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An economic impact assessment of drip irrigation technology in arecanut plantations : an empirical evidence from Karnataka

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Abstract

Based on primary data collected from90 respondents scattered in 15 villages in southern transitional zone of Karnataka-1t was observed that installation of drip irrigation with ISI materials required Rs. 50,394/- per hectare. Adoption of drip irrigation in arecanut gardens has resulted in additional output of 5.03 qtls worth Rs. 67,972/-. The maintenace cost of drip irrigated gardens was found to be lower (Rs. 29,109) as compared to surface irrigated gardens (Rs. 37,856/-). There is substantial saving in cost of cultivation (Rs. 8837/-) of drip-irrigateed gardens which is due to decreased use of labour and inputs. The results of economic feasibility indicated that investment on drip irrigation technology for arecanut cultivation is economically feasible. There is saving of water to the tune of 42.18 acre inches. With this water, it is possible to irrigate an additional area of 2.5 ha.

Key words: Arecanut, impact assessment, drip irrigation, economic analysis

Introduction

Water is the basic need for sustained development of agriculture. Experts have felt that water will be the major resource constraint in future. Though land is limited, there is scope for utilizing the same in an intensified manner to enhance crop production by efficiently utilizing available water resources. The water table has gone very deep affecting the agriculture production due to erratic and scanty rainfall year after year. Failure on monsoons coupled with large scale exploitation of ground water resources far exceeding the rate of recharge has resulted in low water table. In view of this, modern irrigation management practices have to be given due importance. The challenges posed by ground water scarcity can be met by drip irrigation technology.

Drip irrigation is an improved irrigation technology which supplies water directly to the root zone of the plant. The technology is well accepted and adopted in over sixty countries all over the world. The system is fast catching up in India too. India ranks seventh in respect of area under drip irrigation with 70859 ha. In India, the system was introduced in 1980s. From a mere little over 1000 ha in 1985, the area under drip irrigation has now grown to over 70,000 hectares with additional areas being brought under the system every year. The farmers are evincing keen interest to adopt drip irrigation their farms. It is used on a large scale for various crops in the areas of acute water shortage. Ground water scarcity has severely impaired the land productivity posing threat to survival of arecanut industry in the traditional and non-traditional belts of Karnataka. The livelihood of small arecanut growers is under threat. On the one hand, the water resource for agricultural use has been shrinking and on the other the productivity levels of arecanut gardens is falling causing concern to arecanut industry. Central and state governments have been initiating measures from time to time to address the critical issues like ground water scarcity. In an attempt to augment water resources, sizeable investments are being made by the government. How far these investments are economically rewarding needs evaluation. Successful working of the drip irrigation technology and its favorable economic gains would

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convince government and the farmers in prioritising investments. The research findings would help the policy makers for making futuristic policies. It is against this backdrop, the present study is undertaken to investigate the economics of drip irrigation technology. The specific objectives are : 1) To study the impact of technology on productivity and returns. 2) To empirically evaluate the economic feasibility of drip irrigation technology.

Methodology

The study was conducted in southern transitional zone of Karnataka. Three taluks namely Channagiri, Tarekere and Honnali falling under similar agro-climatic conditions were selected for the study as they had higher proportion of area under drip irrigation. A list of villages with extensive adoption of drip irrigation was prepared in consultation with horticulture department of respective taluks. Five villages from each taluk based on area under drip irrigation were chosen for data collection. Further, three adopters from each village, thus making the sample size of forty five, were selected at random. An equal number of non-adopters were selected from the same village for the purpose of comparison. Thus, a total of 90 respondents constituted the overall sample size. The requisite data covering investment, cost of cultivation, yield etc., were collected by survey method with the help of pre-tested and specially designed interview schedule conducted by personally contacting the farmers.

In order to assess the economic impact of drip irrigation technology in comparison with surface irrigation method, four measures of investment appraisal such as 1) Net Present Worth (NPW) 2) Benefit-Cost Ration (BCR) 3) Internal Rate of Return (IRR) 4) Pay-Back Period (PBP) were computed.

Table 1. Investment requirement for installation of drip irrigation system

Rs/ha

Particulars	ISI Materials		Non-ISI Materials	
	Cost	Percent	Cost	Percent
PVC pipes for main line	7875	15.63	5625	19.26
PVC pipes for sub mail line	8125	16.12	5937	20.33
Control volves	2250	4.46	1125	3.85
Laterals	20006	39.70	7631	26.13
Micro-tubes	4500	8.93	2400	8.22
Filters	2750	5.46	1600	5.48
Labour	2250	4.46	2250	7.70
Transport	625	1.24	625	2.14
Accessories	2013	3.99	2013	6.89
Total	**50394**	**100.00**	**29206**	**100.00**

Investment on drip irrigation system is fixed in nature. It is one-time commitment. Once, installed, it lasts upto 15 years. Hence, cash-flows for the entire life period needs to be estimated. In the absence of data on cost and return streams over the life period, certain assumptions are made to work out the cash flows.

1. The life period of drip system was assumed to be 15 years.
2. The cost and benefit streams were assumed to be constant from 8th year onwards to 15th year.
3. The opportunity cost of capital was considered as 10 percent.
4. The production technology was constant.

Results and Discussion

1. Investment :

Installation of drip irrigation system involves additional investment apart from initial investment on bore well and arecanut plantations. The total investment on drip irrigation came to Rs. 50,394/ha with ISI materials and Rs. 29206/ha with non-ISI materials. The material required for drip irrigation system are (i) PVC Pipes for main and sub-mains (ii) Laterals (iii) Micro tubes (iv) Filter (v) control valves. Expenditure on account of laterals was found to be highest in both ISI and non-ISI materials accounted for 39.70 percent and 26.13 percent respectively. The lateral pipe requirement was high and this coupled with higher prices led to higher investment. The PVC pipes for main and sub-mains were the next major cost items together accounting for 31.76 and 39.59 percent of the total cost respectively under ISI and non-ISI sectors. The main drains supply water to the sub-mains which in turn deliver water to the laterals. The laterals are attached with micro-tubes. These micro tubes are responsible for water distribution in the field. The length of the laterals depends upon the number of plant rows. This is the most expensive item in the entire system as this has to be laid for each row of the plants. Micro-tubes are essential parts of the drip system which will release water to the plant slowly and steadily. The expenditure on account of this was the next major item accounting for on an average 8.93 and 8.22 percent. The drip system is provided with a filter to facilitate filtration of irrigation water to prevent accumulation of foreign materials in the microtubues. The accumulation of such materials will hamper smooth flow of irrigation water. Hence, filters are provided for smooth and uninterrupted functioning of the system. The cost of one filter with ISI mark is Rs. 2750 while the non-ISI product will cost Rs. 1600. The cost of filter shared 5.46 percent and 5.48 percent of the total investment respectively with ISI and non-ISI marks Filter is very vital part of the system like heart which removes dirt and other extraneous matter

from water before it reaches plant. Thus, the replacements of microtubes becomes unnecessary besides ensuring quality irrigation water to the plants. Considering these positive aspects, the investment on filter is worthy.

2. Maintenance cost of arecanut gardens with and without drip irrigation

The cost of maintenance of arecanut gardens with drip irrigation and surface irrigation is depicted in the Table 2. The cost of maintenance was worked out for bearing gardens considering the current market prices on inputs. The cost of maintenance was estimated to be Rs. 29019 and Rs. 37856 respectively for gardens under drip and surface irrigation methods. The cost of maintenance was found to be lower in gardens with drip irrigation as compared to gardens without drip irrigation by Rs. 8837. This is attributable to the saving in input cost. This testified to the fact that drip is cost-saving technology. This is corroborated by the findings of Narayana Moorthy (1997).

Table 2. Maintenance cost of drip irrigated and non-drip irrigated gardens

Rs/ha

Particulars	Drip	%	Non-drip	%
I Labour cost				
Basin formation and application of manure and mud	4068	4.68	4515	5.59
Intercultivation	1706	1.96	1642	2.03
Weeding	1471	1.69	3227	4.00
Watch and ward	3731	4.29	3858	4.78
Harvesting	2286	2.63	2059	2.55
Irrigation	-	-	3988	4.94
Sub total	13262	15.25	19289	23.89
II Material Cost				
Farm yard manure	9598	11.04	12608	15.62
Mud	2419	2.78	2571	3.18
Fertilizers	617	0.71	911	1.13
Neem cake	1225	1.41	-	-
Interest on working capital	1356	1.56	2477	3.07
Annual repairs	542	0.62	-	-
Sub total	15757	18.12	18567	23.00
III Fixed cost				
Land revenue	2.00	-	2.00	-
Land red	5000	5.76	5000	6.19
Depreciation	7323	8.42	4190	5.19
Interest on fixed assets	8446	9.71	4357	5.40
Approtional est.cost	10617	12.21	8381	10.38
Int. on est. cost	26542	30.53	20952	25.95
Sub Total	57930	66.63	42882	53.11
Grand Total (I+II+III)	**86949**	**100.00**	**80738**	**100.00**

3. Resource use structure

The details pertaining to resource use structure is given in the Table 3. As evident from the Table : the human labour employment was 231.12 mandays on gardens with drip irrigation while it was 352.93 mandays on gardens with surface irrigation. Drip irrigated gardens required relatively less labour than gardens with surface irrigation. There is a saving of 121.81 mandays of human labour. This clearly indicated that drip irrigation is labour-saving technology. The gardens without drip irrigation where flood method of irrigation is in practice, required substantial quantity of labour for irrigation. Consequently, weed infestation is high in such gardens which again called for use of higher quantity of labour. Besides, there is appreciable saving in farmyard manure and fresh mud in drip irrigated gardens due to efficient use of these resources. Thus, it can be inferred that drip irrigation is not only cost saving but also labour saving technology.

Table 3. Resource use structures of drip irrigated and non-drip irrigated gardens

Per ha

Particulars	Unit	Drip	Non-drip
Human labour	Mandays	231.12	352.93
Bullock labour	pair days	11.38	10.95
Farm yard manure	Cart Loads	33.87	44.50
Fertilizers			
N	Kg	69.91	18.22
P	Kg	69.91	18.22
K	Kg	69.91	18.22
Fresh mud	Cart Loads	48.37	51.43

4. Productivity gains

Regarding productivity gains from drip irrigation, the productivity of arecanut with drip system was 24.93 qtls/ha while the same was 19.90 qtls under surface irrigation indicating a gain of 5.03 qtls. The higher crop productivity under drip irrigation occurred due to continuous supply of water at the root zone of the plant. The plant does not experience moisture stress. (Table 4). The findings are in line with the findings of Magar *et al.,* (1988)

Table 4. Yields of arecanut under drip irrigation and surface irrigation per ha

Particulars	Yield
Drip irrigation	24.93
Surface irrigation	19.90
Incremental yield (qtls)	5.03
Percentage increase	25

5) Effect of drip irrigation on income :

Relative economics of drip irrigation and surface irrigation was analysed to ascertain the income levels of adopters and non-adopters of drip irrigation technology. The gross income was computed by taking into account the current market output prices average for 3 years). The gross income was arrived at by multiplying the total

output with price. The average income level on drip gardens was significantly higher as compared to drip gardens. On an average, income of Rs. 3,36,888 was realised in drip irrigated gardens, while it was Rs. 2,68,916 in surface irrigation indicating a gain of about 25.77 percent. The net income was 249938/ha on drip gardens and Rs. 196194/ha or non-drip gardens. The differential income was quite substantial at Rs. 4760, thus clearly indicating the comparative advantage of drip irrigation technology over the conventional surface irrigation. The benefit cost ratio amply demonstrated the superiority of drip irrigation technology over surface irrigation. (Table 5).

Table 5. Yields and Income **Per ha**

Particulars	With drip	Without drip
Output (qtls)	24.93	19.90
Value of output (Rs.)	336888	268916
Total cost of cultivation (Rs.)	86949	80737
Net income over total cost (Rs.)	249939	188179
Net income over variable cost (Rs.)	3,07,869	2,31,061
Benefit cost ratio (Rs.)	3.87	3.33

6) Water saving

The study investigated into water saving aspect of drip irrigation. The water consumption under drip irrigation system was computed by taking into consideration number of arecanut trees, number of microtubes per tree, discharge per hour, and frequency of irrigation. There was substantial water saving in drip system as compared to surface irrigation. Drip system delivers water to the plans through micro-tubes in precise quantities. Percolation and runoff losses are almost non-existent. The drip system wets only limited area. There is less scope for delivering excess irrigation water thereby wastage is avoided. As the water is directly applied to the root zone of the crop, there is water saving to an extent of 42.18 acre inches as compared to conventional method of irrigation. This amply demonstrated that water requirement under drip irrigation is very low as compared to conventional surface irrigation. This is not the case with surface irrigation under which the water is let into the field till the whole field is drenched to a maximum capacity and as such there is much scope for percolation and evaporation losses. With the saved water, an additional area of 2.5 hectares can be irrigated through drip irrigation. (Table 6). The results are supported by the findings of Narayana Moorthy (1997), Magar *et al.*, (1988) and Kulkarni (1987).

Table 6. Water use efficiency in drip irrigation **per ha**

Particulars	With drip	Non-drip
Water use (acre inches)	17.82	60.00
Water Use efficiency g/acre inch	139.90	32.16
Saving in water (acre inches)	42.18	-

7. Economic feasibility / viability of drip irrigation

The economic feasibility / viability of drip irrigation technology was assessed within the framework of discounted cashflow analysis by computing four measures namely (1) Net Present Worth (NPW), (2) Benefit-cost ratio (3) Internal rate of return. It needs huge financial investment. The investment once committed cannot be retrieved and hence needs careful scrutiny before commitment. Investment worthiness was judged with the help of above measures. The details of their estimation is presented in the Table 7. Since NPW is the difference between discounted costs and discounted benefits, it gives an idea about wealth that could be generated by the new technology over its life span. The NPW is positive and more than zero covering the cost of drip system. The investment on drip system is economically viable as testified by NPW. The benefit-cost ratio was estimated to be 2.52 indicating net returns of Rs. 1.52 for every rupee of investment. The ratio should be greater than unity for the project to be economically viable. Going by this, benefit-cost ratio amply testified the economic feasibility of investment on drip irrigation.

Table 7. Economic feasibility measures of drip irrigation technology

Particulars	Value
Net present worth (Rs.)	65693
Benefit-Cost Ratio	2.52
Internal Rate of return (%)	32.92
Payback period (Years)	1.00

Internal rate of return provides the rate of return over the life span of drip system. The value of IRR was greater than the discount rate suggesting that arecanut growers could safely invest money on drip irrigation system by borrowing at the existing rates of interest from the financial institutions (discount rate 10%).

Conclusions

The foregoing discussion confirmed / testified that drip irrigation technology contributed significantly to reduction in cost of cultivation and increased crop productivity when compared to traditional method of irrigation. It is a labour saving, water saving and cost saving technology. The feasibility measures indicated that installation of drip irrigation is an economically feasible proposition. NPW indicated that drip irrigation generated wealth of Rs. 6,53,391/- over its life period and enabled the farmers to get back their investment on drip irrigation within a year. The BCR exceeded unity indicating economic viability of drip irrigation. Similarly calculation of IRR indicated that farmers could expect annual rate of returns at 32.92% on their investment which is well above the existing rate of interest. The farmers willing

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