



Coconut-Based Cropping System For Socio-Economic Benefits

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Coconut-based cropping system enhances the economic viability of coconut farming as well as the food and nutrition security of the members of the farm-households. As coconut farming is in the hands of small and marginal farmers, promotion of appropriate cropping system becomes important for supporting the socio-economic well being of these disadvantaged groups.

Introduction

Coconut-based cropping system denotes the integration of diverse but compatible combinations of woody species of economic value and arable crops in the interspaces in coconut holdings for deriving socio-economic benefits. The different patterns adopted by farmers are intercropping, mixed cropping and multistoreyed cropping. These are being popularized in most of the major coconut producing countries for enhancing the economic viability of coconut farming. Promotion of multi-species cropping under coconut has much relevance in States like Kerala where the present level of income from coconut fails to sustain the livelihood security of most of the farm-households involved in its culture. Singular increase in the production of coconut alone neither improves the economic condition of the coconut growers nor generates adequate on-farm employment opportunities because of the limitations imposed by the small size of holdings and the system of monocropping.

Studies conducted in India under different agro-climatic conditions have revealed that when diverse but compatible species are grown together under coconut, positive interactions operate in the system

benefiting all the components. In most instances the benefits are linked to enhanced soil life and synergism in sharing growth resources in place of the usual competitive interactions. These become evident from the holdings devoted to coconut-based integrated cropping system. It is in this context that the system of raising additional crops under coconut becomes a technically viable strategy for restructuring the coconut-based economy of the farmers in the producing States. Apart from generating additional sources of income and employment from the holdings under coconut, growing of compatible crop combinations has also been found to improve productivity of the standing palms, availability of protective foods and also health of the soil resource.

Income and Employment Generation

Coconut-based cropping system benefits the practising farm-households by generating additional income and employment. The increase may be manifold depending on the cropping pattern adopted. In farmer-participatory studies as well as case studies of selected holdings the recorded observation was that a holding of 0.4 ha when devoted to intensive intercropping could sustain

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an average family of five members in reasonable comfort. The extent of benefit, however, depends on the cropping intensity adopted and the interest evinced by individuals in farming. Even from very small holdings intensive intercropping generates very high income. In case studies conducted in a few village panchayats in Kerala the annual net income from a holding as small as 0.04 ha was Rs.4,210 or Rs.105,250 per ha. Here the contribution of intercropping to total income was 61%. However, from a slightly larger holding of 0.1 ha the annual net income was only Rs.5,300 or Rs.53,000 per ha which accounted for only 56% of the total income. Despite the disparity in both cases the income derived from intercropping was more than that from coconut, the main crop.

Field observations also revealed that intercropping is more intensive in smaller holdings than in larger ones. In the former units farmers utilize all the available space to grow miscellaneous crops for household consumption. The cropping pattern adopted is also not capital intensive because in most cases family labour takes care of the operational needs and farm saved planting material will be available for growing both seasonal and annual crops. As the holding size increases the cropping density tends to get reduced. While the combination of crops and related activities in the smaller holdings serves only the household needs, it becomes more and more market oriented as the holding size increases. But in both cases food production constitutes the most popular activity without being influenced by market interplays with

the result that a steady supply of carbohydrates as well as protective foods become available for the daily household consumption.

During the visit of farm-households following the farmer-participatory studies, those who have adopted coconut-based cropping system were found growing miscellaneous woody species such as arecanut (*Areca catechu*), mango, jack, wild jack (*Artocarpus hirsutus*), bread fruit (*Artocarpus communis*), cashew, papaya (*Annona* spp.), guava, drumstick (*Moringa oleifera*), tamarind, garcinia, nutmeg, clove, pepper (*Pepper nigrum*), curry leaf (*Murraya koenigi*), *Ailanthus* spp., albizzia, teak, mahogany etc. The non-woody agricultural crops comprised banana, vegetables, root and tuber crops, annual spices etc. While most of the tree species and arable crops formed part of the cropping system in all holdings, tree spices, firewood and timber yielding trees formed part of the system in larger holdings.

In the research studies conducted under different agro-climatic situations the economic benefits of inter and mixed cropping under coconut could be established. The Regional Coconut Research Station, Ratnagiri in Maharashtra State, organized a study involving six perennial spice crops planted in separate blocks of 0.2 ha each under coconut. The results of this study recorded for a period of five years showed higher net income from each block as compared to that from the coconut monocrop block. Among the different crop combinations the nutmeg block recorded the highest average net profit of Rs. 53,951 per

ha followed by the cinnamon block with Rs.37,128 per ha. The net profit from other blocks ranged from Rs.16,640 to Rs.32,532 whereas that from the block under coconut alone was only Rs.12,346. The details are shown in Table-1. In a similar study conducted at Veppankulam in Tamil Nadu State, the net income recorded for different cropping models ranged from Rs.28,697 to Rs.37,780 as against Rs.17,250 for coconut monocrop. Such results were also recorded in studies conducted by the Central Plantation Crops Research Institute, Kasaragod, the details of which are shown in Table-2.

Table 1. Average net profit under different cropping systems (Rs. per ha)

Treatment	Average net profit over 5 years	Percentage increase Over control
Coconut + Nutmeg	53,951	337
Coconut + Cinnamon	37,128	201
Coconut + Clove	25,102	103
Coconut + BlackPepper	35,532	164
Coconut + Allspice	16,640	35
Coconut + Garcinia	27,484	123
Coconut alone	12,346	—

Source: Regional Coconut Research Station, Ratnagiri (1998)

The case studies conducted in selected farm-households have revealed that integration of diverse cropping models contributes to enhanced employment. The additional employment generated from intercropped holdings ranged between 150 and 180 man-days per ha per year. For coconut holdings devoid of intercrops the range was only 60-80 man-days. In a crop mixing trial carried out by the Coconut Research Station at Pilicode in Kerala, enhanced employment opportunities to farm workers was the most conspicuous of the different observations. The number of man-days required for cultivation of one



Table 2. Economics of coconut-based cropping system (Rs. per ha)

Treatment	Grosscost	Grossreturn	Netreturn	Return above monocrop
Coconut+Elephant Foot Yam	64,100	110,900	46,800	14,800
Coconut+Ginger	74,500	142,000	67,500	35,500
Coconut+Cassava	34,700	100,400	65,700	33,700
Coconut+Vegetables	33,000	83,000	50,000	18,000
Coconut+Clove	47,880	101,000	53,120	21,120
Coconut+Banana	59,680	130,150	70,470	38,470
Multistoreyed Cropping System	52,000	140,000	88,000	56,000
Coconut alone	17,000	49,000	32,000	—

Source: Hameed Khan, H. and Sairam, C.V. (2003)

ha of coconut holding was about 150 and the employment potential was almost doubled when intercropped with cassava or colocasia. The Central Plantation Crops Research Institute at Kasaragod in Kerala, has worked out the annual labour requirement for different crop combinations under coconut. According to this, the range in man-days per ha per year for crop combinations involving cassava, elephant foot yam and sweet potato under rainfed cropping was from 250 to 310 as against 150 for coconut alone. Under irrigated cropping the labour requirements were 360 man-days for multistoried cropping and 300 man-days for cocoa combination as against 220 for coconut monocrop.

Increase in the Yield of Coconut Palm

The complementary interactions in a coconut-based cropping system also cause significant increase in the yield of the palms. In the mixed cropping trials at the Regional Research Station, Ratnagiri the average annual yield per palm showed substantial increase ranging from 27.37 percent to 93.52 percent by the end of 13th year after tree spices including black pepper were introduced in coconut blocks as compared to the average yield over

a period of four years prior to the introduction. The percent increase in coconut yield was 79.14 in the cinnamon block; 93.52 in the clove block; 87.76 in the nutmeg block; 72.35 in the all spices block; 33.78 in the garcinia block and 27.37 in the black pepper block in comparison with the average yield of 78.52 nuts for 17 years in the control block. Although the spices and coconut palms received irrigation and the recommended fertilizer inputs, the beneficial effects of mutualism that might have operated in the experimental blocks could have caused the increase in yield of nuts as compared to that of the sole crop of coconut.

The results of studies reported from Sri Lanka in 1993 showed that the positive impact of mixed cropping system involving cocoa, coffee, pepper, clove and cinnamon was visible not only on the mean yield of nuts but also on copra yield. The increase in the mean yield of

nuts per palm per year ranged from 5 percent to 34 percent and that of copra per ha per year showed a range from 13 percent to 31 percent. The highest recorded increase in yield of nuts was for the coconut-coffee combination and of copra it was for the coconut-cinnamon combination. The recorded increases have been linked to the complementary interactions in the system which were instrumental for improving soil fertility and moderating microclimate. The results of the study are shown in Table-3.

In a study carried out by the Coconut Research Station at Nileshwar in Kerala for two years the mean yield of coconut increased to 7,738 nuts per ha when intercropped with groundnut as against 7,685 nuts in the absence of intercrop. The spreading canopy of groundnut not only reduced splash erosion and soil loss in run-off, but suppressed weed growth also by 61 percent. In the same station when two planting densities of cocoa at 300 plants and 600 plants per ha respectively in the centre of coconut rows were tried the post-treatment average annual yield of nuts for six years was 64.1 in the former block and 66.7 in the latter block as against 62.9 in the block of coconut without intercrop. In these studies the palms were found benefited by the cultural

Table 3. Effect of mixed cropping systems on coconut yield (10 year average)

Cropping system	Mean yield (nuts/palm/yr.)	Percentincrease	Mean copra yield (t/ha/yr)	Percentincrease
Coconut+Cocoa	7,504	22	2.18	22
Coconut+Coffee	8,216	34	2.26	26
Coconut+Pepper	6,424	05	2.03	13
Coconut+Clove	7,191	17	2.13	19
Coconut+Cinnamon	7,633	26	2.35	31
Coconut alone	6,123	—	1.79	—

Source: Liyanage and Dassanayake (1993)



operations given to the intercrops and the maintenance expenditure of the coconut gardens was also considerably reduced.

Generates Multiple Sources of Food

As a result of the integration of fruit trees and vegetables in the cropping system diverse food sources become available to the farm-households. In holdings where marketable surplus is generated, it is usually after satisfying the household dietary needs. Thus, apart from cash income, cropping system contributes to the food and nutrition security of the members of the households involved. In a special campaign organized during 2009 for growing vegetables in coconut holdings in the Pattanakkad Panchayat in Kerala, 212 farm-households were effective participants. A close study of the performance of these cropping units indicated that about 10 tonnes of vegetables, cassava, yam, colocasia, banana etc. became available from a total area of around 8.5 ha for sale in the local markets after satisfying the full household demand over a period of six to ten months.

Through appropriate models of intercropping multiple sources of food could be generated at the farm-household level. The usual cropping pattern covers food crops, pulses, fruit plants and spices. These crops are integrated into the holdings depending on the age of the coconut palms and agro-climatic conditions. In Sri Lanka the yield of diverse food crops and annual spices which are commonly grown under coconut for home consumption and sale has been reported, the details of which are shown in Table-4.

Table 4. Yield of commonly grown intercrops in Sri Lanka

Type of crop	Yield per ha per year (t)	Type of crop	Yield per ha per year (t)
Root and Tubers		Fruit Crops	
Cassava	11.0	Banana	49.0
Sweet potato	4.8	Pineapple	14.0
Taro	6.5	Passion-fruit	6.0
Cocoyam	19.6	Papaya	10.0
Grain Legumes		Spices	
Cowpea	0.8	Ginger	20.0
Groundnut	1.3	Turmeric	7.3
Pigeon pea	1.0		

Source: Gunathilake, H.A.J. (2007)

Apart from these crops different categories of farmers have also integrated perennial crops such as cocoa, coffee, pepper, clove, cinnamon, tea, rambutan, avocado, lime, cashew, mango, arcanut etc. and a part of the output becomes available for household dietary consumption.

Likewise, the yield of vegetables/legumes, spice crops, cereals, and fruit trees grown as intercrops in the Philippines has also been estimated. Most of these crops strengthen the food and nutrition security of the households involved in their culture. The details are shown in Table-5.

Other Benefits

The farm-level price of coconut is linked to the prevailing price of coconut oil which is often subject to

unpredictable fluctuations causing disruption in the household economy of those farmers who depend exclusively on the income from coconut. The adverse impact of price instability is experienced mostly by small farmers, especially those who have no other crops other than coconut in their holdings. Even for farmers having larger holdings the situation is not different when coconut is grown as a monocrop. The experience of different categories of farmers is that in the presence of appropriate combinations of crops in the same holding under coconut the additional income generated from these companion crops will act as buffer at times of price decline for coconut or damage to palms consequent on pest and disease infection or natural calamities. On

Table 5. Yield of commonly grown intercrops in the Philippines

Type of crop	Yield per ha per year (t)	Type of crop	Yield per ha per year (t)
Vegetables/Legumes		Root Crops	
Mungbean	0.2-0.6	Sweet potato	6.0-8.0
Ladies Finger	2.0-4.0	Taro	10-35
Cowpea	2.5-3.5	Cassava	15-20
Groundnut	1.0-2.5	Yam	12-15
Tomato	15-30	Arrow root	8.0-15
Squash	15-18	Ginger	5.0-6.0
Bringal	7.0-9.0	Fruit Trees	
Bitter gourd	12-15	Banana	25-35
Spice Crops		Pineapple	20-30
Hot chili	2.0-4.0	Rambutan	2.5-4.0
Black pepper	0.4-0.80	Citrus	15-20
Cereals		Industrial Crops	
Corn	3.0-4.0	Coffee	0.9-1.2 (dry beans)
Upland rice	1.2-1.5	Cacao	0.7-1.5 (dry beans)

Source: Magat, S.S. (2007)



most occasions the total income generated from a unit holding will be more than what could be expected from coconut alone. The farmers are, therefore, relieved of the possible risks associated with single crop economy.

When diverse tree species and arable crops are present under coconut there will be copious addition of plant litter, reduction in the hazards of soil and water erosion and amelioration of the microclimate. These conditions favour enhanced soil life and organic transformations leading to improvement in soil health. As a result, the system achieves self regulation and stability as well as capacity to produce outputs at levels which are profitable and enduring over time. Thus, a properly organized coconut-based cropping system supports conservation of the natural resource base and sustainability in production.

Conclusion

Coconut-based cropping system enhances the economic viability of coconut farming as well as the food

and nutrition security of the members of the farm-households. These benefits become manifest even in small and marginal holdings which are otherwise considered uneconomic operational units. As coconut farming is in the hands of small and marginal farmers, promotion of appropriate cropping system becomes important for supporting the socio-economic well being of these disadvantaged groups. Additionally, the system can also bestow ecological benefits to the community in the form of carbon sequestration, amelioration of local climate, conservation of natural resource base, promotion of agrobiodiversity etc. Considering the socio-economic and ecological functions of coconut-based cropping system, the popularization of the same shall receive adequate priority in the strategy for coconut development in the major producing States in the country.

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Coconut Shell Powder

Coconut shell powder is manufactured from matured coconut shells. The manufacture of coconut shell powder is not an organized industry in India. The product finds extensive use in plywood and laminated board industry as a phenolic extruder and as a filler in synthetic resin glues, mosquito coils and agarbathis. Coconut shell powder is preferred to other alternate materials available in the market such as bark powder, furfurool and peanut shell powder because of its uniformity in quality and chemical composition, better properties in respect of water absorption and resistance to fungal attack. The product is manufactured in sizes ranging from 80-200 mesh. Keeping in view of the vast industrial uses, the demand for coconut shell powder appears to be promising. Coconut shells free from contamination of coir pith, etc., are broken into small pieces and fed into a pulverizer. The powder from the pulverizer is fed into a cyclone and the parallel product is collected in bag filters. The shell powder is then fed into a vibrating sieving machine and packed according to mesh size requirements for various end uses. The rejects from the sieving machine can be recycled in the pulverizer for size reduction. The main requirements for consistent good quality of coconut shell powder, are proper selection of shell of proper stage of maturity and efficient machinery.