COCONUT BASED FARMING SYSTEM (CBFS) FOR SOCIO – ECONOMIC AND ECOLOGICAL BENEFITS

Dr. K.V. Ahammed Bavappa
Formerly Director, CPCRI
Kasaragod and Chief Technical Expert, FAO

Introduction:

In developing countries like India, improving production per unit area of land, time and inputs adopting farming system technology is the most effective method to create productive employment and eliminate poverty on a sustainable basis. Farming system is a highly heterogeneous and complex phenomenon involving soil, plants, animals, power, implements, labour, capital and a variety of other inputs controlled in part by the farming families and influenced to varying degrees by political, economic, institutional and social forces that operate in a given area. Coconut, by virtue of its canopy architecture and rooting pattern permit the harmonious growth of a variety of crops in its inter space integrating animals, poultry and fish as efficient farming systems. The cafeteria of annuals, semi perennials and perennial crops, include tubers, spices, fruits, beverage crops, vegetables, flowers, medicinal plants, grass and legumes. This coupled with the underutilized family labour available in about five million coconut holdings provide ample scope for the adoption of environment friendly and economically viable farming systems.

Coconut the best candidate for adoption of Farming System:

The single stemmed nature of the coconut palm with a cluster of over 30 pinnate leaves on the crown is one of the best morphologic frames that permit transmission of maximum solar radiation to lower layers facilitating the growth of a variety of crop plants of varying light requirement. In addition to the best light transmission ability, almost the entire air space (>95%) is available for growing crops in high densities due to the single thin-stemmed nature of the palm. Since the height of the coconut increases as the years advance, it permits growing crops in different storeys. The grass and legumes that can be grown under the coconut palm permit integration of animals. Coconut when grown on mounds or earthed up bunds with water bodies all round supports fish rearing. The fibrous root system which pastures at depths of 30 to 90cm in a radius of 2m use only about 22% of the soil mass, leaving the rest for other crops to forage. Coconut is thus the most ideally suited crop for adopting farming systems.

Positive aspects of Farming Systems:

Farming with a single crop has many disadvantages. Primarily, there is underutilization of the natural resources such as solar radiation, air space, water and soil. The income is limited to the harvest season of the only crop raised, which if damaged by pest or disease or price fluctuation adversely affects the economy of the farmer. Employment opportunities and organic matter production needed for recycling to improve the health and nutrient status of soil are also low.

In the farming systems, the use of both natural and applied resources is better compared to monocrop. The total returns from the component crops and enterprises are spread over giving a year round stability to the economy of the farmer. The system activities also give productive employment to the under utilized family labour generating additional family income. The systems give partial insurance against crop failures and price fluctuations. There are also indications that the systems have favourable alelopathic interactions which promote productivity.

Integrated nutrient management is an integral part of coconut based farming system. Based on the existing recommendations the main and intercrops receive inorganic fertilizers and organics are added by way of leaf fall recycling, resulting in complementary interactions and biological activities. Economic analysis showed that additional net return ranged from Rs. 10,000/ha to 76, 250-

Criteria for Selection of Components of Farming systems:

The criteria for selection of components of the farming system are the following

1. Shade tolerance
2. Adaptability to soil and climatic conditions of the area
3. Rooting pattern different from coconut
4. Should not grow taller than coconut
5. Availability of recyclable biomass
6. Easiness of processing
7. Good demand and marketing possibilities for produce.
8. Higher employment opportunities.

Types of crops:

A wide range of crops are suited for raising in the farming systems. They are Spices, Tuber crops, Fruit crops, Vegetables, Cereals and millets, Pulses, Medicinal crops, Aromatic crops, Flowering plants, Oil crops and Beverage crops.

Options in farming systems:

a. Age of the palm:

Depending upon the age of coconut plantation, soil, terrain lay of the land and water availability there is scope for the choice of a wide range of crops and planting them in varying densities in association with animal and fish culture.

b. Models for rainfed condidtions

Under rainfed conditions, intercropping with annuals is recommended. A variety of intercrops could be grown in coconut plantations and these include cereals, pulses, oil seeds, rhizomatous crops and fruit crops.

While planting intercrops, a circular area of 2 m radius around the palm which is the active root zone must be left free. Intercrops are planted in pits (cassava, elephant-foot yam), raised beds (ginger, turmeric, coleus), rows (upland rice, pulses, ground nut, soybean) or trenches (pineapple). Both coconut and intercrops should be manured individually and rotation preferred for intercrops.

c. Models for Irrigated Conditions:

In places where assured irrigation facilities are available during summer months, mixed cropping, multistoreyed cropping or high density multispecies cropping systems or mixed farming are advocated.

i. Mixed cropping:

Growing of perennial crops in interspaces of another perennial (in this case, coconut) is termed as mixed cropping. Coconut gardens of over 20 years and with assured irrigation are suitable for mixed cropping. Cocoa, clove, nutmeg, cinnamon, Pepper, coffee and mulberry have been successfully grown as mixed crops in coconut gardens. Drip or sprinkle irrigation may be adopted depending upon water availability. As in the case intercropping, a 2m radius around coconut palm is to be kept free to avoid root competition and individual crops have to be manured. Among these crops, cocoa has been found to be the best. It may be grown either as a single hedge system at a spacing 3 m x 3 m in the interspaces of coconut accommodating

Yield of coconut-cocoa mixed cropping

Cropping system	Coconut (nuts/palm/year)			Cocoa Pods/plant/yr (85-87)
	Pre-experimental	Experimental period	Increase (%)	
Coconut sole crop	68	107	57.4	
Coconut + cocoa (single hedge)	57	109	91.2	25.5
Coconut + cocoa (double hedge)	39	88	125.6	13.5

450 plants or double hedge system at a spacing of 2.5 x 2.5 m accommodating 525 plants.

Pepper, another commercial crop, can be grown using coconut as a standard. Additional pepper can be accommodated in the interspaces of coconut using live or dead standards. Among tree spices, clove and nutmeg perform well.

ii. Multistoreyed cropping:

Multistoreyed cropping involves an intensive system of mixed cropping, wherein crops having varying morphological framework and rooting pattern are mix planted in such a way that their canopies intercept solar radiation at varying heights and their roots forage soil at different zones. One of the popular combinations involves mixed cropping of coconut with pepper, cocoa and pineapple.

In this system, there will be 175 coconut palms spaced at 7.5 x 7.5 m apart. Pepper vines are planted one m away from the base of the palm on the northern side and trained on to the coconut trunk. One row of cocoa grafts is planted in the north-south direction adopting a spacing of 2.5 m between plants. Pineapple suckers are planted in between coconut palms along the row in trenches of 4 m length and 90 cm width at a spacing 60 cm x 30 cm to accommodate 4500 plants/ha. Pineapple performs well in such a system in the initial five to six years and will have to be removed once cocoa develops its full canopy. Productivity of crops in the system is given in the table below.

iii.High density multispecies cropping system:

In this system, several plant species, both annuals, semi perennials and perennials, are grown to meet the diverse needs of the farmer such as food, fuel, timber, fodder and cash. This system is ideally suited for smaller unit of land and aims at maximizing production per unit area of land, time and inputs. This system can be adopted in coconut plantation aged over 25 years with irrigation facilities. Such a system was established in a plot 1.2 ha of coconut plot at CPCRI, Kasaragod. Coconut was spaced at 8m x 8m. Seventeen crops were included with a total population of 13, 030 plants/ha. The annual crops were withdrawn in stages as the perennials grew and utilized more and more space and sunlight. Performance of crops like acid lime, sapota, mango, guava, pepper, papaya and coffee were also withdrawn from the system, as their performance was not economical. It was observed that in such a system there is scope for reducing the fertilizer input to individual crops from the recommended dosage. In the modified HDMSCS, involving banana, pineapple, clove and black pepper, the coconut yield for the year 2002 – 2003 ranged from 130 nuts/palm/year under no fertilizer to 143 nuts/palm/year at two-third of the recommended fertilizer dose. The productivity of the palms declined with the reduction in fertilizer dosage beyond 1/3rd recommended level. 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 return was highest in the treatment, two-third of the recommended fertilizer dose (Rs.63, 579) with a benefit cost ratio of 2.18.

iv. Coconut based mixed farming:

Animals can be profitably integrated with coconut by growing fodder grasses and legumes in the interspaces of palms which can be used for maintaining milch animals. Dung can be used for producing biogas to meet the fuel and lighting requirements of the farmer and the digested biogas slurry can be recycled as manure for the coconut-fodder mixed stands. In addition, pepper can

Yield of crops in the multistoreyed cropping system

Crops	Coconut + Cocoa SH + Pepper+ Pineapple	Coconut + Cocoa DH + Pepper + Pineapple
Coconut (nuts/palm/year)		
(i) Pre-experimental	45.20	38.30
(ii) Experimental period	104.50	88.80
Cocoa (pods/plant/year)	32.30	25.60
Pepper (kg/vine/year)	0.64	0.42

System (Rs.)	Gross cost (Rs.)	Gross return (Rs.)	Net return (Rs.)	Additional Employment Generated (mandays/ year / ha)
Coconut monocrop	17000	49000	32000	
Coconut + Elephant foot Yam	64100	110900	46800	131
Coconut + Ginger	74500	142000	67500	500
Coconut + Vagitables	33000	83000	50000	125
Coconut + Clove	47880	101000	53120	150
Coconut + Banana	59680	130150	70470	230
Coconut based HDMSCS	52000	140000	88000	191
Coconut based mixed farming	172000	258000	86000	600

Source: Economics of palm based farming system CPCRI (2004)

be grown using palm trunk as the standard and tubers, vegetables and banana raised along the field bund borders.

A family model mixed farming unit was maintained at CPCRI, Kasaragod from 1972. Fodder crops were maintained in 1.04 ha of a 60 year old coconut garden. Hybrid Napier Guatimala grass yielded about 60t green fodder/ha/year under coconut shade, which was sufficient to maintain five cross-bred milch animals. Pepper, banana, cassava and vegetables were raised in the border and field bunds. The cow dung slurry from the biogas plant erected and urine were recycled within the experimental area. The outputs from one ha of the model are furnished.

SOCIO – ECONOMIC ASPECTS:

i. Employment opportunities:

From the point of view of small holder, it is important that the system generates adequate employment opportunities for the family labour. Studies conducted at CPCRI, Kasaragod, indicated that the labour input increased from 120 days/ha/year in the case of rain fed coconut mono crop (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 percentage terms, the increased employment generation in the tuber mixed cropping is ranged between 83 and 144. In the case of annual spice mixed-crops such as ginger and turmeric, the labour absorption capability of coconut based system went 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 were observed to be very high. According to CPCRI estimates, the labour input utilization increased from 144 days/ha/year in the case of irrigated mono crop 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 was 61 to 93 over the sole crop. When the assessment was made for the multi-storeyed cropping models, the employment utilization was 335 and 380 days for systems with coca (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 percent over rainfed monocrop of coconut. Since the bulk of the labour

force is available from the family of the farmer, the family income is considerably enhanced when the system is adopted.

ii. Economic benefits

Micro level studies have confirmed that the socio-economic condition of the farmers and the constraints actually faced under their farming situations are the prime factors that would decide the choice of crops and/or livestock components of the farming system by the small holders. For example, the farmers belonging to the Brahmin community in Kerala, Karnataka and Tamilnadu do not include poultry as a component in coconut based farming system. Economic factors like land holding size, availability of labour including family labour, availability of financial resources, profitability, marketing facilities, government incentives and management factors also play a crucial role in the success of the systems. However, the driving force for any farming system to become popular among farmers is essentially the profitability of the system. In general the farmers are more interested in profit maximization than yield maximization.

Though CBFS in one form or the other is practised in most of the coconut growing areas of the country, the impact has not been visible due to the inadequate effort in the transfer of technology highlighting success stories along with appropriate technology packages and alternatives and the economic benefits of the systems. The economics of a few CBFSs is given below.

iii.Ecological advantages.

CBFSs provide an excellent environment for living in view of the wide range of crops grown, the diverse produce generated in the system and available for home consumption and enjoyable micro climate.

Generation of organic matter by the components of the farming system and its recycling has the advantage of reducing pollution by waste materials and improving the health and productive potential of the soil. The roots of the component crops that forage the soil at different levels absorb the nutrients reducing pollution of water by the applied fertilizes. Scope also seems to exist to take advantage of the KYOTO protocol due to the increased CO_2 assimilation by the dense crop canopies and resultant O_2 release leading to reduced environmental pollution.