



# Coconut based farming system for higher income and employment opportunities

P. Subramanian, Thamban. C and H P Maheswarappa

Central Plantation Crops Research Institute, Kasaragod

Coconut plays a pivotal role in the agrarian economy of many states in India and it is predominantly a small holder's crop. More than 90 per cent of the coconut holdings in our country are less than one ha in size. Income generated by cultivating coconut as a monocrop in such small holdings is not sufficient to meet various needs of the farm families. Further, coconut growers are frequently exposed to economic risks and uncertainties owing to rapid price fluctuations. Even though the current price situation is quite encouraging,

coconut growers were badly affected for more than two decades due to low price/price stagnation of coconut and escalating cost of cultivation. In this context it is of paramount importance to promote adoption of coconut based cropping/ farming system as a strategy to enhance income from coconut farming.

## Feasibility of coconut based farming system

Coconut as a monocrop does not fully utilize the basic resources such as soil and sunlight available in the

garden. The rooting pattern in coconut is such that only 25 per cent of land area is effectively utilized and the remaining area could be profitably exploited for raising subsidiary crops. Coconut canopy's space utilization is only 30 per cent and hence plenty of sunlight is infiltrated and fall on ground which is unutilized. As much as 56 per cent of the sunlight is transmitted through the canopy during peak hours (10-16 hrs) in palms aged around 25 years. The diffused sunlight facilitates growing a number of shade tolerant crops in the

interspaces. Depending upon the growth stage of coconut palms a number of other crops can be accommodated in the unutilized area enabling better use of natural resources.

Adoption of coconut based farming/cropping systems help to reduce the variation in gross farm income, especially when the market prices of coconut and its products are low. Coconut based cropping/farming systems involving cultivation of compatible crops in the interspaces of coconut and its integration with other enterprises like dairy, poultry etc. leads to considerable increase in production and productivity per unit area, by more efficient utilization of precious resources like sunlight, soil, water and labour.

Research on coconut based cropping systems at CPCRI has evolved coconut based multistoried cropping model which aims at cultivating three or more crops having different morphological characteristics in the interspaces of coconut so as to intercept sunlight at different levels and feed at different soil depths. The viability of coconut based High Density Multi Species Cropping System (HDMSCS), which involves growing a large number of crops to meet the diverse needs of the farmer, which is ideally suited for smaller units of land and aims at maximum production per unit area of land, time and simultaneously ensuring sustainability, has also been demonstrated at CPCRI. Similarly, the scope for mixed farming in coconut garden involving cultivation of shade tolerant fodder crops in the interspaces of coconut and integrating animal enterprises like dairy, poultry, fisheries etc. and recycling the byproducts obtained

also has been well documented.

### Intercropping in coconut garden

Intercropping refers to growing annuals or biennials in the interspace of coconut. A variety of annuals and biennials can be grown as intercrops in coconut garden. Various tropical tuber crops can be successfully grown as intercrops in coconut garden. They include cassava, colocasia, elephant foot yam, sweet potato, chinese potato, greater yam, lesser yam etc. The tuber crops partially meet the food requirement of a farm family and almost always find a place in the coconut gardens. Ginger and turmeric are the important rhizome spice crops commonly intercropped in coconut gardens. Better performance under partially shaded conditions, fair market demand, easy processing and long storage life are some of the factors that favour growing these intercrops. Experiments at CPCRI Kasaragod have indicated vegetables like snake gourd, bottle gourd, amaranthus, coccinia, brinjal and bitter gourd as compatible crops with

coconut. Intercropping with vegetables helped to generate additional employment to the tune of 215 to 365 mandays/ha/year and among the different sequences tried snake gourd, ridge gourd, amaranthus was found to be the most remunerative one.

Among the fruit crops grown in association with coconut, banana and pineapple are the most popular intercrops in Andhra Pradesh, Tamil Nadu, and Kerala. Banana is a highly profitable intercrop in coconut gardens, which is very popular in areas with good irrigation facilities. Pineapple also performs well in the partially shaded conditions of coconut gardens. However pineapple requires irrigation during the dry period for its successful cultivation. Intercropping with oil seeds crops like groundnut in coconut gardens offers excellent possibilities to obtain additional income. Floriculture under coconut is also a profitable practice. Orchids, Anthuriums and other cut flowers can be grown as intercrop as illustrated by some of the innovative farmers. Medicinal plants such as



Kacholam, Arrowroot, *Sida retusa*, Thipili (long pepper), Neela amari, and Adapathiyam were found to be suitable as intercrops in coconut. Research conducted at CPCRI revealed that arrowroot and Kacholam could be successfully, grown as intercrops in coconut garden.

**Mixed Cropping**

Growing of perennial crops in association with matured coconut palm is referred to as mixed cropping. Studies carried out at CPCRI, Kasaragod and elsewhere reveal that cocoa, pepper, clove and nutmeg are the most compatible crops with coconut and can be grown as mixed crops in the west coast region. For the sake of multiple cropping, the life of a coconut plantation can be divided into three phases. In the initial phase from

planting to 8 years age, there will be adequate space and light for intercropping with short stature annuals. Under no circumstances perennial crops should be planted during this period, because they would overgrow the palms and affect their growth due to inadequate light. In the second phase, from 8 to 20 years, there will be very little penetration of light downwards and practically no cropping is possible during this period. In the third phase from 20 years onwards, any form of mixed cropping with the perennials is possible. By this time the coconut palm attains a height of about six metres, and about 55% of light is available below the palm canopy. About eighty five per cent of the coconut roots are concentrated in the soil of 30 to 120 cm depth. The lateral root spread is however,

limited to two metres from the bole. Hence only 25% of the available land is being utilized by coconut roots for foraging nutrients and water. Many perennial crops can be grown in association with coconut. Their performance depends much on the availability of solar radiation and the level of management.

Mixed cropping should be practised only under assured water supply conditions throughout the year. Perfo-irrigation is preferable as it wets the entire surface. Perfo-irrigation at the rate of 20 mm irrigation once in a week has been found to be optimum for coconut. The crops have to be adequately manured to prevent competition for nutrients between crops. A radius of 2 m has to be kept free around each palm to avoid any competition, except for pepper which has no. Kasaragod has been found to affect the yield of coconut. During the initial years, coconut banana can be raised in the space available which will serve for the shade requirement of mixed crop seedlings and also give additional returns to the grower. Other annual crops which have been found successful, like pineapple, elephant-foot-yam, ginger etc. can be raised along with the perennials in the initial years in a multi-storied manner. Under intensive cropping, the maintenance of the productivity of the land has to be taken care of. As far as possible the crop residues should be recycled to the plot by way of mulch or by incorporation into the soil.

**Multistoreyed Cropping**

This refers to the cultivation of three or more crops having different morphological characteristics in the interspaces of coconut so as to intercept solar radiation at different levels and exploit different soil zones. The experiment on

**Cultural requirements of crops for mixed cropping in coconut garden**

Crops	Propagation	Planting pits	Spacing	No. of plants per ha	Fertilizer dose (g/plant/year)		
					N	P <sub>2</sub> O <sub>5</sub>	K <sub>2</sub> O
Cocoa	Grafts	75 x 75 x 75 cm	3m x 3m (Single hedge)	450	100	40	140
Pepper	Rooted cuttings	50 x 50 x 50 cm	7.5m x 7.5m (At the base of the palm)	175	100	40	140
Clove	Seedlings	60 x 60 x 60 cm	7.5m x 7.5m (At the centre of four palms)	175	300	250	750
Nutmeg	Grafts	60 x 60 x 60 cm	7.5m x 7.5m (Centre of four palms)	175	500	250	1000



the farmer such as food, fuel, timber, fodder and cash. This is ideally suited for smaller units of land and aims at maximum production per unit area of land, time and simultaneously ensuring sustainability. This system includes annuals, biennials and perennials. The crops selected include cash crops, food crops and fodder crops. The biomass other than the economic part is recycled within the system. The annual crops are removed as the canopy size of perennial crops increases. A HDMSCS model was established at CPCRI, Kasaragod in 1.2 ha of 18 year old coconut plantation during 1983 by interplanting 17 additional crops. The crops selected were mango, breadfruit, jack, nutmeg, clove, sapota, acid lime, guava, pepper, subabul, banana, pineapple, papaya, coffee, elephant foot yam, colocasia and cassava. The annual crops (except banana) were withdrawn from the system in stages as the perennials grew and utilized more space and sunlight. Some of the perennials like acid lime, sapota, mango, guava, pepper, subabul, papaya and coffee were also

multistoreyed cropping system initiated in 1970-71 at CPCRI Kasaragod had an intensive four crop combination which included coconut, black pepper (trained on coconut trunk), cocoa and pineapple. Coconut palms above 20 years old are suitable for multistoried cropping. The pepper vine having its canopy at 2-8 m height on the coconut trunk, forms the second floor crop. The spread of the above ground parts of cocoa, which are pruned periodically are confined to a height of less than 3.5m from ground level. This constitutes the first floor. Pineapple forms the ground floor. The distribution of roots of these crops showed that they do not overlap. Cocoa has tap root system. Most of its roots lay within a radius of 80-100 cm laterally. The fibrous roots of pineapple rarely extend beyond 50 cm laterally or vertically. This system requires irrigation during summer months. Recommended dose of fertilizers are to be given to each of the component crops. In the above system, pineapple performed well in the initial years. However, once cocoa

had developed its full canopy, very little sunlight percolates down through its canopy to pineapple. Thus, pineapple could be grown only in the initial 5 or 6 years.

### High density multispecies cropping system

High density multispecies cropping system (HDMSCS) involves growing a large number of crops to meet the diverse needs of



removed from the system as their performance was not satisfactory. Clove has been removed from the system and nutmeg included in its place because of the difficulty in harvesting clove. At present the system has pepper, nutmeg, banana and pine apple. In the HDMSCS models the soil disturbance should be kept minimum and only slash weeding is done. The biomass (other than the economic part) is recycled within the system. In the HDMSCS plot yield of coconut and component crops with two third level of recommended fertilizers was comparable with the application of full doze of recommended fertilizers.

### Coconut Based Integrated Farming Systems

Integrated farming is a common whole farm management approach that combines the ecological care of a diverse and healthy environment with the economic demands of agriculture to ensure a continuing supply of wholesome, affordable food. Coconut based cropping/farming systems, involving cultivation of compatible crops in the interspaces of coconut and integration with other enterprises like dairying, poultry and aquaculture offer considerable scope for increasing production and enhancing productivity per unit area, time and inputs by more efficient utilization of resources like sunlight, soil, water and labour. Majority of the coconut growing soils are poor in soil fertility and needs external inputs, coconut based farming is one of the optional to enhance productivity. Coconut based integrated farming is an ecologically sustainable system which helps the farmer to realize more income. Sustainability is the objectivity of the integrated farming system where production process is optimized through efficient utilization of inputs in safeguarding the environment with

Sl. No.	Component	Area (ha)/ numbers
1	Coconut ( WCT))	175 nos.
2	Fodder grass( BN Co 3) and guinea grass/ Fodder sorghum, fodder maize, (Stylosanthus- annual and perennial), fodder cowpea	1.00 ha
3	Pepper (Panniyur 1) planted in coconut basin and trailed on the coconut stem	175 nos.
4	Banana (Kadali a local variety) planted on border areas	195 nos.
5	Dairy (Holstein Friesian and Jersey cross breed cows) – 8 nos.	0.02ha*
6	Poultry ( 100 broiler birds / batch, 4-6 batches per year)	
7	Japanese quails – 100 layers	
8	Biogas plant (3 m <sup>3</sup> ) – 1 no.	
9	Azolla unit (4 m <sup>2</sup> ) – 3 nos.	
10	Aquaculture (Catla, Rohu, Mrigal, Grass carp) - 1000 fingerlings in the pond of 27.5 x 22.5 x1.5 m	0.062ha

\* includes space occupied by the pump house and farm house

which it interacts.

Coconut based integrated farming system research was started at CPCRI in 1972. Initially experiments were conducted by intercropping fodder grass in a 60 year old coconut garden spaced at 7.5 m x 7.5 m with integration of dairy unit.

The components of the existing coconut based integrated farming system in one ha area maintained under experiment at CPCRI Kasaragod are furnished below.

Beneficial impact of coconut based integrated farming system

- In coconut based integrated farming system, coconut give higher yield compared to monocropping
- Leaf nutrient status are higher under CBIFS compared to monocropping
- Soil nutrient status in terms of organic carbon and available N and P are higher under CBIFS treatments compared to monocropping
- Adoption of CBIFS improve soil physical properties compared to coconut monocropping. CBIFS with organic manure recycling

result in higher water holding capacity, hydraulic conductivity and reduction in bulk density compared to monocropping

- Coconut based integrated farming is an ecologically sustainable system which fetches higher income to cultivator when compared to coconut grown as monocropping

### Economic viability of Coconut Based Cropping/ Farming System

Experiences of CPCRI in maintaining different coconut based cropping/farming systems clearly indicated the economic viability of coconut based multiple cropping and mixed farming compared to monocropping. The net income from one hectare of coconut based high density multispecies cropping system was Rs 1.75 lakhs to 2.25 lakhs while under monocropping situation the net income per hectare was only Rs. 45000/-. The net returns realized from one heater of coconut based integrated mixed farming system model ranged between Rs 2.5 lakhs to Rs 3.00 lakhs per year.