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Economic impact of arecanut based cropping systems: A study of Dakshina Kannada district-Karnataka

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Abstract

The present study was to quantify the economic impact of arecanut based cropping systems in south Karnataka region. It was observed that, farmers are predominantly following three different cropping systems such as 1) arecanut+banana 2) arecanut+cocoa and 3) arecanut+banana+pepper other than arecanut alone as monocrop. These systems were compared with the arecanut monocrop and found that the percentage increase in net returns from systems 1, 2 and 3 over monocrop were 32, 40 and 44 respectively. It was observed that, the percentage adoption of arecanut monocrop was 26, while it was 36, 11 and 27 for system 1, 2 and 3 respectively. The economic impact of different cropping systems were estimated by calculating the average cost per hectare, average yield and the net returns of each cropping system. The economic impact of each system has been worked out by combining the difference in net returns of each system from the arecanut monocrop, and percentage of adoption of each cropping system. The total economic impact in monetary terms due to adoption of cropping systems in the region was found to be Rs.819 million. The methodology used in this study for quantifying the economic impact of arecanut based cropping systems could be used in other cropping systems as well. Moreover, the quantified economic impact figures could be used as an input for formulating policy decisions related to arecanut.

Keywords: Adoption, arecanut, cropping systems, economic impact

Introduction

Arecanut (*Areca catechu* L.) is a perennial crop grown in the humid tropics of India. The crop has a gestation period of 5–8 years and a long economic life span of 35 years. Hence, the flow of costs and returns are spread over a number of years with varying degree of magnitude. In order to minimize the degree of price risks and stabilize the gross farm income, the arecanut farmers are advised to adopt various cropping/farming models through crop intensification, wherein, two or more complementary crops are cultivated in the inter spaces of the main crop. However, the degree of farm intensification and choice of the component crops depend on agro–climatic, edaphic, biotic and socio-economic factors. The trend in wholesale prices of arecanut indicate that the degree of price fluctuation is fairly high (Jayasekhar *et al.,* 2004) and hence, realizing additional income from mixed/ inter crops would certainly help to sustain the economic stability of arecanut gardens.

For many years now raising other crops in the interspaces of arecanut has been a common practice. The diversity of compatible crops in arecanut gardens was reported for the first time by Bavappa (1951). According to Bhat (1974), the main objective of intercropping in arecanut gardens in the earlier days was, not intensive land use, but social and economic situations prevailed during that time compelled them to follow the pattern. Hence, the selection of intercrops and management practices adopted were not based on sound agronomic

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principles alone. A number of field experiments were initiated in early 1960s at the Central Plantation Crops Research lnstitute (CPCRI) Regional Station, Vittal, and the Research Centers' to assess the adverse effects, if any, on the productivity of the main crop (arecanut) due to inter-cropping and to find out the productivity and profitability of the cropping systems practiced.

The input–output analysis of the arecanut based cropping system model at CPCRI raised under irrigation indicated that the estimated net margin from one hectare arecanut based system including other perennial crops namely, cocoa, pepper and banana (semi perennial crop) was evidently much higher than arecanut monocropping (CPCRI, 1990). In another study on the advantages of arecanut based mixed cropping systems using Land Equivalent Ratio (LER), Monetary Advantage (MA), and Competition Ratio (CR), Das and Vijaya Kumar (1991) observed that under the irrigated system, arecanut+cocoa gave a better monetary advantage with an LER of 2.18 than arecanut+pepper where, the estimated LER was 1.50. CPCRI (1991) observed that cocoa is a profitable mixed crop in arecanut garden and for realising the highest returns the optimum spacing for cocoa should be 2.7 m x 5.4 m planted in alternate rows of arecanut.

A comprehensive economic analysis of arecanut based farming systems under farmer field conditions in Kasaragod has been conducted by CPCRI (2000). The net returns from the system had increased with the increase in number of components. However, the share of income from arecanut cultivation in gross return was more than 70 percent. Another field survey in 80 cocoa gardens in Dakshina Kannada district based on purposive sampling of farmers cultivating cocoa as a mixed crop in arecanut gardens (CPCRI, 2005) found that the realized Benefit Cost Ratio (BCR) and Internal Rate of Return (IRR) for arecanut monocrop were 1.13 and 16 percent respectively. The same in the case of arecanut+cocoa system were 1.22 and 17.2 percent respectively, reflecting apparent advantage of the system over monocrop.

While reviewing the important studies on arecanut based cropping systems, we could observe that the missing link is the comparative economic impact of the cropping systems. In recent times there has been increasing pressure to direct agricultural research towards the needs of small–scale farmers and the rural poor. Impact studies had, however, faced both conceptual and empirical challenges, partly due to the complexities of the relationships between agricultural technology and the various dimensions of poverty, with research having both direct and indirect effects on poverty alleviation (Kerr and Kolavalli, 1999). The economic impact studies can be designed for integration into assessment of broader programmatic objectives and ultimately into the economic growth policy goals towards which the research programme should be designed to contribute. The present study is an attempt to analyze the economic impact of arecanut based cropping systems followed by the farmers in south Karnataka region, which is a major arecanut growing tract in India. Although the impact studies go beyond the quantitative measures and explains the broader issues like structural and behavioural analysis as well as socio–economic implications, the scope of the present study is limited to the quantification of economic impact resulting from arecanut based cropping systems.

Materials and Methods

The study was conducted during the year 2009 in Dakshina Kannada district of Karnataka, which is predominantly an arecanut growing district. A multistage random sampling technique was employed for the survey. District being the universe, all five taluks of the district were selected. From each taluk two villages were selected at random. Subsequently, from each of the villages 12 respondents were interviewed. Thus a sample size of 120 respondents were represented the district. A well structured pretested schedule was employed for interviewing the respondents. Cocoa (*Theobroma cacao* L.), Black pepper (*Piper nigrum* L.) and Banana (*Musa acuminata* L.) were the major component crops in arecanut gardens of the study area. In order to compare the different cropping systems, it was pertinent to look into the economics of these cropping systems. Therefore, we have estimated the cost of production of arecanut, cocoa, black pepper and banana separately. It should be noted that the economics is worked out considering

each crop as an intercrop in arecanut and the cost of cultivation estimated for each crop may differ when the system changes[1].

Since the crops selected are perennial in nature, the total investment (pre–bearing establishment cost[2]) and the interest thereon were reduced to an annuity bearing 10 percent interest. The annuity is calculated using the formula given below.

$$A = P / \sum_{i=1}^{n} 1/(1+r)^n \quad \text{where,}$$

A = annuity value

P = total investment

r = rate of interest

n = life of the plantations

The annuity value thus obtained is added to the annual maintenance cost to arrive at the total annual cost per hectare. On the other hand, banana was considered as an annual crop in the system. In order to analyze the economics of the system, the total cost of each component crops were added to the total cost of arecanut monocrop (including amortized annuity value) to realize the total cost incurred by the system as a whole. In the similar manner we have worked out the total returns from the whole system.

Capital productivity analysis is the most important tool for evaluating the financial feasibility of perennial crops and Benefit Cost Ratio (BCR) is an effective method for capital productivity analysis. The *ex–ante* concept of benefit cost analysis is adopted for computing the BCR with the following formula.

$$\sum_{t=1}^{n} B_t/(1+i)^t / \sum_{t=1}^{n} C_t(1+i)^t \quad \text{where,}$$

B_t = benefit in each year

C_t = costs in each year

n = number of years

i = discount rate (discount rate taken is 10 percent)

The economic impact (in rupees) in the district level was calculated using the formula given below.

$(NR_i\text{-}NR_\alpha) * (A*P_i/100)$ *where,*

NR_i = net returns from i^{th} cropping system

NR_α = net returns from arecanut mono crop (Rs)

A = total area under arecanut (Rs) in the district

P_i = percentage of adoption of i^{th} cropping system

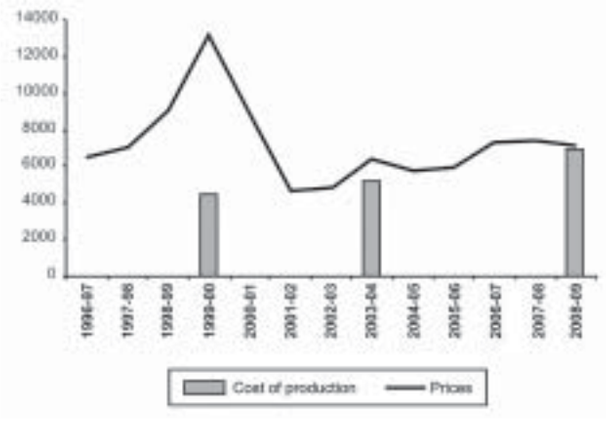
The economic impact estimated in the study is a relative concept, where we consider the additional benefit obtained over the arecanut monocrop by following the cropping systems. We have estimated the percentage of adoption of different cropping systems and the approximate area under each cropping system was estimated using this. Therefore, the estimated area under each cropping system multiplied with additional returns obtained from each system would give the additional economic benefit obtained over arecanut monocrop for each cropping system.

Results and Discussion

Price stagnation and increasing cost of production of arecanut in the recent years have generated livelihood concerns of arecanut farmers in India. It is noticed that the wedge between the cost of production and the market prices are narrowing down since 1999-2000 and of late it has become too narrow that the prices received for arecanut become insufficient to support the livelihood of arecanut farmers (Fig. 1).

This matter could as well view in yet another way by examining the indebtedness of arecanut farmer. Table 1 shows the results of a study conducted on debt pattern among arecanut farmers in Dakshina Kannada district. It was observed that

[1]For instance the cost of cultivation of cocoa intercrop in coconut garden will be different from cocoa intercrop in arecanut.
[2]Arecanut is perennial in nature with a long pre-bearing period followed by several phases of bearing period namely 1) steady yield increasing period, 2) stabilized yield phase, 3) yield declining phase, 4) senile/uneconomic phase. The expenditure during the pre-bearing stage constitute the investment on the crop, while the full benefits take quite some time to accrue regularly.



Note: Figures are in rupees per quintal

Fig. 1. Movement of cost of production and market prices of arecanut

Table. 1. Percentage of loans taken by different holding groups

Holding size (ha.)	Crop loan	Term loan	Total loan	Dependence*
0.4>	4	3	3	30
0.4 to 0.8	6	23	19	50
0.8 to 1.6	48	41	43	90
1.6<	41	33	35	40

Note: *approximate percentage of income obtained from arecanut

farmers having a holding size of 0.8–1.6 hectares are highly indebted. Farmers belonging to this category are more vulnerable as most of them entirely dependent on areca farming for their livelihood. Returning to the issue of narrowing price wedge between the cost of production and market prices of arecanut, it is evident that in the present situation arecanut monocropping is economically unremunerative. The relevance of cropping system arise at this context and it is important for areca growers in general and small holdings of 0.8-1.6 hectares category in particular to follow areca based cropping systems for most of them, the only source of livelihood is arecanut.

While analyzing the arecanut based cropping system practiced among the farmers of Dakshina Kannada district, it was observed that farmers are following three predominant cropping systems, which were, arecanut+banana (System I), arecanut + cocoa (System II) and arecanut + banana + pepper (System III). Among these three systems most predominant was System I, which was adopted by 36 percent of the sample farmers. On the other hand, System II was adopted by 11 percent and System III was practiced by 27 percent of the farmers responded.

For comparing the above mentioned cropping systems with the arecanut mono crop, where 26 percent of the farmers were followed arecanut monocropping, it is imperative to look into the economics of growing these systems. We have already stated that cost of cultivation estimated for each crop in a particular system may differ when the system changes. Moreover, it was found that the farmers were not following the recommended intercrops in the arecanut based cropping system. The recommended and observed plant densities of the intercrops in the farmers field were compared in Table 2.

Table. 2. Recommended and observed plant density and yield per hectare

Crop	Recommended by CPCRI, RS, Vittal		Observed from the survey	
	Population	Yield (kg)	Population	Yield (kg)
Arecanut	1300	3000	1150	2700
Black pepper	1300	1300	600	480
Banana	650	10000	500	4500
Cocoa	650	1300	650	650

This divergence is very much evident in the case of black pepper where, we could find only 600 pepper vines per hectare instead of the recommended 1300 pepper vines. In addition, the corresponding yield difference is also very much evident. In the case of banana though the observed plant population in the farmers field was more or less similar or equal. The yield difference noticed were remarkably high, particularly in the case of cocoa (Table 2).

After analyzing the economics of each crop in the system as well as the arecanut monocrop it was found that the cost of production of arecanut was Rs. 70.5 per kilogram for chali[3] and cost of production of cocoa was Rs. 62.4 per kilogram of dry beans. Cost of production of black pepper and banana was found to be Rs. 37 per kilogram and Rs. 2.9 per kilogram respectively (Table 3).

Even though the cost of production estimates were made for each intercrop (Table 3), the purpose

[3]*This variety is prepared out of riped nuts, which is dried first, then dehusked. Kernels are unboiled and are in whole form, heavy in weight and white in colour.*

Table. 3. Cost of production of arecanut and component crops in the system

Particulars	Arecanut	Cocoa	Pepper	Banana
Establishment cost (Rs/ha)	889962	116359	63850	----
Amortized value (Rs/ha)	67238	10705	5321	----
Annual maintenance cost (Rs/ha)	109989	26549	19050	11500
Interest on annual maintenance cost (Rs/ha)	13235	3319	2286	1380
Total cost (Rs/ha)	190462	40572	26657	12880
Average production (kg/ha)	2700	650	720	4500
Cost of production (Rs/kg)	70.5	62.4	37.0	2.9

Source: computed from survey data

was to find the total cost incurred in each system, which was obtained when the total cost of each crop was added to the total cost of arecanut monocrop. Similarly the net returns from each cropping system were worked out and are shown in Table 4. It is noteworthy that the average net returns from the arecanut monocrop was Rs. 12,000 per hectare, but it reached Rs. 65,500 per hectare in cropping System III.

Table. 4. Economics of different arecanut based cropping systems

Cropping system	Expenditure Rs/ha	Returns Rs/ha	Net Returns Rs/ha	Additional returns*	Benefit: Cost Ratio
Arecanut monocrop	190462	202500	12038	---	1.12
A+B (System I)	203342	247500	44158	32120	1.38
A+C (System II)	231034	280500	49466	37428	1.34
A+B+P (System III)	229999	295500	65501	53463	1.78

Notes: A = Arecanut, B = Banana, C = Cocoa and P = Pepper
*Additional returns over Arecanut monocrop (in Rs/ha)

In order to bring out a more comprehensive picture of the analysis, it need to be estimated the additional returns generated by each of the three cropping systems over the arecanut monocrop from a unit area of land (in this study it is hectare). The additional returns generated from each system as well as the benefit cost ratio of each system are also presented in Table 4. In the study, a discount rate of 10 percent was used and the number of years (economic life span) for arecanut, cocoa and black pepper assumed was 35, 35 and 17 respectively. The additional income generated in each system over arecanut monocrop was found to be in tune with the net returns generated from each system. Again System III was found to generate the highest additional returns with a BCR of 1.78. Although the net returns as well as the additional returns from System II were found to be higher than the System I, the BCR of System I is higher when compared with that of System II. The reason for this could be attributed to the four years of pre–bearing period of cocoa with negligible income. Moreover, banana being an annual crop in arecanut plantation giving returns during the entire period of arecanut crop.

The quantification of economic impact of each system has been worked out by combining the difference in net returns of each system from the arecanut monocrop, and percentage of adoption of each cropping system. The analysis results showed that arecanut+banana+pepper system was giving the highest additional returns among the three predominant arecanut based cropping systems. The total economic impact due to adoption of cropping systems in the region was found to be Rs. 819 million (Table 5). It is important to note that economic impact quantified for a particular year for a cropping system may differ in subsequent years depending on changes in the percentage of adoption or the market prices of the component crops. For instance, we found that, System II (arecanut+cocoa) gave more additional returns than that of System I (arecanut+banana), but the economic impact of System I was higher than that of System II because of the higher percentage of adoption of this system.

Table. 5. Economic impact of different arecanut based cropping systems

Cropping system	Adoption (%)	Additional returns over monocrop (Rs/ha)	Area under cropping system (ha)	Economic impact
Areca monocrop	26	-	7074	-
A+B	36	32120	9795	315
A+C	11	37428	2993	112
A+B+P	27	53463	7346	393
Total	100	-	27208	819

Note: Economic impact quantified in rupees million

Conclusions

Livelihood concerns of the arecanut farmers due to the increasing cost of production and unremunerative market prices inspired us to study the arecanut based cropping systems, which were advised to practice for minimizing the degree of price risks, and stabilize the gross farm in-come. The quantification of economic impact of arecanut based cropping systems is relevant in two ways. Firstly, a simple practical methodology was applied

to estimate the economic impact, which could be used for similar studies on other cropping systems as well. Secondly, the figures of economic impact could be an input for the policy level decisions especially in matters related to arecanut crop. The study also drives to think about the situation, had the entire area been under different cropping systems (only 26 percent area was under arecanut monocrop at present). In that case the total economic impact could have been much higher than that of present estimated Rs. 819 million. The results of the study also leading a few probing questions like farmer's perception on adoption of different cropping systems, reasons for preferring one system over the other and most importantly the reasons for deviating from the recommended practices of arecanut based cropping systems.

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