



# Multidimensional analysis of coconut based farming systems adopted by farmers

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## Abstract

A study was conducted to analyse the techno-socio-economic aspects of coconut based farming system in 90 coconut gardens randomly selected from six wards of Thamarassery grama panchayat in Kozhikode District. Data were collected from the respondents during 2003-04 using a pre tested interview schedule. The results showed that there were about 20 models of CBFS in farmers' fields in the study area. Coconut + arecanut + pepper + banana was the most commonly adopted model of CBFS in the study area, followed by coconut + arecanut + pepper system. The degree of crop intensification varied widely across the farms. The economic analysis of various coconut based farming system models in farmers' fields indicated that they are technically feasible and economically viable. The level of profitability increased with increase in the number of the component crops. The study revealed that low price of agricultural produce was the most important constraint experienced by farmers in the adoption of CBFS, followed by pest and disease problems and lack of labour and high wage rate.

**Key words :** Coconut based farming system, crop intensification, economic analysis, constraints

## Introduction

Coconut plays a pivotal role in the agrarian economy of Kerala state. It is predominantly cultivated in small and marginal holdings and occupies about 40 per cent of the total cultivated area in Kerala. Presently coconut growers in Kerala are more exposed to economic risks and uncertainties owing to the high degree of price fluctuations. In this context, it is needless to emphasize the importance of crop diversification in coconut gardens. The agronomic feasibility and economic viability of adoption of coconut based farming systems have been amply demonstrated in research stations and farmers' fields. In spite of the obvious benefits of coconut based farming system over the traditional monoculture, the extent of adoption of the same is not at a satisfactory level (Thamban and Venugopalan, 2002). Coconut farmers adopt various farming systems depending on their socio-economic priorities. There is a need to study the

existing land use pattern and management trends in the coconut gardens in farmers' fields. Hence, to analyse the techno-socio-economic aspects of coconut based farming system, a study was conducted with the following specific objectives:

- to study the extent of crop intensification in coconut based farming systems
- to analyse the economics of coconut based cropping systems
- to analyse the constraints in the adoption of coconut based farming systems

## Materials and Methods

**Locale of the study :** The study was conducted in Thamarassery grama panchayat in Kozhikode district. Kozhikode is a major coconut growing district and the established commodity markets in the district are also worth mentioning. A number of successful coconut

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farmers' cooperatives are also functioning in the district.

**Selection of respondents:** From Thamarassery grama panchayat, six wards were randomly selected for the study. From each of these wards, 15 coconut farmers were randomly selected as respondents thus making the total sample size 90.

### Measurement of variables

**Extent of crop intensification:** Crop intensification in coconut gardens refers to the degree of adoption of coconut based cropping/farming systems. It is expressed in percentage for individual components. Observations were made for identifying different types of coconut based cropping/farming systems in the study area and frequencies of such types were worked out. Distribution of individual crop/enterprise in the CBFS models observed in farmers' field was also studied.

**Economic analysis of coconut based farming system :** The economic analysis of different CBFS models was done by estimating cost of cultivation, gross returns and net returns as indicated in Sairam *et al.* (2004). While performing these analyses based on the market prices of 2002-03 those component crops/enterprises, which had fetched income through sale alone were included.

**Perception of farmers :** Perception of farmers about the constraints experienced in the adoption of CBFS was analysed by working out perception indices.

**Data collection :** Data were collected from the respondents during 2004 using a pre tested interview schedule.

## Results and Discussion

### Socio-personal characteristics of the farmers adopting coconut based farming systems

Results pertaining to the distribution of farmers according to their age revealed that majority (80 per cent) of the farmers are old i.e., above 45 years, which is in line with general trend observed in Kerala state where the younger generation keeps away from farming. Implementation of appropriate and viable programmes to attract the youth towards farming thus assumes much significance. All the respondents were literates. About 10 per cent of the farmers were degree holders and three per cent were postgraduates. The high literacy rate among farmers indicates that it would be comparatively easy to formulate extension strategies for educating the farmers on new farming methods for sustainable production. Only 52 per cent of the respondents were depending on farming alone as the source of income. The remaining were engaged in other avenues besides farming for income earning. This is also in line with the general trend observed in Kerala state.

About 38 per cent of the farmers were having less than 1 ha land, 42 per cent had 1-2 ha while the remaining 20 per cent had 2 ha and above land holdings. Compared to the state average, the farmers in the study area had larger land holding size. This feature indicates that there is better scope for adopting different models of coconut based cropping/farming systems by the farmers in these localities. However, the results also revealed that a majority (71 per cent) of the coconut gardens were rainfed indicating less scope for including those crops which require irrigation in the CBFS.

Only 62 per cent of the farmers were regularly attending the grama sabhas under the decentralised planning programme in their wards. Contact persons, extension personnel of the local Krishibhavan and newspaper were the most frequently utilized sources of information by the farmers with 69, 38 and 67 per cent of the respondents regularly using these sources respectively.

### Extent of crop intensification in coconut based farming systems

#### Coconut based farming system models in farmers' fields

Farmers adopted different types of CBFS in their coconut gardens. The major types of cropping/farming

**Table 1. Coconut based farming system models in farmers' fields (n=90)**

Sl. No.	Cropping/Farming system	No. of farmers	Per cent
1.	Coconut+ arecanut + pepper + banana	20	22.2
2.	Coconut+ arecanut + pepper	16	17.8
3.	Coconut + arecanut + banana + dairy	7	7.8
4.	Coconut+ arecanut + pepper + banana + dairy	5	5.5
5.	Coconut+ cocoa + pepper + banana	4	4.4
6.	Coconut+ arecanut + banana + dairy + cocoa	4	4.4
7.	Coconut+ banana + elephant foot yam	4	4.4
8.	Coconut+ arecanut + dairy + colocasia + turmeric	3	3.3
9.	Coconut+ arecanut + dairy + colocasia	3	3.3
10.	Coconut + arecanut + pepper + dairy + fodder grass	3	3.3
11.	Coconut+ arecanut + pepper + banana + dairy + cocoa	3	3.3
12.	Coconut+ tapioca	3	3.3
13.	Coconut + banana + dairy + elephant foot yam + turmeric	3	3.3
14.	Coconut+ pepper + colocasia	2	2.2
15.	Coconut+ ginger + pepper	2	2.2
16.	Coconut+ bitter gourd	2	2.2
17.	Coconut + cow pea	2	2.2
18.	Coconut+ arecanut + nut meg	2	2.2
19.	Coconut + vanilla	1	1.1
20.	Coconut + piggery	1	1.1

systems observed in the study area are furnished in Table 1.

The results indicate that coconut+ arecanut+ pepper+ banana is the most common (22.2 per cent) model of CBFS in the study area, followed by coconut+ arecanut+ pepper system (17.8 per cent). The model with coconut+ arecanut + banana + dairy was the next important (7.8 per cent) CBFS observed in farmers' field. Only one farmer each adopted mixed cropping of vanilla and integration of piggery with coconut cultivation.

**Table 2.** Distribution of crop/enterprise in the CBFS models observed in farmers' field

Sl. No.	Crops/Enterprise	No. of farmers	Percentage	Average Planting density per unit area in percentage
<b>I. Intercropping</b>				
i.	Banana	43	47.8	31.5
ii.	Tapioca	3	3.3	52.7
iii.	Elephant foot yam	7	7.8	65.8
iv.	Colocasia	8	8.9	26.4
v.	Bittergourd	2	2.2	42.9
vi.	Cow pea	2	2.2	33.8
vii.	Ginger	2	2.2	62.8
viii.	Turmeric	6	6.7	55.8
ix.	Fodder grass	3	3.3	49.2
<b>II. Mixed cropping</b>				
i.	Pepper	55	61.1	45.4
ii.	Cocoa	11	12.2	38.3
iii.	Arecanut	66	73.3	65.8
iv.	Nutmeg	2	2.2	19.8
v.	Vanilla	1	1.1	43.8
<b>III. Mixed farming</b>				
i.	Dairy	31	34.4	NA
ii.	Piggery	1	1.1	NA

Distribution of crop/enterprise in the CBFS models observed in farmers' field is furnished in Table 2.

### Degree of crop intensification

The degree of crop intensification varied widely across the farms. It could be inferred from the above table that the percentage of intensification varied from 19.8 in the case of nutmeg to 65.8 in the case of arecanut.

Arecanut, pepper and banana were the most frequently observed component crops in the CBFS models in farmers' field, appearing in 73, 61 and 48 per cent of CBFS holdings respectively. It is interesting to note that

arecanut, which is having a similar growth pattern as that of coconut and not usually a recommended mixed crop in coconut gardens, is adopted in a substantial number of CBFS. If the spacing adopted in the coconut garden is more than 7.5 m, arecanut can be accommodated in the CBFS. However, no studies have been conducted on mixed cropping of arecanut in coconut garden. Though not a recommended crop, many farmers have started raising arecanut in coconut gardens when the market price of arecanut turned to be attractive, which even went up to Rs 150 per kg chali (dried arecanut). This is a typical situation where choice of component crop in a farming system is mainly made based on the economic considerations rather than agronomic feasibility. However, of late, farmers are disenchanted by arecanut since the price has crashed down to Rs.45 to 55 per kg. Further, the crop loss due to yellow leaf disease also has become a serious problem in the maintenance of arecanut in the CBFS. Since it is a perennial crop, changing the CBFS through restructuring is rather a difficult option for the farmers. It is imperative that detailed studies in the form of On Farm Research are to be made on the techno-socio-economic aspects of arecanut mixed cropping in coconut gardens.

Pepper has been a traditional mixed crop in coconut gardens. However, farmers perceived great difficulty due to the price fluctuations in pepper market and also crop loss due to foot rot disease. Cocoa is catching up as a remunerative mixed crop in coconut gardens. This crop has recovered from the crisis situation of eighties during which farmers were forced to cut and remove cocoa plants from their CBFS due to price crash and related market problems. At the time of this study vanilla was the most attractive cash crop, though established gardens were very few only.

Banana was the most popular intercrop in the CBFS. According to farmers, there were not many problems in marketing of banana. Further, the crop also was not having any serious pest and disease problem. Colocasia, elephant foot yam and tapioca were the important food crops cultivated in the CBFS in the study area, which were the components of 9, 8 and 3 per cent of CBFS holdings respectively. Farmers opined that these crops fetched remunerative price in the market while they also played a role in ensuring food security in their households by meeting a part of their requirements. It was also observed that these crops were mostly managed by utilizing family labour.

It was observed that vegetables were raised only in a few CBFS holdings in a substantial scale. Bittergourd and cowpea were the important vegetables thus raised. Farmers perceived that partial shade situation in CBFS

is not ideal for most of the vegetable crops and they require open area for better yield. However, a few plants of some of the common vegetables were maintained as part of the homesteads for domestic consumption only. Similarly, turmeric and ginger were raised as intercrops only in a few (7 and 2 per cent respectively) CBFS holdings. Farmers perceived price fluctuation in the market as a major reason for the low level of adoption of these crops.

About 34 per cent of the CBFS holdings were integrated with dairy enterprise. Farmers perceived that integration of dairy unit in their CBFS ensured the availability of cow dung for organic recycling as manure and also provided cash income through the sales of milk. It was observed that farm women played a major role in the maintenance of milch animals in the CBFS. Most of the households depended on the green grass obtained from their farm and nearby areas, apart from the concentrates to feed their animals. Only three per cent of the CBFS holdings had fodder cultivation on a substantial scale in the interspace of coconut palms.

#### Maintenance of plant density in CBFS

The average plant density per ha in coconut gardens varied from 100 in the case of medium and large farms to 170 in the case of small farms. The smaller holdings in the lower parts of the grama panchayat have higher palm density than the comparatively larger holdings in the upper reaches. In most of the coconut gardens, the spacing of coconut is more than the recommended spacing of 7.5 m x 7.5 m, thereby enabling the farmers to take up CBFS practices.

The average number of pepper vines maintained per ha of CBFS is 500, which is less than the recommended intensity. The lower density, according to farmers, is due to the loss of pepper vines owing to the incidence of foot rot disease. Similarly, farmers maintain only 200 arecanut palms per ha of CBFS due to the loss of arecanut palms because of yellow leaf disease incidence. On an average, farmers maintain 250 cocoa trees per ha of CBFS.

Farmers adopt the recommended spacing for intercrops like banana, ginger, turmeric, tapioca, elephant foot yam, colocasia, cow pea, bittergourd etc.

#### Use of labour

The share of labour in the Total Variable Cost varied from 30 per cent to 60 per cent depending upon the degree of farm intensification. Dairy unit demands a major share of farm labour and followed by arecanut and coconut and other component crops like vanilla, pepper, banana etc. The average labour wage is Rs.135 / day in the case of men labour and the same is Rs.80/ day in the case of

female labourers. The skilled labour charges for spraying operations are Rs.225 to Rs.250/man day. In the present context, in which labour charges are increasing at an increasing rate due to various socio-economic factors, adoption of coconut based farming system could be successful only if the share of family labour is increased.

#### Economic analysis of coconut based farming systems

The details of economic analysis of coconut based farming systems in farmers' field in terms of net returns per ha are furnished in Table 3.

Table 3. Distribution of crop/enterprise in the CBFS models observed in farmers' field

Sl.No.	Cropping/Farming system	Per cent	Net Returns (Rs./ha)
1.	Coconut + arecanut + pepper + banana	22.2	150385
2.	Coconut + cocoa + pepper + banana	4.4	179528
3.	Coconut + pepper + colocasia	2.2	74162
4.	Coconut + arecanut + dairy + colocasia + turmeric	3.3	68490
5.	Coconut + arecanut + dairy + colocasia	3.3	61392
6.	Coconut + arecanut + pepper + dairy + fodder grass	3.3	81843
7.	Coconut + arecanut + banana + dairy + cocoa	4.4	69892
8.	Coconut + arecanut + pepper + banana + dairy + cocoa	3.3	137006
9.	Coconut + arecanut + pepper + banana + dairy	5.5	145677
10.	Coconut + ginger + pepper	2.2	45430
11.	Coconut + tapioca	3.3	59029
12.	Coconut + bitter gourd	2.2	37036
13.	Coconut + cow pea	2.2	34438
14.	Coconut + vanilla	1.1	263730*
15.	Coconut + arecanut + nut meg	2.2	53723
16.	Coconut + arecanut + pepper	17.8	51219
17.	Coconut + banana + dairy + elephant foot yam + turmeric	3.3	56238
18.	Coconut + banana + elephant foot yam	4.4	52577
19.	Coconut + arecanut + banana + dairy	7.8	100733
20.	Coconut + piggery	1.1	83400

\*Net returns of coconut + vanilla system worked out based on the present rate of vanilla is Rs. 76,500/-

The net returns from coconut based farming systems in farmers' field ranged from Rs. 34,438/ha as obtained in coconut + cow pea system to Rs. 2,63,730/ha as obtained in coconut + vanilla system. Earlier research efforts had also yielded similar results on the feasibility and profitability of various coconut based cropping/farming systems (Sairam *et al* 1997, Neybe *et al*, 2004). It was observed that the level of profitability increases with increase in the number of the component crops. To improve stability in gross farm income, it is better for the farmers to adopt a flexible cropping/farming system with annuals, biennials and perennials so that varied end products could be realized during different seasons. The level of profitability also depends on the degree of intensification, suitability of the crops to the farm environment, level of investment and management. The scope and advantages for mixed farming in coconut garden involving cultivation of shade tolerant fodder crops in the interspaces of coconut and integrating animal enterprises and recycling the byproducts obtained was revealed by the present study as has been documented by earlier studies (Thampan, 1996). It was evident that those models in which dairy is a component of the farming system, the relative profitability was more due to direct as well as indirect benefits. In those farms, in which cows are reared, the farmer could be able to meet about 50 to 75 per cent of the organic manure requirement of the farm, there by considerably reducing the cost of cultivation.

#### Constraints in the adoption of coconut based farming systems

Farmers experience various constraints in the adoption of coconut based farming systems. The perception of farmers about such constraints is summarised in Table 4.

Table 4. Perception of farmers about constraints in the adoption of CBFS

Sl. No.	Item	Perception Index	Rank
1.	Low price of produce	74	I
2.	Pest and disease problems	70	II
3.	Lack of labour and high wage rate	64	III
4.	High cost of organic manures	60	IV
5.	Lack of availability of organic manures	56	V
6.	Lack of availability of planting materials	50	VI
7.	Lack of support from development agencies	43	VII
8.	High cost of fertilizers	41	VIII
9.	Lack of irrigation facilities	37	IX
10.	Close spacing of coconut	34	X
11.	Poor soil fertility	30	XI
12.	Lack of awareness and knowledge	28	XII

The study revealed that low price of agricultural produce is the most important constraint experienced by farmers in the adoption of CBFS, followed by pest and disease problems and lack of labour and high wage rate. Recently there has been a price crash for many of the agricultural produce commonly raised in the CBFS such as pepper, arecanut etc. Incidence of pests and diseases was perceived as an important problem adversely affecting production of coconut and component crops of CBFS. Eriophyid mite infestation in coconut has considerably reduced the yield of coconut. Similarly, YLD of arecanut, foot rot of pepper, mosaic disease of tapioca etc are the major diseases, which farmers found difficult to manage.

Though it is important to utilize family labour for profitable maintenance of CBFS, during the peak seasons of farming activities hired labour is to be engaged. According to farmers, lack of labour and high wage rate also pose problems in the effective maintenance of CBFS. Skilled labour for coconut and arecanut harvesting is scarce and costly. Lack of availability of organic manures and their high cost is another problem adversely affecting the sustainability of CBFS. Adoption of recommended practices of vermicomposting of organic wastes available in CBFS would be a potential way to overcome this difficulty. This would enhance the efficiency of organic recycling for sustainable maintenance of CBFS.

Quality planting materials is a pre-requisite for ensuring higher production from CBFS. Farmers perceived great difficulty to procure quality planting materials, especially of various inter/mixed crops for the CBFS. Decentralized nurseries for the production and distribution of quality planting materials of crops suitable for the CBFS in the locality would be a viable option to overcome this problem. The farmers also perceived lack of support from developmental agencies as a constraint in the adoption of CBFS. Agencies such as Krishibhavan, the panchayat level office of the Department of Agriculture, mostly implements crop specific development schemes only. Hence, it is essential that efforts be made to formulate and implement schemes to promote adoption of farming systems rather than crop specific schemes.

It has been experimentally proved that quantity of chemical fertilizers to be applied can be reduced, if effective organic recycling is practiced in CBFS. However, use of chemical fertilizers cannot be completely avoided since it would affect the nutrient status of the system in turn affecting the yield of crops. High cost of chemical fertilizers is perceived as a constraint in the maintenance of CBFS. Hence, it is imperative that arrangements are made for providing incentives to

farmers to procure chemical fertilizers for the integrated nutrient management of their CBFS. Many of the recommended crops in CBFS require irrigation. Lack of irrigation facilities prevents the farmers from including such crops in their CBFS.

In the study area, in the higher and middle reaches, optimum spacing has been maintained for coconut palms facilitating accommodation of various inter/mixed crops in the CBFS. However, in the lower reaches where size of land holding is comparatively small, optimum palm density is not maintained. The closer spacing adopted reduces the opportunity for effectively adopting inter/mixed cropping practices. Under such situations restructuring of the holdings to maintain optimum plant density would be necessary for the effective maintenance of CBFS. Poor soil fertility resulting in the low yield of crops in the CBFS is also perceived as a constraint by farmers. Hence, measures to promote the adoption of integrated nutrient management practices, including effective organic recycling, are to be taken to improve the soil fertility status to ensure sustainable production in the CBFS.

Lack of awareness and knowledge about technologies for effective maintenance of CBFS is also perceived as a constraint in the adoption of various recommended practices. Farmer participatory technology transfer programmes related to the recommended practices of CBFS appropriate to the locality are to be organized by the extension agencies such as Krishibhavan along with the implementation of decentralized schemes for promoting coconut based farming systems.

### Conclusion

The study indicated that the degree of crop intensification varied widely across the farms. Arecanut, pepper and banana were the most frequently observed

component crops in the CBFS models in farmers' field. About one-third of the CBFS holdings were integrated with dairy enterprise. The economic analysis of various coconut based farming system models in farmers' fields indicated that they are technically feasible and economically viable. The level of profitability increases with increase in the number of the component crops. The study revealed that low price of agricultural produce is the most important constraint experienced by farmers in the adoption of CBFS, followed by pest and disease problems and lack of labour and high wage rate. Farmers also perceived great difficulty to procure quality planting materials, especially of various inter/mixed crops for the CBFS. Hence, efforts are required to formulate and implement schemes to promote adoption of coconut farming systems rather than crop specific schemes.

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