National
Agricultural
Research
Project

STATUS REPORT

(SOUTHERN 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, Southern, Special and High Range Regions) with a total financial outlay of Rs. 489.01 lakhs for a span of five years have been sanctioned.

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

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

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

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

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

P. C. S. NAIR
Director of Research

24th April, 1984.

CONTENTS

CHAPTER 1

The State and its Agricultural characteristics

1.1 Delineation of the area

Kerala is one of the smallest states in India with an area of 38,863 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 (6883.8mm) 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 the 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

MAP OF KERALA
(SOUTHERN REGION - NARP)
NORMAL RAINFALL(mm)

ERNAKULAM

VEMBANAD LAKE

KADUTHURUTHY AGRIL. SUB DIVISION (T&V)

PALAI AGRIL. SUB DIV. (T&V)

MEENACHIL R.

KOTTAYAM AGRIL. SUB DIV. (T&V)

RUBBER RES. INST. OF INDIA

IDUKKI

ALLEPPEY AGRIL. SUB. DIV. (T&V)

PAMBA R.

CHENGANNUR AGRIL. SUB DIV. (T&V)

ARABIAN SEA

ACHANKOVIL R.

ADOOR AGRIL. SUB DIV. (T&V)

SPECIAL STATION. NARP. SOUTHERN REG.

KALLADA R.

KOTTARAKARA AGRIL. SUB DIV. (T&V)

MANIMALA R.

QUILON AGRIL. SUB DIV. (T&V)

ITHIKKARA R.

PALODE - CPCRI (ICAR)

KALLAR

ATTINGAL AGRL SUB DIV. (T&V)

KILLIYAR

MEDUMANGAD AGRI. SUB. DIV. (T&V)

KARAMANA

KARAMANA MODEL AGRO RES. KAU.

KARIYAVATTOM RES. DEPTS., UNIVERSITY OF KERALA.

CTCRI (ICAR)

AKKULAM CENTRE FOR DEVT. STUDIES.

TRIVANDRUM

PAPPANAMKODU REG. RES. LAB. CSIR.

VELLAYANI: COLLEGE OF AGRI. KAU. REG. RESEARCH STATION NARP. SOUTHERN REG.

NEYYATTINKARA AGRI. SUB DIVISION (T&V)

NEYYAR

BALARAMAPURAM COCONUT RES. STATION - KAU.

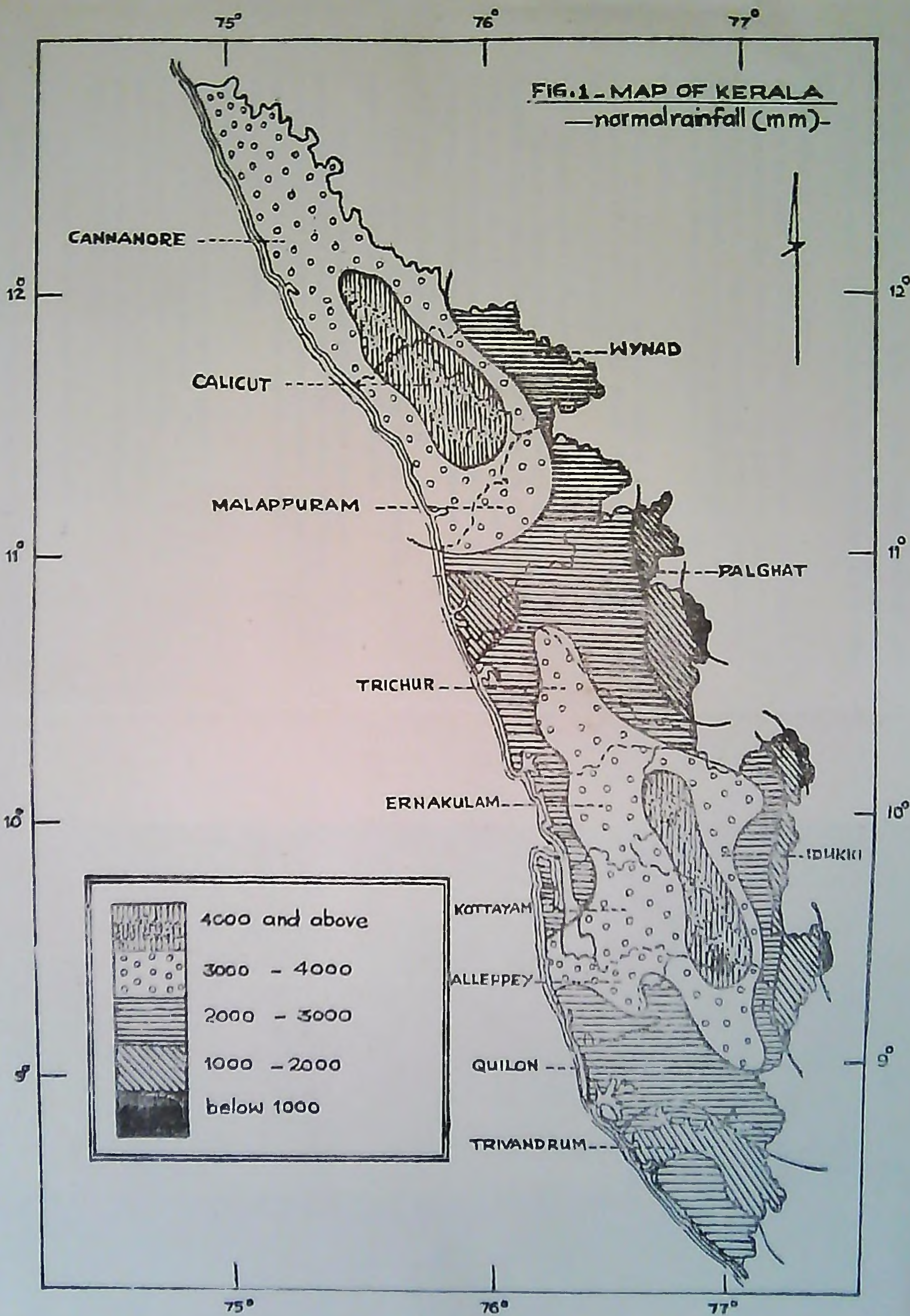
N

	4000 & ABOVE
	3000 - 4000
	2000 - 3000
	1000 - 2000
	PROBLEM AREA
	RIVERS & LAKES
	DIST. BOUNDARY
■	DIST. HEADQUARTERS

-GGNAIR-

FIG.1 - MAP OF KERALA

—normal rainfall (mm)-



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

1.3.6 Potential evapotranspiration

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

1.3.7 Sunshine

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

1.3.8 Special weather phenomena

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

1.3.9 Climate and plant growth

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

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

1.4 Soils

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

The important features of these soils are detailed below:

1.4.1 Red loams

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

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

1.4.2 Laterites

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

1.4.3 Coastal alluvium

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

1.4.4 Riverine alluvium

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

FIG. 2. MAP OF KERALA

- Soil types -

cannanore

kozhicode

malappuram

trichur

ernakulam

kottayam

alleppey

quilon

trivandrum

kottappadi

palghat

idukki

RED LOAMS

LATERITES

COASTAL ALLUVIUM

RIVERINE ALLUVIUM

GREYISH ONATTUKARA

BROWN HYDROMORPHIC

HYDROMORPHIC SALINE

ACID SALINE

BLACK SOILS

FOREST LOAMS

12°

11°

10°

9°

75°

76°

77°

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.

1.48 Acid saline

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

i) Kayal soils

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

ii) Karappadam soils

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

iii) Kari soils

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

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

1.4.9 Black soils

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

1.4.10 Forest loams

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

1.5 General soil fertility ratings for Kerala soils

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

Table 1.1— Fertilizer recommendation based on soil test values

Soil fertility class	% Organic C: Sandy	% Organic C: Clayey/loamy	Recommendation of N, as % to general recommendation	Available P, kg/ha	Exchangeable K, kg/ha.	Recommendation of P & K, as % to general recommendation
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 km^2 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 25,43,129. Kerala leads all other states in India in literacy with 69.17 per cent, the national average being 36.17 per cent. The total number of workers is reported as 62.2 lakhs, out of which 34.5 lakhs are either cultivators, agricultural labourers or those attending to livestock farming, forestry, fishing, plantation management or other activities related to Agriculture. This indicates the pre-dominance of agricultural workers in the State.

1.8 Land use and farming systems

1.8.1 Land tenure system

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

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

1.8.2 Land use and cropping pattern

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

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

	Area (lakh ha)
Total geographical area	38.85
Forest	10.82
Land put to non-agricultural use	2.60
Barren & uncultivable land	0.75
Permanent pastures & grazing land	0.06
Land under miscellaneous tree crops	0.66
Cultivable waste lands	1.23
Fallow other than current fallow	0.27
Current fallow	0.42
Net area sown	22.04
Area sown more than once	6.82
Total cropped area	28.86

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

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

1.8.3 Major Crops

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

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

Crops	Area (lakh ha)	Production (lakh t)	Average yield (kg/ha)
Rice	7.70	12.73	1592
Tapioca	2 73	40.44	14787
Banana & other plantains	0 53	6.60	12367
Coconut	6.61	3211(*)	4860(**)
Arecanut	0.62	10919(*)	175217(**)
Pepper	1.07	0.26	247
Rubber	2.14	1.24	579
Ginger	0.13	0.33	2589
Cardamom	0 55	0.03	53
Tea	0 36	0.47	1202
Coffee	0.53	0.28	525
Cashew	1.37	0.84	617
Cocoa	0.13	0.02	153

(*) million nuts (**) nuts

1.8.4 Farming systems

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

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

1.8.5 Coconut based farming systems

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

1.8.6 Rice based farming systems

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

1.8.7 Homestead farming systems

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

1.9 Research organisation

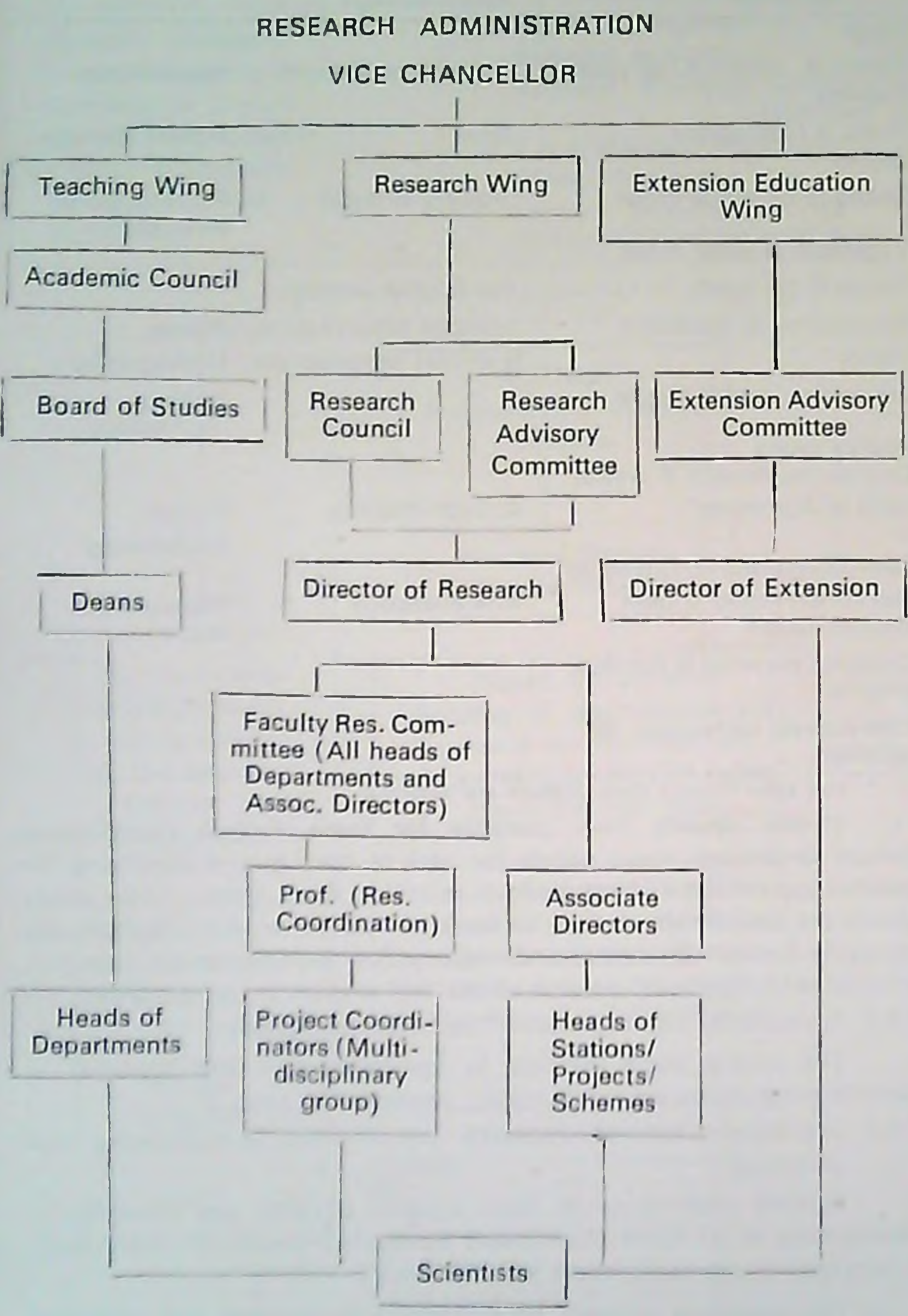
1.9.1 Organisational set up

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

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

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

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


RESEARCH ADMINISTRATION
VICE CHANCELLOR
Teaching Wing
Research Wing
Extension Education Wing
Academic Council
Board of Studies
Research Council
Research Advisory Committee
Extension Advisory Committee
Deans
Director of Research
Director of Extension
Faculty Res. Committee (All heads of Departments and Assoc. Directors)
Prof. (Res. Coordination)
Associate Directors
Heads of Departments
Project Coordinators (Multi-disciplinary group)
Heads of Stations/ Projects/ Schemes
Scientists

PROJECT CO-ORDINATION GROUPS

Agriculture	Veterinary & Animal Sciences	Fisheries
Rice*	Cattle & buffaloes*	Aquaculture
Coconut, arecanut, oil palm		
Cashew	Goat	Fishery Biology
Fruits & Floriculture		
Spices	Poultry & ducks	Fish processing technology
Cocoa & beverage crops		
Vegetable & tuber crops	Pig & other animals	
Pulses & Oil seeds	Artificial insemination & animal reproduction	Fishery Hydrography
Essential oil & medicinal plants		Fishing Technology
Sugarcane, jute & mesta		
Fodder crops		
Crop pests, disease & weeds	Animal diseases	Fishery Engineering
Soils & Agronomy*		
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

Suggestions from

- Research Council
- Faculty Research Committee
- Coordination Groups
- Director of Research
- Director of Extension
- Deans of Faculties
- Vice-Chancellor

Suggestions from

- Extn. Functionaries
- Regional workshop
- Regional Research Advisory Committee
- T & V Monthly Workshops
- District Seminars
- Farmers' Group discussions
- Package of Practices workshop

SCIENTIST
Formulation of Specific Projects

Heads of Station/ Project/Scheme

Discipline – wise meeting convened by Heads of Departments (Review & Suggestions)

Projects requiring immediate attention

Ad hoc sanction

Project Co-ordinator (Scrutiny of the technical programme by multidisplinary groups of scientists with expertise in the crop/area)

Faculty Research Committee (Detailed analysis of priority, technical perfection, resource utilisation etc. by the Heads of Department & Co-ordinators Approval)

Director of Research (Sanction for implementation)

Research Council (Formal approval)

MONITORING THE PROGRESS AND EVALUATION OF THE RESULTS

SCIENTIST

Monthly Reports

Director of Research (Monitoring the progress of work)

Discipline-wise meeting convened by the Heads of Departments

(Overall review of projects in the discipline & suggestions)

Annual and conclusion Reports

Heads of Stations/Projects/Schemes (Scrutiny of data Assessing the Contribution by individual scientists)

Project Co-ordination Groups (Discussion & Evaluation of the results by the multidisciplinary group of scientists with expertise in the crop/area)

Faculty Research Committee (Evaluation of results. Suggestions for further work. Recommendation for inclusion in the Package of Practices)

Director of Research (Publication of Annual Research Reports. Presentation of the report to the Govt. and General Council. Forwarding the findings to the Director of Extension for inclusion in the Package of Practices workshop)

Research Council

(Formal approval. Review of priorities. Issue of broad guidelines)

MAP OF KERALA

KERALA AGRICULTURAL UNIVERSITY
TEACHING & RESEARCH CAMPUSES

R.A.R.S. NORTHERN REGION

R.A.R.S. CENTRAL REGION.

R.A.R.S. REGION OF PROBLEM AREAS

R.A.R.S. SOUTHERN REGION

N

12°
11°
10°
9°

75°
77°

TAMIL NADU

- 7 PILICODE
- 6 PANNIYUR
- CANNANORE
- 9 WYNAD
- CALICUT
- ANAKKAYAM 5
- MALAPPURAM
- 2 NILAMBUR KUNNU
- 18 THAVANUR
- 8 PATTAMBI
- PALGHAT
- TRICHUR
- MANNUTHY 3
- 2 15 5 8 17 4 14 1
- 19 KANNARA
- 10 CHA[illegible]AKUDI
- 20 11 ODAKKALI
- 8 VYTILLA ERNAKULAM
- PAMPADUMPARA 12
- IDUKKI
- KUMARAKOM 7
- KOTTAYAM
- ALLEPPEY 13 THIRUVALLA
- 8 [illegible]
- 8 KA[illegible]
- TRIVANDRUM
- 16 VELLAYANI
- 10
- 7 BALA[illegible]RAMA-PURAM

- POULTRY FARM
- LIVESTOCK FARM
- VETERINARY HOSPITAL
- PIG BREEDING FARM
- CASHEW RESEARCH STATION
- PEPPER RESEARCH STATION
- COCONUT RESEARCH STATION
- RICE RESEARCH STATION
- HORTICULTURAL RESEARCH STATION
- AGRONOMIC RESEARCH STATION
- AROMATIC & MEDICINAL PLANTS RESH. STATION
- CARDAMOM RESEARCH STATION
- SUGARCANE RESEARCH STATION
- KERALA AGRICULTURAL UNIVERSITY-MAIN CAMPUS
- COLLEGE OF HORTICULTURE
- COLLEGE OF AGRICULTURE
- COLLEGE OF VETERINARY & ANIMAL SCIENCES
- INSTITUTE OF AGRICULTURAL TECHNOLOGY
- BANANA & PINEAPPLE RESEARCH STATION
- COLLEGE OF FISHERIES
- DISTRICT HEAD QUARTERS

The Pathanamthitta District was formed on 1-11-1982 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
	Panniyur	Pepper	Pulses

1	2	3	4
	Anakkayam** Tavanur	Cashew	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	2	3	4
	Anakkayam** Tavanur	Cashew	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.

.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	Ambalavayal	20.00 |	33.37	3.99	37.36
Range	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 about 10% of the total investment. This amount is required for land acquisition, station maintenance and basic cultivation costs.

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 re-orientation of the Programmes of the Central Institutes located in the

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

The Committee recommended a detailed procedure for formula-on of programmes for the Regional Research Stations with the active volvement of the development functionaries.

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

The Committee was of the view that the staff strength at the fferent stations has to be improved to give a better proportion bet-een the campus and the outlying stations. The University may consider ncentives to retain the staff at the not-so-well-developed Regional tations.

10.3.6. Extension

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

The extension unit at each Regional Station should be admini-tered by the Associate Director. But the various specialists working n 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.

CHAPTER 2

General Agricultural Characters of the Southern Region

.1. Delineation of the zone

The Southern Region of Kerala comprises of the districts of rivandrum, Quilon, Alleppey and Kottayam. The sandy soils of *Onattukara* egion in the districts of Quilon and Alleppey, the coastal saline tract, the roblem soils of *Kuttanad* and the high ranges falling in some of these istricts are, however, not included in this Region.

The Southern Region, is bounded on the East by Tirunelveli district f TamilNadu, on the South by Kanyakumari district of Tamil Nadu, on the orth by Ernakulam and Idukki districts of Kerala State and on the West y the Arabian Sea. The Region lies between north latitudes 8° 17' and 0° 21' between east longitudes 76° 17' and 77° 25'.

The total geographic area of the four districts constituting the outhern Region is 10,899 sq. km. which includes some of the problem eas and high ranges for which separate NARP regions have been entified. Twentytwo taluks and fiftyseven Community Development locks exist in these districts. However, the Southern Region comprises eighteen taluks and fortyfive Blocks only. Details of the different luks and Blocks contained in the Region are furnished below:

Administrative divisions of the districts under the influence area of the NARP (Southern Region)

District	Taluk	Block	Panchayat	Village
ivan-um	Neyyatin-kara	Parassala	Parassala Karode Kulathur Chenkal Thirupuram Poovar	Parassala Kulathur Chenkal Thirupuram
	,,	*Perumka-davila	Vellarada Kunnathukal Kollayil Perumkadavila Aryancode Ottasekhara-mangalam Perumpazhu-thoor	Vellarada Kunnathukal Kollayil Perumkadavila Keezharoor Ottasekhara-mangalam Neyyatinkara (T)

	Athiyannoor	Athiyannoor	Athiyannoor
		Kanjiramkulam	Karumkulam
		Karumkulam	Kottukal
		Kottukal	Kulathummal
		Vizhinjam	
		Venganoor	
Trivandrum	"	Thiruvallom	Thiruvallom
Neyyatinkara	Nemom	Maranalloor	Maranalloor
		Balaramapuram	Pallichal
		Pallichal	
Trivandrum	"	Kalliyoor	Nemom
		Nemom	Marukil
		Marukil	Vilappil
		Vilappil	
		Vilavoorkal	
Trivandrum	Trivandrum (Rural)	Vattiyoorkavu	Aramada
		Chettivilakom	Anchamada
		Ulloor	Randamada
		Kadakampalli	Chengazhassery
			Cheruvikkal
			Ulloor
			Kadakampalli
			Chettivilakom
			Madathuvilakom
	Kazha-kkuttom	Sreekariyam	Iroopara
		Pothencode	Kazhakuttom
		Mangalapuram	Menamkulam
		Andoorkonam	Melthonnackal
		Kadinamkulam	Keezhthonnackal
		Kazhakkuttom	Veiloor
		Attipra	Andoorkonam
			Kadinamkulam
			Pallippuram
			Uliyazhathura
			Attipra
			Pangappara
Nedumangad	*Vellanad	Vellanad	Vellanad
		Poovachal	Veeranakkavu
		Kattakkada	Mannoorkara
		Kuttichal	Uzhamalackal
		Uzhamalackal	Tholicode
		Tholicode	

	Nedumangad	Karakulam	Karakulam
		Aruvikkara	Nedumangad (T)
		Vembayam	Vembayam
		Anad	Anad A & B
		Panavoor	Panavoor
	*Vamanapuram	Vamanapuram	Vamanapuram
		Manikkal	Manikkal
		Nellanad	Nellanad
		Pullampara	Pullampara
		Nanniyode	Palode
		Kallara	Kallara
		Pangode	
Chirayinkil	Kilimanoor	Pulimath	Pulimath
		Karavaram	Karavaram
		Nagaroor	Navaikulam
		Kilimanoor	Nagaroor
		Pazhayakunnumel	Vellaloor
		Navaikulam	Kilimanoor (T)
		Madavur	Pazhayakunnumel
		Pallickal	Koduvazhanoor
			Alamcode
			Madavur
			Pallickal
	Chirayinkil	Azhur	Sarkara-
		Chirayinkil	Chirayinkil
		Kadakkavoor	Azhoor
		Vakkom	Keezhuvalam
		Anjengo	Kunthalloor
		Kizhuvalam	Kadakkavoor
		Mudakkal	Attingal (T)
			Avanavanchery
			Keezhattingal
			Elamba–
			Mudakkal
			Idakkode
	Varkala	Vettoor	Vettoor
		Cherunniyoor	Cherunniyoor
		Edava	Aiyroor
		Elakamon	Varkala (T)
		Chemmaruthy	Edava
		Manampoor	Chemmaruthy
		Ottoor	Manampoor
			Ottoor

Quilon	Quilon	Ithikkara	Poothakulam	Poothakulam
			Paravoor	Paravur
			Kalluvathukkal	Kalluvathukkal
			Chathannur	Meenad
			Adichanalloor	Adichanalloor
			Nedumpana	Nedumpana
		Mukhathala	Mayyanad	Mayyanad
			Eravipuram	Quilon (T)
			Vadakkevila	Eravipuram
			Thrikkovilvattom	Vadakkevila
			Kottamkara	Thrikkovilvattom
				Kottamkara
		Anchalum-moodu	Kilikolloor	Kilikolloor
			Thrikkadavoor	Thrikkadavoor
			Thrikkaruva	Thrikkaruva
			Sakthikulangara	Sakthikulangara
		Chittumala	Perinad	Perinad
			Kundara	Mulavana
			East Kallada	East Kallada
			Perayam	Mundro island
			Mundro island	
Kunnathur	Sastham-kotta		Sasthamkotta	Sasthamkotta
			Poruvazhy	Poruvazhy
			West Kallada	West Kallada
			Kunnathur	Kunnathur
			Sooranad South	Sooranad South
			Sooranad North	Sooranad North
			Kadampanad	Kadampanad
			Pallickal	Pallickal
		Parakkode	Adoor	Adoor
			Erath	Erath
			Ezhamkulam	Ezhamkulam
			Enadimangalam	Enadimangalam
			Kalanjoor	Koodal
			Kodumon	Kodumon
				Angadikkal
				Peringanad
Pathanam-thitta	Elanthur		Chenneerkara	Chenneerkara
			Omallur	Omallur
			Elanthoor	Elanthoor
			Naranganam	Naranganam
			Mullapuzhassery	Mullapuzhassery
			Kozhencherry	Cherukole
			Cherukole	

	*Ranni	Chittar	Perunad
		Ranni–Perunad	Vadasserikkara
		Vadasserikara	Ranni
		Ranni	Chethakkal
		Ranni–Angadi	Pazhavangadi
		Ranni–Pazhavan-gadi	Angadi
		Vechoochira	
	*Konni	Aruvappalam	Konnithazhom
		Konni	Konni
		Malayalapuzha	Iravon
		Mylapra	Malayalapuzha
		Pramadom	Pathanamthitta(T)
		Vallikkode	Pramadom
			Vallikkode
*Pathana-puram	Pathana puram	Vilakudy	Vilakudy
		Thalavoor	Thalavoor
		Piravanthoor	Pattazhi
		Pattazhi–Vadakkekkara	Pidavoor
		Pathanapuram	Pathanapuram (T)
		Pattazhi–Thekkekkara	Punalur (T)
			Piravanthoor
	*Anchal	Kulathupuzha	Kulathupuzha
		Yeroor	Yeroor
		Alayamon	Alayamon
		Anchal	Anchal
		Edamulackal	Edamulackal
		Karavalur	Karavalur
		Thenmala	Arackal
			Edamon
Kottara-kkara	Chadaya-mangalam	Chithara	Chithara
		Kadackal	Kadackal
		Chadayamanga-lam	Chadayamanga-lam
		Ittiva	Ittiva
		Velinalloor	Velinalloor
		Elamadu	Elamadu
		Nilamel	Nilamel
	Vettikkavala	Ummannoor	Ummannoor
		Vettikkavala	Vettikkavala
		Melila	Melila
		Mylom	Mylom
		Kulakkada	Kulakkada
		Pavithreswaram	Pavithreswaram

		Kottarakkara	Veliyam	Veliyam
			Pooyappally	Thrippilazhikom
			Kareepra	Pooyappally
			Ezhukone	Kareepra
			Naduvathur	Ezhukone
			Kottarakkara	Naduvathur
				Kottarakkara (T)
Alleppey	*Chenga-nnur	Kulanada	Kulanada	Kulanada
			Mezhuveli	Mezhuveli
			Aranmula	Aranmula
			Mulakuzha	Mulakuzha
			Venmony	Venmony
		*Chengannur	Ala	Ala
			Mannar	Vadakkekkara
			Pandanad	Chengannur (T)
			Thiruvanvandur	Mannar
				Thiruvanvandur
				Pandanad
	*Thiruvalla	Koipram	Koipram	Koipram
			Thottapuzhasseri	Thottapuzhasseri
			Ayiroor	Ayiroor
			Ezhumattoor	Ezhumattoor
			Puramattom	Puramattom
			Eraviperoor	Eraviperoor
		Mallappally	Kallooppara	Kallooppara
			Mallappally	Perumpetty
			Kottanad	Kottangal
			Kottangal	Anicadu
			Anicadu	Mallappally
			Kunnamthanam	Kaviyoor
			Kaviyoor	
	*Ambala-puzha	Aryad	Aryad	Aryad
			Mannancherry	Mararikulam South
			Mararikulam South	
	*Sherthallai	Kanjikuzhy	Mararikulam North	Mararikulam North
			Kanjikuzhi	Kanjikuzhi
			Thanneermukkom	Thanneermukkam South
			Mohamma	Thanneermukkam North
			Sherthallai-South	Kokkotha-mangalam
				Sherthallai (North)
				Sherthallai (South)

istrict	Taluk	Block	Panchayat	Village
		*Pattana kkad	Aroor Ezhupunna	Aroor
		*Thycattu-sserry	Chennam-Pallippuram Mattathil Bhagom Perumbalam Arukkutty	Pallippuram Mattathil Bhagom
ottayam	*Changa-nassery	*Madappally	Karukachal Madappally	Karukachal Madappally
		Vazhoor	Vazhoor Nedumkunnam Kangazha Vellavoor	Vazhoor Nedumkunnam Kangazha Vellavoor
	Kanjira-ppally	,,	Chirakkadavu	Chirakkadavu
	,,	Kanjirappally	Manimala Erumeli Kanjirappally Parathode Mundakkayam Koottickal	Manimala Erumeli (North) Erumeli (South) Kanjirappally (T) Cheruvally Mundakkayam (T) Koottickal
	*Kottayam	*Pallom	Puthuppally Vijayapuram Ayarkunnam	Puthuppally Vijayapuram Kottayam (T) Manarkad Ayarkunnam
		Pambady	Akalakkunnam Kooropada Pambady Pallikkathodo Elikulam	Akalakkunnam Kooropada Pambady Anikkad Elikulam
		*Ettumanoor	Athirampuzha Ettumanoor	Athirampuzha Ettumanoor
	Meenachil	Uzhavoor	Kanakkary Kuravilangad Elakkad Kidangoor Uzhavoor Ramapuram Veliyannur Kadaplamattom	Kanakkary Kuravilangad Elakkad Kidangoor Uzhavoor Ramapuram Veliyannur Kurichithanam

	Lalam	Karoor	Lalam
		Mutholi	Vallichira
		Kozhuvanal	Meenachil (T)
		Meenachil	Puliyannur
		Bharananganam	Poovarany
		Kadanad	Bharananganam
			Kadanad
			Vellilappally
	Erattupettah	Melukavu	Thalappalam
		Valiakumara-mangalam	Kondoor
		Thalappalam	Poonjar-Thekkekkara
		Erattupettah	Poonjar-Nadubhagom
		Teekoy	Poonjar-Vadakkekkara
		Thalanad	Melukavu
		Poonjar	
		Poonjar-Thekkekkara	
		Thidanad	
*Vaikom	Kaduthuruthy	Manjoor	Manjoor
		Kallara	Kallara
		Kaduthuruthy	Kaduthuruthy
		Njeezhur	Njeezhur
		Mulakulam	Mulakulam
		Velloor	Velloor
		Thalayolaparambu	Vadayar
	*Vaikom	Udayanapuram	Vaikom (T)
		T. V. Puram	Kulasekharamangalam
		Maravanthuruthu	Chempu
		Chempu	Vadakkemuri

* Part only included

The Southern Region has a total area of 7,262.23 sq. km supporting a population of 6,987,307. The rural and the urban break up of the population statistics in the Region is given in Table 2.1. Of the four districts, Kottayam has the lowest density of population (709 persons/sq. km) and this increases in the order—Quilon (763), Alleppey (1137) and Trivandrum (1578). Kerala is the only State in the country with predominance of females over males.

The Training and Visit system (T & V system) of Agricultural Extension has been implemented in the region under the Kerala Agri. Extension Project. The system involves reorganisation and strengthening of the agricultural extension service in the state.

Table 2.1 Population statistics in the Southern Region, NARP

District	Area sq k. m.	Number of house-holds	Population			Density persons per sq km	Sex ratio females per 1000 males	Genl. literacy rate in the district
			Persons	Male	Female			
Trivandrum								
T*	1,581.80	470.887	2,495,396	1,229,286	1,266,110	1,578	1,030	70.50
R	1,416.30	350,714	1,839,635	904,301	935,334	1,299	1.034	68 84
U	165 50	120,173	655 761	324,985	330,776	3,962	1,018	75.42
Quilon								
T	3,130 87	439,391	2,389,872	1,176,582	1,213,290	763	1,031	74.11
R	3,013.57	376,242	2,019,752	993,160	1,026,592	670	1,034	74.16
U	117.30	63,149	370,120	183,422	186,698	3,155	1,018	73.75
Alleppey								
T	689.71	147,910	7842,87	382 359	401 928	1,137	1,051	78.52
R	660 52	135,850	718,933	350,305	368 628	1,088	1.052	78.47
U	29.19	12,060	65,354	32,054	33,300	2,239	1,038	78.83
Kottayam								
T	1,859 85	229,277	1,317,752	659,012	658,740	709	1,000	81.66
R	1,819.67	210,507	1,210,600	605,622	604,978	665	999	81.51
U	40.18	18,770	107,152	53,390	53,762	2,667	1 007	83.04
Total								
T	7,262.23	1,287,465	6,987,307	3,447 239	3,540,068	962	1,027	
R	6,910.06	1,073,313	5,788,920	2,853,388	2,935,532	838	1,029	
U	352.17	214,152	1,198,387	593.851	604,536	3,403	1,018	
Kerala State								
T	38,863.0	4,423,277	25,453,680	12,527,767	12,925,913	655	1,032	70.42
R	37,075.0	3,631,344	20,682,405	10,167,417	10,514,988	558	1,034	69.11
U	1,788.0	791,933	4,771,275	2,360,350	2,410,925	2,669	1,021	76.11

* T = Total R = Rural U = Urban

Source: Census of India, Kerala Paper 3 of 1981.

The number of T&V Sub Divisions and the Agricultural Extension Units contained in each Agricultural Sub Division in the Region are given in Table 2.2.

Table 2.2: Taluk, blocks T&V Sub Divisions and A.E Units located within the Southern Region.

District	Municipality/ Corporation	Taluks	Blocks	Panchayats	T&V Sub Divisions	AE Units
Trivandrum	4/1	4	12	79	3	28
Quilon	3	5	14	86	3	33
Alleppey	2	4	8	36	3	14
Kottayam	3	5	11	57	3	25

The T&V Sub Division and AE units in the Southern Region are listed in Appendix II

2.2 Holdings

The operational holdings in the Region are generally very small. Nearly 12 lakhs operational holdings exist in the four districts. It can be observed from Table 2.3 that maximum number of holdings (63.82 per cent) is within the range of 0.04 hectare to 0.25 hectare size. According to the classification by the District Rural Development Agency (DRDA), the size of small holdings is one to two hectares and that of marginal holdings below one hectare. Accordingly, there exist 78.407 (6.56%) small holdings and 1,084,760 (90.72%) marginal holdings in the districts constituting the Region. Table 2.3 indicates that there is a predominance of marginal and small farmers in the Region.

Table 2.3. Distribution of operational holdings according to size or holding in the Southern Region districts

Size hectares	Number of holdings				
	Trivandrum district	Quilon district	Alleppey district	Kottayam district	Total
Below 0.04	80,131	66,074	63,542	42,474	252,221
0.04— 0.25	120,811	160.823	159,394	69,839	510,867
0.25— 0.50	48,537	67,601	44,793	26,603	187,534
0.50— 1.00	29,838	43,697	31,721	28 832	134,138
1 00— 2.00	13,749	22 223	16,942	25,493	78,407
2.00 – 3.00	3,071	4,062	3,939	7,761	18,833
3.00— 4.00	1,097	1,597	1,821	3,925	8,440
4.00— 5 00	252	416	574	1,044	2,286
5.00— 10.00	333	470	510	965	2,278
10.00— 20 00	112	111	91	183	497
20.00— 30.00	12	25	22	64	123
30.00— 40.00	8	—	9	21	38
40.00— 50.00	—	—	4	—	4
50.00— and above	30	43	4	13	90
Grand Total	297,981	367,142	323,366	207 267	1,195,756

Source: Agricultural census, 1970–71.

2.3 Climate

The data on the mean monthly values of rainfall, maximum and minimum temperatures and relative humidity in the Southern Region for the last 10 years are given in Appendix-III to V. In terms of standard climatic types, as any other Region of the State, the Southern Region can also be considered as having a tropical humid climate, with an oppressive summer and plentyful seasonal rainfall. The climate is moist and hot, drier in the interior region. The hot season from March to May is followed by the South West monsoon from June to September, the peak month being June. The mean date of onset of the South West monsoon varies from May 25th to June 1st. The North East monsoon occurs from October to November, the peak period being October. The rest of the period (December to May) is generally dry with or without occasional light showers. The variations in temperature during the above seasons are not appreciable. The data regarding the various weather parameters that build the climate of the Region are presented below:

2.3.1. Rainfall

The data on the "normal" rainfall in the Southern Region districts, based on 50 years data (1901-1950) are given in Table 2.4.

Table 2.4: Normal rainfall (mm) in the Southern Region districts

Month	Normal rainfall			
	Trivandrum	Quilon	Alleppey	Kottayam
January	21.2	24.1	25.9	30.3
February	18.0	32.1	29.3	26.3
March	48.0	83.6	59.0	59.8
April	118.1	166.3	133.5	141.3
May	213.9	260.3	291.5	244.9
June	391.1	547.4	663.8	609.3
July	257.4	449.6	552.3	652.9
August	204.5	318.1	370 3	429.5
September	168.9	226.1	272.7	273.2
October	280.2	314.9	330.2	330.6
November	210.2	242.9	219.4	212.8
December	70.1	64.8	64.1	71.7
Total (Annual)	2,001.6	2,760.2	3,012.0	3,082.5

Source: Bureau of Economics and Statistics, Kerala, Trivandrum

The data on the mean rainfall in the Region for the past ten years are presented in Table 2.5.

Table 2.5: Mean rainfall (mm) during the past ten years (1972-'81)

Month	Rainfall			
	Trivandrum	Quilon	Alleppey	Kottayam
January	10.40	1.97	6.64	0.70
February	18.83	46.22	61.88	33.76
March	35.15	53.36	48.18	48.86
April	125.02	222.90	169.78	139.29
May	225.54	241.73	325.76	267.33
June	288.10	422.75	591.33	636.22
July	200.65	430.24	579.39	544.80
August	168.11	275.07	379.20	445.73
September	171.04	253.71	271.17	283.58
October	283.03	361.66	405.11	321.39
November	252.24	299.79	247.86	237.25
December	54.80	35.49	89.38	44.59
Annual	1,832.91	2,644.89	3,174.68	3,003.50

• Mean of nine years

Source: India Meteorological Department, Trivandrum.

Tables 2.4 and 2.5 clearly indicate that there is an increase in the total precipitation in an year, as one goes from South to North in the Region (South of Trivandrum to North of Quilon district). However, the number of rainy days in an year decrease from South to North The number of rainy days and the general spread of total precipitation is more in the Southern part than in the Northern part of the influence area. This is attributed to the more active North East monsoon in the southern part of the Region. The peak period of South West monsoon in the Region is June and early July, while the peak month of the North East monsoon is October. Unlike in the other regions of the State, the rainfall is comparatively well distributed in this region, with the result that the effective annual rainfall is more (about 80%) than that in other Regions. The South West monsoon contributes about 55-60 per cent of the annual precipitation, while the North East monsoon contributes about 35-40 per cent. The first crop season of paddy is benefited by the South West monsoon and the second crop, by the North East monsoon.

2.3.2 *Humidity and Temperature*

The data on the mean humidity and temperature in the Region for the past ten years are presented in Tables 2.6 and 2.7 respectively.

Table 2.6: Mean Relative Humidity (%) in the Southern Region districts for the past ten years (1972-81)

Month	Relative Humidity							
	Trivandrum		Punalur (Quilon District)		Alleppey**		Kottayam*	
	08 30hr	17 30hr	08 30hr	17 30hr	08 30hr	17 30hr	08 30hr	17 30hr
Jan.	72.78	61.44	81.22	43.67	72 80	63.50	77 25	70.62
Feb.	74.56	62 56	80 50	44.60	77 90	68.50	77.33	68.11
March	78 22	66.56	82.10	50.40	77.20	70.37	75.00	66.89
April	80.56	73.56	87 00	68.50	78.50	73.12	75.67	74.44
May	87.56	75 22	90.22	69.33	82.80	77.00	79.89	73.06
June	87 56	79.44	92.60	76 20	89.70	84.75	87.56	82.88
July	88.56	79.11	93 00	77.40	92.00	87.25	88.39	83.88
Aug.	89.11	78.89	93.67	74.78	92.00	85.75	86.89	83.22
Sept.	86.33	78.89	91.67	72.78	88.20	83.50	84.11	80.44
Oct.	87.22	80.33	92.44	77.67	86.10	79.00	84.00	79.44
Nov.	85.89	78.78	92.29	76.00	84.30	75.50	84.87	81.25
Dec.	77.11	68.89	85.50	61.75	77.60	67.25	78.67	73.22

** Mean of eight years * Mean of nine years

Source: India Meteorological Department, Trivandrum.

Table 2.7: Mean temperature (°c) in the Southern Region districts for the past ten years (1972-81)

Month	Mean Temperature							
	Trivandrum		Punalur		Alleppey		Kottayam*	
	Mean Max.	Mean Min.	Mean Max.	Mean Min.	Mean Max.	Mean Min.	Mean Max.	Mean Min.
Jan.	31.66	21.63	34.10	20.24	31.91	22.42	32.37	21.67
Feb.	31.95	22.54	35.47	21.15	32.14	23.71	33.26	22.25
March	32.79	23.91	36.76	22.36	32.97	25.23	33 91	23.60
April	32.79	25.05	35.19	23.19	33.24	25.86	34.31	23.64
May	31.73	24.74	33.70	23.58	32.38	25.59	33.56	23.46
June	29.99	23.57	30.84	22.83	32.38	23.94	31.07	22.99
July	29.52	23.12	30.05	22.53	28.91	23.29	30.10	22.67
Aug.	29.44	23.06	30.19	22.68	28.78	23.56	30.12	22.52
Sept.	30.12	23.31	31.74	22.76	29.71	23.95	30.67	22.97
Oct.	29.97	23.26	31.68	22.67	30.33	23.96	31.10	23.09
Nov.	30.19	23.04	31.87	22.21	30.74	24.06	30.82	22.72
Dec.	31.20	22.84	32.65	21.39	31.59	23.64	31.79	22.80

* Mean of nine years

Source: India Meteorological Department, Trivandrum

From the Tables 2.6 and 2.7, it could be seen that there is not much variation in the relative humidity and temperature in the districts of the

Region. However, the parameters are felt at a higher level towards the northern parts of the Region, particularly in Kottayam and Quilon districts.

2.3 3 Evapo-transpiration

The annual evapo-transpiration is low in the Southern Region (1700 mm) when compared with that in the northern parts of the State. Within the Region, however, there is not much variation in the rate of evapo-transpiration. Based on the open pan evaporimeter data, the mean daily evaporation is 4.30 mm in Trivandrum

2.4 Topopraphy

Based on physical features and agro-climatic situations obtaining in the Region, three natural, well marked sub-regions (into which the whole State is divided) are identified in the Southern Region. These are the low lands the mid lands and the mid uplands. The elevation of the land gradually increases from the low land sea coast to the eastern mid upland area. The three sub-regions show considerable variations in the physiographic conditions, agricultural situations, industrial development etc.

The low land is located in the sea coast, in the back water areas and near the lakes covering the low lying areas. Due to its lower physiographic position, water table in the low land is relatively high. The texture of the soil ranges from sandy loam to clay depending on the type of soil on the adjoining slopes. Rice and rice-based cropping systems are prominent in the low land.

The mid land forms the major part of the cultivated land and is located in the central part of the Region. This physiographic tract includes low hills with steep side slopes enclosing narrow valleys and undulating plains bisected by numerous drainage channels. The land is rich in vegetation. Paddy, coconut, tapioca, pepper, ginger and banana are the main crops grown. Cultivation of spices is also done, though on a small scale. Valleys are very narrow in the districts of Trivandrum and Kottayam. On the other hand, in the districts of Quilon and Alleppey, they are more extensive.

Mid uplands are located at the foot hills of the Western Ghats and other isolated small hill tops consisting of steeply sloping elongated ridges and medium hills with intermittant deep narrow valleys running parallel to the Western Ghats. Crops grown in midlands are also grown in mid uplands.

The upland with its mountainous tracts and the thick ever-green tropical forests exists in all the four districts which constitute the Southern Region. The density of population is lowest in the uplands. The main crop in uplands is rubber. Monsoons take care of the water needs in the uplands. Precipitation is relatively high in this region.

SOIL MAP OF KERALA

SOUTHERN REGION

-NARP-

ERNAKULAM

KADUTHURUTHY AGRI. SUB DIV. (T&V)

PALAI - AGRI. SUB DIV. (T&V)

VEMBANAD LAKE

KOTTAYAM AGRI. SUB DIV. (T&V)

RUBBER RES. INST. OF INDIA

IDUKKI

ALLEPPEY AGRI. SUB-DIV. (T&V)

ARABIAN SEA

PAMBA R.

CHENGANNUR AGRI. SUB DIV. (T&V)

ADOOR AGRIL. SUB DIV. (T&V)

SPECIAL-STN. NARP-SOUTHERN REG.

KOTTARAKKARA AGRI. SUB DIV. (T&V)

ITHIKKARA R.

QUILON AGRI. SUB DIV. (T&V)

PALODE CPCRI.

KALLAR

ATTINGAL AGRI. SUB DIV. (T&V)

NEDUMANGAD AGRI. SUB DIV. (T&V)

KARIYAVATTOM REG. DEPTT. KERALA UNIVERSITY

CTCRI (ICAR)

KARAMANA

AKKULAM CENTRE FOR DEVT. STUDIES

TRIVANDRUM

KARAMANA MODEL AGRO RES. KAU

AGRO RES. STN. (CSIR)

NEYYATTINKARA AGRI. SUB DIV. (T&V)

VELLAYANI AGRI. COLLEGE NARP-SOUTHERN REG.

BALARAMAPURAM COCONUT RES. STN. KAU.

- RED LOAMS.
- LATERITES.
- COASTAL ALLUVIUM.
- RIVERINE ALLUVIUM.
- BROWN HYDROMORPHIC.
- HYDROMORPHIC SALINE.
- FOREST LOAMS.
- RIVERS AND LAKES.
- DIST. BOUNDARY.
- DIST. HEAD QUARTERS.
- PROBLEM AREA.

Soil

The soils are lateritic in origin and are formed by weathering of lic rocks due to heavy rainfall and leaching away of the bases. These characterised by accumulation of hydrated oxides of iron and alumi– n. The texture ranges from sand to sandy loam to sandy clay loam to loam. The soil reaction is acidic and the electrical conductivity is well in safe range. The soil is, in general, deficient in organic matter and t nutrients. In some locations of the southern most area of this on, ill drained soils rich in iron, often reaching toxic concentrations observed. Poor drainage in certain areas of the low lands aggrevates problem. Laterite soils, with hard pans, are found in the southern mid ls of this Region. The Trivandrum and Neyyattinkara taluks of the andrum district have red loam soils which are fairly well drained but are cient in organic matter and nutrients. The soils of the coastal areas of Region are fine sandy to coarse sandy in texture, low in plant nutrients have low water holding capacity (Fig.6). Coconut thrives well in the tal belt. Valuable mineral deposits such as Ilmenite, Rutile, Zircon, manite and Monazite occur in the beach sands in Neendakara and vara areas in the Quilon district, which are being separated and put to strial use.

Large deposits of china clay are available at Kundara, Karimbaloor, avana, Muthupilakad and Thevelakkara in the Quilon district. Lime deposits occur in Ashtamudi lake and other back waters.

In certain parts of Pathanapuram, Pathanamthitta, Nedumangad, nachil and Kanjirappally taluks, forest soils with moderately high ent of organic matter are found. These soils are supplied with medium of available nitrogen but are low in the status of available phosphorus potash.

1 Soil series and soil associations

Based on detailed soil survey of Trivandrum district as per soil nomy, four orders have been identified, viz., Entisols, Inceptisols, sols and Mollisols. Under these orders, ten soil associations and nty three soil series have been established. On the basis of similar eys of Quilon district, four orders viz., Alfisols, Entisols, Inceptisols and lisols have been identified and twenty soil associations have been esta– ned. It is significant that five soil associations—Kazhakuttom, Vizhinjom aravila, Varkala-Thonnackkal and Nedumangad-Palode associations, common to both the districts. Detailed soil survey maps for Kottayam Alleppey districts have, however, not been prepared. Details of the erent soil series and soil associations in the Region other than in ppey and Kottayam districts are given in Appendix VI.

2 Soil problems

The soils of mid land and the low land are poor in base status with

high acidity. The soils are generally deficient in available nitrogen, phosphorus and potash and respond to management practices. These soils offer problems of aluminium and manganese toxicity in the mid lands and of iron toxicity in the low lands, especially under conditions of water logging and restricted drainage which limit crop production.

2.6 Irrigation

Ten rivers namely, Neyyar, Karamana, Vamanapuram, Pumba, Achankoil, Kallada, Ithikkara, Meenachil, Moovattupuzha and Manimala form the major water sources of the river based irrigation system in the Region. Manimala, Pumba and Achankoil rivers are inter district rivers. Ashtamudi lake, Paravur lake, Edava-Nadayara lake and the fresh water lakes at Sasthamkotta and Vellayani also exist in the Region. Some of these lakes however, get contaminated with brackish water resulting from tidal waves from the adjoining sea.

The existing irrigation facilities in the Region are given below:

Only about 60% of the total geographical area of Trivandrum district is arable. Of this, a negligible percentage alone derive the benefit of assured irrigation throughout the year. Paddy is the main irrigated crop cultivated in areas of the district with assured water supply. Vegetables cultivated in parts of Neyyattinkara taluk, and betel vines cultivated in small holdings of Neyyattinkara and Nedumangad taluks are exceptions. These are irrigated by pot watering from rivers, streams and wells. Coconut, which is the most important cash crop, is seldom irrigated due to non availability of water particularly in the months December to May and as such, the crop can be generally considered as rainfed. However, in very small holdings in urban areas, a few farmers irrigate coconuts by pot watering.

The Neyyar irrigation project commissioned in the year 1964 is the only major irrigation project in Trivandrum district. The right and left bank canal systems, taking off from the dam, command 11,740 hectares of the net area in the taluks of Neyyattinkara, Trivandrum and Nedumangad. The sources as irrigation including the Neyyar Dam existing in the district are given in Table 2 8. The total irrigated area is 10.47 per cent of the total cropped area of the district.

In Quilon district also, paddy is the only crop which makes use of irrigation water. However, some vegetables are also cultivated under irrigation, though negligible in extent. The district has abundant water resources for exploitation. The four major rivers, viz., Pumba, Achankoil, Kallada and Ithikkara and their tributaries are flowing through the district. However, they have not been harnessed fully for irrigation. There is plenty of scope for increasing the irrigation potential in the district by implementing some minor irrigation schemes. The Kallada Project and

Pumba Project are the major irrigation projects under execution in the trict. It is expected that the Kallada project would serve an ayacut a of 92,000 ha. and the Pumba project, an ayacut area of more n 25,000 ha. in Quilon district on their completion.

ble 2.8: Sources of irrigation in Trivandrum and Quilon districts and gross area (ha) benefitted (1979–80).

Source	Trivandrum	Quilon
Major irrigation sources	11740 (Neyyar Dam Project)	—
Minor irrigation Class I	1695	1632
,, Class II	6235	5223
Lift irrigation	Nil	996
IPD units—Govt. Schemes	3224	1614
Total	22,894	9,465

urce: Chief Engineer (Irrigation), Kerala

The existing irrigation sources in the Alleppey and Kottayam tricts are given in Table 2.9.

ble 2.9: Sources of irrigation in Alleppey and Kottayam districts and gross area (ha) benefitted (1979–80)

Source	Alleppey	Kottayam
Minor irrigation Class I	3958	1266
Minor irrigation Class II	15596	5258
Lift irrigation	3430	376
IPD Units	2902	967
Total	25886	7877

ource: Chief Engineer (Irrigation), Kerala, Trivandrum.

In Kottayam district, the percentage area irrigated to the net area wn is comparatively negligible (5.5%). There is practically no irrigation the uplands. As the rivers in the district get dried in summer, nly very few lift irrigation schemes are executed. The Moovattupuzha ver Valley Project utilising the tail water from Idukki Hydroelectric roject, when commissioned, is expected to provide irrigation to zhavoor, Kaduthuruthy, Vaikom and Ettumanoor block areas.

The area irrigated in Alleppey district is only 12.4% of the total ea. Four rivers, viz., Meenachil, Manimala, Pumba and Achankoil ow through the district. The Vembanad and Kayamkulam lakes also lay a significant role in irrigation. Besides these, the Pumba Irrigation roject on completion is estimated to irrigate an area of 17,806 ha. Chengannur, Thiruvalla, Karthigappally and Mavelikkara taluks.

The vast extent of inland waters in Quilon and Alleppey districts and the coastal belt offers immense potential for development of inland fisheries in the Region. The sources of fishing consist of lakes, canals and rainfed tanks. Prawns, oil sardine, sardine, shark, thilapia, mackeral, cat fish, mullet, etroplus etc. are the important varieties. The reservoirs of irrigation projects are the other sources of water available for inland fishery. However, these water sources are yet to be properly exploited.

Lake waters, ponds and tanks are also used for retting coconut husk for the manufacture of coir and coir products.

2.7 Land use pattern

The data on land use pattern in the Region are furnished in Table 2.10.

2.8 Cropping pattern

There is a high degree of poly cropping in the Region, particularly in the midlands and mid uplands. Paddy is the main food crop in the low lands. The crop combinations and the crop sequences in the mid upland, mid land and low land presently followed by the farmers of the Region are given below:

Mid upland

Perennial—Rubber, Coconut, Arecanut, Pepper, Cashew etc.
Annual —Tapioca, Banana, Ginger etc.
Seasonal—Paddy, Pulses, etc

Mid land

Perennial—Coconut, Arecanut, Rubber, Jack, Cashew, Nutmeg, Cinnamon, Clove, Pepper, Cocoa etc.
Annuals —Tapioca, Banana, Ginger, Yams, etc
Seasonal—Paddy, Pulses, Vegetables, Groundnut, Sesamum, etc.

Low land

Perennial—Coconut
Annual —Tapioca,Banana, Fodder grass, etc.
Seasonal—Paddy, Pulses, Vegetables etc.

In the dry land area of the mid land and the mid upland mixed cropping pattern is generally followed. Coconut and tapioca are the major crops. Tapioca is grown in the slopes of small hills also. Annuals like sugarcane, pineapple, fodder grass etc., seasonals like tubers, pulses, vegetables sesamum and a wide variety of perennials like cashew, jack, pepper, cocoa, clove etc. are invariably seen in the mid lands and mid uplands.

In the wet lands, where rice-based cropping system is followed, the major crop sequences in the three seasons in the order (Virippu: April–May to September–October; Mundakan: September-October to December–January; and Punja: October–January to March-April) are as follows:

Table 2.10: Land use pattern in the Southern Region districts (1980-81) (in ha.)

Land use pattern	Kerala (actual)	Trivandrum	% to State	Quilon	% to State	Allappey	% to State	Kottayam	% to State
Total geographical area (according to village papers)	3,835,497	218,600	5.63	474,290	12.21	182,270	4.69	219,550	5.65
Forests	1,081,509	49,861	4.61	236,048	21.83	518	0.05	8,141	0.75
Land put to non-agrl. uses	269,824	17,345	6.43	24,822	9.20	30,838	11.43	19,065	7.07
Barren and uncultivable land	85,770	2,229	2.60	2,361	2.75	576	0.67	2,050	2.39
Pastures and grazing land	5,432	34	0.63	37	0.68	15	0.28	86	1.56
Land under miscellaneous tree crops, not included under net area sown	63,875	216	0.34	331	0.52	192	0.30	331	0.52
Cultivable waste	129,032	2,154	1.67	1,493	1.16	2,000	1.55	1,739	1.35
Fallow land other than current fallows	26,836	1,703	6.33	1,190	4.43	1,092	4.06	2,247	8.36
Current fallows	43,579	1,301	3.00	1,853	4.25	2,067	4.74	3,736	8.57
Net area sown	2,179,590	143,756	6.60	206,155	9.46	144,972	6.65	182,165	8.36
Ares sown more than once	705,250	84,169	11.93	88,106	12.49	73,352	10.40	48,024	6.81
Total cropped area	2,884,840	227,925	7.90	294,261	10.20	218,324	7.57	230,189	7.98

Source: Farm Guide, Government of Kerala, 1983.

Paddy—Paddy—Pulses
Paddy—Paddy—Vegetables/Oil seeds
Paddy—Banana
Paddy—Paddy—Fallow

These cropping sequences are followed based on the availability of water. In places where canal irrigation facility is not assured and no other type of irrigation is within the reach of the farmer, the field is kept fallow during the 3rd crop season which falls in summer.

With regard to paddy, the farmers in the Southern districts of the Region generally prefer to cultivate varieties which can give red rice and more straw. Cherady, a local long duration paddy variety, appears to be very popular in the southern districts of the Region, particularly during the second crop season, in view of its high straw content and red colour for the grain. However, both high yielding varieties and local varieties are cultivated.

Eventhough a poly-cropping pattern with a mixed stand of various crops with annuals and seasonals is observed in the mid lands and the mid uplands throughout the Region, four major farming systems can be identified as follows:

2.8.1 Rice-based farming system

The rice based farming system is prevalent in the low lands, where sufficient water is available for irrigation. A single crop, two crops or even three crops of paddy are taken, depending on the availability of water. In *kayal* (back water) lands, paddy is raised after dewatering of impounded water. During the third crop season, which is the summer season, if sufficient water is not available for paddy cultivation, seasonal crops like vegetables such as cucumber, bhindi or amaranthus, pulses or oil seeds are grown in the rice fallows. If no water is available, the field will be kept fallow till the south west monsoon appears, ie., till May end. Under the rice-based cropping system, crop rotation is followed in some places. Here, the rice fields are utilised for raising banana or even tapioca as continuous cultivation of rice results in the attack of pests and diseases and heavy infestation of weeds. Hence, some farmers grow banana in low lands after the harvest of paddy crop. After banana is harvested, tapioca is raised or banana is repeated in the crop sequnece, after which rice is again grown during the third year. This cropping system is followed by some farmers in Neyyattinkara, Kottarakara etc. The following cropping sequence is seen:

Rice-Rice-Pulses—I year, Banana—II year
Rice-Rice-Rice—I year, Tapioca—II year

2.8.2 Coconut based farming system

In coconut based farming system, coconut will be the pivotal crop. This system is in vogue in mid uplands and hill slopes and level areas in

he mid lands. This cropping system includes a number of inter crops ke pepper, arecanut, tapioca, cocoa, banana, clove, ginger, turmeric, odder grass etc. and in some areas, upland rice, pulses and oil seeds. he selection of annual or seasonal crops is made depending on the age f the coconut plants so as to make the best use of the sunshine infiltrating the plantations for maximum out turn from unit area.

8.3 Tapioca based farming system

The mid land and mid uplands of the Region account for about 7% of the tapioca produced in the state. Out of the total area under apioca, about 40–50 per cent of the area is in the form of pure tapioca rop and about 30–40 per cent as inter crop in coconut gardens. In oth the situations, the main planting season is April–May which often xtends to June depending upon the distribution of South West monsoon. lanting in September-October synchronising with the onset of North–ast monsoon is also being practised. The crop is grown in a variety f soil conditions. Though M4 is the most popular variety under ultivation, a number of local varieties, and hybrids such as H–165, –2304, H–1687 are also being cultivated. The unstable market condi-on results in certain degree of risk in its production as a pure rop. Intercropping with suitable seasonal crops of short duration uch as pulses or oilseeds during the early stages of growth of apioca when the crop canopy is loss, is practised in some areas.

.8.4 Homestead farming system

Homestead is an operational farm unit or farming environment n which crop (coconut, tapioca, banana, tree-spices, pepper, vegetables, tc.) livestock, poultry and/or fish production is carried out mainly for he purpose of satisfying the farmer's needs. A complex interaction xists among soil, plants, animals, other inputs and environmental actors in the farmer's plot where he lives and manages.

This type of farming is unique to Kerala and particularly in the Southern Region where farmers utilise the available backyards of their houses for growing a variety of annual and seasonal crops of their own choice. Farmers choose their crops and crop combinations without any scientific basis, the only criterion being their home requirement. Cattle rearing is also undertaken in many homesteads, particularly in he sub urban and rural areas as a complementary enterprise. Crop plus livestock is almost the general rule in homestead farming. More than 50 per cent of the cultivated area in the Region is under homestead cultivation, where marginal and small farmers have coconut or tapioca as the main crop which is intercropped with a variety of perennials annuals and or seasonals. The area may vary from 0.02 ha to 1.0 ha. Homesteads raised in areas exceeding 1.0 ha. are not uncommon, but are

rare. The different perennials include jack, mango, cocoa, pepper, clove, etc. and the annuals include different cultivars of banana, pineapple, etc. Different vegetables, minor tubers, pulses etc. are the seasonal crops seen in this multi-tier system. This system is in vogue in the Region as the agro-climatic conditions favour the raising of a wide variety of crops. In some homesteads, mixed farming of crop-livestock or crop-livestock-fish is practised by farmers, where the waste from one can be recycled to serve as food for the other. The increased productivity of homestead gardens needs more attention, particularly for the small holdings of marginal and small farmers, since these constitute more than 50 per cent of the cultivated area in this Region.

2.8.5 Other farming systems

In certain isolated parts of the Region, farming system with banana, arecanut or pepper as the main crops, also exist.

2.9 Area under important crops

The data on the area under important crops of the Region presented in Table 2.11 show that the major crops according to area under cultivation are coconut, tapioca, paddy, rubber, cashew, pepper and pulses in that order. However, coconut as well as tapioca are grown in the homesteads, with different poly-crop combinations in coconut garden and with immense scope for intercropping in tapioca.

2.10 Production of important crops

The data regarding the production of important crops of the Region furnished in Table 2.12 also highlight the importance of coconut, tapioca, pepper, cashew and rice-based cropping systems in the influence area. Rubber is an important crop in Quilon and Kottayam districts in the mid uplands. This is evident in Table 2.12. Sugarcane is grown extensively around Pandalam and Thiruvalla in Alleppey district.

2.11 Productivity of important crops in the Region

Table 2.13 indicates the trend in productivity in respect of important crops grown in the influence area during a period of five years (1976-81).

Rice productivity during the Kharif season can be seen as unsteady during the years. During the Rabi seasons of these years, the productivity of rice in Trivandrum district shows a decreasing trend. Similar trend can be observed in Alleppey district also; but with a slight improvement during 1980 -81. In Quilon district, the productivity figures fluctuate during 1976-81, while in Kottayam district an increasing trend can be noted after 1978-79. The rice productivity in the summer seasons of 1976-81 has not altered appreciably in Trivandrum district, whereas in Quilon and Alleppey, the figures fluctuate. Increasing trend is noted in Kottayam district upto 1979-80 only.

Table 2.11: Area under important crops [in

Crop	Kerala (actual)	Trivandrum	% to State	Quilo
Rice				
Autumn (kharif)	349,243	15,361	4 40	24,1
Winter (Rabi)	354,132	16,115	4.55	25,0
Summer	98,324	1,107	1.13	8
Total	801,699	32,583	4.06	50,0
Tapioca	244,990	56,545	23.08	54,0
Coconut	651,370	73,771	11.33	81,7
Pulses including tur	33,859	3,240	9.57	2,1
Pepper	108,073	5,362	4.96	9,8
Arecanut	61,242	3,292	5.38	4,2
Ginger	12,662	183	1.45	1,2
Rubber	237,769	8,735	3.67	38,8
Cashewnut	141,277	6,403	4.53	8,6
Banana and other plantains	49,262	6,533	13.26	4,9
Sugarcane + Palmyra	20,990	719	3.43	3

Source: Farm Guide, Government of Kerala 198

uthern Region districts (1980-81)

Alleppey	% to State	Kottayam	% to State
33,019	9.45	13,485	3.86
25,372	7.16	10,799	3.05
24,075	24.49	7,664	7.79
82,466	10.29	31,948	3.99
19,592	8.00	23,003	9.39
63,114	9.69	51,115	7.85
1,034	3.05	2,116	6.25
4,843	4.48	12,786	11.83
2,865	4.68	2,525	4.12
276	2.18	3,418	26.99
4,273	1.80	63,232	26.59
3,863	2.73	1,337	0.95
4,337	8.80	4,559	9.25
2,437	11.61	748	3.56

Table 2.12: Production of important crops

Crop	Kerala (actual)	Trivandrum	% S
Rice			
Autumn (kharif)	553,748	22,685	4.
Winter (Rabi)	548,500	22,352	4.
Summer	169,714	949	0.
Total	1,271,962	45,986	3.6
Pulses	22,479	774	3.4
Tapioca	4,060,911	965,789	23.7
Coconut (million nuts)	3,008	354	11.7
Pepper (Black)	28,519	2,027	7.1
Arecanut (million nuts)	10,805	327	3.0
Ginger (dry)	32,039	447	1.4
Rubber	140.333	5,933	4.2
Cashew (Raw)	81,900	3,025	3.6
Banana and other plantains	317,405	40,819	12.8
Sugarcane (gur)	48,178	104	0.2

Source: Farm Guide, Government of Ke

Southern Region districts (1980-81)

% to State	Alleppey	% to State	Kottayam	% to State
7.18	56,167	10.14	23,301	4.21
7.63	36,741	6.70	19 324	3.52
0.34	51,950	30 61	15,853	9.34
6.46	144,858	11.39	58,478	4.60
7.67	843	3.75	1,513	6 74
24.38	272,917	6.72	408,993	10.07
11.44	294	9.77	188	6.25
12.07	1,007	3.53	1,777	6.23
5.01	366	3.88	370	3.42
10.84	680	2.12	9,608	29.99
18.21	2,771	1.97	36,145	25.76
8.53	2,013	2.46	727	0.89
9.09	20,140	6.35	35,528	11.19
3.00	12,498	25.94	1,504	3.12

The table also indicates a decrease in the productivity of tapioca 1977-78, compared to the preceeding year. However, an increase oral, is noticed from 1977–78 upto 1979-80, after which there is decrease, except in Quilon where a steady increase is seen. Among r districts, Kottayam has the highest tapioca productivity during 81. Highest productivity in Trivandrum and Alleppey districts are d during 1979-80. Similar trend is noticeable also in other districts, during 1976–77. In Quilon, a steady decrease in productivity upto

Table 2.13: Comparative productivity of important crops (kg/ha) in the Southern region during 1976–81

	Trivandrum District					Quilon District					Alleppey District					Kottayam District				
op	76-77	77-78	78-79	79-80	80-81	76-77	77-78	78-79	79-80	80-81	76-77	77-78	78-79	79-80	80-81	76-77	77-78	78-79	79-80	80
ıil	1405	1388	1630	1491	1477	958	1348	1593	1461	1646	1488	1346	1284	1630	1701	1513	1502	1759	1845	1
i	1498	1424	1489	1390	1387	1727	1533	1645	1801	1668	1853	1615	1216	1188	1448	1540	1526	1430	1559	1
nmer	829	520	822	851	857	821	589	680	989	708	2168	2406	2648	2637	2158	1704	1748	2166	2259	2
	14200	14050	14580	17230	17080	16480	12650	14500	16000	16750	15120	14900	15220	16100	13930	20180	16480	16620	20050	17
(no /ha)	5067	4221	5076	4767	4800	4183	4077	3970	3936	4205	5191	4768	5645	5221	4656	4033	3743	3527	3772	3
	494	506	505	239	239	460	444	444	795	795	435	422	391	839	815	369	294	296	716	
black)	230	223	266	331	378	313	267	296	364	350	130	202	227	261	208	150	101	79	109	
(no /ha)	118590	121613	52185	106302	99354	109671	121293	61006	120640	127251	98542	109894	57792	157784	127673	87970	92780	54951	135135	146
dry)	2351	2351	2441	2442	2441	2784	2784	2892	2718	2718	2348	2348	2441	2443	2405	3020	3324	2808	2811	2
	680	641	621	689	679	777	654	689	711	157	642	721	446	667	648	639	627	575	634	
t (raw)	478	727	485	509	480	926	949	738	835	805	911	763	865	538	521	380	681	316	564	
nd other ntains	4141	4710	4923	5988	6248	4077	4435	4964	5863	5877	3793	4335	4747	5097	4644	5153	7368	7784	7115	7
e (gur)	4933	4933	4921	4952	4952	4933	4534	4541	4400	4400	5097	5138	5090	5090	5190	5534	5535	5539	5478	5

ource: Background data from the Directorate of Economics and Statistics, Kerala

lields are located in the narrow valleys which are subject to rom the nearby hillocks during the monsoon, adding to its fertility. he Region is benefitted by well distributed rainfall throughout the ere is immense scope for introducing a variety of crops during mer season.

The table also indicates a decrease in the productivity of tapioca 1977-78, compared to the preceeding year. However, an increase eral, is noticed from 1977-78 upto 1979-80, after which there is decrease, except in Quilon where a steady increase is seen. Among ur districts, Kottayam has the highest tapioca productivity during 81. Highest productivity in Trivandrum and Alleppey districts are d during 1979-80. Similar trend is noticeable also in other districts, during 1976-77. In Quilon, a steady decrease in productivity upto 80 and an increase thereafter is seen, whereas in Trivandrum, ey and Kottayam, the figures for 1976-81 are seen unsteady.

The productivity of rubber in the four districts during the period 81 can be seen fluctuating.

It can also be seen from the table that Cashew productivity in drum and Quilon districts remains unsteady. However, in Alleppey , a decreasing trend and in Kottayam district an increasing trend is able after 1978-79.

The productivity of pepper in the Region is fluctuating and is highest lon district, followed by Trivandrum during the period 1976-81. figures are above the state average. Kottayam has the least producti- In Alleppey district, the productivity has not changed appreciably he years.

Constraints limiting production

General

al selection

The high yielding varieties have not been found suitable for the crop of paddy. There seems to be a need for evolving high g, slightly photosensitive varieties resistant to pests and diseases. for suitable strains of different crops that go in the homestead s and the crop rotations is being felt. As vegetables seem to well in this Region, varieties of different vegetable crops suitable Region need to be identified.

omy

The cultural schedules needed for the different crops suggested is Region have to be evolved. The planting season, plant tion, etc. in the multiple cropping pattern have to be studied. The ial and micro-nutrient requirements for the cropping patterns need o be worked out. Another special feature of this Region is that e fields are located in the narrow valleys which are subject to from the nearby hillocks during the monsoon, adding to its fertility. the Region is benefitted by well distributed rainfall throughout the there is immense scope for introducing a variety of crops during mmer season.

Plant Protection

This Region faces the most serious disease problem of coconut, namely the coconut wilt. In spite of the research work done at the Central Plantation Crops Research Institute, Kayamkulam for a number of years, no viable technology has been evolved to control the disease or to check its spread. A well-planned programme for the formulation of control measures would go a long way in increasing production of the coconut in the State.

A number of new diseases in rice, like stalk burn and brown leaf spot, in addition to rice blast have been noticed in this area. Control measures are needed to obtain the maximum yield potential of the new varieties.

Mixed farming

Cattle rearing is being undertaken in almost all homesteads as a complementary enterprise. Therefore, economic and efficient crop-livestock farming has to be evolved by fitting suitable leguminous fodder crops in the cropping pattern and by efficient organic recycling.

Management of the homestead gardens

A survey of homestead gardens will have to be done. The suitability of the different crops which grow in this poly-cropping system has to be understood. The compatability of the different crops as well as the agrotechniques required to obtain the maximum yield from each of the crops with the input supplied need to be worked out in detail. The ideal plant population in a particular garden (particularly a small garden of about 0.2 ha.) has to be worked out and the information transferred to the field. The long term effect on both soil productivity and pest/disease incidence in these gardens due to the growing of different crops may have to be ascertained. The suitability of the crops may have to be viewed from their nutrition, ability to grow under shade and the pest/disease complex of the different crops.

Varietal improvement

High yielding varieties of rice with resistance to important pests like the brown plant hopper and diseases like bacterial blight and sheath blight are to be evolved. Varieties of groundnut and oil seed crops like sesamum, soybean, suitable for this region have to be identified or evolved. Their suitability both as pure crops and as companion crops in tapioca may also have to be ascertained. Short duration varieties suitable for rice fallows need to be evaluated. High yielding tubers need to be identified.

Cropping system

Studies are required on crop-livestock integrated farming to exploit full potential from unit area. Cropping patterns suitable for rice area will have to be identified. The agro-techniques will have to be worked out

the cropping systems round the year, rather than arriving at the uirement for each crop separately. Agro-techniques for tuber crops, as ıre crop or as intercrop in coconut garden, will have to be stand-sed.

Control measures are needed for checking blast, sheath blight, ath rot, stalk burn and brown leaf spot diseases of rice. Biological trol of pea aphid will have to be worked out. Coconut diseases, icularly wilt, will have to be controlled.

2.2 *Specific*

e based farming system

Rice is grown in the low lands as a tranplanted or direct sown crop ng three seasons as shown below, depending upon the availability of er and other local conditions:

ppu	—	First crop (Autumn)	April-May to September-October
ndakan	—	Second crop (Winter)	September-October to December-January
ja	—	Third crop (Summer)	December-January to March-April

Non-availability of water is often a limiting factor in raising a third of rice during summer. Summer crops such as pulses, sweet potato, etables etc. are grown in a limited number of paddy fields where irriga- facility exists. In other cases, the fields are kept fallow during mer.

Low coverage of high yielding varieties of rice during the second season is found in several areas viz., Neyyattinkara, Quilon, arakkara, Adoor, Pathanapuram, etc., probably due to the non-availa- y of a high yielding variety suitable to these localities, with red grain more straw acceptable to the farmer community.

The major constraints limiting production in rice based cropping em are given below:

The soils of low lands are generally poor in base status with fairly acidity and low content of available plant nutrients. The low content utrients and low base status have resulted from the weathering under ical conditions, of soils which have originated from acidic rocks and hing down of the bases from the soil surface to lower horizons of the ile, leaving the surface soil acidic. These soils often offer problems of toxicity, especially under conditions of water-logging and restricted nage which limit crop production. Iron toxicity is a nutritional disorder vet land rice associated with excess soluble iron. The disorder occurs rongly acidic soils and acid sulphate soils of low base status and lts from the solubilisation of iron under anaerobic and acidic conditions ling to high ferrous concentration in the soil solution often exceeding

the toxic limit of about 300 ppm. Plants absorbing ferrous iron under such conditions may sometimes exhibit toxicity symptoms such as burning of leaf tip, reddish brown or yellow discoloration of leaves which later dry up resulting in stunted growth and decreased grain yield. This situation is seen in the low lands in Alleppey and Kottayam districts and parts of Quilon and Trivandrum districts.

Infection by sheath blight leads to poor filling of the rice grain and other diseases, particularly in the second crop season in Adoor, Kottarakkara, Quilon and Neyyattinkara. Endemic occurrence has been reported from Adoor and nearby areas.

Incidence of pests increases due to favourable weather factors for their multiplication.

Difficulty is observed in strictly following the recommended manurial schedules, due to unexpected and unfavourable climatic conditions during the cropping seasons.

Soil erosion causes sedimentation in the rice fields during monsoon seasons when the precipitation is heavy and the adjoining land is slopey.

Rice fields are fallowed in the third crop season (January to April) due to lack of irrigation facilities and lack of suitable drought resistant crop varieties.

Suitable crop combinations and crop rotations are not available in the rice based farming system, which are acceptable to the average farmers.

Coconut based farming system

In coastal belt and midlands, coconut is the main crop of dry land. A variety of perennials, annuals and seasonal crops are grown as inter-crops. In most cases, the crop combination is decided by the farmers based on their home requirements and availability of inputs, except in the large coconut plantations. Such being the case, the development and standardisation of ideal and scientific polycrop combinations, particularly for the homesteads in each location within the Region becomes a must.

The major constraints limiting production in coconut based farming system are:

Lack of a scientific proposition for an ideal polycrop combination in coconut gardens, including miscellaneous fruit trees such as mango, jack, etc.

High acidity of the soil with low content of available plant nutrients.

Soil erosion in monsoon seasons resulting in depletion of soil fertility.

Unscientific spacing, non-manuring, under–manuring and imbalanced manuring followed by some farmers in view of the high cost of manures and fertilisers and high cost of labour involved in manuring, both being not within the reach of many marginal and average farmers. There are

as where coconuts are planted very close, and not receiving adequate rients through chemical fertilisers.

Lack of irrigation facilit es coupled with low water holding capacity he soil, particularly in coarse textured soils and undulating topography ding to high leaching loss and surface runoff of water and nutrients ng rainy seasons.

Lack of standardised cheap techniques for post-harvest handling and rage of various produce. 'Copra' which is the dried kernel of coconut n item of great market demand. Climatic conditions during post-harvest dling of the kernel very often cause infection of the 'copra' by *Aspergillus* leading to hazards due to aflatoxin.

Lack of a cropping pattern to meet the requirements of home consumption as well as seasonal market demands.

Lack of a scientific proposal for a crop-livestock–fisheries mixed ning suitable to the coconut based system, incorporating the recycling nniques.

ioca based farming system

Tapioca is mainly cultivated in terraced areas in hill slopes of the lands and mid uplands of this region. Under monoculture or as an rcrop, tapioca occupies a considerable part of the cropped area, and is the second most important staple food of the state, next to rice.

The major constraints in tapioca based farming system are mentioned below:

Non acceptance of the high yielding tapioca varieties, other than variety, by the farmers. Many of these varieties are bitter to taste and industrial varieties, not preferred for home consumption. Research is progress at the Central Tuber Crops Research Station, Sreekariyam, vandrum for evolving varieties with good quality tubers and less HCN ntent. Some good quality tuber varieties have already been released m the station.

Unremunerative nature of tapioca cultivation on account of severe ack by rodents.

Lack of post-harvest technology for the preservation of tapioca ers.

Lack of suitable recommendations for seasonal crop varieties of ses and of oilseeds as intercrop with tapioca, during the early stages of wth of the latter, when the crop canopy is less. Work on these lines is progress to find out the varieties of pulses and groundnut which can ld well under such inter cropped situations.

mestead farming system

In Kerala, especially in the Southern Region, majority of the operational holdings come under homestead farming system. Coconuts, inter–

cropped with miscellaneous fruit trees such as mango, jack, guava etc. and various annual and seasonal crops are cultivated in homesteads, usually without any scientific basis for the selection and planting of such crops and crop combinations. Domestic need is the only criterion taken into consideration by the farmers. Multistoreyed cropping system is followed in many homesteads. Livestock becomes an essential component of the homestead in many cases. The dwindling size of the farm holdings causes problems for the farmer. To make his farm viable, he follows either poly culture or monoculture, as opposed to mixed farming, though a lot of horizontal and vertical space is left unutilised.

The major constraints in homestead farming system are given below:

Lack of suitable and economically viable crop combinations for homesteads.

Lack of a scientific crop-livestock-fish production technology with scope for organic recycling. This system is feasible in areas where fish rearing facility is available.

Lack of scientific cropping patterns to utilise all available resources such as ground water, farm and home wastes, solar energy, etc.

Non adoption of manurial recommendations by the farmers due to the high costs involved.

Lack of package of practices for the combination of crops as a whole.

Lack of genetically superior vegetables and other crops with high yield potential and resistance to pests and diseases.

Lack of processing techniques for ripe jack fruit and banana during the peak seasons.

In addition to the above major systems, farming systems based on banana, arecanut and pepper are also seen in certain parts of the Region. Pepper and arecanut are grown as major crops in some tracts of Nedumangad, Pathanamthitta, Pathanapuram, Meenachil and Kanjirappally taluks coming under the mid upland sub zone. Generally, these are under monoculture or are grown with some annual or seasonal intercrops. Wilt and pollu diseases are common in pepper. Different standards have to be tried for training pepper vines. A high yielding variety of pepper 'Panniyoor–1' released by the Kerala Agricultural University is being popularised in the Region and is in great demand. However, this variety does not perform well under shaded or partially shaded conditions.

Banana is another major crop raised by the farmers of this Region. It is cultivated in raised beds in paddy lands in certain parts of Trivandrum, Kottarakara, Adoor, Neyyattinkara and other taluks or in low lands in rotation after a paddy crop. Garden lands are used for the cultivation of banana and other plantains as a pure crop or as an intercrop with coconut.

en it is under monoculture there is ample scope for maximum utilis–n of the space and resources by raising vegetables, pulses, yams etc. ntercrops. Banana is seen as an integral part in all the homesteads. Trivandrum, Nedumangad and Attingal taluks, red banana is grown and sumed with preference. It is an exported commodity.

Only limited research efforts have been made to investigate the ential of these farming systems. Hence, detailed studies are required develop scientific basis for all practices in the banana-based, pepper–ed and arecanut-based farming systems.

2.3 Location specific problems of miscellaneous nature

Lack of a suitable fertiliser recommendation for 'Cheradi', a local g duration second crop rice variety, which is extensively grown in the uthern districts of the Region along with Kottarakara-1 and yamkulam-1.

Low coverage of high yielding varieties of rice during the second p season, probably due to the non-availability of a high yielding variety h red rice and more straw acceptable to the farmers of the Southern tricts of the Region.

'Striga' infestation in upland paddy in Quilon district and lack of per measures to control the weed.

Lack of information on the shrivelling of coconut in relation to gation with brackish water in Ithikkara in Quilon district.

High acidity of the soil in 'Pazhanchira' ela in Attingal Agricultural b Division where rice growth is adversely affected and yield considerably luced. Stunted growth of rice crop is very often observed in this ela. ck of rice varieties suited for the acid soils in 'Pazhanchira' ela of tingal Sub Division.

Incidence of leaf roller, leaf miner and stem borer in rice crop at tive growth stages.

Yellowing of leaves in coconut palms grown in reclaimed paddy lds of Kodumon Panchayat.

Lack of package of practices for betelvine.

Lack of package of practices for red banana.

Root-knot nematodes and other burrowing nematodes in homestead rdens.

Endemic occurrence of sheath blight in paddy in the Region, leading poor filling of the rice grain.

Bunchy-top disease of banana.

Marshy soils submerged in hot water in 'Kazhakkada padom' in uilon district.

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Bunchy-top disease of banana.

Marshy soils submerged in hot water in 'Kazhakkada padom' in uilon district.

Mosaic virus in bhindi.

Mossic virus in tapioca.

Stem bleeding in coconut

Coreid bug attack on coconut

Shedding of spikes in pepper.

Wilting of paddy plants in small patches in large areas with stunted growth in Perinkadavila Panchayath.

Unsuccessful paddy cultivation in Poovar area in Trivandrum district and certain areas in Quilon district where inundation of paddy fields by salt water is noticed

Coconut (root wilt) disease.

2.13 Approaches to research in the Region

As envisaged in the project proposals, the research strategy under the NARP (Southern Region) are oriented to solve the location specific problems of the farmers with a multidisciplinary approach. The basic objective is to increase the net return of the farmers and to utilise the resources of the farms, including family labour, to the maximum extent possible.

Location specific field experimentation need not be multiplied to the extent of becoming a costly and non feasible proposition. The soil series and the identification of a bench mark soil in each soil series will enable the minimisation of the multilocational trials since soils belonging to the same soil family should essentially have the same management. The soil family thus should be used to startify the population of soils in the area under consideration into pragmatic units having inherent attributes to facilitate agrotechnology transfer.

An analysis of the feed back of location specific problems received from the T & V monthly workshops, the Regional Workshops of the N.A.R.P (South Region) and the farmer's group meetings conducted in the Agricultural sub-divisions of the Trivandrum and Quilon districts in April and May 1982 have enabled the broad categorisation of the problems and the suggestions for solution into the following:

2.13.1 Homestead farming system

In more than 55% of the area where coconut or tapioca is the main crop, the existing crop combinations in the homesteads are based on the trial and error experience of the cultivators rather than on scientific findings. The two main research stress in this area will be,

In coconut based homesteads, maximisation of solar, water and soil resources will be attempted by evolving suitable crop combinations,

The major area in Trivandrum and Quilon districts and a sizable area in Alleppey and Kottayam districts are cropped to cassava as an

ercrop in the homesteads of marginal and small farmers. Evolving tems of further intercropping in the space available in the cassava p for maximisation of net output per unit area per annum, minimis-on of soil erosion hazards etc. will be attempted.

3.2 *Rice based farming system*

The areas cropped to lowland rice exist in the entire Region in ribbon valleys. At present, Paddy–Paddy–Vegetables/Oil Seeds, ddy-Banana, Paddy–Paddy–Fallow and Paddy–Paddy–Paddy cropping terns are prevalent according to topography of the land and avai-ility of moisture. Introduction of other crops such as pulses, gro-dnut, sweet potato, sesamum and vegetables in the multiple cropping tem will be attempted in suitable areas delineated and concentrated ension efforts made in those areas to increase the net return from fields.

3.3 *Banana and vegetables*

In all the districts of the Region, where the benefits of both uth–West and North–East monsoons are available growing banana as ainfed crop, both Nendran as well as culinary varieties, is a common ctice. Recommendations suited to the different locations have not n attempted so far. This is an area which will bring in results in ns of increased crop production.

The red banana, exclusively grown and consumed with a prefer-e in the Southern Region is an exported commodity in recent days. studies are available on the different aspects of its cultivation, post vest storage, etc.

In view of air lifting of vegetables from Trivandrum to the lf countries, truck gardening is becoming a practice, not only for nana but also for vegetable crops, such as cowpea, brinjal, ladies ger, etc. Investigations to evolve high yielding varieties of vegetables replace or supplement the existing local varieties will be of consi-able importance in this connection.

3.4 *Mixed Farming*

There are areas on the banks of Ashtamudi lake and Paravur lake Quilon district and also Neyyar Dam reservoir at Purevimala and nboori (tribal areas), where there is scope for trying and successfully plementing mixed farming practices inolving crop livestock-fish, where waste from one will be recycled as a nutrient for the other, thus king the proposition economically viable.

3.5 *Crop suitability*

In view of the fact that the Southern Region consists of undulating rain with steep slopes particularly in the midland and mid upland nes, studies on soil and moisture conservation practices are highly

relevant. Critical requirements of water for the different crops as well as the best crops suited for different portions of the slopes with the objective of decreasing the cost of permanent land improvements have to be worked out. Based on soil survey information and soil resource appraisal available with the State Dept. of Agriculture, crop suitability maps and cropping pattern maps will have to be prepared to assess the suitability of technology to the different locations.

CHAPTER 3

Specific Farming Situations

Identification of specific farming situations in the region

In the Southern Region of Kerala comprising the districts of andrum, Quilon, Alleppey and Kottayam, the agroclimatic conditions cropping patterns are more or less similar, with local variations based soil and physiographic divisions, topography and social factors. The uthern Region is sub divided into nine specific farming situations for ch suitable farming systems and practices are to be developed.

FARMING SITUATION 1

a : Wetland areas of Trivandrum Corporation and
px. 10 km²) Quilon, Kottayam, Chengannur, and Shertallai Municipalities and suburban areas in the vicinity of their boundaries.

nfall : 1800–3000 mm

ography : Level to very gently sloping

l : Mainly laterite with coastal alluvium in some areas in the western side of Trivandrum Corporation and Quilon, Shertallai and Chengannur Municipalities. The soil is acidic (pH 5 to 6) in reaction with sandy clay loam to clay loam texture.

oth : 15–25 cm

gation : Rainfed

sons : 1st crop (Autumn) —April/May–Sept./Oct.
2nd crop (Winter) —Sept/Oct.–Dec./Jan.
Summer–Dec./Jan.-April/May

During the first and second crop seasons commencing in May-June d September/October respectively, sufficient water will be available in als due to the South-West and North-East monsoons. The monsoon l recede by November and the dry period that will commence by cember will continue to be so till May. During this dry period, the ilability of water will get gradually reduced. However, small streams water may still be available in stray areas which would enable the mer to either raise a third crop of rice during summer or to raise other sonal crops like pulses or vegetables. In a few areas, after the harvest the first crop paddy, banana will be raised in a crop sequence. The d will be kept fallow if no water is available for irrigation.

opping pattern : Paddy—Paddy—Fallow or Paddy—banana
Pulses or vegetables are raised in the third crop season, if water is available.

Constraints in production	*Suggested solution*
Problems	
Non-availability of water, particularly during the entire third crop season viz. Dec./Jan to March/ April. Due to lack of water, paddy is not generally cultivated during this season. Only the moisture that is retained in the soil is available during this season.	Developing an efficient ground-water utilisation system. Developing an efficient surface run off water harvesting system making use of the peculiar undulating terrain of the adjoining dry lands and incidence of two monsoons.
	Evolving summer crop varieties with low water requirements, such as pulses seasum groundnut etc.
High soil acidity and iron toxicity in several patches.	Formulating suitable agronomic practices such as improvement of drainage, to reduce the acidity and iron toxicity. Identifying suitable soil ameliorants to correct the acidity and iron toxicity. The effect of different organic materials which chelate iron and of inorganic ameliorants such as lime, magnesium silicate, etc in reducing soil acidity and iron toxicity can be studied. Screening locally available popular high yielding and traditional rice varieties for iron tolerance, to locate varieties which can stand high concentrations of ferrous iron.
Water logging in certain pockets such as in Chenkal kari (Neyyattinkara), Chittumala (East Kallada), Ithikkara, etc.	Developing a good drainage system. Evolving suitable crop varieties for water logged conditions. Developing cheap and efficient systems for recyling the drainage water.
Lack of high yielding rice varieties with high straw yield for the second crop (Sept. to Jan.), suitable for the different areas to replace the currently popular, local long duration variety 'Cheradi' in Trivandrum and Quilon districts.	Evolving a suitable medium duration rice variety with high grain and straw yield for the different situations. Work on these lines has already been initiated.

arrowing of cost: benefit ratio rice cultivation. Due to high ost of labour, paddy cultivation as become uneconomical. Large cale conversion of paddy lands r high value upland crops is oticed in several localities in the egion during the recent years.	Reducing the cost of rice cultivation by modifying the existing package of practices wherever possible in the light of newer findings from fertilizer, plant protection and agronomical trials conducted. Evolving a system for the cultivation of high value crops such as vegetables, banana, coconut etc.

In view of the spiralling land value for house sites and non–vailability of suitable house sites, the rice areas are being filled up and sed for residential purposes. This situation is accentuated by the narrow ost:benefit ratio in rice cultivation. However, patches of greeneries re highly essential in the air polluted conditions in cities. Only suitable egislations can prevent the conversion.

FARMING SITUATION 2

rea: Appx. 105 km²)	Dry lands (uplands) of Trivandrum Corporation and Quilon, Kottayam, Chengannur and Shertallai Municipalities and the suburban areas adjoining the town boundary.
ainfall	: 2000 — 3000 mm per annum.
opography	: Undulating terrain with slopes.
oil	: Laterite and coastal alluvium. acidic (pH 4.5 to 6.0)
epth	: Upto 50 cm.
rigation	: Rainfed.
ropping-attern	: Coconut intercropped with tapioca or coconut intercropped with miscellaneous fruit trees such as mango, jack etc., perennial crops such as cocoa or with annuals such as banana, and various tuber crops. Mainly homestead farming system in small to very small holdings.

Constraints in production

Problems	*Suggestions for solution*
here is no scientific system for the election of crop mixes for the omesteads.	Developing a scientific system for the selection of crop mixes for such small areas.
ack of proper irrigation, particularly in summer except when he crops are raised close to house ites, where pot watering is done.	Evolving a system for utilisation of ground water. Developing drip irrigation system in the small homesteads.

Lack of integration of livestock with crop production	Harvesting the surface run off of the two monsoons. Utilising the waste water from bath and kitchen for irrigation in homesteads. Identifying a suitable fodder crop for the homesteads. Developing a proper farm waste recycling process.
Lack of proper technology for the kitchen gardens in the houses having no cultivable area.	Standardising the vegetable cultivation such as bhindi, chilli, brinjal etc. in pots. Raising vegetable pulses, cucurbits etc. on the terraces of houses.

The upland areas in Municipalities and the Corporation are being converted into small homesteads with new houses in view of the paucity of land in urban areas for house sites. The land owners utilise the money obtained from the sale of produce for investment in more remunerative enterprises. In view of this, the future needs are to develop a viable technology for cultivation of one or two cents of land in urban homesteads to give additional income/additional sudsidiary foods from a cafetaria of crops.

FARMING SITUATION 3

Area (Appx. 110km²)	:	Wet lands of the coastal area sub zone comprising Trivandrum, Quilon and Alleppey districts, covering the western parts of Neyyattinkara. Trivandrum. Chirayinkil, Quilon and Shertallai taluks.
Rainfall	:	1750—3000 mm per annum.
Topography	:	Level or nearly level.
Soil	:	Red loam in the southern parts of Trivandrum district, lateritic and coastal alluvium in the remaining areas. The soil is acidic (pH 4.5 to 6.0)
Depth	:	15 cm to 25 cm.
Irrigation	:	Mainly rainfed with canal irrigation in some areas in Trivandrum district.
Cropping pattern	:	Paddy—Paddy—fallow or Paddy – Paddy—Pulses/Oil seeds/Sweet potato/Vegetables or paddy—banana.

Constraints in production

Problems	*Suggestions for solution*
ow water holding capacity of the oil. The soil near the coastal area as coarse texture and leaching oss of water and nutrients is ppreciable. The roots of crops vill be devoid of moisture unless requent irrigation is given.	Improving the waterholding capacity of the soil. Improving the efficiency of fertilisers by split application.
lazards due to saltish lake water om the sea and its inundation into addy fields (coastal area of ndoorkonam, Azhoor in Chirayinil, also Paravur, Ithikkara Ela, dhichanallor, Shertallai, Pattanad, Vaikom etc.)	Screening rice varieties for salt tolerance. Reclamation of lands with high soil salinity.

(Other Constraints: as given for Farming Situation—1)

FARMING SITUATION 4

rea Appx. 1500 km²)	:	Dry lands of the coastal area sub zone comprising Trivandrum, Quilon and Alleppey districts, covering the western parts of Neyyattinkara, Trivandrum Chirayinkil, Quilon and Shertallai taluks.
ainfall	:	1750—3000 mm per annum.
opography	:	Undulating.
oil	:	Red loam in southerm parts of Trivandrum district. Laterite and coastal alluvium in the remaining parts. soil is acidic. (pH 4.5 to 6.0)
epth	:	Upto one meter.
rrigation	:	Rainfed.
ropping pattern	:	Coconut intercropped with tapioca or with miscellaneous fruit trees such as mango, jack etc. and annuals such as banana and various tubers. Mainly homestead farming systems. Rice in coconut gardens or with tapioca planted with the onset of South West pre-monsoon showers in May, in some parts of Quilon district.

Constraints in production

Problems	*Suggestions for solution*
ack of proper irrigation system. At present, by and large, pot watering is practiced. Water is normally available during the monsoon months and as the rains subside,	Developing a good irrigation system with the possibility of using ground water. Evolving drip irrigation system whereever feasible.

the availability of water will get gradually reduced and water scarcity is felt during Jan to May. Farmers have to depend on wells and ponds for pot watering.	Conservation of moisture with better agrotechniques.
Acidity and low water holding capacity of the soil. Due to the nearness to the sea coast the soil in these areas has course texture and leaching loss is likely. The soil has a pH ranging from 4 5 to 5,5 due to low base saturation.	Corrective measures such as lime application for soil acidity. Improving the water holding capacity by addition of clay and improving the structure by organic matter application. Cover crops and other moisture conservation techniques.
Low content of organic matter and plant nutrients.	Developing a better organic recycling technique. Identifying a proper manurial dose and schedule for various crops in the area.
Lack of a scientific crop-livestock combination in the homestead.	Developing a scientific crop combination suited to the farming situation. Working out a mixed farming system of suitable crop-livestock combination.
Lack of suitable shade tolerant varieties of pulses, groundnut and other seasonals/annuals which can be intercropped in coconut plantations.	The available improved varieties of different pulses, groundnut and other seasonals are to be screened for shade tolerance. Screening of cowpea, blackgram, horsegram, greengram and groundnut varieties for shade tolerance is in progress.
Lack of suitable varieties of companion crops such as groundnut and other seasonals during the early growth phase of tapioca when sunlight will be available in the interspaces.	Available improved varieties of different pulses, groundnut and other seasonal crops are to be screened for companion cropping with tapioca. Work on these lines is in progress.
Lack of suitable technology for a multi-tier system of cultivation in coconut gardens.	Various crop combinations have to be tried and standardised.

FARMING SITUATION 5

Area (Appx 60km²) : Backwater areas of the coastal area sub zone of Trivandrum, Quilon, Kottayam and Alleppey districts covering western parts of Neyyattinkara, Trivandrum, Chirayinkil, Quilon, Kottayam and Chengannur taluks.

Rainfall : 1750—3000 mm per annum.

Topography : Level to sloping.

Soil : Red loam, Laterite and coastal alluvium. The soil is acidic.

Irrigation : Rainfed

Cropping pattern : Coconut. intercropped with tapioca or perennials such as cocoa or miscellaneous fruit trees.
Paddy in low lying areas.

Constraints in production

Problems	*Suggestions for solution*
Soil salinity due to tidal sea water inundation through lakes and backwaters.	Developing suitable crop varieties tolerant to salinity. Reclamation of lands with high soil salinity.
Pollution of water resulting from the retting of coconut husk for coir makng in backwater areas in Quilon and Alleppey districts.	Evolving suitable microbiological techniques for hastening the retting of husk. Confining coconut retting to restricted areas to avoid large scale pollution. Developing a suitable method for utilisation of husk waste left after coir making.
Lack of economically viable mixed farming system.	Developing a suitable and economically viable crop-livestock-fish or crop fish farming system for the backwater areas.

FARMING SITUATION 6

Area (Appx 600km²) : Wet lands of the midland sub zone in Trivandrum, Quilon, Alleppey and Kottayam districts covering eastern parts of Neyyattinkara, Trivandrum, Chirayinkil and Quilon taluks, western parts of Nedumangad, Pathanapuram, Pathanamthitta taluks, majority of the Kottara-

		kkara, Kunnathur, Chengannur, Kottayam, Meenachil and Vaikom taluks and western side of Kanjirappally taluk. The paddy lands are at different levels resembling terraced lands.
Rainfall	:	1880—3500 mm per annum.
Topography	:	Undulating with slopes. Individual fields are level, but the different fields are on different terraces.
Soil	:	Red loam in southern parts of Trivandrum district and laterite in other areas. The soil is acidic, pH ranging between 4.5 and 6.0
Irrigation	:	Canal irrigation in certain parts of Trivandrum district. The rest of the area rainfed.
Cropping pattern	:	Paddy-Paddy-fallow or Paddy-Paddy-Pulses/oil seeds/Vegetables or Paddy-Banana or Paddy-Tapioca Sugarcane in wet lands in the north-eastern parts of Quilon district. Sweet potato, groundnut etc. in rice fallows in the third crop season. Intercropping of banana with amorphophallus, colocasia, vegetables and tapioca.

Constraints in production

Problems.	*Suggestions for solution*
Soil erosion and silting in the ribbon valleys, particularly during the monsoon seasons from the adjoining slopes.	Developing measures to minimise soil erosion from slopes and silting in the ribbon valleys through mechanical practices and proper agronomic techniques.
Lack of red rice variety with high grain and straw yield for second crop season to replace the popular local variety 'Cheradi'.	Developing a suitable rice variety with high grain and straw yield to replace 'Cheradi'.
High acidity, low base status and low content of available plant nutrients.	Improving the efficiency of fertilizer application and developing correct manurial schedules for different crops in such areas.
Fallowing of wet lands where paddy cultivation is not technically feasible due to want of water during third crop season (Jan. to April)	Developing a substitute cropping system dovetailing other food crops with paddy such as tubers, vegetables etc.

Pollution hazards due to the effluents from Kodumon Rubber factory in rice fields of Mangalam Kamalloor and Ambattuchira areas of Quilon district.	Developing suitable management practices of the effluents and identifying proper cultural practices for such areas.

FARMING SITUATION 7

Area (Appx. 2800 km^2) : Dry lands of midland subzone in Trivandrum, Quilon and Kottayam districts, covering eastern parts of Neyyattinkara, Trivandrum, Chirayinkil and Quilon taluks, Western parts of Nedumangad, Pathanapuram and Pathanamthitta taluks, majority of the Kottarakkara, Kunnathoor, Meenachil, Changanachery, Kanjirappally, Chengannur, Kottayam and Vaikom taluks.

Rainfall : 2000 – 3400 mm per annum.

Topography : Undulating with slopes. sometimes steep.

Soil : Red loam of southern parts of Trivandrum district and laterites in other areas. The soil is acidic (pH 5 to 6)

Irrigation : The crops are very rarely irrigated. In certain parts, irrigation from wells, canals etc. is followed. Mostly rainfed.

Cropping pattern : Coconut intercropped with a variety of crops, mainly with tapioca. Miscellaneous fruit trees such as mango, jack etc. are also seen in coconut gardens. Perennials like pepper, cocoa, clove, nutmeg, fodder crops etc. and seasonal crops like horsegram are common in the homesteads with coconut as the main crop. In isolated pockets, cashew orchards are also seen, as in Kottarakkara. Rubber is cultivated as plantations in the eastern parts of this subzone. Arecanut is also grown as main crop in Nedumangad, Palode etc.

Constraints in production

Problems	*Suggestions for solutions*
Lack of a scientific crop mix suited to the garden lands of midland subzone.	Developing a scientific polycrop combination with proper evidences on its effects on soil fertility, moisture conservation, weed suppression, pest and disease minimisation etc. Developing a mixed farming system

	for homesteads with an economicaly viable crop–livestock combination with suitable recycling propositions.
Acidity of the soil coupled with low content of organic matter and available plant nutrients.	Developing suitable manurial dose and schedule for various crop combinations. Identification of crop sequences involving legumes, which improve soil fertility and soil structure.
Lack of irrigation due to non-availability of water during non-monsoon seasons. (Jan. to April-May)	Agro-techniques for maximum moisture conservation. Developing techniques for harvesting run off water during monsoon seasons in the undulating terrain and utilisation of the same in the off-monsoon seasons.
Non-utilisation of space and energy in cashew and rubber plantations.	Identifying suitable intercrops for cashew and rubber plantations. Standardisation of management practices for crop combinations with cashew and rubber as the main crops.
Large scale attack of tapioca tubers by rodents.	Developing suitable rodenticides/ fumigants to control the menace.
Lack of post harvest technology for tapioca tuber.	Evolving suitable methods to preserve the tuber.
Lack of proper agronomic techniques for slopey lands.	Developing suitable cropping pattern and management practices for the slopes.

FARMING SITUATION 8

Area	:	Wetland areas of mid upland subzone covering
(Appx. 80 km²)	:	eastern parts of Nedumangad. Neyyattinkara, Pathanapuram, Pathanamthitta, Kanjirappally and Meenachil taluks.
Rainfall	:	2000 – 3500 mm per annum.
Topography	:	Steep slopes. Paddy fields are level, but in different tarraces.
Soil	:	Mainly laterite with riverine alluvium and forest soil in some areas. The soil is acidic (pH 4.0 to 5.5)
Irrigation	:	Rainfed and canal irrigation in some parts.

ping pattern : Paddy–Paddy-Fallow or Paddy-Paddy–Pulses/vegetables or Paddy-Banana or Paddy–tapioca. A crop cafeteria of banana, yam, colocasia, tubers, vegetables etc. in wetlands.

straints in production

Problems	*Suggestions for solution*
erosion and silting in the rice ing valleys in monsoon sea– (June to November)	Developing proper soil conservation methods and agronomic practices for minimising soil erosion and silting in valleys.
wing of rice fields where paddy ation is not technically le due to want of water during ary to April–May	Developing a crop combination for wetlands with food crops and cash crops. Developing proper management techniques of such crop sequences.
logging and lack of proper age in first and second crop ns (ie. in June to January) rshy areas	Improving the drainage systems with proper designs. Identifying suitable varieties tolerant to such conditions. Management practices of submerged soils.
of a scientific manurial re- mendation considering the soil y status and other factors for op combinations in wet lands.	Developing a scientific manurial dose and Schedule after soil analysis for the various crop combinations in the wetlands. A Cropping pattern including green manure crops and the crops which improve soil structure and fertility status.
of suitable varieties of diffe- vegetables with high yield tial.	To evolve high yielding vegetable varieties by suitable plant breeding techniques.

FARMING SITUATION 9

x. 1700 Km^3) : The gardenlands and dry lands of the mid upland subzone in Trivandrum, Quilon and Kottayam covering eastern parts of Nedumangad, Neyyattinkara, Pathanapuram, Pathanamthitta, Changanacherry, Kottayam, Kanjirappally and Meenachil taluks.

all : 2500–4000 mm per annum.

graphy : Steep slopes of even more than 20 per cent in some locations.

Soil	:	Laterite, acidic.
Irrigation	:	Mainly rainfed with well irrigation in some homesteads.
Cropping pattern	:	Coconut, arecanut rubber, pepper and cashew are the major perennial crops. These are intercropped with other perennials such as cocoa, clove, fruit trees etc. Tapioca is also grown. Roots and tubers, fodders etc. are grown in open and shaded conditions.

Constraints in production

Problems	*Suggestions for solution*
Soil erosion and depletion of fertility status of the soil	Developing proper agronomic soil conservation techniques to minimise soil erosion and for the maintenance of soil fertility.
	Developing suitable Engineering measures.
Lack of irrigation facilities and low moisture conservation.	Developing moisture conservation measures and run off water harvest techniques for use in the non-monsoon seasons.
Lack of scientific polycrop combination suited to the homesteads.	Developing scientific and economic polycrop combination to make use of the horizontal and vertical space and solar energy, considering the soil fertility factors, moisture conservation, weed suppression and chances for pest and disease incidence.
	Developing a mixed farming system with a good crop livestock combination with proper recycling propositions.
Unsettled farming in tribal areas of the subzone.	Developing suitable crop combination catering to the requirements of the tribal people with adequate control/protective measures against wild animals.
	Identifying suitable subsidiary occupations for tribal people using agricultural raw materials.
	Developing a suitable crop-livestock fish farming system for the tribal communities to provide increased income and family labour use.

of high yielding fodder varie– suitable to be grown as pure and intercrop in coconut ens.	To screen the available popular varieties of fodder for shade tolerance in coconut plantations.

General constraints in agricultural production in the Region

In addition to the specific constraints of the nine farming situations ined above there are certain general constrains limiting agricultural uction in the Southern Region, as follows:

Problems	*Suggestions for solution*
of timely and adequate avail- y of various inputs such as s, fertilizers, plant protection nicals etc.	Developing necessary infrastructural systems for the supply of all inputs in time.
	Developing techniques for proper storage of seed materials in the farmer's house.
of stability in demand and ly of various agricultural pro- and lack of proper marketing ems.	Identifying the market demands and forecasting them in order to develop the crop sequences to cater to such demands.
	Developing necessary marketing facilities for various agricultural commodities, suitable for each locality.
of cheap technology for pro- ing, preserving and post harvest dling of various agricultural duce	Identifying cheap techniques for post harvest processing, preservation etc. and storage of various agricultural produce, particularly the locally available fruits and vegetables, considering the post harvest physiology, pathology etc. to avoid deterioration and wastage of the produce.
and disease infestation at erent growth stages of various os.	Developing suitable plant protection measures considering the ecological and economic factors.
	Identifying suitable and tolerant crop varieties for various pests and diseases constantly seen in specific areas.
	Developing suitable cultural practices to minimise the pest and disease

	occurrences, considering the seasons of infestations, alternate/collateral hosts of the pest or pathogens and chances for migration.
Adoption gap existing between the potential use of technology and actual practices in various crops by the farmers.	A constraint analysis of the adoption of various technologies in the Region with respect to various crops, animal husbandry and fisheries at the pre implementation stages of the project
	Assessment of socio-economic and personal characteristics in influencing the adoption behaviour of the farming community in the pre-implementation stage
	Study of the communication system and its utilisation pattern by the farmers in the pre-implementation stage of the project.
	Planning and implementation of various farmer contact programmes including farmer's meets, production and publication of information for materials for farmers based on the research findings etc.
Lack of a system for evaluation and monitoring at micro levels.	Impact studies on various technologies developed and released from the project for adoption.
	Assessment of the technological constraints and constraints related to the infrastructure of any recommended practice at each stage of its implementation in farmer's fields.
	Analysis of constraints pertaining to development technology within the project at each stage of its implementation.

3.3 Distribution of responsibilities of each farming situation to the various Research Stations existing in the Region along with the facilities existing at each station

3.3.1 Regional Research Station, Vellayani

Regional Research Station at Vellayani has state-wide lead

ction for tapioca and other tubers. Thus, this station will,

Undertake location specific research on all aspects of crop improvement, management, post harvest technology storage, processing etc. of tuber crops, with a view to developing homestead farming in the Southern Region of the State.

Develop suitable cropping system for the uplands of the project area, develop multistoried cropping systems with coconut, different tuber crops, banana, groundnut, pulses, forage crops, vegetables etc.

Undertake basic research on location specific problems identified by both the lead station and the special station.

This station will have verification function in respect of homestead ning systems, rice and rice based cropping systems.

The research staff of the Station will work in selected villages to elop a better understanding of constraints in adopting the recommended ctices

The Station will lay out adaptive trials in farmer's fields to study research results of the recommended practices under different soil agro climatic conditions.

It will organise training programmes for extension personnel and ourage them to visit the Research Stations.

The Station will arrange Regional workshops, and
It will summarise and publish its findings periodically.

.2 *Special Station, Kottarakkara*

The Special Station at Kottarakkara will have state-wide lead ction for research on homestead farming. This station will have ification function for tapioca and other tuber crops. The leadership the Special Station will be provided by the Regional Station at layani, while the actual experiments and their conduct will be at tarakkara by the staff of the Special Station.

.3 *Stations other than the NARP Stations*

The Coconut Research Station at Balaramapuram and the Model ronomic Research Station at Karamana are functioning under the ala Agricultural University. Both are situated in the Trivandrum trict. Manurial and agronomic trials on coconut and evolving disease istant high yielding varieties of coconut are the main research respon-ilities of the Coconut Research Station, Balaramapuram. Manurial ls on the different high yielding rice varieties and various agronomic ls on rice are the main research responsibilities of the Model Agronomic search Station, Karamana.

The Central Tuber crops Research Station at Sreekaryam and the Central Arecanut Research Station at Palode are the I. C. A. R. Stations functioning in Trivandrum district.

The Regional Research Laboratory at Pappanamcode, Trivandrum district is a C. S. I. R. Complex. Food preservation and post harvest technology are some of the research programmes undertaken, in addition to research on industrial products.

Geological studies are being undertaken by the Centre for Earth Science, with a good instrumentation unit, in Trivandrum city. The Department of Soil Science of the lead station gets collaborative help from this Centre in micromorphological study of soils of the Region which will be a technical and theoretical support to the applied work contemplated.

The Centre for Development Studies located near Trivandrum city has a good library and offers scope for research on social sciences.

The University of Kerala has headquarters at Kariavattom, Trivandrum with post graduate research departments in Biochemistry, Physical and Organic Chemistry, Marine Biology, Plant Breeding, Statistics, Social Sciences and Geology.

A Meteorological centre under Government of India is functioning at Trivandrum Daily weather data are collected here and weather forecasts are monitored.

The Rubber Research Institute of India and the Headquarters of Central Rubber Board are situated at Puthuppally near Kottayam Town.

3.3.4 State Seed Farms

The Seed Farms under the State Department of Agriculture in this Region are situated at Adoor, Kottarakkara and Kadakkal in Quilon district, Ulloor and Chirayinkil in Trivandrum district. The District Agricultural Farms at Peringamala in Trivandrum district and at Anchal in Quilon district function under the Department of Agriculture, with a multicrop combination under cultivation.

One Extension Training Centre under the State Development Department is functioning at Kottarakkara.

The co-operation of these farms will also be made use of in conducting field experiments and adaptive trials.

Details of the institutions under the Agricultural Department Government of Kerala are given in Table 3.1.

Table 3.1: Institutions of the Agricultural Department in the districts of Trivandrum, Quilon, Alleppey and Kottayam*

istrict	State Seed farms	District Agrl. farms	Coconut nurseries	Others
rivan-drum	Ulloor Chirayinkil	Peringamala	Kazhakuttom Valiathura	Banana nursery, Peringamala, Pesticide Testing Lab., Karamana. Fertiliser Testing Lab., Karamana.
Quilon	Karunaga-ppally Kottarakkara Kadakkal Adoor	Anchal	Karunagappally Kadakkal	Cashew Station, Kottarakkara. Soil Testing Lab, Kavanadu, Quilon, Oil Grading Lab.
Alleppey	Arunootty-mangalam Pullad Veeyapuram	Mavelikkara	Mavelikkara	State Sugarcane Seed Farm, Pandalam. Kayamkulam Kayal Reclamation Scheme, Kayam-kulam. Soil Testing Lab. Kalarkode, Alleppey Mobile Soil Testing Lab. Oil Grading Lab. Seed Testing Lab. Alleppey. Central Hatchery, Chengannur.
Kottayam	Vallachira Kozha	Kozha	Kozha	Soil Testing Lab. Ettumanoor

* Includes problem areas also.

3.3.5 Farmers fields

In areas where KAU Research Station or Agricultural Department Farms are not existing, trials will be conducted in the fields of progressive farmers. However, such plots will be selected only after fixing proper norms and conditions.

CHAPTER 4

EXTENSION

LINKAGE WITH EXTENSION

Any research attempt to be field oriented and fruitful should be losely linked with the feed back system. This is particularly emphasised n the concept of the NARP with research efforts based on the varied and ocation specific problems identified from the farmers' fields.

At present, there is no separate feed back mechanism established exclusively for NARP (Southern Region). Feed back from Training and Visit system is one of the channels for the identification of location specific roblems of each farming situation. All the scientists under the project ctively participate in the T & V monthly workshops conducted regularly t the College of Agriculture, Vellayani and collect the field problems hrough discussions and deliberations with the officers of the State Department of Agriculture. The resource personnel for imparting training o the Departmental officers are drawn from the research personnel of the College of Agriculture, Vellayani. The Scientists also visit the farmers' ields where any peculiar and location specific problems are identified by he extension workers of the State Department of Agriculture.

For improving the linkage with extension agencies, a Zonal Research Advisory Council will be constituted including the senior scientists of the University, Officers of the State Department of Agriculture and supply and service agencies. The constitution of the proposed Council will be as follows:

Zonal Research Advisory Council

Director of Research or Additional Director of Agriculture (T & V)	Chairman
Associate Director NARP (Southern Region)	Convenor
Head of Department of the concerned disciplines	Member
Co-ordinator, T & V Monthly Workshops	,,
Concerned crop Co-ordinators of the University and State evel Scientists in the concerned fields of specialisation	,,
All the Research Scientists of the Region upto the rank of Associate Professor	,,
Regional Officers (T & V) from the Department of Agriculture form the influence area, up to the rank of Deputy Director	,,
Representatives of the other concerned development departments (Fisheries DRDA, Forestry, Animal Husbandry, Irrigation/ Command Area Agency) depending on farming situation and need of these representatives, upto the rank of District Officer, from the influence area	,,

Representative from the ICAR and other Central Institutes located in the influence area	Member
Progressive farmers representing important crops of the Region	"
Extension Specialists of the University posted in the influence area	"

The functions of the Council are:

To review the zonal research efforts.
To assist in identifying the farming constraints/problems at micro level.
To make recommendations on the regional extension as well as field testing programmes in the ensuing season,
To review the transfer of technology developed by the Research Station and problems encountered in its effective implementation, and
To finalise the Package of Practices for all the important crops of the Region.

This Council will meet normally twice in a year, once for Kharif in February/March and once for Rabi in August/September at the Regional Station.

Zonal Research Formulation Committee

Like the Zonal Research Advisory Council, there will be a Zonal Research Formulation Committee for the Region. This Committee will also meet twice in a year soon after the meeting of the ZRAC is over. A consolidated programme of research work will be prepared for the Region as a whole. The technical programmes of work proposed will be discussed and finalised by this Committee.

The Zonal Research Formulation Committee will consist of the following members:

Director of Research	Chairman
Associate Director, NARP (Southern Region)	Convenor
Head of Department of concerned disciplines	Member
Concerned crop Co-ordinator of the University and State Level Scientists in the concerned fields of specialisation.	"
All the research scientists of the Region upto the rank of Associate Professor.	"
Selected Officers, preferably Joint Directors of the Department of Agriculture from the influence area.	"

The functions of the Zonal Research Formulation Committee are:

To review the research work done in the preceeding year in the entire Region,

To fix priorities on researchable problems for formulating new research projects/experiments, and
To formulate and finalise technical programme of work for the Region as a whole, including the Special Station.

CHAPTER 5

ppy of the Letter issued from the Council sanctioning the Sub project

INDIAN COUNCIL OF AGRICULTURAL RESEARCH

Krishibhavan, New Delhi-1

. 12-3/81-Edn. IV. Dated August, 1981.

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

ib:- National Agricultural Research Project for strengthening of regional research capability of agricultural universities – administrative approval for implementation of the sub-project for strengthening of Regional Research Station, Vellayani and a Station at Kottarakara, under Kerala Agricultural University.

r,

I am directed to invite a reference of letter enclosing the revised b project proposals for the strengthening of Directorate of Research, rala Agricultural University with support from National Agricultural esearch Project (NARP).

2 Iam directed to convey the approval of the Council to the plementation by the KAU of the sub-project for the strengthening of gional Research Station, Vellayani and a Centre at Kottarakara under rala Agricultural University involving allocation of Rs. 81.77 lakhs upees eighty one lakhs and seventy seven thousands only) from the ouncil for a period of five years from 1.9.1981 subject to the detailed rms and conditions mentioned at Annexure-1. The details of the item-ise allocation are at Annexure. II. The expenditure on (i) basic cultivan, (ii) station utilities and maintenance and (iii) land acquisition would e met by the KAU/Government of Kerala. The project cost and penditure sanction of the sub-project beyond 31.3.1983 is subject to pproval by the F. F. C. of the Min. of Finance.

3 The vehicle provided under this project is meant for effective onitoring of NARP sub projects and should not be diverted to general se of the university.

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

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

6 Expenditure during 1980-81 will be met from the ICAR budget provision of Rs. 6 crores for NARP. Release of funds beyond 1982-83 will be subject to approval of Finance for continuation of NARP.

7 This issues with the concurrence of the Ministry of Finance vide their U. D. Dy. No. 2254/81-Fin VI dated 22-8-81.

Yours faithfully,
Sd/-
(N. C. JAYARAMAN)
DEPUTY PROJECT COORDINATOR (A).

Annexure—I

NATIONAL AGRICULTURAL RESEARCH PROJECT

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

Eligible expenditure:

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

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

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 ntific staff referred to in (a) above, but in special circumstances exist- staff may be granted the difference between their present allocation the approved lump sum per scientist.

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

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

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

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

2. Costs to be defrayed by the University:

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

a) Acquisition of additional farm land for research purposes.

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

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

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

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

3. Accounting, Disbursement and Audit:

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

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

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

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

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

iii) the additional advances required

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

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

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

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

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

Procurement :

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

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

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

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

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

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

5. **Recruitment:**

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

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

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

6. **Reporting requirements:**

The University will submit to ICAR the following progress reports :

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

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

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

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

7. **Remedies of the ICAR :**

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

ANNEXURE II

e 1 : NARP Subproject for the southern zone of Kerala—Strengthening egional Research Station, Vellayani and a Centre at Kottarakara under Kerala Agrl. University.

gory	Project Cost and Financing (in lakhs)						
	1981-82 (6 months)	1982-83	1983-84	1984-85	1985-86	1986-87 (6 months)	Total
ARP							
y of	1.76	4.16	4.31	4.44	4.61	2.23	21.51
lling vance	0.06	0.16	0.16	0.16	0.16	0.10	0.80
works	4.06	10.00	10.00	4.00	—	—	28.06
oment	5.40	10.00	10.00	—	—	—	24.40
Operating	0.50	1.20	1.20	1.20	1.20	0.70	6.00
Total RP) I	11.78	25.52	25.67	9.80	5.97	3.03	81.77
University							
nal Cost of vation.	0.94	1.95	1.95	1.95	1.95	1.00	9.74
on tenance	0.34	0.84	0.84	0.84	0.84	0.50	4.20
Total II	1.28	2.79	2.79	2.79	2.79	1.50	13.94
versity)							
d Total of	13.06	28.31	28.46	12.59	8.76	4.53	95 71

Additional State/University commitment after 5 years (Annual)

Salary of staff	—	Rs. 4.77 lakhs
Res. Operating Cost	—	Rs. 1.20 lakhs
Equipment Replacement at 10%	—	Rs. 2·54 lakhs
Total	—	Rs. 8.51 lakhs

Table 1 (contd...)

KOTTARAKARA (NEW STATION)

Subject	Professor	Assoc. Professor	Asst. Professor	Total
Horticulture	—	1*	—	1
Agronomy	—	—	2**	2
Soil Science	—	1	—	1
Entomology	—	—	1	1
Pathology	—	—	1	1
Agrl. Econonics	—	—	1	1
Total	—	2	5	7

* Head of Station

** One to be trained in Agrl. meteorology — If suitable agronomist not available soil scientist may be trained.

VELLAYANI

Description wise Statement of Scientific Posts.

Division	Professor		Asso. Professor		Asst. Professor		Total	
	Exis-ting	Addl	Exis-ting	Addl	Exis-ting	Addl	Exis-ting	Add
Plant Breeding	—	—	—	1	—	1	—	2
Agronomy	—	—	—	—	—	—	—	—
Soil Science	—	—	—	1	—	1	—	2
Plant Pathology	—	—	—	—	—	—	—	—
Entomology	—	—	—	—	—	—	—	—
Nematology	—	—	—	—	—	1	—	1
Physiology	—	—	—	—	—	—	—	—
Agrl. Economics	—	—	—	—	—	—	—	—
Agrl. Statistics	—	—	—	1	—	1	—	2
Extension	—	—	—	—	—	1	—	1
Horticulture	—	—	—	—	—	1	—	1
Associate Director	—	1	—	—	—	—	—	1
Total	—	1	—	3	—	6	—	10

Annexure II (Table 2)

SOUTHERN REGION, LEAD STATION, VELLAYANI

	No. of posts	1981-82 (6 months)	1982-83	1983-84	1984-85	1985-86	1986-87 (6 months)	Total
Associate Director (1450-2050+100)	1	11,200	25,200	26,200	27,200	28,200	13,000	1,31,000
Associate Professor (1125-1725)	3	26,250	60,000	61,500	63,000	66,000	30,000	3,06,750
Assistant Professor (800-1600)	6	36,400	84,000	87,600	91,200	94,800	44,000	4,38,000
Total	10	73,850	1,69,200	1,75,300	1,81,400	1,89,000	87,000	8,75,750
Supporting staff								
Agrl. Demonstrator/ (Lab. Asst. 420-720)	7	23,000	52,500	53,900	55,300	56,700	28,100	2,69,500
Drivers (330-515)	2	4,700	12,000	12,300	12,600	12,900	7,000	61,500
Tractor Driver	1	2,500	6,200	6,400	6,600	6,800	3,500	32,000
Photographer (470-830)	1	3,700	8,400	8,600	8,800	9,000	4,500	43,000
Duplicator operator (330-515)	1	2,600	6,200	6,400	6,600	6,800	3,400	32,000
Total	12	36,500	85,300	87,600	89,900	92,200	46,500	4,38,000

Administrative staff

	No. of Posts	1981–82 (6 months)	1982–83	1983–84
Admn. Assistant (910–1550)	1	6,300	15,600	16,200
Stenographer (420–720)	1	3,300	7,500	7,700
Asst. Grade I (420–720)	1	3,300	7,500	7,700
Asst. Grade II (350–580)	1	2,850	6,400	6,500
Typist Grade I (420–720)	2	6,500	15,000	15,400
Total	6	22,250	52,000	53,500

KOTTARAKA

	No. of Posts	1981–82 (6 months)	1982–83	1983–84
Assoc. Professor (1125–1725)	2	15,400	39,300	41,200
Asst. Professor (800–1600)	5	28,000	70,000	73,000
Total	7	43,400	1,09,300	1,14,200

1985-86	1986-87 (6 months)	Total
17,400	8,700	81,000
8,100	4,000	38,500
8,100	4,000	38,500
6,700	3,400	32 450
16,200	8,100	77,000
56,500	28,200	2,67,450

1985-86	1986-87 (6 months)	Total
44,000	22,000	2,04,000
79,000	39,000	3,65,000
1,23,000	61,000	5,69,000

Annexure II (Table 3)

VELLAYANI

Civil Works

	Rs. in lakhs
Remodelling and furnishing of existing Laboratories	10.00
Glass House (75m²)	6.00
Green House (25m²)	2.00
Development of Kayal lands—60 ha	5.00
	23.00

KOTTARAKKARA

(Field Laboratory)

		Area in Sq. m
ead of Centre	25 x 1	25
il & Agronomy Lab.	25 x 3	75
ant Protection Lab	25 x 2	50
grl Economist	25 x 1	25
ility Room	30 x 1	30
ore	20 x 1	20
		225

(inclusive of grossing factor)

onstruction Cost of 225 m² @ Rs. 1125/-per Sqm = Rs. 2.53 lakhs.

esidential Quarters

		in Sq. m
ead of Centre (Assoc. Prof)	1 x196	196
sst. Professor (25% satisfaction)	1 x 120	120
		316

onstruction cost of 316 sqm. at

s. 800/-sq. m Rs. 2.53

Total Civil Works at Kottarakara 5.06

OTAL CIVIL WORKS cost Vellayani and Kottarakara = 28.06 lakhs

ANNEXURE II (Table 4)

EQUIPMENT

I. Soil Science & Agronomy Laboratory

1	Technician Auto Analyser II continuous flow analytical system OR Contiflow Automatic analyser Double channel Model With the following features sample input module, sample injection valve, time programmable, proportionating pump, calorimeter four channel recorder and printer.		1. 5 lakhs
2	Atomic absorption spectro-photometer Two channel atomic absorption/emission spectro photometer with micro computer for 20 elements and corresponding hallow cathode lamps, complete with printer.		1.50 lakhs
3	Integrating quantum/Radiometer/Photometer for environmental and biological studies Mode LI—188 of LI—CVR Ltd., USA.		0.40 lakhs
4	Spectronic 21 Spectrophotometer (UV model)		0. 6 lakhs
5	Corning EEL Flame Photometer—Model 400		0. 3 lakhs
6	Settler Top pan balance—Model—P—1200		0.30 lakhs
7	Satorius single pan balance 200 g.		0.20 lakhs
8	Gas liquid chromatograph—Perkin Elner/ Howlett double column, programmable with FID, PFD, TCD, Packard NPC, ECD		2.00 lakhs
9	Digestion system D512 with built in temperature control 100—450°C, type III, Two step Programmable 0.20 hrs. for Micro Kjeldahl	2 units	0. 4 lakhs
10	Digestion system D5 20 with built in temperature control 100—450, type III, Two step programmable 0.12 hrs. for macro Kjeldahl	2Nos.	0. 4 lakhs
11	Exhaust system for removal for exhaust gases produced in wet digestion complete units	3 Nos.	0.30 lakhs
12	Kjeltec DD system for rapid protein determination distilling unit with basket for 20 receiver flasks, digestion tube, alkaline tank etc.	3 Nos.	0.30 lakhs
13	Refatect Extractor—For quantitative extraction of fats and oils and pesticide residues, model 300-301 with 6 units complete set.	3 Nos.	0.30 lakhs

Cyclotac sample III. Compact, self cleaning ultra rapid mill for grinding grain, forage, leaf samples		
Pressure plate apparatus	2 Nos.	0.20 lakhs
Pressure membrane apparatus		0.20 lakhs
Buoycous moisture meter		0·20 lakhs
	5 Nos.	0.20 lakhs
Physiology Laboratory		
Automatic leaf areameter		0.50 lakhs
Light meter	2 Nos.	0.20 lakhs
Warburg's apparatus	1 No	0.30 lakhs
Binocular Research microscope with Photographic accessories		0.50 lakhs
Vapour pressure Osmometer	1 No.	0.25 lakhs
Trinocular Research Microscope	1 No.	0.20 lakhs
Deep freezer	1 No.	0.15 lakhs
Rettler precision single pan balance		0.20 lakhs
Refrigerated high speed centrifuge		0.50 lakhs
Ultra microtome		0.50 lakhs
800 incubator	2 Nos.	0.30 lakhs
Autoclave	I No.	0.30 lakhs
Gel filtration equipment		0.10 lakhs
Electrophoresis equipment		0.50 lakhs
Digital balance		0 10 lakhs
Farm epuipment and Transport		
Tractor with implements and trailer		1.25 lakhs
Power tiller with trailer and implements		0 50 lakhs
Jeep	1 No.	0.75 lakhs
Mini bus	1 No.	1.25 lakhs
Jeep for special centre	1 No.	0.60 lakhs
Office and Audio Visual equipment		
Photocopier		1.50 lakhs
Camera with accessories	1 No.	0.20 lakhs
Typewriter	4 Nos.	0.20 lakhs
Electronic Stencil cutter		0.25 lakhs
25% of total for equipment costing less than Rs. 5000/-		5.00 lakhs
		25.40 lakhs

Annexure II (Table 5)

Research Operating Cost

Rs. 8000/-Scientist/annum for 10 scientists at Vellayani including T. A.	=	Rs. 4.00 lakhs
for 7 scientists at Kottarakara including T. A	=	Rs. 2.80 lakhs
Total		Rs. 6.80 lakhs

University/State

Normal cost of cultivation of 35 ha rice (at 3000/ha) 15 ha coconut (15 1500 Rs./ha) 10 ha oilseeds and pulses (at 750 Rs /ha) 15 ha tapioca & other tuber (at 200/ha)	Rs. 9.74 lakhs
Station maintenance utilities and other overheads	Rs. 4.20 lakhs
	Rs. 12.94 lakhs

COMMITMENT OF STATE GOVERNMENT

1	Staff Costs 4.35+1.84	=	Rs. 6 19 lakhs
2	Maintenance of buildings		Rs. 0.30 lakhs
3	Maintenance of equipment		Rs. 2.40 lakhs
	Total		Rs. 8 89 lakhs

- It is anticipated that Government land at Kottarakara will be transferred to the University, otherwise a provision of Rs. 25.00 lakhs may have to be provided by the State.

APPENDIX—I

Taluks, T & V Sub Divisions and A E Units in the Region

strict	Sub Division	Agrl. Extension Units
vandrum	Neyyattinkara	Kollayil
		Kunnathukal
		Venpakal
		Perumpazhuthoor
		Pallichal
		Vengannor
		Kottukal
		Ottasekharamangalam
		Marukil
		Trivandrum
	Nedumangad	Kattakkada
		Vithura
		Ushamalaikkal
		Palode
		Nedumangad
		Karakulam
		Pirappancode
		Nellanad
	Attingal	Ulloor
		Mangalapuram
		Kazhakuttom
		Chirayinkil
		Attingal
		Vakkam
		Manampur
		Varkala
		Pallickal
		Kilimanoor
uilon	*Quilon	Elamkulam
		Chathanoor
		Perumkulam
		Kundara
		East Kallada
		Anchalummoodu
		Chadayamangalam
	Kottarakkara	Kadakkal
		Pooyappally
		Kareepra
		Kottarakkara
		Poovathur
		Vettikkavala
		Punalur
		Thalavur
		Pathanapuram
		Kulathupuzha
		Anchal
		Yeroor

* Part only included

	Pathanapuram (Adoor)	Poruvazhi
		Mammudu
		Sasthamkotta
		Adoor
		Ezhamkulam
		Kalanjoor
		Veliyanadu
		Omalloor
		Elanthoor
		Pathanamthitta
		Chittar
		Ranni
		Kozhencherry
		Vadasserikara
Alleppey	*Alleppey	Poochakkal
		Pattanakad
		Shertallai
		Muhamma
		Alleppey
		Ambalapuzha
	*Chengannur	Aranmula
		Chengannur
		Mannar
		Venmony
		Thiruvalla
		Mallappally
		Kumbanad
		Ayiroor
Kottayam	*Kottayam	Kottayam
		Vijayapuram
		Pambady
		Pallikkothodu
		Akalakkunnam
		Kangazha
		Karukachal
		Changanacherry
		Chengalam
	*Kaduthuruthy	Chempu
		Vaikom
		Thalayolaparambu
		Mulakulam
		Kaduthuruthy
		Manjoor
		Ettumanoor
		Kuravilangad
	Palai	Palai
		Ramapuram
		Uzhavoor
		Kidangoor
		Bharananganam
		Erattupettah
		Kanjirappally
		Erumeli

*Part only included.

1972	7.9	trace	2.9	82.8	393.6	134.7	267.6	59 3	163.7	545.5	99.9	104.3
1973	0	trace	19.9	170.0	148.6	356.4	158.3	171.3	46.1	348.2	56.7	46.6
1974	trace	10.5	26.1	193 2	210.6	113.3	359.3	354.6	361.3	114.1	14.7	8.4
1975	8.1	32.4	63.8	243 2	237.3	493.8	201.1	216.3	161.4	305.9	334.3	50.9
1976	1.3	trace	14.0	96.3	77.5	76.2	140.4	149.2	30.6	166.1	330.5	54.8
1977	20.2	28.3	39.5	108.2	428.5	226.6	166.9	82.3	109.7	655.9	243.6	40.5
1978	22.9	12.4	87.8	99.0	362.3	191.9	177.5	161.1	67.1	89.7	722.0	52.1
1979	3.1	73.3	40.5	43.8	117.3	446.2	183.0	178.0	229.0	96.7	273.1	69.3
1980	0	0	21.9	92.6	128.9	361.9	178.0	163.2	179.9	207.3	150.6	81.3
1981	40.5	31.4	36.1	121.1	150.8	479.9	174.4	145.8	361.6	300.9	297.0	29.8
Mean	10.40	18 83	35.15	125.02	225.54	288.10	200.65	168.11	171.04	283.03	252.24	54.80

Source: India Metorological Department, Trivandrum

Appendix—II (2) Mean rainfall (mm) in Punalur (Quilon District) for the last 10 years

Year	January	February	March	April	May	June	July	August	September	October	November	December
1972	NA	48.0	14.2	249.2	NA	181.5	472.0	156.5	233 0	400 4	134.4	68.2
1973	0	0	28 2	206.0	173.8	446.1	298.2	349.1	96.0	490.2	136.9	92.8
1974	9.2	30.0	42.1	188.3	300.1	311.4	536.1	NA	NA	NA	NA	NA
1975	0	80.8	55.8	230.0	154.1	557.1	485.8	418.6	490.4	433.2	231.2	9.4
1976	0	0	63.3	321.6	191.2	144.2	375.6	266.0	117.0	380.3	346.6	20.2
1977	0	23.6	67 6	252.0	425.8	424.8	404.5	132.8	199.6	509.2	411.6	4.2
1978	5.8	65.4	113 2	187.8	425.2	314.4	439.4	327.8	173.4	286.0	571.4	3.8
1979	2.8	149.0	26.2	143.7	220.4	454.2	445.8	218.2	343 2	278 2	451.8	4.6
1980	0	0	39.0	239.8	118.2	487.6	471.2	267.2	207 8	202.4	NA	113.8
1981	0	65.4	84.0	210.2	166.8	859.2	374.4	339.4	423 0	275.0	114.4	2.4
Mean	1.97	46 22	53 36	222.9	241.73	422.75	430.24	275.07	253.71	361.66	299.79	35.49

NA: Not available

Source: India Meteorological Department, Trivandrum

Appendix—II (3) Mean rainfall (mm) in Alleppey for the last 10 years

Year	January	February	March	April	May	June	July	August	September	October	November	December
1972	4.8	114.0	0	74.0	531.6	411.8	633.6	287.2	369.4	413.7	134.4	236.2
1973	0	0	trace	263.4	96.6	576.2	539.4	420.3	153.2	629.3	157.1	60.1
1974	10.8	11.0	5.2	249.6	270.5	308.8	663.4	403.4	307.4	303.3	126.6	33.2
1975	trace	175.8	94.2	232.2	299.0	788.6	593.8	515.0	468.6	501.2	275.0	127.6
1976	0	1.8	33.0	117.6	92.0	224.2	432.1	303.0	117.8	399.4	372.2	2.1
1977	trace	33.7	195.7	141.1	784.2	580.9	508.4	342.7	189.2	552.7	265.4	1.1
1978	12.0	79.8	55.5	191.3	644.6	619.3	735.6	480.7	283.4	337.7	248.5	90.0
1979	7.6	151.7	22.5	80.3	147.6	705.7	579.2	193.8	265.3	208.7	385.4	56.9
1980	0	19.2	70.8	257.3	144.6	751.1	814.0	440.3	135.6	472.5	240.9	268.2
1981	31.2	31.8	4.9	91.0	246.9	946.7	294.4	395.6	421.8	332.6	273.1	18.4
Mean	6.64	61.88	48.18	169.78	325.76	591.33	579.39	378.20	271.17	405.11	247.86	89.38

Source: India Meteorological Department, Trivandrum

Appendix—II (4) Mean rainfall (mm) in Kottayam for the last 9 years

Year	January	February	March	April	May	June	July	August	September	October	November	December
1973	NA	0	3.4	165.7	53.8	425.6	338.8	272.0	78.2	232.7	150.2	84.2
1974	0	42.0	47.4	22.2	647.8	284.7	702.8	570.7	418.2	271.4	69.8	15.8
1975	5.6	84.8	9.0	277.8	141.2	890.2	405.5	696.6	491.6	569.9	275.4	24.5
1976	0	0	34.0	277.0	64.0	216.2	521.8	308.7	152.0	230.2	324.9	21.7
1977	0	2.6	123.4	102.7	353.5	621.8	521.6	254.9	194.6	542.7	216.9	54.2
1978	0	114.6	101.8	144.2	739.6	634.4	681.5	586.6	180.0	135.9	297.6	35.9
1979	0	0	0	66.6	109.6	705.7	475.7	332.6	350.9	290.4	299.4	100.4
1980	0	29.4	37.2	75.0	111.2	829.5	820.0	490.3	100.7	415.9	NA	30.2
1981	0	30.4	83.5	122.4	185.3	1117.9	435.5	499.2	586.0	203.4	263.8	31.4
Mean	0.70	33.76	48.86	139.29	267.33	636.22	544.80	445.73	283.58	321.39	237.25	44.59

NA Not available

Source: India Meteorological Department, Trivandrum

1972	31.4	31.2	32.4	32.7	30.6	31.1	29.6	29.8	30.7	29.7	30.6	31.3
1973	32.0	33.0	33.3	32.4	32.3	29.7	30.0	28.6	30.6	30.0	30.5	30.2
1974	31.1	31.3	32.3	32.3	31.0	30.2	29.1	29.0	29.0	29.7	31.0	32.3
1975	31.8	32.1	32.3	32.5	31.0	28.7	29.1	28.8	29.1	29.0	28.9	30.5
1976	31.3	31.8	33.0	32.4	31.8	31.5	29.7	29.8	30.4	30.3	29.7	30.9
1977	31.4	31.4	33.0	32.9	31.0	29.8	29.9	30.2	30.6	29.4	30.4	31.8
1978	31.6	32.3	32.7	33.0	31.6	29.6	29.0	28.8	30.1	30.3	30.3	31.3
1979	32.0	32.1	32.7	33.5	32.4	30.6	29.5	29.9	30.3	30.8	29.6	31.4
1980	32.4	32.4	33.2	33.3	31.1	30.0	29.5	29.7	30.9	30.2	31.0	31.2
1981	31.6	31.9	33.0	32.9	32.5	28.7	29.8	29.8	29.5	30.3	29.9	31.1
Mean	31.66	31.95	32.79	32.79	31.73	29.99	29.52	29.44	30.12	29.97	30.19	31.20

(b) Mean minimum temperature in Trivandrum (°C) for the last 10 years

1972	20.9	22.2	23.0	24.7	23.9	24.1	23.3	23.2	23.3	23.3	23.2	23.3
1973	22.0	23.6	24.5	25.1	25.0	23.7	23.4	22.6	23.4	23.3	22.9	22.2
1974	20.4	21.2	23.8	24.4	23.9	23.5	22.6	22.6	22.7	22.6	22.9	22.3
1975	21.4	22.8	22.9	24.7	24.4	22.8	22.9	22.7	23.1	11.8	22.9	22.0
1976	21.5	21.5	23.2	24.8	24.8	24.0	23.4	23.2	23.4	23.2	23.1	22.9
1977	25.5	22.0	24.1	25.1	24.1	23.4	23.2	23.7	23.5	23.3	23.1	22.3
1978	21.9	23.2	24.5	25.3	25.5	23.1	22.8	22.8	23.0	23.4	22.5	23.2
1979	22.7	23.5	24.3	25.4	25.0	24.0	23.4	23.2	23.4	23.7	23.2	23.1
1980	21.8	22.8	24.4	25.5	25.6	23.9	22.9	23.1	23.5	23.6	23.5	23.1
1981	22.2	22.6	24.4	25.5	25.2	23.2	23.3	23.5	23.3	23.4	23.1	24.0
Mean	21.63	22.54	23.91	25.05	24.74	23.57	23.12	23.06	23.31	23.26	23.04	22.84

Source: India Meteorological Department, Trivandrum

Appendix III (2) (a): Mean maximum temperature (°C) in Punalur (Quilon district) for the last 10 years

Year	January	February	March	April	May	June	July	August	September	October	November	December
1972	NA	35.3	37.0	35.8	NA	32 9	30.5	30.8	32.3	31.7	32.9	32.1
1973	35.2	35.7	38.1	32.1	34.5	30.6	31.1	29.5	32.3	31.3	32.5	31.9
1974	32.7	34.7	36 6	34.9	32.6	30.5	29.5	NA	NA	NA	NA	NA
1975	34.9	36.0	34.8	35.2	33.3	29.4	30.4	29.4	31.8	30.2	31.1	32 4
1976	33 5	36.1	38.3	35.0	33.6	32.7	30.2	30.6	32.1	32.2	31.4	33.0
1977	34.1	34.8	36.2	36.0	33.0	30.7	30.2	31.3	31 6	31.1	31.4	32.8
1978	34.3	35.2	36 2	35.7	33.0	30.0	29 5	29 2	31.6	32.1	32.5	33.2
1979	34.5	35.8	36.5	36.7	34.1	32.0	29.7	30 9	31.7	33.0	31.3	33.3
1980	34 0	35.8	37.2	35.4	35.3	30.7	29.4	30.2	32 1	31.7	NA	32 5
1981	33.7	35.3	36.7	35.1	33.9	28.9	30.0	29.8	30 2	31.8	NA	NA
Mean	34.10	35.47	36.76	35.19	33.70	30.34	30.05	30.19	31.74	31.68	31.87	32.65

(b) Mean minimum temperature (°C) in Punalur (Quilon district) for the last 10 years

1972	NA	19.9	20.6	22.5	NA	22.8	22.1	22.1	22.3	21.8	21.7	18.7
1973	18.6	20.6	22.1	22.0	23.6	22.6	22.4	21.4	21.6	21.7	21.5	20.0
1974	20.9	20.5	20.8	21.4	22.4	21.7	21.6	NA	NA	NA	NA	NA
1975	21.2	21.8	21.6	22.3	22.2	22.9	23.1	23.4	23.2	22.2	22.0	20.0
1976	19.4	19.1	21.7	21.4	22.7	22.4	23.2	22.0	22.9	22.9	23.1	21.5
1977	19.4	21.7	22.9	24.4	23.7	23.3	22.1	23.8	23.7	23.4	22.9	21.8
1978	20.8	22.8	23.8	24.5	24.2	22.7	22.4	23.0	22.8	23.0	21.6	22.1
1979	21.6	23.0	23.5	24.4	24.4	23.9	23.1	22.8	23.1	23.2	22.7	21.3
1980	19.7	21.1	23.3	24.4	24.5	22.9	22.3	22.8	22.9	23.0	NA	21.9
1981	20.6	21.0	23.3	24.6	24.5	23.1	23.0	22.8	22.3	22.8	NA	NA
Mean	20.24	21.15	22.36	23.19	23.58	22.83	22.53	22.68	22.76	22.67	22.21	21.3

NA: Not Available

Source: India Meteorological Department, Trivandrum

Year	January	February	March	April	May	June	July	August	September	October	November	December
1973	32.3	33.5	33.5	33.8	33.0	30.3	29.0	27.5	29.8	30.0	30.9	31.0
1974	31.2	31.6	32.9	32.7	30.9	29.8	28.5	28.5	29.1	29.5	30.6	31.8
1975	31.5	32.1	32.5	32.8	31.5	28.9	28.7	28.1	29.3	29.5	30.4	31.1
1976	31.5	31.7	32.7	33.1	32.1	31.0	29.1	29.3	30.4	31.0	30.5	31.9
1977	31.8	31.9	33.0	33.4	31.5	30.1	28.0	29.7	30.1	30.9	30.9	32.0
1978	31.6	32.1	32.5	32.9	32.1	29.2	28.4	28.3	29.5	30.8	30.7	32.0
1979	32.5	31.8	33.2	33.5	32.5	30.7	28.8	29.5	30.2	31.1	30.7	31.0
1980	32.4	32.3	33.0	33.4	33.3	30.4	28.8	28.8	29.6	30.7	31.7	31.5
1981	32.0	32.1	33.9	33.2	33.6	28.7	28.9	28.6	29.0	29.5	30.3	32.0
1982	32.3	32.3	33.2	33.6	33.3	20.1	29.9	29.5	30.1	NA	NA	NA
Mean	31.91	32.14	32.97	33.24	32.38	32.38	28.91	28.78	29.71	30.33	30.74	31.59

(b) Mean minimum temperature in Alleppey (°C) for the last 10 years

1973	22.6	24.6	25.8	26.6	26.6	24.4	24.0	23.3	24.1	24.0	24.0	23.1
1974	21.5	22.6	25.3	25.2	25.3	24.1	23.3	23.5	23.6	23.4	23.9	22.6
1975	22.1	23.9	25.1	25.7	24.9	23.4	21.8	23.1	23.5	23.1	23.0	22.7
1976	21.8	23.1	24.9	24.8	25.6	24.6	23.5	23.6	24.1	24.1	24.0	21.7
1977	22.5	23.9	25.1	25.7	24.8	23.9	23.5	24.1	24.2	24.3	24.2	22.9
1978	23.2	24.1	25.3	25.9	25.2	23.3	23.2	23.3	23.7	24.3	24.3	NA
1979	23.3	24.4	25.5	26.3	26.2	24.7	23.7	23.9	24.4	24.5	24.1	23.8
1980	22.1	23.6	25.1	25.8	26.1	24.2	23.1	23.5	23.9	23.0	24.5	29.3
1981	22.8	23.2	24.8	26.1	25.7	23.5	23.7	23.5	23.9	24.0	23.6	23.0
1982	22.3	23.7	25.4	26.5	25.5	23.3	23.1	23.4	24.1	NA	NA	NA
Mean	22.42	23.71	25.23	25.86	25.59	23.94	23.29	23.56	23.95	23.96	24.06	23.64

NA: Not available

Source: India Meteorological Department, Trivandrum

Appendix III (4) (a) Mean maximum temperature in Kottayam (°C) for the last 9 years

Year	January	February	March	April	May	June	July	August	September	October	November	December
1973	NA	34.3	34.5	34.0	33.3	30.3	29.4	28.6	30.0	30.8	30.9	30.6
1974	31.5	33.6	34.0	33.4	32.6	30.8	29.0	29.1	29.9	30.5	30.5	32.3
1975	32.3	32.7	33.4	33.9	32.8	29.6	29.7	29.1	29.9	29.6	30.6	31.7
1976	32.3	33.2	34.3	33.8	33.1	32.4	30.3	30.5	30.2	30.1	31.0	31.6
1977	32.9	33.3	34.8	35.0	32.4	30.7	29.9	30.9	30.5	31.4	31.0	33.2
1978	32.6	32.9	33.7	34.3	33.3	32.9	30.6	30.5	31.2	31.5	29.9	30.0
1979	32.7	33.2	34.1	34.8	34.8	32.1	30.8	31.2	32.1	32.4	31.8	32.9
1980	31.4	32.7	32.0	34.8	35.1	30.6	29.6	30.4	31.7	31.4	NA	31.4
1981	33.3	33.4	34.4	34.8	34.6	30.2	31.7	30.8	30.5	32.2	30.9	32.4
Mean	32.37	33.26	33.91	34.31	33.56	31.07	30.10	30.12	30.67	31.10	30.82	31.79

(b) Mean minimum temperature in Kottayam (°C) for the last 9 years

1973	NA	NA	25.1	24.4	24.8	23.5	22.8	22.2	22.9	22.9	22.6	21.8
1974	19.5	20.3	23.1	22.4	22.4	22.7	22.1	22.2	22.1	22.7	21.5	19.8
1975	19.0	21.3	23.0	24.0	24.3	22.4	22.6	22.6	22.9	22.6	22.9	22.1
1976	20.8	20.9	23.0	22.7	21.7	23.5	23.1	21.4	22.7	23.0	22.8	22.8
1977	22.1	22.7	24.0	24.2	23.7	23.3	22.7	23.4	23.6	23.3	23.5	23.9
1978	22.6	23.8	23.7	23.8	23.3	22.1	22.4	22.5	23.0	23.0	21.8	23.3
1979	23.5	23.3	23.3	23.6	23.4	23.2	22.9	22.7	23.3	23.4	23.4	23.9
1980	21.8	22.1	23.3	23.8	23.9	23.7	22.6	22.9	23.5	23.1	NA	23.9
1981	24.1	24.0	23.9	23.9	23.6	22.5	22.8	22.8	22.7	23.8	23.3	23.7
Mean	21.67	22.25	23.60	23.64	23.46	22.99	22.67	22.52	22.97	23.09	22.72	22.80

NA : Not available

Source : India Meteorological Department, Trivandrum

1973	76	71	77	84	83	89	87	89	83	89	84	79
1974	71	68	79	83	85	87	92	91	91	85	81	67
1975	69	78	82	82	83	91	87	90	90	88	87	77
1976	67	67	74	79	81	78	88	87	83	86	88	78
1977	70	77	77	80	88	89	87	87	84	94	88	72
1978	77	75	82	81	86	87	88	91	85	88	83	81
1979	76	83	79	77	81	87	89	89	88	85	91	83
1980	72	74	77	80	80	89	91	89	84	86	85	81
1981	77	78	77	79	81	91	88	89	89	84	86	76
Mean	72.8	74.6	78.2	80.6	87.6	87.6	88.6	89.1	86.3	87.2	85.9	77.1

(b) Mean relative humidity (%) in Trivandrum at 17 30 hrs for the last 9 years

1973	62	61	65	77	74	84	77	73	75	81	75	71
1974	60	61	67	77	77	77	83	81	84	77	70	64
1975	61	66	67	78	75	83	79	83	83	83	80	69
1976	59	61	65	72	73	71	80	77	75	80	86	70
1977	59	63	68	72	79	78	76	77	78	84	82	66
1978	65	63	69	72	82	78	81	82	76	81	77	71
1979	65	67	66	69	72	79	80	75	81	77	83	72
1980	58	61	67	73	73	82	78	78	76	82	77	70
1981	64	60	65	72	72	83	78	79	82	78	79	67
Mean	61.4	62.6	66.6	73.6	75.2	79.4	79.1	78.9	78.9	80.3	78.8	68.9

Source: India Meteorological Department, Trivandrum

APPENDIX IV (2) (

Mean relative humidity (%) in Punalur (Quilon District

Year	January	February	March	April	May	June	Jul
1972	NA	81	75	87	NA	89	9
1973	83	76	88	90	89	93	9
1974	83	75	83	89	99	95	9
1975	86	88	88	89	90	95	9
1976	75	81	80	87	89	88	9
1977	84	91	84	85	92	93	9
1978	78	76	83	87	91	92	9
1979	82	88	82	86	89	92	9
1980	77	76	79	84	86	94	9
1981	83	83	79	86	87	95	9
Mean	81.2	80.5	82.1	87.0	90.2	92.6	9

(b) Mean relative humidity (%) in Punalur (Quilon Distri

1972	NA	44	46	70	NA	68	7
1973	42	46	49	70	66	80	7
1974	44	41	53	83	74	73	7
1975	62	52	57	68	69	80	7
1976	38	36	43	61	64	65	7
1977	38	47	44	68	78	77	7
1978	38	40	53	64	73	76	8
1979	42	52	54	66	67	77	8
1980	42	45	55	70	65	81	8
1981	47	43	50	65	68	85	7
Mean	43.7	44.6	50.4	68.5	69.3	76.2	

NA : Not available

Source: India Meteorological Department, Trivandrum

s for the last 10 years

eptember	October	November	December
91	93	91	88
92	93	89	84
NA	NA	NA	NA
94	95	92	88
90	92	95	88
91	93	92	83
91	91	94	85
92	91	93	84
90	92	NA	84
94	92	NA	NA
91.7	92.4	92.3	85.5

hrs for the last 10 years

71	83	76	63
71	81	74	69
NA	NA	NA	NA
77	79	73	67
67	76	80	55
73	80	77	59
68	73	70	56
77	72	82	60
71	78	NA	65
80	77	NA	NA
72.8	77.7	76.0	61.8

APPENDIX IV (3) (a)

Mean relative humidity (%) in Alleppey at 08 30 hrs for the last 10 years

Year	January	February	March	April	May	June	July	August	September	October	November	December
1972	72	79	78	77	86	87	90	91	88	87	82	81
1973	76	75	75	78	81	69	89	93	88	89	83	81
1974	73	79	77	82	86	89	93	92	92	87	80	75
1975	76	83	81	81	83	93	94	95	89	92	87	78
1976	71	75	77	78	81	82	92	92	84	84	88	74
1977	70	76	77	78	85	91	93	90	86	86	85	72
1978	73	77	79	79	85	92	93	94	89	81	81	74
1979	74	80	76	75	80	89	92	89	87	83	88	77
1980	68	77	77	79	81	91	93	92	88	87	82	84
1981	75	78	75	78	80	94	91	92	91	85	87	80
Mean	72.8	77.9	77.2	78.5	82.8	89.7	92.0	92.0	88 2	86.1	84.3	77.6

(b) Mean relative humidity (%) in Alleppey at 17 30 hrs for the last 8 years

1972	63	69	70	74	80	81	86	82	81	81	74	70
1973	66	68	71	72	73	83	87	87	81	81	74	69
1974	61	67	69	74	79	82	86	87	85	80	76	65
1975												
1976												
1977	63	67	69	74	78	84	86	84	84	81	76	63
1978	65	67	72	73	79	88	90	88	81	77	74	65
1979	67	71	71	72	75	84	88	84	85	74	79	66
1980	59	67	70	74	76	86	89	86	84	79	73	71
1981	64	72	71	72	76	90	86	88	87	79	78	69
Mean	63.5	68.5	70.4	73.1	77.0	84.8	87.3	85 8	83.5	79.0	75.5	67.3

Source: India Meteorological Department, Trivandrum

Appendix IV (4) (a) Mean relative humidity (%) in Kottayam at 08 30 hrs for the last 9 years

Year	January	February	March	April	May	June	July	August	September	October	November	December
1973	NA	75	75	86	89	91	89	95	86	82	82	75
1974	71	77	79	80	86	89	91	91	82	83	81	73
1975	75	81	80	81	84	94	91	82	90	91	90	87
1976	91	83	81	74	76	74	85	84	83	83	87	77
1977	68	72	75	80	85	87	94	86	84	88	89	85
1978	81	80	78	75	82	87	86	87	85	83	80	79
1979	80	79	71	68	73	86	89	83	83	81	86	76
1980	71	70	66	66	70	90	91	87	80	83	NA	77
1981	81	79	70	71	74	90	84	87	83	82	84	79
Mean	77.3	77.3	75.0	76.7	79.9	87.6	88.9	86.0	84.1	84.0	84.9	78.7

(b) Mean relative humidity (%) in Kottayam at 17 30 hrs for the last 9 years

1973	NA	58	62	74	73	86	82	86	76	83	80	79
1974	65	63	65	97	80	81	90	87	84	75	89	59
1975	59	73	68	79	77	91	95	89	83	83	78	96
1976	98	80	75	75	71	68	78	79	79	83	85	72
1977	59	62	66	73	79	84	89	83	81	86	87	83
1978	75	70	72	71	75	86	81	85	85	81	75	71
1979	71	71	65	67	67	82	85	81	81	77	82	70
1980	69	68	65	69	66	83	87	81	75	75	NA	71
1981	69	68	64	65	69	85	78	78	81	72	74	68
Mean	70.6	68.1	66.9	74.4	73.0	82.9	83.9	83.2	80.4	79.4	81.3	73.2

NA: Not Available

Source : India Meteorological Department, Trivandrum.

APPENDIX V

Soil Series and Soil Associations identified in the Trivandrum and Quilon districts of the Region

District 1	Region 2	Soil Association 3	Soil Series 4	Description 5
Trivandrum	Soils of the low land			Forms the nearly level to very gently sloping coastal plain bordering the sea in the west and tongues of lands extending towards river beds.
	(a) Soils of the coastal delta region	Kazhakuttom Poovar Association.	Kazhakuttom Poovar	Recent marine deposits running as parallel strip between the coast and mid land laterites. "Very deep sandy coastal soils in flat to very gently sloping sand beaches, deltas and lagoons'. Very deep,coarse textured soils developed on flat to very gently sloping coastal alluvium, rarely occuring in depressions also. Kazhakuttom accounts for 52% while Poovar is 48%. Loamy sand to sandy loam surface soils and sub soils. Coconut is the main crop. Paddy is rarely grown.
	b) Soils of Rivarine alluvium	Karamana, Chirayinkil Mudakkal Association	Karamana Chirayinkil Mudakkal	Occur as narrow pockets or stripes along the major rivers of the district. 'Very deep, medium textured yellowish brown riverine alluvium on flat to gently sloping alluvial flats and flood plains'. Very deep with yellowish brown to reddish brown loamy sand to sandy clay loam textural classes· These

1	2	3	4
	Soils of the mid lands		
		Neyyattinkara Vellayani Assocation	Neyyattink Vellayani

oung soils with contrasting textures and stratification
ers. Karamana soils dominate with 65%. Chirayinkil
s in less elevated areas adjoining the coast while
akkal is seen in upstream areas and contains more of
sand fraction and silt. These soils possess the
cteristics of typical alluvium and certain parts are
cted to occasional flooding. Coconut arecanut,
na and vegetables are the major crops. It is about
Marukil series, 25% Kuttichal series and 12% Kunnathu-
oils. The remaining 2% are minor soils. Soils of this
ciation occur on narrow to medium valleys encompass-
the ridges and hills. They have high periodic water
.

ngly to steeply sloping mounds, laterite hills and the
opped low level laterite plateaus intervened by broad
ys—Spread in between low land and mid land
ns.

deep, red loams on level to strongly sloping foot
s and gently undulating plains".

represents the red loam soils of the southern and
ern parts of the district. Very deep sandy loam to
loam soils, free of gravels, with slight increase in clay
ent down the profile occurring on a transitional belt in
een the laterite hill slopes and coastal soils belonging
e Vellayani series. The deep to very deep soils with

Thonnackal Varkala Association	Thonnackal Varkala
Trivandrum Vilappil Association	Trivandrum Vilappil

ly sandy clay loam to clay loam textural grade
ing the laterite are of Neyyattinkara series. Occur
on gently undulating terraced lands.
ut, arecanut, groundnut and vegetables are grown.
to very deep, yellowish brown, medium textured
y laterite soils of tertiary origin on low laterite
us. This association is distributed in the N. W.
of the district Thonnackal series has a deposit of
am to clay surface and sub soils—overlying the
and occurs on the lower slopes of laterite plateaus.
a soils are very gravelly with textural grades ranging
gravelly loam to gravelly clay and generally occur on
u tops. No rock is traceable even in very deep
s.
ut tapioca, rubber and cashew are the major crops.
to very deep, reddish brown, medium textured
y laterite soils derived from gneissic parent rock on
ately to steeply slopping low laterite hills and
ds".
of this association occupy the central part of the
t. They are very deep, reddish brown with a fair
ution of iron and lateritic gravels in the profile.
drum series accounts to 73% and Vilappil 27%.
drum soils possess a thick yellowish red gravelly clay
rizon merging with the soft laterite below. The 'A'
n is comparatively thin and has gravelly loam to
y clay texture. They usually occur on summit, side
and foot slopes of low laterite hills and mounds.

1	2	3	4
		Vizhinjam Vilappil Association	Vizhinja Vilappil
		Amaravila Vembayam Marukil Association	Amarav Vembay Marukil

lappil soils are less gravelly and have gneissic boulders the profile and occur mostly on ridges.

variety of crops like coconut, tapioca, pepper, rubber, shew etc. are grown.

Deep to very deep, medium textured, reddish brown avelly laterite soils, with thick 'A' horizon on strongly to eeply sloping laterite hills, mounds and ridges".

ne characteristics of these soils are similar to those of ivandrum and Vilappil association, except that the zhinjam soils have a comparatively thick 'A' horizon than e Trivandrum series.

Very deep, imperfectly to poorly drained clayey colluvic luvial soils with high periodic water table on flat to very ntly sloping terraced broad valleys".

ccures in the lowest physiographic situations consisting of oad valleys, depressions and old channals. A greater rt is under periodic flooding. It is about 55% of Amaravila % of Vambayam and 10% of Marukil and 5% of mino. ils. These are mostly developed on fluventile deposits. oils are very deep, brown to grey in colour and have am to silty clay texture.

maravila soils have clay to silty clay surface and sub ils with a fair increase in clay content down the profile. embayam soils are also clayey but have less clay content d have sand pockets in the profile. Marukil is more ght in texture and the sand content increases with depth.

Soils of mid uplands	Nedumangad –Palode Association	Nedumanga Palode
	Marukil– Kuttichal– Kunuthukal Association	Marukil– Kuttichal- Kunnathuka

is the major crop grown, followed by pulses or
bles in the off seasons.

ills of Western Ghats consisting of sloping elongated
and high hills with intermittant deep narrow valleys
g parallel to the Western Ghats.

to very deep medium textured, hilly and steep dark
ed, gravelly lateritic soils on high hills and ridges."

nangad series accounts to 88% and Palode 12%.
ave gravelly clay loam surface texture underlain by
ly clay sub soils. They occur on ridge tops, side
and foot slopes. Nedumangad soils are deep to
eep, dark brown having a layer of laterite embedded
aterite stones Palode soils are less deep and have
rganic matter. Partly weathered gneissic rock is
traceable in this soil. Rubber, coconut, arecanut,
r, tapioca etc. are grown.

deep, imperfectly drained loamy to clayey colluvic
al soils with high periodic water table on gently
g terraced narrow valleys".

are very deep, medium to heavy textured with reddish
to dark yellowish brown colour. It is about 40%
il soils, 36% Kuttichal soils and 22% Kunnathukal
Occurs on narrow to medium valleys encompassing
lges and hills. They have high periodic water table.
il soils show a decrease in clay content with depth
are mostly located on medium valleys at lower
ion. Kuttichal soils are medium textured, with few
s in the profile and located in narrow valleys.

1	2	3	4	5
				Kunnuthukal soils have more clay in sub soils and have yellowish brown colour. They occur in the upper part of medium valleys. Soils are poor in nutrient status. Paddy is the main crop. Vegetables, pulses etc. are grown in off seasons.
	Soils of uplands	Kottur-Aryankavu Association	Kottur–Aryankavu Palode	Forest soils, not covered under N. A. R. P. (Southern Region).
Quilon	Coastal alluvium			Derived from sandy coastal alluvium stretching as a narrow belt along the coastal region. Soils are fine sandy to coarse sandy in texture and are greyish brown to reddish brown in colour, having uniform textural grade down the profile, with single grain to week structural development and ill defined horizons.
		Mannar-Kazhakuttom-Needakara soil Association		Mannar soils are more sandy and extends to the centre of Karunagapally and are grouped under psamments. Neendakara soils are coarse loamy mixed isohypothermic, Typics tropofluents. Kazhakuttom soils are grouped under psamments.
Riverine alluvium				Developed essentially from five fluventile sedimentation, occurring as narrow belt along river banks and are subject to frequent flooding during monsoon. Soils are very deep and have ill defined horizons.
	1 Kallada Chirayinkil Soil Association			

2 Vazhamuttom-Pamba Soil Association

Soils of low land

1 Kunnamkara–Mylom Soil Association

2 Yeroor–Maleyathu–mannil Soil Association

3 Mullanikkad–Kodunthara Association

4 Amaravila–Kottenkara Association

Soils of mid land

These are young soils grouped under Entisols falling under fine loamy to clayey family and typic tropofluents.

Located in the valley bottom, old channels and other low lying areas of the coastal, mid land and mid upland region. Soils are developed both by colluvial and alluvial deposits. Texture ranges from sandy loam to clay depending on the type of soil in the adjoining slopes. Water table is high and properties associated with excess wetness are seen in the profile. Soils occur on nearly level to generally sloping lands and are bunded. Erosion is minimum. Sub soil colour ranges from reddish brown to yellowish red. These soils are grouped into 3 orders Entisols. Inceptisols and Alfisols.

Paddy is the major crop grown.

Occurs in the central part of the district. Have low hills, steep side slopes enclosing narrow valleys and undulating plains bisected by numerous drainage channel. Soils are derived mainly from gneissic rock. They are, in general .well drained, very deep, dark reddish brown in colour with thick layer of plinthite or laterite.

1	2	3
		1 Trivandrum–Varkala–Thonnakkal Association
		2 Varkala–Sivagiri Association
		3 Pattazhi–Karavalloor Association
		4 Adoor–Omalloor Association
		5 Vizhinjam–Trivandrum Association
		6 Varkala–Thonnackal Association
		7 Puthenpeedika-Konnithazhom Association
		8 Kottarakkara–Ommannoor Association

ave high amount of gravel throughout the profile depth. ery poor in all major plant nutrients but respond well o manuring.

he soils of these associations are grouped into two orders z., Inceptisols and Alfisols falling into Loamy skeletal to ayey skeletal family under isohypothermic temperature egimes.

Soils of mid upland

1 Nedumangad-Palode Association
2 Ezhukone-Nedumangad Association
3 Channanakadu-Aryankavu Association
4 Perinad-Manniyar Association

Soils of upland.

1 Kottoor-Aryankavu Association
2 Ranni-Aryankavu Association

ated on the foot hills of the Western Ghats and other
ated hill tops in the district. On the Western portion
e soils are located at elevations of 600' above NSL.
siographic units include medium hills with very steep
slopes and foot slopes and narrow valleys. The soils
deep to very deep with high content of humus on
surface. Developed from gneissic parent rock, highly
ally with high amount of stones and boulders in the
ace and sub soil Laterisation is evident in most of the
s. Soils are subject to severe erosional hazards due
ts physiographic position. They are mainly put under
ntation crops.

The soils of these associations are grouped into 3
ers; viz., Entisols, Inceptisols and Mollisols. They
skeletal soils falling into loamy skeletal to clayey
etal family with isohypothermic temperature regime:

se are forest soils of the Western Ghats, not covered
er N.A.R.P. (Southern Region).

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