Coconut based Integrated Farming System Model - Success story

Jacob John, Sudha, B., Meera, A.V and Sajeena,A.
Integrated Farming System Research Station, Kerala Agricultural University, Karamana
Thiruvananthapuram, Kerala 695 002

Coconut has the status of a plantation crop worldwide. Among the main coconut producing states in the country, Kerala ranks first in area and production. Coconut is raised in 7.61 lakh ha and occupies 29.6 per cent of the gross cropped area. However, with respect to productivity it is fifth, next to Andhra Pradesh, Tamil Nadu, West Bengal and Karnataka (Coconut Development Board Statistics 2017-18). Unlike several countries, where coconut is grown in large gardens, Kerala has a unique feature of presence of coconut based home gardens, which have evolved in response to the pressure of shrinking land resource base coupled with high population density. According to the Tenth Agricultural Census of Kerala, the average size of an operational holding was 0.18 ha in 2015-16. This was against 0.22 ha in 2010-11. Also, out of the total holdings, the size group below one ha (marginal farmers) accounts for 96.7 per cent of the total number of holdings and the average size of the group is 0.12 ha (Department of Economics and Statistics, 2019). It is for the populous marginal homestead farmers that intensive land use practices like multitier cropping and integrated farming are becoming increasingly important.

Coconut-based cropping systems are popular in many parts of the world. Multiple cropping in coconut is the most prevalent and chief form of commercial and government-promoted agroforestry. Although most smallholders have intercropped coconuts with arable crops and trees as part of the traditional agroforestry systems, many institutions continue to encourage the intercropping of only selected crops and trees with coconuts. In many cases, this effort has taken the form of the systematic planting or replanting in existing garden areas of regularly spaced palms, which can then be undercropped. Alternatively, undercropping in existing commercial groves of coconut palms has been systematically encouraged. Farmers cultivate a host of crops including perennials, annuals and seasonal crops along with coconut, without identifying optimum crop combinations.

Table 1. Coconut based IFS model (0.2 ha ie 50 cents)	
Components	Area (m^2)
Coconut (WCT) on bunds and adjoining area (30 nos.)	1480
Teak trees along the border (15 nos.)	400
Multitier cropping	
Papaya (6), Garcinia (1), Nutmeg (1), Cocoa (1), Rose apple (1), (1), spices (ginger + turmeric), Clove (1), tuber crops, fodder crops and vegetables	In interspaces of coconut
Mango (1), Bread fruit (1), Jack (1)	
Azolla (in shallow pit of size 2 x 1 x 0.2 m3, lined with silpaulin) -2 units	20
Apiculture unit (Stingless bee): 1 unit	Beneath coconut
Cow unit : cross bred (1+1)	100
Fresh water fish (GIFT: Genetically Improved Farm Tilapia reared)	In trenches dug between the bunds planted with coconut
Total	2000

Coconut based products are currently booming in popularity the world over, but the farmers of coastal tracts of India, where coconut is the major crop often find themselves in a predicament. Coconut when grown as monoculture leads farmers to distress many a times, mainly due to crop loss associated with pests and disease incidences, and market price fluctuations. However, it has been well established that resorting to coconut based integrated farming can well enhance the yield from unit area and bring about considerable spike in farm income, apart from environment friendly effects resulting from saving of fertilizers due to on farm generation of nutrients. Social relevance of such systems is significant as evidenced from the generation of more employment opportunities.

In the past years, attempts to improve the coconut based farming systems have been mainly through a piece meal approach. The crops/enterprises and its management aspects have been singled out and development projects formulated. Improvement of this complex farming system can be achieved only through a whole-farm or integrated systems approach.

The Integrated farming System Research Station (IFSRS), functioning under Kerala Agricultural University at Thiruvananthapuram, is a network centre of the All India Co-ordinated Research Project on Integrated Farming Systems of ICAR, the apex body coordinating research on integrated farming at the National level. The station has developed and validated a highly successful model for coconut based integrated farming (0.2 hectare) which especially suits the land area and other resources of small

and marginal farmers of the state. Research works carried out for five years suggest that the model is quite successful in generating higher yields, better income and is quite eco-friendly in terms of on farm generation of nutrients. The various components included in the model are detailed in Table 1.

The model: Main (base) crop and intercrops

The establishment of the IFS model was initiated during the year 2011-12. The experimental site was a low land (5 m above mean sea level). Coconut palms (West Coast Tall) of fifteen years of age were already planted on raised bunds at the recommended spacing of 7.5 m between palms. Different intercrops like fruit trees, spices, fodder crops (hybrid napier, guinea grass, para grass), spices, beverage crops, tuber crops (cassava, coleus, sweet potato and yams) and vegetables (amaranthus, cowpea, ash gourd etc) as detailed in Table 1 were then planted in the interspaces between palms. All along the boundaries of this model, miscellaneous trees (timber yielding and fruit trees) were planted.

Genetically Improved Farm Tilapia (GIFT): a profitable component

Fisheries, a highly profitable allied enterprise is included in the model. Water channels of 1.5 m depth naturally formed in between coconut bunds as a result of excavation of soil are utilized for fish rearing. Genetically Improved Farm Tilapia (GIFT), a promising fish species which is highly remunerative and suited to shallow water channels is reared in the channels. Fingerlings of GIFT are procured from Vallarpaadam hatchery under MPEDA (Marine Products Export Development Authority) @ Rs. 6 - 10/fingerling (depending on size). The fingerlings of size 1 cm are reared in tanks for one and a half months till they attain a size of 5 cm and thereafter released to water channels. Before release, the channels are dewatered, cleaned and predatory fishes, if any, which may possibly harm GIFT fingerlings, are removed. The pH of water needs to be maintained around 6 -7 for GIFT culture and therefore, acidity of water is periodically corrected by adding lime. GIFT can be reared under low density (3-4 fingerlings per square metre) or under high density (5-6 fingerlings per square metre). Under low density, though number of fish harvested is less, their individual weight will be higher. Under high density though more number of fish are harvested, their weight is less. Feed is supplied @ 10 per cent of body weight of fish. For deciding the quantum of feed to be given, the fish is randomly caught and weighed periodically. GIFT is harvested at 6-8 months of age. The weight of a fish averages between 250-350 g under high density and 600 to 750 g under low density. The fish fetches good price ie.Rs.300/kg. In this model, from the trench area of 5 cents (200 m2), about 200 kg fish could be harvested per cycle, contributing to gross returns as high as Rs.60000/-. Undoubtedly, fisheries is a remunerative enterprise of the model. Moreover, the flesh of GIFT is very tasty and is having much preference in market. Inclusion of fisheries is a very good example of effectively utilizing every bit of land leaving no fallow. Thus, one of the basic principles of integrated farming ie., the most productive utilization of available land is also effectively achieved.

Other enterprises

Other allied enterprises include a dairy unit comprising of a cow and a calf (cross bred). Dung and urine from the dairy unit in turn support organic crop nutrition within the model. A bee hive, houses stingless honeybee which besides supplying honey of medicinal value augments effective pollination of crops managed in field. The fodder unit maintained in the model supplies fresh green fodder. As a supplementary enterprise to support the fisheries unit, two azolla units are maintained in artificially created shallow tanks. The azolla serves as fish feed thereby reducing the feeding cost.

Nutrient generation from the model

Crop residues and dairy outputs (cow dung, cow's urine, stall wash etc) serve as major sources of nutrients within the system. Pond silt rich in plant nutrients, excavated from the fish rearing channels in alternate years also contribute nutrients. The nutrient content of these resources were estimated and plant nutrient generation quantified on an annual basis. It is evident that on an average, plant nutrients to the tune of 177 kg nitrogen, 89 kg phosphorus and 98 kg potassium were generated annually from the model (Table 2). These nutrients were recycled into the system itself, thereby reducing the cost likely to be incurred towards chemical fertilizers. The heavy

Table 2. On farm generation of major plant nutrients from the 0.2 ha model (kg)

Nutrients (kg)	Period under study					
	2014-15	2015-16	2016-17	2017-18	2018-19	Average
Nitrogen	173	127	199	222	166	177
Phosphorus	68	69	105	117	87	89
Potassium	71	76	113	125	103	98

Ginger intercropped in coconut interspaces

Table 3. Yield, economics and employment generation from the IFS model

Year	Coconut Equivalent Yield (Nuts / 0.2ha)	Gross Returns (Rs.)	Net Returns (Rs.)	B:C Ratio	Employment generation (Man days per year)
2014-15	12213	183201	52781	1.40	79.5
2015-16	10776	183191	56922	1.45	69.0
2016-17	13704	232962	52595	1.28	101.0
2017-18	14274	242663	69055	1.4	90.0
2018-19	15170	257891	60919	1.31	87.0

use of (fossil) energy in modern agriculture, mainly through the use of artificial fertilizers is reflected in very low energy output-input rates in the production of certain food products (Heilig, 1993).Hence, reducing the dependence on chemical fertilizers is of considerable significance in the context of environmental benefits. The energy saving accrued by reducing the use of chemical fertilizers in the model was to the tune of 12573 Mega Joules.

On an average, the fertilizer equivalent of the nutrients generated was 386, 446 and 163 kg of urea, rock phosphate and muriate of potash respectively. The price equivalent of the saved fertilizers was worked out as Rs.8236/- in the 0.20 ha model.

Recycling of biological resources, wastes and by-products can improve farm natural resources and incomes. It is always beneficial to integrate enterprises that are particularly good at promoting recycling. For example, the cow eats grass and crop residues and produces organic manures for crops. Fishes are another enterprise that perform ecological services and save money by converting crop, livestock and household wastes into high quality protein and nutrient rich pond mud. Besides, pond mud is so rich that it can replace fertilizer completely in small vegetable gardens. Hence, recycling can have significant impacts on the ecological sustainability of the entire farming system.

Diverse production and food security through integrated farming

The yield, economics and employment potential of the model are presented in Table 3. It is evident that a switch to integrated farming model can very well enhance production up to even tenfold. This is of very high significance as far as a marginal farmer is concerned.

Considering the fact that the average productivity of coconut from 0.2 hectare in Kerala is as low as 1378 nuts, the enhancement in productivity up to 13227 nuts by switching to integrated farming system is of very high significance. Average gross returns from the model were Rs.219982. Average net income was Rs. 58454 and the Benefit: Cost ratio was

Obituary

Shri. Binu Philip Cherian, employee of Coconut Development Board, Kochi passed away on 15th July 2020. Shri. Binu, a native of Vakathanam, Kottayam, Kerala has been working in the Board since 1994. Shri. Binu Philip Cherian is survived by his wife Smt. Dincy Binu and daughter Linta Susan Binu and son Lohith Binu.

Coconut Board family deeply mourn the sudden and untimely death of Shri. Binu Philip Cherian.

1.37. B: C ratio remained higher than 1.0 in all the years which indicates that the model is consistent in generating better profits. Social relevance of the model in terms of employment potential was quite considerable with the generation of 85 man days from the model on yearly basis

By shifting to integrated farming approach, most of the nutritional demands of the household comprising of four adults could be satisfied. On an average 116 kg coconut oil, 2672 litres of milk, 142 kg fruits, 688 kg vegetables (including tuber crops) and 140 kg fish could be obtained from the model annually. Surplus food production could be marketed in generating income.

It could be concluded that in the coconut based integrated farming system model, the components are judiciously selected and are of complimentary nature. Resource recycling is very well practiced within the system enabling less reliance on chemical fertilizers. Diverse food production contributes to family nutrition and the surplus is marketed in generating additional income. The model is consistent in yield performance and is profitable over the years. This model could therefore be adopted by farmers of similar agro-ecological tracts for food security as well as economic (doubling of farmer's income) and environmental benefits. This model, could be further scaled up through the integrated farming systems project (Jaiva Gruham) of the Kerala State Department of Agriculture Development and Farmers' Welfare, which forms part of the Subhiksha Keralam project of the State Government being technically supported by the Integrated Farming Systems Research Station, Karamana, Kerala Agricultural University, Thiruvananthapuram (0471-2343586). ■

References:

1. Department of Economics and Statistics (2019). Tenth Agriculture Census 2015-16 (Provisional Report Phase I). Government of Kerala. p.70.

2. Heilig, G.K. (1993). Lifestyles and Energy Use in Human Food Chains. Working Paper. International Institute for Applied Systems Analysis A-2361 Luxenburg Austria

3. Coconut Development Board Statistics 2017-18 available at https://coconutboard.gov.in/Statistics.aspx

Acknowledgement: The authors are grateful to the Indian Institute of Farming Systems Research (IIFSR-ICAR) and Kerala Agricultural University for the financial assistance and support provided for the project.