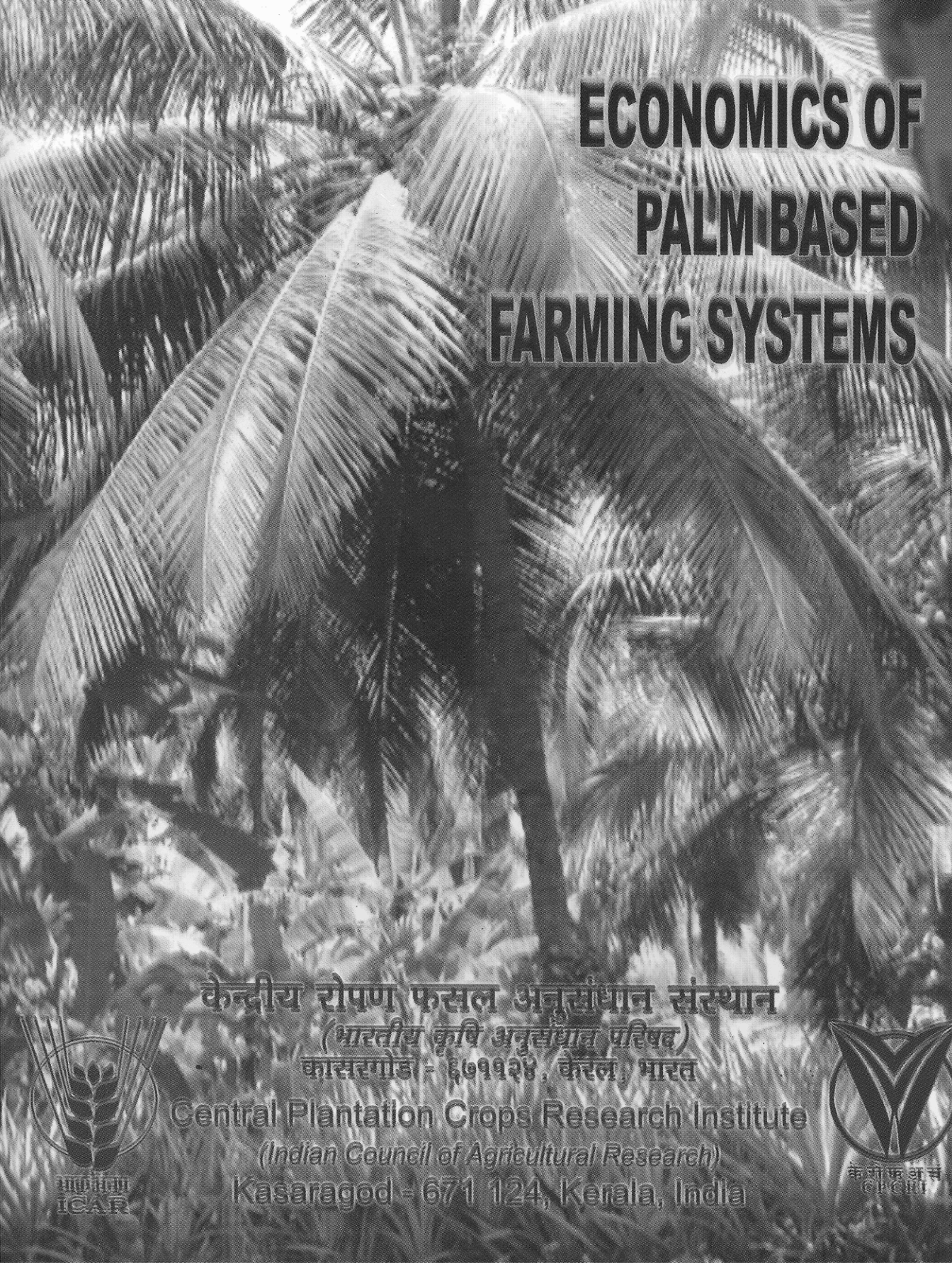

ECONOMICS OF PALM BASED FARMING SYSTEMS

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FOREWORD

Global agriculture is in an interesting phase of under going changes in tune with the world trade agreements. In this process, all the countries are reorienting their research and development strategies to face the newly emerging challenges. Indian agriculture is also facing major challenges to sustain the economic well being of small and marginal farmers, who constitutes more than 80 percent of share in Indian farming.

Research and development organizations are more concerned about the impact of the globalization on Indian plantation crop sector, since it cannot under go short term adjustment as suggested in the Agreement of Agriculture of World Trade Organization.

Competitiveness through higher productivity is one among the strategies suggested by the researchers to overcome the challenges arising out of trade liberalization and globalization. For this, optimum resource use efficiency is the prime theme to be adopted by the farmers.

The wider inter space, light and other natural resources available in plantations could be effectively utilized for cultivating suitable inter/mixed crops, for realizing higher income per unit area and for effective recycling of farm resources. In this approach, few of the animal husbandry enterprises like dairying, poultry and fisheries can be integrated for making the system more sustainable for productivity and profitability. Adoption of these systems in coconut or arecanut gardens is known as Palm Based Farming Systems.

Research efforts made by the Central Plantation Crops Research Institute and the State Agricultural Universities have proved the technical feasibility and economic viability of many palm based farming system models. However, for the successful adoption of these models, the economic worthiness of the investment in these models should be fully convincing to the farmers.

The usefulness of adopting Palm Based Farming Systems would be judged by their potential to generate additional income and employment in small and marginal holdings. This book highlights the economic aspects of palm based cropping/farming system models. I hope this book would be of immense use to farmers, researchers, planners and policy makers related to plantation crops.

I Congratulate the authors for their efforts and appreciate the Digantha Mudrana Ltd., Mangalore for publishing the same in time.

Place : CPCRI Kasaragod
Date : 11th December 2004

V. Rajgopal

V. Rajgopal
Director.

CONTENT

CHAPTER I

INTRODUCTION

1.1 WTO and Indian Agriculture

Indian Agriculture has made rapid strides in the past five decades, making the country self-sufficient in food production. The most important factor responsible for such an achievement is the widespread adoption of improved agricultural technologies. Agricultural sector review (1993) by World Bank stated that broad-based agricultural growth occurred since the 1970's in the Green Revolution parts of India, involving small and medium sized farms. The report further added that in developing countries like India, improving productivity through technology is the only way to create productive employment and alleviate poverty on the required scale.

In view of the economic liberalization and India being a member of the World Trade Organization, certain macro and micro level changes are expected to take place in the primary sector of the Indian economy. Several economists have expressed different views both for and against the economic reforms. Rao (1994) stated that liberalization can be a step in the right direction provided it is used as a strategy not to withdraw the government from the economy, but to shift the focus of government policies and concerns from helping and subsidizing the organized parts of the economy. Such a strategy can promote broad-based agricultural growth, which would not only increase the growth rate of the economy, but also enable the backward areas and the poor to participate in growth and share in its benefits. Vyas (1994), Hanumantha Rao (1995) and Johl (1995) have looked into the complexity of the reforms in Indian economy and critically viewed its impact on Indian agriculture. Gulati and Sharma (1998) stated that if India frees up imports and exports of agricultural products at zero duty, there is a possibility of significant gains from trade. Mishra (1997) and Bisalaiah (1998), while looking at the economic policies from the perspective of social objectives, had stated that selective market intervention is necessary in order to protect the food security of the country.

Since the revised policies of WTO aim to boost agricultural trade through substantial reduction in protectionism, prices of agricultural commodities in member countries are expected to move closer to international prices. Hence, to compete in international markets, product price and cost of production of agricultural commodities produced in the country should be comparable to those in other competing countries. To meet these challenges, Indian agriculture has to maintain a higher level of technical and economic efficiency through higher productivity, for

which technology plays a very crucial role.

1.2 Reorientation of agricultural research

According to Bhalla (1994), the first aim of agricultural technologies is to secure and sustain high production growth rates. Thimmaiah (1994) stated that for a dynamic future for Indian agriculture, it is necessary to achieve and maintain high growth rate in rural income by integrating agriculture with the rest of the Indian economy and with the world economy. Garnaut (1996) argued that effective agricultural reforms like land reforms, intervention by the government in input subsidies and price policies of agricultural commodities might have a larger effect in raising farm incomes and output in India than in China. Ahluwalia (1996) stated that though technology played a crucial role in alleviating India's poverty during 1970's, its contribution to agricultural growth has not been impressive. But later on, the increase in growth rates in agricultural and its allied sectors especially in the Green Revolution parts of the country clearly proved that technology contributed to the growth and development of Indian agriculture. Vaidyanathan (1994) stated that to achieve sustainable growth rates in Indian agriculture, technology should continue to play a major role and at the same time it is necessary to remove non-price and institutional constraints, which do not permit the full exploitation of the chosen technology at farm level. In addition, to achieve a sustainable growth rate in Indian agriculture, the present day agricultural research system has to take a new paradigm, in which need-based research problems are to be identified with active involvement of farmers. At present, agricultural research in India is organized traditionally along disciplinary or commodity lines, and with inadequate involvement of social scientists. Hence in general, the National Agricultural Research System (NARS) in the country has not given major thrust for the farming system perspective. According to the International Wheat and Maize Improvement Programme (IWMIC), traditional research efforts are mostly conducted at research stations, under conditions not representative of farmers' fields. They often focus on increasing the productivity of the farms by generating new technologies, without properly understanding the existing farming systems, resulting in low adoption rate of the evolved technologies.

The researchers involved in the field of agriculture, should realize that at farm level any change caused by the introduction of a new technology will not only affect the component being studied, but the entire farming system within which the component is embedded. Therefore, it is necessary to view the farm level problems of agriculture in a "system" perspective. Further the research problems in agriculture must be need based and should be identified involving the clients' viz., the farmers.

1.3 Economic analysis

The past experience indicates that agricultural research in India has focused mainly on increasing the productivity of crops, while the farmers' objective is to realize better profitability. Hence it is evident, that for better adoption of research

results by the farmers, more attention is required on the economic aspects of the evolved technologies in addition to productivity. Upton (1979), Anderson et al. (1986), Dewett and Chand (1972), Chisholm and Mccarty (1978), Sankhayan (1981), Johl and Kapur (1992) and Dhondayal (1991) have stated that the 'Production Theories' of economics finds wider application in studies on farm management aspects of agricultural economics.

The economic analyses conducted in farmers' fields by Suryanarayana (1958), Khushro (1964), Rao (1965), Saini (1969), Sethuraman (1974), Dhawan and Bensal (1977), Hasan et al. (1982), Anjaneyulu, et al. (1983), Chowdhary and Parthasarathy (1986), Muralidharan (1987), Rao and Parthasarathy (1992), Rao (1993), Chowdhary and Parthasarathy (1993), and Sunandini et al. (1993) have focused on concepts like estimation of cost of cultivation of different crops, assessment of the resource use efficiency and returns to scale using production functions. However, these studies were mainly confined to a single crop enterprise and have not followed the farming system perspective i.e., these studies have performed various economic analyses based on the input-output coefficients for a single crop, without considering other crops and/or animal components of the farm. But in reality, there could be some degree of inter-relationship between the various crops and/or animal components of the farm e.g. output from one enterprise could be used as input in another.

During the sixties, economic analyses in farm management were mainly based on production functions. The Marginal Value Product (MVP) - Factor Cost Ratio (FCR) derived from the production functions indicated high degree of resource inefficiency in different crop enterprises and offered the scope for reallocation of farm resources to increase the productivity and profitability. However, increase in productivity is more a question of input-output management than mere reallocation of scarce resources. Hence from the mid seventies onwards, studies by Parthasarathy and Suryanarayana (1975), Bahadur et al. (1980), Singh (1982), Mohamad (1984), Rani (1984), Ramkumar (1985), Sivasamy (1985), Rao and Parthasarathy (1986), Venkatnarayana (1990), and Rao et al. (1993) performed the empirical analysis in farm management through cost functions. In this approach, the cost economics were studied based on the input-output coefficients in farming. This approach was considered more relevant because of increasing costs of inputs. However, as in the case of production function analysis, the research undertaken using statistical cost functions had also confined mainly to single crop enterprise and not considered other components of the farm.

Linear programming also occupied the prime position in studies relating to resource use efficiency and enterprise combination. Muthiah (1961), Johl and Kahlon (1967), Dhawan and Johl (1967), Sinha (1978), Mrythunjaya and Sirohi (1979) and Parthasarathy (1991) applied programming techniques for performing the economic analysis in studies on farm

management. However, these results were based on certain assumptions, which were often not true under real world situations. Further, these analyses focused mostly on one of the primary components of the farm, assuming that other components are constant.

Economic analysis carried out with farming system perspective considers all the major components of the farm and their technical and functional relationships; hence the results of these studies are more relevant under the real world situations. Economic analysis of multiple enterprise system was attempted by Singh (1961), Rajagopalan et al.(1961) and others using simple budgeting techniques. However, these studies were based on annual crop based farming systems, in which the return to investment was realized within a year.

The above said methodologies such as production function, cost function and programming techniques are suitable for annual crops. In perennial crops, the absence of proper farm accounting procedure impedes proper application of these economic analyses. The distinct features of perennial crops viz., (i) long economic life span (ii) multiphase of growth and bearing (iii) continuous flow of cost and return over a number of years with varying magnitude (iv) long gestation period between the investments in the initial years and pay-off in later years and (v) influence of present input on future output necessitate a different approach for performing the economic analysis.

According to Bokil and Srivastava (1979), the initial investment on perennial crops having a pre-bearing period of about 4-7 years is an asset that cannot be recycled. This component of cost of production is considerably higher than the annual maintenance cost and would take years to get realized by the growers. Hence, while performing the economic analysis in perennial crops, in addition to the maintenance cost, the return from a plantation should therefore cover the initial investment along with its interest. For this, Das (1984) has suggested that the annuity value of the initial investment should be added based on the economic life span of the crop to its annual maintenance cost to work out the cost of production. This approach was subsequently followed by Babu et al. (1993) for performing the economic analysis of other smallholder plantation crops. However, farmers cultivating small holder plantation crops like coconut and arecanut, seldom maintain records of input and output and hence compilation of data for economic analysis of these crops is a tedious task. Hence Sudha and Reddy (1987), Nallathambi et al. (1988), Bastine and Abdulrazak (1991) and Jaganathan (1992) have restricted their estimation of cost of cultivation to the bearing phase of the perennial crop. Gupta and George (1974) and Subrahmanyam and Mohandoss (1982) have collected input-output data for the entire economic life span of Coorg and Mandarin oranges, from a sample comprising of different age groups of the crop and worked out the economics based on the market prices of the relevant years. Chand (1994) criticized this approach, stating that it had

ignored the cross-farm differences in input use and suggested an alternative methodology through construction of lifetime matrix of data for a given variable. However, experience of field officials has indicated that the cross-farm variability of input application occur only during pre-bearing and bearing stages and not across the age of the crop. Moreover in the absence of farm records, neither the farmer nor the research personnel would be able to identify the precise age of the perennial crop. Hence the methodology for constructing lifetime matrix of data lacks field level application.

1.4 Farming Systems Research

The major limitation of the previous authors was that they have performed the economic analysis for a single perennial crop enterprise. This approach lacked the farming system perspective in which, in addition to the main crop of the farm, other components of the same or different enterprises would also be considered.

The objectives of Farming System Research extend from increasing the knowledge about the existing systems to finding solutions to the problems under different farming situations. However, the basic activity in any Farming System Research (FSR) is to understand the present production pattern and farming practices in relation to the different elements of the system. The present publication makes an attempt to describe in detail the various economic aspects of palm based farming systems. The economic analysis of perennial crops performed in the earlier studies were restricted to estimation of cost of cultivation, gross and net returns of a single component of the farm. They were mostly based on either experimental data from research stations. In contrast, in the present study, an attempt was made to perform the analysis of Palm Based Farming Systems viz., Coconut Based Farming Systems (CBFS) and Arecanut Based Farming Systems (ABFS), both under experimental as well as under farmer's field conditions.

CHAPTER II

PALM BASED FARMING SYSTEMS

Plantation crops are broadly classified as estate crops consisting of crops like tea, coffee, rubber and small holder's plantation crops like coconut, cashew, arecanut, cocoa etc. These crops (including that of spices) occupy an area of about six million hectares, which is about 3.4 % in the gross cropped area, and generate an annual income of more than Rs.5,52,590 million and export earning of approximately Rs.93,350 million. Plantation crops serve a variety of human needs such as food, oil, industrial raw materials, beverages and confectionary items. They generate huge employment opportunities directly or indirectly to several millions of people in their production, processing, marketing and international trade sectors.

Coconut, arecanut, cashew and cocoa are the major small holder's plantation crops cultivated in India. In terms of agro-climatic conditions, these crops are cultivated predominantly in the humid tropics and tropical belts of the country extending throughout the peninsular India comprising of Kerala, Karnataka, Tamil Nadu, Andhra Pradesh, Goa, parts of Maharashtra, and the north eastern region. They are cultivated in wide range of soil ranging from sandy to sandy loam, laterite etc. The major socio-economic features in which these crops are cultivated include predominance of small and marginal holdings, medium to resource poor farm environment, less marketable surplus and marketed surplus etc. However in crops such as arecanut and cashew, India is the largest producer in the world and realizes the highest productivity.

The characteristic features of the plantation crops such as a) their perennial nature, b) long gestation period, c) multiplicity of reproductive phase, d) continuous labour requirement, e) irrevocable nature of fixed resources like land etc., necessitates different approach for economic analysis from that of the annual crops.

2.1 Farming systems

System theory was employed by Dent and Anderson (1971), Emery and Frist (1971), Laszlo (1972), and Von (1973) as the guideline for studying farm-system description and analysis. Krantz et al. (1974) defined farming systems as an entire complex of development, management and allocation of resources, as well as decisions and activities which, within an operational farm unit or combination of units, result in agricultural production, processing and marketing of the products.

Ruthenberg (1980) defined farming system as a system which includes all workers and resources (elements of the system) which are under the management control of one decision-maker viz., the farmer, whether he is the owner, or a tenant, or an authorized manager. The structural and functional relationship between the different elements of the farm extend over time and space. They are numerous, direct and indirect and often stochastic. Moreover, they are to some degree undefined because of the human element involved. These relationships are more pronounced in small and marginal farms, when the produce prices are lower and input prices are higher and when the natural conditions are not favourable. Palaniappan (1984) stated that in any farming system, if the management, resource allocation and decision making are restricted to only crop husbandry, it is known as cropping system. If the same were extended to other farm enterprises like dairying, it is known as farming system.

A farming system is a complex, interrelated matrix of soils, plants, animals, power, implements, labour, capital and other inputs controlled in part by farming families and influenced to varying degrees by political, economic, institutional and social forces that operate at different levels. The combined effect of these factors is often location specific and there are many reasons behind their internal relations. In short, farming system is a highly heterogeneous and complex phenomenon.

2.2. Farming systems in the tropics

Tropical agriculture is predominant with small and marginal farmers due to increasing population pressure on land and by sub-division and fragmentation. As compared to medium and large farms in which the major aim is only market-oriented production and profit maximization, in case of the small holder, the farm and the household is closely linked with regard to operations and objectives. The major aim of the small farmers is to stabilize their farm income through capital accumulation in the form of animals or plantations or by technical, social, and economic achievements. Hence small farms are also known as multi-objective farms.

Indian agriculture is predominated by small and marginal farms, which constitute more than three-fourths of the total farm holdings. According to Maji.et.al (1995) the number of small and marginal farms in India has increased from 49.1 million in 1970-71 to 82.1 million in 1990-91 and during the same period, the national average of operational holding size went down from 2.3 ha to about 1.6 ha. Increase in population pressure on land and implementation of land reforms are the major reasons for the increasing trend in small and marginal farm holdings in the country.

With the development of various production, protection and processing technologies in Indian agriculture, at present more emphasis is given for maintenance of soil fertility and productivity, increasing gross farm income and efficient utilization of farm resources through intensive cropping. This is done through

farm diversification or farm intensification, which are often suggested as means for developing small and marginal farms. Haque (1996) defined farm diversification as i) shift from subsistence farming to commercial farming, ii) shift from low value food/non-food crops to high value food/non-food crops and iii) switch over from local to high yielding plant varieties. The diversification would also mean that small farms would not only undertake seasonal crop farming, but also animal husbandry, fishing, agro-forestry, horticulture etc. and would participate in industrial and other non-farm economic activities, as either self-employed or wage earners, for supplementing their incomes. However some distinctions need to be made between farm diversification and farm intensification.

Farm diversification is the method of cultivating different crops in various segments of land of the same farm, while farm intensification is another method of cultivation of different crops on the same unit of land of the farm. In case of farm intensification, two or more complementary crops are cultivated in the interspaces of the main crop. It is also referred as intercropping. Farm intensification provides better yield stability than farm diversification due to the complementary effects of the intercrops, more effective utilization of land and available light, water, or nutrients. While the traditional agricultural practices developed by the farmers over years of experience, focused on increase in production through increase in area and productivity, new agricultural technology based on farming systems added space and time dimensions to these components. This phenomenon is broadly known as multiple cropping. This is a practice through which farm productivity is increased by simultaneous cultivation of crops.

Small and marginal farmers, who are more risk-averse than large farmers, are expected to adopt higher degree of farm diversification or intensification for protection against natural and economic risk. This means that these farmers can make use of the production complemen tarities to reap the benefits of synergism through appropriate choice of crop combinations or other economic activities. This would help them to achieve maximum resource use efficiency through i) intensive use of land, ii) optimum use of time, iii) benefits from additional enterprises, iv) reuse of farm wastes and byproducts, v) rational use of farm family labour and vi) integration of farm and non farm activities.

2.2.1. Findings of the micro level studies

Walker et al. (1983) demonstrated that farm diversification significantly increased crop income stability in semi-arid India. Gupta and Tiwari (1985) confirmed that as compared to large farms, small farms were relatively more diversified. Studies by Thakur et al. (1985) revealed that farm diversification through vegetable cultivation in Himachal Pradesh helped the small farmers to earn sufficient income to make their livelihood. Studies conducted by the Indian Society of Agricultural Economics (ISAE) during 1987 and 1988 indicated that small farmers adopted multi-diversified farming through farm diversification and farm intensification. Jodha (1977) observed that

in the semi-arid regions of India, intercropping is practiced at a proportionately higher rate in small farms as compared to large farms. In contrast, McIntire (1983) found no relationship between the farm size and intercropping in the semi-arid areas of Upper Volta.

A study on diversification of Punjab agriculture by Singh et al. (1985) indicated an inverse relationship between farm size and agricultural diversification. However, the results of a number of other micro level studies conducted in different regions of India indicated that small and marginal farmers were not averse to farm diversification or intensification.

Though farm diversification and intensification are considered to be a favourable solution to increase the gross farm income, it is essential to assess their economic viability in small and marginal farms. Haque (1992) stated that in most cases, small-scale diversification of farming by marginal and small farmers do not generate adequate income for their sustenance. Moreover in the present socio-economic scenario, small and marginal farmers often do not have the ability to invest in additional crop and non-crop enterprises, which require more investment and labour input. They also find it difficult to take the risk of adopting any new agricultural economic activity, unless the relative economic gains from such activity have already been demonstrated elsewhere or unless the expected relative profitability from proposed diversification appears to be reasonably favourable in their perception. This is particularly true if the opportunity cost of such proposed diversification or intensification is high.

2.2.2. Coconut based cropping/ farming systems

Coconut is mostly cultivated as a small holder's crop in India, the average size of a holding being 0.22 hectare. More than 90 % of the five million coconut holdings in the country are less than one ha in size. These small holding coconut farms often do not provide adequate income to the dependent families and do not provide gainful employment opportunities for the family labour throughout the year. However, there are possibilities of increasing the productivity and net returns from coconut stands by raising compatible subsidiary crops and integrating livestock.

Under experimental conditions, among the annuals tried, tubers, rhizome spices, banana and pineapple were the most promising intercrops in coconut gardens, while cocoa was the best among the perennials. However under farmer's field conditions, due to non-adoption of scientific management practices, the productivity levels of these crops are low as compared to their potential productivity.

Multi-storeyed cropping systems are another model of coconut based farming systems under irrigated condition suggested for the humid tropics of India. It is an intensive four-crop combination, which includes coconut, black pepper (trained on coconut trunk), cocoa and pineapple

High Density Multi-Species cropping system is yet another model in coconut based cropping systems. This system involves growing a large number of crops to meet the diverse needs of the

farmer such as food, fuel, timber, fodder and cash, and is ideally suited for smaller units of land and aim at maximum production per unit area, time and input with minimum or no deterioration of land.

From the point of view of smallholder, it is important to note that labour, which is an important factor of production in deciding the cropping systems, comes from the farmer and his family. Experimental studies conducted at CPCRI, Kasaragod, indicated that the labour input increased from 120 days/ha/year in the case of rainfed coconut monocrop (at the adult stage of the palms) to 220 days in coconut + sweet potato system to 250 days in coconut + cassava system; to 251 days in coconut + elephant-foot-yam; to 280 days in coconut + greater yam system; and to 293 days in coconut + lesser yam system Gopalasundarm et. al (1993). In other words, the additional employment generation through tuber crop integration in rainfed coconut farming could be of the order of 100-173 days/ha/year at the third phase of coconut crop. In percentage terms, the increase in employement generation from the tuber mixed cropping is ranging between 83 and 144. However, in the case of annual spice mixed-crops such as ginger and turmeric, the labour absorption capability of coconut based system could go up to 620 days/ha/year or by 417 per cent over the coconut sole crop.

The employment potential of some of the irrigated mixed cropping models are observed to be very high. According to CPCRI estimates, the labour input utilization increased from 144 days/ha/year in the case of irrigated monocrop of coconut (at its stabilized yield stage) to 232 days with single hedge cocoa and further to 278 days with double hedge cocoa under mixed cropping system. In percentage term the increase comes to 61 to 93 per cent over the sole crop system. When the assessment was made for the multi-storeyed cropping models, the employment utilization was worked out at 335 and 380 days for systems with cocoa (single hedge) and cocoa (double hedge) respectively.

In the case of coconut based mixed farming system, the labour absorption rate for one hectare unit was found to be as high as 850 days per year. This rise comes to 490 percent over irrigated monocrop and 608 per cent over rainfed monocrop of coconut. Since it is expected that the bulk of the labour force is available from the family source of the farmer, his family labour income could therefore be considerably raised when he adopts coconut based cropping systems.

2.2.3. Arecanut based cropping systems

Arecanut is one among the palms cultivated under irrigated conditions in the humid tropics of peninsular and northeastern India. Arecanut cultivation is generally labour intensive. According to Nelliat et al. (1981), the average annual labour requirements vary from 275 to 355 man days per hectare. About three million people are depending either directly or indirectly on its production, processing and marketing sectors.

Arecanut, being a perennial crop has a gestation period of about 7 years

and has a long economic life span of about 45 years. The entire economic life span of arecanut can be classified into five phases viz., pre bearing (1 to 4 years), initial bearing (5 to 15 years), gradual increase in yield (15 to 25 years), stabilized yield (26 to 40 years) and yield reduction (> 45 years). In India, arecanut plantations are largely located in fertile valleys in the coastal and ghat regions of Kerala and Karnataka and alluvial deltas of Assam and West Bengal. Kerala, Karnataka, Assam and West Bengal are the major arecanut producing states in the country, accounting for more than 90 per cent of area and production.

Arecanut Based Cropping Systems (ABCS), as a productive land use system has received much attention in the recent past. However, the research efforts on these aspects are being made since the fifties. Bavappa (1951) reported that crops like banana, tapioca, black pepper, colocasia, yams, pineapple, jack and coconut were grown as inter/mixed crop in arecanut gardens.

Abraham (1956) indicated that spices like ginger, turmeric, black pepper and cardamom were suitable for cultivation as intercrops in arecanut gardens. According to Abraham (1956), Naidu (1959), Khader and Antony (1968), Bhat (1974) and Nagaraj (1974), small holding size, long pre-bearing age of arecanut, low income during early bearing phase, production and price risk and seasonality of income from arecanut were the major reasons for adoption of different ABCS models.

Sundaramurthy (1950), Bavappa (1951) and Brahma (1974) have stated that the crops chosen as inter/mixed crop vary from region to region. In general, preference is given for elephant foot yam and tapioca as intercrops in Kerala, citrus in Assam, betelvine in West Bengal and Assam, cardamom in Malanad of Karnataka and a general preference for banana in all the arecanut growing regions.

Das (1990) stated that the success of any farming system in terms of net returns depends on the choice of component species, which is in-turn based on several factors. This includes factors such as soil condition, weather, availability of water for irrigation, shade level, hazards of diseases and pests, varieties, time of planting, level of management etc. In addition, other socio-economic factors such as size of holding, labour resource, management skill, access to capital and credit, market outlet, price behaviour, theft problem, farmer's attitude and goals also influence the choice of the component crops in the farming system.

2.2.4. Socio-economic aspects of Palm Based Farming Systems

Some of the basic studies in multiple cropping conducted by Carneiro (1961), Conkin (1957) and Rappaport (1962) in tropical countries included socio-economic and cultural variables of the farmers along with other scientific parameters. This approach is more relevant in some context. For example, when the farm family, without mechanical help, does most of the work, the number, the age and sex composition of the family are the crucial factors, which change slowly over time, necessitating periodic adjustments in the farming system.

Understanding the rationale and the criteria for decision making by the farmer is an essential element in the design of any alternative farming system. For this, proper knowledge about the socio-economic and cultural traits of farmers is essential. For example, the farmers belonging to the Brahmin community in Kerala, Karnataka and Tamil Nadu do not include poultry as a component in their coconut or arecanut based farming system. According to Bradfield (1986), the adoption of nuclear or joint family system also influences the type and nature of the farming system.

Micro-level studies have confirmed that the socio-economic condition of the farmer and the constraints actually faced under their farming situations are the prime factors that would decide the small holder's choice of crops and/or livestock components of the farming system. According to Lang et al.(1984), Norman (1974), Bartsch (1977) and Rao (1975) and Shaner et al. (1982), economic factors like land holding size, availability of labour including family labour, availability of financial resources, profitability, marketing facilities, government incentives and management factors play a crucial role in the economic viability of any farming system. However, the driving force for any farming system to become popular among farmers is essentially the profitability of the system. Under any farming situation, the fundamental point is that farmers are more interested in profit maxmisation than yield maximisation.

The small holder arecanut farmer raises a wide variety of crops along with arecanut in the initial 4-5 years, primarily to receive some income from the land till the palms come to bearing. He also cultivates a wide variety of crops in adult arecanut garden not only for domestic consumption but also for extra cash income through the sale of additional products.

Das (1990) stated that adoption of PBFS would provide economic stability to the farmer against production and price risks. Rawther and Nair (1982) have reported that in the case of arecanut, the major production risk in Kerala and coastal Karnataka regions is the high level incidence of a disease viz., Mahali (fruit rot disease) during monsoon season. The severity of this disease could lead to the death of the palm and reduces the net returns even upto 75 %. Adoption of ABFS would help to sustain the gross farm income against this disease.

Infrastructure is another major factor, which would influence the adoption of ABFS. During the fifties, since domestic production of arecanut was not sufficient to meet the demand, India had to import large quantities of arecanut from Singapore, Sri Lanka and Malaysia. During 1951-52, the country had imported 45,397 t of arecanut valued to the tune of Rs.466 crores. In an effort to minimize the drain of foreign exchange, the Government of India strengthened the measures undertaken by the State Governments particularly of Karnataka and Kerala, to increase arecanut production. As a result of this, the country became self-sufficient and imports were stopped from 1969. But the gradual increase in arecanut production over and above the domestic demand

caused a glut in the market and towards the end of 1973, the arecanut price fell down to almost half that of 1969-70 prices. In contrast, the cost of various inputs required for arecanut cultivation increased making it an unviable venture. It was on this occasion that the State Governments of Kerala and Karnataka decided to jointly establish a central cooperative institution viz., Central Arecanut and Cocoa Marketing and Processing Co-operatives (CAMPCO), to improve the marketing system and ensure a reasonable price to growers in the two States.

Lakshmanachar (1990) reported that cocoa was a major component of ABFS of northern Kerala and coastal Karnataka. Even now, cocoa is generally grown as a mixed crop in the arecanut gardens of Kerala and Karnataka. It is estimated that at present there are 30,000 cocoa growers in the country. Although cocoa was introduced in India in the sixties, large-scale cultivation started only in the early seventies. At that time there were about six manufacturing units for cocoa products, including the Cadbury India Ltd. This company, besides cultivating cocoa in its private gardens, also encouraged arecanut cultivators in Kerala to take up cocoa cultivation to enable it to meet the local requirements. Simultaneously, the Government of India also encouraged cocoa cultivation, particularly in Kerala and Karnataka. As a result, the area under cocoa increased and consequently its production also increased. The price of cocoa beans which had been increasing in the international markets since 1973 reached its maximum during 1978-79 and as a result of this, the domestic price of cocoa went up to Rs.40/ kg of dry beans. This price rise encouraged the cultivators to increase the area under cocoa. But during the first half of the eighties, there was a sudden fall in the international prices of cocoa beans due to heavy supply from other major cocoa producing countries. This had its reflection in the domestic market and consequently the price of cocoa beans fell down to Rs.13 to 15/kg of dry beans. As a result, cocoa manufacturers in India, particularly Cadbury India Ltd. restricted their procurement only to the produce from their own gardens in Kerala. The price fall left the growers in Kerala and Karnataka in the lurch and their monetary loss was heavy. After this, most of the farmers in northern Kerala, especially in Kasaragod district have removed cocoa, from their ABFS. However, CAMPCO again came to the rescue of the farmers and started a cocoa-manufacturing factory for the manufacture of chocolates and value added cocoa products such as cocoa butter, cocoa mass, cocoa powder etc. Through all these years CAMPCO has helped the arecanut and cocoa growers by providing them better marketing facilities and ensuring a reasonable price for their produce

Researchers claim that adoption of PBFS is one among the best ways to overcome the various production and price risks in coconut or arecanut cultivation. However, the field level success of PBFS mainly depends on the profitablity of the systems under farmers' field conditions, which could be assessed through suitable economic analysis. The following chapter depicts the procedure for performing economic analysis.

CHAPTER III

ECONOMIC ANALYSIS

Before the 1980's, economic analysis of PBFS was carried out by Kannan and Nambiar (1976), Krishnaji et al.(1976), Das (1984), Nambiar et al. (1988), Das (1989), Das (1990), Hegde et al.(1991), Das and Nair (1993) based on experimental data. Opio (1990) used simple Benefit-Cost Ratio for determining the most cost-effective enterprise or optimum intercrop combination under coconut based farming systems. Guzman (1990) applied partial budgeting techniques for analysis of PBFS. As the term suggested, partial budget considers only the variable costs involved in changing from one farming technology to another. Under partial budgeting, the economic viability of a recommended technology may be assessed through the calculated net benefits or Returns Above Variable Costs (RAVC) but the more significant analysis is in terms of Marginal Rate of Return (MRR).

Marginal analysis indicates the average expected gain for the farmer, in return for what has been invested, in changing from one farm practice to another. In addition, this also considers the variability of input and product prices and the minimum acceptable rate of return when farmers are willing to adopt a given technology. It could be used as one among the techniques in the selection of the best alternative for profit maximization in the farming system.

Karunanayake (1990) employed a simple multi-period budgeting technique that could be adopted by the researchers and extension personnel to rank, compare and to explain to the farmers the economics of different multi-period, multi-enterprise models that are being recommended for PBFS. This technique was used taking into account the cost and time required for the production of crops. The expected future revenues from different multi-enterprise models were valued in terms of the sum of their Net Present Values and their Amortized Values or Annuities were used as the main criteria. In addition, return per labour day, cost/price sensitivity index, discount rate sensitivity index, land use factor and crop intensity factor were also used.

To test the economic worthiness of the investment in palms, three common indicators of the financial analysis suggested by Gittinger (1984) viz., the Benefit-Cost Ratio (BCR), the Net Present Worth (NPW) and Internal Rate of Return (IRR) were applied by Das (1985), Karunanayakae (1990), Korikanthimath et al.(1998), Bhalerao et al. (1985) and Singh et al. (1974). In the case of ABFS, Sannamarappa (1993) performed the economic analysis based on experimental data using cost-benefit and investment analysis.

The major limitation of the above studies is that they were based only on experimental data from different research institutions. Since the factors of production like land, labour, irrigation, capital and management were often under controlled conditions in the research institutions, the economic analyses carried out in these studies do not represent the realistic situation of the farmers fields.

3.1 Data sources and collection

The data for performing economic analysis in the present study is collected mainly from two major sources viz., primary and secondary. Secondary data sources are authorized data sources, in which specified agencies concerned with subject matter/crops collects the data (usually on a continuous basis) and publish them. With the advancement of Information Technology, specific web sites such as www://fao.org, www://apcc.org etc. are available for secondary data collection.

Primary data collection in plantation crops can be performed in two ways viz., a) cost accounting method and b) survey method. In the case of cost accounting method, farm records are well maintained and the accounting procedures are well adopted. This is usually being practised in estate crops such as tea, coffee and rubber. However in the case of small holder's plantation crops, adoption of cost accounting method is restricted to large scale plantations only. Though cost accounting method is more precise, in the case of Indian plantation crops sector, predominated with small and marginal farmers, survey method is widely practiced.

3.2 Analytical Procedures

The economic analysis of plantation crops is carried out based on cost and return concepts. This includes

Cost A1:

i) Value of hired labour, ii) values of insecticides, pesticides and other chemicals, iii) Value of manure (owned and purchased), iv) Value of fertilizers v) depreciation on implements and farm buildings vi) irrigation charges vii) land revenue, cesses and other taxes viii) interest on working capital @ 10% per annum, ix) Miscellaneous expenses

Cost A2: Cost A2 + rent paid for leased in land

Cost B1: Cost A1 + interest on owned fixed capital assets (excluding land) @ 5 % per annum

Cost B2: Cost B1 + rental value of owned land (net of land revenue) and rent paid for leased in land

Cost C1: Cost B1 + imputed value of family labour

Cost C2: Cost B2 + imputed value of family labour

Annuity value

Since the economic analysis is based on perennial crops where land is devoted for more than 30 years, one would like to include the opportunity cost of land investment to the total cost. However cultivation of a perennial crop in a land area over a period of time maintains its fertility

and productivity status. Moreover in the present trend, in which pressure on land is more, the opportunity cost of land investment need not be included since the land value continues to appreciate. In order to assess the value of total investment (pre-bearing establishment cost) and the compound interest thereon, the concept of annuity value is being widely used. The annuity value is calculated by using the formula

$$A = \frac{P}{\sum_{i=1}^{n} \frac{1}{(1+r)^n}}$$

where A = Annuity Value

P = Prebearing establishment cost

r = Rate of interest (Opportunity cost of long term investment)

n = Life of the Plantation

The annuity value thus obtained will be added to the annual maintenance cost to arrive at the total cost per unit area.

Investment analysis

To test the economic worthiness of the investment in plantation crops, three common indicators of the financial analysis viz., Benefit-Cost Ratio, Net Present Worth and Internal Rate of Return may be used.

i) Benefit-Cost Ratio (BCR) :

$$BCR = \frac{\sum_{i=1}^{n} \frac{B_n}{(1+i)^n}}{\sum_{i=1}^{n} \frac{C_n}{(1+i)^n}}$$

If BCR is >1, the investment is economically viable

ii) Net Present Worth (NPW):

$$\sum_{i=1}^{n} \frac{Bn - Cn}{(1+i)^n}$$

The higher the value of NPW, the more is the profit that could be realized from the investment.

iii) Internal Rate of Return (IRR):

$$\sum_{i=1}^{n} \frac{B_n - C_n}{(1+i)^n} = 0$$

Where B_n = discounted benefits in each year

C_n = discounted costs in each year

n = number of years

i = discount rate

If IRR is > the long term bank interest rate for agricultural loans, it is recommended that investment can be made by taking institutional credit.

A discount rate of 8 % to 10% is generally considered for long term investment analysis.

3.3 Analysis for cropping/farming systems

The inter-spaces between perennial crops like coconut could be effectively utilized for the cultivation of other annuals, biennials and perennials and such a

practice is referred as Palm Based Cropping System. Adoption of coconut or arecanut based cropping system models improves the resource use efficiency of fixed resources such as land and other natural resources such as water, sun light and human resources such as labour etc. The economic analysis of these systems involves certain specific indicators, which would prove the economic viability of the system.

Monetary Advantage

Monetary advantage of adopting a particular farming system model, under farmers field condition is defined as the ratio between the realized net return of that model to the realized net return from arecanut monocropping.

$$\text{MA of any PBFS model} = \frac{\text{Net return from the PBFS model}}{\text{Net return from perennial monocrop}}$$

The higher the value of Monetary Advantage (MA) the more is the profitablity of the Palm Based Farming System.

Budgeting techniques

Based on the principle of Marginal Rate of Return (MRR), partial budgeting technique can be applied to identify the profitability of inter/mixed crops in coconut or arecanut gardens. Marginal Rate of Return is the ratio of change in net benefits (Change in Returns over Variable Cost) of two alternative technologies to their change in marginal costs (Variable Costs). The results indicate the average gain that can be expected by the farmers when they decide to adopt one particular PBFS model.

$$MRR\ (\%) = \frac{\text{Marginal net benefits } (RAVC_2 - RAVC_1)}{\text{Marginal costs } (TVC_2 - TVC_1)} \times 100$$

Where,

$RAVC_1$ = Return Above Variable Cost for Coconut / arecanut monocrop

$RAVC_2$ = Return Above Variable Cost of the PBFS model

TVC_1 = Total Variable Cost of coconut/ arecanut monocrop

TVC_2 = Total Variable Cost of the PBFS model

The higher the value of MRR (%), the more is the profitability of the farming system model.

Sensitivity analysis

The ultimate objective of growing inter/mixed crops, is to stabilize the gross farm income. Sensitivity analysis is a tool, which could be adopted to prove this. To assess this, the cost-benefit analysis may be carried out for different Palm Based Farming System Models at varying output prices of the main crop.

For example, the gross farm income is estimated by varying the output prices of coconut such as Rs. 2.5 per nut (low), Rs. 4.0 per nut (medium) and Rs. 6.5 per nut (high). The final results would indicate that the economic significance of inter/mixed cropping in coconut garden is better realized when the prices of coconut is low.

Land Equivalent Ratio

The concept of Land Equivalent Ratio (LER) is used to assess the yield advantage in intercropping. Mathematically it is expressed as

$$LER = \sum_{I=1}^{m} \frac{Y_i}{Y_{ii}}$$

Where Y_i is the yield of the i^{th} component crop from a unit area of intercrop expressed, as a fraction of the yield and Y_{ii} is the yield of that component grown as sole crop over the same area. If LER = 1, the various yields harvested from the intercrop could have been obtained from the unit area planted to sole crops, each occupying an appropriate fraction of the total area. Also, the overall yield per unit area of intercrop is never greater than that of the most productive sole crop.

If LER is > 1, and the sole crop yields are identical, an LER of 1+x implies, that the intercrop out yields the sole crops by x%. On the other hand, for a given x, if the sole crop yields are sufficiently different, the LER will not be large enough to imply an overall advantage for intercropping.

Return per Rupee Invested

This index provides an estimate on the economic worthiness of investment in a particular cropping system.

$$\text{Return per Rupee Invested} = \frac{\text{Gross Return}}{\text{Total Variable Cost}}$$

The higher the value of the returns per Rupee invested, the more is the profitablilty realised by PBFS model.

A related index is the return per Rupee invested on labour which indicates the economic efficiency in labour utilization.

$$\text{Return per Rupee Invested On labour} = \frac{\text{Gross Return} - (\text{Cost of Cultivation except that incurred for labour})}{\text{Cost of labour}}$$

The higher the value of the return per Rupee invested on labour, the better is the labour utilization.

Per Day Return

This gives the economic efficiency of the cropping system and is calculated by using the formula

$$\text{Per Day Return} = \frac{\text{Net Return}}{\text{Cropping Period (in days)}}$$

3.4 Economics of coconut based cropping/farming systems

Coconut based cropping/farming system is a common feature among the coconut farmers in different parts of India. However, the scientific adoption of this technology to realize profit maximization is not a common practice in majority of coconut growing tracts.

In West Godavari district of Andhra Pradesh, elephant foot yam, colocasia, ash gourd, turmeric, bottle gourd, cinnamon, amaranthus, banana, cabbage, cauliflower and forage crops are the commonly cultivated intercrops in coconut gardens.

In Orissa, coconut is cultivated primarily as a sole crop. Since the state has a long coastal belt, introduction of

mixed farming with pisciculture as a major component would increase the gross income of the farm. For this purpose, the services of the scientists from the Orissa University of Agricultural Technology and the Central Institute of Fresh water Aquaculture could be utilized.

Few farmers cultivate elephant foot yam and Guinea grass as intercrops in coconut gardens. This practice could promote additional income to the farmers and sufficient fodder to the cattle.

Experiments carried out at CPCRI Kasaragod have indicated that vegetables like snake gourd, bottle gourd, amaranthus, coccinia, brinjal and bitter gourd as compatable crops with coconut. Intercropping with vegetables helped to generate additional employment to the tune of 215 to 365 mandays/ha/year (CPCRI 1995).

In the experiment conducted at Arsikere it was observed that when inter crops like banana, drumstick, french bean, bhendi and redgram, were cultivated in coconut garden, the yield increased from 3200 nuts/ha. to 5150 nuts /ha. In addition, the yield from inter crops were also promising.

The coconut based cropping models at Kahikuchi during 1998 showed that the model having coconut + pepper + banana + lemon + pineapple + ginger could earn a net return of Rs. 64948/ ha as compared to Rs. 20332/ha from coconut monocrop.

At Veppankulam in Tamilnadu, during 2002, the realized average annual yield of coconut in the cropping system model of coconut + mango + pepper + banana + lime + coleus + bhendi was 145 nuts per palm as compared to 104 nuts per palm in coconut monocrop. The intercrops yielded at the rate of 2840 kg / ha banana, 1145 kg/ha coleus and 1723 kg/ha of bhendi.

Among the six species tried as mixed crop in an experiment at Ratnagiri in Maharashtra, coconut + nutmeg was found to be the best with a realized net return of Rs. 110070/ha based on 2001-02 market prices. This was followed by coconut + garcinia (Rs. 58073/ha) and coconut + cinnamon (Rs. 48110/ha). The realized net return from coconut monocrop was Rs. 23770/ha. Other mixed crops like all - spice, clove and pepper gave additional net return over coconut monocrop.

The feasibility studies of intercropping ornamental, medicinal and aromatic crops in the interspace of coconut garden revealed that *Heliconia*, Anthurium, *Jasminum pubescence* and Marigold under ornamental crops and medicinal crops such as Long pepper and Patchouli were compatible as intercrops in coconut garden. (CPCRI, 2003).

In the coconut based high density multispecies cropping system, involving banana as the intercrop, pineapple, clove and black pepper as mixed crops, the coconut yield for the year 2002-03 ranged from 130 nuts/palm/year under no fertilizer control treatment to 143 nuts/ palm/year at two third of the recommended fertilizer dose(Table 1). The productivity of the palm declined with the reduction in the fertilizer levels beyond 1/3rd of the recommended fertilizer treatment.

The yield of the clove tree varied with the fertilizer treatments. The clove yield ranged from 0.246 kg/tree/year under no fertilizer control treatment to 1.44 kg/tree/year at full dose of the recommended fertilizer dose. The average weight of banana bunch was highest in the full recommended dose treatment (6.20 kg/bunch). The average weight of pineapple fruit was highest in the full-recommended fertilizer dose treatment (528 g). The total cost involved in maintaining the system under various fertilizer doses ranged from Rs 48,983(no fertilizer dose) to Rs. 56,973 (Full dose). The net returns were highest in the treatment, two third of the recommended fertilizer dose (Rs 63,579/-) with a Benefit Cost Ratio of 1: 2.18 (Table 2).

Table 1 Output from 1.2 ha coconut based cropping system model at Kasaragod (2002-03)

Treatment	Coconut (Nos)	Pineapple (kg/fruit)	Clove (dry kg/ tree)	Banana (kg / bunch)	Black pepper (kg / bush)
Full dose	133	0.53	1.44	6.21	0.34
2/3rd rec. dose	143	0.52	0.72	5.49	0.63
1/3rd rec. dose	142	0.50	0.52	4.01	0.46
1/4th rec. dose	131	0.43	0.51	4.55	0.70
1/5th rec. dose	132	0.49	0.49	3.43	0.34
No fert.- (Control)	130	0.41	0.25	4.21	0.13

Table 2 Economics of coconut based high density multi - species cropping system model at Kasaragod Rs. per 1.2 ha (2002-03)

Treatment	Cost of cultivation	Gross Return	Net Return	BCR
Full dose	56973	117204	60230	2.05
2/3rd rec. dose	53649	117228	63579	2.18
1/3rd rec. dose	50324	109119	58795	2.16
1/4th rec. dose	49989	106832	56843	2.13
1/5th rec. dose	49787	100351	50563	2.01
No fertilizers (Control)	48983	93015	44032	1.89

Table 3. Economics of coconut based farming systems (Rs./ha)

System	Gross cost	Gross return	Net return	Return above monocrop	** Net return	Additional Employment Generated (mandays/year/ha)
Coconut monocrop	17000	49000	32000	-	22400	
Coconut + Elephant Foot Yam	64100	110900	46800	14800	36300	131
Coconut + Ginger	74500	142000	67500	35500	52700	500
Coconut + Tapioca	34700	100400	65700	33700	58400	130
Coconut + Vegetables	33000	83000	50000	18000	49370	125
Coconut + Clove *	47880	101000	53120	21120	48700	150
Coconut + Banana *	59680	130150	70470	38470	59830	230
Coconut based HDMSCS*	52000	140000	88000	56000	61400	191
Coconut based mixed farming *	172000	258000	86000	54000	65200	600

Source: For employment generation Gopalasundaram, et. al (1993).
Estimated figures for 2001-02 * under irrigated conditions
** When the price of coconut was less by 30%

Economic returns from various coconut based cropping/farming systems are furnished in Table 3.

It could be inferred from the above table that the return over coconut monocrop is ranging from Rs.14800/ha in the case of coconut +elephant foot yam to as high as Rs.56000/ha in the case of coconut based high density multi-species cropping systems. The significance of income from the inter/mixed crops or

Table 4: Economics of coconut based intercropping system in West Bengal*

Crop combination	Cost of cultivation (Rs/ha)	Gross return (Rs/ha)	Net return (Rs/ha)	Profit from intercrop (Rs/ha)
Coconut monocrop	19000	37170	18170	-
Coconut + Turmeric	47000	88620	41620	23450
Coconut + Ginger	73950	132370	58420	40250
Coconut + EF yam	76750	121170	44420	26250
Coconut + Colocasia	36900	68670	31680	13510

Note: Coconut – Rs3.50/nut; Turmeric – Rs 3.50/kg; Ginger – Rs 8.00/kg; EF yam – Rs4.00/kg; Colocassia – Rs 3.00/kg * Based on 2001-02 prices

other enterprises could be better realized if the price of coconut and its products are less. Thus adoption of coconut based cropping/farming systems could stabilize the gross farm income of the coconut farmers.

In West Bengal, adoption of various coconut based intercropping systems could yield a profit ranging from Rs. 13510/ha in the case of coconut + colocasia to Rs.40250/ha in the case of coconut + ginger (Table 4).

Adoption of coconut based cropping / farming systems could pave way for providing additional employment over coconut sole crop. The same ranges from 125 man days per per hectare in the case of coconut + vegetables to 600 man days per year per hectare in the case of coconut based mixed farming (Table 5).

Table 5 Additional employment generation in coconut based farming Systems

System	Additional Employment Generated (man days/ year/ha)
Coconut monocrop	
Coconut + Elephant Foot Yam	131
Coconut + Ginger	500
Coconut + Tapioca	130
Coconut + Vegetables	125
Coconut + Clove	150
Coconut + Banana	230
Coconut based HDMSCS	191
Coconut based mixed farming	600

A field survey conducted during 2001-02 in ninety coconut farmer's holdings each in Kasaragod, Ernakulam and Thiruvananthapuram districts of Kerala confirmed that cultivation of inter/ mixed crops had improved the gross farm income both under rainfed and irrigated conditions. In small and marginal farms, under rainfed conditions, the Marginal Rate of Return (MRR) ranged from 2.73 in the case of coconut + tapioca to 4.96 in the case of coconut + Elephant Foot Yam and under irrigated conditions, the same had ranged from 1.97 in the case of coconut + arecanut to 5.32 in the case of coconut + banana. In the case of medium and large farms, under rainfed conditions, the MRR ranged from 2.75 in the case of coconut + tapioca to 5.6 in the case of coconut + elephant foot yam. Under irrigated conditions, the MRR ranged from 1.47 in the case of coconut + arecanut to 5.79 in the case of coconut + banana.

Technological interventions on intercropping implemented during 2002-03 in farmers field conditions in the East Coast of India for cultivating crops like banana, bitter gourd, snake gourd, bhendi, tapioca, fodder grass, rice, ragi, groundnut etc. proved to be technically feasible and economically viable. The additional net return ranged from Rs.10000/ha in the case of coconut + ragi to Rs.76250/ha in the case of coconut + fodder grass (Table 6).

Table 6 Realized net return through intercropping under Farmer's field conditions in the East Coast of India (Rs./ha)

Cropping System	Net Returns	Net Returns above mono crop
Coconut monocrop	53750	-
Coconut + Tapioca	68750	15000
Coconut + groundnut	63750	10000
Coconut + bhendi	71250*	17500
Coconut + Cumbu Napier	130000**	76250
Coconut + rice	66250	12500
Coconut + ragi	63750	10000
Coconut + banana	78750*	25000
Coconut + snake gourd	66250	12500
Coconut + bitter gourd	70000*	16250

Based on 2002 - 03 market prices in Pondichery region
** Significance at 1% level. *Significance at 5% level.

Integrated nutrient management is an integral part of coconut based cropping system. While the main and component crops receive inorganic nutrients based on individual crop requirements, the organic addition brought through leaf litter recycling, stem flow, through fall etc., complementary interactions and biological activity brings in all benefits of integrated nutrient management on productivity.

A number of studies on response of coconut palms to fertilizer applications have shown that poor bearers exhibiting greater response and the palms with nut yields exceeding 60 nuts per year showing least/no response. The increase in the yield of nuts in control (coconut alone) plot reflected the influence of better management practices like irrigation and probably, its interaction with higher dose of fertilizers. Even after accounting for that, there seems to be some beneficial interactive effect of the crop combination of coconut and cocoa. This synergistic effect of increase in the yield of palms is an excellent example of non-monetary input in crop production. The system functions as a self reliant system based on the regenerative capacity of a biologically active soil and beneficial interactions of the different components involved.

3.5 Economics of arecanut based cropping/farming systems

The experiments on arecanut based farming systems conducted at Assam Agricultural University indicated that based on the average of 1993-95 market prices, the gross return was the highest from arecanut + pepper (Rs. 4.92 lakh/ha) followed by that of arecanut + pepper + fodder grass (Rs. 4.58 lakh/ha) in pre - bearing stage. The net return from these systems was Rs. 3.78 lakh /ha and Rs. 3.52 lakh /ha respectively. During the bearing stage, a gross return of Rs. 6.42 lakh/ ha was realized from arecanut + banana + pineapple system, followed by Rs. 6.01 lakh / ha in arecanut + pepper + pineapple system. However their respective net return was Rs. 5.2 lakh /ha and Rs. 4.29 lakh / ha (Kakaty et.al, 2002)

A study on the arecanut based high density multispecies cropping models was taken up at CPCRI, Research Centre at Mohitnagar during 1983. Nine different crops including annuals, biennials and perennials were tested for assessing their suitablility to grow in arecanut gardens, both under irrigated and rainfed conditions. Result of seven years study showed that all the crops can be grown satisfactorily in the interspaces of arecanut. Black pepper was found to be one of the most productive crops, while pineapple and turmeric were least productive. Arecanut + banana + black pepper + cocoa or acid lime can be a most profitable combination for the region. Due to high water table existing in the region, all the crops including arecanut were found to perform well under rainfed condition except shallow rooted crops like betelvine and black pepper. (Reddy et.al 1993)

Studies on areca based HDMSCS were conducted at CPCRI Regional Station, Vittal during 1983-84 to 1992 - 93. In this system, the return from pepper was maximum (Rs.35104/ha) in the 5th year and later on it decreased. The returns from cocoa reached Rs. 15720/ha during 10th year from 210 trees. This contributed 10% of the total return from the system. Even though banana gave positive net return during second year it failed in the later years. The return from pineapple and coffee were negative throughout the period. (Ravi et.al 1999). Another experiment conducted at the same station with cocoa and clove as inter crops in a 17 year old arecanut garden revealed that by the introduction of intercrops, the arecanut yield is not adversly affected; but slightly improved.

A sample survey conducted at three taluks of South Kanara district in Karnataka revealed that growing inter- crops during pre bearing stage was profitable under different irrigation systems. The total cost of raising intercropping system came to Rs. 42,725/ha under drip irrigation and Rs. 75,233/ha under non-drip irrigation. The gross return realized from intercrops was Rs. 2,02,500 /ha and Rs. 2,18,125/ha for drip irrigation and non-drip irrigation respectively. The net return was higher on drip irrigated by Rs. 18,883/ha due to higher productivity and lower cost of production of intercrops. The cost of establishment could be reduced to an extent of 70.76 percent and 71.48 percent respectively under drip and non-drip irrigation system.

Arecanut based cropping system in North Kerala

Economics of arecanut based cropping/farming system was estimated based on the field servey conducted in 400 arecanut holdings of Northern Kerala. The cost of cultivation is a major aspect, which would influence the degree of farm intensification in arecanut gardens. It was observed that under experimental conditions, the increase in cost of cultivation of ABFS models over arecanut monocrop had ranged from 9.5 % in case of arecanut + cocoa system to 61.2 % in the case of arecanut + banana + pepper + cocoa system (Table 7).

Table 7. Total Cost for Adoption of Different ABFS Models - Experimental Conditions (Rs/ha)

S.No	ABFS Model	Gross Cost	% Increase over monocrop
01	Arecanut monocrop	84140	-
02	Arecanut + banana	107550*	27.8
03	Arecanut + pepper	104260*	23.9
04	Arecanut + cocoa	92130	9.5
05	Arecanut + banana + pepper	126330*	50.1
06	Arecanut + banana + cocoa	115530*	37.3
07	Arecanut + pepper + cocoa	112180*	33.3
08	Arecanut + banana + pepper + cocoa	135640*	61.2

* Significant at 5% level

Based on 1997 - 98 Market prices in Northern Kerala

Under farmer's field conditions, it was observed that though different combinations of arecanut, dairy, coconut, pepper and banana were widely adopted in ABFS, they were mostly undertaken in a non-systematic manner. The technical feasibility and the economic viability of ABFS depend on the average planting density of arecanut which in turn based on the adoption of proper spacing between arecanut palms. However, it was observed that the average planting density in case of arecanut exhibited a high degree of variation, which was mainly due to non-systematic planting of arecanut. Another major observation made was that in most of the farms, the planting density of different component crops like banana, black pepper etc. were far below as compared to their optimum level and hence the realized returns from these component crops are lower than their potential.

Researchers state that the application of optimum dose of organic manures and chemical fertilizers is essential for increased returns from ABFS. However, it was observed that though farmers apply adequate organic manures to arecanut, the same was not applied as per the requirement in case of component crops like coconut, black pepper, cocoa

and banana. In case of chemical fertilizers, neither arecanut nor the intercrops are given the optimum dosage. In spite of this, even under the farmer's field conditions, the average cost of cultivation per unit area had increased with the degree of farm intensification and the share of labour, organic manures and plant protection was more in the Total Variable Cost.

Under farmer's field conditions, in case of marginal holdings, the average annual cost of cultivation ranged from Rs.35,990/ha in case of arecanut monocrop to Rs.1,48,440/ha in case of arecanut + coconut + banana + pepper + dairy systems. The corresponding figures in case of small holdings are Rs.30,960/ha and Rs.1,52,280/ha. In case of medium holdings, the same had ranged between Rs.74,250/ha in case of arecanut + banana + pepper + dairy system to Rs.1,32,670/ha for arecanut + coconut + banana + pepper + dairy system. In case of large farms, the same varied between Rs.1,09,770/ha for arecanut + coconut + banana + pepper + dairy

Table 8. Total Cost for Adoption of Different ABFS Models - Farmers' Field Conditions (Rs/ha)

S.No	ABFS Model	Annual Cost of cultivation			
		Marginal	Small	Medium	Large
01.	Arecanut monocrop	35990	30960	-	-
02.	Arecanut + coconut	55190* (53.3)	90110* (191.1)	- -	- -
03.	Arecanut + dairy	75430* (109.6)	80460* (159.9)	- -	- -
04.	Arecanut + coconut+ dairy	104360* (190.0)	92470* (198.7)	108270 -	- -
05.	Arecanut + banana + dairy	111530* (210.9)	94190* (204.2)	97660 -	- -
06.	Arecanut + banana + pepper + dairy	111910* (210.6)	101700* (228.5)	74250 -	-
07.	Arecanut + coconut + banana + dairy	138030* (283.5)	102860* (232.2)	114840 -	132800 -
08.	Arecanut + coconut + banana + pepper + dairy	148440* (312.4)	152280* (391.9)	132670 -	109770 -

Figures in parentheses indicate percentage increase over arecanut monocrop

* Significant at 5% level

system Rs.1,32,800/ha in the case of arecanut + coconut + banana + dairy system. It was further observed that as the degree of farm intensification increases, the capital requirements per unit area of land for adopting different ABFS is less in medium farms as compared to small and marginal farms. In case of marginal farms, the percentage increase of cost of cultivation for different ABFS models over monocropping ranged from 53.3 % in case of arecanut + coconut system to 312.4 % in case of arecanut+coconut+ banana+pepper+dairy system. The same in case of small farms was ranging from 191.1 to 391.9% (Table 8).

Profitability

The economic analysis performed for different ABFS models under experimental conditions indicated that all the ABFS models had realized higher net returns as compared to arecanut monocrop (Table 9). The same had ranged from Rs.1,30,360/ha in case of arecanut monocrop to Rs.2,14,180/ha in case of arecanut + banana + pepper + cocoa system. The percentage increase of net returns over arecanut monocrop ranged from 6.6 % in case of arecanut + banana system to 64.3 % in case of arecanut + banana + pepper + cocoa. The Marginal Rate of Return was very high for most of the models. The investment analysis performed for testing the economic worthiness of arecanut + banana, arecanut + pepper and arecanut + cocoa models. Since the Internal Rate of Return was highly positive and well above the opportunity cost of capital, it is advisable even

Table 9. Realized Net Return from Different ABFS Models - Experimental condition (Rs/ha)

S.No	ABFS Models	Net Return	Net Return **
01.	Arecanut monocrop	130360	86000
02.	Arecanut + banana	138950	102300
03.	Arecanut + pepper	188240*	126000
04.	Arecanut + cocoa	146380	97500
05.	Arecanut + banana + pepper	198170*	137200
06.	Arecanut + banana + cocoa	152660*	131750
07.	Arecanut + pepper + cocoa	207900*	158300
08.	Arecanut + banana + pepper+ cocoa	214180*	161380

Based on 1997-98 Market prices in Northern Kerala
Note: Figures are rounded to the nearest tens
Net returns was estimated when the unit price of arecanut was @ Rs.65/kg
* Significant at 5% level

** *When the arecanut price was less by 30%*

to acquire credit for investing in these models.

In case of farmer's fields, even under the low level of management, the ABFS models adopted in small and marginal farms realized better net returns as compared to arecanut monocrop. The realized net return in different ABFS models was very high as compared to arecanut monocrop(Table.10). In case of marginal holdings, the realized net return ranged from Rs.36,850/ha for arecanut monocrop to Rs.1,13,580/ha in case of arecanut + banana + pepper + dairy system. In case of smallholdings the same ranged between Rs.28,590/ha in case of arecanut monocrop to Rs.1,09,620/ha in case of arecanut + banana + pepper + dairy system. In case of marginal farmers, the increase in net returns for different ABFS models over that of arecanut monocrop ranged between 1.7 % in case of arecanut + coconut system to 208.2 % in case of arecanut + banana + pepper + dairy system. The respective figures in case of small farms were 69.2 % and 283.4 %. The Marginal Rate of Return was very high for almost all the models, irrespective of holding size.

Table 10. Realized Net Return from Different ABFS Models - Farmer's Field Conditions (Rs/ha)

S.No	ABFS Model	Net Returns			
		Marginal	Small	Medium	Large
01.	Arecanut monocrop	36850	28590	-	-
02.	Arecanut + Coconut	49380* (34.0)	62350* (118.1)	-	-
03.	Arecanut +Dairy	37470 (1.7)	48390 (69.2)	-	-
04.	Arecanut +Coconut + dairy	72430* (96.6)	84890* (196.9)	67590	-
05.	Arecanut + banana+ dairy	80500* (118.5)	77860* (172.3)	101720	-
06.	Arecanut + banana+ pepper + dairy	113580* (208.2)	109620* (283.4)	88120	-
07.	Arecanut + coconut + Banana + dairy	69490* (88.6)	74460* (160.4)	106840	209430
08.	Arecanut + coconut + banana + pepper + dairy	97430* (164.4)	102480* (258.4)	144810	86460

Note : Unit price of arecanut was Rs.65/kg : Other crops based on 1997-98 prices.
The figures are rounded to nearest tens
Figures in brackets indicates percentage increase over arecanut monocrop
* Significant at 5% level

However in all the ABFS models, both under experimental conditions and in farmer's field conditions, the share of arecanut in the gross return was more than 80 %, which indicated that the price of arecanut decided the total profitability of the system. It was further investigated that at reduced level of arecanut prices, the realized net return was more from those ABFS models with higher degree of intensification.

The economic viability of ABFS could be further confirmed through Monetary Advantage (MA) which is defined as the ratio between the realized net return of ABFS to the realized net return under arecanut monocropping. Under experimental conditions, the value of MA was more than unity for all the ABFS models. At the normal rate of arecanut prices, the same was about 1.1 in case of arecanut + banana + cocoa and 1.5 in case of arecanut+ banana + pepper + cocoa. However, at reduced rate of arecanut prices, the same had increased to 1.2 in case of arecanut + banana and 2.8 in the case of arecanut + banana + pepper + cocoa.

Under farmer's field conditions, in the case of marginal farms, under normal rate of arecanut prices, MA had ranged from 1.0 in the case of arecanut + dairy system to 3.1 in the case of arecanut + banana + pepper + dairy system. However, at reduced price of arecanut, the respective figures were 1.7 and 3.8. In the case of small farms, under normal rate of arecanut prices, the MA ranged had ranged from nil in the case of arecanut + dairy system to 6.6 in the case of arecanut + banana + pepper + dairy system. At reduced price of arecanut, the respective figures were 0.8 and 7.7. These results indicate that in general, the MA is better realized at lower level of arecanut prices.

CHAPTER IV

SUMMARY

The Agreements on Agriculture (AoA) of the World Trade Organization (WTO) is posing serious challenges to the global agriculture in general and that of developing countries in particular. Indian agricultural scenario is attempting to make structural transformation in tune with the major elements of AOA. Various socio-economic factors needs to be given due importance while formulating policy perspectives for tackling the challenges arising out of World Trade Agreements.

Indian agriculture predominated by small and marginal farmers, faces stupendous challenges in the present millennium. The challenges to be faced in the agricultural sector of the country are more daunting to the National Agricultural Research System (NARS), which has to be revitalized and integrated for the solution of location-specific problems of increasing and sustaining the productivity of the natural resource base. This would demand a relook into the present strategy being followed by the NARS of the country.

Agricultural research, organized traditionally along disciplinary or commodity lines and without adequate involvement of social scientists' lacked the farming system perspective as they are mostly conducted in research stations under conditions that are not representative of farmers' fields. They often focus on increasing the productivity of the farms by generating new technologies without a proper understanding of the existing farming systems, resulting in low adoption rate of the evolved technologies.

Traditionally the agricultural researchers, having a good idea of the constraints pertaining to their field of specialization use them for research problem definition. By this, they often fail to observe that any change caused by the introduction of a new technology will not only affect the component being studied, but the entire farming system within which the component is embedded. Agricultural research in India, often aims to increase the productivity of crops without paying much attention to the economic viability of those

technologies under farmer's field condition. In contrast, farmers are more interested in raising profits, which need not be necessarily through increase in productivity. Hence, for better adoption of research results by the farmers, in addition to productivity, more attention is required on the economic aspects of the evolved technologies.

Production Theories of Economics finds wider application in studies on farm management aspects of agricultural economics. Since the sixties, several studies have been undertaken in this line to study the farm efficiency measures through production function, profit function, cost function and later on through programming techniques. However most of these studies were confined to a single crop enterprise without considering other crops and/or animal components of the farm and hence have not given enough thrust for the farming system perspective.

Plantation crop plays a major role in the agricultural economy of India. For performing the economic analysis in the case of perennial crops, their distinct features such as (i) long economic life span (ii) multiphase of growth and bearing (iii) continuous flow of cost and return over a number of years with varying magnitude (iv) long gestation period between the investments in the initial years and pay-off in later years and (v) influence of present inputs on future output, necessitate a different approach to be followed.

Even the earlier studies, which were undertaken to perform the economic analyses of perennial crops, have not followed the farming system perspective. They were either restricted to the estimation of cost of cultivation, gross and net returns of a single component of the farm or were mostly based on experimental data of the research institutes. Since the factors of production such as land, labour, irrigation, capital and management are often kept under controlled conditions in the research institutes, the economic analyses carried out in these studies need not represent the realistic situation of the farmers' fields. But, the results of those analyses carried out with farming system perspective, considering all the major components of the farm with their technical and functional relationships are more relevant under the real world situations.

Research based on farming system perspective has different aims from increasing the knowledge about the existing farming systems to finding solutions to the problems under different farming situations. However, the basic

activity in any Farming System Research (FSR) is to understand the present production patterns and farming practices in relation to the different elements of the system. One of the major advantages of adoption of Palm Based Farming Systems, as claimed by the researchers is the intensive use of land. By logic, this advantage should be better realized in a State like Kerala wherein more than 90 per cent of the cultivators possess small or marginal holdings.

Small and marginal farmers are more risk-averse than medium or large farmers, and hence they are expected to adopt higher degree of farm diversification or intensification for protection against natural and economic risks. Cultivation of more than one crop could be done through farm diversification or farm intensification and both are often suggested as means for developing small and marginal farms. Researchers claim that farm diversification or intensification would help them to achieve better resource use efficiency through rational use of land, family labour, time and other farm resources. In addition, this would also help them to reap the benefits from additional enterprises like dairying and help to reuse farm wastes and byproducts.

Though farm diversification and intensification are considered to be a favourable solution to increase the gross farm income, it is essential to assess their economic viability in small and marginal farms, since small-scale diversification of farming by marginal and small farmers do not generate adequate income for their sustenance. Moreover under the present socio-economic scenario, small and marginal farmers often do not have the ability to invest in additional crop and non-crop enterprises, which require high investment and labour inputs. They also find it difficult to assume risks by adopting any new agricultural economic activity, unless the relative economic gains from such activity have already been demonstrated elsewhere or unless the expected profitability from the proposed farm diversification or intensification appears to be reasonably favourable in their perception. This is particularly true if the opportunity cost of such proposed diversification or intensification is high.

Though farm intensification is considered as one of the better methods for improving the productivity per unit area, it is unfortunate that these are often capital intensive and they are evolved without proper understanding of the field level problems faced by the small and marginal farmers. Hence most of them are technically feasible mostly in medium and large farms. In addition, for obvious reasons the small

and marginal farms have to face certain perennial land related problems such as closer planting of palms, underplanting with new seedlings nearer to the older plants etc. These problems are hindering the systematic cultivation of other inter/mixed crops in small and marginal farms.

The researchers claim that adoption of different PBFS models would create additional employment opportunities in rural areas especially to landless agricultural labour. But, this is valid only under those conditions in which the labour demand is met through adequate supply. However, in a state like Kerala where the preference for white-collar jobs is rather pervasive even in rural areas, the labour supply is often below the demand. Labour scarcity and increase in labour cost is not conducive for high degree of farm intensification especially in states like Kerala, where people prefer off farm employment over on farm employment. One could argue that availability of labour would not have a serious impact on farm intensification since the total labour requirement in small and marginal farms are low and there is abundant supply of family labour. But, it is not necessary that the available family labour would be used only for agricultural purposes. Under conditions prevalent in Kerala, it is quite common for marginal and small farmers to seek off-farm and non-farm employment. But, with the increase in competition all over the world, coconut or arecanut monocrop alone could not be economically viable and farmers should adopt palm based farming systems for profitablity.

In all the PBFS models, both under experimental conditions and in farmer's field, the share of the main crop in the gross returns, often exceed 80 %. A situation, in which the price of coconut or arecanut is on the increasing trend, the significance of inter/mixed crops in PBFS are not realized by the farmers. But a price crash for the main crop produce would severely affect those arecanut farmers who are either adopting monocropping or adopting PBFS in a non-systematic manner. This would adversely affect the medium and large holdings in which a major share of gross farm income is from the main crop. Hence in order to overcome this, it is necessary to practise suitable PBFS in a more systematic manner. However coconut and arecanut farmers face several constraints for non-adoption of PBFS in a systematic manner.

The constraint analysis indicated that size of land holdings; labour scarcity, increasing labour cost and lack of capital availability are the major constraints, which affects adoption of different PBFS models.

To overcome the above constraints, future research and development and policy measures for small and marginal farmers should focus on the theory of economies of scale. For this development schemes on PBFS are to be implemented on Co-Operative farming or joint farming.

The concept of Farming Systems Research is the most appropriate solution to develop suitable palm based farming system models, which could be easily adopted by the farmers. Farming System Research is a research process that views the farm in a holistic manner and considers various interactions in the system. This process starts with the farmers and learns about their environments, resources, methods of production, problems and opportunities, aspiration, and how they react to change. Then it moves on to the development of different PBFS models through on-farm experiments and finally evaluating them for their appropriateness by the arecanut farmers themselves. In this process, it is necessary to create effective collaboration with other institutional and developmental agencies which are closely associated with the needs of the farmers.

The adoption of FSR approach in place of the traditional approach to agricultural research poses a considerable challenge to any country interested in it, and the existing institutions and individuals may resist the change. However, the time has now come for all those really interested in the well being of the resource poor small and marginal farmers in developing countries like India. For this the policy makers and researchers should realize and appreciate this new paradigm in agricultural research and orient themselves to this new approach.

To conclude, Palm Based Farming System is a profitable technology to be adopted by the coconut and arecanut farmers. The economic significance of PBFS could be realized only at a lower price for the main crop produce. But PBFS systems as suggested by the research institute cannot be practised as such, due to predominance of small and marginal farms in this system. Hence in future, location specific refinement of PBFS is required considering the socio - economic factors of coconut and arecanut farmers. The research institute should adopt the concept of Farming System Research and should evolve new technologies considering the socio-economic parameters of the farmers. In order to realize economies of scale of production, co-operative farming or joint farming may be encouraged. For this the developmental agencies should come forward with specific schemes.

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