Economic Analysis of Coconut Cultivation under Micro-irrigation

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Introduction

Coconut sector plays a pivotal role in the agrarian economy of many states in India. In Kerala, it occupies about 40 per cent of the total cropped area and provides livelihood to millions of farm families. However, the productivity level remained low in the State and there is a wide gap existing between the potential and actual yields. Scarcity of irrigation water is also considered as one of the major constraints in resource use management in coconut farming in Kerala. This problem is more prominent in northern parts of the State, which receive 75 per cent of the rainfall during the period from June to August. A prolonged duration of summer results in moisture stress which adversely affects the crop productivity.

Farmers in this region came to be aware of the micro-irrigation as a water conserving technology during the early 1980's and subsequently many coconut growers have installed micro-irrigation system in their gardens. Government also implemented programmes that encouraged farmers to adopt water conserving micro-irrigation technology, by providing incentives in the form of subsidy under the centrally sponsored scheme on "use of plastics in agriculture" through the State Department of Agriculture. Effective field implementation of micro-irrigation technology in coconut gardens could help the farmers in the judicious use of scarce water resources for enhancing the productivity and income from coconut farming.

In this back-ground, a study was conducted to analyse the economic benefits of adopting micro-irrigation technology in coconut farming with the following specific objectives.

Objectives

To study the economics of coconut cultivation under micro-irrigation as compared to conventional system of irrigation.

Research Methodology

LOCALE : The study was conducted in Kasaragod distict of Kerala state. From Kasaragod district, all the four development blocks were selected for the study.

RESPONDENTS : From the list of coconut farmers adopting drip irrigation in each of the four development blocks, 50 coconut farmers were selected for the study through simple random sampling. Thus a total of 200 adopters were selected for the study. Similarly from the same locale, 200 coconut farmers who did not adopt micro-irrigation systems, but were irrigating their coconut palms through the conventional basin method, were also selected for comparison.

Measurement of Variables

The economic analysis was performed based on the cost concepts and through cash flow analysis which are operationalised as follows :

Plant Density

In all the coconut gardens under study, the plant density, which is an important factor in the estimation of cost of cultivation, was observed as the number of palms per hectare.

Average Productivity of Coconut

The average productivity of coconut palm, which is also an important factor in the estimation of cost of cultivation, was recorded as the number of nuts per palm per year.

Cost Concepts

The cost concepts to assess the total variable cost, total cost, gross return and net return per unit area were employed for the economic analysis of coconut cultivation based on the standard norms adopted for perennial crops (Das, 1985).

Total Variable Cost

The total variable cost in coconut cultivation consists of charges for hired as well as imputed value of family labour, harvesting charges, expenses on organic manures, chemical fertilizers, expenditure towards the energy and plant protection. One per cent of the sum of these expenditure was added as miscellaneous cost mainly accounting for the transport of the inputs. Though 50 to

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75 per cent of the organic manures are recycled within the farming system, as per the conventional norms, the imputed value is accounted for the variable cost. The input applied for both bearing and non-bearing palms are taken into consideration to arrive the value of total variable cost. Students 't' test was applied to test the significance of the variation in application of major inputs among the two groups.

Fixed Cost

The fixed cost in the coconut cultivation refers to the expenditure incurred during the establishment period of coconut. The total fixed cost include the annuity value which represent the fixed cost and depreciation. It was calculated based on the annuity method by using the formula,

$$\text{Annuity Value, } A = \frac{P x i}{1-(1+i)^n}$$

Where, A (Rs./ha) is the fixed cost (weightage to the expenditure incurred during the pre-bearing phase of coconut palms),

P is the actual expenditure during the establishment phase (Rs./ha),

i is the interest rate (12 per cent is assumed to be the present long term investment rate of interest in banks) and

n is the economic life span, assumed as 50.

Gross Cost

Gross cost refers to sum of fixed cost and total variable cost involved in coconut cultivation.

Gross Returns

In this study, gross returns refers to the total returns representing the sum of main product, viz., coconut and its by products. Regarding the returns, the per palm productivity as well as the income from the by product were also recorded.

Net Returns

Net returns, in this study, is the difference between the gross return and gross cost.

Depreciation

A value of depreciation (salvage value at the rate of 10 per cent) was calculated based on straight-line depreciation method for the fixed assets like drip system, store house, farm building, cattle sheds etc.

Cash Flow Analysis

The objective of conducting cash flow analysis in the economic analysis of coconut in this study was to ascertain the economic feasibility of adopting micro-irrigation technology in coconut farming. For this purose Benefit Cost Ratio (BCR) and Net Present Worth (NPW) were analysed.

Benefit Cost Ratio (BCR)

Benefit Cost Ratio (BCR) refers to the ratio between the discounted returns to discounted cost.

Net Present Worth (NPW)

Net Present Worth (NPW) refers to the difference between discounted returns and discounted cost.

Results and Discussion

The results pertaining to the analysis of economics of coconut cultivation under micro-irrigation and conventional basin method of irrigation are furnished in the following paragraph.

Plant Density

Under the conventional irrigation systems, the average plant density in coconut gardens varied from 186 in the case of medium farms to 194 in the case of marginal farms. The share of bearing palms ranged from 88.00 per cent in small farms to 85.00 per cent in medium farms. Similarly in the gardens adopting drip irrigation system, the plant density varied from 181 in medium farms to 190 in marginal farms. The share of bearing palms accounted for 88.00 per cent in medium farms to 84.00 per cent in marginal farms.

Productivity Levels

The average productivity level of coconut in coconut gardens under drip method and conventional basin method of irrigation are given in Table 1.

TABLE 1—AVERAGE LEVEL OF COCONUT PRODUCTIVIY (NUTS/PALM//YEAR)

Particular	Marginal farm (<0.5 ha)		Small farm (0.5 to 1.0 ha)		Medium farm (1.0 to 1.5 ha)		Large farm (<1.5 ha)	
Method of irrigation	C	D	C	D	C	D	C	D
Productivity	50	47	62	65	69	67	80	79

C-Conventional basin irrigation method, D-Drip irrigation method.

It could be inferred from the above table that in the case of the farmers adopting conventional irrigation system, the average productivity of coconut ranged from 50 to 80 nuts per palm per year. The productivity was 50, 62, 69 and 80 nuts per palm per year in marginal, small, medium and large farms respectively. In the case of farmers adopting the drip irrigation system, productivity of coconut ranged from 47 to 79 nuts per palm per year. The productivity was 47, 65, 67 and 79 nuts per palm per year in marginal, small, medium and large farms respectively.

Cost of Cultivation of Coconut

The average cost of cultivation for coconut under conventional irrigation systems as well as under drip irrigation systems are discussed in detail, to analyse the comparative economics of coconut cultivation under these two situations.

Labour Cost

Labour, one among the prime factors of production, plays a prominent role in farming. Its role assumes greater importance in socio-economic situations as prevailing in Kerala, in which it is not only costly but also scarce. However, this problem could be tackled by increasing the share of family labour especially in the case of small and marginal farms.

Under conventional irrigation system, the average cost towards the labour varied between Rs. 11,280/ha in the case of medium farms to Rs. 12,000/ha in the case of small farms and the relative share of family labour is high in the case of small and marginal farms, (35.00 and 36.30 per cent, respectively) as compared to medium and large farms (31.28 to 31.74 per cent). The share of labour for harvesting ranged from 32.92 in marginal farms to 38.04 in large farms. The cost of labour required for irrigation ranged between 14.00 to 18.00 percent in the conventional system as against 10.00 to 14.00 per cent in the case of drip system.

Similarly, in the case of farmers adopting the drip system, the average labour cost varied from Rs. 10520/ha both in the case of marginal and large farms to Rs. 10375/ ha, in the case of small farms. The share of family labour in small and marginal farms is 35.66 and 38.02 per cent, respectively and the respective figures in the cases of medium and large farms are 31.95 and 33.75 per cent. The expenditure towards harvesting varied from 37.35 per cent in small farms to 41.83 per cent in large farms.

Organic Manures and Chemical Fertilizers

Farmers used different types of organic manure to coconut palms. Farm yard manure, compost, cow dung, green leaf manure, poultry manure and ash were the important types of organic manures used. Based on the resources, age of the palm, and availability of organic manures, farmers applied them either once in two years or annually. The average quantity of organic manures applied per palm varied between 18 to 20 kg per annum and the quantity of organic manure applied increased with the size of holdings. The study further revealed that there was no significant difference between the coconut gardens with drip irrigation and conventional basin method of irrigation with respect to the quantity of organic manures applied.

The average expenditure towards the chemical fertilizer varied from Rs. 13 to Rs. 18 per palm per year and the quantity of fertilizer applied was higher in the case of large farms as compared to other categories. Since the study is confined to irrigated gardens, the percentage of farmers applying chemical fertilizers was high. There was no significant difference in the quantity of chemical fertilizers applied per palm between the two groups of farms. However, it was observed that the amount of chemical fertilizers as well as organic manure applied increased with the age of the palms.

Plant Protection

In coconut gardens with conventional basin method of irrigation, the average expenditure on plant protecion, for taking chemical control against pests like rhinoceros beetle, eriophyid mite and diseases like bud rot, stem bleeding etc., ranged between Rs. 375/ha in the case of small farms to Rs. 720/ha in the case of large farms. In the case of farmers adopting drip systems, it ranged from Rs. 350/ha in the case of small farms to Rs. 600/ha in the case of medium farms. The variation can be attributed to the fact that the incidence of pests and diseases was comparatively lower in drip irrigated coconut gardens, resulting in less expense for plant protection.

Total Cost

In coconut gardens with conventional basin method of irrigation, the average total variable cost ranged from Rs. 20, 619/ha in the case of small farms to Rs. 21766/ha in large farms. The respective total cost including the annuity value ranged from Rs. 22, 115/ha to Rs. 27, 496/ha. The total variable cost in the case of farmers adopting drip system ranged between Rs. 18,382/ha in the case of marginal farms to Rs. 19,786/ha in the case of large farms and their respective total cost is Rs. 21,682/ha and Rs. 25,726/ha. The medium and large farmers adopted more number of recommended practices of cultivation and thus incurred higher cost of cultivation as compared to small and marginal farmers.

Gross and Net Returns

Three-year average price of Rs. 3.50 per nut (Source: Directorate of Economics and Statistics, New Delhi) was taken as the unit value of nut. The gross returns for the farmers adopting the conventional basin irrigation method varied from Rs. 28,550/ha in the case of marginal farms to Rs. 44,890/ha in the case of large farms. In the case of farmers adopting drip irrigation method, it varied between Rs. 29,050/ha in marginal farms to Rs. 45,667/ha in large farms (Table 2).

TABLE 2—ECONOMICS OF COCONUT CULTIVATION UNDER CONVENTIONAL BASIN AND DRIP IRRIGATION METHODS (RS./HA)

S. No.	Particulars	Marginal farm (< 0.5 ha)		Small farm (0.5 to 1.0 ha)		Medium farm (1.0 to 1.5 ha)		Large farm (< 1.5 ha)	
1.	Hired labour	3850	2400	3500	2800	3450	2715	3630	2570
2.	Own/family labour	4200	4000	4330	3700	3580	3200	3700	3550
3.	Harvesting charges	3950	4120	4100	3875	4250	4100	4500	4400
4.	Organic manures	3750	3600	3800	3900	4100	4200	3950	3870
5.	Chemical Fertilizers	2240	2310	2420	2610	2800	2750	2900	2790
6.	Energy for irrigation	2000	1250	1890	1420	1650	1500	2150	1860
7.	Plant protection	470	520	375	350	675	600	720	550
8.	Miscellaneous cost	205	182	204	187	205	191	216	196
9.	Total Variable cost	20665	18382	20619	18842	20710	19256	21766	19786
10.	Depreciation	250	1500	550	1750	670	1890	980	2100
11.	Annuity value	1200	1800	2100	2250	3150	2870	4750	3840
12.	Total cost	22115	21682	23269	22842	24530	24016	27496	25726
13.	Average yield per ha	8100	8200	10230	10530	11040	11320	12640	12882
14.	Value of by-products	200	350	450	380	500	470	650	720
15.	Gross returns	28550	29050	36255	37235	39140	40120	44890	45667
16.	Net returns	6435	7368	12986	14393	14610	16104	17395	19941

The realized net return in the case of farmers adopting the conventional irrigation system varied from Rs. 6,435/ ha in the case of marginal farms to Rs. 17,395/ha in large farms; In the case of farmers adopting drip irrigation system, it varied from Rs. 7,368/ha in marginal farms to Rs. 19,941/ha in large farms.

Though technologies are often claimed to be scale neutral, in the present study medium and large farms realized better net returns mainly due to better application of inputs like organic manures and chemical fertilizers and other management practices. This is in line with the discussion made earlier (4.4.3.3.4), in which it was indicated that the average cost of cultivation of coconut was higher in medium and large farms as compared to small and marginal holdings.

Cost of Installing Drip Irrigation System

The average expenditure for installing drip irrigation system in coconut gardens as revealed in the study is given in Table 3.

TABLE 3—INVESTMENT COST OF INSTALLING DRIP IRRIGATION SYSTEM IN COCONUT GARDENS

S. No.	Size of holding (ha.)	Installation Cost (RS.)
1.	< 0.2	6,000
2.	0.4	10,000
3.	0.8	16,000
4.	1.0	20,000
5.	2.0	45,000

It could be inferred from the results that the average cost of installing the drip irrigation system for coconut varied from Rs. 6,000 for 0.2 ha to Rs. 45,000 for 2.0 ha.

Cash Flow Analysis

The details of the cash flow analysis of coconut cultivation under conventional basin method and drip methods of irrigation are furnished in Table 4.

TABLE 4—CASH FLOW ANALYSIS OF COCONUT CULTIVATION UNDER CONVENTIONAL BASIN AND DRIP METHODS OF IRRIGATION

Particulars	Size of holding (< 0.5 ha)		(< 0.5 to 1.0 ha)		(1.0 to 1.5 ha)		(< 1.5 ha)	
	C	D	C	D	C	D	C	D
Benefit Cost Ratio	1.29	1.32	1.56	1.58	1.59	1.63	1.63	1.71
Net Present Worth	49087	52127	99059	110135	111447	112135	132684	140232

C-Conventional basin irrigaiton method, D-Drip irrigation method.

The results of the cash flow analysis showed that farmers adopting drip irrigation in their coconut gardens were realizing higher Benefit-Cost Ratio (BCR) and Net Present Worth (NPW) as against the farmers adopting the conventional basin method of irrigation. The BCR for the farms with drip irrigation ranged between 1.32 in marginal holdings to 1.71 in large holdings; in the case of coconut cultivation with basin irrigation, it ranged between 1.29 to 1.63, respectively. Similarly, the NPW of coconut cultivation with basin irrigation ranged between Rs. 49,087 in marginal holdings to Rs. 1,32,684 in large holdings; in the case of coconut cultivation with drip irrgation, it ranged between Rs. 52.127 to Rs. 1,40,232, respectively.

Apart from the economics point of view, adoption of drip irrigation system has to be viewed on sustained management of water resources in the farm. It is being recommended to those areas where the ground water table is drastically reducing. The water use efficiency under drip system is higher than that of conventional system. Under the present socio-economic conditions in which labour is not only costly but also scarce, it is always advisable to adopt less labour intensive technologies. In coconut cultivation, adoption of drip irrigation system is one among them through which about 80 man days labour per ha could be saved as compared to the conventional irrigation system (Dhanapal *et al.*, 1998). The cash flow analysis further indicated that the relative profitability (BCR) of installing drip irrigation system increases with the land holding size, there by this study proved that adoption of drip irrigation systems in medium and large holdings is economically more viable as compared to small and marginal farms.

Conclusion

Coconut, which is predominantly a small holder's plantation crop, is grown mostly under small and medium holdings where the resources are often limited. This is particularly true in the case of coconut gardens of Kerala, where more than 80 per cent of the cultivation is under rainfed conditions. Proper management of the major farm resources is warranted under the situations like those prevailing in northern Kerala, where there is a continuous dry spell for a period of six months (November to May) and the coconut farmers, especially in the mid land and upland conditions face acute water shortage during the summer. Scientific experiments clearly indicate that adoption of irrigation could considerably increase the productivity in coconut by enhancing efficient utilization of other inputs like organic and inorganic nutrients by palms. The comparative economic analysis of coconut cultivation, under the conventional basin method and micro-irrigation methods, clearly indicated the beneficial effect of adoption of drip irrigation system in coconut gardens.

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