

COST- BENEFIT ANALYSIS OF DRIP IRRIGATION IN COCOA AS MIXED CROP IN ARECANUT PLANTATION

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Introduction

Cocoa is cultivated as mixed crop in arecanut, coconut and oil palm plantations. In India, the productivity of the crop is very low (380 kg ha^{-1}) (GOI, 2010). The present production is not able to meet the industrial demand for cocoa beans. Thus, there is an ample scope to grow cocoa as mixed crop. Irrigation and nutrition are most important to increase productivity as it cannot withstand water and nutrient stress. Drip irrigation is found to increase production in many other crops and cocoa also responded well to drip irrigation and nutrition (Abdul Haris *et al.*, 1999). With this background, an attempt has been made to test the economic viability of drip irrigation and nutrition in cocoa - arecanut cropping system.

Materials and Methods

The experiment was conducted at the Experimental Farm of Central Plantation Crops Research Institute, Regional Station, Vittal, Karnataka, India during 1988 to 1997. Cocoa was planted with a spacing of 2.7 m x 5.4 m in twenty seven year old arecanut plantation. The soil of the experimental site is laterite with a pH of 5.6. The experiment was laid out in split plot design with three drip irrigation levels as main plots *viz.*, 50%, 100% and 150% ET and four fertilizer levels as sub plots *viz.*, 0, 50, 100 and 150 per cent of recommended fertilizer dose (100:40:140 g N: P₂O₅: K₂O/palm/year). Fertilizers were applied in two splits *i.e.*, 1/3rd in June and 2/3rd in September-October. The crop was drip irrigated during post monsoon season.

For estimating cost of production the annuity value approach was followed (Gattinger, 1981). The total investment was amortized into an annuity value bearing 10% interest rate, which was added to annual maintenance cost for arriving at cost of cultivation, net returns and net returns on rupee spent. Similarly, in case of drip irrigation, annual fixed cost for the system was calculated and added to annual maintenance cost. For working out the cost and return, the following norms were followed.

1. A period of 3 years was considered as the pre-bearing period for arecanut. Economic life span under good management has been assumed as 25 years.
2. Establishment cost included land clearing, digging of pits, planting, planting material and bore-well in case of drip irrigation and labour cost for all operations.
3. The cost of cultivation included cost of inputs like fertilizers, manures, pesticides etc. and labour cost for different operations like application of inputs, spraying, irrigation and harvesting (Table 1).
4. The establishment cost of drip system was Rs. 15,000/ha and its life span was considered as 10 years for calculating annual fixed cost of drip system. Annual fixed cost for drip and annuity were added to annual maintenance cost every year.

Table 1. Input cost for cocoa (Rs. per unit quantity)

Input	Price per unit (Rs.)
Seedling	5/ seedling
Urea	5.56/ kg
Rock Phosphate	4.70/ kg
Muriate of Potash	4.66/ kg
Copper Sulphate	130/ kg
Lime	15/ kg
Labour charges	125/ man day
Dry bean	100/ kg

The annuity was calculated using the following formula

$$A = P \times \frac{i}{1 - (1+i)^{-n}}$$

Where,

A= Annuity value

P = Total investment

i = rate of interest

n = life of palms

Annual fixed cost for drip and the annuity value thus obtained were added to annual maintenance cost to arrive at total annual cost of cultivation. The price of Rs.100 per kg of dry bean was considered for computing the gross returns of the produce obtained from each treatment. The net returns were worked out after deducting the cost of cultivation from the gross returns and expressed in 'ha⁻¹. The net profit per rupee investment for different treatments was worked out as the quotient of total cost of cultivation over the net profit per hectare for a given treatment. The yields after stabilization *i.e.* after 5th year were considered for economic analysis.

Results and Discussion

Cost of cultivation

The estimated cost of cultivation of cocoa in arecanut plantation per hectare as per treatment is given in Table 2. The establishment cost for three years in case of drip irrigation was Rs. 65,000. The annuity on establishment cost in this study was Rs. 4,800/ha, while the annual fixed cost of drip irrigation system was Rs.3,000/ha. However, the entire drip irrigation system needs to be replaced after 10 years. The annual maintenance cost during bearing stage was Rs. 23,200/--.

Net returns and net return per rupee investment

At the existing market rate of Rs.100/kg dry bean, drip irrigation at 100% ET increased the net income considerably (Table 3). Drip irrigation with 100% ET registered maximum net returns of Rs.53,300 ha⁻¹ followed by 150% ET (Rs.51,900). The increase in net return with 100% NPK over absolute control was 120%. The nutrition treatments such as 50 and 100% NPK resulted in 105-112% increase in net returns over absolute control.

Table 2. Estimated cost of cultivation for cocoa ('ha⁻¹) when grown as mixed crop in arecanut garden

Particulars	(Rs. /ha)
1. Establishment cost during pre-bearing stage (3 years)	50,000
2. Cost of drip system	15,000
3. Total establishment cost including drip system	65,000
4. Annuity value for establishment cost	4,800
5. Annual fixed cost of drip irrigation system	3,000
6. Labour charges for annual maintenance	13,200
7. Input charges for annual maintenance	10,000
8. Total annual maintenance cost during bearing stage	23,200
9. Total cost of cultivation per year with annuity value during bearing stage	28,000
10. Total cost of cultivation per year with annuity value during bearing stage with fixed cost for drip irrigation	31,225

Table 3. Effect of drip irrigation and nutrition on yield, net returns and net return per rupee investment in cocoa (Mean of four years 1993-1997)

Treatments	Mean dry bean yield (kg/ha)*	Cost of production (Rs. ha ⁻¹)	Gross returns (Rs. ha ⁻¹)	Net returns (Rs. ha ⁻¹)	Net return per rupee investment
Drip irrigation level					
I ₁	694	32000	69400	37400	1.17
I ₂	876	32000	87600	55600	1.74
I ₃	839	32000	83900	51900	1.62
Fertilizer level					
F ₁	752	27800	75200	47400	1.70
F ₂	796	29900	79600	49700	1.66
F ₃	853	32000	85300	53300	1.66
F ₄	810	34100	81000	46900	1.38

* Source (Abdul Haris *et al.*, 1999)

Note: I₁ - 50% ET drip level; I₂ - 100% ET, I₃ - 150% ET; F₁ - No NPK; F₂ - 50% NPK; F₃ - 100% NPK; F₄ - 150% NPK.

Mean data indicated that 100% ET was highly profitable with highest net returns per rupee investment of 1.74. Net return per rupee invested was 1.66 both in case of 50 and 100% NPK. Net return per rupee investment was maximum in absolute control (1.70) due to less cost of production. The control was profitable mainly due to adoption of drip irrigation. Similar observations of better returns in arecanut by following drip irrigation were reported by Abdul Khader (1988) and Dinesh Kumar and Mukundan (1996) and in other crops by Sivappan and Lamm (1995). The study revealed that drip irrigation and nutrition are highly profitable in cocoa as mixed crop in arecanut plantation. With adoption of drip irrigation, the advantages accrued were, reduced labour charges on weeding and irrigation and diesel charges due to less operational hours.

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