National Agricultural Research Project

STATUS REPORT

(CENTRAL REGION)

Kerala Agricultural University

Vellanikkara

Trichur - 680 654

English

STATUS REPORT

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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, Sourthern, 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 km². 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 km² 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

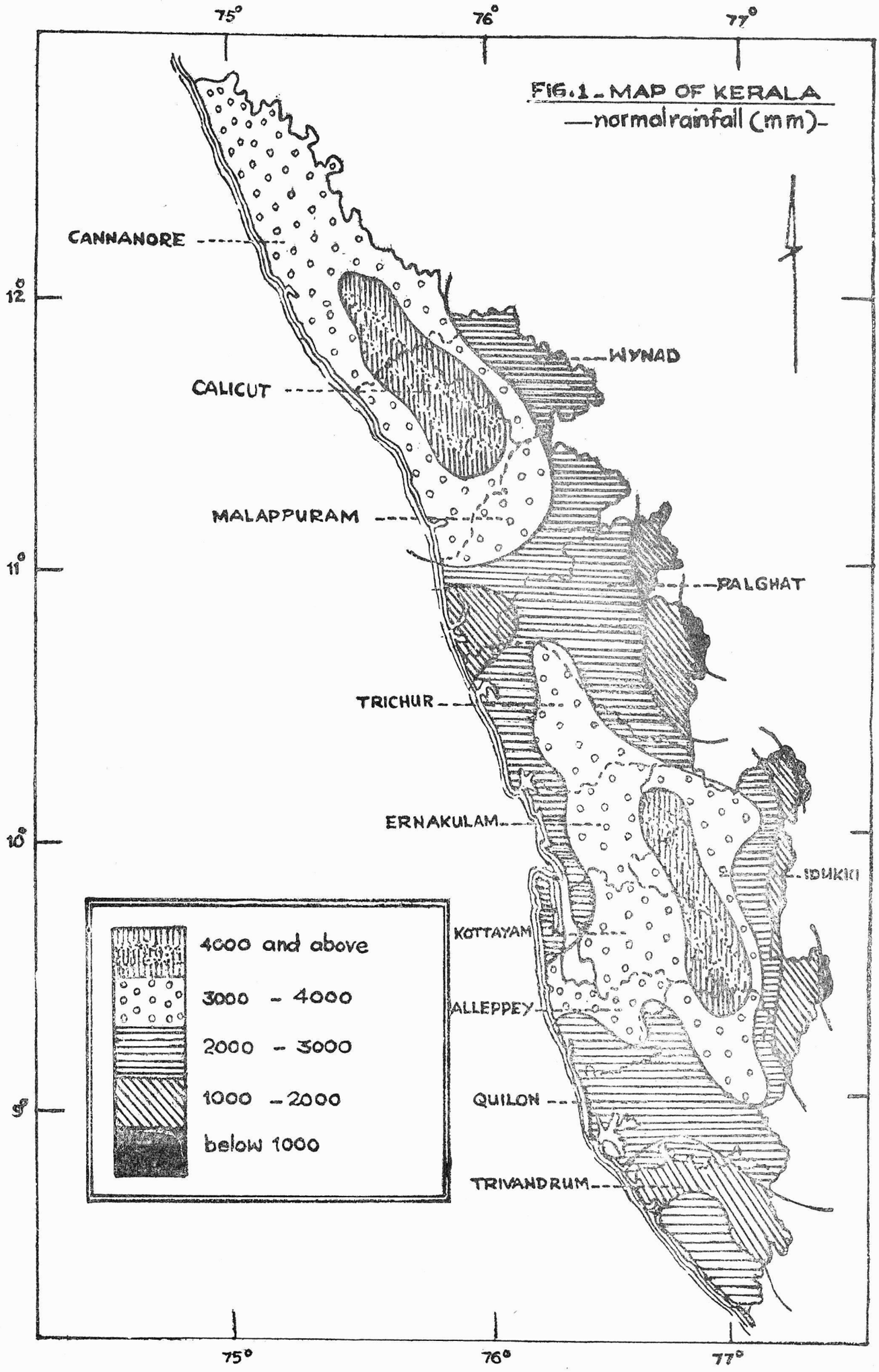


FIG.1 - MAP OF KERALA
—normal rainfall (mm)-
75°
76°
77°
12°
11°
10°
9°
CANNANORE
CALICUT
MALAPPURAM
WYNAD
PALGHAT
TRICHUR
ERNAKULAM
IDUKKI
KOTTAYAM
ALLEPPEY
QUILON
TRIVANDRUM
4000 and above
3000 - 4000
2000 - 3000
1000 - 2000
below 1000

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.

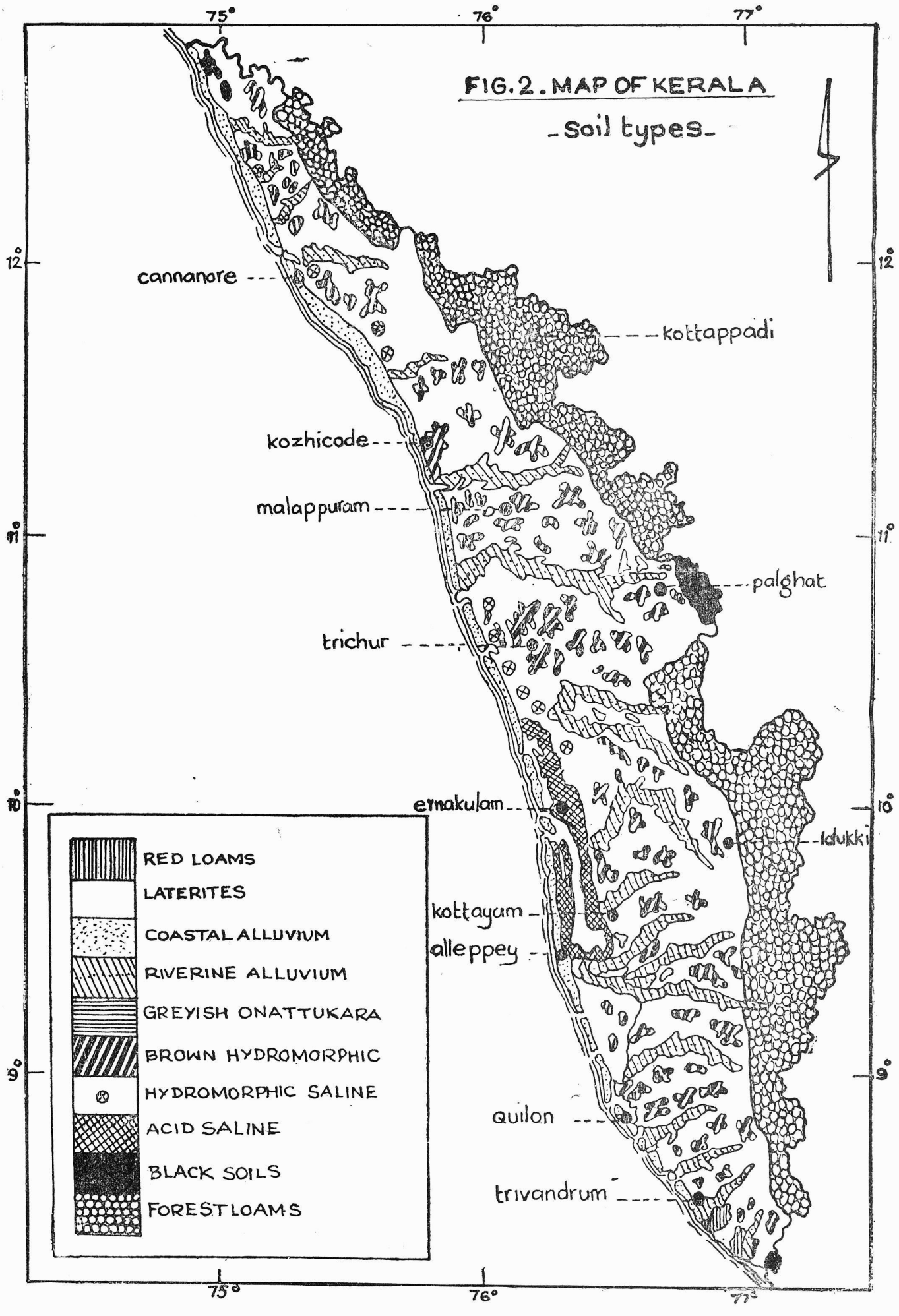


FIG. 2. MAP OF KERALA
-Soil types-
75°
76°
77°
12°
11°
10°
9°
cannanore
kottappadi
kozhicode
malappuram
palghat
trichur
ernakulam
idukki
kottayam
alleppey
quilon
trivandrum
RED LOAMS
LATERITES
COASTAL ALLUVIUM
RIVERINE ALLUVIUM
GREYISH ONATTUKARA
BROWN HYDROMORPHIC
HYDROMORPHIC SALINE
ACID SALINE
BLACK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

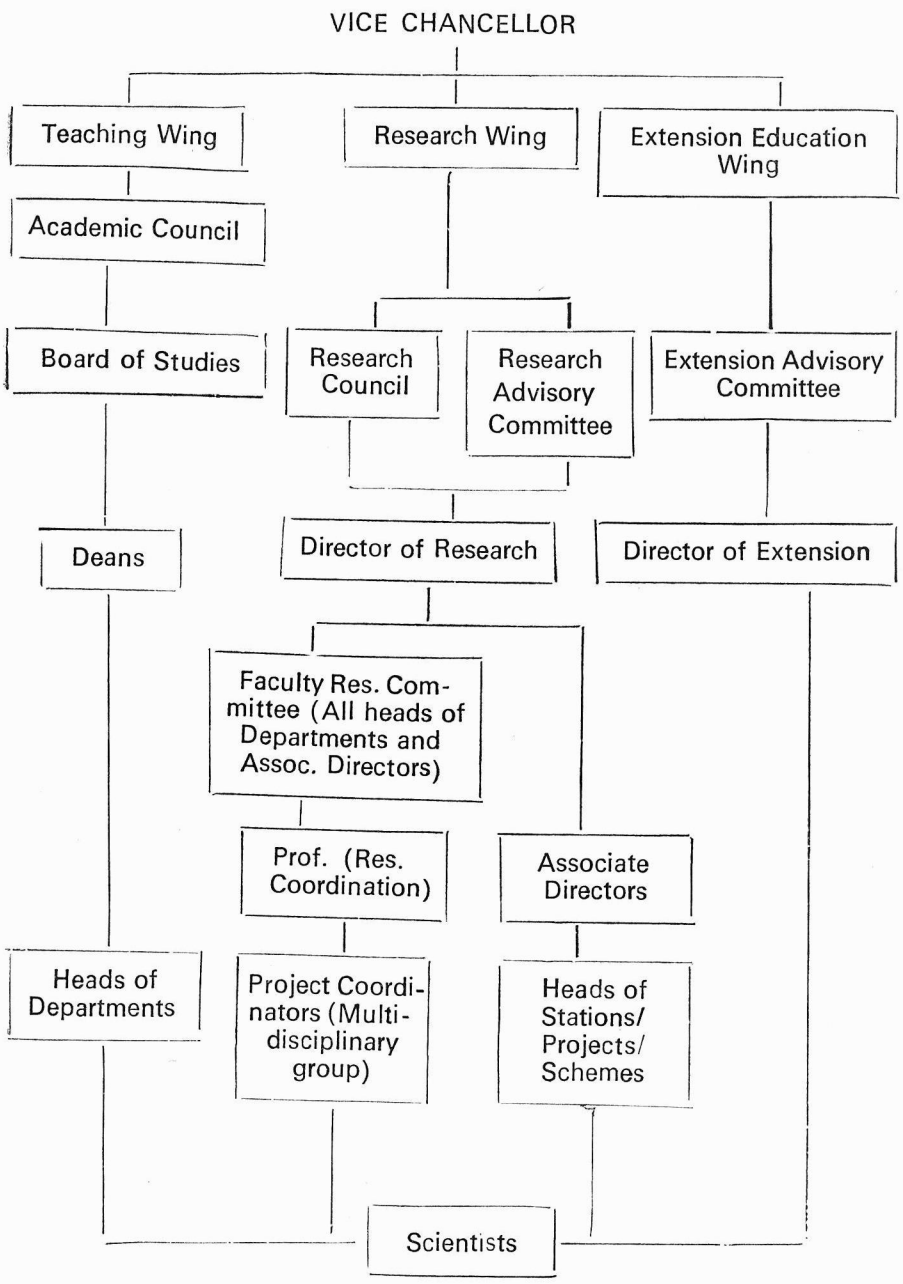
The organisational set-up of the Research Wing of the University is schematically presented in page 13.

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

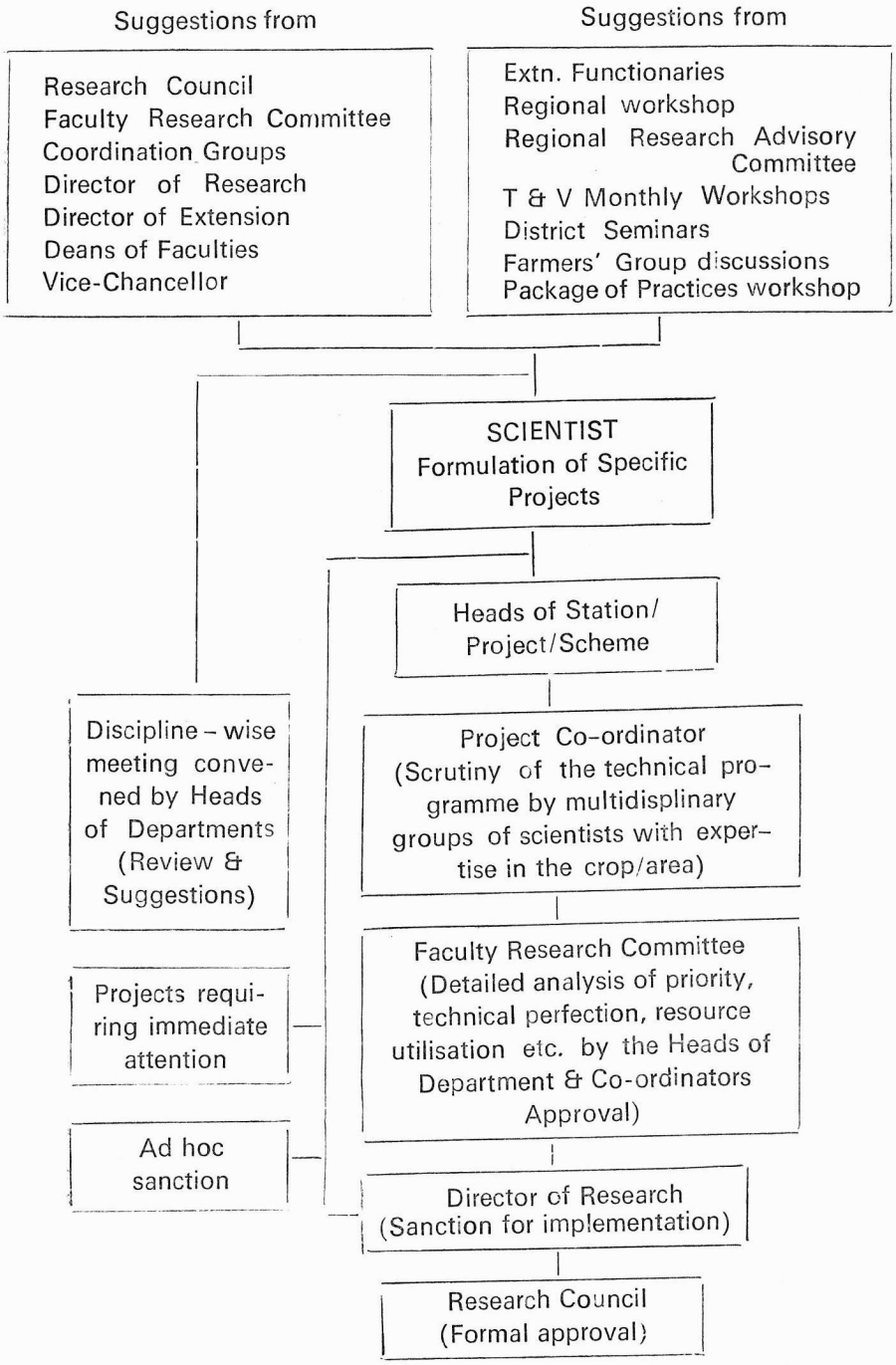
The various steps involved in the formulation and approval of research programmes are schematically presented on page 15.

1.9.3 Implementation of research programmes & monitoring the progress

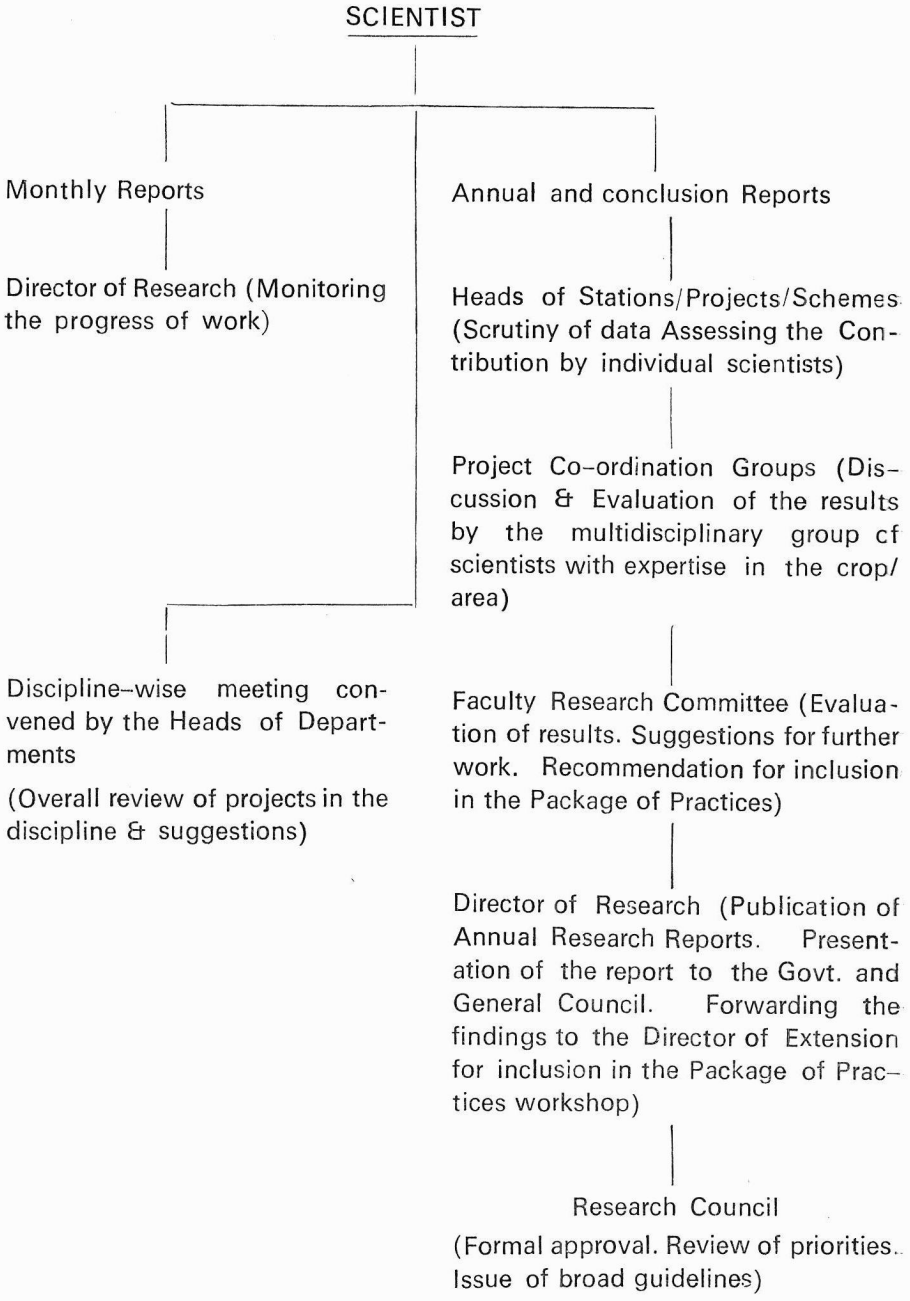
Besides undertaking its own research projects, the University is participating in 33 ICAR Coordinated Research Projects (26 Agriculture, 5 Veterinary & Animal Sciences and 2 Fishery).

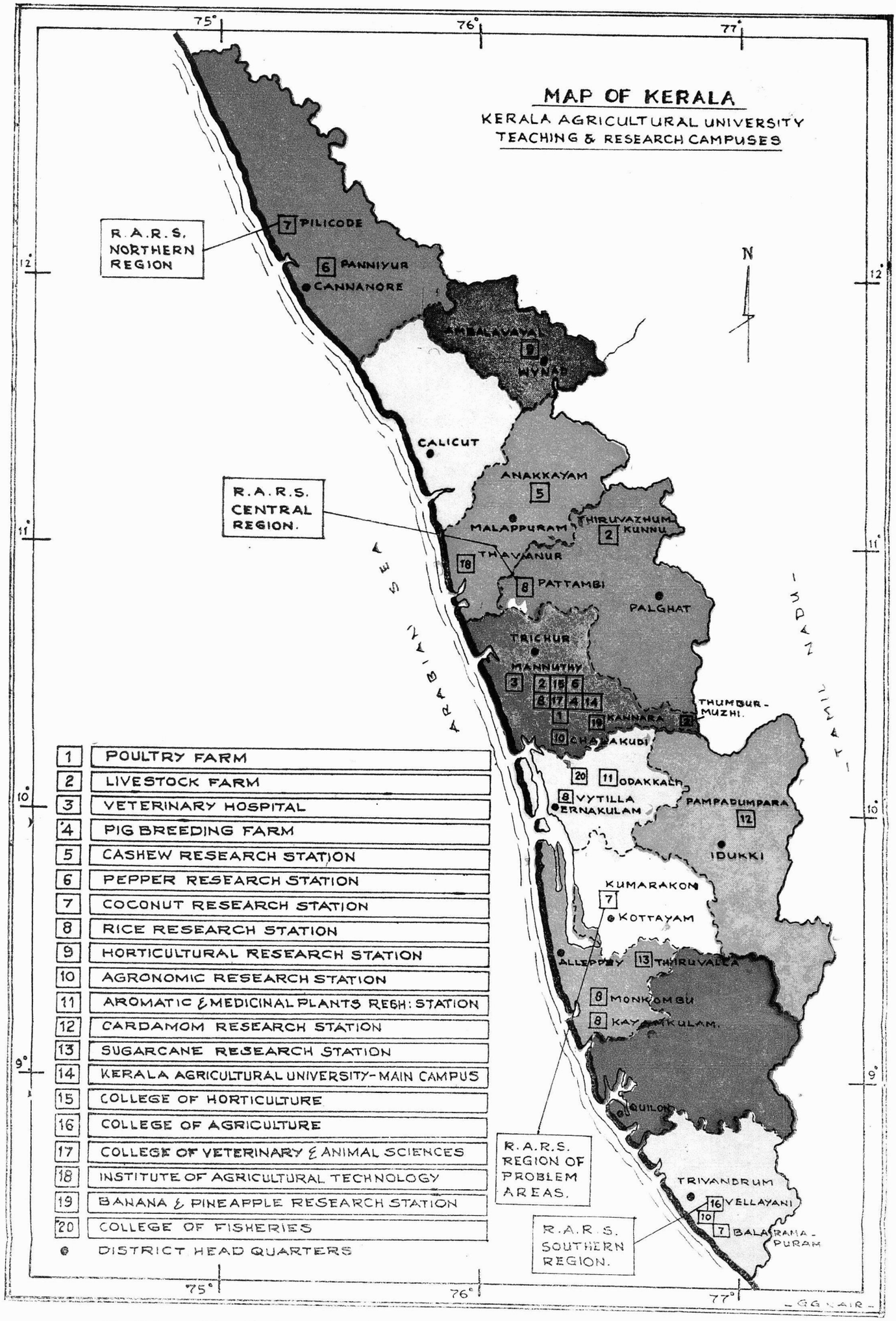
The procedure adopted for monitoring the progress and evaluating the research results is presented on page 16.

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

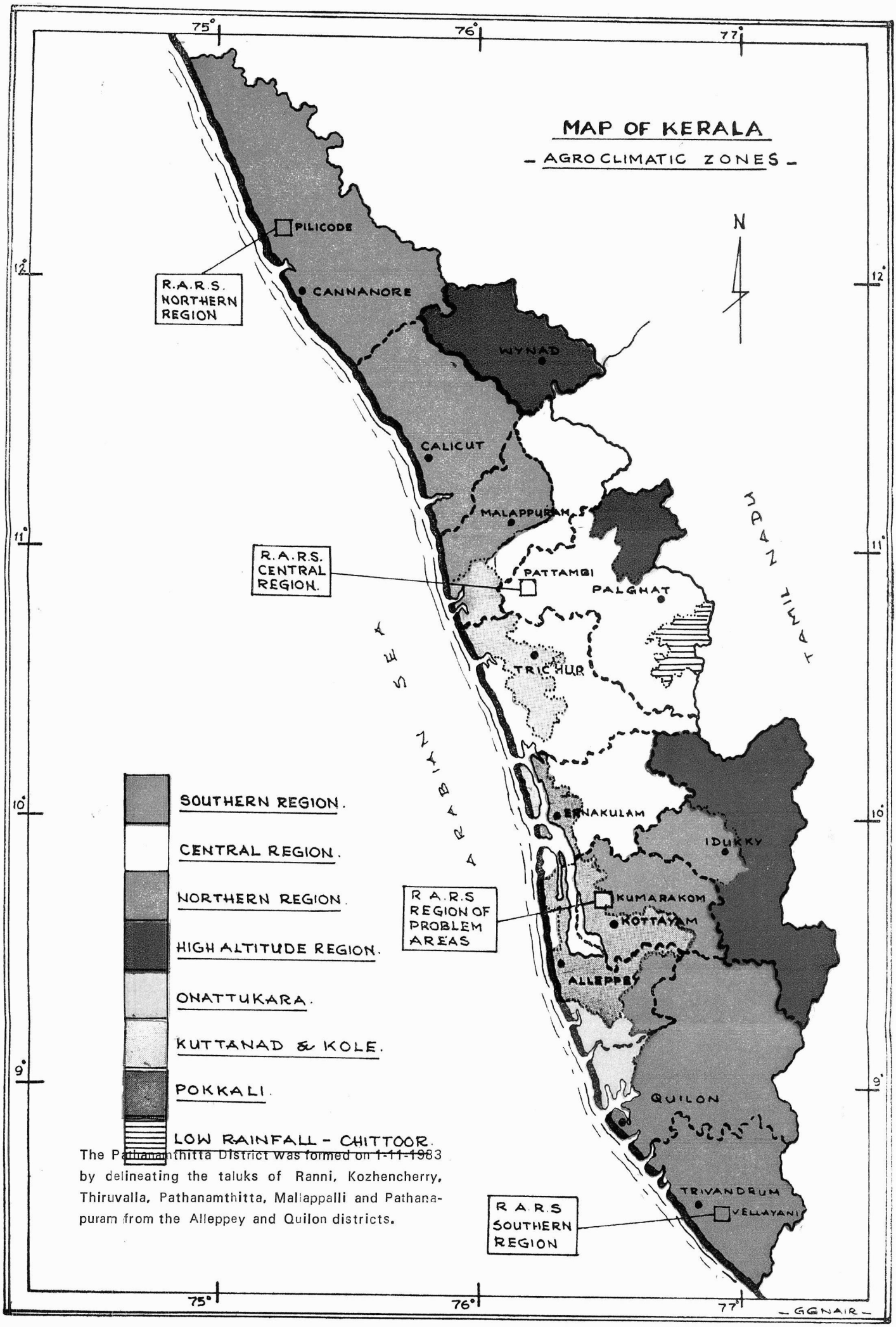
Sub-Stations will have lead functions in respect of particular crop (s) / programme (s) that could not be covered at the Regional Station due to locational reasons and due to variations in soil and climate.

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.



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.

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

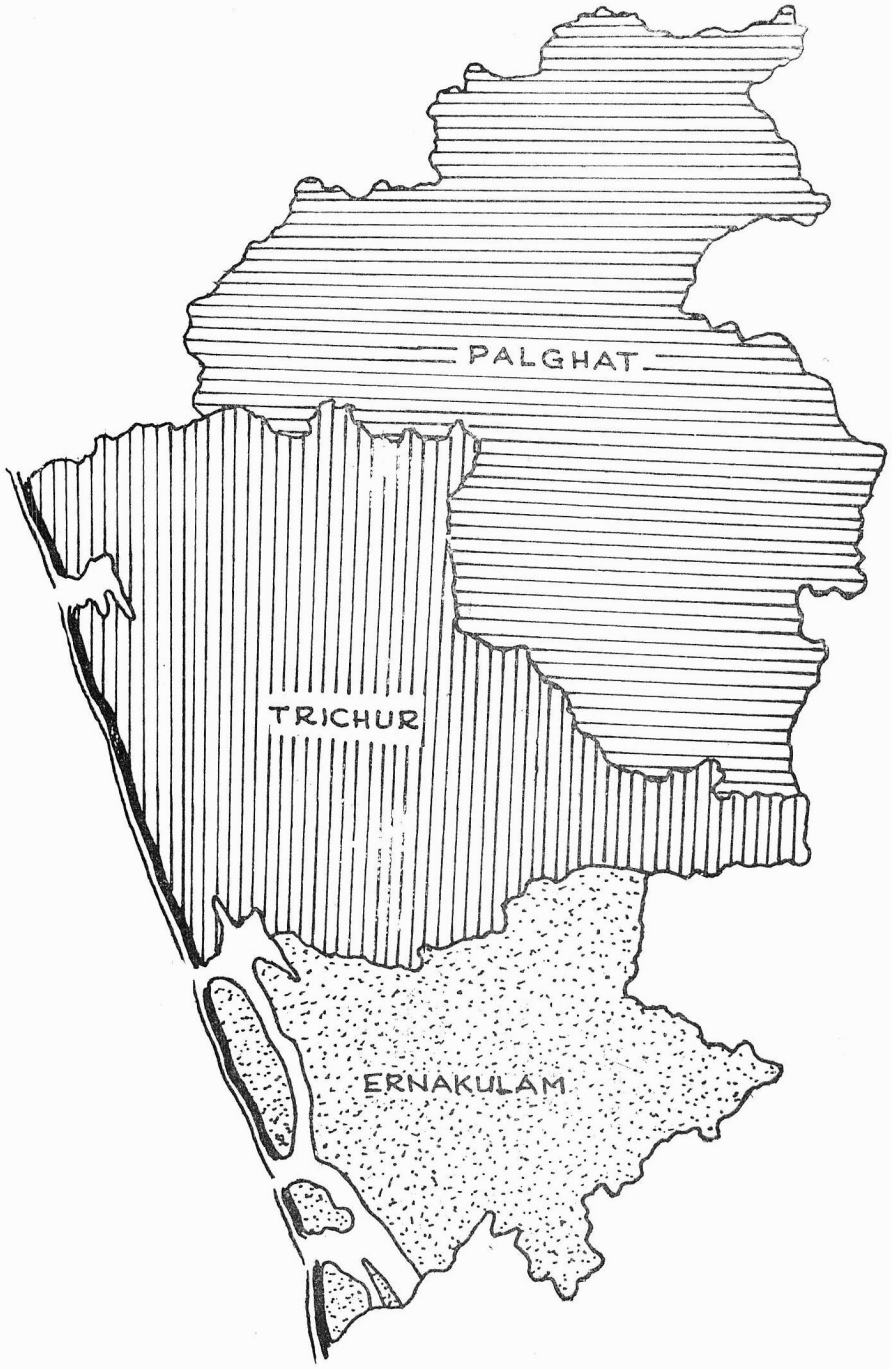
The expenditure of the University on Agricultural Extension comes to around 2% of the total budget. The Research Review Committee noted that the Extension Education programmes need further strengthening. It has been recommended to have a unit of Extension Staff at each of the Regional Stations. The strength 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.

NARP- CENTRAL ZONE



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CHAPTER 2

General Agricultural features of the zone.

2.1 Delineation of the zone.

The Central Zone consists of the three central Districts of the Kerala State viz., Palghat, Trichur and Ernakulam excluding the high ranges, coastal saline tracts and other isolated areas like *Kole* lands with special soil and physiographic conditions. The Central Zone covers a total geographic area of 9.831 sq. km. The Zone comprises of 17 Taluks with 44 Development Blocks covering a total of 274 Panchayats. (Table 2 A). The total population of the Zone is 70,12,152 (1981 census) and the number of farming families is about 3.8 lakhs. The density of population varies between a minimum of 465 per Sq. km. (Palghat District) and a maximum of 1,052 per Sq. km (Ernakulam District) with a mean value of 773 per Sq. km against the State average of 654 per Sq. km. The percentage of literacy works out to 68.14, Ernakulam District ranking first with 75.71, followed by Trichur District (72.32) and Palghat District (55.88) There are about 8.3 lakhs of holdings in the Zone (Table 2 B) out of which 6.5 lakhs (78.3%) fall below one hectare in extent. Only 13215 holdings (1.2%) have areas above 4 hectares.

Table 2 A

Delineation of Central Zone

District	Taluk	Municipalities/ Corporation	Block	Town	Panchayat	Area in Sq. km.	Population	Density	Literacy	Farm families (Approx.)
Palghat	5	3	12	1	91	4392	2041912	465	55.88	1,20,965
Trichur	5	6	17	1	98	3031	2436975	804	72.32	1,20,716
Ernakulam	7	6	15	4	85	2408	2533265	1052	75.71	1,37,450
	17	15	44	6	274	9831	7012152			3,79,131

Table 2 B

Land holding pattern of Central Zone

Size of holding	Number of holding			Total No. of holding	Percentage
	Palghat	Trichur	Ernakulam		
Below 1 ha.	100773	264735	285223	650731	78.78
Between 1 to 2 ha.	66351	21655	28375	116381	14.47
Between 2 to 4 ha.	21384	8702	16353	46439	5.16
Above 4 ha.	803	11880	532	13215	1.59
	189311	306972	330483	826766	

2.2 Climate

2.2.1 Rainfall

The Central Zone, being situated on the windward side of the Western Ghats and falling within the direct–sweep of South-West-monsoon receives heavy rainfall. Ernakulam District is benefited by the highest average rainfall (3550 mm), followed by Trichur (3215 mm). Palghat District being located in the Palghat gap of the Western-Ghats receives only an average of 2115 mm of annual precipitation. Eventhough the zone receives good amount of rainfall, the distribution pattern of the precipitation is quite erratic. More than 75 percent of the annual precipitation is received during the three months of June, July and August, torrential rains leading to flooding of low lands and enhancing the surface run off of top soil. The monthly distribution pattern of rainfall of the region is represented in fig. (Table 3)

Table 3: Average monthly rainfall of central zone (mm)

Month	Palghat	Trichur	Ernakulam
January	9.8	9.3	18.0
February	9.3	8.8	23.6
March	27.0	28.6	54.4
April	79.6	86.6	136.1
May	158.4	274.3	310.1
June	503.4	803.4	792.1
July	649.9	761.4	785.9
August	363.0	458.6	523.5
September	169.5	250.3	296.6
October	257.2	307.5	365.7
November	140.9	158.3	216.9
December	29.7	30.3	54.6
Total	2397.7	3177.4	3577.5

Source: Directorate of Economics and Statistics, Kerala. This normal is based 1901 to 1950 data.

According to the climatological parameters, Palghat has a tropical type of climate except in the Attappady hills. The District receives heavy showers during the South West monsoon period from May to August and

scanty North East monsoon showers during October–November. The Attappadi hills and the eastern part of the District adjoining Coimbatore District of Tamil Nadu receive very low rainfall and are subject to very long drought spells from December to May.

The warm humid weather conditions of Trichur District is influenced by the coastal wind and marine climate. Based on the pattern of receipt of precipitation there are four seasons in the District.

Dry spell	—	December to February
Hot weather period	—	March to May
South West monsoon period	—	June to September
North East monsoon period	—	October, November

Ernakulam District has typical humid climate with heavy annual rainfall (3550 mm). The South West monsoon is the major contributor, about 60 per cent of the annual precipitation being recorded during this period. The share of the North East monsoon is 25 per cent and the remaining 15 per cent as summer showers. Among the three Districts of the zone, the rainfall distribution pattern is more uniform in this District.

2.2.2. *Temperature*

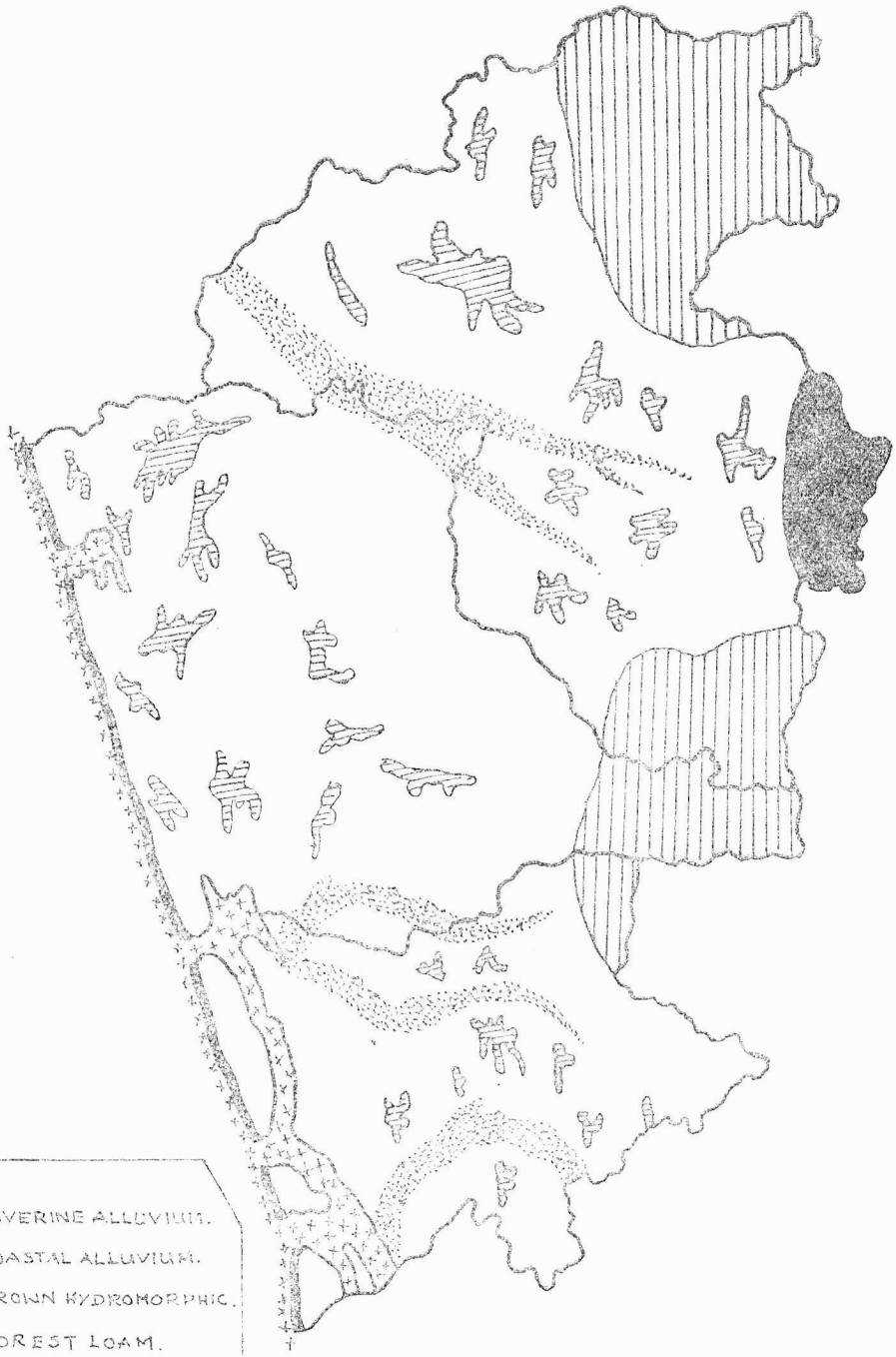
The variations in the levels of temperature are only marginal in the Districts of Trichur and Ernakulam as they are influenced by the coastal marine climate. On the other hand in Palghat District the temperature variations are more pronounced. The average maximum temperature of the zone varies from 24.8°C to 31.4°C and that of minimum from 21.1°C to 23.1°C striking a mean range from 22.7°C to 27.5°C. However the mean value for humidity is as high as 82 per cent, the months from June to August recording values above 90 per cent.

2.3 Topography

The land mass of the Central Zone can be classified into three natural physiographic divisions viz., the high land, the mid land and the low land. The topography of the high land region is mountainous with altitudes ranging from 400 to 2000 metres above M. S. L. The mid land region has a rolling topography with hills and valleys. The land of the coastal area is made of river deltas, back waters and the shore lands of the Arabian Sea. The landscape of the zone is traversed by six rivers. The Bharathapuzha with tributaries Malampuzha, Valayar, Mangalam, Meenakara, Gayathry, Pothundi and Kanhirapuzha provides good irrigational facilities to the Palghat District. Bhavani and Siruvani, the tributaries of Cauvery flows through the Attappadi tract of the Palghat District. Trichur District is situated between the two big rivers of Kerala – the Bharathapuzha and the Periyar. Other important rivers of the zone are the Chalakudi, Karuvannur and Keechery.

NARP - CENTRAL ZONE

- SOIL MAP -



2.3.1 Land utilization

The total geographical area of the zone is 9,73,689 hectares which covers about one-fourth of the total land mass of Kerala. The forests occupy about 2,47,876 hectares in this zone which accounts for 25.5 per cent of the total area. The forest areas are mainly concentrated in the Attappady tract of Palghat District, Talappally, Mukundapuram and Trichur taluks of Trichur District and Malayattur ranges of Kunnathunadu Taluk and Kothamangalam Taluk of Ernakulam District.

An area of 83,000 hectares of the zone is classified as non-agricultural lands which work out to 31.5 per cent of the area of the State classified under this category. Barren and uncultivable waste lands cover, an area of 13,594 hectares while permanent pastures and other grazing lands occupy 953 hectares. Land under miscellaneous tree crops account for an area of 11,554 hectares which forms only 17.6 per cent of the total area under miscellaneous tree crops in the State. Cultivable waste lands extend to an area of 34,354 hectares, while fallows other than current fallows occupy 10,295 hectares. The current fallows account for 16,326 hectares of the zone, which works out to 37.6 per cent of the current, fallows of the State.

The net area sown in the zone is estimated as 5,26,847 hectares and area sown more than once as 2,69,007 ha. which represents 24.2 per, cent and 39.9 percent of the corresponding categories of the land mass of Kerala. The per capita cultivated land of the zone works out to 0.11 ha which is on par with the State average (Table 4).

2.4 Soils identified in the Central Zone based on physiographic Divisions.

The Central Zone consisting of the three Districts of Ernakulam, Trichur and Palghat is complex in its topographical features and as such the soils identified in the Zone are included in different groups on the basis of the physiographic positions, morphological characteristics and other physiochemical properties.

Based on the physiographic heterogenity, the Central Zone is divided into four broad geomorphic units and twelve soil associations have been mapped based on the similarity in the nature of development and other morphological characteristics like colour, texture, structure, consistency permeability, drainage, etc.

The four physiographic divisions are:-

a. The rocky elongated ridges and hillocks on the north eastern and south eastern parts of the zone, characterised by the presence of loamy soils developed under forest cover.

Table 4: Land utilization pattern of Central Zone

	Mode of utilisation	Palghat	Trichur	Ernakulam	Total of Central Zone	Percentage to central Zone area	State area	Percentage to state area
1	Total geographical area	4,38,980	2,99,390	2,35,319	9,73,689		38,85,497	25.05
2	Forest	1,38,257	1,03,619	8,123	2,49,999	25.47	10,81,509	22.92
3	Land put to non agricultural purpose	32,318	21,596	30,379	84,293	8.66	2,63,497	31.50
4	Barren and uncultivable land	13,027	2,666	212	15,905	1.63	78,187	11.39
5	Permanent pastures and other grazing lands	497	212	189	898	0.09	5,630	16.93
6	Land under miscellaneous tree crops	8,669	1,340	1,343	11,352	1.17	65,502	17.64
7	Cultivable waste land	24 187	4,922	5,255	34,364	3.53	1,25,015	27.48
8	Fallow and other than current fallow	5,017	2,954	2,584	10,534	1.08	27,685	37.19
9	Current fallow	6,871	4,954	3,908	15,679	1.61	43,384	37.63
10	Net area sown	2,11,535	1,56,856	1,80,402	5,48,793	56·36	21,80,740	24.16
11	Area sown more than once	1,18,913	72,139	75,546	2,66,598	27.38	6,73,480	39.94
12	Total cropped area	3,30,448	2,28,995	2,55,948	8,15,391	83.74	30,40,000	78.23

b. The mid undulating region characterised by the narrow and broad valleys, elevated plains and isolated hillocks located in between the eastern high lands and back water areas of the west.

c. Bottom lands with concave relief (the Kole lands) located towards the western parts of Trichur District.

d. Sea board on the west consisting of the coastal alluvial plain.

2.4.1. Soil associations mapped

Soils occurring in each physiographic division are grouped into different soil associations and accordingly twelve soil associations are mapped in the Central Zone comprising of three Districts. They are:-

A. Rocky elongated ridges and hillocks.

1. Vaniampara—Painkulam—Neriyamangalam III Association:-

Soils grouped under this association are relatively old and are formed as a result of weathering of gneissic rocks and charnekites under forest cover. The soils are deep to very deep, moderately to excessively drained with moderate permeability. The textural range noticed is from loam to gravelly silty clay loam and colour varies from black to dark reddish brown. Partly weathered gneissic boulders and quartz gravels are seen to occur down the profile,

Soils of Vaniampara series consists of moderately deep to deep, very dark brown to black loamy surface soils underlained by dark greyish brown gravelly loam soils. Soils grouped under Painkulam series are very deep and dark brown in colour with clay loam surface and gravelly clay loam sub-surface soils. Neriyamangalam III series represents deep to very deep, well drained dark reddish brown clay loam surface soils followed by yellowish red silty loam sub-surface soils.

Area occupied by this association is under forest and the slope gradient varies from 20 to 60%. Soils mapped under the association are seen distributed on the hilly and forest region towards the South-Eastern part of the Central Zone.

2. Karuvarachindaki—Paruthimala II—Anakkatty Association:-

Soils grouped under this association are found to occur in the strongly sloping to very steep hilly regions of Attappadi forest.

Karuvarachindaki series represents the very deep dark reddish brown to dusky red clay loam surface soils underlained by red coloured soils of the same texture with increase in clay percentage down below. The soils seem to have gneissic gravels in the sub-soils in deeper layers.

Paruthimala II series represents very deep dark yellowish brown to dark greyish brown, silty loam to silty clay loam soils developed from

gneissic parent material. Anakkatty series located in steep to very steep hilly regions of Mannarghat Taluk consists of deep to very deep yellowish red to reddish brown loamy soils developed under forest cover. The soils have a compact gravelly texture in the subsurface while very few gravels are seen in deeper layers.

B. The Mid-undulating Region

This land form represents the major cropped area of the Central zone. Eight soil associations mentioned below are mapped in this region.

3. Thodupuzha—Punnamattom—Odakkali—I Association:-

This association consists of the gravelly soils of Thodupuzha and Odakkali—I series and riverine alluvium of Punnamattom series occurring on moderately to strongly sloping garden lands in the Central and Eastern parts of Ernakulam District. Thodupuzha and Odakkali—I series represents deep to very deep gravelly clay loam soils followed by gravelly clay sub-soils. Riverine alluvium occurring along the garden lands are grouped under Punnamattom series. All the three soil series are well drained with moderate permeability and are medium in nutrient status. They are suitable for a wide variety of crops.

4 Kothamangalam—Kuttamangalam—Charalade Association:-

Soils mapped under these three series occurring in geographic association in gently to moderately sloping lands are confined to valley portions in Kothamangalam, Muvattupuzha and Kunnathunad Taluks.

The yollowish brown, Kuttamangalam soils are deep with sandy clay loam texture, whereas the gravelly Kothamangalam soils are very deep with clay loam texture. The Charalade soils are deep to very deep, yellowish brown clayloam to clay soils with red mottlings in the sub-soil. The Kuttamangalam and Charalade soils being located in valley portions are put under paddy cultivation whereas the Kothamangalam soils occurring along the valley fringe can be put under a wide variety of crops under irrigation.

5 Thrikkakara—Mulanthuruthy—Ayroor Association:-

Soils mapped under this Association are seen in nearly level to gently sloping paddy fields towards the Central and western parts of Ernakulam District.

Thrikkakara soils are imperfectly drained deep dark yellowish brown fine textured clay soils deposited over organic debris. Soils grouped under Ayroor series are very deep greyish brown silty clay loam surface textured soils underlained by greyish brown clay loam to clay subsoils formed by mixed alluvium. Mulanthuruthy soils are deep to very deep, dark greyish brown sandy loam to sandy clay loam surface texture followed by highly mottled clay sub-soils. These three soils have

moderate water holding capacity and medium natural fertility. They are medium to acidic in reaction. These soils are put under paddy cultivation.

The Thrikkakara soils limit the choice of crops due to continuous wetting because of the lay of the land.

6 Ayyanthole—Kizhupallikkara—Kolazhy Association:-

Soils occupied by this association are located in narrow and broad valleys in the central part of Trichur District.

Soils of Ayyanthole series are dark greyish brown and very deep with surface texture varying from sandy loam to clay loam. They possess highly mottled (red) clay sub-soils. Soils are developed from colluvium and alluvial sediments brought down from the neighbouring slopes. Kizhupallikkara series represents very deep dark grey colluvial deposits showing wide variation in surface texture and stratification of sediments. Here also the sub-soil is mottled with red colour. The grey colour of soil denotes impeded drainage.

Kolazhi series comprises of deep to very deep dark brown well drained gravelly clay loam to sandy clay loam surface soils followed by brownish yellow clay loam to silty clay loam sub-soils.

The soils grouped under this association are located in the valley portions of the central undulating plains in Trichur, Mukundapuram and Thalappilly Taluks. These soils are put under paddy cultivation.

7 Koratti—Anjur—Velappaya Association:-

Soils grouped under this association are redeveloped over laterites and are located in the gently to moderately sloping lands and elevated plains, in Mukundapuram, Talappilly, Trichur and Ottappalam Taluks. They are put under coconut, arecanut, cashew, banana etc.

Koratti series represents dark brown to reddish brown deep to very deep soils with clay loam to gravelly clay loam surface texture followed by gravelly clay sub-soils. Soils are developed over quariable laterite.

Anjur series consists of moderately deep to deep dark reddish brown soils, derived from hard laterite. The surface soil is gravelly clay loam in texture and sub-soil gravelly clay.

Soils grouped under Velappaya series are moderately deep to deep dark brown gravelly clay loam soils developed over quariable laterite.

8 Peruvemba-Koduvayoor-Valiyavallampathy Association:-

Soils grouped under this association are located on very gently to moderately sloping lands in the broad valley portion in Chittoor, Palghat and Ottappalam Taluks, representing the major paddy growing area of the tract.

Peruvemba series represents light medium textured surface soils with dark brown colour. The sub-soils are medium to heavy textured with reddish yellow to dark yellowish brown colour. Quartz and ferro-manganese gravels are noticed in the profile. Koduvayoor series represents very deep sandy clay loam alluvial soils with dark greyish brown to yellowish brown colour. The soils are well drained. Valiyavallampathy series represents imperfectly drained very deep, black to dark brown fine textured silty clay loam soils. Calcium carbonate nodules are seen distributed in the profile. Cracks are developed during summer. These soils are put under paddy cultivation.

9 Kottekkad-Kanjikkulam-Mannoor Association:-

The soils grouped under this association occurring on the sloping lands and elevated plants are formed by the weathering of gneissic rocks under subtropical climate. They are seen distributed in Chittoor, Ottappalam and Palghat Taluks.

Kottekkad series represents deep to very deep sandy clay loam to silty clay loam yellowish brown soils. Kanjikkulam series consists of deep to very deep dark brown gravelly clay loam soils developed over laterite. The Mannoor series consists of moderately deep to deep gravelly clay loam, yellowish red soils occurring in the gently sloping plains. Gneissic gravels are seen scattered throughout the profile.

Soils under this association are put under a wide variety of dry land crops.

10 Karakkurissy-Kunnathara-Vadanamkurissy Association:-

Soils grouped under this soil association are found to occur in nearly level to gently sloping valleys of Mannarghat, Ottappalam and parts of Palghat Taluks.

Karakurissy series represents very deep, loamy soils with very dark brown surface soils and greyish coloured sub-soils. Kunnathara soils consist of very deep dark brown loamy alluvial soils occurring on nearly level to very gently sloping lands. Vadanamkurussi series represents very deep dark yellowish brown silty loam soils underlined by dark greyish brown loamy sub soils, developed from colluvial deposits.

The soils grouped in this association are put under paddy.

C. Bottom lands with concave relief:-

11 Konchira-Anthikad-Perumpuzha Association:-

Soils grouped under this association are peculiar in its nature of development, occurrence and behaviour. They are located in the Kole lands most of which area are below sea level. Main characteristics of the soil included in this association is the predominent clayey texture throughout the profile. Colour of the soil ranges from dark brown to black. The soils are alluvial in origin and are imperfectly drained.

Soils of Konchira series are deep to very deep and fine textured and found to occur as deposits over organic debris. Depth of the organic layer varies considerably. Uniform clay texture is a typical character. Anthikad series also consists of very deep dark greyish brown fine textured clayey soils developed over alluvium. These soils are also having lime shells distributed in the sub soils. Perumpuzha soils are similar in its characteristics with Anthikad soils, but do not have lime shells in the profile.

The soils are medium acidic in reaction and are subjected to inundation resulting in periodic high water table.

Soils mapped under this association are distributed towards the western parts of Trichur and Mukundapuram Taluks.

D. Sea board on the west consisting of the coastal alluvial plain:-

12 Manathala-Udayamperoor-Vypeen Association:-

The soils included in this association are located towards the western coastal belt extending from Sherthalai on the South to Punnayurkulam on the North. This sandy belt formed out of coastal alluvial sediments is mainly put under Coconut cultivation. Rice is cultivated in the low land portions.

Soils of this association are young with immature profile development. Manathala series comprises of very deep dark brown to dark yellowish brown excessively drained sandy soils.

Udayamperoor series is uniform in texture with sandy loam soils of yellow colour. Vypeen soils are fine textured black silty clay loam soils occurring along the low land portions in the coastal belt.

2.4.2 Soil types identified in the zone

2.4.2.1 Laterites

Laterites are found in the mid land physiographic division of the zone. Laterites are typical weathering products of gneissic and granitic rocks developed under humid tropical conditions. Heavy rainfall and high temperature prevalent in the zone are conducive to the process of laterisation. *In situ* laterites have been formed by the leaching of bases and silica from parent rock with concurrent accumulation of oxides of iron and aluminium. The surface soils are mostly reddish brown to yellowish red in colour. The texture of surface soils ranges mostly from gravelly loam to gravelly clay loam. These soils have in general A B (C) profiles which are deep to very deep. The profiles have well developed horizon with abundant ferruginous and quartz gravels. The plinthit is characterised by a compact vesicular mass below the B horizon, composed essentially of a mixture of hydrated oxides of iron and aluminium. Extensive stretches of undurted laterites with hard surface crust are of common occurrence in

the zone. Laterities are in general poor in available nitrogen, phosphorus and potash and are low in bases. The organic matter content is also low. They are generally acidic with a pH range from 5.0 to 6.2. These soils are generally well drained and respond well to management practices.

2.4.2.2 Coastal alluvium

These soils are found in the coastal tracts of Trichur and Ernakulam Districts. They have been developed from recent marine deposits and show incipient development expressed in immature AC profiles. The texture is dominated by sand fraction. They are excessively drained with very rapid permeability. The horizon is usually thin and the surface textures observed are loamy sand and sandy loam. The water table is high in low-lying areas like Ponnani and Nattika Taluks. Profiles in these areas show mottlings in lower layers. These soils are poor in plant nutrients and have low cation exchange capacity. They are also very low in soil organic matter content.

2.4.2.3 Riverine alluvium.

These soils occur mostly along the banks of the rivers and their tributaries mentioned earlier. They show wide variations in their physico-chemical properties and in the arrangement of layers depending obviously on the nature of alluvium that is deposited and the characteristics of the catchment area through which the river flows. Horizon differentiation is not well expressed. They are very deep soils with surface texture ranging from sandy loam to clay loam. The fine sand fraction usually predominates. Presence of mica flakes has been observed in the alluvial soils of Trichur and Ernakulam Districts. In old basins, clay illuviation is noticed in the profile. Hydromorphic conditions are also variously expressed as grey colours and mottlings and accumulation of organic matter in lower horizons as in Kole lands of the Trichur District. These soils are comparatively more fertile than laterite soils. They respond well to management practices.

2.4.2.4 Brown hydromorphic

Hydromorphic soils as a group occur extensively in all the three districts of the Zone. These soils are mostly confined to valley bottoms between undulating topography in the mid land and in low lying areas of the 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 variations in physico-chemical properties and morphological features. In a majority of these soils, the water table is high. The development of the soil profile has occurred under impeded drainage conditions. These soils therefore exhibit characte-ristic hydromorphic features like clay horizons, presence of mottling, streaks, hard pans, organic matter deposition, iron-manganese concretions, etc, In certain areas, occurrence of gravel and laterite within the profiles has been observed, indicative of the colluvial factor in soil formation. In

general these soils are very deep and brownish in colour. The surface texture varies from sandy loam to clay. The coarse and fine fractions show varying patterns in their occurrence within the profiles. These soils are generally poor in phosphorus, calcium and other bases. The soil reaction is in the acidic range.

2.4.2.5. Hydromorphic saline

The saline soils are met within the coastal tract of Ernakulam and Trichur Districts.. The origin, genesis and development of these soils have been under peculiar physiographic conditions and are not comparable to saline soils occurring in other parts of the country. The net work of back-waters and estuaries bordering the coast serve as inlet for the tidal waters to flow into these areas, causing salinity. Wide fluctuations in the intensities of salinity have been observed. Only one crop of paddy is raised in these areas during July to November using saline resistant tall varieties. During rainy season in June-July, most of the salt is washed out, leaving the fields, where mounds are prepared, free from salts. Conductivity of the soil during this season ranges from 0.1 to 2 mmhos/cm, which is only about one-tenth of the values during March-April. These soils are in general brownish black, deep and imperfectly drained. The profiles show wide variations in texture as is common in the alluvial soils. Being developed under impeded drainage conditions due to high water table, these soils show characteristic aquic properties. These soils do not respond to higher levels of nitrogenous fertilizers. Their lime requirement is high and they are poor in phosphorus.

2.4.2.6 Acid saline

Acid saline soils are encountered in the coastal tract of Ernakulam District. The main problems faced are the accumulation of acids and salts under prolonged waterlogged conditions and hazards due to salinity. These soils are susceptible to seasonal ingress of saline water as a result of tidal inflow from the sea. They exhibit characteristics of one submerged forest area. They are black in colour, poorly drained heavy textured soils, distributed in flat areas lying 1-2m below mean sea level. They are submerged for nearly 6 months in a year from June to November. The profiles show typical aquic characteristics. Decomposed organic matter is often observed in lower layers. These soils are highly acidic in reaction.

2.4.2.7 Black soils

Black soils are found in the Kerala state, only in the Chittoor Taluk, of the 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 in colour, low in organic matter, calcareous, moderately alkaline, high in clay content

and cation exchange capacity and are very sticky and plastic. They are generally located in gently sloping to nearly level lands. These soils are deficient in nitrogen and phosphorus but have moderate levels of potassium and calcium.

2.4.2.8 Forest loams

These soils are the products of weathering of crystalline rocks under forest cover. They are restricted in occurrence in the forest areas of high ranges of the eastern part of the zone. 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. They are dark brown in colour, with loam to silty loam texture. The dark colour of surface horizons is due to the presence of organic matter derived from the vegetation. In denuded areas leaching and deposition of humus in lower layer is observed. The B horizon usually contains gneissic gravell and boulders. The C horizon consists mostly of gneissic parent material under different stages of weathering. These soils are generally acidic with pH ranging from 5.5 to 6.3. They are rich in nitrogen but poor in bases because of heavy leaching.

2.5 Cropping pattern

The main cropping patterns followed in the central zone are enumerated in table 5. Definite cropping patterns are followed only in the case of annual crops. In the uplands where perennial crops are raised no rigid pattern of intercrops are followed.

Table 5. Cropping patterns of the central zone

a. Annual crops–Wet lands
   1 Rice—Rice—fallow
   2 Rice—Rice—Pulses/vegetables
   3 Rice—Rice—Rice
   4 Rice—Pulses/vegetables—fallow
   5 Rice—Sesamum—fallow
   6 Banana—Vegetables/tubers

b. Annual crops—uplands
   1 Rice—Sesamum
   2 Tubers/Banana (Rainfed)

c. Perennial crops—uplands
   1 Coconut intercropped with a variety of annuals like vegetables, tubers, rice, millets etc.
   2 Arecanut intercropped with annuals

3 Coconut intercropped with perennials like pepper, arecanut etc.

4 Homesteads—of a collection of perennial and annual crops.

5 Plantation crops like Rubber, Tea, Coffee, Cashew and Pineapple.

6 Lemon grass and other essential oil plants and tree crops

7 Fruit trees like Mangoes, Jack etc. mainly as homestead crops.

2.5.1. Crop productivity and production

The district wise area under various crops and their production furnished in Tables 6, 7 and 8. The Central zone is the major rice growing tract of the state. This region accounts for about 50 per cent of the area under rice in Kerala and 52 per cent of rice produced in the State. Rice is cultivated in central plain lands and in lower valleys and to some extent in the coastal sand belt. Rice is also cultivated in the upland as 'modan' paddy synchronising with the south west monsoon. Coconut is another important crop which is grown mainly in the homesteads concentrated mostly in Trichur and Ernakulam districts. Other oil seed crops of the region are sesamum and groundnut. While groundnut is cultivated mostly in Palghat district, sesamum is cultivated in Ernakulam and Trichur districts and to a lesser extent in Palghat district. Pulses occupy a considerable area in this region. Banana and pineapple are extensively cultivated in this zone especially in the district of Trichur. Tuber crops cover an area of 40.99 thousand hectares. Tapioca and sweet potato are, the major tubers under cultivation in this region. Other tubers include yams, colocasia, coleus etc. Arecanut is grown as irrigated crop in the valleys and river banks especially in Trichur District.

2.6. Analysis of constraints limiting production of major crops

1 Rice

a. Lack of improved high yielding varieties suited to specific farming situations.

b. Constraints in adopting the recommended manurial schedule due to the unfavourable climatic conditions during the cropping seasons.

c. Lack of assured irrigation facilities and adoption of unscientific water management practices

d. The low productivity during the second crop season.

e. Increased incidence of pests and diseases due to the favourable weather factors for multiplication of pests and diseases.

f. Difficulties in adoption of improved cultural practices due to unfavourable moisture regimes during the crop growth phases.

g. Lack of response for most of the major nutrients due to leaching losses and fixation of nutrients to unavailable forms.

h. Heavy incidence of weed especially in dry sown areas.

II) Coconut:

a. Unscientific spacing and mixed cropping systems followed by cultivators.

b. Planting of poor genetic material due to lack of proper mother palm seed and seedling selection.

c. Nonmanuring, undermanuring and unbalanced manuring.

d. Lack of proper soil and moisture conservation in rainfed crop.

e. Absence of regular economical re-planting programme.

f. Non adoption of prophylactic plant protection measures.

III) Pulses and oil seeds.

a. Lack of improved varieties suited to the farming situations existing in different locations

b. Manurial recommendations are not followed correctly by the growers.

c. Acidic soils existing, in the zone acts as limiting factor

d. Lack of proper culture isolated from soils of the zone for inoculating the pulse seeds.

e. Moisture regime fluctuations are at the mercy of the vagaries of weather and affect the production of the crop to a great extent.

IV) Vegetables and Tubers.

a. Lack of assured irrigation facilities

b. Processing and marketing of vegetables and tubers are a problem, especially during the peak production periods.

c. Lack of improved varieties resistant to pests and diseases.

d. Non adoption of recommended manurial practices.

V) Pepper

a. Lack of technology for inter cultivation.

b. Improper selection of cultivars

c. Non-adoption of fertilizer recommendations

d. Lack of soil and moisture conservation methods

e. Increased incidences of pests and diseases.

An analysis of the production gaps of the major crops of the central zone are furnished below.

Crops	Average production kg/ha	Potential production kg/ha	Production gap kg/ha
Rice			
I Crop	3020	4000	980
II Crop	2416	4000	1584
III Crop	2319	3000	681
Dryland rice	600	1000	400
Pulses			
Black gram	450	800	350
Green gram	400	800	400
Cowpea	670	1000	160
Oilseeds			
Sesamum	290	450	160
Groundnut	880	2000	1120
Coconut	28 nuts/ tree 28	100 nuts/ tree (irrigated) 70 nuts/ tree (Rainfed	72 nuts/tree 42 nuts/ tree
Tuber crops			
Tapioca	16.5 T/ha	25 T/ha	8.5 T/ha
Sweet potato	6.2 T/ha	20 T/ha	13.8 T/ha
Fruit crops			
Banana	7.5 kg/ bunch	12 kg/ bunch	4.5 kg/ bunch
Spices			
Pepper	236 g/ std	1000 g/ std	764 g/ std

Table 6

Area of major crops (1980-81) Central Zone (Hectares)

Crops	Palghat	Trichur	Ernakulam	Total	Percentage to State area	State Production
A Food Crops						
.1. Rice						
Autumn	89762	40584	43174	173520	49.68	349243
Winter	89550	49168	39719	178437	50.39	354132
Summer	4322	20562	19607	44491	45.25	98324
Total	183634	110314	102500	396448	49.45	801699
2. Cereals and millets						
1. Jowar	1839	11	5	1855	98.67	1880
2. Ragi	968	34	4	1006	68.39	1471
3. Other cereals and millets	2062	103	190	2169	78.56	2761
4. Pulses						
Autumn	3699	2447	825	6971	69.75	9994
Winter	5663	458	315	6436	52.81	12188
Summer	1365	408	375	2148	18.38	1677
3. Sugar crops						
1. Sugarcane	2324	4	80	2408	29.95	8041
2. Palmyrah	8020	940	369	9329	72.04	12949
Total	10344	944	449	11737	55.92	20990

4. *Condiments and Spices*						
1. Pepper	1532	4010	6652	12194	11.28	108073
2. Chillies	181	2	—	183	15.68	1167
3. Ginger	410	168	2162	2740	21.64	12662
4. Turmeric	375	169	789	1333	40.76	3270
5. Cardamom	3366	—	—	3366	6.23	54044
6. Arecanut	2352	6633	6151	15136	24.71	61242
7. Tamarind	3084	1468	806	5358	48.63	11017
8. Others	280	424	1484	2188	42.13	5193
Total	11580	12874	18044	42498	16.56	256668
5. *Fruits*						
Mango	5194	4645	4412	14251	24.91	59207
Jack	4242	3884	4377	12503	21.28	58750
Banana	850	1389	1414	3644	27.29	13133
Other plantains	3215	3270	3256	9741	26.74	36425
Pineapple	156	485	584	1225	21.09	5809
Papaya	560	887	1870	3317	36.47	9095
Cashewnuts	12710	7122	4063	23900	17.03	139917
Others	2327	956	712	3995	27.46	14548
Total	29254	22634	20688	72576	21.54	336884
6. *Vegetables*						
Drumstick	884	631	1101	2616	18.44	14183
Tapioca	12397	6673	12789	31859	13.07	243763
Sweet potato	1721	178	68	1967	39.63	4964
Tubers	2865	2467	2969	8301	24.78	33503
Others	1819	914	2670	5403	40.70	13274
Total	19689	10868	19597	50149	16.19	309687

1	2	3	4	5	6	7
B. Non-food crops						
1. Oil seeds						
Groundnut	12581	—	—	12581	99.29	12671
Sesamum	1304	1487	2703	5494	31.20	17607
Coconut	21885	53549	60070	135404	20.43	662657
Others	596	145	204	945	47.75	1979
Total	36266	55181	62977	154424	22.22	694914
2. Fibre						
Cotton	5247	—	—	—	100	5247
3. Drugs & Narcotics						
Betel leaves	8	85	136	229	16.89	1356
Lemongrass	108	76	607	792	13.24	5982
Total	116	161	743	1021	13.10	7791
4. Plantation crops						
Tea	662	438	30	1130	3.08	36690
Coffee	2264	33	172	2469	0.23	57949
Rubber	9347	8950	21311	39608	18.47	214415
Cocoa	284	898	3603	4785	23.64	20238
Total	12557	10319	25116	47992	14.60	328692

Table 7

Production of major crops under Central Zone 1980–81 (Tonnes)

Crops	Palghat	Trichur	Ernakulam	Total	Percentage to State production	State Production
1. *Rice*						
Autumn	190593	49477	59764	299834	55.15	553748
Winter	176176	62382	57161	295719	53.91	548500
Summer	7013	35712	27676	70401	41.48	169714
Total	373782	147571	144601	665954	52.35	1271962
2. Jowar	827	5	2	834	98.70	845
3. Ragi	678	38	3	719	63.57	1131
4. Other cereals and millets	1320	66	122	1508	85.29	1768
5. Pulses	6620	2365	1085	10070	44.80	22479
6. Sugarcane (GUR)	16245	17	495	16757	34.78	48178
7. Black pepper	170	690	1264	2124	7.43	28519
8. Chillies (dry)	161	2	—	163	15.32	1064
9. Ginger (dry)	439	182	5474	6095	19.02	32039
10. Cured turmeric	602	264	1462	2328	37.91	6141
11. Processed cardamom	198	—	—	198	6.10	32.44
12. Arecanuts (million)	354	1483	1098	2935	27.16	10805
13. Mango (in '000)	15022	21354	33164	69540	24.67	281873

1	2	3	4	5	6	7
14. Jack (in '000)	19071	14742	23261	57074	21.80	261764
15. Banana	18855	24536	15017	58408	33.06	176683
16. Other plantains	4745	8773	12617	26135	18.57	140722
17. Raw cashew	3920	1934	2103	7957	9.71	881900
18. Tapioca	177648	92555	240267	510470	12.57	4060911
19. Sweet potato	11302	845	398	12545	38.05	32967
20. Groundnut	8145	—	—	8145	99.03	8225
21. Sesamum	301	405	769	1475	38.48	3833
22. Coconut (million nuts)	80	347	327	754	25.07	3008
23. Cotton (bales of 170 kgs)	9847	—	—	9847	100.00	9847
24. Tea	1219	1002	—	2221	4.38	50716
25. Coffee	656	20	100	776	3.29	23540
26. Rubber	4516	6739	13929	25184	17.95	140333
27. Cocoa (dry beans)	15	130	522	667	22.09	3020

Table 8

Average yield of Major Crops
grown in Central Zone

	Crops	Average yield T/ha				State
		Pal-ghat	Tri-chur	Erna-kulam	Cent-ral zone.	aver-age yield
1	Rice					
	Autumn	2.29	1.22	1.45	1.65	1.83
	Winter	2.00	1.36	1.38	1.58	1.68
	Summer	1.72	1.82	1.59	1.71	1.71
	Average yield	2.00	1.47	1.47	1.67	1.63
2	Jowar	0.43	—	0.40	0.41	0.45
3	Ragi	0.70	1.13	0.75	1.19	0.77
4	Other Cereals & millets	0.64	0.64	0.64	0.64	0.64
5	Pulses	0.62	0.70	0.72	0.67	0.61
6	Sugarcane (GUR)	7.06	4.00	6.19	5.75	5.80
7	Pepper	0.13	0.12	0.27	0.17	0.27
8	Chillies (dry)	0.89	1.00	—	0.94	0.92
9	Ginger (dry)	1.67	1.04	2.51	1.74	2.50
10	Turmeric (Cured)	1.62	1.57	1.85	1.68	1.90
11	Cardamom (processed)	0.05	—	—	0.05	0.05
12	Jack	4.30	3.90	4.84	4.34	4.21
13	Banana	13.35	15.84	11.80	13.66	6.20
14	Other plantains	1.97	2.69	0.40	1.68	
15	Cashew	0.28	0.27	0.48	0.34	0.59
16	Tapioca	15.35	13.75	20.60	16.56	16.70
17	Sweet potato	6.43	6.04	6.04	6.17	6.44
18	Ground nut	0.88	—	—	0.88	0.88
19	Sesamum	0.29	0.28	0.31	0.29	0.26
20	Coconut (million nuts)	3350.93 nuts/ ha	6087.88 nuts/ ha	5193.94 nuts/ ha	4877.58 nuts/ ha	4576.00 nuts/ ha
21	Cotton (170 kg bales)	276.92	—	—	276.92	276.92
22	Tea	2.02	2.27	—	2.14	1.29
23	Coffee	0.37	0.76	0.74	0.62	0.62
24	Rubber	0.61	0.69	0.54	0.61	0.57
25	Cocoa	0.06	0.16	0.16	0.12	0.12

CHAPTER 3

Specific Farming Situations

3.1 Wet lands—Annual crops

3.1.1 Farming Situation WLA 1

Area: The low lands of the mid undulating region of the Palghat, Trichur and Ernakulam Districts, characterised by the narrow and broad valleys located in between the eastern high lands and the back water areas of the sea coast.

Soil type: Mainly laterite with patches of riverine alluvium near the banks of rivers and coastal alluvium bordering the west coast; soils are well drained light textured with sandy loam to loamy textured surface soils. The soil reaction is in the acidic range and they are of poor fertility status.

Rain fall: South West monsoon period 1500 to 2000 mm
North East monsoon period 500 to 1000mm
Summer showers meagre

Cropping pattern: Rice—Rice—Fallow

The first crop rice is usually dry sown with the receipt of early monsoon showers during April-May and harvested by July–August. The second crop is mainly a transplanted crop with varieties of 130–150 days duration. The nurseries are generally raised during July-August and transplanted by September-October.

Irrigation facilities: Only supplementary irrigation facilities are available and that too is not available during summer months.

3.1.2 Farming situation WLA—2

Area— Low lands of the mid land and coastal tracts of the three districts of the zone bordering the irrigation channels and lift irrigation sources.

Soil type— Laterite, river alluvium and coastal alluvium with patches of brown hydromorphic soils. Except the river alluvium the soils are of low fertility status as the bases have been subjected to heavy leaching losses. The reaction of the soil is in the acidic range.

Rainfall— Same as that of the WLA–1 situation.

Cropping pattern: Rice—Rice—Pulses/Vegetables

Rice is grown during the first and second crop season as in WLA–1. Pulses are grown after the harvest of the second crop rice utilizing the residual moisture and supplemented by irrigation wherever

possible. Vegetables are grown in limited areas utilizing the family labour to the maximum. Irrigation is provided by digging small pits in the field and pot watering the plots. The pulses usually grown are cowpea, blackgram and to a limited extent greengram. Bhindi, gourds, amaranthus and brinjal are the common vegetables grown besides water melon in some areas.

Irrigation facilities: Supplementary irrigation facilities available upto the month of February. Can utilize residual moisture for raising pulses.

3.1.3 Farming situation WLA—3

Area— Low lands of the valleys of undulating terrain of the three districts of the zone where perennial water sources are available. These areas are scattered among the farming situation WLA-2. explained earlier.

Soil type— Same as that of WLA-2

Rainfall— -do-

Cropping pattern: Rice—Rice—Rice

The first and second crop rice are raised as mentioned in WLA-1. The third crop (puncha) rice is raised in limited areas where there is assured water supply. The whole crop is transplanted using short duration rice varieties like Triveni, Annapoorna etc. The nursery is usually raised during January and transplanted during February. The harvest will be completed by March end or the first fortnight of April.

Irrigation facilities: Lift irrigation facilities are available in these areas throughout the three seasons as well as facilities for drainage during monsoon seasons.

3.1.4 Farming situation WLA—4

Area—This farming situations is limited to areas of lands lying just above the low lands of the valleys of the mid land regions of the central zone. As they are in the upper reaches of the field and away from the sources of irrigation, drought conditions prevail soon after the fag end of the South West monsoon.

Soil type— Same as in WLA-2.

The texture is little more loose and drainage conditions more conducive.

Rainfall— Same as in WLA-2

Cropping pattern: Rice— Pulses —Fallow vegetables

The first crop rice is usually dry sown during Apirl-May and

harvested by August—September. In areas of water scarcity generally a pulse crop is raised instead of the rice as in the earlier farming situations. The residual moisture is utilized for raising pulses like cowpea, blackgram and greengram.

Irrigation facilities: Irrigation facilities are meagre when the South West monsoon receeds. Limited water will be available in the nearby sources for lift irrigation for a short period.

3.1.5 Farming situation WLA—5

Area— These are semi-wet lands, water logged conditions being limited to the severe South West monsoon period only. Soon after the South West monsoon these lands exhibit the characteristics of an upland with no irrigation facilities.

Soil type— Similar to WLA-2

As drought conditions prevail during the major period of the year, moisture stress is experienced from October to June. The organic matter content is low and there will be problem of dry land weeds.

Rainfall— Same as that of WLA-2

Cropping pattern— Rice-sesamum-fallow

After the first crop rice which is raised a dry sown crop during April-September, the sesamum seeds are sown after ploughing, bringing the plots to tilth. This crop is raised with the residual moisture alone and is seldom given any irrigation. Usually long duration sesamum varieties are preferred in this region. The sesamum crop harvest will be completed by December end.

Irrigation facilities— Nil

3.1.6 Farming situation WLA-6

Area— Low lands of the valleys and coastal plains bordering the sea coast. The area is distributed among the three districts, majority of the area contributed by Trichur and Ernakulam districts.

Soil type— Same as in WLA-1

Rainfall— Same as in WLA-1

Cropping pattern— Banana intercropped with vegetables/tubers

Irrigated banana is raised in wet lands usually for catching the Onam Market during August-September. The suckers are

planted during September–October in wet lands and irrigated during summer months. The vegetables and small tubers are grown as intercrops during rainy season and harvested before March-April.

Irrigation facilities— Supplementary irrigation facilities available to a limited extent even during summer months.

3.2 Uplands—Annual crops

3.2.1 Farming situation ULA-1

Area— These areas are known as *'Modan'* lands in this region. They are uplands with little or no facilities for irrigation. These lands occupy the topmost portion of the undulated terrain of the mid-land region of the zone and is distributed in all the three districts of the zone, majority being in the district of Palghat.

Soil type— Mainly laterite, gravels present, low organic matter content, poor in fertility status, well drained with undulating topography.

Rainfall— Same as in WLA-1

Cropping pattern— Rice–Single crop

The rice is raised as a purely rainfed crop in the uplands employing drought resistant/tolerant varieties. Sown during April/May with the onset of monsoon the harvest will be over by September. In limited areas a sesamum crop is raised after the harvest of the rice crop.

Irrigation facilities— Nil

3.2.2 Farming situation ULA-2

Area— Same as that of ULA-1

Soil type— -do-

Rainfall— -do-

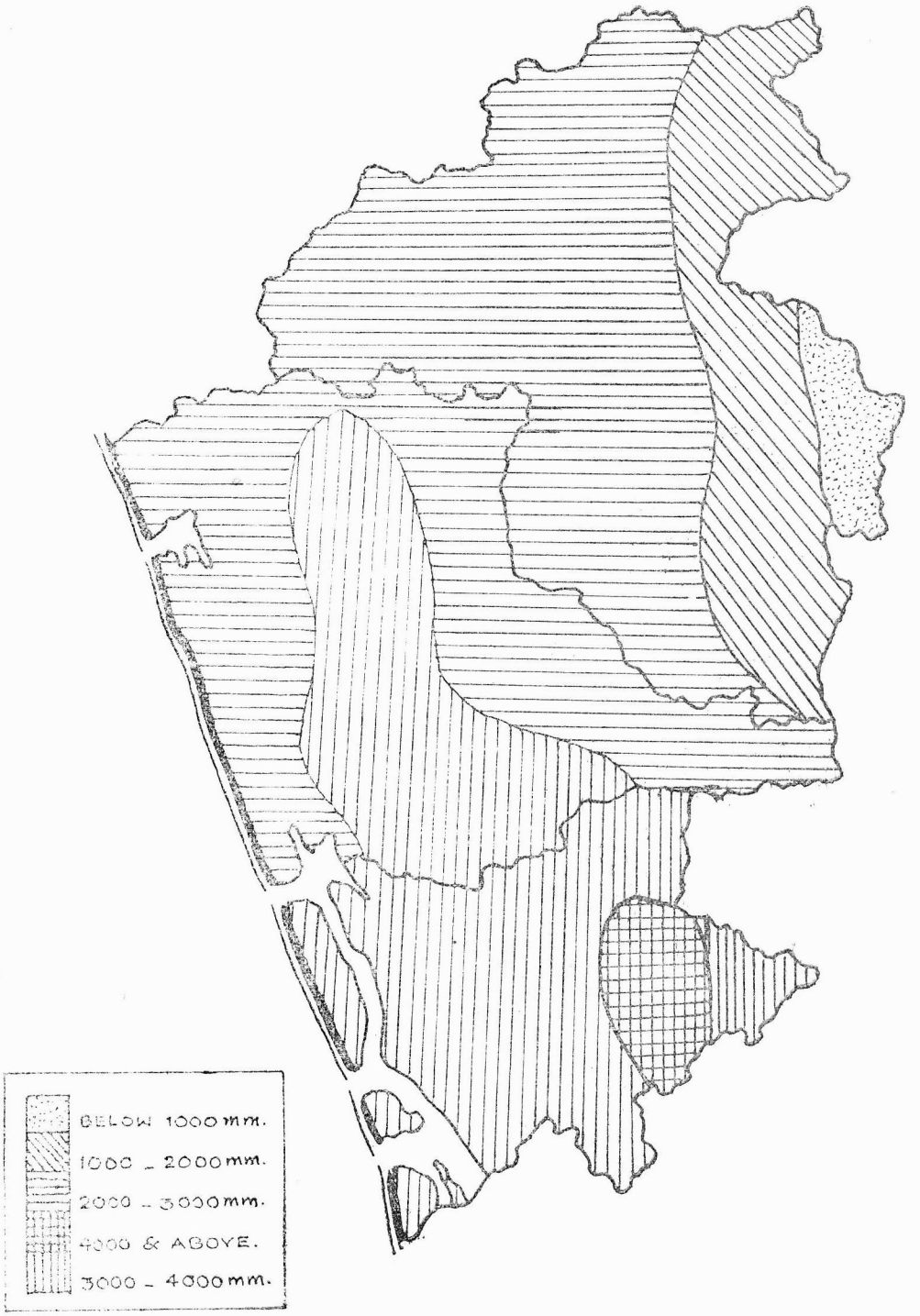
Cropping pattern— Tapioca or other tubers/rainfed banana

Tapioca and banana are raised in uplands purely as rainfed crops. The tapioca setts are planted by April-May after the receipt of first showers. Varieties of 10 months duration are usually preferred. Banana suckers are also separated from clumps and planted after the receipt of showers. One or two ratooning is usually allowed for banana before splitting and separating the clumps.

Irrigation facilities— Nil

NARP_ CENTRAL ZONE

RAINFALL PATTERN



3.3 Perennials

3.3.1 Farming situation ULP-1

Area— Similar to ULA 1, WLA-5 and WLA-6

Soil type— -do-

Rainfall— -do-

Cropping pattern— Coconut intercultivated with annuals like Tuber, Banana, Pulses, Vegetables etc.

Irrigation facilities— Limited. Supplementary irrigation facilities only, limited with sources like wells and small tanks. Majority of cultivation based on rainfall only.

3.3.2 Farming situation WLP/A-1

Area— Similar to WLA-4

Soil type— -do-

Rain fall— -do-

Cropping pattern— Arecanut intercultivated with annuals like Tubers, Banana, Vegetables etc.

Irrigation facilities— As in WLA-4

3.3.3 Farming situation ULP-2

Area— Same as in ULP-1

Soil type— -do-

Rain fall— -do-

Cropping pattern— Coconut intercultivated with perennials like Pepper, Cocoa etc.

Irrigation facilities— As in ULP-1

3.3.4 Farming situation ULP-3

Area— Small homesteads scattered throughout the central region, about 3.75 lakhs in number of varying extents ranging from 5 ha. to a few cents.

Soil type— Same as in ULP-1

Rain fall— Same as in ULP-1

Cropping pattern— A mixed cultivation of an assorted perennial and annual crops.

Irrigation facilities— As in ULP-1

3.3.5 Farming situation ULP-4

Area—Mainly concentrated in the high ranges and upper physiographic region of the zone and scattered in isolated patches of the mid lands. Includes large plantations with areas more than 100 hectares and middle and small plantation ranging from a few cents to 100 hectares also. The total area under this farming situation in the zone is about 67000 ha.

Soil type: This farming situation is generally associated with forest soils and to a limited extent with riverine alluvium and laterites.

Rain fall: Areas with high rain fall, well distributed during the three seasons are preferred for adopting this farming situation. The average annual rain fall varies from 3700 m m. to 2750 m m.

Cropping pattern: Plantation crops like Rubber, Coffee and to limited extent Tea. In the lateritic region Cashew and Pineapple are also raised in about 2400 ha.

Irrigation facilities: The crops are raised as rainfed plantations. In limited areas of Trichur district irrigation is practiced for raising Pineapple.

3.3.6. Farming situation ULP–5

Area: In the lower reaches of high lands and in the middle lateritic belt of the zone this cropping situation is found in isolated patches.

Soil type: Mainly laterites of poor fertility status with no irrigation facilities. Well drained loamy soils are preferred.

Rain fall: Same as that of in ULP–3

Cropping pattern: Perennials, essential oil plants and trees. Lemongrass, palmarosa, Vetiver, Cinnamon etc.

Irrigation facilities: Nil

3.3.7. Farming situation ULP-6

Area: Scattered patches in the mid land and coastal low lands of the region.

Soil type: Mainly laterites and coastal sandy alluvium.

Rain fall: Same as that of farming situation ULP–3

Cropping pattern: Perennial fruit trees like Mango, Jack etc.

Irrigation facilities: Nil. Raised as rainfed crop only.

3.4. Analysis of constraints in production

Farming situation	Present recommendations of improved practices.	Constraints in adoption of the recommended practices in the farming situation.	Programmes suggested taken up under NARP.
(1)	(2)	(3)	(4)
3.4.1. Farming situation WLA–I	*Rice I crop.* Improved varieties, Aswathy, IR8, Sabari, Jaya, Bharathi, Supriya, Mashuri, Rohini, Annapoorna, Triveni, Jyothi.	As semi-dry cultivation of dry broadcasting or dibbling is practiced the varieties recommended fail to perform well if South West monsoon is late or is irregular. Most of the varieties are white kernelled, which is not liked for local consumption.	Programe for evolving semi-tall varieties from the traditional tall red kernelled varieties like PTB. 1, PTB. 23. PTB. 26 through irradiation has been taken up.
		Though the dwarf varieties have non lodging character, the straw yield is very low. The farmers prefer a semitall variety for increased straw yield.	Hybridisation programmes have already yielded a culture 1907 with semitall stature and grain yield potential of HYV and better straw yield. Further programmes are under way.
		Weeds pose as a menace during the dry sown first crop season. Identification of grass weeds from the seedlings of the	Hybridisation programme has been taken up to evolve HYV with pigmentation at some of the plant parts so

1	2	3	4
		recommended varieties is not possible at early stages. So many cultivators grow low yielding varieties like PTB. 9 and PTB. 26 in preference to HYV recommended, as the plant parts of PTB. 9 and PTB. 26 are pigmented and weeding operation is easy.	that the weeds can be identified from the pigmented HYV.
		In certain areas of the State there are short periods of flooding during the peak periods of South West monsoon when the rice crop will be submerged for one to two weeks. The recommended varieties are not found suitable for such locations.	A programme has been formulated screening varieties suitable for such situations. HYV, with tall stature and duration of 140 to 150 days capable of withstanding floods for short periods will be identified.
Crop management	Fertilizer recommendations. 90–45–45–medium duration 70–35–35–short duration	Application of fertilizers at recommended levels during this season is not practicable as the present recommendations are for varieties based on the duration and not based on the season or the farming situation.	Technical programmes have been chalked out to schedule manurial recommendations suitable for each farming situation.

		Leaching and run off losses of solubie N and K fertilizers are maximum during this season. Hence farmers are relectant to apply the fertilizers at the recommended levels.	Studies have been initiated to evolve proper technology for minimising the loss of fertilizers and to increase the efficiency of fertilizer use.
		Lack of response to application of Phosphatic fertilizers has been observed in many parts of the region. Hence farmers are usually relectant to apply phosphatic fertilizers at recommended levels.	Programmes have been formulated to take up projects for identification of the factors responsible for the lack of response of P application.
Seeds and sowing	It has been recommended that transplanting is better than dibbling/broadcasting.	In large areas of the state, transplanting of rice is not possible during the first crop season due to uncertain rainfall. So farmers adopt dibbling or broadcasting during this season. Dibbling operation being costly, farmers generally adopt broadcasting which brings down the 1crop yield.	Programmes for fabrication of seed drills for dibbling paddy seeds will be taken up under NARP, so that farmers can take up mechanised dibbling during I crop season.
	Weed management-Hand Weeding and use of Weedicides.	Weed management practices recommended are found not successful for dry sown I crop, as there will be rampant weed growth during this season.	Projects on chemical control of weeds in dry sown I crop season have been formulated.

1	2	3	4
	II crop season varieties. Same as that of I crop except Rohini.	In addition to the limitations mentioned under the I crop season, it has been observed that there is a decline in the yield when HYV are used during II crop season, which is not pronounced when, traditional varieties are used.	Technical programmes have been drawn out and projects formulated for identifying the factors responsible for the yield decline. Programmes are taken up to evolve photosensitive long duration semitall varieties suitable for accommodation in the changing time schedule of nursery raising.
Crop management	Fertilizer application same as in I crop.	The basal application of fertilizers can be adopted as the field conditions are optimum. The top dressing of fertilizers are to be scheduled properly for taking into account the variety and water availability.	Same as that of I crop season
		As most of the farming operations are simultaneous, scarcity of labour is a problem and hence field preparations are not followed as per recommendations.	Labour saving small scale machinery are to be fabricated for mechanisation of the farming operations and reducing the drudgery of labour.

Crop protection		The second crop season is quite conducive for the incidence of pests and diseases.	
		Lack of varieties with built–in resistance to the attack of pests and diseases is a constraint to increased production.	Programmes have been initiated to evolve varieties resistant to sheath blight of rice through hybridisation and irradiation. Cultures 1954 and 25331 have been identified as promising cultures as good donors — Investigations are programmed to evolve red kerneled varieties using these cultures as donors.
3.4.2. Farming situation *WLA-2* I and II crop rice same as in WLA–1. III crop pulses. Improved varieties of cowpea.	Pusa barsathi Manjeri local No.5269,S-288, C-152S–488, Pusa Phalguni, P-118, Pusa dofasli, Kanakamani and New era.	Cowpea raised during the III crop season is mainly for grain purpose, utilizing the residual moisture after II crop rice. Only in limited areas cowpea is raised for vegetable purpose utilizing the family labour. The varieties recommended have protracted flowering nature, which require at least 2 or 3 pickings. The yield of grains do not comensurate with the wages of the large number of labourers employed for tne harvest.	Evolution of varieties of cowpea (grain type) suitable fo growing in command areas on an extensive scale and the pods of which can be harvested completely in one picking is aimed at under NARP. One culture has been evolved in this station.

(1)	(2)	(3)	(4)
	Blackgram varieties recommended—T-9, Co2, SI.	As blackgram is raised with the residual moisture after II crop rice with facilities for meagre or no irrigation, drought is experienced during the pod maturity stage. The varieties now recommend do not perform well under drought conditions.	Screening of varieties are envisaged under the projects taken up under NARP for identification of types resistant/ tolerant to drought conditions during the fag end of the crop.
	Greengram varieties recommended—Pusa baisaki, NP 24, Co2.	Soils of Kerala being acidic in reaction, the performance of varieties now recommended are found to be not satisfactory.	Varieties suitable to the acidic soil conditions and drought are to be screened. Projects for identification of suitable varieties have been taken up.
	Horsegram varieties recommended—Co1, Pattambi local.	The performance of both the varieties recommended are poor as they are a bit long duration in character.	Varieties of short duration drought resistant and suitable for raising in acidic soil conditions will be screened for identification of suitable types for the region.
Crop management:	Fertilizer recommendation greengram N P K 20—30—30 kg/ha. Horsegram 25kg P_2O_5/ha.	The recommendations are of a general nature without taking into consideration the soil type and the cropping system followed.	Manurial schedule for the cropping system as a unit is aimed at in the projects taken up under NARP.
Seed storage:	No specific recommendations are furnished.	The processing and storage of the pulse grains are a problem	Studies have been taken up for scheduling correct proce-

		to the cultivators as the pulse grains are subjected to severe attack of storage pests and diseases. Very low recovery of viable seeds are obtained after the storage of seeds beyond six months.	ssing and protection measures for the preservation of pulse grains beyond periods of six months.
Vegetables:	No improved varieties are recommended.	The local varieties used by the farmers are found susceptible to common pests and diseases and poor in yield, even though they have good taste and keeping quality.	Varieties with tolerance/ resistance to maior pests and diseases and yield potential are to be identified. Projects have been taken up for screening varieties of Bhindi, Brinjal, Amaranthus etc.
3-4-3 Farming situation WLA–3.	I & II crop rice same as in WLA–1 III crop-rice varieties–Jaya, IR-8, Sabari, Bharathi, IR-20, Supriya, Annapoorna, Triveni, Rohini, Jyothi.	Same as in WLA–1 -do-	Same as in WLA-1 -do-
Crop management	Fertilizer recommendations. same as that of WLA-1	Fertilizer recommendations are based on the duration of varieties and not based on the season. Recommendations are for each crop. Farming system as a unit is not considered.	Scheduling of manurial practices based on the cropping system as a unit has been taken up under NARP.

(1)	(2)	(3)	(4)
3.4.4 Farming situation WLA-4	Rice I crop same as in WLA-1	Same as in WLA-I	Same as in WLA-1
	Pulses/Vegetables II crop same as in WLA-3	Same as in WLA-3	Same as in WLA-1
3.4.5 Farming situation WLA-5	Rice I crop same as in WLA-1	Same as in WLA-1	Same as in WLA-1
	Sesamum II crop varieties recommended— Kayamkulam I -do- II	Varieties recommended are suitable for sandy soil tracts like that of Onattukara. These varieties are not coming up under the low land rice fields.	Short duration high yielding varieties suitable for growing in the wet land rice fallows are to be identified. For the zone. Trials will be taken up under NARP.
3.4.6 Farming situation WLA-6	I crop Banana varieties recommended: Nedunendran, Zanzibar.	Cultivators use only the suckers selected from their field as no good quality varieties are offered.	varietal screening for identification of high yielding types from local collections are attempted at BRS Kannara.
	Manurial schedule, 190-115-300 gm/plant of N, P and K	As per the present recommendation the application of manures terminates at 4 months after planting. The cultivator's practice is to manure the plants up to the heading stage.	Detailed studies on the period of utilization of nutrients by Banana during the various stages of growth are taken up at BRS Kannara. Based on the results, recommendations on the time, dose and method of application of fertilizers will be modified.

		Vegetables/tubers same as in WLA-2	As in WLA 2	As in WLA-2
3.4.7.	*Annual crop uplands*: Farming situation ULA–1	I Crop rice. varieties recommended PTB-28, PTB-29, PTB-30, ARC-11775	The high yielding ARC 11775 culture has the disadvantage of the white kernel colour which is not liked by the cultivators.	Hybridization and mutation breeding programmes are envisaged under NARP for evolving drought resistant and tolerant to Blast disease varieties with red kernels.
		Crop management Fertilizer application 40-20–20 NPK	As the crop is dry sown difficulties are experienced while practicing the recommendations of fertilizer application, especially in sloping terrain.	Cultural and manurial practices are to be standardised for the upland rice. Programmes will be initiated.
		Weed management same as in ULA-1 dry sown rice.	As in WLA–1	As in WLA-1
		Sesamum II crop varieties recommended. Nil	Lack of HYV of sesamum suitable for upland condition is a constraint to production.	Screening of local and other available varieties of Sesamum will be undertaken for selection of varieties suitable for drought conditions as existing in uplands.
3.4.8	*Farming system ULA-2*	Tubers/Banana rainfed. Banana, Tubers-Varieties Tapioca-H–97, H–165, H 226 M-4, H-1687, H–2304.	No HYV of Banana are recommended. For tubers high yielding varieties are available but as most of them are bitter and industrial varieties, farmers are reluctant to cultivate in large	The Banana Research Station at Kannara is engaged in screening varieties of Banana for raising as rainfed crop. The C. T. C. R. I. Trivandrum has taken up programmes for

1	2	3	4
		areas as they are not preferred for consumption.	evolving varieties with good quality tubers.
3-4-9 *Perennial crop uplands* Farming situations ULP 1 to 7	Recommendation for each crop is furnished as regards varieties, manuring schedules, spacing, inter culture etc.	Recommended practices are based on crop as a unit and not the farming system as a unit. Hence the farmers have followed unscientific crop mixtures, spacing of crops and cultural practices which have proved constraints to production.	Package of practices recommendations based on the cropping situation as a unit and not individual crops as basic unit, are to be formulated. Manurial and cultural practices for the whole cropping system is to be worked out. Projects will be initiated under NARP for bringing out location specific package of practices recommendation for each cropping situation.

3.5. Existing research set up and functions in the central zone

Name of the station	lead function	Verification function
1) Regional Agricultural Research Station, Pattambi.	Rice Pulses Rice based farming system.	
2) Research Station & Instructional Farm, Mannuthy	Agricultural implements.	Rice Tubers
3) College of Horticulture & Main Campus of Kerala Agricultural University, Vellanikkara	Plantation crops Pepper Vegetables Cashewnut	
4) Agronomic Research Station, Chalakudy	Water management	
5) Research Station for Aromatic and Medicinal plants, Odakkali.	Lemon grass, medicinal plants	
6) Banana Research Station, Kannara	Banana and Pineapple.	
7) Sub Centre at Eruthiampathy (proposed)	Dry farming	Rice Pulses Oil seeds

CHAPTER 4

Extension

4.1 Linkages with extension agencies

4.1.1 Research Advisory Committee

The Zonal Research Advisory Committee for the Central Zone has been constituted with members from among the senior Research Scientists of the university, Officers of the Department of Agriculture, Minor irrigation and Co-operation and also from the Development Department. Representatives of the local bodies and elite farmers are also envisaged to be co-opted as members of the Advisory Committee. The Committee will be holding half-yearly meetings for assessing the farming situations and identifying the production constraints. Research priorities will be determined during the meetings and a regional research plan will be formulated which would include work of different stations under the University, state department and NARP sponsored projects. Periodical review of the programmes, will be made during the meeting and new projects, modifications of on going project etc. will be formulated based on the review of the the progress and evaluation of the programmes.

4.1.2 Laison with the Department of Agriculture

The Headquarters of the Joint Director of Agriculture is located at Palghat. The Joint Director of Agriculture have jurisdiction over the complete Central Zone area. Deputy Directors of Agriculture are stationed at the Headquarters of the three districts of the zone viz., Palghat, Trichur and Ernakulam. Besides two more Deputy Directors of Agriculture are functioning as Head of the Farmers Training Centres at Trichur and Pattambi one Deputy Director of Agriculture for Horticultural Development with Headquarters at Ernakulam and another in-charge of the Fertilizer quality control Laboratory at Pattambi also have their jurisdiction of activities in Central zone area. In addition to these, the Deputy Director of Agriculture attached to the Land Mortgage Bank, Palghat is in charge of the Coconut Development programmes in the zone. The zonal advisory committee includes all these officers besides the District Agricultural officers and the Subject Matter Specialists of the Department of Agriculture. The ultimate objective of the Zonal Advisory Committee is to formulate Package of practices recommendations specific to each farming situation of the zone.

4.1.3 Training and Visit System

The T and V programme is scheduled to be implemented in the Central zone area. The resource personnel for imparting training to the

Departmental Officers will be selected from the Research personnel of the Zone. The Lead Station, Regional Agricultural Research Station Pattambi is already conducting training courses for the Departmental Officers on Rice Production Technology under the Minikit programme.

4.1.4 Adoption of Villages

The Regional Agricultural Research Station, Pattambi has adopted two villages viz., Trithala and Keezhayoor near the station under the Lab-to-Land programme and the adopted farming families are given periodica training and are provided with input materials, like improved varieties of planting materials and livestocks. Adaptive trials will be laid out in those villages as well as in other locations of the zone for evaluation of the research data at the beneficiary level, under specific farming situations. A Krishi Vigyan Kendra is also functioning in the Central Zone with Regional Agricultural Research Station, Pattambi as Headquarters. Regular Kisan Melas, Farmers seminars, Field days etc. are programmed under the auspices of the Kendra and regular visit of the farmers to the Research stations of zone are envisaged. Training programme for farmers to impart practical knowhow of improved farming practices will be taken up under the Krishi Vigyan Kendra. Tribal Development Programmes are another important field in which the activities of the Regional Agricultural Research Station will be given emphasis.

4.2 Reporting of research data and Recommendations

The Zonal Research Committee after the review and evaluations of the research programme of the Central Zone will approve specific package of practices recommendations for each farming situation of the zone. These materials will be brought out in the form of pamphlets, popular articles, farming bulletins, handouts and radio talks etc. for carrying the message to the beneficiary level in the influence area, of not only the Central Zone but also to the whole state as the research responsibilities of the Regl. Agricultural Research Station, Pattambi with regards to rice crop, pulses and rice based farming systems cover the whole state of Kerala. Information charts, models, plans, photographs etc. depicting the improved cultural and farming practices will be prepared and a Central museum will be established at the Regional Agrl. Res. Station, Pattambi for the benefit of visiting farmers and Scientists. The extension wing attached to the Regional Agricultural Research Station, Pattambi will be functioning as a communication centre for the Central Zone.

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. 12-2/81-Edn. IV Dated 27th Aug. 1981

To

The Comptroller, Kerala Agricultural University
P. O. Mannuthy, Trichur.

Sub: National Agricultural Research Project for strengthening of regional research capability of agricultural universities—administrative approval for implementation of the sub project for Regional Research Station, Pattambi with a centre at Mannuthy and a Station at Eruthampathy under Kerala Agricultural University.

Sir,

I am directed to invite a reference of letter enclosing the revised sub-project proposals for the setting up of a regional research station at, Pilicode for support from National Agricultural Research Project (NARP).

I am directed to convey the approval of the council to the implementation by the KAU of the sub-project for Regional Research Station, Pattambi with a centre at Mannuthy and a station at Eruthampathy involving a total allocation of Rs. 84.46 lakhs (Rupees eighty four lakhs and forty six 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 details of the item-wise 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/Govt. of Kerala. The project cost and expenditure sanction of the sub-project beyond 31st March 1983 is subject to approval by the Expenditure Finance Committee of the Ministry of Finance (Government of India).

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

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

The University is requested to take urgent action to implement the project according to the agreed guidelines in respect of recruitment of staff, procurement of equipment, preparation of Master Plan, implementation of civil works/programmes, etc.

Expenditure during 1980-81 will be met from the ICAR budget provision of Rs. 4/-crores for NARP. The expenditure beyond 1982-83 will be subject to the clearance of Finance for continuation of NARP during VI Plan.

The sanction issued with the concurrence of the Ministry of Finance vide their U. O. No. 2225/81/Fin.IV dated the 22nd August 1981.

Yours faithfully
Sd/-
(M. C. JAYARAMAN)
Deputy Project Coordinator (A)

Copy forwarded for information and necessary action to:

1 Sri. N. Kaleeswaran, Vice-Chancellor, Kerala Agricultural University, P. O. Mannuthy 680 651, Trichur, Kerala.

4 Dr. P. C. S. Nair, Director of Research, Kerala Agricultural University, Vellanikkara.

5 Registrar, Kerala Agricultural University, Trichur.

6 University Engineer, Kerala Agricultural University,

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 atmost 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 additional scientific and supporting staff specified in the sub-project 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 well 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 in 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 it, if it reasonably considers that the University, in incurring expenditure, has seriously breached the guidelines contained above, a specific circumstance 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(Table—1)

Additional staff recommended at Pattambi

Discipline	Professor	Assoc. Professor	Asst. Professor	Total
Agronomy	—	2 *	2	4
Plant Breeding	1	—	1	2
Soil science	1	—	2	3
Entomology	—	—	1	1
Agrl. Economics	—	1	1	2
Extension	—	—	1	1
Horticulture	—	—	1	1
Biochemistry	—	—	1	1
Agrl. Engg/Soil conservation	—	1	1	2
Total	2	4	11	17
Mannuthy				
Agronomy	—	1	—	1
Plant Breeding	—	1	—	1
Agrl. Engineering	—	—	1	1
Total	—	2	1	3
Eruthampathy (New Station)				
Agronomy	—	1 **	—	1
Plant Breeding	—	—	1	1
Total	—	1	1	2

* To be trained in agricultural meteorology if agronomy man not available soil science man trained in Meteorology.

** If not available Asst. Professor may be appointed.

Annexure II

NARP Sub-project for regional research station, Pattambi with a centre at Mannuthy and a station at Eruthampathy at Kerala Agricultural University (KAU)

PROJECT COST AND FINANCING

(Rs. in lakhs)

Category	1981-82 (6 months)	1982-83	1983-84	1984-85	1985-86	1986-87 (6 months)	Total
I. NARP							
1. Incremental staff (Table–2)	2.32	5.19	5.36	5.61	5.81	2.74	27.03
2. Travelling allowance	0.06	0.16	0.16	0 16	0.16	0.10	00.80
3. Civil works (Table-3)	2.01	11.00	11.00	—	—	—	24.01
4. Equipment (Table-4)	4.42	9.00	9.00	3.00	—	—	25.42
5. Operating cost (Table–5)	0.60	1.40	1.40	1.40	1.40	1.00	7.20
Total NARP	9.41	26.75	26.92	10.17	7.37	3.84	84.46
II. University							
1. Normal or commercial cost of cultivation	0.10	0.21	0 21	0.21	0.21	0.11	1.05
2. Station maintenance	—	0.10	0.10	0.10	0.10	0.05	0.45
3. Utilities/Overheads	—	0.05	0.05	0.05	0.05	0.05	0.25
Total University	0.10	0.36	0.36	0.36	0.36	0.21	1.75
Grant total I & II	10.29	26.11	27.28	7.53	7.73	4.05	86.21

University/State liability after 5 years (Annual)

Incremental staff	5.97 lakhs
Operating cost	1.40 ,,
Equipment replacement @ 10%	2.54
Total	9.91 lakhs

ANNEXURE II (Table 2)
STAFF COAST AND PHASING

Designation and scale of post	No. of posts	1981-82 (6 months)	1982-83	1983-84	1984-85	1985-86	1986-87 (6 months)	Total
I Lead Station—Pattambi								
a) Scientific posts								
i) Professor (1450-2050+100)	2	0.20	0.48	0.50	0.52	0.54	0.26	2.50
ii) Assoc. Professor (1125–1725)	4	0.35	0.79	0.82	0.84	0.88	0.40	4.08
iii) Asst. Professor (800–1600)	11	0.70	1.54	1.62	1.69	1.76	0.77	8.00
Total (a)	17	1.25	2.81	2.94	3.05	3.18	1.43	14.66
b) Supporting staff								
i) Laboratory Attendant (330–515)	2	0.05	0.12	0.12	0.13	0.13	0.07	0.62
ii) Driver (330–515)	2	0.05	0.12	0.12	0.13	0.13	0.07	0.62
iii) Tractor Driver (330–515)	1	0.03	0.06	0.06	0.07	0.07	0.04	0.33
iv) Photographer (470–830)	1	0.04	0.08	0.08	0.09	0.09	0.05	0.43
Total (b)	6	0.17	0.38	0.38	0.42	0.42	0.23	2.00
c) Administrative staff								
i) Administrative Officer (910–1550)	1	0.07	0.16	0.16	0.17	0.17	0.08	0.81
ii) Stenographer (420–720)	3	0.11	0.23	0.23	0.23	0.24	0.12	1.16
iii) Duplicator Operator (330-515)	1	0.03	0.06	0.06	0.06	0.07	0.04	0.32
Total (c)	5	0.21	0.45	0.45	0.46	0.48	0.24	2.29
Grand total I	28	1 63	3.64	3.77	3.93	4.08	1.90	18.95
II Mannuthy centre								
a) Scientific post								
i) Assoc. Professor (1125-1725)	2	0.18	0.39	0.41	0.42	0.44	0.21	2.05
ii) Asst. Professor (800–1600)	1	0.05	0.14	0.15	0.16	0.17	0.06	0.73
Total (a)	3	0.23	0.53	0.56	0.58	0.61	0.27	2.78

1	2	3	4	5	6	7	8	9
b) Supporting staff								
i) Design Engineer (750-1450)	1	0.06	0.13	0.13	0.14	0.14	0.07	0.67
ii) Sr. Technician (450-785)	1	0.03	0.08	0.08	0.09	0.09	0.05	0.42
iii) Sr. Draftsman (450–785)	1	0.03	0.08	0.08	0.09	0.09	0.05	0.42
iv) Technician Gr. III (350–580)	2	0.06	0.13	0.13	0.14	0.14	0.07	0.67
v) Attendant (330–515)	2	0.06	0.12	0.13	0.13	0.13	0.06	0.62
Total (b)	7	0.34	0.54	0.54	0.59	0.59	0.30	2.80
Total II (a & b)	10	0.47	1.07	1.10	1.17	1.20	0.57	5.58
III. Eruthampathy centre								
a) Scientific Staff								
Assistant Professor (800–1600)	2	0.12	0.28	0.29	0.30	0.31	0.16	1.46
Total (a)	2	0.12	0.28	0.29	0.30	0.31	0.16	1.46
b) Supporting Staff								
i) Agrl. Demonstrator (410–720)	2	0.07	0.15	0.15	0.16	0.16	0.08	0.77
ii) Peon (280–400)	1	0.03	0.05	0.05	0.05	0.06	0.03	0.27
Total (b)	3	0.10	0.20	0.20	0.21	0.22	0.11	1.04
Total III (a & b)	5	0.22	0.48	0.49	0.51	0.53	0.27	2.50
Total I, II & III	43	2.32	5.19	5.36	5.61	5.81	2.74	27.03

ANNEXURE II (Table 3)

CIVIL WORKS

Pattambi

(in sq. m.)

Division	Staff	Area m^2 (includes grossing factor)	Unit	Floor area
Agronomy				
	Store	20	1	20
	Analytical Laboratory	150	1	150
	Professor	25	1	25
	Assoc. Professor	25	3	75
	Total			270
Plant breeding				
	Laboratory	25	5	125
	Store	20	1	20
	Professor	25	1	25
	Assoc. Professor	25	2	50
	Total			220
Agrl. Chemistry & Soil Science including centre for laterite management				
	Processing room	70	1	70
	Laboratory	25	12	300
	Store	20	2	40
	Instrument room	20	1	20
	Chamber room	20	1	20
	Professor	25	1	25
	Assoc. Professor	25	3	75
	Total			550
Nematology & Entomolgy				
	Laboratory	25	3	75
	Instrument room	20	1	20
	Store	25	1	25
	Assoc. Professor	25	1	25
	Total			140
Pathology				
	Laboratory	25	3	75
	Culture room	20	1	20
	Media preparation room	20	1	20
	Store	20	1	20
	Assoc. Professor	25	1	25
	Total			160

Other departments			
Extension			
Assoc. Professor	25	2	50
Agrl. Economics			
Assoc. Professor	25	1	25
Statistics & others			
Jr. Asst. Professors	25	9	225
Meteorology	25	1	25
Utility room	50	1	50
Total			375
Administration			
Assoc. Director	40	1	40
Steno to Assoc. Director & Office	30	1	30
Central Office	100	1	100
Stationery record room	30	1	30
Seminar room	100	1	100
Dark room	20	1	20
Library	100	1	100
Total			420
Total lab.			2135
Floor area available			1349.61 or 1350.00
Addl. area recommended			785.00
Farm			
Seed store	100	1	100
Fertilizer store	40	1	40
Drying yard	100	1	100
Sales counter	40	1	40
Implement & Tractor shed	100	1	100
Green house	75	1	75
Glass house	40	1	40
Net house	40	1	40
Jeep shed	40	1	40
Meteorological lab.	100	1	100
Total			675
Residential	*No. of posts*		
Assoc. Professor	6	196 x 2	392
Asst. Professor	7	120 x 2	240
Other posts	24	50 x 2	100
Total			732
Mannuthy			
Field laboratory		25 x 7	175*
Officer in charge		room already available	
*includes engineering lab. also			

Residential			
Assoc. Professor	196	1	196
	Total		371
Eruthampathy			
Field laboratory	25	2	50
Assoc. Professor	25	1	25
Residental			
Assoc. Professor	196	1	196
	Total		271

Abstract

Estimate of cost estimates of civil works

Pattambi		
Laboratory	785 sq. m. at Rs. 1125/sq. m.	8.83 lakhs
Research Farm		
Structure	675 sq. m. at Rs. 500/sq. m.	3.37 lakhs
Residential	732 sq. m. at Rs. 800/sq. m.	5.86 lakhs
		18.06 lakhs
Mannuthy		
Field lab.	175 sq. m. at Rs. 1125/sq. m.	1.97 lakhs
Residential	196 sq. m. at Rs. 800/sq. m.	1.57 lakhs
		3.54 lakhs
Eruthampathy		
Field lab.	75 sq. m. at Rs. 1125/sq. m.	0.84 lakhs
Residential	196 sq. m. at Rs. 800/sq. m.	1.57 lakhs
		2.41 lakhs
Total of (1), (2) & (3)		24.01 lakhs

ANNEXURE II (Table 4)

List of equipments

1 Research wing on farm implements and machinery

Sl. No.	*Items*	*Cost (Rs.)*
1	*Material Testing of Equipment*	
	Brinnell/Rockwell hardness tester Carbon/ sulphur analyser	25,000
2	*Draft Measuring Equipment*	
	Mechanical, electrical and hydraulic dynameters	17,500
3	Strain Indicators with recorders	35,000

4	*Measuring tools* Types, scales, calipers, vernier calipers, micrometers, guages, dial guages, universal lever protractors, combination etc. surface plate	15,000
5	*Prime movers* Electrical motors and Head engines	10,000
6	*Workshop tools, accessories on equipment* Milling attachment, sheet bending machine electric operated blower, workshop hand tools, machine tools (grinders, drillers, etc.) Hydraulic jack, weighing balances, chain block, platform cranes, trolleys etc.	2,75,000
7	*Drawing and Drafting equipment* Ammonia printing machines, copying machine, paper trimmer, staplers, drawing equipment	12,500
8	*Electrical energy Measuring Equipment* Voltmeter, Ammeter, Multimeters, power factor meters, energy meters, whattmeters, Electrical testers, storage batteries	10,000
		3,95,000 or
		Rs. 3.95 lakhs

II. Research wing on onfarm irrigation engineering

Sl. No.	Items	Cost (Rs.)
1	*Soil testing equipment* Soil moisture meter, oven, balances. bulk density measuring apparatus, soil samplers, soil strength measuring equipment like vene sheet apparatus, cone penetrometer, particle size sieve sets, sieve shaker	35,000
2	*Air/fluid measuring equipment* Anemometers (vene, hot wire) stop-watches, Voltmeters, orific meters, gas flow meters, notches water meters, velo-moters etc	
3	*Pressure measuring equipment* Merometers, pressure guages, vacuum gauges, Benometers	5,000
4	*Prime movers and pumps* Motor pumps, diesel engines, etc.	35,000
5	*Electrical control equipment* Variable speed drivers, inverter stroboscope	
		2,25,000 or
		Rs. 2.25 lakhs

III. Research wing on small scale farm level processing technology

Sl. No.	Items	Cost (Rs.)
1	*Temperature measuring equipment* Thermometers, temperature recorder with matching thermo couplers and recorders	1 25,000
2	*Prime movers:* Motors and diesel engines	12,000
3	*Special workshop tools and accessories* Shaping machine, boring machine press, spot welding machine, pipe bending machine etc.	60,000
4	*Speed measuring equipment* Digital/Mechanical tachometer, Stroke counter, revolution counter	12,500
		2,09,500 or
		Rs. 2.09 lakhs

IV Miscellaneous

Calculators, work tables, audio visual aids and equipments, cupboards and racks for storing delicate instruments and workshop tools	1,25,500 or
	Rs. 1.26 lakhs

Laboratory equipments

Agronomy and Soil Sciences

Hot air oven	2
Muffle furnace	1
Analytical balance	1
Top pan balance	1
Deionizor	1
Centrifuge	1
Conductivity bridge	1
Magnetic stirrer	1
Constant temperature bath	1
Micro kjeldal digestion unit	4
Distillation apparatus	2
Block digestor	2
Water still	1
Fume hood	1
Homogenizer	2
Gas plant	1

Wet sieving machine	1		
Seed moisture tester	1		
X–ray defraction unit	1		
Petrographic microscope with accessories	1		
Micropedological equipment	1		
	Total		692000 or
		Rs.	6.92 lakhs

Plant Breeding & Plant Physiology

Hot air oven	1	5000
Microscope	2	8000
Microtome	1	5000
Refrigerator	1	7000
Single pan balance	1	4000
Leaf area meter	1	5000
		34,000 or
	Rs.	0.34 lakhs

Nematology, Entomology and Pathology

Binocular microscope	2	30000
Autoclave	1	8000
Oven	1	4000
Incubator	1	12000
Deep Freeze	1	7000
Centrifuge	1	7000
Shaker	1	5000
Inoculation chamber	1	5000
Vacuum oven	1	12000
Vacuum pump	1	10000
Insect rearing chamber	1	5000
		105000 or
	Rs.	1.05 lakhs

Meteorology

Thermohygrograph	1	7000
Nett radiometer	1	7000
Lux meter	1	10000
Automatic rain guage	1	3000
Thermometer	5	5000
		32000 or
	Rs.	0.32 lakhs

Water management

Tensiometer	100	10000
Permeameter	2	10000
Conductivity bridges	4	8000
Run off measurement device	1	15000
Pressure plate & Membrane-Apparatus	1	13000
Infiltrometer	1	5000
		61000 or
		Rs. 0.61 lakhs

Field equipment

Tractor with implements	1	125000
Power tiller	1	40000
Sprinkler units	1	50000
Weighing scales	2	20000
		2,35000 or
		Rs. 2.35 lakhs

Transport

Mini Bus (Lead station)		150000
Car (,,)		75000
		225000 or
		Rs. 2.25 lakhs

Office equipment

Typewriter	2	10,000
Duplicating machine	1	15,000
Electronic calculator	5	20,000
		45000 or
		Rs. 0.45 lakhs

Library documentation, education

Micro film reader and other accessories	1 set	25000
Slide projector	1	5000
Camera	1	10000
		40000 or
		0.40 lakhs
25% for equipment cost less Rs. 5,000/-piece		3.2 lakhs
	Total	25,42,000
		Rs. 25.42 lakhs

ANNEXURE—II (Table 5)

Research operation costs

ICAR

		Rs. in akhs
Pattambi		
For 17 scientists @ Rs. 8000/- per annum 6.80 but limited to Rs. 6.00		6.00
Mannuthy		
For 3 scientists @ Rs. 8,000/- per annum		1.20
Eruthampathy		
For 2 scientists @ Rs. 8000/- per annum		0.80
	Total	8.00

University

B	Normal or commercial cost of cultivation of 30 ha. rice @ Rs. 3000/- pulses and oilseeds 10 ha @ Rs. 1500/- banana for 5 ha @ Rs. 4000/- tapioca 5 ha. at Rs. 2000/- other tubers 5 ha @ Rs. 2000/- miscellaneous crops 5 ha @ Rs. 2000/- and water management studies 5 ha. @ Rs. 2000/-	1,05,000
C	Gross income off setting cost of cultivation	65,000
D	Station maintenance	
	i) Station maintenance $1\frac{1}{2}\%$ of civil work	45,000
	ii) Utilities and other overheads	25,000

OO