops etc. Research/ extension linkages are also promoted through the training of extension staff by research personnel, including visit to research stations and visits of research staff to farmers fields and participation in the activities of the department of Agriculture from time to time.

OO

APPENDIX I

Copy of the Letter issued from the Council sanctioning the Sub-project

INDIAN COUNCIL OF AGRICULTURAL RESEARCH
"Krishi Bhavan" New Delhi-1

No. 12-1/81-Edn. IV Dated 31st August, 1981

To

The Comptroller,
Kerala Agricultural University,
P. O. Mannuthy-680 651.

Sub:- National Agricultural Research Project for strengthening of regional research capability of agricultural universities—administrative approval for implementation of the sub-project for strengthening of Regional Research Station, Kumarakom and sub-stations at Kayamkulam, Vyttila, Moncompu and Kole Land under Kerala Agricultural University.

Sir,

I am directed to invite a reference of letter No. R (2) 3015/81 dated 15-1-1981 enclosing the revised sub-project proposals for the strengthening of Directorate of Research, Kerala Agricultural University with support from National Agricultural Research Project (NARP).

2. I am directed to convey the approval of the Council to the implementation by the KAU of the sub-project for the strengthening of regional research station Kumarakom and sub-stations at Kayamkulam, Vyttila, Moncompu and Kole Land under Kerala Agricultural University, involving a total allocation of Rs. 113.91 lakhs (Rupees one crore thirteen lakhs and ninety one thousand only) from the Council for a period of five years from 1-9-81 subject to the detailed terms and conditions mentioned at Annexure-I. The detailes of the itemwise allocation are at Annexure-II. The expenditure on (i) basic cultivation, (ii) station utilities and maintenance and (iii) land acquisition would be met by the KAU/Government of Kerala. The project cost and expenditure sanction of the sub project beyond 31-3-1983 is subject to approval by the E. F. C. of Ministry of Finance.

3. The vehicle provided under this project is meant for effective monitoring of NARP sub-projects and should not be diverted to general use of the University.

4. First instalment of funds would be released after the undertaking is signed by the University and State Government and forwarded to the ICAR.

5. The final allocation in respect of civil works would be determined after the approval of the Master Plan nomination of architects and the detailed estimates. Pending this, funds may be utilised only for work relating to preliminary survey and repair/modification of existing buildings.

6. Expenditure during 1981-82 will be met from the ICAR budget provision of Rs. 513 crores for NARP. The release of funds beyond 1982-83 will be subject to the approval of finance for continuation of NARP.

7. This issues with the concurrence of the Ministry of Finance vide their U. O. No. 2289/81 Fin. VI dated 25-8-1981.

Yours faithfully,

Sd/-

(M. C. JAYARAMAN)

Deputy Project Co-ordinator (A).

Copy forwarded for information and necessary action to:-

1. Dr. Kaleeswaran, Vice-Chancellor, Kerala Agricultural University, P. O. Mannuthy-680651, Trichur, Kerala.
2. Sri. C. Thomas, Commissioner (Agri), Government of Kerala, Department of Agriculture, Trivandrum.
3. Shri. M. S. Joseph, Director of Agri., Govt. of Kerala, Trivandrum.
4. Dr. P. C. S. Nair, Director of Research, Kerala Agrl. University, Vellanikkara, Trichur, Kerala (5 copies).
5. Registrar, Kerala Agrl. University, Trichur, Kerala.
6. Examiner, Local Fund Accounts, Govt. of Kerala, Tvm.
7. Planning Commission (Agri. Division) Yojana Bhavan, New Delhi.
8. Under Secretary (Integrated Fin.) Krishi Bhavan.
9. Director (Fin.) ICAR, with a request that a separate account may be maintained in respect of releases made under the NARP. This project sanction is being issued on the basis of clearance from Fin. Div., Dept. of Agrl.
10. Budget Section, ICAR (11) GA II Section, ICAR.
11. Accounts II Section, ICAR (13) P. C. Unit, ICAR.
12. Edn-II Section, ICAR (15) DDG (E) DDG (CS)/DDG (s)/ DDG (AS)/ ADG (S)/ADG (FC)/ADG (Agro.)/ ADG (IDA)/ADG (NARP)/ Director (works) /Architect 9 NARP). Dy. Proj. Co-ordinator (A)/ Scientist (NARP) I. II & III.
13. Guard file (17) Accounts Officer (NARP), ICAR.

Sd/-

(H. P. CHAMOLA)

Accounts Officer (NARP)

Annexure—I

NATIONAL AGRICULTURAL RESEARCH PROJECT

Terms and conditions for Administration of NARP and utilisation of Funds:

1. Eligible expenditure:

NARP would for a period of at most five years finance on a grant basis the following expenditure under approved sub-projects:

a) *Incremental staff*: The full salary and applicable allowances as admissible under University rules improve from time to time for the based on current pay scale. However, no housing allowance will be financed for such staff if they are provided with housing by the University.

b) *Research operating funds:*

— running costs of vehicles used by research staff,
— other travel expenses,
— laboratory and office supplies,
— temporary labour and inputs required for field experiments, in excess of 'normal' or 'commercial' cultivation costs (see 4 (b) below)

Such expenditure will normally be applied only to the incremental scientific staff referred to in (a) above, but in special circumstances existing staff may be granted the difference between their present allocation and the approved lump sum per scientist.

c) *Equipment*: The cost of basic scientific, office and farm equipment (Rs. 5,000 and above) on the basis of an approved list specified in the sub-project. In addition a lump sum (not to exceed 25% of basic equipment) may be provided for minor items (below Rs. 5,000) and for supplementing the basic equipment. Where only a relatively small sum is spent on major items, a comprehensive list of all equipment may be provided. Purchase of items costing over Rs. 5,000 from the supplementary list will require prior ICAR approval as will any change in the basic equipment list.

d) *Civil works*: Cost of laboratory and office space and related fixtures, housing and farm development on the basis of the approved civil works programme. Land Development over minor farm structures, roads, land shaping, fencing and supplementary irrigation works in accordance with the long term needs of the station, provided a major part of the farm is set aside for research on rainfed farming. Housing will be provided for staff who need to live on the station and for other staff on the basis of an analysis of accomodation available in neighbouring towns, rents asked and commuting required. Generally this will not exceed housing up to 25% of scientific staff and some limited units of housing for other staff. If proposed housing exceeds the proportion provided at

existing zonal stations, the evidence presented must be conclusive and subject to ICAR approval. Housing would be provided in accordance with the standards specified in the sub-project.

e) *Training*: Cost of organizing workshops for extension and research staff and for providing non-degree training for SAU research staff at advanced centres of research in India and at the ICAR Central Staff College for Agriculture.

2. Costs to be defrayed by the University:

The following costs will form part of the sub-project and of the budget allocated to the officer-in-charge of the sub project, but will be met 100% by the University/State.

a) Acquisition of additional farm land for research purposes.

b) Normal or commercial costs of cultivation for the research farm, including land preparation, estimated on the basis of the expected cropping pattern The University/state will, on the other hand, retain the gross income from the farm.

c) Building maintenance and security, utilities, and similar station overhead costs.

At the end of the project period (5 years) the University/state also be responsible for the cost of:

a) Incremental staff;
b) Research operating funds;
c) Maintenance and replacement of equipment (10%) and
d) Maintenance of completed civil works (1-1/2%)

3. Accounting, Disbursement and Audit:

a) The entire grant-in-aid is governed by the schedule of Terms and Conditions governing such grants from the Council. The expenditure on the scheme may be restricted to the account sanctioned by the Council under each sub-head, subject to the final adjustment on the basis of the Audit Certificate to be furnished to the Council in the prescribing proforma in due course.

b) The University will maintain separate accounts for each sub-project and each head of expenditure (NARP and University) under the sub-project

c) For each sub project the University will submit (with its progress report, see para 9 below) to ICAR every six months a budget request including

i) the estimated requirements under each of the above heads of expenditure for the succeeding six months

ii) a duly authorised certificate of expenditure showing amounts spent to date and available under each head from previous advance, and

iii) the additional advances required

d) The grant-in-aid released by the Council is lapsable and will have to be utilized during the current financial year. The unspent balance if any remaining at the close of the financial year will have to be reduced to the Council or get revalidated for utilization in the subsequent year for which prior approval of the Council is necessary.

e) Savings under the head of expenditure may not be reallocated to other head of expenditure without ICAR's prior approval.

f) ICAR may reasonably determine that completion of certain transactions by the University such as acquisition of land, be an additional condition of disbursement against civil works expenditure.

g) Auditors as specified in the University regulation within nine months of the end of the financial year, will submit to ICAR an audit report for each sub-project (or Grant utilization certificate) covering all heads of expenditure (ICAR and University finance) for the proceeding financial year. This would be a condition for continued NARP report of the sub-project in question. In addition, ICAR reserves the right to carry out an independant audit of sub project account and leave reasonable access to University property and records for the purpose.

h) The project period may be exceptional cases, be extended to allow completion of civil works and equipment procurement. Possible savings on scientific staff and operating funds would be cancelled at the end of the project period.

4. Procurement :

Procurement of civil works and equipment would follow standard university procedures as reviewed and approved by PFC and be subject to the following :

a) ICAR approval of master plan for each research station sub project;

b) Architectural brief for all laboratory buildings, (wherever necessary this may be prepared by ICAR consultants);

c) For sub projects where the construction work, excluding housing, ie. estimated to cost more than Rs. 4,00,000 ICAR approval of;

   i) the nomination of the architects;
   ii) final design drawings and cost estimates;
   iii) list of proposed prequalified contractors;
   iv) bid evaluation and proposed contract awards; and
   v) proposed construction supervision arrangement

d) In case of equipment costing more than Rs. 50,000 ICAR approval of awards to other than the lowest bidder.

5. Recruitment:

a) The University will recruit sub project staff according to its own procedures which will have been approved by the ICAR as a condition of the University's eligibility.

b) In the case of senior staff, and specifically the officer-in-charge of a sub project, the SAU would invite an ICAR representative to serve on the Selection Committee;

c) Scientific and senior Administrative staff recruited under the sub project would be required to sign a commitment not to apply for or accept another position for atleast two years, and the University agrees not to transfer staff during the operation of the sub project.

6. Reporting requirements:

The University will submit to ICAR the following progress reports :

a) A six-monthly progress report, attached to the request for funds, described in para 6 (b), containing details of physical implementation recruitment, etc. to date in accordance with proforma provided in the prescribed proforma.

b) A seasonal summary of research results would be prepared for each sub project;

c) A completion report at the end of the project examining the scientific results obtained in relation to the research objectives that were established at the outset.

The six-monthly report should normally reach ICAR by March and September of each year, seasonal summaries of research results by February and August and the completion report by twelve months after the approved closing date.

7. Remedies of the ICAR :

The ICAR may at its discretion and after due notification to the University, discontinue advances under any or all heads of expenditure for a sub-project, and if necessary deduct from available balances under other sub projects financed by its, if it reasonably considers that the University, in incurring expenditure, has seriously breached the guidelines contained above, a specific circumstances which could justify such action include failure on the part of the University to submit satisfactory expenditure statements or audit certificates improper procurement practices, failure to obtain ICAR approval for reallocation of funds or changes in specification, failure to implement the research programme, etc. should such cases come to the notice of ICAR the University will be given reasonable opportunity to rectify the situation.

ANNEXURE-II

NARP subproject for the region of problem areas of Kerela Agricultural University—Strengthening of Regional Research Station, Kumarakom and sub-station at Kayamkulam, Vyttila, Moncompu and Kole Land.

(Rs. in lakhs)

Category of expenditure	1981-82 (6 modths)	1982-83	1983-84	1984-85	1985-86	1986-87 (6 months)	Total
I. NARP							
1. Incremental staff							
a) Salary	2.69	5.40	5.61	5.76	5 97	3.58	29.01
b) T. A.	0.12	0.30	0.30	0.30	0.30	0.18	1.50
2. Civil works	3.20	21.00	21.00	—	—	—	45.20
3. Equipment	4.90	10.00	10.00	4.00	—	—	28.90
4. Research operating cost	0.50	2.00	2.00	2.00	2.00	0.80	9.30
Total NARP-I	11.41	38.70	38.91	12.06	8.27	4.56	113.91
II. University							
5. Basic cultivation cost	0.06	0.16	0.16	0.16	0.16	0.10	0.80
6. Station maintenance	—	0.21	0.21	0.21	0.21	0.21	1.05
7. Utilities/overheads	0.05	0.13	0.13	0.13	0.13	0.08	0.65
8. Land acquisition	2.00	—	—	—	—	—	2.00
Total II (University)	2.11	0.50	0.50	0.50	0.50	0.39	4.50
Grand total I & II	13.52	39.20	39.41	12.56	8.77	4.95	118.41

Additional University/State undertaking after five years

(Annual)

1	Incremental staff	6.27	lakhs
2	Research operating cost	2.00	,,
3	Equipment replacemt @ 10%	2.89	,,
		11.16	,,

Annexure-II (Table-1)
Cost of additional staff proposed

Posts and pay scale	No. of posts	1981-82 (6months)	1982-83	1983-84	1984-85	1985-86	1986-87 (6 months)	Total
Kumarakom								
Scientific staff								
Assoc. Professor (1125-1725)	3	0.25	0.55	0.58	0.58	0.60	0.30	2.86
Asst. Professor (800-1600)	11	0.71	1.37	1.43	1.49	1.54	0.99	7.53
Total	14	0.96	1.92	2.01	2.07	2.14	1.29	10.39
Supporting staff								
Field Asst./Lab. Attendar (330-515)	6	0.15	0.34	0.35	0.36	0.37	0.24	1.81
Driver (330-515)	1	0.03	0.06	0.06	0.06	0.06	0.04	0.31
Boat Driver (330-515)	1	0.03	0.06	0.06	0.06	0.06	0.04	0.31
Sarang (330-515)	1	0.03	0.06	0.06	0.06	0.06	0.04	0.31
Tractor Driver (330-515)	1	0.03	0.06	0.06	0.06	0.06	0.04	0.31
Artist (470-830)	1	0.04	0.08	0.08	0.05	0.10	0.06	0.45
Photographer (470-820)	1	0.04	0.08	0.08	0.09	0.10	0.06	0.45
Total	12	0.35	0.74	0.75	0.78	0.81	0.52	3.95
Administrative Staff								
Asst. Accounts Officer (910-1550)	1	0.08	0.15	0.16	0.16	0.17	0.10	0.82
Asst. Grade-I (420-720)	2	0.07	0.15	0.15	0.15	0.16	0.09	0.77
Stenographer (420-720)	1	0.04	0.07	0.07	0.08	0.08	0.04	0.38
Typist Grade-I (420-720)	2	0.07	0.15	0.15	0.16	0.16	0.09	0.78
Peon (280-400)	2	0.05	0.09	0.09	0.09	0.10	0.05	0.47
Duplicating Operator (330-515)	1	0.03	0.06	0 06	0.06	0 06	0.03	0.30
Total	9	0.34	0.67	0.68	0.70	0.73	0.40	3.52

Kayamkulam								
Scientific staff								
Asst. Professor		1	0.06	0.13	0.14	0.14	0.15	0.10	0.72
J. A. P.		1	0.05	0.09	0.10	0.11	0.11	0.06	0.52
	Total	2	0.11	0.22	0.24	0.25	0.26	0.16	1.24
Vyttila								
Asst. Professor		1	0.06	0.13	0.14	0.14	0.15	0.10	0.72
	Total	1	0.06	0.13	0.14	0.14	0.15	0.10	0.72
Kole land								
Asst. Professor		1	0.07	0.13	0 14	0.14	0.15	0.08	0.71
J. A. P.		1	0.05	0.10	0.10	0.10	0.11	0.06	0.52
	Total	2	0.12	0.23	0.24	0.24	0.26	0.14	1.23
Moncompu								
Assoc. Professor		2	0.21	0.41	0.43	0.43	0.45	0.26	2.19
Asst. Professor		6	0.36	0.73	0.76	0.79	0.81	0.49	3.94
	Total	8	0.57	1.14	1.19	1.22	1.26	0.75	6.13
Supporting staff								
Lab. Attender		4	0.12	0.23	0.24	0.24	0.24	0.14	1.21
Boat Driver		1	0.03	0.06	0 06	0.06	0.06	0.04	0.31
Sarang		1	0.03	0.06	0.06	0.06	0.06	0.04	0.31
	Total	6	0.18	0.35	0.36	0.36	0.36	0.22	1.83
						Abstract			
1 Kumarakom			1.65	3.33	3 44	3.55	3.68	2.21	17.86
2 Kayamkulam			0.11	0.22	0.24	0.25	0.26	0.16	1.24
3 Vyttila			0.06	0.13	0.14	0.14	0.15	0.10	0.72
4 Kole land			0.12	0.23	0.24	0.24	0.26	0.14	1.23
5 Moncompu			0.75	1.49	1.55	1.58	1.62	0.97	7.96
	Grand Total		2.69	5.40	5.61	5.76	5.97	3.58	29.01

Annexure–II (Table 2)

DISCIPLINE–WISE DISTRIBUTION OF ADDITIONAL POSITIONS

KUMARAKOM

Discipline	Professor	Assoc. Prof.	Asst. Prof.	J. A. P.	Total
Plant Breeding	—	—	1	—	1
Entomology	—	—	1	—	1
Microbiology	—	—	1	—	1
Biochemistry	—	—	1	—	1
Agrl. Engineering	—	—	2	—	2
Fishery	—	1	1	—	2
Horticulture	—	—	2	—	2
Plant Physiology	—	—	1	—	1
Extension	—	1	—	—	1
Economics	—	1	—	—	1
Weed Science	—	—	1	—	1
	—	3	11	—	14

MONCOMPU

Soil Science	—	1	1	—	2
Plant Pathology	—	—	2	—	2
Extension	—	—	1	—	1
Plant Physiology	—	—	1	—	1
Entomology	—	1	—	—	1
Plant breeding	—	—	1	—	1
Total	—	2	6	—	8

KAYAMKULAM

Botany				1	1
Agrl. Engineering			1	—	1
Total			1	1	2

VYTTILA

Soil Science			1	—	1
Total			1	—	1

KOLE LAND

Discipline	Prof.	Assoc. Prof.	Asst. Prof.	JAP	Total
Agronomy	—	—	1	—	1
Plant Breeding	—	—	—	1	1
Total	—	—	1	1	2

ABSTRACT

1 Kumarakom	—	3	11	—	14
2 Moncompu	—	2	6	—	8
3 Kayamkulam	—	—	1	1	2
4 Vyttila	—	—	1	—	1
5 Kole Land	—	—	1	1	2
Total	—	5	20	2	27

Annexure–II (Table 3)

Estimate of works

Abstract

Construction of laboratory at Rs. 1105/–sq.m. for 2532 sq.m.	27.98 lakhs
Construction of farm buildings at 500/- sq.m. for 1120 sq.m.	5.60 ,,
Residential houses at Rs. 800/– sq.m. for 1452 sq.m.	11.62 ,,
	45.20 lakhs

	in sq. m.		
	Laboratory	*Farm*	*House*
Kumarakom	1382	660	1086
Moncompu	780	410	366
Vyttila	230	50	—
Kayamkulam	140	—	—
	2532	1120	1452

Civil works at Kumarakom

Central facilities:

Agronomy, Plant Physiology and Weed Science:

	Area	Unit	Floor area (m^2)
Chemical and glasswares Store	20	1	20
Analytical lab.	165	1	165
Processing room	80	1	80
Professor	20	1	20
Associate Professor	15	1	15
			300
Plant Breeding			
Laboratory	50	1	50
Store	20	1	20
			70
Soil Science & Biochemistry			
Professor	20	1	20
Assoc. Professor	15	1	15
Laboratory	165	1	165
Store	20	1	20
Instrument room	20	1	20
Processing room	20	1	20
Fume hood room	20	1	20
			280

Entomology:			
Associate Professor	15	1	15
Laboratory	50		50
Instrument room Insectary (A/C)	20	1	20
Stores	20	1	20
			105
Pathology, Microbiology & Nematology			
Associate Professor	15	1	15
Professor	20	1	20
Laboratory	250	1	250
Instrument room (A/C)	20	1	20
Media preparation room	20	1	20
Culture room	20	1	20
Store	20	1	20
			365
Engineering			
Assistant Professor	25	1	25
			25
Extension Economics			
Associate Professor	25	2	50
			50
Administration			
Associate Dircctor	40	1	40
Central Office	80	1	80
Stationery, record room	20	1	20
			140
Ancilliaries			
Seminar/lecture room	100	1	100
Exhibition	40	1	40
Dark room-photo-copying-processing	20	1	20
			160
Documentation			
Library	40	1	40
Librarian	20	1	20
Stock room	30	1	30
			90

Total lab. space required	1585 sq.m.
Existing	203 ,,
Addl. required	1382 sq.m.

Farm			
Seed store (M)	60	1	60
Fertilizer store (M)	30	1	30
Drying yard (M)	100	1	100
Implement shed (M)	80	1	80
Green house (M)	100	1	100
Net House (M)	40	1	40
Cattle shed	80	1	80
Others			170
			660

Annexure—II (Table 4)

Civil works

Moncompu

Division	Area m^2	Unit	Floor area m^2
Agronomy and Plant Physiology			
Chemical and glasswares store	20	1	20
Analytical laboratory	100	1	100
Processing room	40	1	40
Associate Professor	15	1	15
			175
Plant Breeding			
Laboratory	100	1	100
Seed store	20	1	20
Associate Professor	15	1	15
			135
Soil Science			
Laboratory	75	1	75
Store	20	1	20
Instrument room	20	1	20
Processing room	20	1	20
Fume hood room	20	1	20
Associate Professor	15	1	15
			170
Plant Pathology			
Laboratory	75	1	75
Media preparation room	20	1	20
Culture room	20	1	20
Store	20	1	20
			135

Entomology

Professor	20	1	20
Assoc Professor	15	1	15
Laboratory	100	1	100
Insectary	20	1	20
Stores	20	1	20
			175
Extension	20	1	20
Administrative staff and supporting staff	250	—	250
Total floor space required			1060 sq.m.
Existing space			280 ,,
Addl. laboratory space required.			780 ,,

Farm

Seed store	60 x 1	60
Fertilizer store	30 x 1	30
Drying yard	100 x 1	100
Implement shed	80 x 1	80
Green house	100 x 1	100
Net house	40 x 1	40
		410 sq.m.

Kayamkulam

Plant breeding

		Sq.m
Seed store	20 x 1	20
Laboratory	75 x 1	75
Assoc.Professor	15 x 1	15
		110

Agronomy & irrigation Engineering

Store	20 x 1	20
Laboratory	75 x 1	75
Assoc.Professor	15 x 1	15
		110

Plant Protection

Store	20 x 1	20
Laboratory	75 x 1	75
Associate Professor	15 x 1	15
Utility Room	30 x 1	110

Administration

Adm.Office for 10	110 x 1	110
Total floor space required		440
Already available		300
Addition lab floor space required		140 sq.m.

Vyttila

Agronomy & Plant Breeding Lab.

Laboratory	100 x 1	100
Assoc.Professor	15 x 2	30
Store	20 x 1	20
	—	150

Soil Science

Laboratory	1 x 25	25
Store	1 x 20	20
Processing room	1 x 20	20
Fume hood room	1 x 20	20
	—	85

Fishery

Laboratory	25 x 1	25
Utility room	30 x 1	30
Administrative	40 x 1	40
Office		95

Total lab.space required		330 sq.m.
Less existing building		100 ,,
Addl.lab.space required		230 sq.m.
Field facilities		
Covered threshing floor	1 x 50	50
		50

Residences

Kumarakom

Assoc. Director	1	1 x 196	196 sq.m.
Assoc. Professor	3	1 x 150	150 ,,
Asst. Professor	11	2 x 120	240
Other staff	22	50 x 2	100
			686
Trainees Hostel 20 beds			400
			1086

Moncompu

Prof.& Station incharge	1	1 x 196	196
Assoc and Asst.Professor	7	1 x 120	120
Other staff	7	1 x 50	50
			366

Total 1452 sq. m.

Annexure II (Table 5)

LIST OF EQUIPMENTS

Kumarakom

Agronomy & Plant Physiology		
Mufle furnance	1	8000
Analytical Balance	2	16000
Top pan balance	1	10000
Deionizer	1	8000
Centrifuge	1	10000
Conductivity bridge	2	8000
Constant temperature bath	1	6000
Wet Sieving machine	1	6000
Seed moisture tester	1	5000
Plant growth chamber with temperature, humidity and light control.		50000
		1,27,000
Plant Breeding		
Hot air oven	1	5000
Microscope	2	20000
Microtome	1	5000
Refrigerator	1	8000
		38,000
Soil Chemistry		
Microkjeldal digestion unit	4	1000
Atom spek (Atomic absorption spectro photometer)	1	200000
*pH meter	1+1	30000
Mill for grinding plant materials	1	9000
Double distillation apparatus	1	6000
Mufle furnace	1	8000
Spectronic—20	1	15000
Shaker to accomodate 20–25 conical flask	1	5000
Fume hood	1	10000
Flame photo meter	1	12000
Refrigerator centrifuge	1	25000
*One portable		3,30,000
Entomology & Nematology		
Binocular microscope	1	15000
Research microscope	1	8000
Insect rearing chamber	1	5000

Stereo Zoom microscope	1	8000
Field cages (8' x 8' x 8')	1	20000
Sieves of different types		10000
		66,000
Pathology		
Auto clave	1	8000
Incubator	1	12000
Deep freezer	1	7000
Incubation chamber	1	12000
Vacuum oven	1	12000
Vacuum pump	1	10000
Zoom stereo microscope	1	8000
Culture room with U. V. light		15000
		84,000
Engineering & water Management		
Measuring instruments (Weirs, notches pressure gauges etc.)		10000
Prototypes of existing exil flow pumps, motors, etc.		100000
Tensio meter	100	10000
Permeater	5	5000
Infiltrometer	10	5000
		2,32,000
Meteorology		
B type observatory	1	15000
Net radiometer	1	7000
Lux meter	1	7000
Thermometer (Soil)	5	5000
Sorensen's Psychrometer		6000
		39,000
2. Field equipment		
Tractor with trailor & implements	1	125000
Power tiller		30000
Weighing scales	2	20000
Paddy seed drier	1	10000
		1,85,000
3. Transport		
Mini bus	1	125000
Motor boat	1	100000
		2,25,000

4. Library, documentation, education		
Slide projector	1	5000
Camera	1	10000
Photo copies	1	15000
		30,000
5. Office equipment		
Typewriter	2	10000
25% for items costing less than Rs. 5000/piece		10000
		3,40,000
Total: Kumarakom		17,06,000
Moncompu		
Agronomy & Plant Physiology		
Mufle furnance	1	8000
Analytical balance	2	16000
Top pan balance	1	10000
De-ionizer	1	8000
Centrifuge	1	10000
Constant temperature bath	1	6000
Seed moisture tester	1	5000
Growth chamber with temperature humidity and light control		50000
		1,13,000
Plant breeding		
Hot air oven	1	5000
Microscope	2	8000
Refrigerator	1	8000
		21,000
Soil Chemistry		
Microkjeldal digestion unit	1	10000
*pH meter	1+1	30000
Mill for grinding plant materials	1	9000
Double distillation apparatus	1	6000
Spectronic–20	1	15000
Shaker to accommodate 20–25 conical flask	1	5000
Fume hood	1	10000
*One portable		85,000
Entomology and Nematology		
Binocular microscope	1	15000
Microscope	1	8000
Insect rearing chamber	1	5000
Stereo zoom microscope	1	7000
Field cages (8' x 8' x 8')		20000
		55,000

Pathology		
Auto clave	1	8000
Incubator	1	12000
Deep freezer	1	7000
Incubation chamber	1	12000
Vacuum pump	1	12000
Vacuum pump	1	10000
Zoom stereo microscope	1	8000
Culture room U. V. light		15000
		84,000
Meteorology		
D type observatory	1	15000
Sorension's psychrometer		5000
		20,000
Field equipment		
Tractor with trailer & implements	1	125000
Power tiller	1	30000
Weighing scales	1	10000
Paddy seed drier	1	10000
		1,75,000
3. Transport		
Motor Boat		75000
		75,000
4. Library, documentation, education		
Slide projector	1	5000
Camera	1	10000
		15,000
5. Office equipments		
Typewriter	2	10,000
25% of total for unallocate items		1,60,000
Total: Moncompu		8,20,000
Kayamkulam		
Meteorology station (B type)		15000
Screen house (4'x4'x4')		10000
Seed moisture tester		5000
Hot Air oven		5000
Res. Microscope		15000
Sprinkler set		150000
Lux meter		7000
Tensio meter		10000
Permea meter		5000
Infiltrometer		5000
		2 27,000
Unallocated items 25%		57,000
		2,84,000

Vyttila

Microkjeldal unit	2	5000
Mill for grinding material	1	9000
pH meter	1	15000
Double distillation apparatus	1	6000
Shaker mechanical		5000
Flame photometer	1	12000
Spectronic-20		15000
25% unallocated items		15000
	Total	80,000

ABSTRACT

Kumarakom	17.76 lakhs
Moncompu	8.20 ,,
Kayamkulam	2.84 ,,
Vyttilla	0.80
Kole Land	—
	28.90 ,,

Annexure—II (Table 6)

Research operating costs

	(Rs. in lakhs)
Kumarakom (at Rs. 8000/scientist/year for 14 additional scientist.	5.60
Moncompu for 8 additional scientists	3.20
Kayamkulam for 2 scientists	0.80
Vytilla for one scientist	0.40
For Kole land for two scientists	0.80
Total	10.80

Cultivation costs and maintenance costs

A. University—Recurring expenditure		
i) Basic cultivation expenses 3 ha rice @ Rs. 2000/ha 5 ha pulses and oil seeds @ Rs. 1000/- per ha Coconut 10 ha @ Rs. 1500/-ha		80,000
ii) Gross income off setting cost of cultivation.		50,000
iii) (a) station maintenance 1½ of civil work		1,05,000
(b) utilities and other over heads		65,000
		1,70,000
Non-recurring		
B. Land acquisition (garden land for quarters)		2,00,000

APPENDIX II

PROGRAMME OF WORK FOR FIVE YEARS WITH EFFECT FROM 1-2-1982

First year (1982-83) from February 1982 onwards

i) Selection and appointmenf of scientific, administrative and supporting staff.

ii) Acquisition of laboratory equipment and their installation.

iii) Preparation of plans and estimates for the construction of laboratories and other residential buildings, their approval. Inviting tenders for construction works.

iv) Conducting regional workshops with officers of the Department of Agriculture, Scientists of the University and progressive farmers for the identification of research gaps.

v) Organising orientation training on the objectives and philosophy of N. A. R. P. to the members of the Research Stations.

vi) Preparation and approval of technical programmes for experimentation.

vii) Laying out experiments, adaptive trials, observational trials.

viii) Organising an 'information museum'.

ix) Preparation of materials and publication of extension information literature.

x) Collection of basic information and preparation of a status report of the project.

xi) Conducting training classes for the staff of the development departments and extension personnel on selected topics of local importance.

xii) Organising training programmes to farmers as part of extension activities.

xiii) Publication of periodical reports and findings as booklets and newsletters on selected topics like 'root (wilt)' disease of coconut, Salvinia control, weed problem of special region etc.

xiv) Conducting a Socio-economic survey in problem areas. Selection of sample to be completed.

Second year (1983-84)

Setting up laboratories in the new buildings after their completion.

Conducting periodical regional workshops to propose changes in the research, testing and extension programmes of the influence area

—contd.....

Continuation of experiments, adaptive trials and observational trials. Collection of data, tabulation, analysis and interpretation of results of the above field experiments and trials.

Improvement of the information museum.

Socio-economic Survey in problem areas to be continued.

Continuation of the programme of work listed as item (ix), (xi), (xii) and (xiii) of the first year.

Third and Fourth year (1984-85 & 1985-86)

All the programmes of the second year will be continued.

Fifth year (1986-87)

Continuation of the above programmes and their assessment.

Preparation of final reports, tabulation and analysis of experimental data and their interpretation. Publication of results with suggestions and recommendations.

MONTHLY BREAK-UP OF PROGRAMMES FOR THE FIRST YEAR (1982-83)

April

Selection and appointment of supplementary scientific, administrative and supporting staff. Introducing the scientific personnel to the programmes of NARP.

May

i) Organisation of the First Regional Workshop with Officers of the department of Agriculture, Scientists of the University and progressive farmers.

ii) Identifying the field problems, visits to problem areas.

June

Preparation of technical programmes based on the research need dentified in the regional workshop. Fixing the priority of implementation of experiments—Submission of technical programmes to various bodies and groups for discussion, modification and approval for implementation.

July

Listing out laboratory equipment needed for the project and fixing the priority.

August

i) Collection of data and preparation of a hand book/brochure on the 'Special Region'.

ii) Procurement of furniture and some of the laboratory equipment.

iii) Initiation of identification, description and control measures for the the weed flora of the problem areas.

iv) Planting of coconut seedlings in the experimental areas.

September

i) Procurement of laboratory equipment continued.

ii) Laying out experiments, adaptive and observational trials on intercropping.

iii) Preparation of extension information literature on root (wilt) disease of coconut, pest and diseases of paddy and coconut.

iv) Laying out observational trials on weed control (in coconut gardens).

October

i) Setting up information museum.

ii) Publication of brochure on Special Zone.

iii) Continuation of the experiments and observational trials initiated earlier.

iv) Preparation of half yearly report on the work done.

v) Selection of sample for socio economic survey.

November to March

Continuation of all the above programmes.

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