RESEARCH PRIORITY SETTING IN AGRICULTURE: THE KERALA PERSPECTIVE

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Foreword

Agriculture sustains livelihoods of nearly two-third of population in India. After independence, several programmes were launched in the field of Agriculture to achieve self-sufficiency in food grains production and to improve the economic status of farmers. Agricultural research system in the country is now well-equipped and matured in status to respond to the challenges thrown from time to time. The food crisis of 1964 was the real test of resilience of the Indian food sector, and the scientists succeeded in tiding over the crisis through a seed-fertilizer-irrigation technology which transformed the Country from the status of a food deficit nation to that of a self sufficient one. As we all know, this quantum jump in production of food grains, popularly called the "green revolution". Gains in food grain productivity were effectively translated into a national food security system with enhanced farm income and additional employment opportunities – both directly and indirectly. The achievements made were impressive and we are no more haunted by talks of famine.

In the new millennium, the priority setting for the agricultural system in the Country must be in tune with the new challenges. It must sustain the accomplishments of the past, while addressing newly emerging problems in the new world order and changing market environments. This assumes more urgency because public funded research is being subjected to closer scrutiny on the one hand, and public investments in the agricultural sector are declining on the other hand. There is a general feeling that in a liberalised economy, agricultural research must be more market responsive and demand driven. Agricultural research in India is also on this path. Introduction of the concept of priority setting, monitoring and evaluation is an earnest effort in this direction.

The technical bulletin entitled " Research Priority Assessment in Agriculture" is the outcome of a collaborative project with the prestigious National Centre for Agricultural Economics and Policy Research, New Delhi – 110 012 by Dr.Satheesh Babu.K and a multidisciplinary team of scientists. I am happy that the team could identify the production limiting constraints of the major production systems of Kerala in a location specific manner. They have also succeeded in quantifying the extent of economic losses using an acceptable framework. The study has also identified the areas of research and policy gaps requiring intervention.

I congratulate the authors for their painstaking efforts to consolidate the materials in the form of a publication of this nature. I hope all stakeholders will be benefited by this research effort.

Dr.GSLHV Prasada Rao

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CHAPTER I

INTRODUCTION

The performance of a research system is closely linked to its internal and external accountability (Mruthyunjaya, 1996). Accountability refers to the system's ability to justify the relevance and quality of its programmes to all stakeholders, and the use of its resources to achieve the stated objectives. Internally, planning and priority-setting process are improved when the objectives, targets and goals of the research system are clear and well integrated with the policy goals set for the sector. Externally, financial support to the research system can best be maintained when the system provides timely, accurate and objective problem solving in terms of its outputs and outcomes.

1.1 Background and Historical Perspective

The agricultural research system in India has been remarkable in terms of responding to the challenges, thrown to it from time to time. The biggest challenge faced by the system was solving the looming famines and food crises. The food grain production in 1950-51 was just 51 million tonnes. The Grow More Food (GMF) campaign had by then illustrated conclusively the inability to bring additional area under cultivation. The alternate option of food imports was fraught with its own consequences. Food grains import in 1966 reached an all time high 10.4 million tonnes. The foreign exchange crisis that occurred at this time reminded everyone that food imports could not be a long-term solution. The third option was food aid. Opposition to food aid was fast gaining momentum in the US, and there were even suggestions in the US Congress to apply Triage Principle against India. Triage is a wartime principle adopted in military hospitals. Its rationale is to "save those who can be saved, and not wasting limited, resources on those, who cannot be saved" ! Under such compelling and humiliating circumstances, our political leadership had the only option of increasing food grain production from per unit land cultivated. The agricultural research system in India responded remarkably to the challenge, and the tryst with the high yielding varieties heralded a 'green revolution'. Despite two consecutive droughts during 1965 and 1966, which affected 41.1 and 30.7 percentage of total cultivated area respectively, the food grain production in the five years from 1967-68 to 1971-72 averaged 100 million tonnes. This doubling in food grain production took just 20 years, what most of the agriculturally developed countries achieved in 100 years. The role of the agricultural research system in transforming a food deficit country to a food surplus country is well acknowledged.

The research managers had also a relatively simple task of resource allocation in the context of the 'major' objective of self-sufficiency in food grain production (Pal and Joshi, 2000). Experience and judgement were relied upon to ensure a fair and efficient allocation of research resources. However, the challenges faced by the agricultural production scenario underwent a sea change in the nineties. Today the country is getting ready to take off to the twenty first century, the agricultural production and research are facing second generation problems of green revolution such as degradation of land and water resources, declining nutrient use efficiency, multiple nutrient imbalance, soil and water pollution, and changing pest-disease-weed syndrome (Paroda, 1995). Within the frame work of self-sufficiency in food grain production, new issues like efficiency, sustainability, diversification of agricultural production base, reduction of regional, sectoral and crop-wise imbalances, poverty alleviation, export competitiveness and export-led growth are to be addressed urgently. In other words, the national research agenda is growing rapidly in size and complexity (Pal and Singh, 1997). The conventional approaches of research resource allocation based on research managers' conventional wisdom, experience, and peer group interactions may not hold good as in the past, considering the complexities of issues involved. The investment in agricultural research and extension are declining, calling for more rational allocation of the available research resources (Ranjitha, 1996). Against a plea for supporting agricultural research by allocating at least one per cent of agricultural GDP (Kumar, 1996), agricultural research is prompted to become more market-responsive and demand-driven against the fast changing international environment. Historically, agricultural research in India has not been subjected to such resource rationing. Introduction of the concepts of priority setting, monitoring and evaluation (PME) is to be understood against such background. It is not meant to supplant the existing research prioritization processes, but to supplement it with more objective and transparent quantitative analysis and interpretation in an era of increasing social auditing and accountability.

1.2 Objectives

The specific objectives of the study are:

- To identify the production limiting constraints in the major production systems of Kerala in a location-specific manner
- To assess the extent of economic loss caused by the constraints, and
- To identify areas of research/policy gaps requiring intervention.

1.3 Organization of the study

Besides the introductory chapter, the report is organized into five chapters. Chapter two attempts a review of literature of the study and the methodological framework employed. Chapter three describes the socio-economic characteristics and uniqueness of the study area. The findings of the study are reported and discussed in chapter four. The fifth chapter identifies the areas of research/policy gaps, requiring technology/policy refinements and intervention.

CHAPTER II

METHODOLOGY

This part attempts a systematic review of literature relevant to the study and discusses the methodological framework used in the study, covering mainly the sampling design, concepts employed and analytical tools used.

2. 1 Coverage

The study covers the whole of Kerala state. The State falls in the agro-ecoregion "West Coast Plains and Ghats". The five agro-climatic sub-classification evolved in the state during the launching of the National Agricultural Research Project (NARP), viz., the NARP Southern Zone, NARP Central Zone, NARP Northern Zone, NARP Hill Area Zone and the NARP special zone of Problem Area have been followed for the study (Kerala Agricultural University, 1989a). The major crop production systems in each zone have been covered in detail, while identifying the production constraints and assessing the economic loss. Rubber, coffee and tea production systems that come under the direct purview of the Rubber Board, the Coffee Board and the Tea Board have been left out.

The identification of sub-production systems within each production system of an eco-region have been done in consultation with the National Agricultural Research System (NARS), if there is a unit functioning in the region, Regional Agricultural Research Station (RARS) or Commodity Research Station of Kerala Agricultural University functioning in the agro-eco-region, and subject matter specialists (SMS) of the Department of Agriculture, Government of Kerala in the concerned area. The details of technical experts involved in the rapid rural appraisal are furnished in Appendix-I.

2. 2 Types of data and sampling design

The study is based on primary as well as secondary data. The district-wise data on area, production and productivity of crops pertaining to the period from 1997-98 to 1999-00 were collected from the Directorate of Economics and Statistics, Government of Kerala, Thiruvananthapuram. The triennium average was worked out, and the district having highest acreage for a crop production system based on the triennium average in the zone was purposively selected for detailed study. A representative taluk (tehsil) was selected from the district in consultation with specialists from NARS, Kerala Agricultural University and the Department of Agriculture as detailed in section 2.1 for the selection of sub-production system, and three representative villages from the selected taluk was selected similarly for the selection of respondent farmers. Fifteen farmers were selected from each village randomly, thus making the total sample size 45 for each sub-production system.

2.3 Method of Enquiry

The information required for the study was collected from the sample farmers through personal interview, using a pre-tested, structured schedule of enquiry (Appendix-II). This information was supplemented through semi-structured interview and discussions with concerned experts from NARS, Kerala Agricultural University and the Department of Agriculture, Government of Kerala (Appendix-I).

2.4 Period Study

The secondary data pertains to the accounting years from 1997-98, 1998-99 and 1999-2000. The primary data under investigation pertains to the agricultural year 2001-2002.

2.5 Concepts Used in the Study

2.5.1 Operational expense

The farm cost accounting practice for determining the operational expenses of seasonal and annual crops have been followed. The operational expenses in this case includes the cost of seed/planting material, cost of organic manures and chemical fertilizers, cost of plant protection chemicals, cost of hired animal/machinery, cost of human labour (whether hired or not), and the cost other inputs, if any (like staking for banana and flowering hormone for pineapple). For all perennial crops like coconut and cashew, only the cost of maintenance is considered as operational expense.

2.5.2 Yield

The yield is the physical land productivity of the production system expressed as physical output per unit cultivated area. The yield is expressed as kilogram of grain output realized per hectare for rice, number of nuts per standard hectare (standard ha) for coconut, kilogram of bunches per standard ha for banana, kilogram of berries per standard ha for pepper, kilogram of nuts per standard ha for cashew and kilogram of fingers per hectare for ginger, kilogram of tubers per hectare for cassava and kilogram of fruits per hectare for pineapple. (The concept of standard hectare is explained under section 2.5.7).

2.5.3 Gross income

Gross income includes the total value of the main produce (grain, nut, bunches etc.) valued at the farm gate price. Wherever income from by-products have been reported, gross income in such cases includes income from main produce plus income from the by-product(s).

2.5.4 Gross margin

The gross margin is computed by netting out the operational expenses from the gross income (Johnson, 1990).

2.5.5 Cost of production

Cost of production is estimated by dividing the operational expense per hectare by the yield per hectare so that the cost of producing one kg of output can be arrived.

2.5.6 Benefit-cost ratio

The benefit-cost ratio indicates the gross return per rupee invested in the production system. The gross income was divided by the operational expenses to estimate the benefit-cost ratio.

2.5.7 Standard hectare

In crops like rice, the agro techniques are highly standardised, including the seed rate and spacing. However, in crops like coconut, areca nut, black pepper, banana (*nendran*), cashew etc., there is no uniformity in the plant-to-plant spacing, with the result that plant population in a unit area (like one ha) varies considerably. In order to overcome this problem, the National Bank for Agriculture and Rural Development (NABARD), while formulating the unit cost of investments for term lending and scale of finance for crop loans, have evolved a concept of "Standard hectare", consisting of a fixed plant population. These concepts *per se* have been followed to overcome the difficulties posed by diverse agro techniques, and facilitate better comparison. Thus, one standard hectare of coconut consists of 175 palms, while that of banana (*nendran*) consists of 2000 plants. One standard hectare of cashew consists of 200 plants, while that of black pepper consists of 1000 standards.

2.5.8 Constraints

Constraints have been broadly defined as the production limiting factors (Barker *et al.*, 1985). Production constraints were due to abiotic and biotic factors.

2.6 Review of Literature

Returns to public funded agricultural research investment are receiving increasingly more attention now (Evenson and Jha, 1973; Kumar *et al.*, 1977; Norton and Davis, 1981; Wise, 1986; Pardy and Craig, 1989; Jha *et al.*, 1995; Ranjitha, 1996; Kumar, 1996; Pal and Singh, 1997 and Kristjanson *et al.*, 1998).

As public investment in agricultural research has expanded, more importance is being put to its efficiency and productivity. Research managers and decision makers seek information on research pay off in order to assess alternative uses for public funds. In addition, the public itself is increasingly concerned about the productivity of public expenditure (Norton and Davis, 1981). This triggered a series of exercises to determine the returns on agricultural research investment. Most of such works are unanimous in the view that investment in the agricultural research system has yielded social rates of return far in excess of those realized in other sectors of the economy (Evenson and Jha, 1973; Kumar *et al.*, 1977; Wise, 1986; Pardy and Craig, 1989; Ranjitha, 1996; Kumar, 1996; Pal and Singh, 1997).

However, research priority setting based on objective analyses with a quantitative frame work were scanty until Gryseels *et al.* (1992) developed a priority setting frame work for use by the Technical Advisory Committee (TAC) of the Consultative Group on International Agricultural Research (CGIAR) in allocating scarce resources among regions, commodities and activities. Kelley *et al.* (1995) used a multi-objective framework of economic efficiency, equity, internationality and sustainability for assessing research priorities at the International Centre for Research in the Semi-Arid Tropics (ICRISAT). The criteria for establishing choices among competing research activities were transparent and interactive. Garrity *et al.* (1996) conducted research priority exercise at the rice ecosystem levels. Ramaswamy *et al.* (1996) carried out constraint analysis in rice production system at regional level in the four southern states of India, viz., Andhra Pradesh, Karnataka, Kerala and Tamil Nadu, and prioritised a research agenda based on it. A similar exercise has been done for rice in eastern India by Widawsky *et al.* (1996).

Jha *et al.* (1995) studied 68 commodities in 25 states of India using a modified congruence method by incorporating the value of output, poverty alleviation, sustainability, export orientation etc. into the frame work and illustrated that a shift in research resources from cereals and sugarcane to pulses, fibres, oil seeds, fruits and vegetable, spices and agro-forestry was needed in India.

Thus, research priority assessment and setting at the mega (international) level, macro (national) level, and meso (regional) level has gained momentum. However, micro-level analysis was scanty until Roy and Datta (2000) identified the production constraints in the Rice-Wheat cropping system in the Trans-Gangetic plains of Haryana. The economic bearing of each constraint for the agro-ecoregion was estimated, and the future research agenda was arrived at based on the socio-economic implication. Such an exercise was done in the dairy sector in Karnal and Kaithal districts of Haryana by Saxena *et al.* (2002). The present study is intended to bridge such information gaps in the agro-ecological zones of Kerala based on a micro-level analysis.

2.7 Analytical Tools and Frame work

Tabular and percentage analysis were carried out to estimate the operational expenses, gross income, and gross margin. The growth in the key indicators of agricultural development was estimated by the compound growth rate (CGR). Trend lines were fitted with individual series using an exponential function of the type:

$Yt = \alpha \beta^{t}$ -- (i)

where $\beta = (1 + r)^{t}$ and $\alpha = b_0$

The estimation was carried out in the log-linear form as:

$\ln Y = \ln A + \ln b$ ------------------------------ (ii)

The CGR was worked out as (Acharya and Madhani, 1988):

CGR (%) = [Anti ln (ln b) - 1] x 100 ------------(iii)

Measure of variability used was the coefficient of variation (CV). It was worked out by the expression:

$$CV (\%) = \frac{\sigma}{\bar{X}} * 100 \text{ ----------------- (iv)}$$

where σ is the standard deviation, and $\bar{X}$ is the arithmetic mean of an individual time series.

The prioritization of production constraints is based on the economic loss to the production system in the agro-ecological zone. The economic loss is estimated following Roy and Datta (2000) and Saxena *et al.* (2002).

Average yield loss attributed to the i^{th} constraint (ϕ) was estimated as:

ϕ = n.p.l. ----------------------------- (v)

where n = proportion of area affected by the i^{th} constraint

p = probability of occurrence of the i^{th} constraint

l = absolute yield loss attributed to the i^{th} constraint

The total production loss in the agro-eco region (n) will be:

$n = \phi.N$ -------------------------- (vi)

where N = area under the reference crop in the agro-eco region

The value of production loss to the reference crop in the agro-eco region (Z) is estimated as:

$$Z = n.P \text{ ------------------------------ (vii)}$$

where P = price of output per unit of the reference crop in the agro-eco region.

The more the estimated value of production loss attributable to a constraint in an agro-eco region, the more priority it invites in research/technology intervention.

The congruence method (Jha *et al*, 1995) was used to determine the priority setting across crops and regions. It tries to allocate research resources in proportion to the relative value of production (VOP) by region and commodities. The value of production was estimated at the triennium average (1997-99) of production and wholesale prices to even out the year-to-year fluctuations. The value of production (VOP) provides a starting point for rationalizing research allocation. This way efficiency in research resource allocation is ensured, i.e., if research has to enhance production, it is better done where the value of production is large. This initial benchmark is later converted into a composite baseline by adjusting the value of production (efficiency) with other research concerns such as equity, sustainability and export potential. This composite index acts as the priority setting index for normative resource allocation.

CHAPTER III

AGRARIAN ECONOMY OF KERALA: A UNIQUE SETTING

The agrarian economy of Kerala exhibits certain uniqueness that distinguishes it from her sister states of India. A high density of population, rainfall distribution, wage rate structure, highly literate and trade unionized peasantry and labour force, and the predominance of fragmented, and extremely small operational holding pattern give an entirely different picture. The highly diversified physical features and agro-ecological situations provide more than 30 micro-agronomic environments, facilitating the growth of more than 20 major crops. It is therefore, necessary that a clear understanding of the agro-climatic conditions and socio-economic setting of the study area be made, to draw appropriate and meaningful interpretation of the findings.

3.1 Location

Kerala state is situated at the Southwest corner of the Indian peninsula between 8°18' and 12°48' North latitudes and 74°52'and 77°22' East longitudes, as a narrow strip of land, 32 to 130 km wide, between the Western Ghats in the East and the Arabian Sea in the West. It has a geographical area of 38863 km^2 and a coastal line of 580 km in length. It accounts for 1.18 per cent of India's land surface area and accommodates 3.44 per cent of her population (Government of India, 1991a).

Table 3.1. Indicators of Human Development

Country	Life expectancy at birth	Infant Mortality rate (per thousand births)	Adult literacy (per cent)
China	68.9	43	80.9
Indonesia	63.5	53	83.2
India	61.3	70.0	65.38
Kerala state (India)	72.0	15.6	90.92
Malaysia	71.2	12	83.0
Philippines	67.0	36	94.4
Pakistan	62.3	80	37.1
Republic of Korea	71.5	10	97.9
Singapore	77.1	5	91.0
Sri Lanka	72.2	16	90.1
Thailand	69.5	29	93.5

(Source: Government of India, 2002)

The land resources is highly diversified in its physical features and agro-ecological conditions with the undulating topography ranging in altitude from below mean sea level (MSL) to 2694 m above MSL. Based on the topography, the land resources have four well-delineated natural divisions, viz., the low land (< 7.5 m from MSL), the midland (7.5 to 75.0 m above MSL), the highland (75 to 750 m above MSL), and the high ranges (750.0 m above MSL), each running almost parallel in the North-South orientation (Kerala Agricultural University, 1989a).

The state ranks first among Indian states in literacy with a literacy rate of 90.92 per cent, as against the national average of 65.38 per cent (Government of India, 1991b). The male and female literacy rates are 94.20 and 87.86 percentages, exhibiting very little disparity as against the All-India average of 75.85 and 54.16 percentages. Similarly, the life expectancy of 71.67 years at birth is also the highest in the country against 61 years at the All-India level. Kerala's infant mortality of 15.6/1000 is also the lowest in India while the national average is 72/1000 (Government of India, 2002). The better quality of life is indicative of the well-developed social sector, giving rise to a "Kerala Model of Development" (Kannan, 1990), which is comparable to any developed Asian country (Government of India, 2002) (Table 3.1).

3.2 Sectoral Share in the Net Domestic Product

The share of the primary sector (agriculture and allied activities) in the net domestic product (NDP) of the state was 39.2 per cent during 1980-81 at the current prices. It has come down to 34.5 per cent by 1996-97. The share of the secondary sector also declined during this period while the tertiary sector has increased during the corresponding period (Table 3.2). In real terms, the share of the primary sector showed declining trends, while that of tertiary (services) sector showed increasing trends over the years. The share of the secondary sector has remained stagnant around 24 per cent.

Table 3.2. Sectoral share in the net domestic product

Sector	1980-81	1990-91	1995-96
At Current Prices			
Primary	39.2	38.9	37.6
Secondary	24.4	26.4	23.1
Tertiary	36.4	40.7	39.3
Total	100.0	100.0	100.0
At Constant Prices (1980-81)			
Primary	39.2	35.9	33.7
Secondary	24.4	24.0	24.1
Tertiary	36.4	40.1	42.2
Total	100.0	100.0	100.0

(Source: Government of Kerala, 1996; Government of Kerala, 1998)

3.3 Climate

The state experiences a warm humid tropical climate. The mean temperature ranges from 23°C in the cooler months to 33°C in the hot spells, the coolest months being December-January and the hottest months March-May. The mean relative humidity ranges from 70-85 per cent, January-March being the dry months and May-November the humid.

The state as a whole experiences mega thermal climate, which indicates that the crop growth is not inhibited by temperature - but by rainfall (Kerala Agricultural University, 1989a).

3.4 Rainfall

The state receives a mean normal rainfall of 3108 mm from the South-West monsoon from June to August and North-East monsoon from September to November. The average annual rainfall during 2001 was 2908 mm, with -6 percent departure from the normal (Government of Kerala, 2002).The rainfall follows a bi-modal pattern with the peak of South-West monsoon occurring in June and the peak of North-East monsoon in October (Table 3.3 and Fig.3.1).

Table 3.3. Monthly Rainfall in Kerala during 1997-2001

(mm)

Month	1997	1998	1999	2000	2001	Mean
January	2.1	8.7	2.0	14.2	19.7	9.3
February	3.8	1.5	23.9	67.4	29.2	25.2
March	37.5	10.8	22.1	23.0	6.9	20.1
April	62.9	64.9	124.2	98.8	230.1	116.2
May	134.0	170.6	471.0	129.8	246.7	210.4
June	551.0	722.9	614.0	649.2	706.7	648.8
July	941.9	600.1	656.9	335.9	587.4	624.4
August	520.4	366.5	250.3	580.1	348.0	413.1
September	291.0	516.4	85.4	198.8	224.9	263.3
October	284.5	440.5	544.9	216.5	320.1	361.3
November	284.7	129.0	71.3	80.9	177.6	148.7
December	92.7	87.6	5.0	70.2	10.0	53.1
Total	3206.5	3119.5	2871.0	2464.8	2809.3	2893.8

(Source: Government of Kerala, 2002)

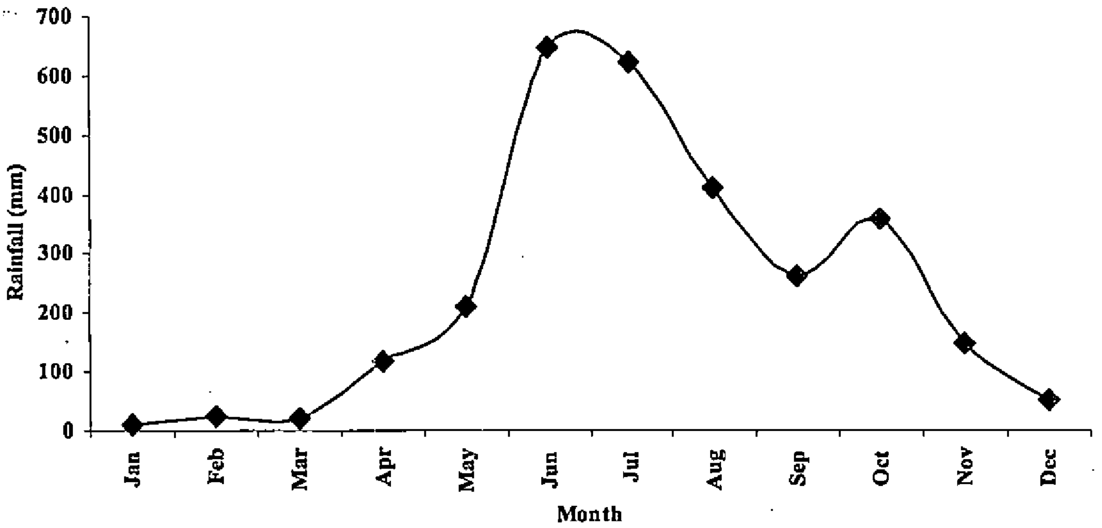

Fig. 3.1 Mean monthly rainfall pattern in Kerala

3.5 Soils

The major soil types of Kerala are laterite (oxisol), red loam (alfisol), coastal alluvium (entisol), riverine alluvium (entisol, inceptisol), saline hydromorphic (alfisol), brown hydromorphic (alfisol, inceptisol), Kuttanad alluvium (entisol, inceptisol). Onattukara alluvium (entisol), black soil (vertisol) and forest loam (Mollisol, alfisol). The laterite soils are the major soil type, covering about 65 per cent of the total area. The state provides an ideal setting for laterisation with the rainfall, temperature and humidity pattern prevailing.

3.6 Water Resources and Irrigation Potential

Irrigation is the most critical input for increasing the productivity of crops. Out of a gross cropped area of 24.17 lakh hectares, 4.21 lakh hectares is irrigated in Kerala, which works out to a meager 14.42 per cent of the gross cropped area (Government of Kerala, 2002). A basic constraint experienced by the rain fed production environments is the uncertainty and variability in the total annual rainfall and its seasonal distribution. Irrigation reduces this uncertainty and risk to a considerable extent.

Even though the period from December to April characterizes the period of lowest rainfall, irrigation needs are less for December and January months because they are comparatively cooler months having lower evapo-transpiration. However, the months from February to April being dry months, and keeping the mega thermal climate of the state in mind, irrigation is required during this period.

Kerala is a land of rivers and backwaters. There are forty four (41 west-flowing and 3 east-flowing) river resources in the State. However, being monsoon fed, most of them practically turn into rivulets in the summer months. Its implications are clear. Water is seldom available for irrigation when the need for it is highest. It underlines the need for an efficient water harvesting system whereby the run-off during the rainy season is harvested, to be recycled during the dry months to impart stability in crop production.

3.7 Demographic features

Kerala is one of the most densely populated states in India. The density per square km is 8.19 km^2 (Table 3.4) while it is only 324/ km^2 for the country as a whole (Government of India, 2002). This has been exerting tremendous pressure on the limited land resource base against steadily declining per capita land availability, especially from the seventies onwards.

Of the total working population in the State, only 25.55 per cent are agricultural labourers (Table 3.5). This is understandable when viewed against the fact that the cropping pattern is dominated by perennial cash crops, which are less labour intensive. The labour intensive food crops like rice, cassava etc. has been continuously losing their acreage due to high wage rate and declining relative profitability (Babu *et al.*, 1993). The labour force is thus increasingly being compelled to turn to the non-farm sector for employment opportunities. The per capita land availability is currently 0.12 ha.

3.8 Distributional Pattern of Operational Holdings

The average size of operational holdings in Kerala is only 0.33 ha as against the national average of 1.57 ha. Nearly 93 per cent of the holdings are below one hectare in size (Table 3.6). The small and marginal farmers together accounted for 97.79 per cent of the total number of operational holdings against 77.96 per cent for the country as a whole. Similarly 70.39 per cent of the area operated belonged to the small and marginal farmers against the All India pattern of 32.79 per cent, indicating their overwhelming presence in the agricultural production front.

The high population density coupled with small operational holdings have led to the evolution of a special food production system in the state, viz., the home garden agriculture (syn. homestead farming). It is a household level food production system practised around the home with a multi-species of annual and perennial crops along with/or without livestock, poultry and/or fish for the purpose of meeting the fundamental requirements of the household, viz., food, fodder, fuel, timber, mulch and medicare, and also to generate additional income through the sale of surplus to purchase the items that are not obtainable, readily available, or affordable to be produced in the homesteads (Fernandes and Nair, 1986; Ninez, 1987 and Salam *et al.*, 1995).

Table 3.4. Population Density and Land per Capita in Kerala

Year	Density per km^2 (No.)	Land per capita (ha)
1901	165	0.60
1911	184	0.54
1921	202	0.49
1931	245	0.41
1941	284	0.35
1951	349	0.28
1961	435	0.23
1971	549	0.18
1981	654	0.15
1991	749	0.13
2001	819	0.12

(Source: Government of Kerala, 2002)

Table 3.5. Distribution of Farm Population in Kerala

Sl. No.	Particulars	Total	Rural	Urban
1	Total workforce	8301087 (100.00)	6176865 (74.41)	212422 (25.59)
2	Cultivators	1015983 (12.24)	931989 (91.73)	83994 (8.27)
3	Agricultural labourers	2120452 (25.54)	1887758 (89.03)	232694 (10.97)

(Source: Government of India, 1991b).

Figures in parentheses indicate percentage to the respective total

This traditional household level food production system has resulted in an intensive land use system aimed at deriving the maximum benefit out of the limited land resource base both spatially and temporally. The agricultural production base of Kerala is characterized by the predominance of homestead farming.

Table 3.6. Distributional pattern of operational holding and average size by size groups

Sl. No.	Size group	Area operated (million ha)		No. of operational holdings (million Nos.)		Average size of holding (ha)	
		Kerala	India	Kerala	India	Kerala	India
1	Marginal (below 1 ha)	0.88 (49.16)	24.62 (14.87)	5.02 (92.62)	62.11 (58.99)	0.18	0.40
2	Small (1-2 ha)	0.38 (21.23)	28.71 (1.73)	0.28 (5.17)	19.97 (18.97)	1.36	1.44
3	Semi-medium (2-4 ha)	0.25 (13.97)	38.35 (23.16)	0.098 (1.81)	13.91 (13.21)	2.59	2.76
4	Medium (4-10 ha)	0.11 (6.15)	45.05 (27.20)	0.02 (0.37)	7.63 (7.25)	5.38	5.90
5	Large (10 ha & above)	0.17 (9.50)	28.89 (17.45)	0.003 (0.06)	1.67 (1.59)	58.00	17.33
	Total	1.79 (100.00)	165.60 (100.00)	5.42 (100.00)	105.29 (100.00)	0.33	1.57

(Source: CMIE, 1996)

Major crops like coconut, areca nut, cassava, banana, pepper etc. are raised mostly under the homestead situation.

Table 3.7. Land Use Pattern in Kerala during 1999-00

Sl. No.	Parameters	Area ('000 ha)	As % to the total Geographical area
1	Geographical area	3885.50	100.00
2	Forest	1081.51	27.83
3	Land put to non-agricultural uses	333.82	8.59
4	Barren & uncultivable land	28.34	0.73
5	Permanent Pastures & other grazing land	6.82	0.18
6	Land under tree crops and not included in the net area	20.20	0.52
7	Cultivable waste	62.71	1.61
8	Fallow other than current fallow	31.53	0.81
9	Current fallow	68.02	1.75
10	Net area sown	2258.67	58.13
11	Area sown more than once	657.84	16.93
12	Total cropped area	2916.51	75.06
13	Cropping intensity	-	129.13

(Government of Kerala, 2002)

3.9 Land Use Pattern

With a high rainfall distribution and population density, every inch of the land in the state is put to appropriate use with little or negligible barren and uncultivable land (Table 3.7). The percentage area kept under agricultural purpose is nearly 75 per cent. It is probably the highest in the country. The cropping intensity of 129 per cent is also indicative of the intensive land use pattern despite the dominance of perennial crops in the cropping pattern.

3.10 Cropping Pattern

The cropping pattern of Kerala is highly diversified and includes food as well as non-food crops.

Table 3.8. Cropping Pattern in Kerala during 2000-01

Sl. No.	Crops	Area ('000 ha)	As percentage to the gross cropped area
1	Rice	347.46	11.58
2	Jowar	2.53	0.08
3	Ragi	0.87	0.03
4	Pulses	10.81	0.36
5	Sugarcane	5.76	0.19
6	Pepper	199.37	6.64
7	Ginger	11.26	0.38
8	Turmeric	3.96	0.13
9	Cardamom	41.29	1.38
10	Areca nut	85.38	2.84
11	Banana*	92.87	3.09
12	Cashew nut	86.23	2.87
13	Tapioca	111.18	3.70
14	Sweet potato	0.98	0.03
15	Groundnut	6.92	0.23
16	Sesamum	1.94	0.06
17	Coconut	936.29	31.19
18	Rubber	474.36	15.80
19	Coffee	84.74	2.82
20	Tea	36.85	1.23
21	Others	441.80	15.35
	Total cropped area	3001.70	100.00

(Source: Government of Kerala, 2002)

*Includes Nendran and other plantains

Even though the cropping pattern consists of more than 20 crops, hardly a dozen crops occupy more than one per cent of the total cropped area. Coconut occupies the highest share in the total cropped area (31.19 per cent). This is followed by rubber (15.35 per cent), rice (11.58 per cent), pepper (6.64 per cent), tapioca (3.70 per cent), banana (3.09 per cent) and cashew (2.87 per cent) in that order. Crops like areca nut and coffee occupy around two per cent of the total cropped area while tea and cardamom occupies slightly more than one per cent of the cropped area. The rest of the crops occupy less than one per cent of the gross cropped area (Table 3.8).

3.11 Labour Wages

The workforce in Kerala is much better off than their counterparts elsewhere in the country. The labour force, by virtue of their better organizational strength and bargaining power enjoys one of the highest wage rates in the country (Table 3.9). The average wage rate for male labour during 1999-2000 was Rs.125-150/day while that of female labourers was in the range of Rs.70-110/day. It is more than one and half times the average daily wages of agricultural labour in the neighboring state of Tamil Nadu, and more than twice their counterparts in Karnataka and Andhra Pradesh.

Table 3.9. Daily Agricultural Wages in India: 1993-94

Sl.No.	State	Daily Average Wages (Rs.)
1	Andhra Pradesh	37.63
2	Assam	54.27
3	Bihar	42.94
4	Gujarat	63.20
5	Haryana	97.43
6	Himachal Pradesh	57.90
7	Karnataka	34.69
8	Kerala	76.99
9	Madhya Pradesh	39.74
10	Maharashtra	50.70
11	Orissa	43.75
12	Punjab	107.15
13	Rajasthan	55.54
14	Tamil Nadu	45.76
15	Uttar Pradesh	57.19
16	West Bengal	46.79

(Source: Government of India, 1997)

The foregoing analysis clearly illustrates that the ethos of farming in Kerala is distinctly different from that of Indian agriculture as a whole. This uniqueness is to be borne in mind while approaching the results of the study.

3.12 Key Indicators of Agricultural Development

A study of the crop production systems in isolation may not provide a correct picture as the performance of a system cannot be independent of the over all agrarian economy to which they belong to. The performance of the agrarian economy of the state is evaluated using the following selected "key indicators" of agricultural development.

3.12.1 Parity index

The parity index explains the terms of trade in agriculture by weighing the parity (or lack of it) between the price received for agricultural consumables and agricultural inputs. A perusal of the parity index shows that the agrarian economy of Kerala was subjected to unfavorable terms of trade through out the eighties and nineties, except for one or two stray years (Table 3.14 and Fig.3.2). Even though the price paid by the farmer, and the price received by the farmer has grown proportionately during the eighties, the payments have outgrown the receipts in the nineties. Favourable terms of trade are a prerequisite to ensure sustained interest of farmers in farming. Unfavorable parity discourages large-scale private investment in agriculture. Prolonged disparity may even result in existing farmers leaving farming altogether, and new entrants finding their entry into the sector unattractive. This stark reality is operating in the agricultural sector of Kerala.

Table 3.10. Compound Growth Rate of Terms of Trade in Kerala's Agricultural sector

(% / annum)

Sl.No.	Particulars	Period from	
		1980-81 to 1989-90	1990-91 to 1999-00
1	Price paid	10.01**	12.24**
2	Price received	10.08*	10.86**
3	Parity index	0.06^{ns}	- 1.23*

** Significant at 1% level * Significant at 5% level ns - non-significant

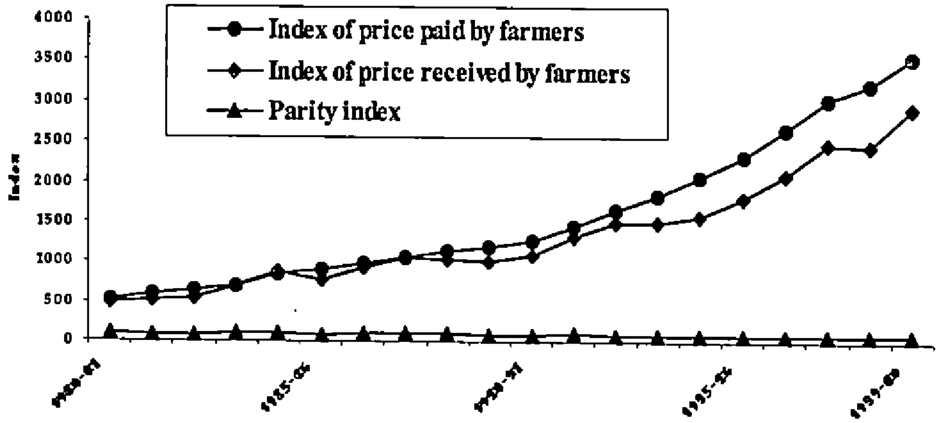

Fig. 3.2. Index of price paid, price received and parity index of farmers in Kerala

3.12.2 Cropping intensity

Cropping intensity indicates the intensity with which the arable land is being utilized for crop husbandry. It is expressed as a percentage of net sown area to the total cropped area (or the gross sown area). The net sown area was 21.80 lakh ha in 1980-81. It increased to 30.02 lakh ha in 1999- 2000. The gross sown area was 28.85 lakh ha in 1980-81. It increased to 30.02 lakh ha in 1999-2000. The cropping intensity has remained fairly stable around 132 per cent through out the period, except a marginal increase during 1989-90, 1992-93, 1993-94, 1994-95 and 1995-96. (Fig.3.3). Towards the second half of the nineties, the cropping intensity declined to 129 per cent. The growth rate in cropping intensity is positive in the eighties as well as in the nineties, being less than one per cent per annum in both periods (Table 3.11).

Table 3.11. Compound Growth Rate of Net Sown Area, Gross Sown Area, and Cropping Intensity and Current Fallow.

(% / annum)

Sl. No.	Particulars	Period from	
		1980-81 to 1989-90	1990-91 to 1999-00
1	Net sown area	0.24**	0.24**
2	Gross sown area	0.38*	0.95**
3	Cropping intensity	0.14^{ns}	0.89*
4	Current Fallow	0.79**	7.15**

** Significant at 1% level * Significant at 5% level ns - non- significant

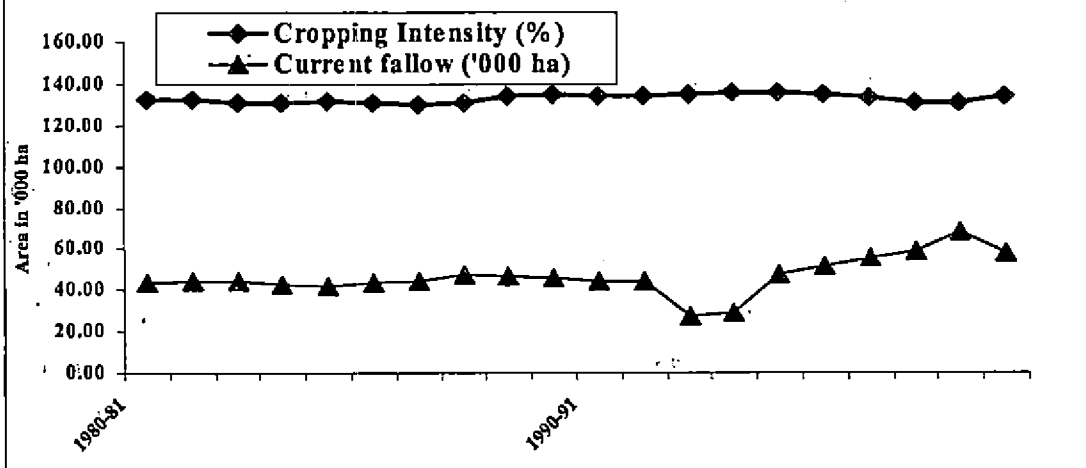

Fig. 3.3. Cropping intensity and current fallow in Kerala

The low growth in cropping intensity is due to a combination of factors. Firstly, the cropping pattern is dominated by perennial crops like coconut, rubber, pepper, cashew etc., which leaves less room for areas sown more than once. Secondly, there is no incentive for more intensive cultivation in view of the unfavorable terms of trade, high wage rate structure and declining relative profitability of major crops (Babu *et al.*, 1993). This may result in increase in the percentage of current fallow.

3.12.3 Current fallow

The area under current fallow has been increasing steadily over the years (Fig.3.3). It has increased from 0.44 lakh ha in 1980-81 to 0.68 lakh ha in 1998-99, and is around 0.58 lakh ha currently. The growth in current fallow is positive and significant during the eighties and nineties but the growth is more pronounced in the nineties.

3.12.4 Acreage ratio of important crops

Acreage ratio refers to the acreage of an individual crop expressed as percentage of the total cropped area. The average ratio of the major crops has been presented in Table 3.12. A perusal of the table indicates that rice, coconut, tapioca, rubber, pepper, banana, ginger and cashew together account for 74.96 per cent of the total cropped area in Kerala during the year 1999-2000. The acreage ratio of rice, tapioca and ginger has been declining continuously while that of coconut, rubber, black pepper and cashew are on the rise. This trend is truly indicative of the changing relative profitability of these crops (Babu *et al.*, 1993 and Babu, 1998). Rice, tapioca and ginger are labour-intensive crops. The high wage rate structure coupled with a highly

Table 3.12. Acreage ratio of important crops in Kerala

Year	Rice	Coconut	Tapioca	Ginger	Banana	Rubber	Pepper	Cashew
1980-81	27.79	22.58	8.49	0.44	1.71	8.24	3.75	4.90
1981-82	27.78	22.95	8.54	0.46	1.72	8.18	3.73	4.82
1982-83	27.20	23.56	7.95	0.44	1.68	8.95	3.76	4.94
1983-84	25.86	23.84	8.14	0.52	1.73	9.48	3.71	4.97
1984-85	25.40	10.00	7.54	0.51	1.79	10.85	3.68	4.76
1985-86	23.67	24.59	7.08	0.55	1.85	11.53	4.24	4.81
1986-87	23.13	24.60	6.72	0.58	1.86	11.94	4.49	4.65
1987-88	20.83	26.74	5.96	0.50	1.94	12.24	5.04	4.19
1988-89	19.49	27.56	5.72	0.48	2.00	12.94	5.30	4.21
1989-90	19.32	29.01	6.81	0.46	1.96	13.13	5.02	4.10
1990-91	18.52	28.81	4.85	0.47	2.17	13.50	5.58	3.83
1991-92	17.92	28.57	4.70	0.51	2.15	13.88	5.89	3.71
1992-93	17.64	28.24	4.43	0.46	2.14	14.07	6.01	3.58
1993-94	16.66	28.98	4.30	0.37	2.37	14.37	6.05	3.51
1994-95	16.50	29.89	4.27	0.46	2.38	14.54	6.14	3.47
1995-96	15.36	29.80	3.70	0.42	2.38	14.64	6.26	3.37
1996-97	14.27	29.86	3.99	0.44	2.39	15.08	6.06	3.21
1997-98	13.04	29.77	4.09	0.42	2.72	15.67	6.06	3.19
1998-99	9.08	22.70	2.90	0.29	2.10	12.10	4.68	2.35
1999-00	11.65	30.81	3.73	0.38	3.07	15.75	6.60	2.97

trade unionized labour force are compelling many farmers to switch over to less labour intensive perennial crops like coconut, rubber, cashew, pepper etc. Here, once the initial establishment of the plantations is over, the involvement of labour is limited to routine maintenance and harvesting only.

3.12.5 Area under irrigation and irrigation intensity

Irrigation has a significant role to play in any agrarian economy through yield increase and yield stabilization impacts. It mitigates the bad effects of dry spells, especially during the summer months. This is truer for all perennial crops where the negative impact of a drought will be carried over to the next 2-3 years, unlike in the case of seasonal and annual crops where the impact will be limited mostly to the corresponding year only.

The net area under irrigation was 285 lakh ha in 1999-2000. The gross area under irrigation has been increasing steadily over the years (Table 3.13 and Fig.3.4). It was 381 lakh ha in 1980-81, and 470.7 lakh ha was brought under irrigation by 1999-2000. The growth rate of gross irrigated area was non-significant during the eighties and the nineties.

Table 3.13. Compound Growth Rate of net and gross irrigated area

(% / annum)

Sl. No.	Particulars	Period from	
		1980-81 to 1989-90	1990-91 to 1999-00
1	Gross irrigated area	0.83^{ns}	1.82^{ns}
2	Intensity of irrigation	0.45^{ns}	0.87^{ns}

ns - non-significant

The irrigation intensity expresses the gross area irrigated as a percentage to the total cropped area. Fig.3.4 reveals that the irrigation intensity has been stagnating around 13-15 per cent of the cropped area during the period of analysis. It meant that more than three fourth of the cultivated area in Kerala are subjected to the vagaries of weather.

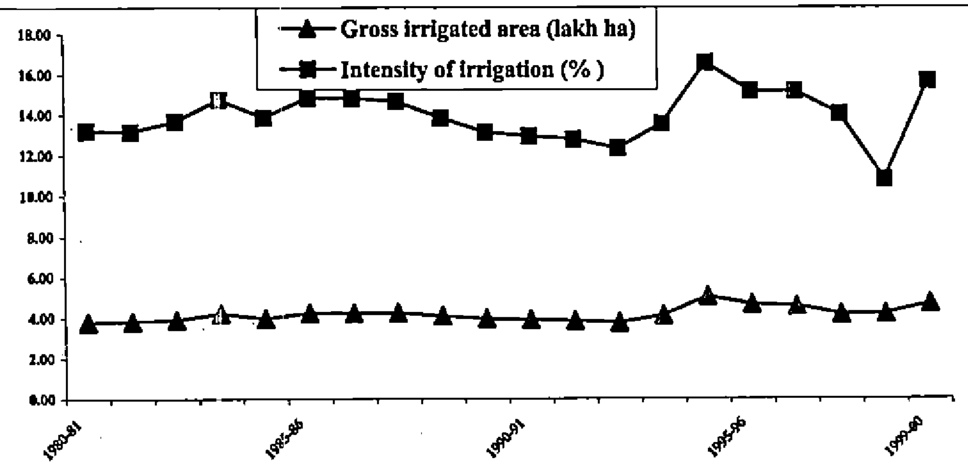

Fig. 3.4. Gross irrigated area and Intensity of irrigation (%) in Kerala

3.12.6 Coverage under high yielding varieties

The coverage under high yielding varieties for rice in Kerala is depicted in Fig.3.5. It can be noted that the area under high yielding varieties is showing considerable year-to-year fluctuations.

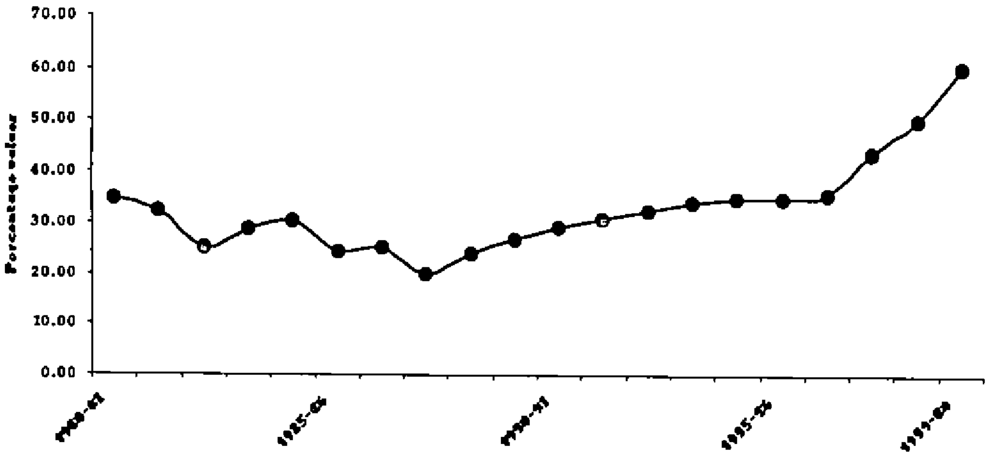

Fig. 3.5. Percentage area under high yielding varities (HYVs) in Kerala

During the year 1980-81, nearly 35 per cent of the rice area was covered by high yielding varieties. By the year 1999-00, 60 per cent of the rice area was under high yielding varieties, indicating that the rice farmers of Kerala are not averse to modern technology.

CHAPTER IV

PRODUCTION CONSTRAINTS

This part presents the production constraints identified in the major production systems of each agro-ecosystem in Kerala, and the economic implications thereof. The state is divided into five agro-climatic zones. They are (i) the Southern Zone (ii) Central Zone (iii) Northern Zone (iv) Hill Area Zone and (v) the Special Zone of Problem Areas.

4.1 Southern Zone

The southern zone comprises of the districts of Thiruvananthapuram, Kollam, Pathanamthitta, Alappuzha and Kottayam with a total geographical area of 6517 km^2, covering 16.8 per cent of the area of the state. The zone has a tropical humid climate with oppressive summer and plentiful seasonal rainfall. Unlike in the other zones of the state, rainfall is comparatively well distributed with the result that the effective annual rainfall is more (80 per cent) than that in the other zones. The annual average rainfall for the zone is 2246 mm. The mean maximum and minimum temperature of the zones are 34.06°C and 21.74°C respectively. The major soil type is laterite, the texture ranging from sand to sandy loam and clay loam. The laterites are in general poor in available nitrogen, phosphorus and potash, and low in bases. The organic matter is also low. The soils are generally acidic with a pH range from 5.0 to 6.2. The major crops of the zone are rice, coconut, tapioca, pepper, cashew, rubber, areca nut etc. (Kerala Agricultural University, 1989a).

Rice production system, coconut production system, and cassava production system were the major production systems studied in the zone.

4.1.1 Rice production system

Rice is the staple food of Kerala and a natural selection as a wetland crop. A single crop system was widely practised in the rain fed areas, from April-May with the onset of South-West monsoon and harvested in September (Ist crop). In the irrigated lands, a double crop system was generally practised, with the first crop season as already mentioned, while the second crop was raised from September-October to January. However, the increasing labour expenses and diminishing relative profitability, irrigated rice production is increasingly becoming a single season affair.

Kollam district, which accounted for 27 per cent of the rice area in the zone, was selected. Poruvazhy, Sooranad (South) and Sooranad (North) villages were selected from

Table 4.1. Cost of Cultivation of paddy in Southern Zone

Sl. No.	Particulars	Rs./ha	As % to total
1	Planting material	695.58	4.35
2	Machinery hiring	2030.79	12.70
3	Male labour	4550.73	28.45
4	Female labour	5447.75	34.06
5	Human labour	9998.49	62.52
6	Organic Manure	1690.81	10.57
7	Chemical fertilizers	1356.66	8.48
8	Plant Protection Chemicals	220.44	1.38
9	Operational Expenses	15992.76	100.00

Kunnathur taluk of the district. Irrigated rice production system in the winter (second) season was the predominant system. The cost of cultivation is presented in Table 4.1.

Rice production is a labour intensive enterprise in the study area, accounting for nearly 63 per cent of the operational expenses. The traditional inputs like human labour, organic manure and seeds together accounted for 77 per cent of the operational expenses, while the modern inputs like chemical fertilizers, machinery and plant protection chemicals had a lesser role in the production system (less than one fourth of the operational expenses), thereby indicating the traditional method of cultivation.

The average grain yield was 2579 kg/ha. The grain yield accounted for 75 per cent of the gross income, while the income from straw was only 25 per cent of the gross income (Table 4.2). Even though the benefit-cost ratio was 1.31, the average farm gate price of Rs.6.50 per kg was only marginally higher than the cost of production of Rs.6.20 per kg. It is indicative of the lower returns to the capital invested and not commensurating with the rigorous supervision required for rice cultivation.

Table 4.2. Average yield, cost of production and BCR of paddy production system in Southern Zone

Sl. No.	Particulars	Quantity
1	Average yield	2579.25 kg/ha
2	Average farm gate price	Rs.6.50/kg
3	Income from grain	Rs.15800.56/ha
4	Income from straw	Rs.5182.99/ha
5	Gross Income	Rs.20983.55/ha
6	Gross Margin	Rs.4990.79/ha
7	Cost of Production	Rs.6.20/kg
8	BCR	1.31

Table 4.3 **Major production constraints in the rice production system and their economic implication for Southern Zone**

Sl.No.	Constraint	Estimated economic loss (Rs./ha)	Estimated economic loss in the zone (million Rs.)	Rank
1	Loss due to labour unavailability	1547.55 (100.00)	99.26	I
2	Loss due to drought at maturity stage	1276.73 (100.00)	81.89	II
3	Loss due to stem borer attack	773.78 (100.00)	49.63	III

Figures in parentheses indicate percentage farmers affected
(Zonal area reckoned at 64140 ha)

The major production constraint experienced was the non-availability of human labour, especially for the harvesting and threshing operations (Table 4.3). Conventionally, these operations were carried out by female labour for kind payment in grains. Consequent to the fall in farm harvest price of paddy, labourers started demanding cash payment for these operations, which was resisted by the farmers. This resulted in delay in harvesting and threshing operations. Ultimately the farmers had to accede to the demand of labourers, and agree to cash payment or settle with kind payment plus additional cash incentives.

The second major constraint experienced was loss in grain yield due to drought, especially in the maturity stages. Though the crop was irrigated, water was not available in sufficient quantity for timely irrigation. Loss due to stem borer attack was the third production limiting constraint. Though the spraying of recommended insecticides prevented further spread of stem borer, the spraying is initiated only after sighting " dead hearts " or " white ear heads ".

4.1.2 Coconut production system

Kerala accounts for nearly 53 per cent of area and 45 per cent of production of coconut in India. Coconut plays a pivotal role in the state economy. It is the major source of edible oil in the state. Coconut is mostly raised under rain fed conditions in the garden lands. The West Cost Tall (WCT) was the most commonly cultivated variety.

Thiruvananthapuram district accounted for 34 per cent of coconut area in the zone; Coconut growers from Kunnathukal, Perumkadavila and Athiyannur villages in Neyyattinkara taluk were selected for the study. The cost of maintenance is presented in Table 4.4.

Table 4.4. Cost of maintenance of coconut in Southern Zone

Sl.No.	Particulars	Rs./Std ha	As % to total
1	Male labour	8132.11	48.50
2	Female labour	0.00	0.00
3	Human labour	8132.11	48.50
4	Organic Manure	6273.68	37.42
5	Chemical Fertilizers	2098.38	12.52
6	Plant Protection Chemicals	261.85	1.56
7	Operational Expenses	16,766.02	100.00

Human labour accounted for nearly 49 per cent of the cost of maintenance of bearing palms. Basin preparation, application of manures and fertilizers, plant protection operations and harvesting were the domain of male labourers, and the involvement of female labourers were nil. The supply of plant nutrients was mostly through organic manures. Expenditure on chemical fertilizers was nominal. Similarly, expenses on plant protection chemicals were also negligible.

Table 4.5. Average yield, cost of production and BCR of coconut production system in Southern Zone

Sl. No.	Particulars	Quantity
1	Average yield	5939.72/std ha
2	Average farm gate price	Rs.4/ nut
3	Income from nuts	Rs.25055.17/ std ha
4	Income from byproducts	Rs.2583.40/ std ha
5	Gross Income	Rs.27638.57/ std ha
6	Gross Margin	Rs.10872.55/ std ha
7	Cost of Production	Rs.2.82/ nut
8	BCR	1.65

The yield was 5940 nuts per standard hectare per year. Income from nuts constituted about 91 per cent of the gross income. The cost of producing one nut was Rs.2.82 while the average farm harvest price fetched was Rs.4/ nut (Table 4.5). There was no processing or value addition. The unhusked nuts were sold mostly to village traders in the primary form.

The major production constraint was the attack of eriophyid mite (Table 4.6). It was a minor pest in coconut in Kerala until 1999-2000. However, it assumed the proportion of a major pest during 1999-2000 and 2000-2001, causing severe damage. The yield loss attributed to this pest during this period is 21.8 per cent of the total production (Coconut Development Board, 2000). Though the pest is brought under control with the use of pesticides, with the active involvement of the local bodies during 1999-2000, the yield has not reached the pre-infestation levels.

Coreid bug attack was the second major production-limiting factor. The attacked buttons do not develop, turning tender nuts barren.The third constraint limiting production was the price fall. Only the negative variations below the average farm harvest price are reckoned as loss due to price fall. About twenty per cent of the farmers did not receive the average farm harvest price.

Table 4.6. Major production constraints in coconut production system and their economic implication for Southern Zone

Sl. No.	Constraint	Estimated economic loss (Rs./ha)	Estimated economic loss in the zone (million Rs.)	Rank
1	Loss due to eriophyid mite	3767.46 (100)	998.98	I
2	Loss due to coreid bug attack	1248.83 (68.89)	331.14	II
3	Loss due to price fall	277.52 (22.22)	73.59	III

Figures in parentheses indicate percentage farmers affected

(Zonal area reckoned at 265160.92 ha)

4.1.3 Cassava production system

Cassava or Tapioca is an important tuber crop of Kerala. Its tubers are utilized as a staple food, or as a vegetable, cattle feed or as a raw material in starch industries. The crop is grown in the State under rain fed conditions. The main planting seasons are April-May with the onset of the South-West monsoon, and September-October with the onset of the North-East monsoon.

Table 4.7. Cost of Cultivation of Cassava in Southern Zone

Sl.No.	Particulars	Rs./ ha	As % to total
1	Planting Materials	1017.60	4.02
2	Male labour	17675.97	69.75
3	Female labour	165.05	0.65
4	Human labour	17841.02	70.40
5	Organic manure	5576.94	22.01
6	Chemical Fertilizers	776.15	3.06
7	Plant Protection Chemicals	129.25	0.51
8	Operational expenses	25340.96	100.00

Thiruvananthapuram district, which accounted for 35 per cent of cassava acreage in the zone, was selected. Respondent farmers from Chengal (South), Chengal (North) and Athiyannur villages of Neyyattinkara taluk who raised cassava as a monocrop were selected. The details of cost of cultivation are presented in Table 4.7. Human labour accounted for 70 per cent of the operational expenses. The cultivation was relied mainly upon organic sources of plant nutrients, which were only supplemented by chemical fertilizers like tapioca mixture. The use of plant protection chemicals was negligible. Whatever used were rodenticides to prepare rat baits.

Table 4.8. Average yield, cost of production and BCR of Cassava production system in Southern Zone

Sl. No.	Particulars	Quantity
1	Average yield	13,589.51 kg/ ha
2	Average farm gate price	Rs.3.50/ kg
3	Gross income	Rs.49062.50/ ha
4	Gross margin	Rs.23721.54/ ha
5	Cost of production	Rs.1.86/ kg
	BCR	1.94

The average yield was very low (13.59 tons/ ha). The cost of production was Rs.1.86/kg of tubers. The average farm gate price during the reference period was Rs.3.50/kg for fresh tubers. This was quite remunerative and offers a benefit cost ratio of 1.94 per rupee invested (Table 4.8).

A major production constraint experienced by the cassava production system was the year-to-year fluctuation of market prices. The tubers were marketed directly to the private traders in the primary form only. There were instances of pre-harvest contracts also. In the absence of processing and value addition facilities, the farmers were operating in an oligopsony market, where a few traders dictated the farm harvest prices. Even though the average farm harvest prices were Rs.3.50/kg, as many as 44.44 per cent farmers received prices less than that level. Such negative deviations only were taken into account while assessing the loss due to price fluctuations (Table 4.9). A perusal of the fluctuations in the average farm harvest price of major crops in Kerala shows that the instability of price of tubers was more in the nineties than in the eighties (Table 4.10). The variability was measured in terms of the coefficient of variation.

Table 4.9. Major production constraints in cassava production system and their economic implication for Southern Zone

Sl. No.	Constraint	Estimated economic loss (Rs./ha)	Estimated economic loss in the zone (million Rs.)	Rank
1	Loss due to price fluctuation	3717.61 (44.44)	274.45	I
2	Loss due to rat attack	2242.32 (100.00)	165.54	II
3	Loss due to mosaic attack	340.44 (57.78)	25.13	III

Figures in parentheses indicate percentage farmers affected
(Zonal area reckoned at 73824 ha)

Table 4.10. Coefficient of variation of average farm harvest price of major crops in Kerala

(per cent)

Sl.No.	Crops	Period from 1980-81 to 1989-90	Period from 1990-91 to 1999-00
1	Paddy	19.03	24.57
2	Tapioca	26.46	30.00
3	Banana	19.18	26.57
4	Coconut	30.43	18.83
5	Black pepper	53.88	75.70
6	Ginger	44.97	37.64

The second major constraint experienced was the loss due to rat attack. Though farmers were using rat-traps and baits, increased menace was experienced due to declining cassava-growing area. This has resulted in cultivation in pockets, thereby causing more concentrated incidence of rat menace in the pockets. The third major constraint was due to the incidence of cassava mosaic. Being a virus, once the incidence is noted, no curative measures become successful. Cassava mosaic results in yield reduction. Secondly, it adversely affects the farmer in another manner. Once a pocket is affected by cassava mosaic, there is no demand for stems as cuttings for the next season. This results in loss of revenue due to non-marketability of stems. The farmers themselves are compelled to look for mosaic free planting materials for the next season from another area by shelling out more money.

4.2 Central Zone

The central zone consists of three central districts of Kerala, viz., Thrissur, Palakkad and Ernakulam, excluding the high ranges, the coastal saline tracts and other isolated pockets like the Kole lands having special soil and physiographic conditions. The geographic area of the zone is 9,73,689 ha, covering 25 per cent of the area of the state.

The zone, being situated on the windward zone of the Western Ghats and falling within the direct sweep of South-West monsoon, receives heavy rainfall. Ernakulam district receives the highest average rainfall (3550 mm), followed by Thrissur (3215 mm). Palakkad district, being located in the Palakkad gap of the Western Ghats, receives only an average of 2115 mm of annual rainfall. However, the landscape of the zone is traversed by six major rivers of the state (Bharatapuzha, Bhavani and Siruvani tributaries of Cauvery, Periyar, Chalakkudy, Karuvannur and Kecheri). They provide good irrigation facilities in the area. It is no wonder that the total area under irrigation in the central zone works out to 61 per cent of the total irrigated area in the state.

The zone is characterized by comparatively heavier rainfall during the South-West monsoon period, leaving in between a dry spell of six months from December to May. The mean maximum and minimum temperatures of the zone are 31.4°C and 21.1°C respectively. The laterites are found in the midland physiographic division of the zone. In the coastal tracts of Thrissur and Ernakulam, the predominant soil type is coastal alluvium, while riverine alluvium occurs along the riverbanks, and brown hydromorphic is confined to the valley bottoms. Black soil is found in Chittur taluk of Palakkad district, as extensions of the black cotton soils of adjoining Coimbatore district. The central zone is the major rice-growing tract of the state and accounts for about 50 per cent of rice in the state. Coconut, areca nut, groundnut, sesamum, banana, cotton, pulses and pineapple are the other important crops of the zone (Kerala Agricultural University, 1989b).

Rice production system, coconut production system, banana production system and pineapple production system were studied in detail in the zone.

4.2.1 Irrigated Rice Production System

The predominant rice culture in the zone is irrigated low land rice. The source of irrigation is canals, diversion channels or ponds. It is mostly transplanted rice. The performance of the crop is highly stable and predictable as compared to rain fed rice.

Palakkad district, the 'rice bowl' of Kerala was selected for the study. Respondent farmers were selected from Alathur, Erumayoor and Kannadi villages of Alathur taluk. The main crop was the autumn (first) season rice, and farmers who had assured irrigation sources take a second crop during the winter season. In the autumn rice, need for irrigation is limited because the crop season is more or less synchronizing with the monsoon season. Early season is dry (April-May), but the later growth period is wet. The cost of cultivation is presented in Table 4.11.

Table 4.11. Cost of Cultivation of Irrigated Rice in the Central Zone

Sl. No.	Particulars	Rs./ ha	As % to total
1	Seed	990.97	7.81
2	Machinery hiring	864.53	6.81
3	Male labour	1343.30	10.59
4	Female labour	6143.29	48.43
5	Human labour	7486.59	59.01
6	Organic manure	99.26	0.78
7	Chemical Fertilizers	2579.70	20.33
8	Plant Protection Chemicals	186.30	1.47
9	Herbicide	149.79	1.18
10	Operational Expenses	12686.06	100.00

Human labour accounted for 59 per cent of the operational expenses. Modern inputs like agricultural machinery, chemical fertilizers, plant protection chemicals and herbicides accounted for 30 per cent of the operational expenses. The supply of plant nutrients was through chemical fertilizers, and there was practically little emphasis on an integrated plant nutrient management system.

The average grain yield works out to 3218 kg/ha. The cost of producing one kilogram of paddy is Rs.3.94, which compares favourably with the average farm gate price of Rs.5.50/kg (Table 4.12). The income from grain accounted for 91.38 per cent of the gross income. The system offers Rs.1.53 per rupee invested.

Table 4.12. Yield, cost of production and BCR of irrigated rice in Central Zone

Sl. No.	Particulars	Quantity
1	Average yield	3217.90 kg/ha
2	Average farm gate price	Rs.5.50/ kg
3	Cost of Production	Rs.3:94/kg
4	Income from grain	Rs.17698.46/ha
5	Income from straw	Rs.1668.89/ha
6	Gross income	Rs.19367.35/ ha
7	Gross margin	Rs.6681.29/ ha
8	BCR	1.53

The major production constraint experienced in the tract was loss due to price fall. The farm gate price of paddy was Rs.750/q during the year 1998-1999. It fell down to Rs.550/q during 2000-2001. This reduced the margin of profit considerably. As high as 42 per cent farmers were affected by the abrupt price fall. The farmers were very critical about the co-operative mills functioning in the area, who should have come forward and procured the produce at the declared support price of Rs.650/q. Instead, they kept away from the market for want of government support, leaving the farmers entirely at the mercy of private millers.

The second major production constraint was the loss due to the non-availability of labour, especially for the harvesting and threshing operations (Table 4.13). Due to its proximity with Tamil Nadu, migrant labourers were more in Palakkad than other rice tracts of Kerala. In spite of this fact the timely availability of labour was a problem. The third constraint was the increasing cost of critical inputs like chemical fertilizers, plant protection chemicals, diesel, kerosene etc. due to decontrol and reduction in subsidies admitted by the government. This resulted in a situation where farmers were compelled to cut down the level of those critical inputs, which adversely affected the grain yield. Though it is in the order of Rs.66.44 per hectare basis, the adverse terms of trade in the farm sector in general, and the imbalance caused by spiraling price of purchased inputs in the face of depression in output prices calls for introspection by all concerned.

Table 4.13. Major production constraints in irrigated rice and their economic implication for the Central Zone

Sl. No.	Constraint	Estimated economic loss (Rs./ha)	Estimated economic loss in the zone (million Rs.)	Rank
1	Loss due to price fall	723.05 (42.22)	72.22	I
2	Loss due to labour unavailability	717.21 (86.67)	71.63	II
3	High price of inputs	66.44 (6.67)	6.64	III

Figures in parentheses indicate percentage farmers affected
(Zonal area reckoned at 99877 ha)

4.2.2 Rain fed Rice Production System

Rain fed low land rice is cultivated in Palakkad district extensively. The first season crop is raised along the onset of monsoon in April-May and harvesting completed by September-October. It is mostly direct seeded rice. A combination of factors likes water logging due to heavy rains, water stress due to seasonal deficit in rainfall and adoption of traditional crop management practices cause low yield during the season.

The details of cost of cultivation are presented in Table 4.14. It can be seen that the mode of cultivation was traditional, with modern inputs like machinery, chemical fertilizers, herbicides and plant protection chemicals accounting for a mere 21 per cent of the operational expenses.

Table 4.14. Cost of Cultivation of Rain fed Rice in Central Zone

Sl. No.	Particulars	Rs./ ha	As % to total
1	Seed	1017.89	7.91
2	Machinery hiring	913.78	7.10
3	Male labour	3668.55	28.51
4	Female labour	5465.44	42.48
5	Human labour	9133.99	70.99
6	Organic manure	24.71	0.19
7	Chemical Fertilizers	1558.41	12.11
8	Herbicide	37.02	0.29
9	Plant Protection Chemicals	180.43	1.40
10	Operational Expenses	12866.23	100.00

Human labour accounted for 71 per cent of the operational expenses. They used a higher seed rate as a risk coping strategy and incurred a higher amount on seed. Similarly, they had economized the expenditure on chemical fertilizers, plant protection chemicals etc.

Table 4.15. Yield, cost of production and BCR of Rain fed Rice in Central Zone

Sl. No.	Particulars	Quantity
1	Average yield	2169.08 kg/ha
2	Average farm gate price	Rs.5.50/ kg
3	Cost of Production	Rs.5.93/kg
4	Income from grain	Rs.11929.92/ha
5	Income from straw	Rs.1458.22/ha
6	Gross income	Rs.13388.14/ ha
7	Gross margin	Rs.521.91/ ha
8	BCR	1.04

Table 4.16. Major production constraints in Rain fed Rice and their economic implication for Central Zone

Sl. No.	Constraint	Estimated economic loss (Rs./ha)	Estimated economic loss in the zone (million Rs.)	Rank
1	Loss due to labour unavailability	425.94 (37.78)	31.04	I
2	Loss due to price fall	241.44 (37.78)	17.59	II
3	Loss due to high price of inputs	52.37 (2.22)	3.82	III

Figures in parentheses indicate percentage farmers affected

(Zonal area reckoned at 72874 ha)

The average grain yield was 2169 kg/ha, which was much lower than the yield levels achieved under the irrigated system (Table 4.15). This is understandable also. The grain yield in rain fed rice tends to be lower, because farmers are tempted to spend less on market purchased modern inputs like chemical fertilizers and pesticides when there is uncertainty about the quantity and timing of rainfall. Instead, they place more thrust on traditional - but time-tested management practices like higher seed rate (or plant population), more labour-intensive cultivation practices etc. This has pushed up the cost of production to Rs.5.93 per kg, and it was higher than the average farm gate price. This has resulted in a low benefit-cost ratio of 1.04 per rupee invested.

The production constraints of the system are presented in Table 4.16. The constraints are same as in irrigated rice. Only the intensity and economic implications differed. The non-availability of human labour affected production more than price fall. This is understandable as the system is more labour intensive than irrigated rice. Loss due to price fall and high price of inputs were the other production limiting factors.

4.2.3 Coconut Production System

Thrissur district accounts for 42 per cent of the coconut grown in the zone.

Table 4.17. Cost of maintenance of coconut in the Central Zone

Sl.No.	Particulars	Rs./ ha	As % to total
1	Male labour	14011.39	73.68
2	Female labour	63.88	0.34
3	Human labour	14075.27	74.01
4	Organic manure	3664.28	19.27
5	Chemical Fertilizers	695.14	3.66
6	Plant Protection Chemicals	373.24	1.96
7	Machinery hiring	209.46	1.10
8	Cost of maintenance	19017.39	100.00

Respondent farmers from Pookkode, Thaikkad and Vadakkekkad villages of Chavakkad taluk were selected. Coconut is mostly cultivated as a rain fed crop in the region. The details of cost of maintenance are presented in Table 4.17. It can be seen that human labour was the main item of expenditure, accounting for nearly 73 per cent of the maintenance cost. The plant nutrients were supplied through organic as well as inorganic sources. The expenditure on plant protection chemicals was less than two per cent of the maintenance cost. The annual average yield was 6746 nuts per standard hectare. The cost of production was Rs.1.94 per nut, which compared favorably with the average farm gate price (Table 4.18). There was hardly any processing in the farm, and the unhusked nuts were disposed as such immediately after the harvest. The benefit-cost ratio was Rs.2.07 per rupee invested.

Table 4.18. Average yield, cost of production and BCR of coconut production system in the Central Zone

Sl. No.	Particulars	Quantity
1	Average yield	9784.47 nuts/ std.ha
2	Average farm gate price	Rs.3.50/ nut
3	Gross income	Rs.39391.48/ std.ha
4	Gross margin	Rs.20374.09/ std.ha
5	Cost of production	Rs.1.94/ nut
6	BCR	2.07

Table 4.19. Major production constraints in coconut and their economic implication for Central Zone

Sl. No.	Constraint	Estimated economic loss (Rs./ha)	Estimated economic loss in the zone (million Rs.)	Rank
1	Loss due to eriophyid mite attack	5485.10 (100.00)	1062.29	I
2	Loss due to price fall	2465.25 (82.22)	477.44	II
3	Loss due to rhinoceros beetle	35.78 (4.44)	6.93	III
4	Loss due to bud rot	30.92 (6.67)	5.93	IV
5	Loss due to stem bleeding	21.50 (6.67)	4.16	V

Figures in parentheses indicate percentage farmers affected

(Zonal area reckoned at 72874 ha)

The major production constraint was the eriophyid mite attack. It affected all the growers (Table 4.19). The loss due to price fall affected 82 per cent growers. Rhinocerous beetle attack, bud rot and stem bleeding were the other production constraints, though the intensity and severity of incidence was low.

4.2.3 Banana production system

Banana is one of the most important fruit crops grown in Kerala. The humid tropical climate with a well-distributed rainfall enables its cultivation through out the state. Both plantains – the culinary types and fruit bananas are grown here, 'Nendran' (AAB group) is the most important variety cultivated in Kerala. It is a dual-purpose variety. It accounts for 45 per cent banana area in the zone. While most clones of banana are grown exclusively as a rain fed crop, '*Nendran*' is grown under irrigated conditions only. It is in high demand for table purpose, as an ingredient of baby food preparations and weaning food, and for chips making.

Thrissur district accounted for 24 per cent of area under *Nendran* banana in the zone. Respondent farmers from Cheruval, Parappukkara and Thottippal villages of Mukundapuram taluk were selected. The details of cost of cultivation are presented in Table 4.20. The cultivation of Nendran banana is capital-intensive (Rs.1.27 lakh per standard ha). Human labour accounted for 52 per cent of the operational expenses. This was followed by expenses on staking material, organic manures and chemical fertilizers in that order.

Table 4.20. Cost of Cultivation of Banana (*Nendran*) in the Central Zone

Sl.No.	Particulars	Rs./Std ha	As % to total
1	Planting material	7888.79	6.21
2	Male labour	65000.00	51.20
3	Female labour	682.11	0.54
4	Human labour	65682.11	51.74
5	Organic manure	21237.41	16.73
6	Chemical Fertilizers	13159.84	10.37
7	Fuel charges for irrigation	989.37	0.78
8	Plant protection chemicals	1359.38	1.07
9	Staking	16641.03	13.11
10	Operational Expenses	126957.93	100.00

The average yield was 25 t/standard hectare. The cost of production was Rs.5.05 per kg. There was considerable seasonal variation in the price ranging from Rs.8-14/ Kg. The prices were high during the festival season of Onam in August-September. During the rest of the period, it remained depressed. However, the crop was highly remunerative as is evident from the gross margin and benefit-cost ratio (Table 4.21). Every one rupee invested in the production system fetched a return of Rs.2.54.

The cultivation of banana was fraught with a number of problems. The most important production constraint was the loss due to price fluctuations and price fall. About twenty nine per cent of farmers were affected by this constraint (Table 4.22).

Table 4.21. Average yield, cost of production and BCR of Banana (*Nendran*) in Central Zone

Sl. No.	Particulars	Quantity
1	Average yield	25,140.00 kg/std ha
2	Average farm gate price	Rs.8-14/ nut
3	Cost of production	Rs.5.05/kg
4	Income from bunches	Rs.3,07,230.46/std ha
5	Income from suckers	Rs.15,820.82/std ha
6	Gross income	Rs.3,23,051.28/std ha
7	Gross margin	Rs.1,96,093.35/std ha
8	BCR	2.54

This was followed by the loss caused by the attack of pseudostem weevil. It is becoming a serious pest in recent times. Adult female weevil punctures and inserts eggs into the pseudostem. Grubs emerging out feeds extensively on the pseudostem, which results in drooping of the entire plant. There is only an ad hoc recommendation to control the pest in the Package of Practices, Recommendations-Crops (Kerala Agricultural University, 2002). According to the farmers, this is not effective.

Table 4.22. Major production constraints in Nendran banana and their economic implication for Central Zone

Sl.No.	Constraint	Estimated economic loss (Rs./std.ha)	Estimated economic loss in the zone (million Rs.)	Rank
1	Loss due to price fluctuations	5864.20 (28.89)	143.68	I
2	Loss due to pseudostem weevil attack	2156.78 (97.78)	52.85	II
3	Loss due to wind	1292.90 (57.78)	31.68	III
4	Loss due to Fe / Al toxicity	1151.96 (40.00)	28.23	IV
5	Loss due to bunchy top	763.11 (40.00)	18.70	V

Figures in parentheses indicate percentage farmers affected

(Zonal area reckoned at 24502 ha)

The next constraint is damage caused due to wind. There is crop insurance; but at present the coverage is only to crop loanees. Farmers who do not avail loans from commercial banks or co-operatives cannot have insurance coverage. Being raised mostly in the tropical humid low lands, iron and aluminium toxicity is causing considerable damage. It affected 40 per cent of banana growers. There is an information gap with the farmers in identifying the iron and aluminium toxicity problem. This is a priority area to be addressed. Bunchy top disease is also causing economic loss. Being a viral disease, once the symptoms appear, rouging out and destroying the diseased plants and control of the vector to protect non-affected plants are the only options available.

4.2.4 Pineapple production system

Pineapple is grown mostly at low elevations in areas with a temperature range of 15-30°C. It can be grown in a wide range of soils, but they do not tolerate water logging. The unique fruit qualities and high productivity under marginal conditions make pineapple cultivation a commercially important proposition.

Ernakulam district accounts for 92 per cent of pineapple area of the zone. Vazhakkulam region in Muvattupuzha taluk is fast emerging as a major pineapple-growing tract of Kerala. Ayavana, Manjallor and Kallurkad villages of Muvattupuzha taluk were selected. Pineapple was grown either as a pure crop on plantation scale or as an intercrop in coconut gardens. The variety 'Mauritius' was the most popular variety grown. It was ideal for table purpose. The cost of establishing one hectare of pineapple as pure crop is presented in Table 4.23.

Table 4.23. Cost of establishment of pineapple (pure crop) in the first year in Central Zone

Sl. No.	Particulars	Rs./ ha	As % to total
1	Planting materials	36507.03	43.25
2	Male labour	12956.87	15.35
3	Female labour	786.90	0.93
4	Human labour	13743.77	16.28
5	Organic manure	3419.81	4.05
6	Chemical Fertilizers	29929.52	35.46
7	Plant Protection Chemicals	121.62	0.14
8	Herbicides	521.92	0.62
9	Flowering hormones	160.16	0.19
10	Total establishment cost	84403.83	100.00

As the crop was ratooned for two years, the conventional economic analysis was not realistic. The cash flow statement of the pure crop is shown in Table 4.24. The initial investments were recovered within one year. The net present value was Rs.3.10 lakhs per ha with a benefit cost ratio of 3.35. The internal rate of return was more than 50 per cent.

As an intercrop, the initial investments were less. So is the net present value of the investment (Table 4.25). Even though the initial investments were recovered in one year, the benefit cost ratio was lower (2.46).

The major production constraints of the crop in the zone are presented in Table 4.26. There were violent fluctuations in the price of pineapple from year to year and also within a year. For example, the price fluctuated from Rs.7.50/ kg in November-December 2000 to Rs.3.50/ kg in June 2001. This inter-year and intra-year fluctuation in the price of output was causing maximum damage to the farmers. The second major production constraint was the incidence of heart rot. Though it affected only 22 per cent of growers, the damage caused is heavy. There is no effective remedy for the disease. Water stagnation predisposes the plant to heart rot incidence and lack of drainage in low lands aggravates the damage. Another problem related with water stagnation is the high incidence of root rot. There were many cases of farmers growing pineapple in the wetland being devastated by the increased incidence of root and fruit rot. These two problems were considerably less in the garden land crop. There was no recommendation in the Package of Practices, Recommendations (Crops) for the control of fruit and root rot. The drenching of 1 per cent Bordeaux mixture, or 2 per cent zineb / mancozeb / ziram is being recommended now (Kerala Agricultural University, 2002). The farmers do not view this a cost-effective measure. The third major problem was the non-availability of labour at critical periods, especially for weeding and harvesting. The labourers are averse to work as the serrated leaves of pineapple may cause injury or irritation, and as high as 96 per cent farmers complained that they had to shell out extra wage as an additional incentive to carry out these operations in time. Incidence of mealy bug was a minor problem, affecting less number of farmers. The damage caused was also not serious.

Table 4.24. Cash flow analysis of pineapple cultivation (Pure crop) in Central Zone

Year	Capital Investment	Operation & Maintenance cost	Cash outflow	Cash inflow	Cash flow	Discount factor (12%)	Discounted cash outflow	Discounted cash inflow	Discounted cashflow
1	35449.61	48954.22	84404.83	148010.50	63606.71	0.8929	75360.56	132152.27	56791.71
2	0.00	37953.62	37953.62	280912.80	242959.20	0.7972	30256.39	223941.95	193685.55
3	0.00	37192.62	37192.62	121332.50	84139.88	0.7118	26472.97	86362.08	59889.10
						Total	**132089.93**	**442456.93**	**310366.36**

Pay back period - 1 year Net present value - Rs.3, 10,366.66

BCR - 3.35 IRR > 50%

Table 4.25. Cash flow analysis of pineapple cultivation (Inter crop) in Central Zone

Year	Capital Investment	Operation & Maintenance cost	Cash outflow	Cash inflow	Cash flow	Discount factor (12%)	Discounted cash outflow	Discounted cash inflow	Discounted cashflow
1	19994.47	38812.79	58807.26	105762.20	46954.96	0.8929	52506.48	94430.55	41924.07
2	0.00	27129.64	27129.64	98840.12	71710.48	0.7972	21627.58	78794.74	57167.16
3	0.00	37759.26	37759.26	105268.70	67509.40	0.7118	26876.30	74928.15	48051.86
						Total	**101010.36**	**248153.45**	**147143.08**

Pay back period - 1 year Net present value - Rs.1, 47,143.08

BCR - 2.46 IRR>50

Table 4.26. **Major production constraints in pineapple and their economic implication for Central Zone**

Sl.No.	Constraint	Estimated economic loss (Rs./ha)	Estimated economic loss in the zone (million Rs.)	Rank
1	Loss due to price fluctuations	5297.12 (55.56)	29.19	I
2	Loss due to heart rot	2851.07 (22.22)	15.71	II
3	Loss due to non-availability of labour at critical periods	725.45 (95.56)	3.99	III
4	Loss due to root rot	603.26 (6.67)	3.32	IV
5	Loss due to water stagnation	390.16 (24.44)	2.15	V
6	Loss due to mealy bug attack	135.71 (8.89)	0.75	VI

Figures in parentheses indicate percentage farmers affected
(Zonal area reckoned at 5510 ha)

4.3 Northern Zone

This zone consists of the four northern districts of Kerala, namely, Kasargod, Kannur, Kozhikode and Malappuram. It has a geographical area of 10,94,600 ha covering 28.2 per cent of the area of the state. The zone lies sandwiched between the Western Ghats in the east and the Arabian Sea in the west, presenting a series of hills and valleys intersected by rivers and streams.

The annual average rainfall for the zone is 3378 mm. Although the zone is endowed with plentiful rainfall, a prolonged dry spell of five to six month's duration occurs every year from December to May. Moisture stress experienced during this period affects the growth and production of perennial crops like coconut, areca nut and pepper. The mean maximum and minimum temperatures of the zone are 33°C and 23°C respectively. Being located in a pedogenic environment highly conducive for laterisation, more than 75 per cent of the zone is occupied by laterites and associated soils. The agricultural potential of these soils is very low. Rice in the wetlands, and coconut, cashew, cassava, rubber, areca nut and pepper are the important crops of the zone (Kerala Agricultural University, 1989c).

4.3.1 Rice Production system

Malappuram district accounted for 46.72 per cent of the rice area in the zone. Eranadu, Thonnala and Vengara villages of Tirurangadi taluk were selected for the study. Winter (second) season paddy is the predominant production system, and it accounted for 61 per cent area and 58.34 per cent rice production in the district.

The details of the cost of cultivation are presented in Table 4.27. The district has the maximum migrants to the Middle East (Gulf) countries. Therefore, the system of leasing was very prevalent. Unemployed youth and agricultural labourers were the tenants. Rent for leased land accounted for 41 per cent of the operational expenses. Human labour constituted 32 per cent of the operational expenses. There was less reliance on organic manures, and plant nutrient needs were met mainly through the application of chemical fertilizers.

Table 4.27. Cost of cultivation of rice in Northern Zone

Sl.No.	Particulars	Rs./ ha	As % to total
1	Seed	678.32	3.64
2	Machinery hiring	670.04	3.59
3	Male labour	3020.80	16.21
4	Female labour	2949.40	15.82
5	Human labour	5970.20	32.03
6	Organic manures	1037.53	5.57
7	Chemical Fertilizers	2453.79	13.16
8	Plant Protection Chemicals	261.88	1.41
9	Rent for leased land	7567.28	40.60
10	Operational expenses	18639.04	100.00

The average grain yield was 3325 kg/ha. The cost of producing one kilogram of paddy was Rs.5.40, which was a close to the average farm gate price of Rs.5.50/kg. The income from grain was 77 per cent of the gross income (Table 4.28). The benefit cost ratio of the production system worked out to 1.22 per rupee invested.

Table 4.28. Average yield, cost of production and BCR of rice production in Northern Zone

Sl. No.	Particulars	Quantity
1	Average yield	3324.79 kg/ha
2	Average farm gate price	Rs.5.50/kg
3	Cost of production	Rs.5.40/kg
4	Income from grain	Rs.17582.94/ha
5	Income from straw	Rs.5248.24/ha
6	Gross income	Rs.22831.18/ha
7	Gross margin	Rs.4192.14/ha
8	BCR	1.22

The major production constraints of the system are presented in Table 4.29. Drought at the maturity stage was the most significant one. Eighty per cent rice farmers were affected by the constraint. The loss due to the non-availability of human labour at the harvesting and threshing time was the second major constraint. It affected 51 per cent farmers. Private contractors were supplying harvesters on custom hiring basis. They were brought mostly from Tamil Nadu and designed for the uplands. Harvesters suitable for the wetlands were not available. Loss due to stem borer and leaf roller attack were the other production limiting constraints.

Table 4. 29. Major production constraints in rice and their economic implication for Northern Zone

Sl.No.	Constraint	Estimated economic loss (Rs./ha)	Estimated economic loss in the zone (million Rs.)	Rank
1	Loss due to drought at maturity stage	10495.91 (80.00)	361.72	I
2	Loss due to unavailability of labour for harvesting and threshing	848.94 (51.10)	29.26	II
3	Loss due to stem borer attack	368.16 (44.44)	12.69	III
4	Loss due to leaf roller attack	108.83 (28.89)	3.75	IV

Figures in parentheses indicate percentage farmers affected

(Zonal area reckoned at 34463 ha)

4.3.2 Coconut production system

Kozhikode district is the major coconut producing area of the zone, accounting for nearly 34 per cent of the total coconut area. Kavilumpara, Maruthongara and Narippatta villages of

Badakara taluk were selected. Coconut was raised mostly under the rain fed condition. The details of cost of maintenance of the system are presented in Table 4.30. Human labour accounted for 45 per cent of the maintenance cost. Plant nutrients were mainly supplied through organic manures. It accounted for nearly 52 per cent of the maintenance cost. Chemical fertilizers were applied only to supplement the organic manures. There were hardly any expenses on plant protection operations.

The average productivity of the production system was 8347 nuts per year per standard hectare. The higher productivity could enable cost effective production. The cost of producing one nut was Rs.2.18, which compared quite favorably with the average farm harvest price (Table 4.31).

Table 4. 30. Cost of maintenance of coconut production system in Northern Zone

Sl.No.	Particulars	Rs./ ha	As % to total
1	Male labour	8251.93	45.32
2	Female labour	0.00	0.00
3	Human labour	8251.93	45.32
4	Organic manure	9407.46	51.67
5	Chemical Fertilizers	511.12	2.81
6	Plant protection chemicals	36.63	0.20
7	Maintenance cost	18207.14	100.00

Table 4.31. Average yield, cost of production and BCR of coconut production system in Northern Zone

Sl. No.	Particulars	Quantity
1	Average yield	8346.75 nuts/std ha
2	Average farm gate price	Rs.4/nut
3	Gross income	Rs.33356.98/std ha
4	Gross Margin	Rs.15149.84/std ha
5	Cost of production	Rs.2.18/nut
6	BCR	1.83

Table 4.32. Major production constraints in coconut production system and their economic implication for Northern Zone

Sl.No.	Constraint	Estimated economic loss (Rs./ha)	Estimated economic loss in the zone (million Rs.)	Rank
1	Loss due to eriophyid mite attack	2272.33 (100.00)	863.50	I
2	Loss due to bud rot disease	227.57 (40.00)	86.48	II
3	Loss due to stem bleeding	77.44 (13.00)	29.43	III

Figures in parentheses indicate percentage farmers affected
(Zonal area reckoned at 3,80,008 ha)

The major production constraint of the system was eriophyid mite attack (Table 4.32). It affected all the growers of the study area. The next important production-limiting factor was bud rot disease. Forty per cent farmers reported the disease-affected palms. Stem bleeding also affected production and subsequent loss of palms, though its incidence was not widespread.

None of the farmers reported loss on account of price fall or fluctuations. The average farm harvest price of Rs.4/nut was relatively higher than the other parts of the state. This along with cost effective production enabled farmers to sustain production without loss.

4.3.3 Cashew production system

The Portugese introduced cashew into India in the 16th century as a crop for soil conservation. Even now, it is considered as a crop for wasteland development and afforestation, with the result that it is "grown" in the marginal lands and not "scientifically cultivated". It has the label of a "lazy man's crop".

In Northern zone, cashew is grown extensively in the coastal lands and laterites not suitable for other crops. Kannur and Kasargode districts account for 78 per cent of cashew area in the zone, out of which 44 per cent acreage is in Kannur district. Chengali, Irikkur and Kurumathur villages from Taliparamba taluk formed the study area. The details of maintenance cost are presented in Table 4.33. Once the crop gets established, farmers collect the fallen apple along the nuts, and remove the nuts manually from apple. The nuts are then sold with or without drying. Female labour and children are being utilized for this purpose, mostly on contract basis. That explains why female labour accounted for 96 per cent of the maintenance cost. Very few farmers applied modern production inputs like chemical fertilizers. The farmers were traditionally not using plant protection measures due to operational reasons and because of the fact that cashew was a 'lazy man's crop'. The controversy on the use of 'endosulfan' for the control of tea mosquito has added further reluctance to this. It is thus necessary to educate the farmers on the benefits of resorting to integrated pest management (IPM) practices, with organic pesticides. This is both a technology as well as extension constraint.

Table 4.33. Cost of maintenance of cashew in Northern Zone

Sl. No.	Particulars	Rs./ ha	As % to total
1	Male labour	0.00	0.00
2	Female labour	13751.11	95.91
3	Human labour	13751.11	95.91
4	Organic manures	178.41	1.24
5	Chemical Fertilizers	408.37	2.85
6	Plant protection chemicals	0.00	0.00
7	Maintenance cost	14337.89	100.00

The average yield realized was 725 kg/ha, which is quite low. The cost of maintenance of producing one kilogram of cashew nut is Rs.19.79, which fetched Rs.30/- per kg at the farm gate (Table 4.34). The benefit-cost ratio of the production system was Rs.1.52 per rupee invested.

Table 4.34. Average yield, cost of production and BCR of cashew production system in Northern Zone

Sl. No.	Particulars	Quantity
1	Average yield	724.48 kg/ha
2	Average farm gate price	Rs.30/kg
3	Gross income	Rs.21734.42/ha
4	Gross Margin	Rs.7396.53/ha
5	Cost of production	Rs.19.79/kg
6	BCR	1.52

The major production constraint was the loss caused by tea mosquito bug attack. This accelerated subsequent inflorescence blight by *colletotrichum* infestation. The pest appears during the flushing and emergence of panicle. It causes drying of inflorescence and die back of the shoot. Hence, the damage is severe (Table 4.35). This pest affected about 40 per cent of the plantations. The next problem was the damage caused by stem borer attack. The pest causes yellowing of leaves, drying of twigs and the presence of holes at the base of stem with exuding sap. It ultimately destroys the tree. Every respondent farmer reported loss due to stem borer attack. However, the extensity was low. There is at present an ad-hoc recommendation only for its control (Kerala Agricultural University, 2002).

Table 4.35. Major production constraints in cashew production system and their economic implication for Northern Zone

Sl. No.	Constraint	Estimated economic loss (Rs./ha)	Estimated economic loss in the zone (million Rs.)	Rank
1	Loss due to tea mosquito bug attack and inflorescence blight	1194.78 (40.00)	75.62	I
2.	Loss due to stem borer attack	824.75 (95.56)	52.20	II

Figures in parentheses indicate percentage farmers affected
(Zonal area reckoned at 63293 ha)

4.4. High Range Zone

The High Range zone is a sub-region of the Western Ghats. The climate prevailing in this zone is largely mild subtropical. The High Range zone comprises of the district of Wynad and Idukki, the Nelliampathy and Attappady hill ranges of Palakkad district, Thannithode and Seethathode panchayats of Pathanamthitta district, Ariyankavu, Kulathupuzha and Thenmala panchayats of Pathanapuram taluk in Kollam district and Peringanmala, Aryanad and Vithura panchayats of Nedumangad taluk as well as Kallikad and Amboori panchayats of Neyyattinkara taluk in Thiruvananthapuram district. The total geographical area of the zone is 11,14,067 ha, covering 28.67 per cent of the area of the state.

The Wynad and Idukki ranges are the major high ranges of the zone. The Wynad range is situated at an elevation of 700 to 2100 m above MSL. The average annual rainfall is 3966.6 mm. The region receives heavy rainfall during the South-West monsoon during the period from June to September. Dry spell occurs during December to March. The mean maximum and minimum temperatures are 29.6°C and 19.6°C respectively. The soil type is forest loam, characterized by a surface layer of humus and other organic matter at various stages of decomposition. This region is famous for plantation crops and spices (Kerala Agricultural University, 1991).

Idukki range is situated at an elevation of 800 to 1100 m above MSL. The tract receives both South-West and North-East monsoon rains. The average annual rainfall is 3375 mm. Very heavy rainfall occurs during the months of June, July and August, while the rainfall is very low during December to March. The period from November to January is the coldest period, when the minimum temperature ranges between 10 °C and 15 °C. Two types of soils, viz., forest loam and laterite are seen mainly in the tract. Coffee, cardamom, pepper, tea, coconut, areca nut are the important crops grown (Kerala Agricultural University, 1991).

4.4.1 *Rice Production System*

Wynad district accounted for 82 per cent of the total rice area in the zone. Unlike other areas in the State, the High Range has only two rice growing seasons of about 5-6 months due to low maximum and minimum temperature prevailing through out the year. This is locally known as *Nanja* (Ist crop) and *Punja* (2 nd crop).

Table 4.36. Cost of Cultivation of rice in the High Range Zone

Sl. No.	Particulars	Rs./ ha	As % to total
1	Seed	766.16	3.77
2	Machinery hiring	3293.71	16.19
3	Male labour	6406.23	31.49
4	Female labour	4089.28	20.19
5	Human labour	10495.51	51.58
6	Organic manures	4111.99	20.21
7	Chemical Fertilizers	1521.98	7.48
8	Plant protection chemicals	157.20	0.77
9	Operational Expenses	20346.55	100.00

First crop paddy accounted for nearly 78 per cent of the rice cultivated in the district. The balance area is under second crop. Respondent farmers belonged to the Ambalavayal, Sultan Battery and Purakkadi villages of Sultan Battery taluk. The input-wise cost of cultivation is presented in Table 4.36. Traditional inputs like human labour, seed and organic manures accounted for 75.56 per cent of the operational expense. Human labour constituted 52 per cent of the operational expense. Modem inputs like machinery, chemical fertilizers and plant protection chemicals formed 24.44 per cent of the operational expense. The operational expense of Rs.20347/ha is one of the highest for traditional rice production.

Table 4.37. Average yield, cost of production and BCR of rice production system in the High Range Zone

Sl. No.	Particulars	Quantity
1	Average yield	3354.46 kg/ha
2	Average farm gate price	Rs.6.50/kg
3	Cost of production	Rs.6.11/kg
4	Income from grain	Rs.21746.96/ha
5	Income from straw	Rs.4191.76/ha
6	Gross income	Rs.25,938.72/ha
7	Gross Margin	Rs.5454.82/ha
8	BCR	1.27

The average productivity of the system was 3355 kg/ha. The cost of producing one kilogram of paddy worked out to Rs.6.11. The average farm gate price was very close at Rs.6.50/kg (Table 4.37). It was obviously the high productivity and less incidence of pest/disease that enabled the farmers to have a favourable benefit-cost ratio of 1.27 per rupee invested.

Table 4.38. Major production constraints in the rice production system and their economic implication for the High Range Zone

Sl.No.	Constraint	Estimated economic loss (Rs./ha)	Estimated economic loss in the zone (million Rs.)	Rank
1	Loss due to leaf roller attack	57.26 (24.44)	0.92	I
2	Damage due to nematode	36.72 (13.33)	0.59	II
3	Loss due to blast	36.61 (6.67)	0.58	III

Figures in parentheses indicate percentage farmers affected
(Zonal area reckoned at 16105 ha)

The major production constraint of the system was loss due to leaf roller attack. This was followed by loss due to nematode and blast attack (Table 4.38). However, the severity was low, and hence it resulted in less economic loss.

4.4.2 Pepper production system

Pepper (*Piper nigrum*) is a native of wet tropical forests and its centre of origin is in the Western Ghats of India. It is the "king of spices", and Kerala history is chequered by the lure of pepper trade by the Arabs, Portuguese, Dutch, French and the English traders. Kerala continues to be a leading producer of black pepper in India. The "Spice districts" of Kerala are Wynad and Idukki. Idukki district accounts for 57 per cent of area under pepper in the zone. Respondent farmers belonged to Kalkundal, Pampadumpara and Parathode villages of Udumbanchola taluk. The details of maintenance cost are presented in Table 4.39. Nearly half of the maintenance cost was incurred on human labour. It was mostly male labour. Black pepper vines require support (known as standards) for their establishment. Both living and non-living standards can be used to trail pepper vines. However, a variety of forestry species are used as standards in Kerala. Male labourers can have the advantage of carrying out the interculture and harvest operations under such mode of cultivation easily. Hence, the involvement of female labour is nil. It was mostly cultivated organically with minimum use of chemical fertilizers and plant protection chemicals.

Pepper has been a traditional component of India's export basket. As the soil fertility status of the forest loam soil is high, use of chemical fertilizers etc. was low.

Table 4.39. Cost of maintenance of black pepper in the High Range Zone

Sl. No.	Particulars	Rs./ Std ha	As % to total
1	Male labour	8198.81	49.59
2	Female labour	0.00	0.00
3	Human labour	8198.81	49.59
4	Organic manure	6090.23	36.84
5	Chemical Fertilizers	647.92	3.92
6	Plant protection chemicals	1596.62	9.66
7	Maintenance cost	16533.58	100.00

The average yield was just 444 kg/ha (Table 4.40). The cost of production worked out to Rs.37.22/kg, which compared well with the average farm harvest price of Rs.80/kg. A major problem of the pepper economy was that as it was an export-oriented crop, all the distortions and fluctuations of the international market was carried forward to the domestic market. Hence, there were violent inter-year and intra year price fluctuations. For instance, the average farm harvest price of black pepper was Rs.66/kg during 1994-95. It increased to Rs.88/kg during 1996-97, and it soared to Rs.174/kg and Rs.180/kg and Rs.205 kg during 1997-98, 1998-99 and 1999-2000 respectively. During the year 2000-2001, it fell down to Rs.80/kg. The instability of price was as high as 76 per cent in the nineties (Table 4.10). The benefit-cost ratio worked out to 2.02 per rupee invested.

Table 4.40. Average yield, cost of production and BCR of pepper production system in the High Range Zone

Sl. No.	Particulars	Quantity
1	Average yield	Rs.444.27/ std ha
2	Average farm gate price	Rs.80/kg
3	Gross income	Rs.33414.87/ std ha
4	Gross margin	Rs.16881.29/ std ha
5	Cost of production	Rs.37.22/kg
6	BCR	2.02

Table 4.41. Major production constraints in the pepper production system and their economic implication for High Range Zone

Sl.No.	Constraint	Estimated economic loss (Rs./ha)	Estimated economic loss in the zone (million Rs.)	Rank
1	Loss due to price fall	2906.12 (48.89)	2702.85	I
2	Loss due to slow wilt	789.81 (86.67)	73.60	II
3	Loss due to drought	481.64 (84.44)	44.88	III
4	Loss due to wind	341.96 (57.78)	31.86	IV
5	Loss due to quick wilt	136.53 (31.11)	12.72	V
6	Loss due to mealy bug	24.53 (4.44)	2.29	VI

Figures in parentheses indicate percentage farmers affected
(Zonal area reckoned at 93182 ha)

The maximum damage to the production system was caused by the violent price fluctuations (Table 4.41). The slow wilt disease caused second major loss. It affected 87 per cent plantations. The symptoms become pronounced during water stress. As the crop was raised mostly under rain fed conditions, it was subjected to periodic droughts, which adversely affected the plantations. Unlike annual crops, here the adverse effect had a prolonged influence into the future. The occasional winds and gale caused damage to standards and vines. Though loss due to wind is insurable, at present the benefit of insurance is extended only to those farmers who avail crop loan. Quick wilt is now brought under control. Mealy bug attack caused sporadic loss only.

4.4.3 Ginger production system

Ginger (*Zingiber officinale*) is indigenous to tropical India. It is a major spice being used for the treatment of stomach disorders and rheumatism. Dried ginger was traded from India via Arabia to the Middle East. Wynad district accounts for 77 per cent of ginger area in the zone. Respondent farmers were selected from Ambalavayal, Purakkadi and Sultan Battery villages of Sultan Battery taluk.

Table 4.42. Cost of cultivation of ginger in High Range Zone

Sl. No.	Particulars	Rs./ ha	As % to total
1	Planting material	18975.46	35.00
2	Machinery hiring	354.77	0.65
3	Male labour	14705.25	27.13
4	Female labour	5472.67	10.10
5	Human labour	20177.92	37.22
6	Organic manure	9974.81	18.40
7	Chemical Fertilizers	3731.59	6.88
8	Plant protection chemicals	996.26	1.84
9	Operational Expense	54210.81	100.00

The input-wise cost of cultivation is presented in Table 4.42. Human labour accounted for 37 per cent of the operational expense. Expenses on machinery hiring closely followed this. Tractor or tiller was hired widely for the land preparation. Plant nutrients were supplied mainly through organic manures, which were supplemented by chemical fertilizers. The cultivation was labour as well as capital intensive.

Table 4.43. Average yield, cost of production and BCR of ginger production system in High Range Zone

Sl. No.	Particulars	Quantity
1	Average yield	7401.93 kg/ha
2	Average farm gate price	Rs.8.33/kg
3	Gross income	Rs.62,373.15/ha
4	Gross margin	Rs.8162.34/ha
5	Cost of production	Rs.7.32/kg
6	BCR	1.15

The average productivity of the system was 7402 kg/ha. The cost of producing one kilogram of rhizome was Rs.7.32 (Table 4.43). The problem of price fluctuation, which was applicable to pepper, is evident here also. For example, one kilogram of ginger fetched Rs.22/kg during 1990-91. It soared up to Rs.52.50/kg in 1994-95 and Rs.64/kg in 1999-2000. However, the farm gate price during 2000-2001 crashed to Rs.8.33/kg. The instability in the average farm harvest price of ginger in Kerala was 45 per cent in the eighties, and 38 per cent in the nineties. The benefit-cost ratio of the system was 1.15 per rupee invested.

The crop suffered from heavy incidence of bacterial wilt. It affected 91 per cent growers (Table 4.44). As it is caused by soil-borne, vascular wilt pathogen, the multiplication and spread is very fast. This, along with the price crash has left a devastating effect on most ginger farmers in the zone.

Table 4.44. Major production constraints in the ginger production system and their economic implications for the High Range Zone

Sl.No.	Constraint	Estimated economic loss (Rs./ha)	Estimated economic loss in the zone (million Rs.)	Rank
1	Loss due to bacterial wilt	9029.35 (91.11)	69.06	I
2	Loss due to price fall	2461.86 (35.56)	18.83	II

Figures in parentheses indicate percentage farmers affected
(Zonal area reckoned at 7648 ha)

4.5 Special Zone of Problem Area

The zone as a whole lies in the physiographic division "low land", and is divided into four major geographical tracts. They are (i) Onattukara (722 km^2), (ii) Kuttanad (1078 km^2), (iii) Pokkali (840 km^2) and the Kole lands (2614 km^2) (Kerala Agricultural University, 1989d). The zone enjoys a humid tropical climate without any change in the seasons. The average annual rainfall is 3000 mm, out of which 42.2 per cent is received during the South-West monsoon during June-September. The high intensity of rainfall during this period along with the low altitude results in heavy floods during the autumn season and drought during the later period of winter season. The maximum temperature in the zone varies from 30°-36°C. The minimum temperature falls within a range of 21°-25°C. The major crops grown in the zone are rice in the low land, and coconut, areca nut, banana, sesamum, tapioca and vegetables in the upland (Kerala Agricultural University, 1989d).

4.5.1 Rice production system in the Kuttanadu region

The Kuttanadu region is a unique wetland ecosystem in the world. It comprises of the low-lying lands and the backwater areas spread over Alapuzha, Kottayam and Pathanamthitta districts. A good portion of this area lies at a level of 1.0 to 2.5 m below mean sea level (MSL), and is submerged for the major part of the year. On the Western side, Kuttanadu is separated from the Arabian Sea by a narrow strip of land. Kuttanadu is a sedimentary formation, shaped by the confluence of four major rivers, viz., the Achan Kovil, Meenachil, Manimala and Pampa, which drain into the Vembanad Lake.

Table 4.45. Cost of cultivation of summer rice in Kuttanad region

Sl. No.	Particulars	Rs./ ha	As % to total
1	Seed	1571.30	8.38
2	Machinery hiring	1376.88	7.34
3	Male labour	2405.87	12.83
4	Female labour	9576.83	51.07
5	Human labour	11982.70	63.90
6	Organic manure	0.00	0.00
7	Chemical Fertilizers	3196.78	17.05
8	Herbicides	203.41	1.08
9	Plant protection chemicals	421.46	2.25
10	Operational Expense	18752.53	100.00

The area is susceptible to seasonal ingress of saline water as a result of tidal inflow from the sea. Hence, the soils of Kuttanad are faced with serious problems of hydrology, floods, acidity and salinity. They are typical waterlogged soils. Summer (III season) rice is the major crop, cultivated from September-October to January-February. An additional crop of rice is raised during the first season from April-May to August-September in the *kayal* lands, representing deeper soils. Respondent farmers were selected from Champakkulam, Nedumudy and Ramankary villages of Kuttanadu taluk. The input wise expenditure is furnished in Table 4.45. Sixty four per cent of the operation expense was accounted by human labour. Modern production inputs like seed, machinery, chemical fertilizers, herbicides and plant protection chemicals constituted nearly 36 per cent of the operational expense.

Table 4.46. Average yield, cost of production and BCR of summer rice production system in Kuttanad Region

Sl. No.	Particulars	Quantity
1	Average yield	4545.56 kg/ha
2	Average farm gate price	Rs.6.50/kg
3	Cost of production	Rs.4.13/kg
4	Income from grain	Rs.28202.94/ha
5	Income from straw	Rs.2836.93/ha
6	Gross income	Rs.31039.97/ha
7	Gross margin	Rs.12287.34/ha
8	BCR	1.66

The average productivity of the system was 4546 kg/ha. The cost of production worked out to Rs.4.13/kg, which left a reasonable margin at the average farm harvest price of Rs.6.50/kg.

Income from grain yield formed 90.86 per cent of the gross income. The benefit-cost ratio of the system was 1.66 per rupee invested (Table 4.46). The farmers viewed this return low, considering the risk involved in the cultivation of summer rice in the peculiar agro-climate.

The major constraint affecting production was the non-availability of labour, especially for harvesting and threshing. Reluctance on the part of the agricultural labourers to conduct these two operations on kind payment alone was emphatic. Farmers had to shell out additional cash incentives and food to complete these operations timely. The problem was extensive, and cutting across size groups (Table 4.47).

Table 4.47. Major production constraints in summer rice production system and their economic implication for the Kuttanad region

Sl. No.	Constraint	Estimated economic loss (Rs./ha)	Estimated economic loss in the zone (million Rs.)	Rank
1	Loss due to labour shortage for harvesting and threshing	3545.53 (100.00)	73.29	I
2	Loss due to improper recovery of straw	3043.43 (86.67)	62.91	II
3	Loss due to gall midge attack	2137.28 (60.00)	44.18	III
4	Loss due to leaf roller attack	1997.53 (73.33)	41.29	IV
5	Loss due to fall in price	984.19 (35.56)	20.34	V

Figures in parentheses indicate percentage farmers affected
(Zonal area reckoned at 20670 ha)

This compelled many farmers to resort to mechanical harvesters. However, the recovery of straw was low due to non-availability of harvesters suitable for the wetlands. They had to abandon the straw, or make additional payments for manual harvest of hay. This led to skipping the application of organic manures in the next crop or cutting down its level. Gall midge and leaf roller attack were other constraints, causing considerable economic loss. Many farmers were adversely affected by the price fall. The price of paddy was stable around Rs.750-700/q during the last two years. It crashed to Rs.650/q during 2001-2002. It adversely affected 36 per cent farmers, who could not receive the farm gate price.

4.5.2 Rice production system in the Kole lands

The Kole lands lie contiguously along the coastal strip of Thrissur and Malappuram districts. The tract consists of reclaimed lakebeds. The low-lying areas are situated 0.5 m to 1.0

m below the mean sea level (MSL). The soils of the kole lands are mainly the product of weathering of river alluvial deposits and colluvium. Major portion of the area are occupied by river alluvium of recent origin. Only one paddy crop is generally taken during the summer (third) season from December-January to April-May, by raising temporary earthen bunds. The fields are under submergence during the rest of the year. The efforts by Governmental agencies have resulted in the construction of permanent bunds, drainage channels, regulators etc. This has facilitated the cultivation of an additional crop during the second crop season. The gross area under rice is 18,632 ha, out of which the second season rice is cultivated in 5001 ha (26.84 per cent) only (Johnkutty and Venugopal, 1993).

Table 4.48. Cost of cultivation of summer rice in the Kole lands

Sl.No.	Particulars	Rs./ ha	As % to total
1	Seed	1087.46	5.03
2	Machinery hiring	2752.77	12.74
3	Male labour	2138.83	9.90
4	Female labour	8753.53	40.52
5	Human labour	10892.36	50.42
6	Organic manure	1801.43	8.34
7	Chemical Fertilizers	3791.04	17.55
8	Plant protection chemicals	1279.82	5.92
9	Operational Expense	21604.88	100.00

Respondent farmers were selected from Aranattukara, Chittilappally, and Chettupuzha villages of Thrissur taluk in Thrissur district. The input wise operational expense of cultivating summer rice is given in Table 4.48. Traditional inputs like organic manure and human labour accounted for 59 per cent of the operational expense, while modern inputs like high yielding variety seeds, machinery, chemical fertilizers and plant protection chemicals accounted for 41 per cent of the operational expense.

Table 4.49. Average yield, cost of production and BCR of summer rice production system in the Kole lands

Sl. No.	Particulars	Quantity
1	Average yield	4532.26 kg/ha
2	Average farm gate price	Rs.6.50/kg
3	Cost of production	Rs.4.77/kg
4	Income from grain	Rs.29457.97/ha
5	Income from straw	Rs.2366.40/ha
6	Gross income	Rs.31824.37/ha
7	Gross margin	Rs.10219.49/ha
8	BCR	1.47

The average productivity of the system was 4532 kg/ha. The cost of producing one kilogram of paddy was Rs.4.77, which compared favorably with the average farm gate price of Rs.6.50/kg. The income from grain yield formed 93 per cent of the gross income (Table 4.49). The benefit-cost ratio of the system worked out to 1.47 per rupee invested.

The constraint that caused highest economic loss was the price fall. Nearly one-fourth farmers could not receive the average farm gate price of Rs.6.50/kg (Table 4.50). All respondent farmers experienced labour shortage for harvesting and threshing operations.

Table 4.50. Major production constraints in summer rice production system and their economic implication for the Kole lands

Sl. No.	Constraint	Estimated economic loss (Rs./ha)	Estimated economic loss in the zone (million Rs.)	Rank
1	Loss due to price fall	3929.95 (24.44)	53.57	I
2	Loss due to labour shortage for harvesting and threshing	3535.16 (100.00)	48.19	II
3	Loss due to gall midge attack	2945.97 (95.56)	40.16	III
4	Loss due to stem borer attack	2209.48 (68.89)	30.12	IV
5	Loss due to improper recovery of straw	1472.98 (100.00)	20.08	V

Figures in parentheses indicate percentage farmers affected
(Zonal area reckoned at 13631 ha)

Mechanical harvesters were used, but they were not designed for the wet lowlands of Kerala (They were designed for the garden lands of Tamil Nadu). This caused improper recovery of straw and economic loss thereof. Among the pest problems, loss due to gall midge attack was more extensive and severe than loss due to stem borer attack.

The foregoing analysis clearly illustrated that though the area of each zone was small, the production constraints of crops varied across agro-ecological zones Even when the constraints were similar, its severity and intensity of economic loss differed across zones.

The initial benchmark, worked out on the basis of value of production (VOP) is presented in Table 4.51. It provides a base to allocate research resources in proportion to the relative value of production (VOP) by region and commodities. The value of production was estimated at the triennium average (1997-99) of production and wholesale prices to even out the year-to-year fluctuations. The value of production (VOP) provides a starting point for rationalizing research allocation.

Table 4.51.Value of production (VOP) of crop production systems and ranks in the different agro-eco zones

(million Rs.)

Crops	Southern Zone	Central Zone	Northern Zone	Hill Area Zone	Special Zone of Problem Areas
Rice	719.58 (4)	2394.59 (2)	576.08 (7)	306.62 (6)	538.94 (2)
Cassava	4095.27 (2)	1098.07 (4)	1470.85 (5)	963.10 (4)	17.93 (8)
Banana (Nendran)	540.48 (5)	1321.08 (3)	1121.31 (6)	744.60 (5)	170.00 (3)
Pine apple	33.56 (9)	283.30 (8)	53.18 (10)	67.01 (8)	4.03 (10)
Coconut	5,59,800.22 (1)	4,66,294.11 (1)	11,94,250.78 (1)	51,776.11 (1)	1,04,325.00 (1)
Area nut	100.46 (8)	639.94 (5)	1676.09 (3)	131.65 (7)	165.36 (4)
Cashew	211.16 (6)	144.36 (9)	1507.14 (4)	44.46 (9)	28.4 (7)
Pepper	1118.04 (3)	459.31 (6)	1759.72 (2)	6559.64 (2)	16.81 (9)
Ginger	174.64 (7)	288.45 (6)	145.16 (8)	1632.90 (3)	38.38 (6)
Turmeric	13.29 (10)	0.90 (11)	62.06 (9)	38.38 (10)	52.07 (5)
Cardamom	0.31 (12)	0.87 (12)	0.01 (12)	25.80 (11)	-
Cocoa	7.19 (11)	7.02 (10)	4.40 (11)	14.43 (12)	1.14 (11)

Figures in parentheses indicate the respective ranks

It can be noted that coconut, cassava, pepper, rice and banana *(Nendren)* shall receive more research resources in that order in research funding in the southern zone based on the value of production (VOP). Coconut, rice, banana *(Nendren),* cassava and areca nut production systems invite more research attentions in the central zone by this yardstick. Coconut production system ranks first in the northern zone also, followed by pepper, areca nut, cashew and cassava in that order.

Coconut, pepper, ginger, cassava and banana (*Nendren*) justify higher research allocation in the hill area zone. In this special zone of problem areas, coconut, rice, banana *(Nendren)* and areca nut calls for more research attention. The efforts to prepare a modified index based on zonal level for modifiers such as per capita net domestic product (equity), degraded land area (sustainability), or export earnings were constrained by the absence of data at the zonal level.

CHAPTER V

TECHNOLOGY GAPS AND FUTURE RESEARCH AGENDA

Research organizations, whether private or public, regional, national or international can no more evade social monitoring and auditing. The agricultural research systems will be subjected to more such social scrutiny in future on account of the vital issue of food and nutritional security on the one hand, and the presence of enormous stakeholders involved on the other. Hence, the road to future research is full of challenges. It cannot afford to assume the traditional commodity or discipline based research approach considering the complexity of issues involved. In the present section, the effort will be to focus on research portfolio that requires strengthening against the background of production constraints to be tackled.

5.1 Policy gaps and Interventions

5.1.1 Correction of distortions in terms of trade

Kerala farmers have been operating under adverse terms of trade for long. As pointed out earlier, favourable terms of trade is a prerequisite to ensure sustained interest of farmers in farming, and to prevent the exodus from the farm to non-farm sector. Suitable policy interventions are required to correct the distortions in terms of trade so that there is overall incentive to the agricultural sector. This will boost up the cropping intensity and reduce the area under current fallow to a considerable extent.

5.1.2 Overcoming structural weaknesses

There are certain built-in structural constraints in the organization of Kerala's agriculture. The major contributor of this structural weakness is the preponderance of small and marginal farmers, to the extent that 98 per cent of the operational holdings and 70 per cent of the operated area are under their ownership and management. Therefore, Kerala's agricultural sector is basically smallholder's agriculture. It imposes inherent problems in achieving economy of large scale and mechanization. The route to cost effective production is only through increased productivity. This is to be achieved despite a high wage rate structure and low labour productivity. As the small size holdings gradually become economically non-viable units, on-farm income becomes inadequate to sustain the farm family. This drives more and more farmers to off-farm employment to supplement the farm income. Slowly, the dependence on agriculture reduces, and it leads to the evolution of "part-time farmers", whose involvement in farming is limited to mere supervision of farm operations, as against "full-time farmers" who are "owner cultivators". As part-time farmers run their farm business in conjunction with other occupations, they do not rely entirely on the success in farming for his livelihood security, and objectives of farming are different from their counterparts elsewhere. Maximizing production or profit need not be their preoccupation. They aim to achieve trade offs in these conventional farm objectives with objectives in non-farm sector also. This leads to less adoption of scientific cultivation, and increasing reluctance to post harvest handling or value addition. Harvested produce is disposed off at the farm gate itself. This has resulted in a high cost, low productivity equilibrium in Kerala's agriculture. Breaking this equilibrium poses the biggest challenge to the agricultural research and extension system that is relentlessly aiming to bring a transformation in this attitude towards farming. The traditional cultivation shall give way to a commercially viable, cost-effective mode of production. Collective and group efforts are to be mobilized in overcoming the disadvantages of small-scale production and to introduce selective mechanization at appropriate levels. The group farming approach in rice cultivation was such an attempt, but got bogged down in problems later.

5.1.3 High literate state with low water literacy

The high rainfall pattern in Kerala offers opportunities as well as challenges. Though the state receives a rainfall of about 3000 mm, 80 per cent of it is received in five months from June to October. In the absence of scientific water conservation and harvesting, most of it is lost to the Arabian Sea as run off. The undulating topography of the state facilitates this process. Subsequently, there is a drought like situation every year from the months of January to middle of May. There is drinking water crisis, and many sensitive crops are devoid of life saving irrigation. The low water literacy in a high literate state is quite unfortunate. The growth of irrigation facility in the state has also been tardy. As irrigation is a critical input that increases the productivity of other inputs, this shall merit the special attention of policy makers to impart more stability and resilience to Kerala's agricultural sector. Here also, the thrust shall be to evolve low cost micro-irrigation systems suitable for the smallholdings.

5.1.4 Building up rural green brigade

No improvement in agricultural production is socially relevant unless it has a human face. Kerala is faced with the paradox of the highest percentage of unemployed youth in the country coupled with scarcity of agricultural labour during critical stages of farm operations. This is despite the high wage rate beckoning them. Farmers are facing severe shortage of skilled labourers for transplanting, harvesting, threshing and spraying in rice, and plant operations in perennial crops like coconut, areca nut, cashew, pepper etc. The reluctance to take up these skilled jobs that offer high wages is a problem of attitude, resting on the futile hope for a white collar or office job. It resulted in situations where technically sound solutions were practically not feasible. For example, effective control of rhinoceros beetle and red palm weevil needs prophylactic leaf axil filling of the three top most leaf axils around the spindle with Sevidol G or naphthalene balls. When labour shortage is felt for even routine harvesting, farmers are content with one leaf axil filling by skipping the other two. Farmers face such dilemma wherever repeat application/ spraying is involved in tree crops.

Attitudinal changes are to be brought about through massive campaigns, training, and converting many of these manual operations into mechanized or semi-mechanized operations. Thus, a brigade of rural work force is to be built up in every village on lines of "Self Help Groups" (SHGs).

5.2 Technology Gaps and Research Agenda

5.2.1 Location - specific Package of Practices and Recommendations

In spite of large variability in the agro-climatic settings in the various zones, there are only blanket recommendations for the state as a whole. There is no location-specific zonal package of practices or recommendations now, reflecting the regional realities. One of the main objectives of the National Agricultural Research Project (NARP) was to strengthen regional research capabilities and to evolve zonal level packages. It is reasonable to assume that one of the causes of low adoption of agro techniques is that they are not location-specific. Hence, this aspect needs immediate attention of the research managers.

5.2.2 Land Capability and Land Use Planning Studies

No scientific land capability and land use planning studies have been conducted in Kerala with the result that crops are extended to areas unsuitable agronomically, economically or ecologically. Large-scale coconut cultivation on reclaimed paddy lands, and rubber cultivation in the ecologically fragile zone of Kuttanad are two classical examples. A multi-disciplinary, multi-agency team shall think in terms of a land resource planning, whereby an arable land map is prepared in terms of the relative agronomic, ecological and economic advantages for the state as a whole.

5.2.3 Soil and Water Conservation

Nearly 85.6 per cent of the gross cropped area in Kerala is under rain fed farming. Due to inadequate soil moisture during the summer months, productivity of many perennial crops cannot be fully achieved. At the same time, heavy loss of fertile topsoil is experienced during the rainy season. Appropriate biological and structural means of soil and water conservation must be devised and popularized to check this problem. This is particularly relevant for the high land and high ranges.

5.2.4 Strengthening Indigenous knowledge base

There is a huge wealth of indigenous knowledge base with the farming community. Many of such indigenous knowledge are time-tested and developed over generations of farmers. The bactericidal property of cow dung slurry and urine in the control of bacterial leaf blight in rice is a classical example. Identification and documentation of such indigenous knowledge base for on-station testing, verification and relaunching a much-refined technology can improve the sustainability of the agricultural production base.

5.3 Rice production systems

5.3.1 Need for more mechanization

The rice production systems in the state are, by and large, labour-intensive production systems. The labour-intensity with the exception of the northern zone varied between 52 per cent in the hill area zone to 71 per cent in the central zone under rain fed situation. There is the paradox of high wage rate and low productivity of agricultural labour along high unemployment rate on the one hand, and shortage of labour during critical stages of farm operations on the other hand. This calls for higher levels of mechanization in rice culture in Kerala. Development of appropriate low cost machinery, suitable for the small-sized wetland holdings needs immediate attention. Suitable design changes are needed keeping in view the importance of grain to the farm family subsistence and straw to the livestock ration. This will make the production more cost effective, and efficient in the long run.

5.3.2 Integrated nutrient management system

It is widely known that conjunctive use of organic as well as inorganic sources of plant nutrients result in higher agronomic efficiency than organic fertilizers alone. An integrated nutrient supply system is good for soil health, and sustainable production. The rice production systems of Central zone, Northern zone and Kuttanad in special zone of problem areas had exclusively depended on inorganic chemical fertilizers for the supply of plant nutrients with little or no application of organic manures. This is not good from the scientific soil fertility management point, especially in the acidic soils of Kerala. Location-specific research on the possibility of identifying suitable strains of biofertilizers, and suitable varieties of *Dhaincha* or *Gliricidia* or other tree species that may meet the organic matter requirement of the production system are to be strengthened.

5.3.3 Strengthening post harvest technology and market linkages

As the marketable surplus of paddy is generally low, the farmers are reluctant to undertake post harvest handling, and the tendency was to dispose off the paddy grain and straw in the farm itself in the primary produce form. Only the grain needed for home consumption and straw for cattle are retained. This placed the farmers at the mercy of private millers, who exploited the situation to their advantage. Par boiling and milling can provide value addition and price stability. When the price of paddy fluctuated between Rs.750/q to Rs.650/q, and even Rs.550/q, the price of milled rice remained stable around Rs.1250-1300/q. Since parboiling and milling is not worthwhile at individual level with the level of marketable surplus available, collective efforts are to be encouraged. Strong market linkages are to be developed, and market monitoring and information sharing are to be developed.

5.3.4 Strengthening rain fed rice research

Technology generation in rice has, by and large, concentrated on better-endowed irrigated rice. This was historically necessary for a state, which is chronically deficit in rice production. As the increase in the acreage of irrigated rice over the years is marginal, the rain fed rice production system continues to be a major production system in the State. But the productivity of rain fed rice continues to be low. Hence, more research efforts are needed in rain fed rice to evolve suitable semi-dwarf, short-duration, drought tolerant high yielding varieties.

5.4 Coconut Production Systems

5.4.1 Phased replanting of old and senile palms

Coconut has been in cultivation traditionally over generations. It is not scientifically cultivated in the sense that adoption of recommended spacing; fertilizers and plant protection operations are very low. The number of uneconomic and senile plants is very high, with the result that productivity is low as compared to newly introduced areas of Tamil Nadu, Karnataka and Andhra Pradesh. It requires a carefully drawn long-term strategy of phased replanting with new cultivars, following proper spacing and inculcating sound management practices. This alone would elevate the traditionally cultivated coconut gardens into the status of commercially viable plantations.

5.4.2 Low adoption of hybrids

The traditional tall varieties are more in cultivation. This suits the part time farm management by the farmers. Planting of hybrid coconuts is sensible only if they are grown in a congenial environment and supplied with adequate nutrients and water and optimum plant protection measures adopted to enable the palms to express their full yield potential (Yusuf and Gopalasundaram, 1991). Hybrids that perform reasonably well to marginal management are absent. Even when in demand, sufficient number of quality planting materials of existing hybrids is not available. Due to the above reasons, the cultivation of hybrid coconuts is very low. An additional advantage of hybrid coconuts is that they do not elongate as fast as the tall varieties.

Hence, pest and disease management, especially the spraying operations and harvesting will be easier.

5.4.3 Coordinated extension efforts

At present, coordinated extension efforts are absent in coconut. The Kerala Agricultural University, Central Plantation Crops Research Institute and Coconut Development Board are the three agencies providing technical inputs. The developmental programmes of the State Government are being implemented through the Department of Agriculture. It is felt that sound technologies and innovations evolved by various research organizations are not reaching the farmers, who are the its ultimate users. There is also acute shortage of scientific manpower in the research/extension organizations. Once the existing vacancies are filled and manpower is deployed in priority areas of research, it will speed up the process of technology development and upgradation. There shall also be more frequent experience sharing for updating scientific information among all functionaries in the agricultural sector.

5.4.4 Product development and diversification

Price fluctuation was a major production constraint in most of the agro-ecozones. There was no processing and the farmers disposed off the harvested nuts in the unhusked form in the farm itself. As mentioned earlier, when the average farm harvest price of coconut exhibited instability of 18-30 per cent, the price of branded, packed coconut oil remained fairly stable around Rs.38-40/kg during the corresponding period. Produce development and diversification is a sure path to reduce price fluctuations. Hence, this shall receive more attention.

Coconut contributes to around seven per cent of the total vegetable oil production in the country. Chances of increased use of coconut oil as edible oil are also limited. Hence, new products and uses shall receive more research attention. The possibility of using coconut oil as lubricating oil in automobiles is to be explored fully. Some research efforts are taking place in this direction at the College of Agricultural Engineering & Technology of the University at Tavanur in collaboration with the Coconut Development Board. A break through can revolutionize the coconut economy of Kerala.

Similar efforts are needed for new product development and diversification. For example, if packaged properly, tender coconut water offers ample opportunities as a soft drink. The Dairy Science Department of the University has already developed coconut yogurt and paneer. Coconut biscuits, chips and vinegar are sure possibilities. The Malaysian Agricultural Research Institute has already developed coconut honey. Coconut cream, coconut cream powder and coconut flour are commercially produced and marketed in a large scale in Philippines, Malaysia, Thailand and Singapore. If the University along with the Coconut Development Board and the Central Food Technological Research Institute are providing the R & D leadership in such ventures, corporate bodies will come forward to start commercial production and marketing. The University can earn handsome revenue by means of royalty. There is already precedence in this regard for cashew apple utilization.

5.4.5 Management of eriophyid mite

The present recommendation for the management of eriophyid mite consists of application of 2 per cent neem oil + garlic oil emulsion or 0.004 per cent azadirachtin or 0.4 per cent micronized wettable sulphur. Three rounds of spraying are recommended in a year. This is cumbersome in the senses that farmers ignore repeat spraying due to labour shortage. Technology refinements are needed to make the recommendation more crisp and operational.

5.4.6 Control of stem bleeding

The cause of the disease is a fungus known as *Theilaviopsis paradoxa*. The present control measure consists of removing the affected parts with a chisel and dressing the wound with coal tar or Bordeaux paste. Root feeding or soil drenching of tridemorph in four months are also recommended, but farmers are not keen to apply tridemorph because of its cost. The chiseling of affected tissues is a very cumbersome method.

5.4.7 Control of bud rot

Bud rot is a fatal disease affecting palms of all ages. Sanitary measures like cleaning affected parts and the application of Bordeaux paste cannot be done by the farmer himself. They can carry out the operation only with the help of a skilled labour who can climb up the top and carry out the operation. Steps to identify the pathogen infestation in early stages are also very vital in its effective control.

5.4.8 Tolerance breeding

The high cost of labour along with shortage of skilled labourers, and farming activity being followed as a secondary occupation compels the need to look into alternate pest/disease control measures in coconut. In view of the reluctance by farmers to use more pesticides in coconut to control pest incidence like rhinoceros beetle, coreid bug and eriophyid mite and in view of their strategy not aimed at maximizing nut production, tolerance/resistance breeding shall receive more importance. Breeding for pest, disease and environmental stress tolerance can overcome many of the present operational problems in coconut management.

5.5 Cassava production system

5.5.1 Role as a home garden crop

Due to the competition for land space, areas for the commercial sole cropping of cassava may be hard to find in the coming years. It has already lost considerable area to rubber crop, the immediate competitor. However, the role of cassava as a home garden crop in the interspaces of coconut has not received adequate attention. Cassava continues to be a major source of dietary energy for the low-income households. Hence, instead of breeding for higher tuber yield *per se*, the focus shall be on crop associating ability of cassava in coconut gardens and its cooking quality. A high yielding cassava variety having the cooking quality of M_4 (a Malaysian clone of cassava with moderate yield) is yet to be evolved and adopted.

5.5.2 Breeding for quality improvement

A major factor that stands in the way of widespread consumption of cassava is the hydrogen cyanide content, which inhibits the functioning of pancreas. Traditional breeding works concentrated on higher tuber yields alone. In the present era, individual plant yields are not the main consideration of cassava. The marketability of the tubers, and quality aspects like beta-carotene and hydrogen cyanide content shall receive more attention.

5.5.3 Separate breeding strategy for culinary and industrial purpose cassava

The conventional breeding did not distinguish between culinary purpose varieties and industrial purpose varieties with high starch content. Such a segmented breeding strategy will improve the marketability of the tubers considerably.

5.5.4 More product development and diversification

Even though a number of value added cassava based products have been developed by various research organizations, large-scale production has not taken place. The current demand for cassava tubers are mainly for human consumption, in cattle feed making, and in starch industries. The prices are subjected to wide fluctuations based on a change in demand from these sectors. Hence, more appealing product development and diversification strategies are to be pursued. The post harvest technology in cassava is to be strengthened to achieve this end so that it paves way for market expansion and diversification.

5.5.5 Better rodent management

Rodents have been posing increasing food and health problems. The losses inflicted by rats to cassava cultivation are huge, because of their preference for the tubers. The present approach of rat control is made at individual farm level. This will not provide a lasting solution.

An area based approach, involving baits and traps are to be evolved with full participation from farmers and local bodies.

5.6 Banana

5.6.1 Strengthening market linkages

There was wide fluctuation in farm harvest price of banana. The banana trade was totally controlled by private traders, and the group efforts by farmers did not yield satisfactory results. The marketing linkages of banana growers are to be strengthened. The self-help groups shall be encouraged to venture into processing and value addition. When the price of bunches fluctuated between Rs.8-14/kg, the price of banana chips remained fairly stable around Rs.50-60/kg. Post harvest technology in banana shall receive more focused attention.

5.6.2 Technology refinements in pest and disease management

Technology gaps have been identified in the control of pseudostem weevil as well as bunchy top. Both affected major proportion of growers. More technology refinements are needed to make the control more effective.

5.6.3 Management of Fe / Al toxicity

Banana cultivated in the low lands were subjected to Fe / Al toxicity. The immediate concern would be to educate the farmers on identifying the problem, and initiate management practices to alleviate this constraint. Technology refinements are also needed in this area.

5.7 Pineapple production system

5.7.1 Need for sound agro techniques for Mauritius variety

The Package of Practices, Recommendations of Kerala Agricultural University has been based on the performance of the Kew variety, while most of the farmers cultivated the variety Mauritius, which was more suitable for table purpose and distant marketing. As the growth and duration of the two varieties differed widely, the need for separate agro techniques for the Mauritius variety was felt for long. It is only recently that the University has come up with a package of practices and recommendations for the variety Mauritius (Kerala Agricultural University, 2002).

5.7.2 High yielding varieties needed

Currently, no high yielding varieties released from Kerala Agricultural University are available for cultivation. There is the felt need of a high yielding variety similar to Mauritius that is locally suitable.

5.7.3 Better management of heart rot

There is no recommendation for the control of heart rot. The disease is so prevalent in the low land crop that farmers are turning away from pineapple cultivation in the low land out of sheer frustration. The research efforts shall pay more attention in this area.

5.8 Cashew production system

5.8.1 Replanting of low yielder

The productivity of cashew nut is very low now due to a variety of factors. The existing cashew plantations in Kerala are mostly of seed origin and are genetically poor. Moreover, many of the existing plantations have passed their economic bearing stage. Currently, five per cent of the farmers cultivated improved varieties of cashew. There shall be a massive replantation scheme with comprehensive incentives to replace low yielding seedlings with high yielding grafts.

5.8.2 Thrust on scientific cultivation

Cashew is a lazy man's crop and cashew was not "cultivated" in many areas. It was simply "grown" without any scientific practices. Though cashew can survive neglect, economic yields can only be obtained from scientifically managed plantations.

5.8.3 Effective control of tea mosquito and inflorescence blight

Tea mosquito is a serious pest of cashew, causing yield damage up to 30 per cent. The controversy on endosulfan has a set back to tea mosquito control with the result that farmers have stopped spraying altogether. Even though there are alternate recommendations like Quinalphos, Phosphamidon and Carbaryl, there has been low acceptability. Phosphamidon cannot be sprayed during flowering stage, as it is highly toxic to honey bee. It indicates that technology refinements are required in this area.

5.8.4 Effective control of stem borer

There is only an adhoc recommendation of swabbing the trunk and exposed roots with carbaryl, phytosanitation and prophylactic swabbing of the trunk with carbaryl coal tar and kerosene. More effective control measures are required for combating this pest.

5.8.5 Commercial exploitation of cashew apple

Cashew is traditionally grown for the kernels. The apples are now grossly wasted. A number of cashew apple product have been standardized by the University like cashew apple syrups, squashes and ready to serve beverages. The commercial exploitation of cashew apple is to be stimulated for strengthening the cashew production base in the state by increasing returns per unit area cultivated.

5.9 Pepper production system

5.9.1 Breaking low yield equilibrium

The productivity of pepper is low and stagnant during the last decade. Black pepper is virtually "black gold" considering its export potential. Enhancing the productivity of traditional cultivars, whose berries have inherent superiority and demand, is the biggest challenge to the R & D system.

5.9.2 Product development and diversification

There is no value addition at the producers level in black pepper now. The volatile price situation can be conditioned only through processing, product development and diversification. Globally, the demand for value added pepper products are on the increase. Pepper oleoresin, white pepper etc. can ensure higher returns to the spice economy. However, being a smallholder crop, such facilities are to be developed regionally in the major production centres, instead of expecting the small farmers to duplicate such facilities. "Agro growth centres", where such facilities can be shared, are to be established in major production centres.

5.9.3 Exploitation of organically produced pepper

By and large, spices are produced organically in the two major production centres of Idukki and Wynad districts. Organic pepper commands a premium in the global markets. However, there is at present no effort to brand or package pepper properly keeping the global markets in mind. This shall start by standardizing the agro techniques for organic pepper cultivation.

5.9.4 Technology refinements for the control of slow and quick wilt

All chemical control measures for the control of slow and quick wilt are prophylactic in nature. Application of chemicals once the symptoms are manifested is not effective. Hence, extension and technology refinements are required in this area.

5.9.5 Tolerance breeding

Keeping in view the need for organic pepper and stringent international standards for pesticide residues, tolerance/ resistance breeding is to be fully explored in the management of slow and quick wilts. More safe pesticides, keeping international safeguards in mind, are to be evolved and popularized in the long run.

5.10 Ginger production system

5.10.1 Effective management of bacterial wilt

There is no recommendation for the control of bacterial wilt in the Package of Practices, Recommendations (Kerala Agricultural University, 2002). Being the most destructive disease of ginger, concerted research efforts are vital for the long run success of this cash crop.

5.10.2 Strengthening post harvest research

There is no processing of harvested produce now. There is not even large scale drying, though dried rhizomes fetch better and more stable price. This is a viable strategy to cope up with violent price fluctuations. Strong post harvest research to have product development and diversification is inevitable. In Sri Lanka, farm level extraction of ginger oleoresin through distillation is widespread. Production and sale of freshly harvested rhizomes in an oligopsony market, dominated by a few private traders cannot protect the interest of the farming community. Strong and diversified post harvest technology that can be easily adopted at producer's level can only protect the welfare of the peasantry in the long run.

5.11 Institutionalizing priority setting

Agricultural production systems are not static systems. Production constraints in the eighties are different from that in the nineties. So also are the challenges and opportunities. The 21st century presents an altogether different paradigm. Hence, there shall be a systematic and institutionalized effort to track production constraints and quantify the extent of socio-economic dimensions dynamically at various points of time. It is hoped that the priority setting, monitoring and evaluation (PME) cell takes up this challenge.

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APPENDIX - I

List of personnel who rendered technical support in the rapid rural appraisal

Sl. No.	Name	Designation
1.	Dr. S. Ramanathan	Principal Scientist, Central Tubercrops Research Institute, Sreekaryam, Trivandrum (Dist.)
2.	Dr. N.P. Nair	Associate Professor & Head, Coconut Research Station, Kerala Agricultural University, Balaramapuram, Trivandrum (Dist.)
3.	Dr. Kuruvilla Varghese	Associate Professor & Head, Cropping Systems Research Station, Kerala Agricultural University, Karamana, Trivandrum (Dist.)
4.	Smt. C.K. Sajitha	Deputy Director of Agriculture, Office of the Principal Agricultural Officer, Civil Lines, Quilon (Dist.)
5.	Dr. P.J. Joy	Associate Director of Research, Regional Agricultural Research Station, Kerala Agricultural University, Kumarakom, Kottayam (Dist.)
6.	Dr. S. Leena Kumary	Associate Professor, Kerala Agricultural University, Mancompu, Alleppy (Dist.)
7.	Dr. P.V. Balachandran	Associate Director of Research, Regional Agricultural Research Station, Pattambi, Palghat (Dist.)
8.	Dr. M. Mohandas	Associate Dean, College of Co-operation, Banking & Management, Kerala Agricultural University, Vellanikkara, Trichur (Dist.)
9.	Dr. E.K. Thomas	Associate Professor and Head, Department of Agricultural Economics, College of Horticulture, Kerala Agricultural University, Vellanikkara, Trichur (Dist.)
10.	Dr. U. Jaikumaran	Associate Professor and Head, Agricultural Research Station, Mannuthy, Trichur (Dist.)

Sl. No.	Name	Designation
11.	Dr. Gregory Zachariah	Associate Professor, Regional Agricultural Research Station, Kerala Agricultural University, Pattambi, Palghat (Dist.)
Sl. No.	Name	Designation
12.	Dr. M.C. Narayanankutty	Assistant Professor (SS), Regional Agricultural Research Station, Kerala Agricultural University, Pattambi, Palghat (Dist.)
13.	Dr. Jyothy M.L.	Assistant Professor (SS), Regional Agricultural Research Station, Kerala Agricultural University, Pattambi, Palghat (Dist.)
14.	Mrs. M.B. Komalam	Assistant Director of Agriculture, Government of Kerala, Chavakkad, Trichur (Dist.)
15.	Sri. P. Chandrabhanu	Technical Assistant, Office of the Principal Agricultural Officer, Chembukkavu, Trichur (Dist.)
16.	Dr. V.S. Devadas	Associate Professor and Head, Pineapple Research Station, Kerala Agricultural University, Vazhakkulam, Ernakulam (Dist.)
17.	Dr. Rema Menon	Associate Professor and Head, Banana Research Station, Kannara, Trichur (Dist.)
18.	Sri. P.T. George	President, KHDP Self Help Group, Thottippal, Trichur (Dist.)
19.	Dr. K.C. Aipe	Associate Director of Research, Regional Agricultural Research Station, Kerala Agricultural University, Ambalavayal, Wynad (Dist.)
20.	Sri. K. Shivanandan	Deputy Director of Agriculture, Office of the Principal Agricultural Officer Civil Lines, Kalpetta, Wynad (Dist.)
21.	Dr. C.V. Sai Ram	Sr. Scientist (Agrl. Economics), Central Plantation Crops Research Institute, Kasaragod (Dist.)
22.	Dr. V. Krishna Kumar	Sr. Scientist (Agronomy), Central Plantation Crops Research Institute, Kasaragod (Dist.)

Sl. No.	Name	Designation
23.	Dr. P.C. Balakrishnan	Associate Director of Research, Regional Agricultural Research Station, Kerala Agricultural University, Pilicode, Kasaragod (Dist.)
24.	Sri. V. Suresh	Deputy Director of Agriculture, Office of the Principal Agricultural Officer Civil Lines, Kannur (Dist.)
25.	Sri. A.V. Sudhakaran	Deputy Director of Agriculture, Office of the Principal Agricultural Officer Civil Lines, Calicut (Dist.)
26.	Smt. Caroline Thankamma	Deputy Director of Agriculture, Office of the Principal Agricultural Officer Civil Lines, Calicut (Dist.)
27.	Dr. P.V. Habeebur Rahman	Associate Professor (Agronomy), Kelappaji College of Agriculture, Engineering & Technology, Kerala Agricultural University, Tavannur, Malappuram (Dist.)
28.	Smt. Ummu Jameela	Assistant Director of Agriculture, Government of Kerala, Tavannur, Malappuram (Dist.)
29.	Smt. Sakkeena Bai	Agricultural Officer, Krishi Bhavan, Edappal, Malappuram (Dist.)

APPENDIX - II

PRIORITIZING PRODUCTION CONSTRAINTS IN AGRICULTURE

- A Study for Efficient Research Resource Allocation in Different Agro-Ecoregions -

Survey Instrument for RRA/Household Survey

1. Farmer's ID

Ecoregion: Production system:

District: Block: Village:

Name of the Respondent: Mr./Mrs.

2. Land Use:

Size of land holding: ____________ acre

Season	Cultivated area	Irrigated area	Source of irrigation
Kharif Rabi Summer			

3. Cropping pattern

Season	Crop or inter-crop	Area	Irrigated area
Kharif			
Rabi			
Summer			

4. Information on livestock:

Livestock	Number	Breed

5. Resource use pattern and crop yields:

Resource	Unit	Crop				
		Crop 1	Crop 2	Crop 3	Crop 4	Crop 5
Seed						
Fertilizer						
a)						
b)						
c)						
d)						
e)						
Pesticide						
insecticide						
Weedicide						
Irrigation	No.					
Labour						
Crop yield						
a) Main product						
Marketed						
a) Main product						
b) By-product						

6. Resource use pattern and livestock production:

Input/Output	Unit	Livestock type				
		LS 1	LS 2	LS 3	LS 4	LS 5
Fodder						
a)						
b)						
c)						

Concentrate						
a)						
b)						
c)						
d)						
Medicines						
Production						
a)						
b)						
c)						
d)						
Product marketed						
a)						
b)						
c)						
d)						

7. Constraints to crop production: Crop: ______________________________

Constraint	Area affected	Yield with constraint	Probability of occurrence
Drought			
Submergence			
Diseases			
Insects			
Weeds			
Soil fertility (deficiency)			

Soil fertility (toxicity) Adverse soils Groundwater Surface water Other constraints: Lodging Cold Long duration Crop establishment			

8. Constraints to livestock

Constraint	Name livestock	Affected animal (no.)	Loss in yield per animal	Probability of occurrence
Diseases Fodder unavailability Summer season Rainy season Winter season Nutrient unavailability Insemination				

9. Constraints related to common property resources

Common property resource	Problem	Area affected	Affected party	Loss of resources
Common land				
Grazing land				
Village pond				
Village forest				

10. General constraints

a) Unavailability of human labour

Season	Month	Crop	Activity
Kharif			
Rabi			
Summer			

b) Constraints related with implements

Farm operation	Season*			Crop*			Constraint	Existing practice
	Kh	Rb	Sm	CR1	CR2	CR3		
Ploughing								
Harrowing								
Transplanting								
Weeding								
Spraying								
Harvesting								
Threshing								
Winnowing								

* Tick the relevant season or crop (Kh refers: Kharif season. Rb: Rabi season. Sm: Summer season

c) Unavailability of credit

Purpose: (i) (ii) (iii)
Amount: (i) (ii) (iii)

APPENDIX - III

List of participants who attended the feedback workshop pertaining to the NARP, Northern, Hill Area and Problem Zones on 17-2-2002

Sl. No.	Name	Designation
1.	Dr. R. Vikraman Nair	Director of Research, Kerala Agricultural University, Vellanikkara, Trichur - 680 656
2.	Dr. A. Sukumara Varma	Associate Dean, College of Horticulture, Kerala Agricultural University, Vellanikkara, Trichur - 680 656
3.	Dr. M. Mohandas	Associate Dean, College of Co-operation, Banking & Management, Kerala Agricultural University, Vellanikkara, Trichur - 680 656
4.	Dr. E.K. Thomas	Associate Professor and Head, Department of Agricultural Economics, College of Horticulture, Kerala Agricultural University, Vellanikkara, Trichur - 680 656
5.	Dr. K.C. Aipe	Associate Director of Research, Regional Agricultural Research Station, Kerala Agricultural University, Ambalavayal, Wynad - 673 593
6.	Dr. B. Jayaprakash Naik*	Associate Professor, Regional Agricultural Research Station, Kerala Agricultural University, Pilicode, Kasaragod - 670 353
7.	Dr. N. Rema Bai**	Professor and Head, Rice Research Station, Kerala Agricultural University, Mancompu, Alleppy - 688 503
8.	Dr. S. Leena Kumary	Associate Professor, Rice Research Station, Kerala Agricultural University, Mancompu, Alleppy - 688 503
9.	Dr. U. Ramachandran	Associate Professor, Department of Development Economics, College of Co-operation, Banking & Management, Kerala Agricultural University, Vellanikkara, Trichur - 680 656

Sl. No.	Name	Designation
10.	Dr. K. Jesy Thomas	Associate Professor, Department of Agricultural Economics, College of Horticulture, Kerala Agricultural University, Vellanikkara, Trichur - 680 656
11.	Dr. P.A. Valsala	Associate Professor, Department of Plantation Crops & Spices, College of Horticulture, Kerala Agricultural University, Vellanikkara, Trichur - 680 656
12.	Dr. N. Saifudeen	Associate Professor & Head, Centre for Land Resource, Research and Management, College of Horticulture, Kerala Agricultural University, Vellanikkara, Trichur - 680 656
13.	Dr. A.M. Ranjith	Associate Professor, Department of Entomology, College of Horticulture, Kerala Agricultural University, Vellanikkara, Trichur - 680 656
14.	Dr. C. George Thomas	Associate Professor (Agronomy), Central Cocoa Research Project, College of Horticulture, Kerala Agricultural University, Vellanikkara, Trichur - 680 656
15.	Dr. T. Sheela Paul	Associate Professor, Department of Plant Pathology, College of Horticulture, Kerala Agricultural University, Vellanikkara, Trichur - 680 656
16.	Dr. Sathees Babu K.	Assistant Professor (Sr. Scale), Department of Agricultural Economics, College of Horticulture, Kerala Agricultural University, Vellanikkara, Trichur - 680 656
17.	Dr. P. Indira Devi	Assistant Professor (Sr. Scale), Department of Agricultural Economics, College of Horticulture, Kerala Agricultural University, Vellanikkara, Trichur - 680 656
18.	Mr. T. Paul Lazarus	Assistant Professor, Department of Agricultural Economics, College of Horticulture, Kerala Agricultural University, Vellanikkara, Trichur - 680 656

Sl. No.	Name	Designation
19.	Dr. P. Suresh Kumar	Assistant Professor (Sr. Scale), Department of Soil Science & Agricultural Chemistry, College of Horticulture, Kerala Agricultural University, Vellanikkara, Trichur - 680 656
20.	Mr. V.S. Deepa Kumar	Senior Research Fellow, PME Cell, Directorate of Research, Kerala Agricultural University, Vellanikkara, Trichur - 680 656
21.	Mr. U. Pradeep	P.G. Student, Department of Agricultural Economics, College of Horticulture, Kerala Agricultural University, Vellanikkara, Trichur - 680 656
22.	Mr. K.M. Divya	P.G. Student, Department of Agricultural Economics, College of Horticulture, Kerala Agricultural University, Vellanikkara, Trichur - 680 656
23.	Ms. Aswathy Vijayan	P.G. Student, Department of Agricultural Economics, College of Horticulture, Kerala Agricultural University, Vellanikkara, Trichur - 680 656

* represented the Associate Director of Research, NARP Northern Zone, Pilicode

** represented the Associate Director of Research, NARP Problem Zone Area Kumarakom

APPENDIX - IV

List of participants who attended the feedback workshop pertaining to the NARP, Central and Southern Zones on 18-2-2002

Sl. No.	Name	Designation
1.	Dr. R. Vikraman Nair	Director of Research, Kerala Agricultural University, Vellanikkara, Trichur - 680 656
2.	Dr. M. Mohandas	Associate Dean, College of Co-operation, Banking & Management, Kerala Agricultural University, Vellanikkara, Trichur - 680 656
3.	Dr. P. Saraswati	Associate Director of Research, NARP Northern Zone, Regional Agricultural Research Station, Kerala Agricultural University, College of Agriculture, Vellayani, Trivandrum - 695 522
4.	Dr. E.K. Thomas	Associate Professor and Head, Department of Agricultural Economics, College of Horticulture, Kerala Agricultural University, Vellanikkara, Trichur - 680 656
5.	Dr. F.M.H. Kaleel	Associate Professor and Head, Department of Agricultural Extension, College of Horticulture, Kerala Agricultural University, Vellanikkara, Trichur - 680 656
6.	Dr. E.V. Nybe	Associate Professor and Head, Department of Plantation, Crops & Spices, College of Horticulture, Kerala Agricultural University, Vellanikkara, Trichur - 680 656
7.	Dr. N.P. Nair	Associate Professor and Head, Coconut Research Station, Kerala Agricultural University, Balaramapuram, Trivandrum
8.	Dr. U. Jaikumaran	Associate Professor and Head, Agricultural Research Station, Mannuthy, Trichur - 680 651

Sl. No.	Name	Designation
9.	Dr. V.S. Devadas	Associate Professor and Head, Pineapple Research Station, Kerala Agricultural University, Vazhakkulam, Ernakulam - 686 670
10.	Dr. Jose Mathew	Associate Professor and Head (i/c), Department of Agronomy, College of Horticulture, Kerala Agricultural University, Vellanikkara, Trichur - 680 656
11.	Dr. N. Saifudeen	Associate Professor & Head, Centre for Land Resource, Research and Management, College of Horticulture, Kerala Agricultural University, Vellanikkara, Trichur - 680 656
12.	Dr. A.K. Babylatha	Associate Professor, Department of Pomology & Floriculture, College of Horticulture, Kerala Agricultural University, Vellanikkara, Trichur - 680 656
13.	Dr. U. Ramachandran	Associate Professor, Department of Development Economics, College of Co-operation, Banking & Management, Kerala Agricultural University, Vellanikkara, Trichur - 680 656
14.	Dr. A.M. Ranjith	Associate Professor, Department of Entomology, College of Horticulture, Kerala Agricultural University, Vellanikkara, Trichur - 680 656
15.	Dr. C. George Thomas	Associate Professor (Agronomy), Central Cocoa Research Project, College of Horticulture, Kerala Agricultural University, Vellanikkara, Trichur - 680 656
16.	Dr. T. Sheela Paul	Associate Professor, Department of Plant Pathology, College of Horticulture, Kerala Agricultural University, Vellanikkara, Trichur - 680 656
17.	Dr. Satheesh Babu K.	Assistant Professor (Sr. Scale), Department of Agricultural Economics, College of Horticulture, Kerala Agricultural University, Vellanikkara, Trichur - 680 656

Sl. No.	Name	Designation
18.	Dr. P. Indira Devi	Assistant Professor (Sr. Scale), Department of Agricultural Economics, College of Horticulture, Kerala Agricultural University, Vellanikkara, Trichur - 680 656
19.	Dr. P. Suresh Kumar	Assistant Professor (Sr. Scale), Department of Soil Science & Agricultural Chemistry, College of Horticulture, Kerala Agricultural University, Vellanikkara, Trichur - 680 656
20.	Mr. T. Paul Lazarus	Assistant Professor, Department of Agricultural Economics, College of Horticulture, Kerala Agricultural University, Vellanikkara, Trichur - 680 656
21.	Dr. M.C. Narayanankutty*	Assistant Professor (SS), NARP Central Zone, Regional Agricultural Research Station, Kerala Agricultural University, Pattambi, Palghat - 679 383
22.	Mr. V.S. Deepa Kumar	Senior Research Fellow, PME Cell, Directorate of Research, Kerala Agricultural University, Vellanikkara, Trichur - 680 656
23.	Mr. U. Pradeep	P.G. Student, Department of Agricultural Economics, College of Horticulture, Kerala Agricultural University, Vellanikkara, Trichur - 680 656
24.	Mr. K.M. Divya	P.G. Student, Department of Agricultural Economics, College of Horticulture, Kerala Agricultural University, Vellanikkara, Trichur - 680 656
25.	Ms. Aswathy Vijayan	P.G. Student, Department of Agricultural Economics, College of Horticulture, Kerala Agricultural University, Vellanikkara, Trichur - 680 656

* represented the Associate Director of Research, NARP Central Zone, Regional Agricultural Research Station, Pattambi, Palakkad.

APPENDIX - V

List of participants who attended the final workshop on 22-2-2003

Sl. No.	Name	Designation
1.	Dr. M. Mohandas	Associate Dean, College of Co-operation, Banking & Management, Kerala Agricultural University, Vellanikkara, Trichur - 680 656
2.	Dr. A. Sukumara Varma	Associate Dean, College of Horticulture, Kerala Agricultural University, Vellanikkara, Trichur - 680 656
3.	Dr. K.P. Prameela	Associate Professor, PME Cell, Directorate of Research, Kerala Agricultural University, Vellanikkara, Trichur - 680 656
4.	Dr. Molly Joseph	Associate Professor & Head, Department of Rural Banking & Finance Management, College of Co-operation, Banking & Management, Kerala Agricultural University, Vellanikkara, Trichur - 680 656
5.	Mr. J. Joseph	Deputy Director of Agriculture, Office of the Principal Agricultural Officer, Government of Kerala, Ernakulam (Dist.)
6.	Mrs. Lai George	Deputy Director of Agriculture, Office of the Principal Agricultural Officer, Government of Kerala, Palakkad (Dist.)
7.	Dr. A.M. Ranjith	Associate Professor, Department of Entomology, College of Horticulture, Kerala Agricultural University, Vellanikkara, Trichur - 680 656
8.	Dr. T. Sheela Paul	Associate Professor, Department of Plant Pathology, College of Horticulture, Kerala Agricultural University, Vellanikkara, Trichur - 680 656
9.	Mr. Jinaraj. P.V.*	Agricultural Officer, Krishi Bhavan, Government of Kerala, New Mahe, Kannur (Dist.)

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Sl. No.	Name	Designation
10.	Dr. E.V.K. Padmini	Associate Professor & Head, Department of Co-operative Management, College of Co-operation, Banking & Management, Kerala Agricultural University, Vellanikkara, Trichur - 680 656
11.	Dr. E. Vinai Kumar	Assistant Professor (Sr. Scale), Department of Co-operative Management, College of Co-operation, Banking & Management, Kerala Agricultural University, Vellanikkara, Trichur - 680 656
12.	Dr. Satheesh Babu K.	Assistant Professor (Sr. Scale), Department of Agricultural Economics, College of Horticulture, Kerala Agricultural University, Vellanikkara, Trichur - 680 656
13.	Dr. K.A. Sunandha	Assistant Professor, Department of Development Economics, College of Co-operation, Banking & Management, Kerala Agricultural University, Vellanikkara, Trichur - 680 656
14.	Dr. E.G. Ranjit Kumar	Assistant Professor, Department of Co-operative Management, College of Co-operation, Banking & Management, Kerala Agricultural University, Vellanikkara, Trichur - 680 656
15.	Mr. V.S. Pratheesh	P.G. Student, Department of Agricultural Economics, College of Horticulture, Kerala Agricultural University, Vellanikkara, Trichur - 680 656
16.	Mr. U. Pradeep	P.G. Student, Department of Agricultural Economics, College of Horticulture, Kerala Agricultural University, Vellanikkara, Trichur - 680 656
17.	Ms. Aswathy Vijayan	P.G. Student, Department of Agricultural Economics, College of Horticulture, Kerala Agricultural University, Vellanikkara, Trichur - 680 656

* represented the Principal Agricultural Officer, Kannur District.