NATIONAL AGRICULTURAL RESEARCH PROJECT

COMPLETION REPORT (PHASE-I)

--CENTRAL ZONE--

Regional Agricultural Research Station, Pattambi

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I. INTRODUCTION

The Indian Council of Agricultural Research has sanctioned the Sub-Project for the Central Region of Kerala, with a Regional Research Station at Pattambi, a Sub-centre at Mannuthy and a Sub-station at Eruthiampathi under the National Agricultural Research Programme with a view to strengthen the regional research capability. The administrative approval for implementation of the sub-project was accorded by I.C.A.R. during August 1981 for a total estimated cost of Rs.86.21 lakhs. The Executive Committee of the Kerala Agricultural University at its 105th meeting had approved the proposal for implementation of the sub-project for a period of five years from 1.9.1981.

The Central Region consists of the three central districts of Kerala viz., Palghat, Trichur and Ernakulam excluding the High ranges, coastal saline tracts and other isolated areas like Kole lands with special soil and physiographic conditions (Fig.1). The region comprises of 17 taluks, 44 Development Blocks and 274 Panchayats. The geographical area of the region is 973,689 hectares which is 25% of the area of the state. The total population of the region is 70.12 lakhs (1981 census) which accounts for 27.54% of the population of the state. The density of population varies between a minimum of 456 per sq.km. (Palghat district) and a maximum of 1,053 per sq.km. (Ernakulam district) with a mean value of 773 per sq.km. against the state average of 654 per sq.km.

1.1 Agroclimatic conditions of the zone

Eight agro-climatological situations were identified in the Central Zone of Kerala based on altitude, rainfall pattern and soil conditions.

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1.1.1 Characteristics used to identify Agro-climatological situations

Altitude	Annual Rainfall	Soil	Relief
Low elevation MSL to 7.5 M (LE)	Low Below 1500 mm (LRF)	Saline hydro-morphic soil water logged (SHS)	Coastal area (CA)
Medium elevation 7.5 to 75 M (ME)	Medium 1500-2500mm (MRF)	Alkaline Black soil (BS)	Lowland (wet-lands, Area below MSL-KOLE, Water logged)
High elevation 75 to 750 M (HE)	High 2500 & above (HRF)	-	Uplands (Garden land, Modan land, Palliyals, Hill slopes)

1.1.2 Agro climatological situations of central region

No.

1. CA - LE - HRF (coastal area - Low elevation - High rain fall)
2. CA - LE - SHS - HRE (KOLE and POKKALI)
3. ME - HRF (Medium elevation - High rainfall)
4. HE - HRF (High elevation - High rainfall)
5. HE - MRF (High elevation - Medium rainfall)
6. HE - LRF (High elevation - Low rainfall)
7. ME - BS - LRF (Medium elevation - Black soil - Low rainfall)
8. HR - LRF (High ranges)

1.2. Influence area of the zone:

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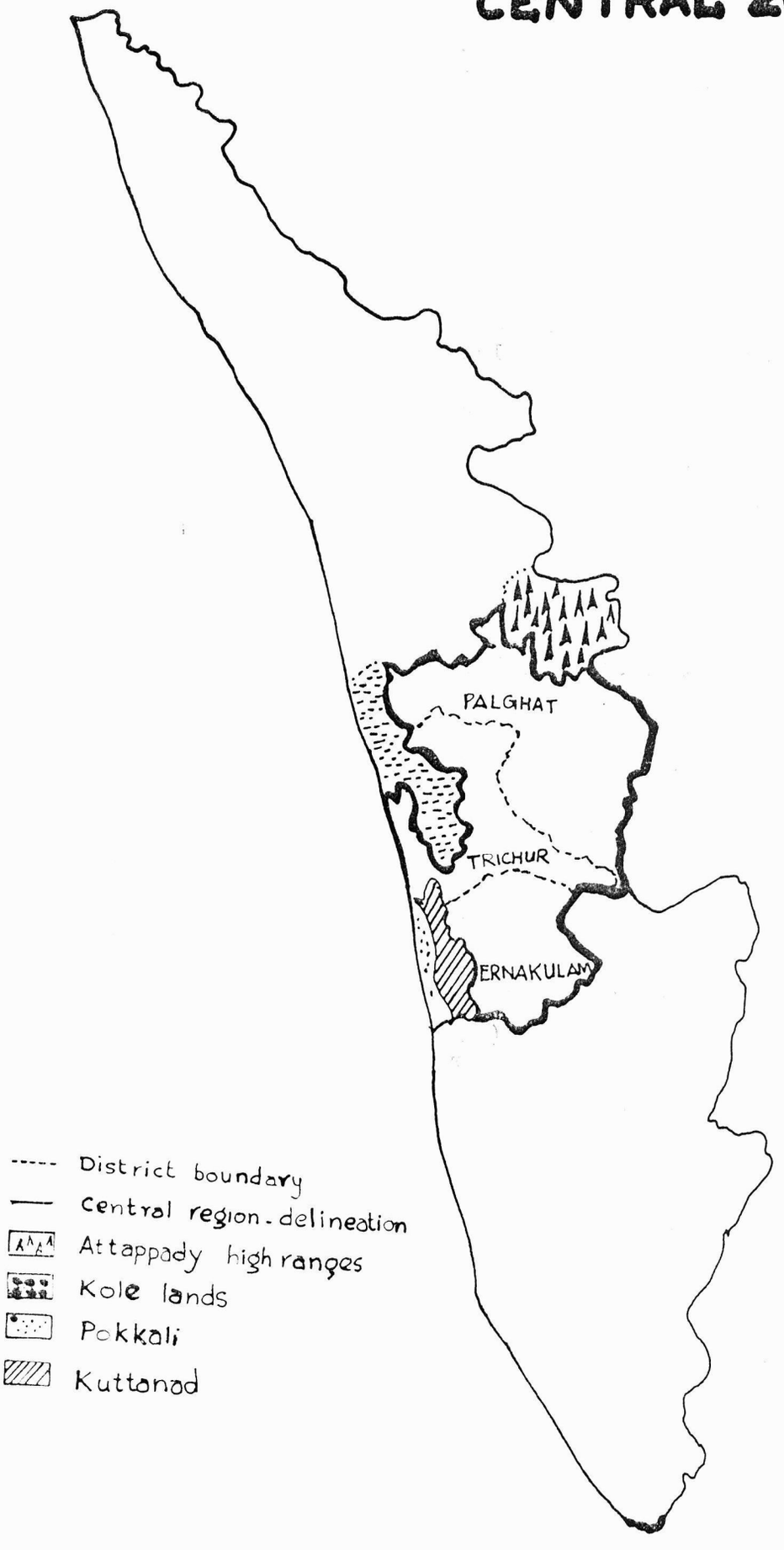
CENTRAL ZONE



CENTRAL ZONE - SUMMARY OF AGRO-CLIMATOLOGICAL SITUATIONS

Sl. No.	Agro-climatological situation & features	Principal crops (% of cropped area)	Major cropping systems (% of net cropped area)	Special Features	Location Districts/Blocs
(1)	(2)	(3)	(4)	(5)	(6)
1.	Coastal low elevation high rainfall area	Rice, Coconut, Pulses	Rice-Rice-Fallow Water fallow-Rice-Vegetables	Low fertility of soil and occassional salt and water inundation	Ernakulam North Perur
a)	Sandy soil, coastal alluvium	Homesteads with coconut, banana and vegetables	Homesteads with intercrops like banana, vegetables, mango, cashew in coconut garden	Raised garden lands - Predominantly homesteads.	Trichur Cranganore Thalikkulam Mathilakam Chowghat.
b)	Low level lands				
c)	Rainfall 2500 mm				
2.	Coastal area of low elevation with salinity hydromorphic soil	Rice, Coconut	Rice-prawns-prawns coconut	Low level, salt water inundated area (Pokkali) Rice raised on mounds & later distributed. Rice mixed cropping with prawn. Coconut raised on bunds only.	Ernakulam Vytila Edappally Palluruthy Cochin Vypeen Parur (S)
	High rainfall - 2500mm				
a)	Saline hydromorphic soils		water fallow-rice Rice-water fallow Coconut (on bunds only)	Areas mainly below MSL, N and K rich saline hydromorphic soil water logged	Trichur Anthikkad Vellangallur Irinjalakkuda Cherpu Puzhakkal
b)	Low bunds - salt water inundated - below MSL in certain areas				
c)	Rainfall 2500 mm.				

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(1)	(2)	(3)	(4)	(5)	(6)
3.	Medium elevation low lands with high rainfall a) Lateritic sandy loams b) Low level lands c) Rainfall 2500 mm	Rice Coconut Pulses vegeta- bles Sesamum Banana Tubers	Water fallow-rice-rice-water fallow Rice-Rice-vegetables Pulses. Rice-sesamum Rice-Rice-Green manure Rice-Banana-Rice (2/3 year rotation) coconut on bunds.	Low level lands first crop raised as rainfed, 2nd & 3rd crop with supplementary irrigation. Flooding experienced during S.W. Monsoon period and drought during January and May.	Ernakulam Pampakuda Vadavancode Koovappady Perumbavur (M) Vazhakkulam Alway (M) Alangad Parakadavu Angamali Mulamthuruthi Trichur Mala Trichur (M) Kunnamkulam(M) Chowannur Mullasseri
	Uplands	Coconut Arecanut Banana Tapioca Pepper Mango, Jack Cashew Sesamum Pulses Vegetables Tubers	Crop raised as homestead, modan paddy raised during S.W. Monsoon period. Pulses, vegetables, tubers mainly rainfed.	Undulating topography and light textured lateritic soils. Supplementary irrigation provided using water lifting devices. Drought experienced from January to May.	Palghat Thrithala Pattambi Ottappalam

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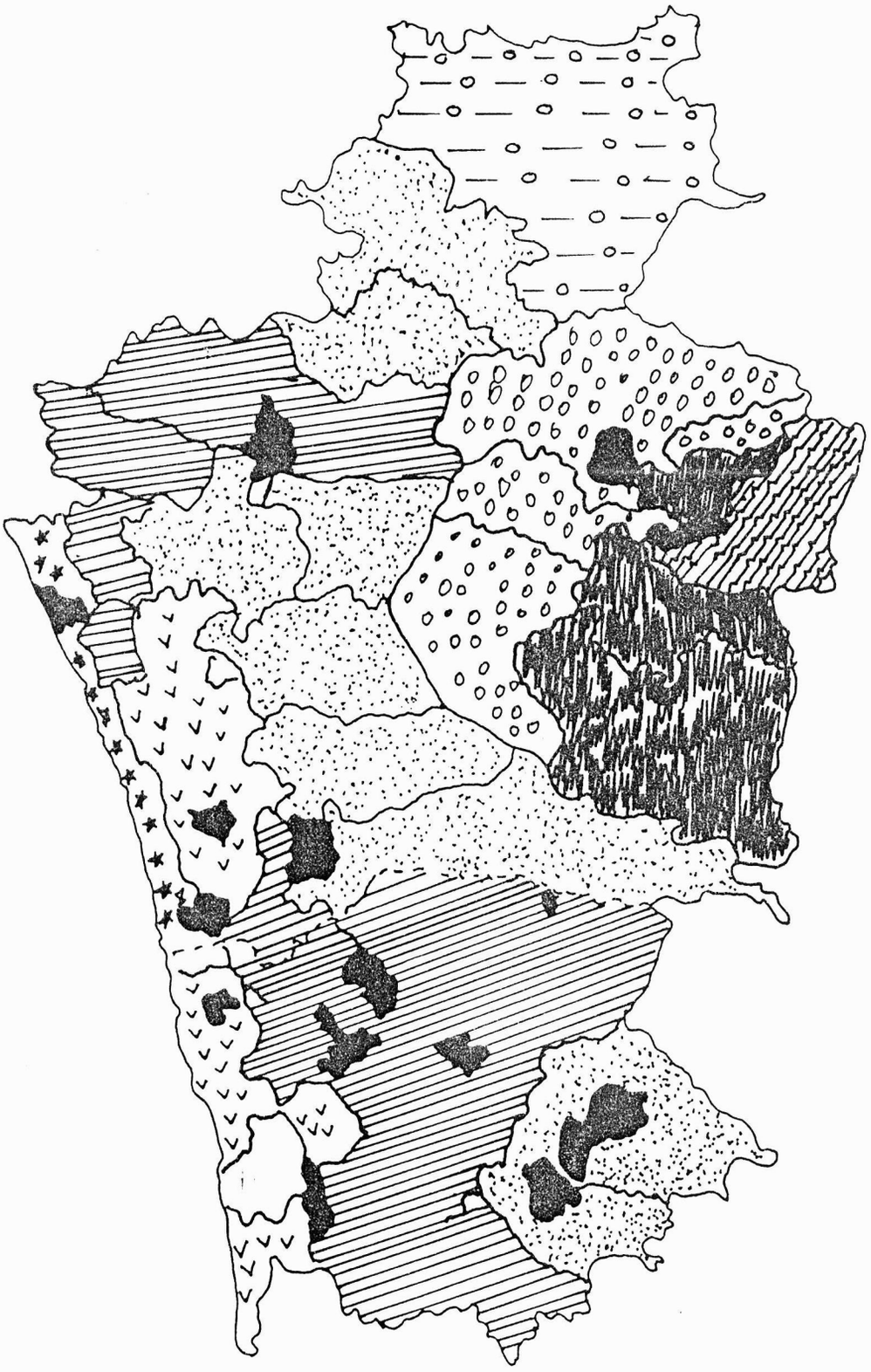
AGRO-ECOLOGICAL SITUATIONS OF CENTRAL ZONE



AGRO ECOLOGICAL SITUATION - 1- CA-LE-HRF
" " - 2- CA-LE-SHS-HRF
" " - 3- ME - HRE
" " - 4- H-E-HRF
" " - 5- H-E - MRF
" " - 6 - H-E - LRF
" " -7- ME - BS - LRF
" " -8- HR - LRF

(1)	(2)	(3)	(4)	(5)	(6)
4.	High elevation low lands high rainfall a) Sandy loam b) Rainfall 2500 mm	Rice Banana Coconut Vegeta-bles Tubers Sesamum	Rice-Rice-Rice Rice-Rice-Fallow Rice-Rice-Vegeta-bles/Pulses Rice-Sesamum Rice-Banana (Two years) Rice Tapioca/Yam (3/2 year) coconut on bunds	First crop raised mainly rainfed, 2nd and 3rd crop supplemented with irrigation. Pulses and sesamum raised with residual moisture. Koot-tumundakan system (mixing 1st and 2nd crop rice seeds) practised in certain areas	Ernakulam Elamdusam Moovatupuzha Moovatupuzha(M) Kothamangalam Trichur Chalakudy Kodakara Ollukkara Wadakkanchery Pazhayannur
	Uplands: a) Lateritic loams b) Undulating topogra-phy with terraces, slops and hill tops.	Coconut Arecanut Banana Tapioca Pepper Mango Jack Cashew Rice-Pulses Sweet Potato	Crops raised in homesteads polycrop mixtures	Well drained uplands crop raised mainly as rainfed. Drought experienced during January to May	Palghat Mannarghat Sreekrishnapuram
5.	High elevation, low lands with a) Lateritic brown loamy soil b) Undulating topogra-phy c) Rainfall (1500 - 2500 mm)	Rice Pulses Vegeta-bles Sesamum Groundnut Banana Coconut Palmyrah on bunds.	Rice-Rice-Rice Rice-Rice-Pulses/Vegetables Rice-Vegetables/Pulses, Rice-Banana Rice-Groundnut Coconut } ON BUNDS Palmyrah }	Major area covered under irrigation. Soils slightly heavier in texture that laterite and fertile. High crop intensity is followed.	Palghat Alathur Palghat Palghat (M) Coyalmannam Nenmara

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(1)	(2)	(3)	(4)	(5)	(6)
Uplands		Coconut Palmyrah Tapioca Banana Pepper Mango Jack Cashew Pulses Groundnut	Crops raised in homesteads as mixed crop	Undulating topography with hill tops, terraced and garden lands Rainfed crop supplemented with irrigation in ayacut areas.	..
6.	High elevation with low rainfall:				
a)	Brown and red soils	Rice, Ragi, Jower, Maize, Groundnut, Pulses, Vegetables, Cotton and Palmyrah on bunds	Rice-Rice-Rice Rice-Rice-Pulses/ Vegetables Rice-Ragi Rice-Jower Rice-Groundnut Rice-Vegetables-Groundnut	Soil near neutral clay loam in textures, Irrigation facilities in limited areas,	Palghat Kollengode Nenmara
b)					
c)	Rainfall 1500mm				
Uplands:		Coconut, Palmyrah, Pepper, Tapioca, Mango, Jack, Cotton Groundnut and banana	Crops raised as mixed crop in homesteads	Neutral soils, clay loam in texture, Irrigation facilities available only in limited areas.	Palghat Chittoor

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(1)	(2)	(3)	(4)	(5)	(6)
7.	Medium elevation low land with Black soil and low rainfall:				
a)	Black soil	Rice, Sugarcane, Groundnut, Pulses, Cotton, Coconut, Palmyrah	Rice-Rice-Rice Rice-Rice-Fallow Rice-Rice-Pulses Rice-Rice-Groundnut Sugarcane (3 years) Pulses - Cotton Coconut and Palmyrah on bunds.	Black alkaline soils with impeded drainage and sulphide injury - After cultivation difficult. (Poonthal padam)	
b)	Low level lands with impeded drainage				
	Uplands	Coconut, Palmyrah Mango, Jack, Tamarind, Tapioca, Cotton, Pulses and Sweet Potato.	Crop raised in homesteads as Polycrop mixture	Black soils of alkaline reaction, and impeded drainage soil hard when dry. Irrigation facility available in major areas.	
8.	High ranges low rainfall:				
a)	Brown soil	Rice, Vegetables, Pulses, Sugarcane Mellets, Wheet, Dats. Coffee, Tea Orange, Cardamom Grass	Rice-Rice-Vegetables Millets - Vegetables Millets - Wheat - Dats Groundnut-Potato - Crops raised as plantations Coffee, Tea, Orange Cardamom, Grass.	Crops raised as rainfed Irrigation facilities meagre	Palghat Attappadi Nenmara

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1.3 Climate and Soil

1.31 Climate

1.311 Rainfall

The Central Region, situated on the windward side of western ghats receives heavy rainfall during South West monsoon. Ernakulam is benefitted by a maximum average rainfall of 3550 mm (Neriamangalam recording the highest in the state, 5883 mm), Trichur having a rainfall of 3215 mm whereas Palghat receives only 2115 mm. More than 75% of the rainfall is received during June, July, August (South West monsoon period.) The locality around Eruthempathy is typically a low rainfed area in the whole state.

1.312 Water balance of the region:

In the Palghat District, the water deficit is prolonged for a longer period from November to May whereas in Ernakulam district, the water deficit is only from November to April.

1.313 Temperature:

The variations in the levels of temperature are only marginal in the Districts of Trichur and Ernakulam as they are influenced by the coastal marine climate. On the other hand in Palghat District the temperature variations are more pronounced. The average maximum temperature of the zone varies from 24.8°c to 31.4°c and that of minimum from 21.1°c to 23.1°c striking a mean range from 22.7°c to 27.5°c. However the mean

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76°E

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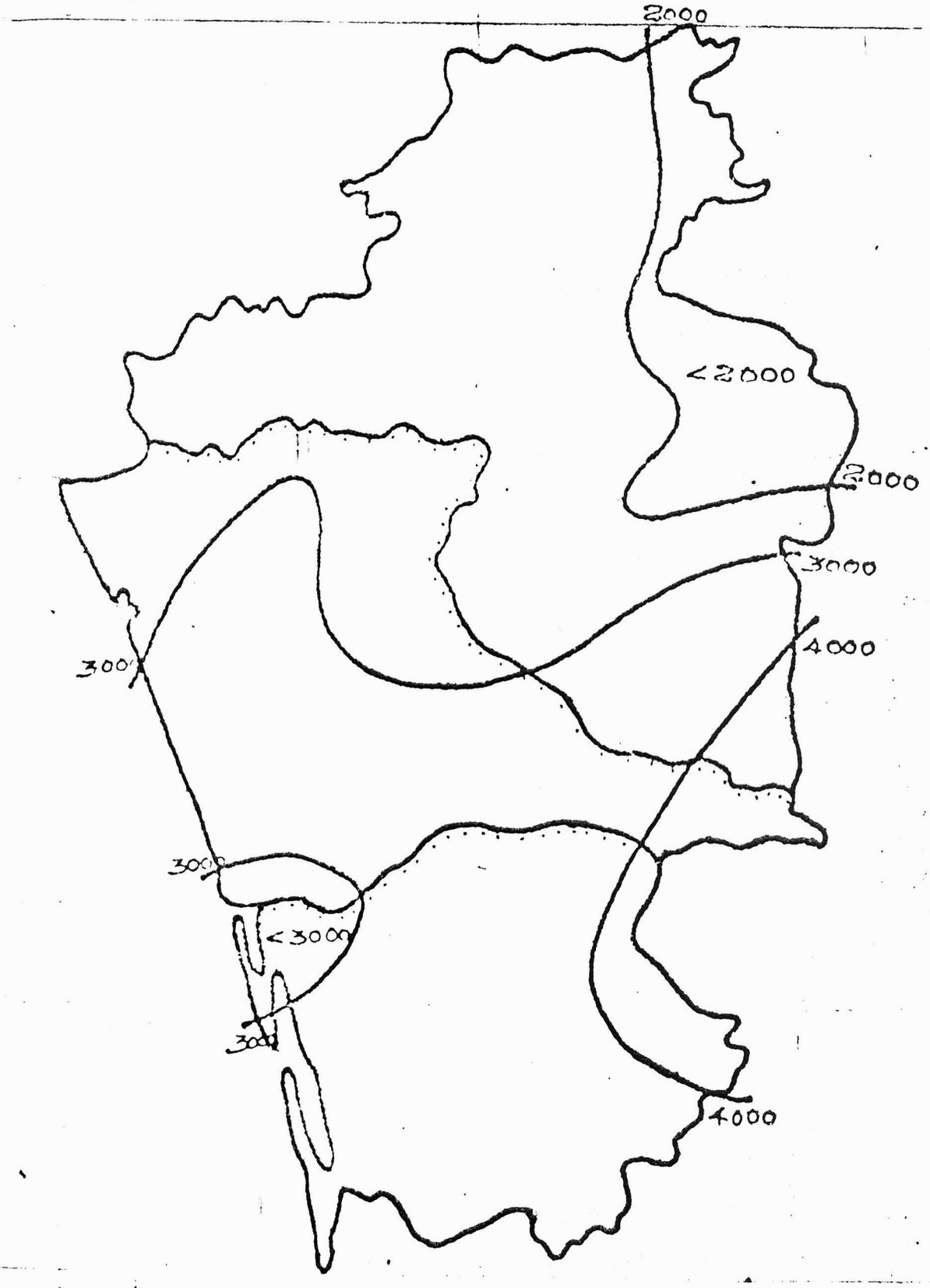
77°E

ANNUAL RAINFALL (mm.) (1901-'79)



76°E

77°E

value for humidity is as high as 82 per cent, the months from June to August recording values above 90 per cent.

1.314 Humidity:

The average Relative Humidity is about 70% in Trichur and Ernakulam district whereas it comes down to about 40% in Palghat District during December to March due to the entry of hot winds from Tamil Nadu through the Palghat gap.

1.32 Soil

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

1.321 Laterites

Laterites are found in the mid land physiographic division of the zone. Heavy rainfall and high temperature prevalent in the zone are conducive to the process of laterisation. The surface soils are mostly reddish brown to yellowish red in colour. The texture of surface soils ranges mostly from gravelly loam to gravelly clay loam. Extensive stretches of undurted laterites with hard surface crust are of common occurrence in the zone. Laterities are in general poor in available nitrogen, phosphorus and potash and are low in bases. The organic matter content is also low. They are generally acidic with a pH range from 5.0 to 6.2. These soils are generally well drained and respond well to management practices.

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1.322 Coastal alluvium

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

1.323 Riverine alluvium

These soils occur mostly along the banks of the rivers and their tributaries. Horizon differentiation is not well expressed. They are very deep soils with surface texture ranging from sandy loam to clay loam. The fine sand fraction usually predominates. Presence of mica flakes has been observed in the alluvial soils of Trichur and Ernakulam Districts. These soils are comparatively more fertile than laterite soils. They respond well to management practices.

1.324 Brown hydromorphic

Hydromorphic soild as a group occur extensively in all the three districts of the Zone. These soils are mostly confined to valley bottoms between undulating topography in the mid land and in low lying areas of the coastal strip. They have been formed as a result of transportation and sedimentation of material from adjoining hill slopes and also through deposition by rivers. In a majority of these soils, the water table is high. The development of the soil profile has occurred under impeded drainage conditions. In

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

1.325 Hydromorphic saline

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

1.326 Acid saline

Acid saline soils are encountered in the coastal tract of Ernakulam District. The main problems faced are the accumulation of acids and salts under prolonged waterlogged conditions and

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hazards due to salinity. These soils are susceptible to seasonal ingress of saline water as a result of tidal inflow from the sea. They are black in colour, poorly drained heavy textured soils, distributed in flat area lying 1-2m below mean sea level. They are submerged for nearly 6 months in a year from June to November. The profiles show typical aquic characteristics. Decomposed organic matter is often observed in lower layers. These soils are highly acidic in reaction.

1.327 Black soils

Black soils are found in the Kerala state, only in the Chittoor Taluk, of the Palghat District. They are found to occur in patches and are considered as extensions of the Black cotton soils observed in the adjacent Coimbatore District. These soils are dark in colour, low in organic matter, calcareous, moderately alkaline, high in clay content and cation exchange capacity and are very sticky and plastic. These soils are deficient in nitrogen add phosphorus but have moderate levels of potassium and calcium.

1.328 Forest loams

These soils are the products of weathering of crystalline rocks under forest cover. They are restricted in occurrence in the forest areas of high ranges of the eastern part of the zone. These soils are generally acidic with pH ranging from 5.5 to 6.3. They are rich in nitrogen but poor in bases because of heavy leaching.

1.4 Irrigation pattern:

The total area under irrigation in the Central Region is 1,45,210 hectares which works out to 61 per cent of the total area irrigated in the State.

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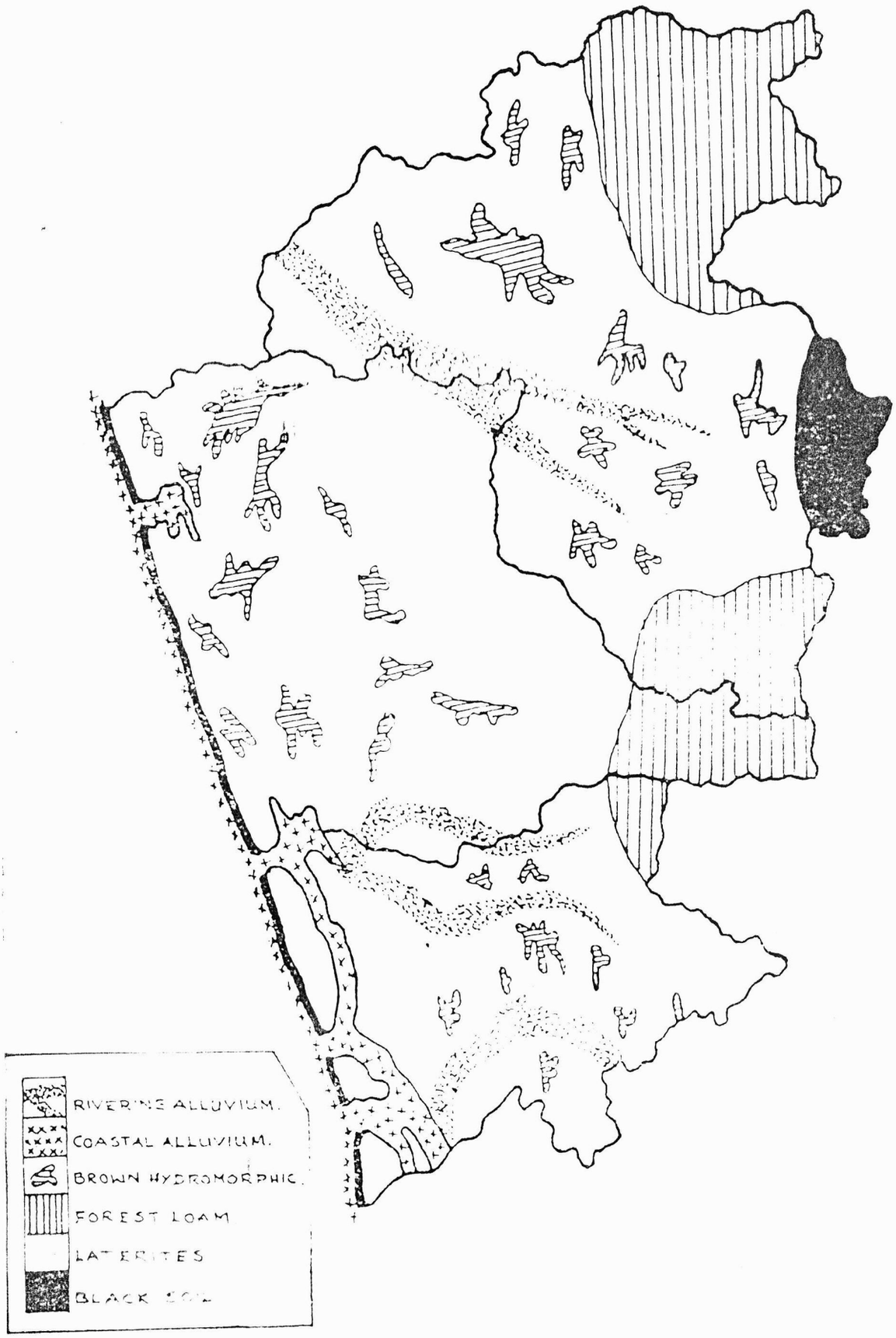
- SOIL MAP -



Source wise, the Government canal provides irrigation to 59 per cent while private tanks and wells account for about 15 per cent of the total irrigated area. Irrigation water is mainly utilised for raising rice crop (2,09,970 ha). In Trichur District coconut and areacanut are also grown widely under irrigated conditions.

There are 24 major and medium irrigation projects implemented in the State out of which 17 are located in the Central Region. These projects are operated in Bharathapuzha, Keechery, Chalakudy, Periyar, Karuvannur and Muvattupuzha river basins.

1.5 Land use pattern:

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

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

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fallows other than current fallows occupy 10,295 hectares. The current fallows account for 16,326 hectares of the zone, which works out to 37.6 per cent of the current, fallows of the state.

The net area sown in the zone is estimated as 5,26, 847 hectares and area sown more than once as 2,69,007 ha. which represents 24.2 per cent and 39.9 per cent of the corresponding categories of the land mass of Kerala.

1.6 Farming situations

1.61 Wet lands-Annual crops

1.611 Farming Situation WLA 1

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

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

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

Cropping pattern: Rice-Rice-Fallow

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

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raised during July-August and transplanted by September-October.

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

1.612 Farming situation WLA-2

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

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

Rainfall: Same as that of the WLA-1 situation.

Cropping pattern: Rice-Rice-Pulses/Vegetables

Rice is grown during the first and second crop season as in WLA-1. Pulses are grown after the harvest of the second crop rice utilizing the residual moisture and supplemented by irrigation wherever possible. Vegetables are grown in limited areas utilizing the family labour to the maximum. Irrigation is provided by digging small pits in the field and pot watering the plots. The pulses usually grown are cowpea, blackgram and to a limited extent greengram. Bhindi, gourds, amaranthus and brinjal are the common vegetables grown besides water melon in some areas.

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

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1.613 Farming situation WLA-3

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

Soil type : Same as that of WLA-2
Rainfall : -do-
Cropping pattern: Rice-Rice-Rice

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

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

1.614 Farming situation WLA-4

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

Soil type: Same as in WLA-2

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

Rainfall: Same as in WLA-2

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Cropping pattern: Rice-Pulses-Fallow vegetables

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

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

1.615 Farming situation WLA-5

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

Soil type: Similar to WLA-2

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

Rainfall: Same as that of WLA-2

Cropping pattern - Rice-sesamum-fallow

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

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Irrigation facilities - Nil

1.616 Farming situation WLA-6

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

Soil type: Same as in WLA-1
Rainfall - Same as in WLA-1

Cropping pattern: Banana intercropped with vegetables/ tubers.

Irrigated banana is raised in wet lands usually for catching the Onam Market during August-September. The suckers are planted during September-October in wet lands and irrigated during summer months. The vegetables and small tubers are grown as intercrops during rainy season and harvested before March-April.

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

1.62 Uplands-Annual crops

1.621 Farming situation ULA-1

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

Soil type: Mainly laterite, gravels present, low organic matter content, poor infertility status, well drained with undulating topography.

Rainfall: Same as in WLA-1
Cropping patter: Rice-Single crop

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

Irrigation facilities: Nil

1.622 Farming situation ULA-2

Area: Same as that of ULA-1
Soil type: -do-
Rainfall : -do-

Cropping pattern: Tapioca or other tubers/rainfed banana.

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

Irrigation facilities: Nil

1.63 Perennials

1.631 Farming situation ULP-1

Area: Similar to ULA 1, WLA-5 and WLA-6
Soil type: -do-
Rainfall : -do-

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

Irrigation facilities: Limited. Supplementary irrigation facilities only, limited with sources

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like wells and small tanks. Majority of cultivation based on rainfall only.

1.632 Farming situation WLP/A-1

Area - Similar to WLA-4
Soil type -do-
Rainfall -do-

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

Irrigation facilities - As in WLA-4.

1.633 Farming situation ULP-2

Area - same as in ULP-1
Soil type -do-
Rainfall -do-

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

Irrigation facilities - As in ULP-1

1.634 Farming situation ULP-3

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

Soil type - Same as in ULP-1
Rainfall - Same as in ULP-1

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

Irrigation facilities - As in ULP-1

1.635 Farming situation ULP-4

Area: Mainly concentrated in the high ranges and upper physiographic region of the zone and scattered in isolated patches of the mid lands.

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Includes large plantations with areas more than 100 hectares and middle and small plantation ranging from a few cents to 100 hectares also. The total area under this farming situation in the zone is about 67,000 ha.

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

Rainfall: Areas with high rainfall, well distributed during the three seasons are preferred for adopting this farming situation. The average annual rainfall varies from 3700 mm to 2750 mm.

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

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

1.636 Farming situation ULP-5

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

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

Rainfall: Same as that of in ULP-3

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

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Irrigation facilities: Nil

1.637 Farming situation ULP-6

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

Soil type: Mainly laterites and coastal sandy alluvium.

Rainfall: Same as that of farming situation ULP-3

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

Irrigation facilities: Nil. Raised as rainfed crop only.

1.7 Cropping pattern and Major crops

1.71 Cropping pattern

Definite cropping patterns are followed only in the case of annual crops. In the uplands where perennial crops are raised no rigid pattern of intercrops are followed.

1.711 Annual crops - Wet lands

1. Rice-Rice-Fallow
2. Rice-Rice-Pulses/Vegetables
3. Rice-Rice-Rice
4. Rice-Pulses/Vegetables-Fallow
5. Rice-Sesamum-Fallow
6. Banana-Vegetables/Tubers

1.712 Annual crops - uplands

1. Rice-Sesamum
2. Tubers/Banana/[illegible](Rainfed)

1.713 Perennial crops - uplands

1. Coconut intercropped with a variety of annuals like vegetables, tubers, rice, millets etc.
2. Arecanut intercropped with annuals

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3. Coconut intercropped with perennials like pepper, arecanut etc.

4. Homesteads of a collection of perennial and annual crops

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

6. Lemon grass and other essential oil plants and tree crops

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

1.72 Major crops

The diversity in the agroclimatological conditions experienced in the region is reflected in the wide range of crops cultivated here. One of the features of agriculture in central Kerala is its poly culture in which an assortment of annual and perennial crops are raised in the homestead gardens with coconut as the pivotal crop. In the low lands rice is grown predominantly and other crop like pulses, oilseeds, tubers and vegetables are fitted in the cropping sequence. Uplands generally suppot a poly crop of perennials and annual. In higher elevations (hills & hillocks) except in the case of plantation, crops like rubber, coffee, cardamon, tea, etc. are raised generally as pure crops.

Rice is the major crop covering nearly half of the total cropped are of the region, at the same time accounts for 50 per cent of the total area under rice in the state. Other important crops raised are coconut, and pulses.

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Cotton crop in the state is confined to the Central Region, so also more than 95 per cent of the area under groundnut in the state is located in the Palghat Districr of the region. Vegetables are widely raised in river banks and lake beds.

1.721 Area under major crops in Central Region and percentage share to the State are presented in Table 1.

1.722 Production, percentage to state production and productivity of major crops in Central Region are given in Table 2.

1.723 Crop wise area under irrigation in Central Region are presented in Table 3.

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TABLE - 1

AREA UNDER IMPORTANT CROPS IN CENTRAL ZONE (1984-85)

(In hectares)

Crop	Ernakulam	Trichur	Palghat	Total Region	Percentage to the State
Rice					
1. Autumn	36690	35576	86339	158605	
2. Winter	38422	49705	78006	166133	
3. Summer	14071	17259	1967	33297	49.20
Total :	89183	102540	166312	358035	
Cumar	5	9	1682	1696	93.08
Ragi	2	29	817	848	70.67
Other cereals	136	78	1789	2003	81.42
Pulses	1395	2440	8662	12497	43.54
Sugarcane (Gur)	50	5	2690	2745	35.02
Pepper	6192	3780	1665	11637	11.00
Chillies	--	3	187	190	18.98
Ginger	2282	96	410	2788	19.18
Turmeric	626	149	290	1065	36.02
Betel Nut	5727	6201	2170	14098	24.83
Tamarind	741	1460	2999	5200	46.64
Mango	4595	4550	5752	14897	24.88
Jack	3942	3644	3844	11430	19.68
Banana	2145	1577	1778	5500	34.11
Other Plantain	3333	3273	2404	9010	25.52
Ground Nut	---	---	11744	11744	99.32
Coconut	22954	54030	60881	137865	20.80
Rubber	34319	11019	13013	58351	18.70
Pineapple	589	344	202	1135	23.46

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TABLE - 2

PRODUCTION OF IMPORTANT CROPS IN CENTRAL ZONE (1984-'85)

(In tonnes)

Crop	Ernakulam	Trichur	Palghat	Total Region	Percentage to state production	Productivity
Rice						
1. Autumn	62011	42606	196006	300623	54.75	1895 Kg/ha
2. Winter	64482	73828	151524	289834	53.68	1745 Kg/ha
3. Summer	22706	3947	2940	56593	33.88	1700 Kg/ha
Total :	149199	147381	350470	647050	51.52	.....
Jowar	2	3	866	871	94.16	514 Kg/ha
Ragi	2	24	671	697	69.70	822 Kg/ha
Other Cereals	87	50	1286	1423	78.66	710 Kg/ha
Pulses	999	1742	6289	9030	44.29	723 Kg/ha
Sugarcane (GUR)	288	29	13961	14278	33.39	5202 Kg/ha
Pepper	547	677	253	1487	8.57	128 Kg/ha
Dry Chillies	---	3	164	167	18.29	879 Kg/ha
Dry Ginger	7385	156	986	8527	20.67	3059 Kg/ha
Cured Turmeric	1125	233	523	1881	36.27	1766 Kg/ha
Betel Nut	1089	1071	372	2532	27.31	180 (Nos. in 000) 179600
Tamarind	1005	3038	7821	11864	50.38	2282 Kg/ha
Mango	12025	20070	41898	73993	38.27	4967 Kg/ha
Jack (Nos.in 000)	16939	13818	14573	45330	19.84	3966 Nos.
Banana	26465	17594	12446	56505	29.80	10274 Kg/ha
Uther Plantain	16392	7194	11542	35128	24.80	3899 Kg/ha
Ground Nut	----	----	11697	11679	99.39	994 Kg/ha
Coconut (nos. in million)	363	297	76	736	21.31	5469 Nos.
Rubber	21727	7507	6879	36113	19.11	619 Kg/ha
Pineapple	6491	2864	2461	11816	19.74	10411 Kg/ha

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TABLE - 3

Central Region, Kerala - Area under Irrigation Cropwise 1980-81

(ha)

DISTRICT / Crop	Ernakulam	Trichur	Palghat	Total
RICE	70100	48409	91461	2,09,970
Vegetables	6	330	273	609
Tubers	--	77	--	77
Coconut	7046	29719	1972	38,735
Arecanut	696	6243	774	7,713
Clove, Nutmeg Cinnamon	437	106	5	548
Other condiments and spices	32	609	166	807
Banana	664	660	582	1,906
Betel leaves	11	45	4	60
Sugarcane	1	5	659	665
Others	2780	1374	1540	5,694
T o t a l :	81773	87575	97436	2,66,784

Source : Statistics for planning - Directorate of Economics and Statistics, Government of Kerala, 1983.

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1. 8. General agricultural problems of the agro-climatical zones.

1. 81. Costal area - low elevation - high rainfall.

Rice :

The first crop of rice is usually dry broadcasted, during April, May with expectations of South West Monsoon early showers. Due to delayed Monsoon, the first crop is affected by flooding during vegetative phase and second crop during the reproductive phase due to drought. Lack of high yielding varieties suitable for dry sowing, and technology for application of fertilizers under dry sown conditions and weed management under the situations are other constraints to rice production. As the field will be flooded during the early part of second crop season planting and fertilizer application is also difficult.

Coconut :

Dearth of organic matter in the coastal tract stand in the way of adoption of the recommended dose of organic manures in the sandy soil tract. As the monsoon is severe, farmers find it difficult to contain the applied fertilizers. The second split of fertilizer application is also made difficult if the North East Monsoon is delayed or meagre. The attack of palms by Nephantis, and red palm weevil and diseases like stem bleeding and root wilt also affect nut productivity in certain areas.

Pulses :

Pulses raised in the rice follows are generally affected by drought and inherent soil acidity problem. The high rate of labour wages existing in this region is another limiting factor for extensive pulse cultivation.

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Tapioca :

Lack of high yielding short duration varieties suitable for the rice fallows is the main draw-back for extending the area under tapioca under this farming situation.

Banana :

As there is good demand for banana bunches locally marketing the same is not a problem, but lack of suitable areas without prolonged water logging in this low elevation situation is the main constraint for raising this crop. The high speed of coastal wind also lead to crop damage at heading stage. Protection by providing propping has become a costly practice. Lack of irrigation facilities during summer months and the spread of diseases like Kokkan and Bunchy top are the other problems encountered by the farmers.

1.8.2. Coastal area - low elevation - saline hydromorphic soil - high rainfall :

This situation covering an area of is confined to Ernakulam District only. As these are come under the purview of the special zone of Kerala with problematic soil condition, the details and the constraints in production are provided in the summary of the report for special zone.

1.8.3. Medium - Elevation - high rainfall :

This situation characterised by high rainfall and medium elevation and is one of the major agro-climatological farming situation of the Central Zone.

Rice :

As in the case of situation - I, the extreme dependance on rainfed farming makes the rice farming vulnerable to vageries of the nature. There is scarcity for irrigation water and drought is experienced during the later period of 2nd crop.

Banana/Tapioca :

The torential rains received during the short period of 90 days from June to August under the situation leads to water logging for short periods in low lands causing damage to these crops. Thus lack of proper drainage

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facilities during the peak monsoon period is the main constraint in production.

Pepper :

Pepper crop is also affected by temporary water logging. The quick-wilt disease is present in this situation causing heavy damage to pepper vines.

1.8.4. High elevation - high rainfall :

As in the case of situation 3, this farming situation also covers the development blocks of the three district of the Zone.

Rice :

Even though irrigation sources are available the first crop rice is still raised as rainfed and drought is experienced during the early part of the crop period. As flooding invariably follows after the monsoon break, it is not possible for timely applicatior of basal fertilizers and manures. As the cropping intensity is high, scarcity of labourer is experienced during peak season, causing problem in adoption of improved agricultural technology. Koottumundakan system - of rice cultivation is practised in parts of this area due to the exhorbitant rice in labourer wages and this has lead to decline in total crop yields and increased pest and disease problems.

Pulses/Vegetables/Sesamum :

These crops are raised as catch crops only in limited areas in rice follows due to high rate of labour wages prevalent in this area.

Coconut :

The rootwilt disease of coconut is spreading in this area. As no suitable remedial measures are identified, yield decline in coconut palms are noticed.

Groundnut :

Lack of availability of good quality seeds suitable for raising in rice fallows and the partially shaded conditions of coconut gardens are the main bottlenecks

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experienced in extension of area under this crop. Difficulty in marketing the pods are also reported by farmers as a reason for not raising the crop in this areas.

Vegetables :

Farmers are reluctant to extend the area under pulses due to the higher cost of labour and difficulty in marketing the perishable vegetables which come to maturity at the same period.

1.8.5. High elevation low lands with medium rainfall :

The situation comes under the Palghat gap tract of Kerala and is popularly known as "The rice bowl of Kerala".

Rice :

Inadequacy of organic manures in this tract limits organic manure application to the crop during all seasons; which has resulted in depletion of organic matter in soil. The lack of availability of high yielding varieties suitable for dry sowing during Kharif season is another production constraint experienced in this situation. Non availability of labourers during peak season and exhorbitant wage hike prompt many farmers to adopt less tillage which causes decline in crop yield.

Pulses :

Lack of improved varieties with synchronized flowering character is the main bottlenecks for farmers for extension of area under pulse crop.

1.8.6. High elevation law rainfall :

This situation is located in the rain shadow areas of Palghat district. Severe drought being experienced from December to May is the major constraint to production in this situation. The non-availability of high yielding varieties of crops suitable for the drought prone area is another important constraint. Lack of improved technology for the dry farming tract is a major research gap in dry farming situations.

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1.8.7. Medium elevation - Black soil - Law rainfall :

This situation is confined to the black soil tract of Chittur Taluk of Palghat District and it occupies an area of 20,027 hectares.

Rice :

The soils become problematic during 2nd crop season due to sulphide injury. The ill drained soil conditions of this heavy texture black soil produces toxic gases soon after the transplanting of rabi-rice which damage the crop very much. In certain areas Zinc deficiency is noticed.

Sugarcane :

Proper improved technology for raising sugarcane in the Chittur area is lacking. At present the recommendations of the Coimbatore tract of Tamil Nadu is followed in this area. Lack of irrigation facilities is another constraint in production.

Cotton :

Lack of high yielding varieties suitable for this location is the main constraint.

Groundnut :

Lack of improved strains suitable for raising under the dry farming conditions of the tract is the main lacuna and constraint to production. The 'tikka' leaf spot disease is another factor which causes yield decline in this crop.

1.8.8. High ranges - Law rainfall :

The Attappadi block of Palghat District covering an area of 22,500 hectares comes under preview of the situation. As this comes under the territory of the high ranges zone, the details are, dealt with the summary of the report for that zone.

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1.9. Existing Research Stations in the Zone :

The following research Stations are located in this region even before the start of the NARP project catering to the needs of farming community.

Sl. No.	Station	Location	Responsibility for Research	
			before NARP	after NARP
1.	Regl. Agrl. Res. Station, Pattambi.	Pattambi	Rice	Rice based farming systems, pulses, oilseeds, soil management in addition to rice Research.
2.	Agrl. Res. Station Mannuthy and Instructional Farm, Vellanikkara.	Mannuthy	Rice	Sub Centre for RARS, Pattambi & Problem areas of Kole in Trichur. Oil seeds.
3.	Eruthempathy Sub Centre.	Eruthempathy		Rice, Groundnut, Pulses dry farming.
4.	Agronomic Res. Station, Chalakudy.	Chalakudy	Water Management	Water Management
5.	Banana Research Station, Kannara.	Kannara	Banana Pineapple	Banana and Pineapple.
6.	Medicinal and Aromatic Res. Station, Odakkali.	Odakkali	Lemongrass	Medicinal Plants
7.	Livestock Res. station, Thiruvizhamkunnu	Thiruvizhamkunnu.	Livestock	Livestock fodder, Agroforestry.

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1.9.1. Laison with sister organisations :

The following research centres/development units/ state department institutes are operating in this region.

Sl.No.	Name of the Station/Institute	Crops/Aspects of Research/ Development
1.	Central Plantation Crop Research Unit Sub Centre, Kannara.	Arecanut and Arecanut based farm system.
2.	Central Marine Fisheries Research Institute, Ernakulam.	Mariculture
3.	Central Institute of Fish Technology, Cochin.	Fisheries Technology
4.	Kerala Forest Research Institute, Peechi, Trichur.	Forestry.
5.	Kerala Engineering Research Institute, Peechi.	Irrigation and Aricultural Machinery.
6.	Command Area Development Agency, Trichur.	Command Area Management
7.	National Bureau of Plant Genetic Resource, Regional Station, Vellanikkara, Trichur.	Germ Plasm collection
8.	Coconut Development Board, Cochin.	Coconut Development.

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2. SUB PROJECT OBJECTIVES AND STRENGTHENING

Physical and Financial:

With the implementation of the project, purchase of new equipments, vehicles, undertaking civil works, recruitment of scientific ans support staff etc. has been effected the details of which are furnished below:

2.1. Staff Positions:

Staff sanctioned and appointed prior to and after starting NARP in the central region are given below:

Sl. No.	Category	Incremental staff sanctioned & in position as on 26-11-'86		
		Sanctioned	In position as on 26-11-'86	Vacant
(1)	(2)	(3)	(4)	(5)
(a)	Scientific posts			
Pattambi				
1.	Professor, Plant Breeding Associate Director	1	1	-
2.	Professor of Soil Science	1	1	-
3.	Associate Professor (Agron.)	2	1	1
4.	Associate Professor (Agrl. Economics)	1	-	1
5.	Associate Professor (Agri./Soil conservation)	1	-	1
6.	Assistant Professor(Agro)	2	1	1
7.	Assistant Professor (Plant Breeding)	1	1	-
8.	Assistant Professor (Entomology)	1	1	-
9.	Assistant Professor (Soil Science)	2	1	1
10.	Assistant Professor (Agrl. Economics)	1	-	1
11.	Assistant Professor (Extension)	1	-	1
12.	Assistant Professor (Horticulture)	1	1	-
13.	Assistant Professor (Bio-Chemistry)	1	1	-
14.	Assistant Professor (Agrl. Engineering)	1	1	-

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(1)	(2)	(3)	(4)	(5)
Mannuthy				
1.	Associate Professor (Agronomy)	1	1	-
2.	Associate Professor (Plant Breeding)	1	1	-
3.	Assistant Professor (Agrl. Engineering)	1	-	1
Erutheampathy				
1.	Associate Professor (Agronomy)	1	1	-
2.	Assistant Professor (Plant Breeding)	1	-	1
(b)	Administrative & Supporting Posts			
Pattambi				
1.	Administrative Officer	1	1	-
2.	Stenographer (Typist Gr.II)	2*	1	1
		(*) One post shifted to Mannuthy.		
3.	Duplicator Operator	1	1	-
4.	Laboratory Attender	2	2	-
5.	Driver	2	2	-
6.	Tractor driver	1	-	1
Mannuthy				
1.	Design Engineer	1	-	1
2.	Senior Grade Technician	1	-	1
3.	Senior Grade Draftsman	1	-	1
4.	Stenographer (Typist Gr.II)	1	1	-
5.	Technician Gr.III	1	1	-
6.	Attender	2	2	-
Erutheampathy				
1.	Agrl. Demonstrator (Farm Assistant)	2	2	-
2.	Peon	1	1	-

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2.1.2 POSITION IN RESPECT OF STAFF PRIOR TO 'NARP'

(1)	(2)	(3)	(4)	(5)
	(a) Scientific Posts			
	Pattambi			
1.	Associate Professor	6	6	-
2.	Assistant Professor	11	2	9
3.	Junior Assistant Professor	9	1	8
	(b) Administrative & Supporting			
1.	Section Officer	2	2	-
2.	Senior Office Superintendent	1	1	-
3.	Office Superintendent (FC&D)	1	1	-
4.	Farm Supervisor(Vety.) Gr.I	1	1	-
5.	Farm Supervisor (Agr) Gr.II	3	3	-
6.	Senior Grade Assistant	5	5	-
7.	Assistant Gr.I	3	3	-
8.	Assistant Gr.II	1	1	-
9.	Technician Gr.I	1	1	-
10.	Technician Gr.III	1	1	-
11.	Typist, Senior Grade	1	1	-
12.	Typist Gr.II	1	-	1
13.	Farm Assistant, Senior Grade	3	3	-
14.	Farm Assistant, Gr.I	5	5	-
15.	Farm Assistant Gr.II	9	9	-
16.	Farm Assistant Gr.I (Vety.)	1	1	-
17.	Laboratory Assistant Gr.II	1	1	-
18.	Laboratory Assistant Gr.II (Hr.)	4	4	-
19.	Laboratory Assistant Gr.III	4	4	-
20.	Peon (Hr.Gr.) (300-450)	3	3	-
21.	Peon (Hr.Gr.) (290-425)	1	1	-
22.	Peon (280-400)	1	1	-
23.	Regular Mazdoor (Hr.Gr.) (300-450)	12	12	-
24.	Regular Mazdoor (280-400)	6	6	-
25.	Regular Mazdoor (290-425)	2	2	-
26.	Watchman (Hr.Gr.) (290-425)	1	1	-
27.	Watcher/Watchman (280-400)	3	3	-
28.	Sweeper (280-400)	1	1	-

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(1)	(2)	(3)	(4)	(5)
29.	Driver (Hr.Gr.I)	1	1	-
30.	Driver (Gr.II)	1	1	-
31.	Head Peon	4	4	-
Mannuthy				
1.	Associate Professor (Agro.)	1	1	-
2.	Assistant Professor (Bot.)	1	1	-
3.	Junior Assistant Professor	3	3	-

2.2 FARM DEVELOPMENTS:

Under Farm Development the existing main irrigation and drainage chanel were deepened, widened and silt removed. Desilting and deepening of one irrigation tank was done and provided with motor and pump. Farm road at Vth block were strengthened for easy transport of tractor to the field. Premises of the main Office building were beautified by planting fresh ornamental plants and arranging potted plants.

2.3. BUILDINGS

The building works are carried out under the supervision of the Engineering Wing of the University headed by the Director of Physical Plant. The details of the Civil Works undertaken under NARP are furnished below:

Sl. No.	Particulars of Building RARS, Pattambi	Date of start	Sanctioned Area (M^2)	Sanctioned Cost	Implemented Area (m^2)	Implemented Cost
1.	Laboratory Buildings	16-7-84	780.58	12,00,000	874.06	11,84,242.98
2.	Staff Quarters V type - 2 nos.	13-3-83	2x165	3,00,000	2x 165.36	1,94,702.91
3.	Staff Quarters IV type duplex	31-3-83	2x110	3,00,000	218.86	5,46,908.23
4.	Staff Quarters II type duplex	31-3-83	2x59	1,25,000	120.57	1,54,587.27

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(1)	(2)	(3)	(4)	(5)	(6)	(7)
5. Farm Buildings						
a. Glass house		29-11-84	40	47,000	40	1,70,332.74
b. Green house		29-12-84	75	70,000	75	
c. Net house		28-1--84	40	36,000	40	
d. Seed store drying yard		20-11-84	10.1	92,000	104	9,00,030.77
e. Fertilizer store		19-9--84	41.5	36,000	41.5	45,521.72
f. Sales counter		19-9-84	40	36,000	40.7	51,518.95
g. Implement & Tractor shed		19-9--84	137	88,000	103	99,160.54
h. Jeep shed		20-11-84	43	39,000	43.8	47,674.20
i. Meteorological Laboratory		15-11-84	100	1,20,000	100	1,44,154.00
II. SUB CENTRE, MANNUTHY						
Field Lab.			175	2,60,000	172.12	3,21,515.70
Quarters type V			165	2,16,000	165	2,61,797.52
Cement purchase (82-83)			-	-	-	1,44,000.00
						34,56,147.53

2.4 Equipments

Additional equipments were purchased after starting the NARP to the extent of budget availability to meet the demands andrequirements of various disciplines in a limited way. The purchase of equipments is carried out observing the store purchase rules framed by the Government of Kerala. Prior approval of the ICAR is always taken before procuring equipments costing above Rs.5,000/- A list of equipments purchased year wise is given in Appendix-I.

2.4.1 Books and Periodicals

The Regional Agricultural Research Station has a good collection of library books. A brief account of books purchased under NARP is given in Appendix-II.

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2.4.2. Transport

With a view to increase transport facilities in farm and for the Station the following items were purchased.

1.	HMT Zeter Tractor with accessories	- 1,05,643.01
2.	Kuboto Power Tiller with accessories	- 44,930.76
3.	Mini Bus	- 1,91,053.00
4.	Ambassador Car	- 79,157.00

2.5. Financial

The year wise expenditure for each head for the period from 1/11/81 to 26-11-86 is given in appendix-III.

2.6. Technical

The technical aspect is given the top most priority. Since there is close co-ordination with the Department of Agriculture, it is possible to get quick information about the genuine problems faced by the farmers. Detailed discussions on the problems are made in the T and V monthly workshops, six-monthly regional workshops and in annual kisan melas where officers from the Department of Agriculture and Scientists of the Station participate. Location specific problems are thus identified. The technical programme is chalked out in such a way that the findings will have a direct bearing on the problem faced by the farmers in the farming situation concerned.

2.6.1. Objectives

The National Agricultural Research Project has been formulated by the Indian Council of Agricultural Research to strengthen the research activities in the different agro-climatic regions through state Agricultural Universities.

This sub-project envisages the integrated development of the central region with a view to maximise the productivity and farm income by intensifying research on various crops and cropping system. The aim of such regional research works is to tackle location specific problems in the agro-climatic regions in a more effective manner. Apart from

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carrying out research activities, the project also aims at establishing strong functional linkages between the research and extension agencies at the regional level. The National Agricultural Research Project of the Central region caters to the research needs of Palghat, Trichur and Ernakulam Districts.

2.7. Research mandate

The Research activities of the Regional Agricultural Research Station are spread over six disciplines of Plant Breeding, Agronomy, Soil Science, Entomology, Plant Pathology and Social Science. The Station is actively engaged in intensive research with a multi disciplinary approach on rice production technology and improvement of pulse production.

.1. The lead functions assigned to the Regional Agril. Research Station, Pattambi are intensive research on rice, pulses and oilseeds and rice based farming systems. The station will also function as an advanced centre for studies on laterite soil management.

3. Formulation of technical programme

The technical programme of work incorporating the location specific problems and recommendations made at zonal Research Advisory Council and monthly T&V workshops, drafted by the head of research stations and schemes is discussed in detail at the meeting convened by the Associate Director for this purpose at the zonal headquarters. The Scientist concerned with the crops and disciplines from the research Stations and colleges, officers of the D.O.A. participate, discuss and finalise the research programmes for different stations and schemes. These are placed before ZARC for discussion and adoption before submission to Director of Research for final approval at the concerned Co-ordination group and Faculty Research Committee Meeting. The proposals for farm trials are finally approved at the state level Technical Committee Meeting. The approved technical programme of work is communicated to concerned Scientist for incorporation and revision if any for further implementation.

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8.1. The Scientific staffs has been appraised of the NARP objectives. The research programmes have been revised in the light of NARP objectives to give multidisciplinary approach for solving location specific and need based problems. Field day, Agricultural seminar, joint field visits, group discussion, frequent visits of extension personnels, to research stations etc. served to give feed back to the Scientists. Based on this the scientist recast research programmes for succeeding reasons after giving priority on location specific problems.

8.2. The time lag in holding the Faculty Research Committee Meeting and State Level Technical Committee Meeting delay the implementation of project in the proper time. Since the Scientist have to give more attention to the location specific and problem oriented research only a little time is available for basic research.

Research Extension Linkages

Linkages with D.O.A.

9.1. The research staff in the zone and the Officers of D.O.A. are meeting periodically at various forums to discuss the location specific problems and to fix priorities of research and extension. Six resource personnels from this station are participating in the T & V monthly workshops of Palghat, Malappuram, Ernakulam and Kozhikode districts. There are regularly held for two days in every month for each of the four districts. Besides the monthly workshop they are also participating in the District Technical Committee meetings of the T&V programme. The monthly workshops of the Palghat and Malappuram districts are being convened at this station. Besides, at the request of the Departmental extension personnels the scientists of this station are conducting field visits for offering technical advice to overcome the field problems under the Diagnostic team of T&V programme.

.....43/-

Programme	Number during period from 1981-86
T&V workshops	48
Diagnostic teams	32
Special training programmes	35

2.9.2.Linkage with other research organisation

Contacts were established whenever required with ICAR institutions, Rubber Board, Centre for water Resoarces Development and Management (CWRDM) and Tamil Nadu Agricultural University, Coimbatore.

9.3.Linkage with input agencies

This station is supplying breeder seed to NSC, Departmental seed farms and to local farmer's of the area. Good relationship, were established with firms like cynamids, FACT, Madras fertilizer, IFFCO, Mysoore phosphates etc. In the monthly T&V workshops input agencies are also participated.

9.4. Monthly workshop and ZRAC meetings

Monthly workshop under T&V is conducted for two days for formulating messages to the farmer for each fortnight. The crop situations, problems in the field etc. are discussed and solutions suggested. The workshop is attended by Officers of DOA, Resource Personnel, input agencies and Scientist of other research organisations. These workshops also function as a venue to present the field problems to the scientists and to get necessary technical advice.

The Zonal Research Advisory Council (ZRAC) meetings are being organised regularly twice in a year, one for the kharif and the other for the Rabi seasons. This attended by Officers of the department of Agriculture of the zone resource personnel, Scientists of Research Stations of the Zone and Agricultural College Research and extension programmes of the zone is reviewed in the meeting and future programmes suggested. The conduct of farm trials are discussed in this forum and got approved by the State Technical Committee under the Chairmanship of the Director of Agriculture.

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So far, nine ZRAC meetings have been conducted as detailed below:

	Date(s)	No. of participants
First	4--5--1982	38
Second	11-1--1983	51
Third	24-6--1983	44
Fourth	17-1--1984 & 18-1--1984	97
Fifth	17-8--1984 & 18-8--1984	82
Sixth	1--2--1985 & 2--2--1985	104
Seventh	22-1-1986 & 23-1-1986	102
Eightth	5--9--1986 & 6--9--1986	90
Nineth	28-7--1987 & 29-7--1987	85

2.9.5. EXTENSION ACTIVITIES

2.9.5.1. Krishi Vigjan Kendra (K.V.K.)

A Krishi Vigjan Kendra is operating in the R.A.R.S, Pattambi campus catering to the needs of the farming community. The centre has organised a number of training programmes and undertook several extension activities the details of which are as shown under:

2.9.5.2. Training programmes as on 31-7-'86

		Batches	No. of participants
1.	State level training programme on rice production technology	19	392
2.	State level training programme on pest and disease surveillance	1	18
3.	State level training programme on pulse production technology	14	322
4.	Training programme on bee keeping	1	8
5.	In-service training programme for Agricultural Demonstrators	13	296

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6.	Field training course for final year D.A.Sc. students of the Institute of Agrl. Technology, Tavanur.	18	206
7.	Classes on rice breeding for post graduate students of Guruvayurappan College, Calicut, St. Joseph's College, Devagiri and Govt. College, Pattambi.	5	84

2.9.5.3. Village adoption programme

Village adopted - Thrithala and Keezhayoor

Adaptive trials - 8 nos.

2.9.5.4. Programmes Implemented

1. Social forestry programme
2. Farm trials - 16 nos.
3. Annual health camp - 8 nos.
4. Group discussion - 42 nos.

2.9.5.5. Lab-to-Land programme

1. Demonstrations - 10
2. Scientification plot for coconut and bamana - 10
3. Bee keeping units - 6
4. Group discussions - weekly meetings - 4
5. Value of inputs distributed to the families (1985-86) - Rs.13,983.50

2.9.5.6. Kissan mela, Krishi darsan and Rice days - 9 nos.

No. of farmers participated - 4200.

2.10. Research facilities and achievements prior to NARP implementation.

2.10.1. Prior to NARP the station has got laboratory facilities for Agricultural Chemistry, Plant Pathology, Entomology, Agronomy and Botany. A scheme for irrigating the farm with Bharathapuzha water has also been initiated by Minor irrigation Department. The station has also got residential quarters and teachers hostel. A small library with important Scientific books and journals were also available earlier.

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10.2. Major contributions of the station before the implementation of the NARP are summarised below:

a) Fortyone improved paddy strains - Aryan to Bharathi - have been released from the station of which 34 are evolved by selection from among the popular local varieties and seven by hybridisation. This seven High Yield Varieties with their wide adaptability to different agroclimatic regions have played an important role in stepping up rice production in the state.

b) For increasing Nitrogen use efficiency it is recommended to apply nitrogen as sulphur coated urea or placement in mud balls or as urea briquets. Incubating urea with moist soil or blending urea with neem cake can also increase the efficiency of nitrogen.

c) So increase productivity of old rice seedlings deep and bunch planting were found effective.

d) Bavistin 50. W.P. has been found as the best systemic fungicide against rice blast. Similarly against Dithane-Z-78 was found effective against brown spot disease.

e) Two cowpea varieties Kanakamony (PTB-1) and Krishnamony (PTB-2) were released from this station.

f) Leaf seald disease of rice (Rhynchosporium oryzae) was first reported from this station.

g) Most of the local tall indica varieties released from this station namely PTB-18, PTB-21, PTB-33 are resistant to major pests of rice and these has been accepted as donors of resistance to pests and are utilised by breeders all over India and abroad.

.....47/-

2.11 Significant research achievements

2.11.1. Rice

2.11.1.1. Crop Improvement:

Rice research conducted in the Crop improvement division of Regional Agricultural Research Station, Pattambi during the period under report, resulted in identifying three promising rice varieties. They are Suvarnamodan (PTB 42), Swarnaprabha (PTB 43) and Reshmi (PTB 44). These varieties were well accepted by the cultivators and consumers and released for large scale cultivation. The following table gives an account of the description and yield data.

Description of the newly released rice varieties from Pattambi

Variety	Percentage	Duration	Plant type	Average yield t/ha	Grain type
1. Suvarna-modan (PTB 42)	Selection from ARC 11775	115-120	Semitall	2.60	Long bold
2. Swarna-prabha (PTB 43)	Bhavani x Triveni	100-110	Semitall	3.08	Long bold
3. Reshmi (PTB 44)	Gamma ray induced mutant of Oorpandy	150-180	Tall	3.00	Short bold

"Suvarnamodan" having 115-120 days duration with white kernel is suitable for dry sown conditions. It is of medium tall stature and moderately resistant to pests and diseases.

"Swarnaprabha" is a medium or intermediately tall variety with short duration and white kernelled. This variety can be cultivated during all the three seasons and is also suitable for the modan lands (uplands). NPK levels above 70:35:35 are not recommended. It is resistant to blast, moderately resistant to stem borer and susceptible to sheath blight and bacterial leaf blight and moderately resistant to drought.

.....48/-

Reshmi, a tall, typical season-bound variety having red kernel. It is suitable for growing in the second crop season (Rabi), tolerant to salinity, suitable for Kootumundakan system as the Mundakan variety. Low NPK levels of 40:20:20 kg/ha only are recommended.

Red Triveni selection of this station has out yielded Triveni in the trials conducted at Research Station as well as farm trials in Malappuram and Trichur districts.

There are 9 promising pre-release cultures from the Regional Agricultural Research Station, Pattambi now under minikit and adaptive trials.

Out of these only two cultures namely, the red kernelled cul. 23332-2 and the white kernelled cul.1727 (Photo 3) are recommended for trials in all areas and all seasons. Cul.1727 has out yielded IRRI variety IR-36 by 0.5 T/ha in 43 locations tried in 18 countries during 1983-84, and occupied third position in yield trials of 1984-85.

Cul. 1-5-4 is a long duration type with plant height similar to Jaya and duration similar to Mashoori. This white kernelled type given stable yields under low NPK levels also and can be tried in Virippu and mundakan seasons.

Cul. 745 and Cul.736 are specifically meant for high altitude areas like Wynad and Idukki districts. Early good germination and vigorous seedling growth even under cold condition are the special traits of these white kernelled cultures.

Cul. BR 51-315-4 and Cul. BR 52-96-3 are two white kernelled cultures, found to be suitable for temporarily flooded and submerged situations in virippu season. These showed good performance under ratooning also.

Cul.841 and cul.871 are season bound tall cultures for the mundakan season only. Both the white kernelled 841 and red kernelled 871 are to be tested and compared with varieties like Co-25, PTB-4, Reshmi, Lakshmi and Kottarakkara-1.

Brief particulars of all these cultures are furnished in table.

.....49/-

Brief particulars and special features of promising pre-release rice cultures from the Regional Agricultural Research Station, Pattambi.

Culture	Parentage	Plant type	Kernel colour	Seed to seed duration (days)	Special features
BR 51-315-4	IR 20 x IR 5	Semi dwarf	White	145-155	Suitable for situations having temporary submergence and flooding during Virippu season. Shows good ratoon performance also.
BR 52-96-3	- do -	- do -	- do -	145-155	- do -
745	IR 8 x CH 1039	- do -	- do -	160-165	Suitable for high altitude areas in Wynad and Idukki districts. Early seed germination and vigorous seedling growth under low temperature.
796	Jaya x CH 1039	- do -	- do -	160-165	- do -
041	PTB 15 x Co-25	Tall	White	160-180	Season bound cultures suitable for mundakan season only. Will come to harvest only by January end.
071	Co-25 x (Triveni x Vellathil Kolappala)	- do -	Red	160-180	- do -
23332-2	Gamma ray mutant of MN 54-42	Semi dwarf	- do -	110-115	Leaves broad and dark green. Leaf tips will show drying just before maturity. Roundish grain with good rice recovery. Suitable for all the three seasons.
1-5-4	T(N)1 x Co-25	- do -	White	135-145	Suitable for Virippu and Mundakan Seasons. Stable yield under low NPK level also.
1727	Triveni x IR2061	- do -	- do -	120-125	Suitable for all the three seasons. Slender grains.

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Under screening programme for drought tolerance in short duration series Cul.23332-2 was found to be drought tolerant.

2.11.1.2. Crop Production

A. Fertilizer Management

a. Pooled analysis of grain yield data of permanent manurial experiments with tall indica series from 1961 to 1985 (25 years) revealed that during virippu (Kharif), cattle manure and NPK joint application was significantly superior to other treatments recording a 7.6% increase in yield over NPK alone. For mundakan season (Rabi) cattle manure + green leaves + NPK joint application were significantly superior to all others recording an increase of 5.6% yield than NPK alone.

Where as the results in the permanent manurial experiments with dwarf indica series (Jaya) which started in 1973 revealed that cattle manure application alone was significantly superior to all the treatments during Virippu, while it was on par with the joint application of cattle manure + NPK and cattle manure + Green leaves during mundakan. The increase for cattle manure alone, cattle manure + NPK and cattle manure + green leaves over NPK alone were 24, 19 and 18% during virippu and 12, 11 and 10% during mundakan respectively. This result revealed that combined application of organic and inorganic fertilizers resulted in a significantly higher rice yield.

b. It was found that in places where rice-rice-green manure cropping system is in practice, the kharif and rabi rice need to be given 75 per cent of the fertilizer dose for each season instead of giving 100 per cent of the dose for both the season (Table.4)

c. In locations having rice-rice-fallow cropping system, application of 50 per cent of the fertilizer dose for Kharif and 100 per cent of the dose for the rabi rice or 75 percent for both the season is sufficient instead of giving 100 per cent of the dose for both the seasons. In places where application of fertilizers is found to be difficult due to local field conditions the former is preferred (Table.5).

.....51/-

TABLE - 4

Grain and Straw yield as affected by fertilizer treatments in a rice-rice-green manure cropping system

Treatments	Total yield Kg/ha							
	Grain				Straw			
	1984	1985	1986	Pooled mean	1984	1985	1986	Pooled mean
T1	6225	8545	6276	7115	4837	7394	6068	6100
T2	5900	8283	6032	6741	4437	7247	6319	6001
T3	5411	8368	5752	6499	4615	7353	6326	6090
T4	6078	7942	6767	6929	5094	7233	6920	6416
T5	6140	8217	6370	6909	4596	6836	6667	6033
T6	5541	7137	5921	6200	4535	5274	5230	5013
T7	5984	8185	6042	6737	4537	6435	5775	5502
T8	6196	7183	6290	6556	7207	5476	5280	5405
T9	5444	7338	6200	6327	4152	6249	6055	5485

TABLE - 5

Grain and Straw yield as affected by fertilizer treatments in a rice-rice-fallow cropping system.

Treatments	Total yield Kg/ha							
	Grain				Straw			
	1984	1985	1986	Pooled mean	1984	1985	1986	Pooled mean
T1	7097	8050	7469	7000	6105	7491	6905	6060
T2	6461	7490	6006	6919	5034	6033	6721	6196
T3	6062	8020	6602	6095	5793	6919	6040	6520
T4	6969	8732	7462	7721	5674	7200	6550	6477
T5	7061	8230	7395	7565	5634	6434	6726	6265
T6	6674	7000	6756	7106	5593	6474	5017	5961
T7	7115	8295	7003	7764	6527	7520	6409	6045
T8	6691	7917	6965	7191	5653	6321	6110	6020
T9	6679	7505	6706	7017	5329	5606	5310	5415
	—	—	572.2	497.1	522.4	1175.5	667.1	601.1

.....52/-

d. To develop N management technology for dry sown low land rice, an experiment was conducted and the results indicated that there are significant difference in grain yield due to different treatment. The highest yield was recorded in treatment where urea super granules was applied with the seed in the same furrow at the time of sowing. Application of N fertilizer after first weeding is also found to give better yield. The N fertilizer applied in furrow was found to be useful in reducing the weed growth. (Table.6).

e. Fertilizer requirement for Mashoori under transplanted condition during Kharif season was found to be 50:25:25 kg NPK/ha and application of N in 4 equal splits (25% N as basal, 25% at 20 DAT, 25% at 40 DAT and 25% at 60 DAT was found to be the best) (AICRIP report 1984-85).

f. A fertilizer management trial for rice variety Mashoori reveals that for Mashoori as a transplanted crop during rabi season 50:25:25 kg N, P_2O_5 and K_2O /ha is sufficient since no significant difference in yield can be observed among different levels of fertilizers tried. With regard to time of application of 25% N as basal 25% N at 20 DAT and 50% N at 40 DAT is found to be the best which is on par with application of 50% N as basal, 25% N at 20 DAT and 25% N at 40 DAT. (AICRIP report 1983-84, 1984-85).

g. Application of carbofuran at the rate of 0.75 kg ai/ha in conjunction with urea at the rate of 10 kg N/ha by broadcasting 20 days after transplanting increases grain yield significantly compared to separate application of the insecticide and fertilizer (Table.7)

h. Sulphur coated urea is found to be the best form for increasing the fertilizer nitrogen use efficiency in transplanted rice.

.....53/-

TABLE - 6

Effect of Treatment on grain yield

Sl.No.	Treatments	I year	II Year	III year	Mean
1	Ordinary urea in 3 splits as per package	3790	3883	2790	3488
2	Ordinary urea in full basal in corporation	3523	2787	3190	3167
3	Ordinary urea in plough furrow with seeds in same furrow	3290	3033	3383	3235
4	Ordinary urea in plough furrow with seeds in alternate furrow	3947	3183	3270	3467
5	Ordinary urea applied after first weeding	4120	4103	3120	3781
6	Urea Super granules and seeds in same furrow	4447	4223	4667	4446
7	Urea Super granules and seeds in alternate furrow	3153	3950	3920	3674
8	Urea Super granules applied after first weeding	3167	4067	3447	3560
9	" " in plough fullow after broadcasting seeds	3747	3867	4167	3927
10	Neem cake coated urea in plough furrow	3687	3700	3507	3631
11	Enriched farm yard manure in plough furrow	3953	3947	3453	5784
12	Control - No fertilizer	2750	2200	1283	2078
	C.D. (0.05)	1237	493	827	185

.....54/-

TABLE - 7

Date on the grain yield of rice as influenced by joint application of carbofuran and urea

Treatments:	Grain yield (Kg/ha)				
	Puncha 03 Kole lands	Puncha 04 Kole lands	Kharif 03 A.R.S. Mannuthy	Rabi 03 A.R.S. Mannuthy	Av. yield (Pooled)
1. 0.5 Kg/ai/ha carbofuran broadcast	6600.00	2925.09	3500.00	3500.00	4153.27
2. 0.75 Kg ai /ha " "	6523.03	2067.73	3050.00	3250.00	4122.09
3. 1.00 Kg/ ai/ha " "	6600.60	3363.60	3900.00	3625.00	4394.32
4. 0.5 Kg ai/ha carbofuran broadcast + 10 Kg N/ha urea broadcast	6000.00	3340.07	4000.00	4000.00	4335.02
5. 0.75 Kg ai/ha carbofuran broadcast + 10 Kg N/ha urea broadcast	7250.77	3340.06	4500.00	4475.00	4093.46
6. 1.00 kg ai/ha carbofuran broadcast + 10 Kg N/ha urea broadcast	7050.00	2909.19	4250.00	4000.00	4572.30
7. No carbofuran, 10 Kg N/ha urea alone	6300.00	3022.93	3100.00	2700.00	3700.73
8. 0.5 Kg ai/ha carbofuran placement	6479.03	2790.14	4000.00	3550.00	4204.99
9. 0.75 Kg ai/ha " "	6694.00	2962.20	4050.00	4225.00	4402.00
10. 1.00 Kg ai/ha " "	6479.03	2999.31	4250.00	4500.00	4557.20
11. 0.5 Kg ai/ha " + 10 Kg N/ha urea	6044.00	3063.41	4630.00	4625.00	4795.60
12. 0.75 Kg ai/ha " + 10 Kg N/ha	6094.00	3247.20	4750.00	4050.00	4935.32
13. 1.00 Kg ai/ha " + 10 Kg N/ha	6794.00	3070.16	4600.00	4775.00	4009.79
14. No carbofuran " + 10 Kg N/ha urea	6150.00	2999.31	3200.00	3100.00	3062.33
F test	N.S.	N.S.	N.S.	N.S.	Sig
C.D. (0.05)	—	—	—	—	49?

i. The N loss through ammonia volitilization from the submerged rice soils recorded 5.3% of applied N during virippu (Kharif) season and 9.5% during mundakan (Rabi) season under different sources and methods of application. Major portion of the loss to the extent of upto 75% occured during the Ist 6 days period and then slowly declined. Among the different sources used, Lac coated urea, urea super granules and urea split application helped to reduce the loss (Table.8)

Table- 8

% Loss to applied N, through Volatilisation

	Virippu		Mundakan	
	1985	1986	1985	1986
1. Urea split ($\frac{1}{2}+\frac{1}{4}+\frac{1}{4}$)	1.86	1.05	3.54	4.3
2. Urea full basal	1.02	2.79	6.74	8.9
3. L.C. Urea	0.87	Not tested	Not tested	Not tested
U.S.G.	..	1.11	3.71	7.4
4. Neem coated urea	1.99	5.34	5.96	Not tested
Coaltar Urea	..	..	..	8.64
5. Green leaf urea (1.1)	1.22	0.86	4.94	5.70
6. Gypsum coated urea	..	..	..	9.47
7. Rock phosphate coated urea	..	..	..	9.53

B. WATER MANAGEMENT

a. The results from the water management for rice trial conducted in a lateritic sandy loam soils of Pattambi revealed that for summer rice, 5 cm. irrigation two days after the disappearance of ponded water from one week after planting is sufficient, instead of giving 5 cm. continuous submergence through-out the crop period when the ground water table is shallow. (Table.9 & Table.10).

b. The total water requirement of rice during the Rabi season was worked out to 2362 mm for medium duration variety (Jaya) while that during the summer season was 2520 mm for short duration variety (Triveni). Of this, 27.3 and 72.7 percent were accounted for evapotranspiration and percolation during Kharif and Rabi seasons and 19.9 and 80.1 per cent during summer season respectively.

.....56/-

TABLE - 9

Rice yield as affected by water regimes

Treatments :	Grain yield kg/ha				Straw yield Kg/ha			
	1984	1985	1986	Pooled mean	1984	1985	1986	Pooled mean
T1 - 5 cm submergence throughout the crop period	2415	3322	4370	3369	2100	3009	3711	2993
T2 - 5 cm submergence two days after the disappearance of ponded water.	2507	3264	4159	3336	2170	3409	3916	3165
T3 - Treatment 2 + protective irrigation at critical stages	2471	3409	4452	3444	2222	3460	4201	3323
T4 - 5 cm submergence till maximum tillering thereafter as in T2	2529	3176	3957	3220	1992	3497	3025	3104
T5 - 5 cm submergence three days after the disappearances of ponded water.	2410	2695	3552	2002	2033	2056	3506	2025
C.D. (0.05)	..	392.1	554.7	357.8	...	464.7	365.3	300.2
S.Em.	105.2	127.3	100.0	109.7	66.0	150.8	110.6	94.5

Irrigation treatments were started one week after transplanting.

.....57/-

TABLE - 10

Water use efficiency, irrigation interval & number of irrigations as influenced by water regimes

Treatments :	Water use efficiency (Kg/ha mm)				Irrigation interval (days)				Number of Irrigation			
	1904	1905	1906	Mean	1904	1905	1906	Mean	1904	1905	1906	Mean
T1	2.72	3.04	3.30	3.02	2.53	1.49	1.51	1.04	33.31	55.3	57.0	4.5
T2	3.94	3.30	3.72	3.60	0.50	4.03	4.47	5.99	10.0	17.0	19.5	15.5
T3	3.49	3.03	3.13	3.22	5.45	2.49	2.62	3.52	15.5	33.0	33.0	27.2
T4	3.07	3.27	3.59	3.50	6.37	3.41	3.32	4.37	13.3	24.3	26.0	21.2
T5	4.17	2.01	3.75	3.50	0.06	5.69	5.49	6.60	10.0	14.5	15.0	13.4
C.D. (.05)	..	..	..	..	1.0	0.59	0.47	1.93	1.93	2.20	2.20	
S.Em.	0.33	0.32	0.35	..	0.50	0.19	0.15		30.63	0.71	0.72	

.....58/-

The data on daily water consumption indicates that all the components of water requirement increases towards summer season and the mean per day requirement was worked out to 15.53, 19.15 and 34.58 mm during Kharif, Rabi and summer seasons respectively.

Shallow continuous submergence is preferred under normal field conditon.

Under limited resources of water phasic stress irrigation can be practiced for summer rice to the advantage of saving substantial quantity of irrigation water without any significant reduction in yield. About 20-30 per cent more area can be irrigated with the s ame water resources by adopting any of the following phasic stress irrigation schedules.

Schedule	Growth phase		
	Rooting to max. tiller	Max. tillering to heading	Heading to maturity
1. 5cm irrigation for attaining	Saturation point	Continuous submergence	Continuous submergence
2. -do-	Continuous submergence	Saturation point	Saturation point
3. -do-	Hair cracking of surfaces	Continuous submergence	Hair cracking of surface

Under shallow ground water table condition, moderate rainfall and low evaporative demand, irrigation for second crop transplanted rice need be scheduled only five days after the disappearance of ponded water. This will save appreciable quantity of irrigation water without any significant reduction in yield.

Studies on rice based cropping patterns revealed that from the economic point of view, Rice (Semi-medium) - Rice (medium) - Groundnut (Average net income Rs.3803/- per ha) and Rice (medium) - Rece (medium) sesamum - Daincha (average net income Rs.3112/- per ha) are the most profitable rice based cropping patters.

On an average the above said crop sequence use 3428 mm and 3840 mm of water respectively where as the three crops of rice (medium/semi medium duration varieties) use 5224 mm of water and four crops of rice (short duration varieties) use 4677 mm of water. Thus Rice (semi medium) Rice (medium) groundnut and Rice (medium) - rice (medium-sesamum-daincha rotation are most advisable in rice fields in view of the higher net income and less water use.

.....59/-

C. WEED MANAGEMENT

a. Application of Benthiocarb at the rate of 1 Kg. ai/ha 6 days after sowing followed by one hand weeding on 30 days after sowing is found to be the most effective in terms of weed control and grain yield in direct sown paddy fields.

b. A trial conducted to develop easy and economic method of chemical weed control for transplanted rice showed that with regard to grain yield there is not significant difference between weed free check, hand weeding 20 and 40 DAT, application of weedicides and non weeded control. This indicates that under Pattambi conditions for transplanted rice weed control can be achieved by proper land preparation and water management practices. (AICRIP report 1983-84, 1984-85).

c. Application of Oxyflurofen (ghoal) @ Rs.24 kg ai/ha as pre-emergent spray was found to be effective for controlling all types of weeds in dry sown rice during first crop season. For transplanted rice during second crop season, benthiocarb @ 2 kg ai/ha and Oxyflurofen (goal) @ 0.24 kg ai/ha were found to be the best weedicides at A.R.S, Chalakkudy.

d. Factors causing yield decline in Rabi

The major factor causing yield decline in the high yielding rice varieties raised during the Rabi season in Kerala was identified as spikelet sterility. Correlation analysis with weather components experienced during certain critical stages of the crop growth and both sterility and yield revealed that the high wind velocity from flowering to maturity attributed to the main weather component causing sterility.

e. Evapo transpiration rates of Jaya and Triveni

The study on the evapo transpiration rates of Jaya and Triveni varieties of rice indicated that ET of Jaya was 41% higher than PET in June-September (Kharif) and 46% higher in October-January (Rabi). ET of Triveni was 41% higher than PET in June-September and 58% higher in October-January. Jaya and Triveni had similar ET during Kharif, but Triveni used 0.14 mm/day more water than Jaya during rabi.

.....60/-

11.1.3. CROP PROTECTION

A. Plant Pathology

42 experiments spread over 5 year from 1981-82 to 1985-86 were conducted on fungal and bacterial diseases of rice. The diseases studied were blast, sheath blight and bacterial leaf blight. The experiments included screening trials to assess the reaction of entries in the NSN and important rice varieties cultivated in Keralaagainst major diseases and chemical control trials.

I. Screening trials

a. Blast: Screening trials against leaf blast were conducted from 1981-82 to 1985-86 as detailed below:

Year	No. of entries tested	No. of entries with screening 3 and less in 0-9 scale
1981-82	688	70
1982-83	383	89
1983-84	326	45
1984-85	558	32
1985-86	647	27
Total :	2602	263

Among these 263 low scoring entries, 21 entries were identified as highly resistant (Score 0) to leaf blast (Table. 11). Two KAU cultures viz. KAU-153-1 (IR 1561 x PTB 33) and KAU 200 (IR 156 x PTB 33) were found resistant to leaf blast.

.....61/-

TABLE- 11

Entries showing highly resistant reaction to leaf blast during the period 1981-82 to 1985-86 at R.A.R.S, Pattambi

IET No.	Cross
6840	P 1215936/Sigadis
7072	Surekha x Kakkatiya
7380	--
7753	--
8377	Rasi/ADT-21
7797	Vikram/CR 57-1550
7802	IR-8/Siam 29/Pankaj
8209	IR-2061-464-246/IR-8635
8263	MTU 4407/Sigadis
8305	IR-4432-28-3/IET 5118
8319	IET 4141 x CR 98-7216
8325	-do-
8342	IR 8 x Surekha
8343	-do-
8345	-do-
8215	Phouren/IR 24
8334	OS 4/Phalguna
8336	-do-
8955	IET 4141/CR 98-7216
8956	-do-
8958	-do-

b. Sheath blight

Screening trials against sheath blight were conducted during the year 1981-82 to 1985-86 as detailed below:

Year	No. of entries tested	No. of low scoring entries 3 + 3 in 0-9 scale
1981-82	668	256
1982-83	382	107
1983-84	324	152
1984-85	536	214
1985-86	653	269
	2563	998

.....62/-

Among these 998 acoring entries only 3 entries IET 7153 (T 141 x T 141 mutant), IET 7776 (JR 49) and IET 7792 (IET 2886 x Annapoorna) were rated as highly resistant to sheath blight.

In another experiment while assessing the resistance and yield performance of 22 promissing cultures against sheath blight, IET 7300 (MNP-36 x CR 12) x Pankaj and IET 5912 (Sons x Mashoory), IET 5735 (Improved Sabarmathi x Sona) and Pankaj were found promising with higher yields and low disease incidence.

c. Brown spot:

Out of 668 entries tested under NSN I and II during the year 1981-82, 274 entries were identified as low scoring entries with a score of 3 and less. No entries could rated as highly resistant.

d. Bacterial leaf blight:

In bacterial leaf blight screening programme conducted during 1982-83 and 1983-84 out of 600 entries tested none were found as highly resistant while 194 entries were included in the score range of 3 and less than 3.

In another attempt to study the resistance of traditional PTB varieties and high yielding varieties to bacterial leaf blight, it was found that traditional PTB varieties too are susceptable to the disease. Varieties PTB 29 and PTB 30 were found as moderately susceptable where as PTB 4, 12, 15, 16, 29 and 33 were moderately resistant. Highly resistant reaction was shown by IR 5 Aswathy and Co-25.

e. Multiple resistant entries:

A few entries of NSN I of Kharif 1983 exhibited resistance to more than one disease. Four entries IET 8236, IET 8288, IET 8314 and IET 8748 showed multiple resistance to blast, sheath blight and bacterial leaf blight (Table.12)

.....63/-

TABLE. 12

Entries in NSN I resistant to more than one disease in Kharif 1983.

LET No.	Cross	Blast	Sheath blight	Bacterial leaf blight
8334	(DS4 x Phalguna)	x	x	
8336	(-do-)	x	x	
8215	(Phouren x IR 24)	x		x
8956	(IET 4141 x CR-93-7216)	x		x
8236	(CR-151-79/CR 1014)	x	x	x
8288	(Vikram/Benong III)	x	x	x
8314	(IR 32/IET 6314)	x	x	x
8748	(Jaya/T22A)	x	x	x

II. Chemical Control

Chemical control trials were conducted on blast, sheath blight and bacterial leaf blight both under AICRIP and KAU programmes. The experiments were designed both to develop a suitable economic spray schedule as well as to evaluate new fungicidal formulations for the control of major diseases. Results obtained from the various trials are summarised below.

(1) Blast:

In the economic spray schedule trial for the control of blast, among various fungicidal combinations tested the following two schedules are found effective in controlling the disease with higher yield.

i. Application of Bavistin (0.1%) at tillering phase followed by Kitazin (0.1%) at Pt and following stages.

ii. Application of Bavistin (0.1%) at tillering followed by hinosan (0.1%) at P.I. and flowering stages.

Among the new EC/WP fungicidal evaluated against blast diseases Topsin. M, Fungoren 50 WP and Kitazin 48 EC were found promising. These are comparable to Hinosan.

.....64/-

Among the granular fungicides tested against blast as soil application, coratop 5G, and Kitazin 17g were found promising in disease control.

(2) Sheath blight:

In the economic spray schedule for the control of sheath blight spraying MBC at the rate of 1g/L followed by a second spray of Topsin M 75WP at the rate of 1g/L 15 days later could effective to control the disease. Rotational spraying with Vitavax (1g/L) followed by Hinosan (1ml/L) was found as the best fungicidal combination for sheath blight control.

Various studies using different chemicals were conducted for the control of sheath blight disease of rice, and the more effective treatments are given below:

i. Spraying Brassicol WP (0.1%) at 30 and 45 DAT
ii. Spraying MBC (0.1) twice at 15 days interval
iii. Spraying validacin 3L at the rate of 2ml/L twice at 15 days interval.

(3) Bacterial leaf blight:

Spraying cowdung extract (20g fresh cowdung in one litre of water) twice at 15 days interval was found to check bacterial leaf blight and in on par with antibiotics like Penicillin, Panshamysin and Plantomysin in disease control.

Copper shyness and effect of copper components in rice disease control

While evaluating the efficiency of Bordeaux mixture and fytolan in controlling rice diseases, it was found that both these chemicals are Phytotoxic to the dwarf rice varieties tested with the exception of Jyothi and IR-5. Untreated plots had a higher grain yield eventhough their rating of disease score was high.

Among the various chemicals evaluated against seed borne infection Thiride 75 WP, Capton, Faltaf 80 WP and Dithane M-45 was found as good seed dressing fungicides (Table. 13).

Paddy seeds treated with fongoren 50 WP (2g/kg of seed) gave better protection to seedlings from leaf blast upto 60 days. Under wet sown and 40 days under dry sown conditions. (Table. 14).

.....65/-

TABLE - 13

Effect of fungicidal seed treatment on germination and seed infection

Treatments	Quantity per kg. of seed	Percentage of germination	Percentage of infected seeds	
			Blotter method	Agar plate method
Bavistin 50 WP	1 g	90	18 (24.29) (*)	74 (59.4)
Foltaf 80	2.5 g	95	11 (19.18)	55 (47.88)
Dithane M-45	2.75 g	92	11 (19.18)	73 (58.82)
Thiride 75 WP	2.75 g	92	2 (5.77)	32 (34.27)
Captan	2.5 g	92	9 (14.33)	61 (51.81)
Vitavax	2.0 g	95	18 (24.69)	72 (58.35)
Disease check	..	91	36 (36.48)	94 (76.01)
CD (0.05)		NS	13.6	9.22
CV (%)		1.96	44.86	11.27

(*) Values in paranthesis are transformed values.

.....66/-

TABLE - 14

Effect of Seed Treatment with Seed Dressing Fungicides on Seedling Blast Control

Treatment No.	Fungicides and dose	Leaf blast score (based on 0 - 9 scale)						
		Dry seed dressing			Wet seed dressing			
		20 DAS	30 DAS	40 DAS	30 DAS	40 DAS	50 DAS	60 DAS
1	Bavistin 25 SD (2 g/kg of seed)	3.67	5.00	7.00	3.67	6.67	7.33	7.67
2	Bavistin 5 WP - do -	3.00	4.00	6.00	3.00	4.33	5.00	5.33
3	Bavistin (25%) + TMTD (50%) - do -	4.00	5.00	7.00	4.00	6.67	6.67	7.00
4	Captaf 50 WP (3g/kg of seed)	6.00	7.00	8.00	5.00	6.67	6.67	7.33
5	Dithane M 45 75 WP - do -	4.33	5.33	7.00	4.33	6.67	6.67	7.33
6	Fottaf 80 WP - do -	3.00	4.33	6.00	3.33	4.33	5.00	5.00
7	Fongoren 50 WP (2 g/kg of seed)	2.00	3.00	5.00	3.00	3.67	4.00	4.00
8	Check (untreated)	7.00	8.00	9.00	6.00	7.00	8.00	8.00
	C.V. %	17.8	8.5	..	7.9	8.9	11.5	8.4
	C.D. (0.05)	1.29	0.70	—	0.56	0.9	1.25	0.94

.....67/-

B. ENTOMOLOGY

a. Seedling root dip in 0.02% chlorpyriphos for 12 hours before transplanting can effectively control gall midge attack. (Table. 15)

b. Among the various insecticides tested triazophos (Hostathion) was found to be more effective in reducing the leaf rotter damage and monocrotophos ranked next to it. (Table.16)

c. Reshmi (PTB-44) is a multiple resistant variety with resistance to leaf folder and gall midge.

2.11.1.4. Post Harvest Technology

A. Seed Technology

a. Jaya seeds stored in poly bags (700 gauge) could retain germinability for a maximum of 13 months and Triveni for a maximum period of 9 months without reduction in viability below 80 per cent. (Table. 17)

b. PTB strains of the first crop season have higher volume weights (kg/ha) than those of the second crop season. The range of measure weight for the first crop strains was from 58.6 to 64.2 kg per hectolitre with a mean of 61.2, while the second crop season strains had values ranging between 55.9 to 62.4 kg per hectolitre with an average of only 58.8.(Table. 18).

The high yielding varieties tested also recorded a higher volume weight during the first crop seasons. The range was from 54.6 to 60.5 and 53.4 to 59.5 kg/ha respectively during the first and second crop season. Bharathy and Jyothy recorded lowest volume weight during both the seasons. (Table. 19).

c. The results of the studies on the post-harvest dormancy of important high yielding paddy varieties cultivated in Kerala showed that variation ranging from 8 to 62 days during virippu and 2 to 40 days during Mundakan season exists for the varieties tested. During both the seasons the minimum dormancy was recorded by the short duration variety Triveni and maximum by the long duration variety Jagannath. The period of dormancy is higher in virippu than in mundakan season. (Table. 20).

.....68/-

TABLE - 15

Seedling root dip experiment

Tr.No.	Treatments	1902-03 I Crop			1902-03 II Crop		
		% SS 15 DAT	% SS 25 DAT	% SS 35 DAT	% SS 15 DAT	% SS 25 DAT	% SS 35 DAT
1	Chlorpyriphos (Seedlings dip)	1.40 (6.70)	1.62 (6.25)	0.92 (4.66)	0.57 (3.00)	0.00 (0.00)	0.29 (2.22)
2	Chlorpyriphos (Spray at 5 DAT)	13.10 (21.42)	6.77 (15.00)	6.00 (14.25)	1.73 (6.26)	1.60 (6.97)	1.50 (7.03)
3	Carbofuran 361 (Broadcast at 5 DAT)	12.10 (20.36)	8.56 (16.90)	6.20 (14.19)	0.06 (3.72)	1.75 (7.56)	1.99 (7.00)
4	Thcrate 10 g (Broadcast at 5 DAT)	12.37 (20.55)	10.02 (18.19)	6.11 (13.92)	0.21 (1.20)	0.67 (3.19)	1.02 (5.69)
5	Control	12.15 (20.20)	10.59 (18.00)	0.00 (2.94)	0.52 (2.04)	0.59 (2.03)	0.79 (3.43)
	Significance	*	*	*	NS	*	NS
	C.D. at 5% lelvel	2.97	4.02	5.00	..	3.77	..

Figures in parenthesis are transformed angular values.

S.S. - Silver Shoot.

.....69/-

TABLE - 16

Effect of foliar application of insecticides on the leaf folder damage and grain yield (% Damaged leaves ∓ Mean of three replications

Sl.No.	Treatments		Rate (Kg ai/ha)	Kharif 1903 mean	Kharif 1904 mean	Overall mean for Kharif	Rabi 1903 mean	Rabi 1904 mean	Overall mean for Rabi	Grain yield (kg/ha)		
	Common name	Trade name								Kharif 1904	Rabi 1904	Mean
1	Fenvalerate	Sumicidin 20 EC	0.30	7.7	—	7.7	22.1	..	22.1	—	—	—
2	Fenvalerate	-do-	0.15	14.9	—	14.9	21.0	—	21.0	—	—	—
3	Cypermethrin	Ripcord 10 EC	0.075	— -	10.7	10.7	— -	0.0	0.0	2260	3326	2797.00
4	Cypermethrin	- do -	0.05	— -	62.5	62.5	— -	0.6	3.6	2041	3030	2935.50
5	Triazophos	Hostathion 40 EC	0.50	1.0	0.5	1.1	3.6	0.9	2.3	1730	3301	2519.50
6	Triazophos	- do -	0.35	2.0	0.2	1.1	3.7	0.9	2.3	3039	4057	3540.00
7	Monocrotophos	Monocil 40 EC	0.50	5.0	1.4	3.2	5.7	1.3	3.5	2721	3729	3225.00
8	Monocrotpphos	- do -	0.35	5.0	2.0	3.9	5.6	3.0	4.3	3023	3704	3363.50
9	Carbosulfan	FMC-35001 24 EC	0.25	10.4	67.2	38.8	17.8	31.4	24.6	2260	2621	2444.50
10	Carbosulfan	- do -	0.15	— -	93.6	93.6	— -	24.2	24.2	903	2047	1915.00
11	SAN-155	SAN-155-90 SP	0.25	1.9	— -	1.9	6.7	— -	6.7	——	----	---- —
12	Phosalone	Zolone-35 EC	0.50	7.5	70.3	42.9	12.9	18.0	15.9	1050	2940	2003.00
13	Maximum Protection treatment		—	47.7	97.4	72-5	97.3	12.1	54.7	1587	3030	2700.50
14.	Untreated control		—	15.8	97.9	56.9	32.4	30.0	32.7	903	2022	1902.50
	C.D. at 5% level									1050	945	

TABLE - 17

Germination of paddy seeds kept in different types of containers

Container	Months after harvest												
	1 Dec.	2 Jan.	3 Feb.	4 Mar.	5 Apr.	6 May	7 June	8 July	9 Aug.	10 Sept.	11 Oct.	12 Nov.	13 Dec.
Poly bag (700 guage)													
Jaya	93	89	91	92	92	91	91	87	86	83	85	80	70
Triveni	91	90	90	90	87	85	84	80	60	44	0	—	—
Poly lined gunny													
Jaya	93	90	90	95	92	91	90	91	86	86	80	69	43
Triveni	90	90	92	94	90	80	80	52	10	4	0	—	—
Double gunny													
Jaya	93	89	94	94	93	93	87	89	70	42	12	0	0
Triveni	93	90	93	93	95	89	80	25	1	0	0	—	—
Single gunny													
Jaya	93	90	93	93	94	91	89	86	74	33	8	2	1
Triveni	93	94	90	95	90	91	80	31	1	0	0	—	—
Plywood bin													
Jaya	93	90	92	94	95	91	91	85	84	75	45	27	4
Triveni	95	86	87	89	90	83	75	22	2	1	0	—	—
Mud Pot													
Jaya	93	90	92	94	95	91	91	85	84	75	45	27	4
Triveni	95	86	87	89	90	83	75	22	2	1	0	—	—
Cement Pot													
Jaya	93	91	92	94	95	94	90	80	70	47	25	12	0
Triveni	90	92	92	93	94	88	74	23	1	0	0	—	—
Bamboo basket													
Jaya	93	87	93	91	92	90	89	84	75	26	6	2	0
Triveni	94	92	91	95	90	86	78	13	0	0	0	—	—

TABLE - 18

Measure (volume) weight of important PTB rice varieties

First crop season strains	Volume weight (kg/hl)	Second crop season strains	Volume weight (kg/hl)
PTB-1 (Aryan)	59.4	PTB-4 (Vellari)	56.7
PTB-2 (Veluthari-kayama)	58.6	PTB-12(Chitteni)	62.4
PTB-5 (Veluthari-kayama)	59.9	PTB-15(Kavungin poothala)	57.6
PTB-8 (Chuvannai Thavalakannan)	62.6	PTB-16 (-do-)	55.9
PTB-9 (Veluthari Thavalakannan)	63.8	PTB-18 (Eravappandi)	61.8
PTB-10 (Thekken Cheera)	58.9	PTB-20(Vadakkan Chitteni)	61.1
PTB-22 (Velutha vattan)	60.3	PTB-21(Thekkan)	57.2
PTB-23 (Cheriya aryan)	62.1	PTB-27 (Kodiyan)	58.7
PTB-26 (Chenkayama)	62.6	PTB-33 (Athikarai)	58.3
PTB-31 (Ilappapu-chempan)	64.2		
PTB-32 (Aruvakkari)	60.9		
Mean	61.2		58.8

.....72/-

TABLE - 19

Measure (volume) weight of important high yielding rice varieties

Varieties	Volume weight (kg/ha)	
	1st crop season	IInd crop season
IR-8	60.5	57.0
IR-20	60.0	59.5
Jaya	59.2	58.9
Mashuri	59.2	58.7
Aswathy	58.3	58.1
IR-5	58.1	57.0
Sabary	58.1	56.4
H4	57.2	57.2
Bharathy	54.6	53.4
Annapoorna	59.4	59.1
Rohini	59.1	57.4
Triveni	57.4	57.0
Jyothy	56.9	56.1
Mean	58.23	57.37

.....73/-

TABLE - 20

Period of dormancy of important high yielding rice varieties cultivated in Kerala during Virippu and Mundakan season.

Cultivar	Duration (days)	Period of dormancy (in days)	
		Virippu	Mundakan
Triveni	95-105	8	2
Annapoorna	90-100	14	4
Jyothi	110-125	14	4
Mashuri	125-145	14	4
Rohini	75-110	16	4
Bharathy	115-125	18	14
Aswathy	120-125	20	
Jaya	120-125	20	14
IR-8	125-135	22	12
Sabary	125-135	24	12
IR-5	135-140	28	20
Jagannath	140-160	62	40

B. Agricultural Engineering

a. Three numbers of paddy winnower cum cleaner have been fabricated at NARP workshop, Mannuthy. The performance of the unit is as follows:

Paddy for seed purpose - 600 kg/hour
Paddy for grain purpose - 1000 kg/hour

The first model of this equipment was transferred to College of Agriculture, Vellayani.

The second model was transferred to IAT, Tavanur. The third one is available at NARP workshop, Mannuthy.

b. Field testing of two row paddy dibbler is being continued. Improvement on the metering device are being made.

2.11.2 PULSES

2.11.2.1 Crop Improvement

a. Two high yielding lines (Cul.9 and 7) with better grain quality than Krishnamony have been isolated. The important characters of these cultures are as follows:

	Culture 7	Culture 9
1. Plant type	Like Krishnamony	Like Kanakamony
2. Flowering	35-40 days	Early 35-40 days
3. Seed size	Like Krishnamony small seeded	Like Kanakamony, bold seeded
4. Seed colour	Red	Red
5. Grain yield	Yielding more than the check PTB-2 (1120 kg/ha)	(High yielder) Yielding more than the check PTB-2 (1371 kg/ha)

b. In a selection programme for long podded vegetable type cowpea from summer rice fallows

.....75/-

the variety IIHR-61-B has recorded the highest green pod. (Table 21)

c. Cowpea variety PTB-1 is found more tolerant to drought situations than IITA cowpea.

TABLE 21

Green pod yield(kg/ha) for three seasons

Varieties	1985 summer	1986 summer	1987 summer	Mean for 3 seasons
5269	6592	13431	10085	10036
Pusabarsathi	9012	14856	14104	12657
Mayyanad local	7000	8934	10628	8854
Co-2	5580	13463	*	9522
Kolenchery-13	5815	10392	8837	8348
Kongad	5951	9322	10348	8540
IIHR 6-1-8	11753	15575	20008	15779
Manjeri black	7469	10529	10549	9516

* Plant population was insufficient in Co-2 which resulted in abnormal yield.

2.11.2.2. Crop Production

a. Studies on input contribution in summer cowpea revealed that among different production inputs irrigation was most important followed by weeding and fertiliser application, the withdrawal of which significantly reduced summer cowpea grain yield by 54.35%, 29.86% and 18.12% respectively over full package of practice recommendations. (988 kg/ha.) The full package of practice produced 76.21% more grain yield than farmer's practice. (Table 22)

....76/-

TABLE 22

Yield data due to different input contribution in summer cowpea

Treatment	Grain yield of summer cowpea Kg/ha				Mean reduction in grain yield due to withdrawal of the input (kg/ha)	Mean input contribution (%)
	1985	1986	1987	Pooled mean		
T1 :f	191	486	27	235	753	76.21
T2 :r	1010	972	983	988	--	--
T3 (T2-R)	995	894	937	942	46	4.66
T4 (T2-F)	792	820	815	909	179	18.12
T5 (T2-P)	975	861	851	896	92	9.31
T6 (T2-1)	290	891	171	451	537	54.35
T7 (T2-W)	622	753	705	693	295	29.86
C.D. (0.05)						

f = Farmer's practice; r = full package; R less rhizobium; F less fertilizers; P less plant protection, I less irrigation U less weeding.

b. Rhizobium and molybdenum did not have any significant influence in pulse yield. However, the highest yield was recorded in treatment where the seed was treated with molybdenum alone in cowpea and black gram. In the case of green gram the seed treated with rhizobium molybdenum recorded the highest yield.

c. Coating cowpea seeds with Mussoriephos at varying levels and to compare with soil application did not have any significant incluence on yield. However, seed coating with 10 kg P205/ha recorded highest yield than soil application.

.....77/-

d. Application of phosphorous at the rate of 25 kg P205/ha and pottassium at the rate of 10 kg K20/ha was effective in increasing the grain yield of horse gram.

e. The most economic water management practice for summer grown blackgram is scheduling irrigation at IW/CPE ratio of 0.50. For this either bed or order strip method of irrigation can be successfully followed. Either one hand weeding or one interculture or pre-emergent spray of nitrogen (toke-25) is effective in controlling weed growth in blackgram.

f. Cowpea needs irrigation, (50 mm depth) at an IW/CPE ratio of 0.75 (at about 15 days interval) or at critical stages of branching flowering and pod formation for higher yield and water use efficiency when raised in rice fallows during summer season.

2.11.2.3 Post Harvest Technology

a. Cowpea seeds stored in polythene jar with screen lid could maintaining the germination of 75 per cent with low beetle damage of 25 per cent for a period of 7 months after harvest (Table 23).

2.11.3 OTHER CROPS

2.11.3.1 Groundnut:

a. Three groundnut varieties TG-3, TG-14 and Spanish Improved are potential yielders than the existing recommended varieties. These three varieties have been approved by the variety Evaluation Committee and recommended for general cultivation.

.....78/-

TABLE-23

Percentage germination and insect damage of cowpea seeds (PTB-1) stored in different containers for a period of 9 months

Sl. No.	Type of container	Period after harvest (months)							
		2	3	4	5	6	7	8	9
1.	Polythene jar (with seven lid)	86 (1.60)	82 (3.60)	76 (4.00)	76 (19.40)	75 (23.00)	75 (25.30)	71 (25.30)	62 (39.50)
2.	Tin container	89 (0.49)	76 (1.18)	80 (2.60)	78 (11.50)	48 (19.50)	27 (92.30)	17 (100.00)	11 (100.00)
3.	Single gunny	90 (9.20)	84 (4.00)	80 (5.00)	76 (12.90)	34 (28.00)	27 (94.30)	25 (96.60)	16 (96.00)
4.	Polythene bag(thin)	86 (0.20)	87 (7.70)	80 (9.20)	68 (12.20)	29 (59.10)	31 (32.50)	15 (57.20)	6 (71.10)
5.	Polythene bag (thick)	91 (1.20)	82 (9.70)	79 (10.30)	35 (43.30)	26 (74.80)	0 (100.00)	0 (100.00)	0 (100.00)
6.	Plastic line gunny	90 (0.40)	87 (1.64)	76 (3.35)	49 (37.50)	34 (56.00)	0 (100.00)	0 (100.00)	0 (100.00)
7.	Double gunny	90 (0.20)	82 (3.00)	76 (8.80)	43 (35.90)	21 (37.10)	21 (75.60)	7 (95.60)	0 (100.00)
8.	Mud pot	87 (0.23)	79 (4.95)	69 (14.00)	30 (23.29)	17 (57.94)	19 (84.62)	11 (100.00)	0 (100.00)
9.	Plywood tin	85 (1.40)	64 (7.40)	52 (10.95)	47 (14.30)	28 (40.10)	16 (96.00)	4 (100.00)	0 (100.00)
10.	Bamboo basket	85 (0.00)	72 (7.10)	28 (34.70)	25 (59.80)	15 (78.70)	2 (100.00)	0 (100.00)	0 (100.00)
	SE -	2.33	7.15	16.92	20.27	17.65	21.99	20.38	19.20
	SE ±	(0.58)	(3.20)	(12.00)	(16.40)	(20.98)	(28.75)	(25.54)	(20.11)

(The whole figures are percentage germination and values in paranthesis are percentage of insect damage)

b. A spacing trial for newly recommended varieties of groundnut, TMU-2, TG-14 and spanish improved revealed that in all the three varieties the highest pod yield was recorded at closer planting i.e., 15 x 15 cm.

c. Pooled analysis of three year's data revealed that pottassium and sulphur had no significant influence on pod yield.

d. The results from the weed control studies in groundnut showed that oxyfluorofen is effective in controlling the weeds. However, the highest pod yield was recorded for Benthiocarb at the rate of 1 kg ai/ha.

e. Scheduling irrigation at 50 mm depth to groundnut grown in summer rice fallows at an IW/CPE ratio of 0.9 i.e. at 11 days interval was found to increase pod yield significantly. Application of 25 Kg/ha each of $P_2 O_5$ and K_2O was found to be adequate.

2.11.3.2. BANANA

a. Low land - Considering the water use efficiency, total water used and number of irrigation applied, it is recommended that banana variety nendran need be irrigated at IW/CPE ratio of 0.9 i.e. 11 irrigations at an interval of 13 days with 200 litres of water per plant (50 mm) under high water table condition i.e. when the water table is within 1.5 m. It is also advisable

.....79/-

to mulch the basins of banana with poor quality paddy straw which could increase yield to the tune of 15%.

b. Upland - Another study conducted under low water table (upland) condition revealed that it is better to irrigate banana in laternate days at 10 mm depth (40 lit/plant) for higher bunch yields. This required 69 irrigation and 690 mm of water.

c. The three season's results of the banana based cropping pattern studies on intercropping banana with tapioca, groundnut, cowpea and bitter gourd showed that none of these intercrop have influence on bunch weight, number of hands per bunch on number of fingers per bunch. So the intercrops did not affect the yield of the main crop of banana. Cost benefit ratio was worked out for different intercrops tried tapioca was found to be most economic followed by tapioca and cowpea (cowpea planted on the ridges of tapioca crop). By planting tapioca along with banana 30.6% increase in profit was obtained, where as banana + tapioca + cowpea, it was 29.85% and 21.32% respectively.

2.11.3.3. SESAMUM

a. Two cultures of sesamum (culture 1 & 5) were found to be high yielders for uplands of Kerala.

b. Studies revealed that sesamum responded well to irrigation, surface irrigation at 30 mm depth during the critical stage of 4-6 leaf, branching, flowering and pod formation increases the yield by 15-40%.

.....81/-

The best schedule is two irrigation one each at branching (32nd day) and pod formation (45th day) stages. In case of only one irrigation is to be given at the time of flowering. Scheduling irrigation to sesamum based on climetological approach is to be done at 0.75 IW/CPE.

2.11.3.4. TAPIOCA

a. Considering the number of irrigation and total water used it is advisable to schedule irrigations to tapioca during summer seasons at IW/CPE ratio of 0.50. Approximate interval between irrigations in this schedule comes to about 24 days. Adoption of such an irrigation schedule could increase the tuber yield over unirrigated control to the tune of 92 and 43 per cent at 9 months and 11 months harvest respectively.

It was also observed that an irrigated crop harvested at 9 month, yielded equally or better than an unirrigated crop harvested at 11 month, and hence saves two months. This finding is of practical application for farmers who are desirous of raising a short crop of paddy in the single crop paddy lands immediately after the harvest of tapioca.

Intercropping tapioca with groundnut, cowpea, greengram and blackgram will increase the net income per hectare without sacrificing the yield of tapioca.

.....82/-

Both the pure and intercropping systems needs 50 mm irrigation at 0.3 IW/CPE ratio.

For better water economy and higher tuber production, it is recommended to irrigate tapioca based on any one of the following two schedules (1) all furrow irrigation with 25 mm water at 100 mm CPE (2) Alternate furrow irrigation alternatively with 50 mm water at 75 mm CPE.

2.11.3.5. SWEET POTATO

Sweet potato, grown in summer rice fallows needs irrigation (50 mm depth) at 1.2 IW/CPE ratio (at an interval of ten days), for higher yield. A dose of 50 kg/ha each of N and K_2O is sufficient for irrigated sweet potato.

2.12. Finding transalated into recommendations.

a. Three rice varieties namely Suvarnamodan (PTB-42), Swarnaprabha (PTB-43) and Resmi (PTB-44) were released and included in the package of practice recommendations.

b. In the case of Medium duration rice varieties the viability can be maintained at 80% if stored in poly bags (700 gauge) upto 12 months; and upto 8 months in the case of short duration rice varieties. (included in the P.P. recommendations).

c. Rice variety Resmi is resistant to leaf folder and tolerent to gallmidge. (Included in the P.P. recommendations).

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d. Resurgence of leaf folder is noted in plots treated with carbofuran (Included in the P.P. recommendations).

e. Spray fresh cowdung for the control of Bacterial leaf blight of rice. (Included in the P.P. recommendations)

f. Spray Topsin-M. 70 WP for control of rice blast in sheath blight (Included in the P.P. recommendations)

g. A fertilizer dose of 50:25:25 is recommended for the variety Mashoory. The N may be applied 50% as basal 25% at active tillering and 25% 1 week before panicle initiation. (Included in the P.P. recommendations)

h. During the mundakan crop season 5 cm irrigation once in 6 days will be quite adequate for project areas where water is assured. (Included in the P.P. recommendations).

i. For summer rice 5 cm irrigation two days after disappearance of Ponded water is sufficient, instead of 5 cm continuous submergence through out the crop period.

j. Validacin 3L @ 2 ml. per litre of water is recommended for the control sheath blight disease of rice. (Subject to clearence of the product by the central insecticide Board).

k. Triazophos (Hostathion) @ 0.35 kg ai/ha is recommended for the control of leaf folder; (subject to the clearence of the product by the central insecticide board.)

l. In gallmidge endemic areas the roots of rice seedlings may be dipped in 0.02% suspension of Chloropyriphos for 12 nos. prior to transplanting. (includedin the package of practice recommendations)

.....84/-

3. Sub Project impacts

This sub project envisages the integrated development of the central region with a view to maximise the productivity and farm income by intensifying research on various crops and cropping systems.

3.1. Physical

3.1.1. Staff : With the implementation of this project the following incremental staff were sanctioned and appointed.

	Pattambi	Mannuthy	Eruthempathy
Associate Director	1	-	-
Professor	1	-	-
Associate Professor	4	2	1
Assistant Professor	11	1	1
Junior Assistant Professor	-	-	3
Design Engineer	-	1	-
Administrate and supporting posts	10	7	3

3.1.2. Building:

After the implementation of the sub project an additional aea of 955 sq.m. are made available for laboratory which helps in the improvement of working condition to 526 sq.m. were 9/10 made available as farm structures like glass house, green house net house, seed store, fertilizer store, sales counter Meteorological laboratory implement and jeep shed.

In addition, construction of housing facilities with an area of 829 sq.m. were sanctioned and constructed after the implementation of NARP.

3.1.3. Transport Ecuipments & Library facilities

With the implementation the project the transport facilities of the zone were improved by the purchase of minibus, staff car and the speed of preparation cultivation were increased by the purchase of tiller, tractor etc.

.....85/-

Costilier laboratory equipments like Zoom binacular microscope, flame photometer, Calton B.O.D incubator, Spectrophotometer etc. and the new books and periodicals were purchase. Which boost up the research activities of the zone. 17 lakh repees were utilized for this purpose.

3.2. Conceptual

The research and other activities in the zone are implemented in accordance with the NARP concept. The research technical programmes of the zone are formulated as per the guide lines of NARP. A good integration was maintained among research, teaching extension. Teaching and extension personnels were invited to all zonal workshops and zonal meeting and achieved maximum participation.

A strong extension linkage has been developed. The research staff in the zone and officers of DOA are meeting periodically at various forms for discussing the location specific problems and fixed priorities of research and extension programmes.

The status Report of the zone as per the NARP concept was prepared and the detailed information about the zone was documented in it. In this report are incorporated an in depth information on the natural resources and infrastructural facilities available in the zone, the crops and croping systems, the existing practices, productivity and production of crops, yield potential and gaps, problems and constraints of crop production agricultural machinery and implements, livestock and livestock production problems, research extension linkages and gaps, research priorities and strategies etc.

3.3. Technical

The extent of adoption of specific technologies recommended together with the rationable for important crops are given below.

.....86/-

Recommendations (1)	Adoption pattern (2)	Rationale (3)
A. Rice		
I. Crop improvement - Varieties		
a. Uplands (Modanland, Purely rain-fed) PTB-28, 29, 30 and Swarnamodan.	PTB 28 is the most popular variety (about 60%) followed by PTB 29 and 30.	PTB-28 is more drought resistant and moderately resistant to blast.
b. Palliyals (Single crop terraced uplands)		
1. Medium duration: Aswathy, Jaya, Bharathi, IR-8, Mahsuri and Karthika.	Jaya is the most popular variety if Medium duration are grown. Generally short duration are taken (80%)	High yield potential of Jaya and its general tolerance to pests and diseases attract farmers.
2. Short duration: Triveni, Annapurna and Jyothi.	Jyothi occupied 80% of the area where short durat ion varieties are cultivated followed by Triveni.	High blast resistance and high consumer preference (being red kerneled). make Jyothi more acceptable.
c. Double crop wet lands		
1. Dry sowing Dibbling. First crop and second crop Medium duration: Aswathy, Sabari, Jaya, Bharathy, Mahsuri, Karthika, IR-8, and Swarnaprabha.	Jaya and Swarnaprabha are most popular followed by Bharathi and Aswathy.	In dry sown situations rice blast is very severe. The varieties Jaya, Swarnaprabha have got moderate resistance.
2. Transplanting First and second crop Medium duration: Jaya IR-8, Sabari, Bharathi, Aswathy and Mahsuri. During II crop, PTB-4 and PTB-20 are recommended where High yielding varieties are not coming up well.	Bharathi, Jaya and Mahsuri occupied an area of 70%. IR-8 is not grown at all.	They are preferred for their high yield potential and quality rice. IR-8 is not grown because of its low palatability to keralites.

(1)	(2)	(3)
Short duration: Annapoorna Jyothi, Triveni and Swarnaprabha.	The recommended varieties occupy about equal, area, except jyothi which is having a better coverage.	Jyothi gives high yield and resistance to blast and BPH.
Third crop (Punja) Short duration: Annapoorna, Triveni, Jyothy and Swarnaprabha.	Among these short duration varieties Triveni is having the maximum coverage (80%) followed by Annapoorna and Jyothy	Rice quality, high yield & short duration makes Triveni preferable.
d. Low rainfall area of Chittoor taluk of Palghat district		
1. First crop - Direct seeded		
Medium duration varieties:- Jaya, Mahsuri and IR-20.	The most popular variety is Mahsuri which occupies an area of 80%	Mahsuri is preferred due to its rice quality, which fetches a high premium price
Short duration varieties:- Jyothi and Triveni	The recommended varieties occupy about an equal area	
2. Second crop: Transplanted.		
Medium duration varieties: IR-20 and Mahsuri.	IR-20 occupies 2/3rd of the area.	IR-20 is resistant to stem borer.
Short duration varieties: Jyothi and Triveni	The varieties occupy and equal area.	
3. Poonthalpadams		
Cul. BR.51-315-4 and Mahsuri	Cul. BR-51-315-4. Slowly replaces Mahsuri.	Cul. BR-51-3154 is found to more adoptable to ill drained condition of poonthal-padams.

II. Crop production		
a. Seed rate		
1. Broad casting: 80-100 kg/ha 2. Dibbling : 80 - 90 kg/ha. 3. Transplanting: 60 - 85 kg/ha.	Generally adopted. some farmers use higher seed rate especially for broadcasting.	To compensate poor germination and bird damage.
b. Age of seedlings		
1. Short duration varieties 18 days 2. Medium duration varieties 20-25 days	Farmers adopt recommended aged seedlings largely. 30% use overaged seedlings.	over aged seedlings are used due to the late receipt of monsoon and delay in preparatory cultivation due to labour scarecity.
c. Spacing		
1. First crop Medium duration varieties 20x15 cm Short duration varieties 15x10 cm 2. Second crop Medium duration varieties 20x10 cm Short duration varieties 15x10 cm 3. Third crop Medium duration varieties 20x10 cm Short duration varieties 15x10 cm	Generally the recommendations are adopted by about 40% of the farmers. Others resort to wider spacing.	Earlier, wider spacing was given by the labour due to planting of local varieties. The introduction H.Y.V and the present recommendations are yet to be practiced by the labourers. More over the farmers are in a hurry to finish more area per unit time.

d. Leaving alley ways Leave a spacing of 30 cm after planting every 3m to facilitate spraying and other cultural operations.		Only a very few farmers adopt this recommendation being a new one.	The farmers fear a low yield due to leaving a row unplanted.
e. Manures and fertilizers			
1. Application of 5 t/ha organic manure as basal.		The entire recommended quantity is not applied by farmers.	Scarecity and high transportation cost of the material.
2. Fertilizer schedule	N.P.K. (kg/ha)		
Uplands PTB-28,29 & 30 (Modan)	40:20:20	Some farmers (30%)are adopting the full dose. But many farmers either give higher (N. only) or lower quantities of recommended dose.	Farmers use complex not meeting the full requirement of 'P' and 'K' due to the easiness in transporting and application. The financial constraints and limited resources make the farmers limitted to the use of N fertilizer alone. Which give immediate response by a greenish look to the crop.
HYV (short duration)	60:30:30		
Wet lands HYV (short duration)	70:35:35		
,, HYV (Medium)	90:45:45		
,, Local varieties	40:20:20		
,, H_4	70:45:45		
,, Mahsuri	50:25:25		
3. Method of fertilizer application Apply 'P' Full as basal. Apply 'K' .. as basal and half at P.I. stage. Apply 'Nitrogen' in split as basal and top dressing at Maximum tillering and P.I. stages.		Under dry sown conditions only very few adopt basal application. Under transplanted condition 50% apply basal manures, others use either complexes or 'N' fertilizers at Tillering and P.I. stages.	Farmers fear that basal application will induce weed growth. Non availability of P in time also make the farmers to skip basal dose. Comparatively high transportation cost of straight fertilizers and the task of mixing at proper dose generally leads to low P od

f. Weed control in dry sown rice		
Application of benthiocarb (3 l/500 l)/ha or Butachlor (2.5 l/500 l)/ha on the same day of seeding or the next day.	Generally not adopted	Lack of awareness, availability and special care to be taken up for weedicide application.
III. Crop Protection		
a. Nursery		
1. Spraying ekalux (1 ml/litre) or dimecron (0.5 ml/litre) or monocrotophos (1.5 ml/litre) against stemborer, gallmidge etc. 10 days before uprooting seedling.	Only a very few farmers are adopting plant protections in nursery. Some farmers are using chemicals which are not specified for certain pests.	The farmers do not feel the importance of nursery protection. The farmers who resort to the application of chemicals other than the recommended ones, are using what ever chemicals are available in the market.
2. Spraying Hinosan (1 ml/litre) or Bavistin (1 g/litre) against rice blast 10 days before up rooting seedling.		
3. Apply Carbofuran (250 g/100 sq.m) against stem borer and gallmidge 10 days after seedling.		
4. Seedling root dip in 0.02% Chlorpyriphos for 12 hours prior to transplanting in gallmidge endemic areas.	Not adopted	The farmers are not adopting this recommendation as it is a laborious process. Perceptible benefits. not realised as it is a prophylactic measure. Moreover the non availability of large containers for retaining seedlings also limitted the adoption.

b. Main field		
1. Stemborer, Gallmidge, leafroller Rice bug, brown plant hopper, spraying monocrotophos (1.5 ml/lit.) dimecron (0.5 ml/litre), ekalux (2 ml/litre), Carbofuran (18 kg/ha) metacid (1 ml/litre)	Generally 75% adopt plant protection measure, most of the farmers adopt spraying E.C. formulations.	The farmers who resort to the application of chemicals other than the recommended ones. Due to high cost of granular insecticide use in main field is limitted.
2. Blast, sheath blight, sheath rot, brown spot. Spraying hinosan (1 ml/litre) Bavistin (1 g/litre) Dithane - 2.78 (4g/litre)	About 50% of the farmers adopting this recommendation.	Non-application of fungicide is mostly due to non-availability of the recommended chemical locally in smaller packing and due to high cost of the [illegible] chemical.
3. Spraying fresh cowdung extract (20 g/litre) against bacterial leaf blight.	Generally adopted	Being a low cost input the farmers are ready to accept the recommendation
IV. Post harvest technology		
a. Storage of rice seeds in polythene bags (700 guage) to retain viability over 80% more than 9 months	Only 10 percent of the farmers adopt this recommendation	Non adoption is mainly due to the unawareness of the new technology. The farmers only adopt the conventional systems of storage.

B. Pulses : Cowpea

a. Varieties

New era, PTB-1
(Kanakamany) C-152
PTB-2 (Krishnamony)

Recommended varieties are adoptedonly about 30% farmers. Among the recommended varieties New era is adopted largely. Others use local varieties.

Cowpea is generally not grown for grain purpose. It is used as a vegetable in kitchen gardens and grown as a pure crop in rice fallows after the harvest first or second crop paddy. Lack of sufficient quantities of the recommended varieties to large areas. The local varieties are stable yielders and well adopted to local situations.

2. Seed rate
Broadcasting 20-25 kg/ha
Dibbling 20 kg/ha
For vegetable type 10-12 kg/ha.

Adopted by about 80%

Some farmers use high seed rate in order to maintain plant population and stand required for higher yields.

3. Seed inoculation with Rhizobium and pelleted with lime

Usually not adopted

Unawareness, laborious process and the Rhizobium cultures are available only at microbiological laboratory Pattambi.

4. Fertilizer recommendation

Lime - 250 kg/ha or dolomite 400 kg/ha.
N - 20 kg/ha
P_2O_5 - 30 kg/ha
K_2O - 10 kg/ha

Not usually adopted

Some farmer's use FYM only. Many believe that pulses donot require fertilization

5. Plant protection		
a. Pod borers Spray carbaryl (0.2%) or Fenthion (0.05%)	Not adopted	Financial constraints non awareness of the benefits, pod borers are not an important pest.
b. Pea aphids Spray Malathion (0.05%) or quinalphos (0.03%)	Adopted only by about 15%	Found effective, but not practiced because of uncertain returns, risk involved and the cultivation is mainly confined to kitchen gardens.
c. Fungal disease Spray Bordeaux mixture (1%)	Usually not adopted.	Un awareness and difficulty in identification of the disease symptoms.
C. Groundnut		
1. Varieties. TMV-1, TMV-2, TMV-7 TG-3, TG-14, Spanish improved.	Mostly TMV_2 is cultivated (80%). The other recommended varieties are adopted by only 5% of the farmers.	The groundnut cultivation area is limited to Chittoor taluk and adjacent to Tamil-nadu border. Lack of sufficient quantities of seed also limitted the adoption of the recommended varieties. Local varieties are well adopted to local situations Farmer's use their own seeds.

b.	Main field		
1.	Stemborer, Gallmidge, leafroller Rice bug, brown plant hopper, spraying monocrotophos (1.5 ml/lit.) dimecron (0.5 ml/litre), ekalux (2 ml/litre), Carbofuran (18 kg/ha) metacid (1 ml/litre)	Generally 75% adopt plant protection measure, most of the farmers adopt spraying E.C. formulations.	The farmers who resort to the application of chemicals other than the recommended ones. Due to high cost of granular insecticide use in main field is limitted.
2.	Blast, sheath blight, sheath rot, brown spot. Spraying hinosan (1 ml/litre) Bavistin (1 g/litre) Dithane - 2.78 (4g/litre)	About 50% of the farmers adopting this recommendation.	Non-application of fungicide is mostly due to non-availability of the recommended chemical locally in smaller packing and due to high cost of the [illegible] chemical.
3.	Spraying fresh cowdung extract (20 g/litre) against bacterial leaf blight.	Generally adopted	Being a low cost input the farmers are ready to accept the recommendation
IV.	Post harvest technology		
a.	Storage of rice seeds in polythene bags (700 guage) to retain viability over 80% more than 9 months	Only 10 percent of the farmers adopt this recommendation	Non adoption is mainly due to the unawareness of the new technology. The farmers only adopt the conventional systems of storage.

B. Pulses : Cowpea

a. Varieties

New era, PTB-1
(Kanakamany) C-152
PTB-2 (Krishnamony)

Recommended varieties are adoptedonly about 30% farmers. Among the recommended varieties New era is adopted largely. Others use local varieties.

Cowpea is generally not grown for grain purpose. It is used as a vegetable in kitchen gardens and grown as a pure crop in rice fallows after the harvest first or second crop paddy. Lack of sufficient quantities of the recommended varieties to large areas. The local varieties are stable yielders and well adopted to local situations.

2. Seed rate
Broadcasting 20-25 kg/ha
Dibbling 20 kg/ha
For vegetable type 10-12 kg/ha.

Adopted by about 80%

Some farmers use high seed rate in order to maintain plant population and stand required for higher yields.

3. Seed inoculation with Rhizobium and pelleted with lime

Usually not adopted

Unawareness, laborious process and the Rhizobium cultures are available only at microbiological laboratory Pattambi.

4. Fertilizer recommendation
Lime - 250 kg/ha or dolomite 400 kg/ha.
N - 20 kg/ha
P_2O_5 - 30 kg/ha
K_2O - 10 kg/ha

Not usually adopted

Some farmer's use FYM only. Many believe that pulses donot require fertilization

5. Plant protection		
a. Pod borers Spray carbaryl (0.2%) or Fenthion (0.05%)	Not adopted	Financial constraints non awareness of the benefits, pod borers are not an important pest.
b. Pea aphids Spray Malathion (0.05%) or quinalphos (0.03%)	Adopted only by about 15%	Found effective, but not practiced because of uncertain returns, risk involved and the cultivation is mainly confined to kitchen gardens.
c. Fungal disease Spray Bordeaux mixture (1%)	Usually not adopted.	Un awareness and difficulty in identification of the disease symptoms.
C. Groundnut		
1. Varieties. TMV-1, TMV-2, TMV-7 TG-3, TG-14, Spanish improved.	Mostly TMV_2 is cultivated (80%). The other recommended varieties are adopted by only 5% of the farmers.	The groundnut cultivation area is limited to Chittoor taluk and adjacent to Tamil-nadu border. Lack of sufficient quantities of seed also limitted the adoption of the recommended varieties. Local varieties are well adopted to local situations Farmer's use their own seeds.

2. Seed rate Pure crop spreading type TMV-2 - 75kg kernels/ha. Bunch types TMV-2, TMV-7 , 100 kg kernels/ha Mixed crop in coconut gardens - Spreading type 60kg kernels/ha. bunch type 80 kg kernels/ha.	Adopted by all	High seed rate helps to maintain plant population and this incidently checks need growth.
3. Fertilizer recommendation Cattle manure or compost 2 t/ha. NPK 10:75:75 kg/ha Gypsum 200 kg/ha.	Generally adopted	Some farmers use FYM or cattle manure only. Uncertain returns.
4. Irrigation Irrigate crop once in 7 days	Usually not adopted grountnut is mostly grown as a rainfed crop during Kharif season.	Non-adoption is due to the lack of irrigation water.
5. Plant protection		
a. Red hairy caterpillars spray carbaryl 0.15%	Adoption is only 10%	Farmers are aware of its importance, but benefit. cost ratio is low due to risk involved under low soil moisture conditions.
b. Ants/earwigs/termites apply BHC 10% DP or Aldrin 10% DP. in soil at the time of seeding.		
c. Tikka leaf spot disease spraying with Bordeaux mixtures 1% before flowering.	Most of the farmers adopt spraying of Bordeaux mixture.	--

4. Summary and conclusion

4.1 Achievements

4.1.1. Physical

With the implementation of the project purchase of new equipment, vehicles, under taking civil works, recruitment of scientific and supporting staff etc., effected and the details are represented in histograms.

4.1.2. Conceptual

By the implementation of the sub project the linkage of scientists in the zone with Officers of the Agricultural Department, input agencies and scientists of the other organisations has been fully established. The research programmes taken up were problem oriented and location specific.

4.1.3 Technical

4.1.3.1. Research contributions

Lead functions - Regional Agricultural Research Station, Pattambi.

Rice and rice based farming system, Pulses.

Research achievements -

1. Three rice varieties viz. Swarna modan (PTB 42), Swarnaprabha (PTB 43) and Resmi (PTB 44) were released for general cultivation.

2. Rice cultures - 23332-2; 1727; 1-5-4; 745; 796; BR 51-315-4, BR 52-96-3; 841 and 871 are under the stages of release.

3. A fertilizer dose of 50:25:25 Kg N P_2O_5, K_2O/ha is recommended for the variety mahsuri. The N may be applied as 50% basal 25% at active tillering and 25% 1 week before panicle initiation.

4. In rice-rice-(Medium)-fallow cropping system, the NPK dose for second crop can be reduced to 75% of the recommended level.

5. In rice-rice(med.)- green manure cropping system, a reduction of fertiliser dose for first and second crop by 75% is recommended.

6. Placement of N in the form of urea super granules can be delayed upto 20 days after transplanting without detriment to the yield of the crop during first crop season.

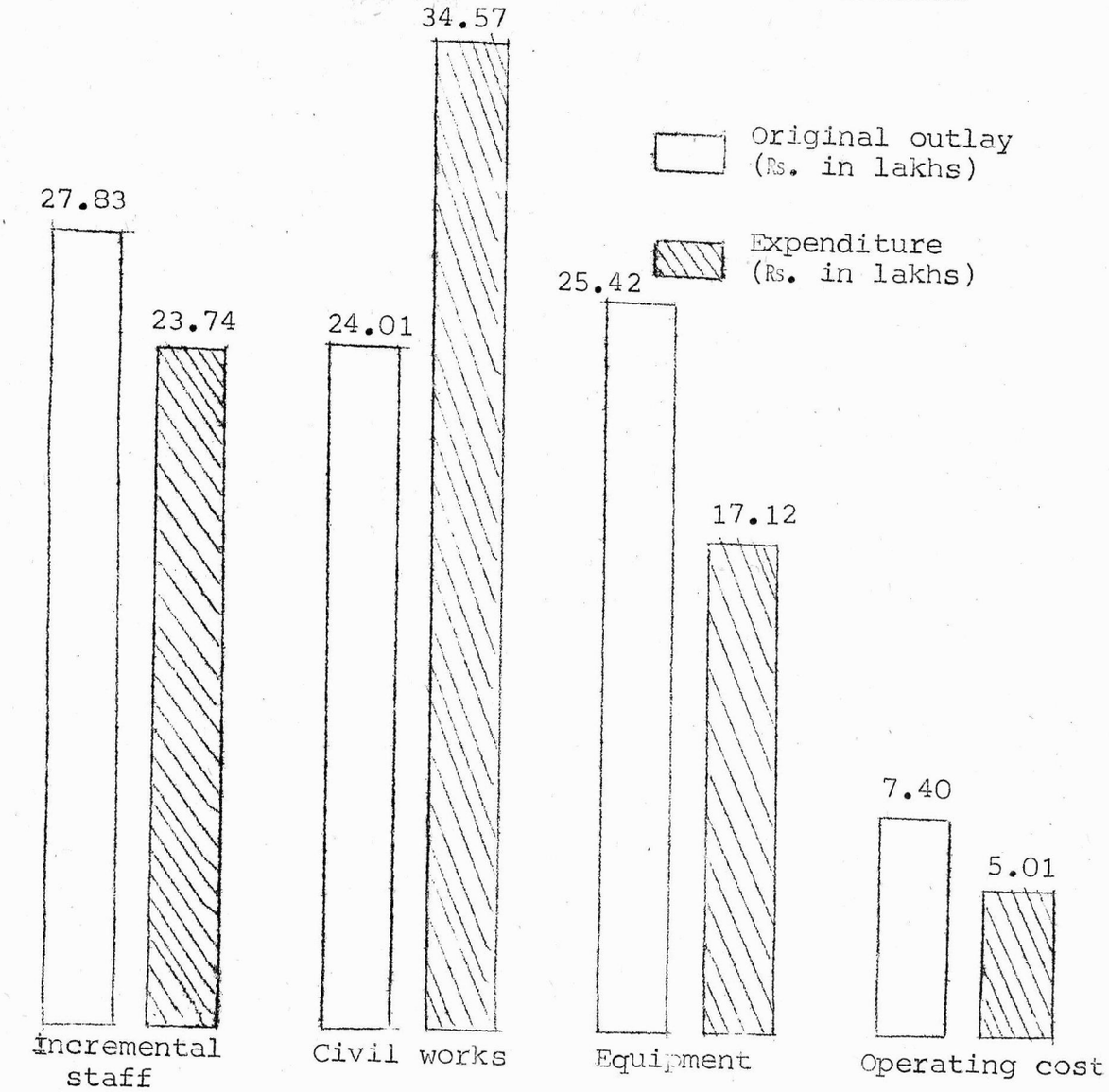
7. Maximum N use efficiency was achieved when sulphur coated urea was employed as N source for rice.

8. During the second crop season 5 cm irrigation once in 6 days will be quite adequate for project areas where water is assured.

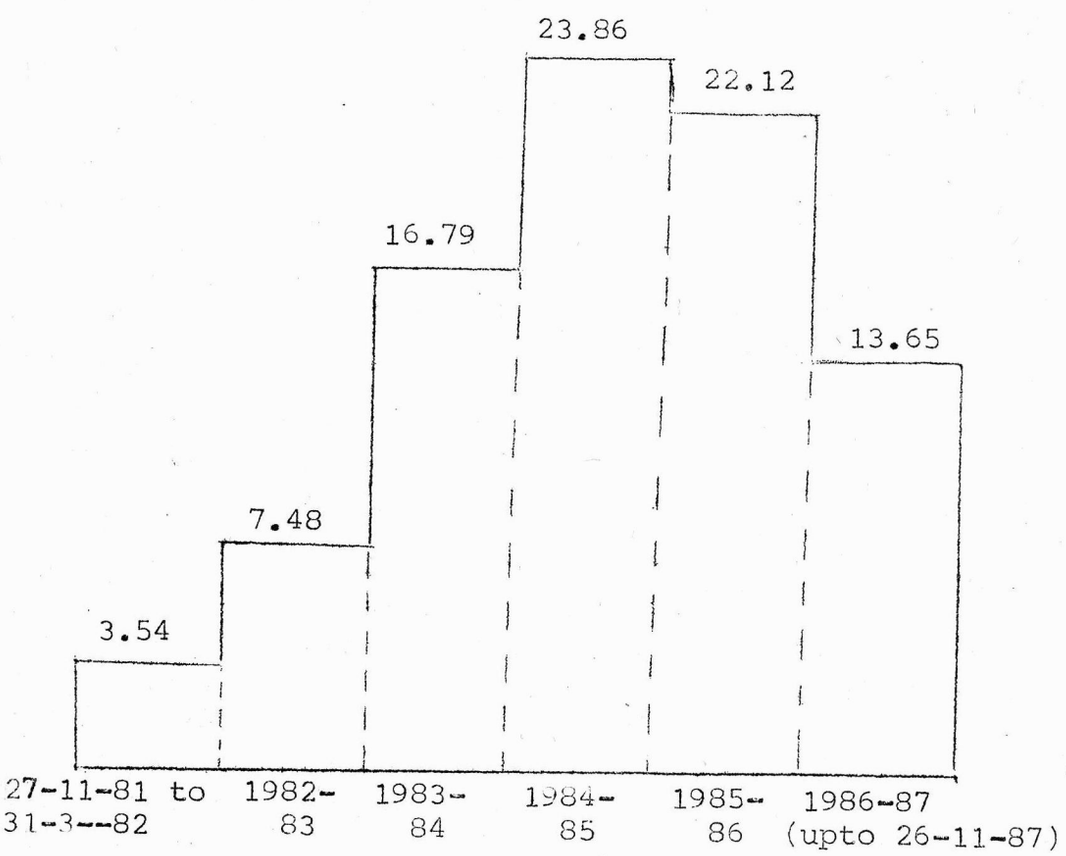
9. For summer rice 5 cm irrigation 2 days after disappearance of ponded water is sufficient instead of 5 cm continuous submergence throughout the crop period.

10. The N loss through ammonia volatilization from the submerged rice soils recorded 5.3% of applied N during the first crop season and 9.5% during the second crop

NARP Phase-I: Financial outlay and Expenditure

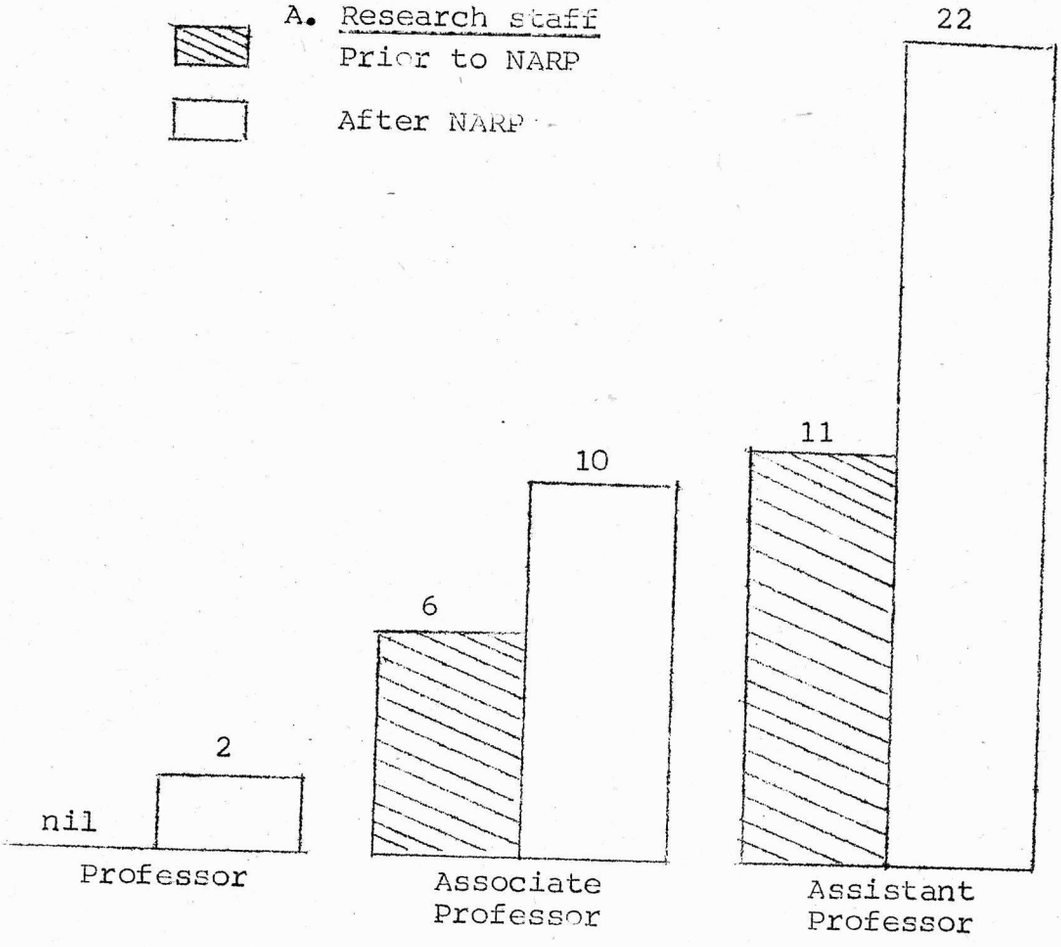


Yearwise financial expenditure (Rs. in lakhs)

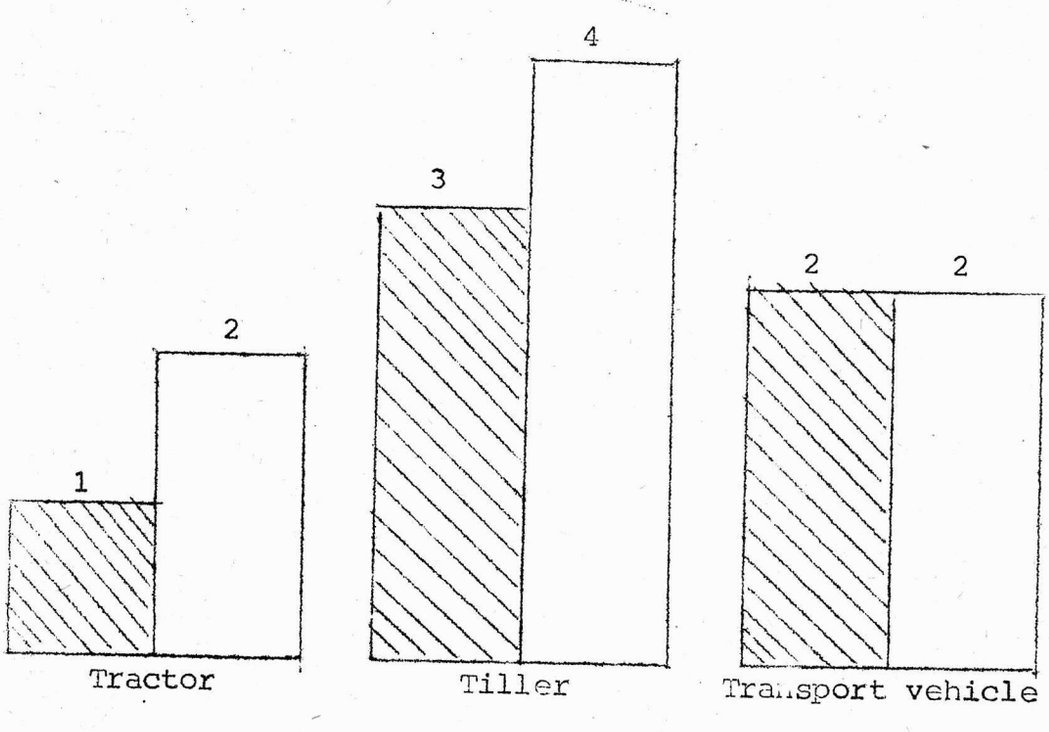


NARP Phase-I: Impact on strengthening of R.A.R.S, Pattambi

A. Research staff



B. Farm machinary



under different sources and method of application. Among the different sources used lac coated urea, urea super granules and urea split application helped to reduce the N loss.

11. Benthiocarb and Butachlor were found as the best pre-emergent weedicide for rice in dry sown condition.

12. Resurgence of leaf folder is noted in plots treated with Carbofuran.

13. Rice variety Resmi is found resistant to leaf folder and tolerant to gall midge.

14. Triazophos (Hostathion) @ 0.35 kg ai/ha is found very effective in controlling leaf folder.

15. In gall midge endemic areas dipping roots of rice seedlings in 0.02% suspension of Chlorophyriphos for 12 hours prior to transplanting is found effective.

16. Spraying of fresh cow dung (20 g/litre) extract was found very effective for the control of bacterial leaf blight of rice.

17. Spraying of topsim - M. 70 WP was found very effective in controlling blast and sheath blight.

18. Validacin - 3 L @ 2 ml/litre of water is found very effective in controlling sheath blight.

19. The chemical fongrene 50 WP was found as the best seed dressing agent in checking seedling blast.

20. The viability of medium duration rice variety can be maintained at 80% if stored in poly bags (700 guage) at 12 months of storage. The viability of short duration is also maintained at 80% upto 8 months if stored in poly bags of 700 guage.

21. A pulse variety Krishnamony (PTB-2) has been evolved and released for general cultivation.

22. Two cultures (Cul 9 and 7) with better grain quality than Krishnamony has been isolated.

23. Cowpea variety Kanakamony (PTB-1) is found more tolerent to drought situations.

24. For summer cowpea irrigation was found as the most important input.

25. Application of phosphorus and Potassium @ 25 kg P_2O_5/ha and 10 Kg K_2O/ha was effective in increasing the grain yield of horsegram.

26. Cowpea seeds stored with screw lid could maintain the germination of 75% with low beetle damage of 25% for a period of 7 months after harvest.

Verification functions - Sub centre, Mannuthy Rice, Groundnut, Pulses, and fabrication of farm machinery.

Research achievements:

1. Application of urea in the form of urea super granules increases grain yield in paddy. The dose of Nitrogen can be reduced considerably if urea-super granules are used.

2. Joint application of Carbofuran @ 0.75 kg. ai/ha and urea to supply 10 kg. N/ha, 20 days after planting of paddy increases grain yield and controls pests.

3. Seed treatment with molybdenum @ 1 gm/kg of seed increases the grain yield in pulses.

4. Groundnut variety J4 recorded the highest yield of pods. This variety also recorded the highest shelling percentage.

5. Sesamum varieties ACV-1 and C14-3 are the two promising varieties for rabi in uplands and in summer rice follows respectively.

6. A paddy winnower-cum-cleaner has been fabricated, which has the efficiency of cleaning 1000 kg/hour for grain purpose and 600 kg/hour for seed purpose,

7. The cropping system involving tapioca as intercrop in banana var. nendran recorded the highest net returns.

8. A two row paddy dibbler has been devoloped. Efforts are being made to incorporate a fertilizer applicate with the dibbler.

Testing function : Sub centre, Eruthempathy groundnut, dry farming.

Research Achievements

Conformative results of testing of new varieties and cultures of groundnut, blackgram and horsegram has not obtained.

4.1.3.2.

IDENTIFICATION OF SPECIFIC PROBLEMS AND ACTIONS TAKEN

Sl. No.	Problems identified	Action Taken/Recommendations given
1	RICE	
	A. CROP IMPROVEMENT	
	1. Evolving high yielding rice varieties with built in resistance to diseases like Sheath blight, blast bacterial blight, Tungro and grassy stunt virus and pests like stemborer BHP and gallmidge.	Some of the varieties like Rohini, Jyothi, Cul-1907 developed at this Station were also found to be resistant to leaf blast. Prerelease cultures viz., 25315, 25331, 1954, 25335, 25100, MO 130, MO 168, MO 170. were showing Resistant to shealth blight.
	2. Breeding Semitall photosensitive high yielding varieties for the second crop season.	Cul-25100 released as 'Reshmi' is satisfying the requirements with a high yield.
	3. Evolving varieties suitable to withstand temporary flooding and ill drained conditions.	Cul-BR-51-315-4 and BR 52-96-3 have been found to be promising in flood prone areas.
	4. Developing suitable varieties for dry sown and upland areas.	The variety 'Swarnaprabha' released recently is also found to be suitable for dry sown and upland conditions.
	5. Stress Physiology in Rice.	Under screening programme for drought tolerance, Cul-23332-2 was found to be drought tolerant.

(Contd.....2)

1	2	3
B.	CROP PRODUCTION	
6.	Studies on slow release Nitrogen sources 'N' inhibitors, applications time and techniques for maximum fertilizer efficiency.	Sulpher coated gives maximum 'N' use efficiency, Urea as supergranules gives a higher yield, Placement Techniques were tried.
7.	Evolving Fertilizer recommendations specific to varieties.	Recommendations were given for Mazhoori, IR-8, Jaya etc. based on the research findings.
8.	Herbicidal cum cultural methods of weed control for upland and wet land conditions.	Weed control operations for direct sown low land rice. Application of Benthiocarb @ 1kg/ha at 6 DAS is recommended. Economics of weed control under transplanted conditions are workedout.
9.	Fertilizer recommendations specific to seasons.	Recommendation was given as 50:25:25 kg/ha of N,P and K for first and second crop season for medium fertile soils.
10.	Cause for lack of response for P & K in rice	Two trials had been conducted and found that there was no response. No conclusion could be drawn.
11.	Methods of application of water and moisture requirement at critical stages.	A normal 5 cm water throughout the crop growth is not necessary. Result indicated that to give irrigation 5 cm depth 3 days after disappearance of applied water in Mundakan (II) Crop and 2 days in summer is found to be sufficient to get a good yield.

(Contd.....3)

1	2	3
C.	PLANT PROTECTION :	
12.	Control of diseases like blast, Sheath blight and bacterial leaf Blight.	Spraying Topsin. M. 70 WP @ 10g/litre is found very effective against blast and sheath blight. Spraying MBC (1 gm/l) twice at 15 days interval or spraying MBC 1g/l followed by spray of Topsin M (1gm/l were found to be most effective against sheath blight of rice. Spraying validacin 3 L @ 3 L @ 2ml/litre of water is found effective against sheath blight disease. Spraying cowdung extract (20gm/l) was found to be effective against BLB of rice.
13.	Control of rice pests of a. gallfly	Seedling root dip in chlorphyriphos C.02% solution for 12 hrs. effectively control the gallmidge incidence and recommended for package of practice.
	b. Leaf roller	Hostathion (Triazophos) was found to be very effective against leaf rollers.
14.	Economic dose of Quinalphos 25% EC	750 ml of Ekalux 25EC was found to be economic dose for Rice pest control and recommended.
15.	Conjunctive application of carbofuran and urea for increased efficiency.	Carbofuran when applied in conjunction with 10 kg of N in the form of urea was to given high yields and better pest control.
D.	Post harvest Technology	
16.	Processing of paddy.	A paddy winnower cum cleaner wasdeveloped in ARS, Mannuthy and found to be very efficient.
17.	Storage studieson paddy.	Storing Jaya seeds in Poly bags (700 guage) found to retain the viability for a period of 13 months while for Triveni it was for 9 months.

1	2	3
II.	PULSES AND OILSEEDS	
	A. PULSES :	
	Screening and selection of shade tolerant pulses and long podded cowpea for rice follows.	Fortynine cowpea varieties tolerant to partial shade have been identified. PTB_2 (Krishnamony) a high yielding grain type cowpea is released for cultivation for summer rice fallows. Horsegram culture recording 15-20 percent higher yield than the local variety have been identified.
	B. SESAMUM	
	Evolution of medium duration drought resistant sesamum with multiple pods.	Work initiated
	C. GROUNDNUT	
	Bunchy variety of groundnuts suitable for coconut gardens and as pur crop.	A spacing trial with groundnut varieties in coconut garden was conducted. Spanish improvement and TMV2 recorded highest yield coconut gardens and recommendation was given for optimum spacing. TG3 and TG 14 were found to be good bunch varieties with a higher yield potential.
	D. OTHER CROPS	
1.	TAPIOCA	
	Evaluation of high yielding varieties.	A trial has been initiated for studying the yield performance of different varieties/selections. Tapioca and groundnut intercropping studies revealed that Tapioca M4 + groundnut variety GC-3 combination gave a maximum tapioca yield.

4.1.3.3. SPECIFIC TECHNOLOGIES RECOMMENDED AND ADOPTED

The three new rice varieties released (Swarnamodan, Swarnaprabha and Reshmi) from this station is getting warm reception from the farmers. Among this Swarnaprabha is more popular due to its adaptability to all seasons and locations. Resmi - a tall, photosensitive variety is getting more popularity due to its high grain and straw yield.

As a low cost technology spraying of fresh cowdung extract (20g/litre) is adopted by all farmer's, when ever BLB symptoms are observed and identified.

The fertilizer recommendation of Mahsuri is also adopted by many farmers to get maximum productivity, because this variety is popular especially in Palghat district as it get a high premium price.

4.1.3.4. Specific technologies recommended but largely not adopted.

The recommendation of seedling root dip in 0.02% chloropyriphes solution against gallmidge is not adopted by the farmers as it is a laborious process. Non availability of large containers for retaining seedlings as well the time lag before planting are also reasons for non adoptions.

The technology developed for retention of seed viability namely storing in 700 guage polythene bags also is not being adopted probably due to the unawareness of the new technology. The farmers have not yet changed from their conventional storage systems.

4.2. ADDITIONAL REQUIREMENTS REALISED TO MEET THE NEEDS OF THE REGION :

The research programmes initiated during phase I has to be continued and intensified in order to tackle the location specific problems. The following areas are worth mentioning.

4.2.1. Dry Farming Technology for Eruthempathy region/area

Low rainfall area of central region comprising of Chittoor and Kollengode Taluk differ widely from other agro climatic areas of the region. The rainfall here is less than 1000 mm precipitation, covering about 50000 hectares. Black soil is predominent and the mean temperature range is between 40°c (April-May) to 21°c (January-February). Research should be started in the following lines for improving the farming practices.

1. Standardisation of premonsoon tillage operations for moisture conservation.
2. To increase the water holding capacity by addition of suitable organic matter.
3. Devising and Testing tillage implements for cultural operations.
4. Contour bunding for moisture conservation.
5. Water management practices in addition to mulching and cover crops.

4.2.2. HORTICULTURE :

1. Research for selection and screening of new varieties suitable for the Central region for vegetable and tuber crops. For this rice fallow and river bed (during summer) has to be utilised to the maximum possible extent.
2. Water and Fertilizer management for the above crops in the rice follows and river beds.

3. Standardisation of Agronomic practices for Banana growing as rotation crop in wet lands.

4. To evaluate cost - benefit ratio of various cropping systems and tubers.

5. Storage studies on vegetables and vegetable seeds.

4.2.3. OLERICULTURE

This envisages the following aspects.

1. Survey and collection of varieties and species of vegetables and horticultural plants and their allied species.

2. Vegetative propagation and seed multiplication of promising ones.

3. Breeding and induced mutation for developing new varieties.

4. Nutrition, irrigation and indoor and out door cultivation of these plants.

4.2.4. Operational Research Projects

ORP on Management practices for dry sown first crop, second cropof rice and on the economic utilisation of rice fallows and post-harvest Technology.

4.2.5. Animal husbandary:

Cattle rearing has to be economically intertwined with the rice based cropping system for the mutual benefits. The following approaches are to be attempted.

1. Enrichment of paddy straw for nutrient and digestability and their effect on the milking and working ability of the cattles.

2. Evaluation of supplementation of paddy stock with urea-Molasses block.

4.2.6. Post harvest Technology.

Post harvest Technology is an important aspect needing a lot of attention. Hence the important aspects that can be taken for research are mentioned here.

1. Analysis of field level constraints in seed processing and preservation of the produce of major crops like Rice, Pulses, Vegetables, Oil seeds etc.
2. Identification of factors responsible for loss of viability of seeds and developing proper techniques.
3. Studies on occurrence, extent of damage and control measures of the seed borne pests and diseases.
4. Seed dormancy and Techniques to overcome it.

4.2.7. Management Information system

This is proposed to establish a management information system for stream lining the research management, economic analysis and labour management aspects. The results can be utilised as a consultancy to the farming community.

4.2.8. Infrastructural facilities

The infrastructural additional facilities needed to implement the above is briefly listed out.

4.2.9. Civil works

1. Class room for Trainees.
2. Animal shed with provision for metabolism studies.
3. Strengthening the Farm campus and irrigation sources.

4.2.10. Equipments

1. Hotair oven
2. Weighing balance - Analytical
3. Sprinkler unit.
4. Projector with accessories.
5. Camera.
6. Weigh bridge.
7. Chaff cutter
8. Ergometer
9. Boiling machine
10. Garden tractor
11. Power generator
12. Photocopying machine.
13. Mini Coputor.

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APPENDIX I

LIST OF EQUIPMENTS PURCHASED

(Year wise)

Sl. No.	Name of equipment	Cost (Rs.)
1	2	3
A. R.A.R.S. Pattambi		
1981-82		
1.	Tiller	44,930.76
2.	Tractor	1,05,643.81
3.	Mini bus including transport charge	1,93,053.74
4.	Ambassador car including transport charge	79,157.00
5.	5 HP Jet Pump	4,569.40
1982-83		
1.	Zoom binocular microscope (2 nos.)	32,270.50
2.	Inoculation chamber (1 No.)	6,050.61
3.	Keltron Electronic Calculator (5 Nos.)	18,690.00
4.	Deep freezer (1 No.)	16,024.58
5.	Irrigation materials and freight charges	3,834.88
6.	Centrifuge model R-24 (1 No.)	8,750.96
7.	Autoclave (1 No.)	7,659.05
8.	Grinder (1 No.)	3,115.40
9.	Conductivity meter along with conductivity cell	5,038.00
10.	Duplicating machine	10,924.78
11.	Double pan counter scale (1 no.) Double pan counter, set of weights	1,468.16
12.	Metallic stand for net radiometer (1 No.)	1,300.00
13.	High Precision constant Temperature bath (1 No.)	6,754.00

1	2	3
14.	Bench platform set	1,875.80
15.	Calton B.D.D. Incubator (1 No.)	15,657.60
16.	Labimex (Thermohydrograph) (2 Nos.)	7,724.20
17.	Remi Revolutionary Research Centrifuge (1 No.)	6,156.00
18.	Electric hot air oven (1 No.)	9,200.00
19.	Electric muffle furnace (1 No.)	5,200.00
20.	Dol starter	555.00
21.	Spare parts for jet pump	76.31
22.	Almirah	9,370.00
23.	Chair, tables	20,315.00
24.	Metallic stand for net radiometer	1,300.00
25.	Radiation instrument stand	140.55
26.	Advertisement charges	3,103.60
Glasswares:		
1.	Kjeldahl distillation assembly (2 nos.)	798.34
2.	Micro kjeldahl distillation set (4 nos.)	6,350.40
3.	Double distillation water still (1 no.)	3,789.52
1983-84		
1.	Lux meter with freight charges	7,860.75
2.	Cabinet stand	1,160.75
3.	New Tuliman self-indicating bench platform scale (1 No.)	5,629.24
4.	Materials for fencing	305.08
5.	Agro meter weight instruments	4,049.94
6.	Automatic rain guage (1 No.)	5,789.36
7.	Voltage stabiliser (1 no.)	1,424.50
8.	Vacuum oven (1 no.)	9,741.30
9.	Deioniser (1 set)	9,310.68
10.	Refrigerator (1 no.)	9,121.95
11.	Bench platform	11,672.25
12.	Expenditure for installation of radiation instrument	176.36

1	2	3
13.	Soil Thermometer (10 nos.)	906.42
14.	Microtome (1 no.)	1,831.50
15.	Electric hot air oven	12,000.00
16.	Electric hot air oven with dial thermo meter	9,200.00
17.	Insect rearing chamber	28,160.00
18.	Seed moisture meter (1 no.)	9,143.00
19.	Advertisement charges	3,706.00
20.	Rent handling charges and agency charges for clearing the import of balance from Germany	735.00
1984-85		
1.	Thermometers	2,326.50
2.	Spare lamp for zoom microscope	301.05
3.	Triple beam balance (1 no.)	479.25
4.	Water still	915.84
5.	Microfilm reader with balance due (1 no.)	15,223.74
6.	Electric motor	2,491.70
7.	Flame photometer (1 no.)	66,413.60
8.	pH meter	4,576.00
9.	Hot plate (1 no.)	1,960.00
10.	Trinocular microscope (1 no.)	12,364.00
11.	Voltage stabilizer	815.85
12.	Remi 4 place swing out head angle head	2,984.80
13.	Hand compression sprayer (1 no.)	566.55
14.	Furniture	1,18,146.15
15.	Gas cylinder, freight charges, security deposit	4,967.40
16.	Chromatography pit (1 set) including delivery and loading charges	1,749.00
17.	Advertisement charges	4,182.00
18.	Glasswares	19,028.65
1985-86		
1.	Grinding mill (1 no.)	4,180.00
2.	Polarising microscope (1 no.)	43,675.25

1	2	3
3.	Potters' tower (1 no.) and accessories	15,782.50
4.	Slide projector (1 no.)	6,325.00
5.	Cork boring machine (1 no.)	415.38
6.	Battery operated conductivity meter	3,705.67
7.	Bank commission	1,084.00
8.	Voltage stabilizer (1 no.)	4,856.95
9.	X.R.D.	7,04,772.00
10.	Electric timer (2 nos.)	528.00
11.	Water Bath (1 no.)	825.00
12.	Spectro photometer	19,440.00
13.	pH meter (1 no.)	3,808.00
14.	Gas plant (1 unit)	12,320.00
15.	Chemicals	1,445.15
16.	Glasswares	22,988.80
1986-87		
1.	Fume hood	10,879.00
2.	Keltron over head projector	3,976.00
3.	P.A. system	4,761.00
4.	Avitrol Trolley	1,564.00
5.	Block Digestor	28,561.57
6.	Gas plant accessories	6,042.50
7.	Glass wares	14,415.70
B.	ARS, Mannuthy	
1.	High pressure gass cylinder	2,306.00
2.	Reduction gear box (10:1)	7,247.50
3.	-do- (5:5)	
4.	Acetylene cylinder - including delivery charges	4,235.00
5.	Platform balance with weights	3,125.30
6.	Julaman Counter scale 10 kg. capacity including cost of weights and charges towards packing and forwarding	4,672.60

1	2	3
7.	Pipe bending machine	3,822.00
8.	Drilling machine and accessories	32,050.68
9.	Addison Tool and cutter grinder	24,216.50
10.	Shapimg machine	49,751.30
11.	Hardness tester	7,195.00
12.	Universal milling machine	2,53,031.96
13.	Side and face milling cutter	940.00
14.	Winnower-cum-cleaner (cost of materials and labour charges)	2,547.57
15.	Universal vice and drill point and tap lead grinding attachment (accessories to tool & cutter grinder)	5,024.50
16.	Materials purchased to make the electrical system of milting machine in working condition	93.10
17.	Loading, unloading, freight charges etc., of machines	6,950.70
18.	Installation charges of milling machine	325.00
19.	Installation of machines	260.75

APPENDIX: II

A brief account of books purchased under NARP

Year	No.of books purchased	Amount
1984-85	40	2,130.75
1985-86	96	18,175,37
Total	136	20,306.12

The following journals are also being subscribed.

1. Indian Horticulture
2. Indian Journal of Agricultural Economics
3. Poultry guide
4. Livestock adviser
5. Current Science
6. Dairy guide
7. Indian Journal of genetics and Plant Breeding
8. Madras Agricultural Journal
9. Fertilizer News
10. Pesticides
11. Plant Breeding Abstracts
12. Crop Science
13. Agronomy Journal
14. Indian Journal of Plantation Crops
15. Indian Journal of Plantation Crops
16. Indian Journal of Extension Education
17. Indian Journal of Agronomy
18. Japan Agricultural Research

APPENDIX - III

Project expenditure - statement showing the year-wise expenditure for each head - for the period from 1-11-81 to 26-11-86

Sl. No.	Name of the sub head	Original outlay approved (in lakhs)	81-82 (1-11-81 to 31-3-82)	82-83	83-84	84-85	85-86	86-87 upto 26-11-86	Total
1.	Incremental staff	27.83	0.02	2.62	3.92	5.21	6.39	5.58	23.74
2.	Civil works	24.01	--	1.49	6.95	14.45	5.75	5.93	34.57
3.	Equipment	25.42	3.52	3.13	5.23	3.08	8.46	0.70	*17.12
4.	Operating cost	7.40	6.00	0.24	0.69	1.12	1.52	1.44	5.01
5.	Farm Development	--	--	--	--	--	--	--	--
	Total	84.66	3.54	7.48	16.79	23.86	22.12	13.65	80.44

* Bank refunded the L.C. Account of Rs. 7,00,000 as per credit note dt. 3.10.86 issued on 27-10-86.

APPENDIX - IV

Scientific papers published:-

The number of scientific and popular articles published by different stations are summarised below:-

[illegible]ar	Institute in the Region	Scientific articles	Popular articles
1981-82	College of Horticulture, Vellanikkara.	27	33
1982-83	" "	56	28
1983-84 a.	" "	33	—
b.	Regional Agricultural Research Station, Pattambi.	7	15
c.	Agronomic Research Station, Cholakudy.	2	—
d.	Banana Research Station, Kannara.	1	—
e.	Directorate of Extension, Mannuthy.	5	—
1984-85 a.	College of Horticulture, Vellanikkara.	35	59
b.	Regional Agricultural Research Station, Pattambi.	3	—
c.	Agricultural Research Station, Mannuthy.	1	—
d.	Agronomic and Medicinal Plants Research Station, Odakkali.	1	—
e.	Banana Research Station, Kannara.	7	—
1985-86 a.	Regional Agricultural Research Station, Pattambi.	8	4
b.	Banana Research Station, Kannara.	7	—