IRRIGATION INVESTMENTS IN SMALLHOLDER COCONUT FARMING IN KERALA-INDIA

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ABSTRACT

An evaluation of the irrigation investments in smallholder coconut crop in Kerala State in India showed that the share of irrigation costs to total costs was 25-50 percent in small irrigated holdings. Yhe average variable cost of irrigation was Rs. 1,667.36 and the average capital cost was Rs. 1,031.49 per hectare. The irrigation investments showed wide variations among holdings of different land categories and also different sources qf irrigation.

INTRODUCTION

In the uplands of Kerala State, plantation crops have dominated the cropping systems. They include tea, coffee, rubber, coconut, arecanut and cardamom. The downward trend in production of some of these crops in recent years is a discomforting feature in agriculture in this region. There exists scope for increasing the productivity of these crops by way of (i) irrigation and (ii) scientific management practices. At present only coconut and arecanut are irrigated to a considerable extent. The rural economy of Kerala is closely linked with these crops. Any developmental strategy drawn with regard to these crops will have an impact on the small holdings which constitute more than 90% of the total holdings.

The identification of ideal sources of irrigation and optimum management strategies need a thorough understanding of the present status of development and management. Hence a study was taken up on the irrigation investments with reference to the major irrigated plantation crop of the state, viz., coconut.

METHODOLOGY

The district of Kasaragod was selected for the study in view of the fact that the percentage of irrigated area to the total area cultivated was the maximum in this district with respect to the crop under study, viz., coconut.

A multi stage random sampling procedure was adopted for the study. The total sample of 193 holdings was distributed wnong three physiographic zones, viz., low land (altitude less than 7.5 m above MSL), midlands (lying between 7.5m and 75 m above MSL) and highlands (more than 75 m above MSL). Two major sources of irrigation in each zone was considered for the study. The final sample categories were as follows:

S_1 : Lowland well source

S_2 : Lowland river

S_3 : Midland well

S_4 : Midland rivulet

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S_5 : Highland tanks

S_6 : Highland rivulets

The data pertained to the year 1992-93.

The following procedure was used to compute the irrigation investments in coconuts in a boconut based farming cropping system.

(i) Cost of irrigation and pumping.

The levelised annual cost (LAC) approach which is equivalent to the Net Present Worth (NPW) approach in which each of the cash flows is determined and discounted to a present value, is used to compute the pumping cost. The LAC is defined as,

$$LAC = \frac{\text{Annualised Cost}}{\text{Annual Energy output}} \quad \text{where,}$$

Annualised cost = Capital Investment x CRF + annual operation, maintenance and repair costs + annual fuel costs.

The annual energy output for the pumping systems is in proportion to the amount of water pumped in m^3/year for a given system. Hence the annual water output is considered. Capital Recovery Factor (CRF) is given by,

$$CRF = r/1- (1-r)^{-CL}$$

Where 'r' is the annual discount rate and OL is the operating life of the system. In this study the annual discount rate was taken as 15 percent, being the lending rate of the banks (or the rate at which the farmer is able to borrow money) and the operating life of the system as 25 years.

The annualised cost is given by,

AC = I x CRF + OMR + FC, where,

AC is the annualised cost, l is the capital investment, OMR is the annual operation, maintenance and repair cost, FC is the fuel cost (either electricity charges or Diesel/Kerosene/Petrol charges depending upon the number of hours of operation in a year).

The annual water output was worked out using the relationship,

$$w = \frac{75 \text{ x } E \text{ x } HP \text{ x } N}{T}$$

where E efficiency which ranged from 0.5 to 0.7, HP is the horsepower of the pumpset, N the number of working hours and T the total head.

(ii) Allocation of area in mixed crop stands.

Since coconut was grown as a mixed crop in the hornesteads it was necessary to allocate the effective area occupied by each crop in the crop mix. Tle following methodology was used for allocating the area under each crop (Kaseko, 1976).

Suppose A and B are in mixed stands. Let dA and dB be densities of the same crops in a pure cropping system.

d' A and d'' B be densities of the same crops when they are mixed.

TA and TB be areas effectively occupied by these crops and T be the total area.

Let aA = d' A/dA and aB = d' B/dB

It is accepted that area occupied by A and B are proportionate to aA and aB respectively. It is also accepted that

Ta/aA = TB/aB and TA + TB = T

Thus,

TA = T [(aA/(aA + aB)} and TB = T [(aB/ (aA=aB))]

This can be generalised to include 'n' crops in mixed crop stands as follows:

$$\sum_{i=1}^{T=n} Ci, \text{ where } Ci = ai/ \sum_{i=1}^{n} ai$$

The coefficient, Ci is that part of the cultivated land effectively occupied by crop i.

(iii) Allocation of irrigation costs to individual crops

The cost of irrigation pumping for the whole farm was worked out. Based on the total cost and total water output irrigation cost per unit of water (m^3) was computed out. For individual crops the cost allocation was done as follows. Based on the methodology (ii) the effective area for each crop in the homestead was found out. ne area was allocated for bearing as well as non bearing palms. Based on the effective area occupied by each crop the total water output was allocated and irrigation cost for individual crop was worked out based on unit cost of water.

RESULTS AND DISCUSSION

ANNUAL IRRIGATION COSIS

The average annualised capital costs per farm was worked out to Rs. 783.94 (Table 1). This was the highest in the case of midland holdings irrigated from rivulets source (S4) (Rs. 958.25) and it was the lowest in the case of lowland holdings irrigated from rivers (S2) Rs. 535.05).

The reason for this can be attributed to the predominance of high power pumpsets used in the midland rivulets category because considerable number of farmers were using high horse power diesel pumpsets only, due to lack of electricity. In the case of lowland river category more than 90 percent use 1.5 HP electrical pumpsets and 42.86 percent use 1.5 HP kerosene pumpsets.

The variable costs comprising repair costs, fuel charges and labour costs were Rs. 92.47, Rs. 391.96 and Rs. 782.76 per farm, respectively. The average variable cost was worked out to Rs. 1267.19 per farm.

The repair and maintenance charges showed less variation among different categories of farms. It ranged from Rs. 85.75 in the lowland river category to Rs. 104.35 in the midland well category.

The fuel charges showed wide variability from Rs. 101.48 in lowland river category to Rs. 673.00 in midland rivulets category. The probable reason for this could be attributed to the lesser frequency of irrigation in the former case and higher horse pumpsets in the latter. The labour costs were the highest in the lowland well category and the lowest in lowland river category.

The annual irrigation costs per hectare showed a different pattern compared to the per farm analysis (Table 2). This was because the average size of gardenland ranged from 0.40 in lowland wells to 1.08 hectares in highland rivulets category. The annualised capital cost per unit area showed a decreasing pattern from Rs. 2024.35 to Rs. 809.97 for the lowland wells category to highland rivulets category. The average annualised capital cost was worked out to Rs. 1031.49 per hectare. The repair charges also showed a declining trend from Sl to S6 with an average of Rs. 121.67. The fuel charges were the highest in the midland rivulets category and the lowest in lowland river category.

The labour cost was comparatively much higher in the low-land well category because of the more number of hours the pumpsets were operated. The labour cost was the lowest in lowland river irrigated category (S2), because of the lesser frequency and quantity of irrigation.

The average variable cost per hectare was worked out to Rs. 1667.36 for the entire sample with the highest value for lowland wells category (Rs. 3554.35) due to higher repair, fuel and labour costs as a result of the highest operational hours and higher frequency of irrigation. The variable cost per hectare was worked out to be the lowest in lowland river category (Rs.793.80) as a result of lesser frequency and quantity of irrigation.

UNIT COSTS OF IRRIGATION WATER

Details of unit cost of irrigation water, fuel costs as well as total pumping costs are given in Table 3. It could be seen that the ftiel costs was Rs. 0.10 per m^3 of water pumped out, which was the lowest in the case of electrically operated pumpsets. Compared to this the cost was almost 2 times higher in the case of diesel operated pumping units (Rs. 0.23/m3). In the case of kerosene pumpsets, the unit cost was Rs. 0.17 per m3 of water. In S1, S4 and S5 categories, the unit cost of electricity was the same (Rs. 0.08 per unit of water). In S3 and S6 it was Rs. 0.13 and Rs. 0.14 per unit of water. The electricity cost was the highest in the case of S2 category because of lesser hours of pump operation. In the case of kerosene operated pumping units also, the unit cost of fuel was the highest in lowland river category. In the case of diesel units, the unit cost was Rs. 0.23 per m^3 of water which was uniform in all the four categories (S3, S4, S5 and S6) using the diesel units. The unit cost has been doubled in diesel operated units compared to electricity operated units.

The average fuel cost for the entire sample per unit of irrigation water was worked out to Rs. 0.17 per m^3. The total pumping costs comprising of fuel, repairs and labour charges was found to be the highest in the case of electric pumpsets (Rs. 1.00 per m^3) followed by kerosene (Rs. 0.90) and diesel (Rs. 0.87 per m^3) units.

The average pumping cost per m^3 of water for the entire sample was worked out to Rs. 0.93. The average quantity of irrigation water used per hectare of irrigated area was worked out to 3824.6 m^3; This was the highest in the low land well category (5801.05 m^3). This can be attributed to (i) higher frequency of irrigation in lowland well categories; 29.03 per cent once in a week and 54.84 per cent twice in l week compared to the lower frequency of irrigation in lowland rivers category (all irrigating once in a fortnight) (ii) highest number of hours that pumpsets were put to operation in the lowland wells category (8.47 hours/week) compared to the lowest number of hours in the case of lowland rivers category (1.52 hours/week).

SHARE OF IRRIGATION COST TO TOTAL COST

It could be seen from Table 4 that the share of irrigation to the total cost was the highest in the case of lowland wells (42 per cent), while it was the lowest in highland tanks category (25.02 per cent). In other words irrigation cost alone accounted for more than 25 per cent of total maintenance cost among the various categories. The high share of irrigation costs justified the need for proper development and conservation of irrigation facilities particularly in the cultivation of high value gardenland plantation crops.

The highest share of irrigation costs noticed in lowland wells category could be attributed to the higher annualised capital costs, repair, fuel and labour costs as a result of higher frequency and quantity of irrigation water used.

The share of irrigation cost was the lowest in the case of highland tanks category. Though the irrigation costs as such was high in this category, the comparatively larger amounts spent on other inputs such as organic manure and fertilizer reduced the proportionate share of irrigation costs in the total costs.

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Table 1
Details of Annaul Irrigation Cost in Sample Holdings (Rs. Per holding)

Land Category	Annualized Capital cost	Variable cost		Average	
		Repairs	Fueld Charges	Labour Cost	Variable cost
S_1	809.74	98.39	255.74	1067.61	1,421.74
S_2	535.05	85.71	101.48	130.33	317.52
S_3	648.43	104.35	339.22	705.52	1,149.09
S_4	958.25	100.03	673.00	951.50	1,724.53
S_5	893.84	97.22	264.42	808.42	1,170.06
S_6	874.77	77.68	562.52	864.21	1,504.41
Total	783.94	92.47	391.96	782.76	1,267.19

Table 2
Details of Annual Irrigation Costs per hectare (In Rs.)

Land Category	Annualized Capital cost	Repairs	Variable costs		Cost/m^3	
			Fuel Charges	Labour cost	Average of water	
S_1	2,024.35	245.98	639.35	2,669.03	3,54.35	0.87
S_2	1,337.63	214.28	253.70	325.83	793.8	1.94
S_3	1,137.60	183.07	595.12	1,237.75	2,015.95	1.02
S_4	977.81	102.07	686.73	970.92	1,759.72	0.60
S_5	893.84	97.22	264.42	808.42	1,170.06	0.84
S_6	809.97	71.93	520.85	800.19	1,392.97	1.04
Total	1,031.49	121.67	515.74	1,029.95	1,667.36	0.93

Table 3
Cost of Irrigation Water in Sample Farms

S_1	0.08	0.14	-	0.10	0.97	0.69	-	0.87	5801.05
S_2	0.23	0.22	-	0.23	2.48	1.55	-	1.94	1562.2
S_3	0.13	0.20	0.23	0.18	1.17	0.20	0.70	1.02	3886.25
S_4	0.08	0.14	0.22	0.16	0.64	0.71	0.57	0.60	4885.68
S_5	0.08	0.14	0.24	0.11	0.87	0.79	0.77	0.84	2815.48
S_6	0.14	0.18	0.23	0.20	1.18	1.00	1.01	1.04	3454.88
Avarege	0.10	0.17	0.23	0.17	1.00	0.90	0.87	0.93	3824.6

Total cost = Annualised capital cost + variable cost
(repairs , fuel and labour costs)

S_1 - lowland wells
S_2 - lowland rivers
S_3 - midland wells
S_4 - midland rivulets
S_5 - highland tanks/ponds
S_6 - highland rivulets

Table 4
Cost Components in Coconut Cultivation (In Rs. Per ha)

Labour@	1376.28 (8.03)	1013.51 (9.54)	1136.90 (11.45)	1202.09 (12.69)	876.34 (6.87)	905.74 (7.52)	894.27 (12.17)	900.68 (17.82)	762.70 (12.01)
Organic Manure	3261.32 (19.02)	2958.83 (27.86)	2539.78 (25.58)	2504.19 (26.43)	3432.19 (26.93)	3587.59 (29.87)	2225.57 (30.29)	2896.57 (57.30)	1867.37 (29.40)
Fertilizers	2551.60 (14.88)	1820.25 (17.14)	637.18 (6.42)	1007.02 (10.63)	3209.67 (25.17)	1533.49 (12.73)	1750.91 (23.83)	93.51 (1.85)	3040.92 (32.13)
Irrigation	7204.00 (42.01)	2780.29 (26.18)	3999.82 (40.29)	2866.53 (30.26)	3190.32 (25.02)	4207.64 (34.93)	-		-
Crown Clearing	287.21 (14.40)	455.13 (4.29)	146.03 (1.47)	121.92 (1.29)	244.62 (1.92)	92.09 (0.76)	625.78 (8.52)		
Harvesting	2469.07 (14.40)	1591.31 (14.99)	1468.57 (14.79)	1771.30 (18.70)	1795.71 (14.08)	1719.07 (14.27)	1850.62 925.19)	1164.38 (23.03)	1680.72 (26.46)
Total cost	17149.48 (100.00)	10619.32 (100.00)	9928.33 (100.00)	9473.05 (100.00)	12749.47 (100.00)	12045.62 (100.00)	7347.14 (100.00)	5055.14 (100.00)	6351.71 (100.00)

Figures in parentheses indicate percentage to total cost
@ Labour includes labour for intercultural operations and transporting of nuts, manures and fertilizers.