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Economic analysis of tomato cultivation with drip irrigation system

K. Arulmani
Ph.D. Research Scholar, Annamalai University, Chidambaram, Tamil Nadu- 608002

G. Srinivasan
Associate Professor, Department of Agricultural Economics, Annamalai University, Chidambaram, Tamil Nadu- 608002

R. Jayasankar
Associate Professor, Department of Agricultural Extension, Annamalai University, Chidambaram, Tamil Nadu- 608002

***Abstract*---**The water crisis is going to be a major problem in all sectors including agriculture in the very future. In agriculture, to tackle this deficit of water availability, to make sure food security for the rising population with the scarce water resource, to increase water productivity and water use efficiency the environment-friendly drip irrigation technology is being adopted. It is widely utilized for the high-value horticultural, plantation, sugarcane and more specifically row spaced crops. According to India's Agricultural Ministry annual report, vegetables are an important crop in India's horticulture sector. In the production of horticultural crops, the state of Tamilnadu is being one of the key producers in the country. A multistage sampling technique is being used for the selection of the study area with a sample of 50 respondent farmers cultivating tomato with the adoption of the Drip Irrigation System in the study area. The objectives of the present study are i) To work out the cost of construction of a Drip Irrigation System ii) To calculate the cost of cultivation of Tomato with a Drip Irrigation System iii) To find the economic viability of the investment made in Drip Irrigation System. To accomplish the stated objectives, theoretical and empirical frameworks, as well as statistical and analytical tools, were used. The total cost of cultivation of tomato with a drip irrigation system was Rs. 414606.28 and a total cost of Rs. 243143 was calculated for the installation Drip Irrigation System for tomato cultivation for an area of 1 hectare with spacing of 1. 2m×0.6m. The Net profit per kg in production of tomato was Rs.16.91 and the Economic feasibility of the investments in the cultivation of tomato with the Drip Irrigation System was viable for the farmers with

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remunerative and profitable. From the constraint analysis it has been suggested to provide a technical training programme in the maintenance of drip sets is very essential for the farmers and also providing timely technical support is needy.

***Keywords*---**drip irrigation technology, drip irrigation system, economic viability, total cost, constraints.

Introduction

An estimate revealed that in the next two decades, India is going to find a reduction in the availability of water for agriculture. To tackle this deficit of water availability for agriculture and to make sure food security for the rising population with scarce water resource, technologies that increase water productivity and water use efficiency with an environment-friendly approach has to be followed. One such technology is the Drip Irrigation Technology which is also known as Micro Irrigation Technology. It is widely utilized for the high-value horticultural, plantation, sugarcane and more specifically row spaced crops. According to India's Agricultural Ministry annual report, vegetables are an important crop in India's horticulture sector, occupying an area of 10.9 million ha during 2020-21 with a total production of 197.2 million tonnes with average productivity of 17.98 tonnes/ha. In the production of horticultural crops, the state of Tamilnadu is being one of the key producers in the country. The objectives of the present study are i) To work out the cost of construction of a Drip Irrigation System ii) To calculate the cost of cultivation of tomatoes with a Drip Irrigation System iii) To find the economic viability of the investment made in Drip Irrigation System and iii) To find the constraints in the cultivation with drip irrigation system.

Methodology

In India, the advanced estimates of area, production and productivity of tomato in Tamilnadu during 2020-21 were 851.69 M.H, 21002.81 M.T and 24.66 M.T respectively. The state of Tamilnadu shares 6.5 Percent of the total area of tomato cultivation in India. With the report of the state horticulture department, tomatoes are majorly been grown in the district of Krishnagiri. In area, production and productivity the district of Krishnagiri is being first with 26051.00 Ha, 30.10 tonnes and 784135.10 tonnes during 2020-21. Among the 38 districts in the state of Tamil Nadu, Krishnagiri district was purposively selected for the present study since it is one of the major vegetable growing districts in the state with 26051.00 Ha of area, 784135.10 tonnes of production and 30.10 tonnes of productivity during the year 2020-2021. A multistage sampling technique is being used for the selection of the study area by considering the state of Tamil Nadu as the first stage, Krishnagiri district in the second stage, Thally and Shoolagiri block (based upon the highest area under tomato cultivation) in the third stage and 50 respondent farmers cultivating tomato with the adoption of Drip Irrigation System in the study area were selected at last.

For the collection of primary data, a well-structured and pre-tested interview schedule was used. The sample farmers were personally contacted and the required data were collected through the interview method the secondary data were collected from the records available in the statistical office of Krishnagiri district, Office of Joint Director of Horticulture, Krishnagiri district, government publications and other published materials.

Tools of analysis

To accomplish the stated objectives, theoretical and empirical frameworks, as well as statistical and analytical tools, are necessitated for the analysis of data is discussed in this section. Simple average, percentage analysis and different cost components were used to work out the cost of production, gross and net returns between adopters and non-adopters of Drip Irrigation System for Tomato cultivation, the statistical tools are as follows.

Cost of Cultivation of Drip Irrigated Tomato

Operation-wise cost of cultivation of drip Irrigated Tomato cultivation per hectare was estimated using Cost A2+FL as per CACP (2005).The CACP (2015) is operating various costs such as Cost A1, Cost A2, Cost B1, Cost B2, Cost C1, Cost C2, and Cost C3 for the calculation of the cost of cultivation. FL = Family labour.

Investment analysis

Investments were made by the farmers for the drip-irrigated cultivation of tomato with this efficient method. As tomato has a gestation period of crop growth considerable investments are made before the crop begins to yield. The returns are spread over a long period. To measure the economic feasibility of the drip set and equipment 10, 12 and 15 percent interest rates were taken as a discounted rate. The INCID (1994) study anticipated that the drip irrigation system would last for five years, and the net present value (NPV) and Benefit-Cost Ratio (BCR) were calculated and analysed on that premise.

Break-even analysis

Break-even analysis was used to compute the appropriate production level that leaves no profit or no loss to the investments made in the production of tomato with the adoption of a drip irrigation system.

Constraint analysis

The Response Priority Index (RPI) was used to quantify constraints. It was built as a product of Proportion of Responses (PR) and Priority Estimate (PE), where PR for the ith constraint is the ratio of responses for a specific constraint to total responses, as calculated by equation.

Results

With the data obtained from the sample respondents of tomato cultivators under the Drip Irrigation System, the selected analytical tools were operated on the data and presented accordingly.

Table - 1
Installation and Maintenance cost of Drip Irrigation System

(Per hectare)

S. No	Components	Cost (Rs)	Per cent
1	PVC pipes	21175	8.71
2	Laterals	1467	0.60
3	Emitting Pipes	198373	81.59
4	Valves	5204	2.14
5	Screen Filters	3400	1.40
5	Venturi and Main fold	2250	0.93
6	By-Pass Assembly	700	0.29
7	Fittings and Accessories	3609	1.48
8	Maintenance Cost per year	6965	2.86
	TOTAL	243143	100.00

A total cost of Rs. 243143 was calculated without subsidy for the installation Drip Irrigation System for tomato cultivation for an area of 1 hectare with spacing of 1.2m×0.6m since the drip irrigation system is provided to the farmers under subsidized schemes by the governments of the union and state. The cost of emitting pipes occupied 81.59 percent of the total cost of establishing the drip set followed by PVC pipes with 8.71 percent. An annual maintenance cost of Rs. 6965 was included in the cost of construction of the drip set.

Cost of Cultivation of Tomato under Drip Irrigation System

Calculations on the cost of cultivation of tomato per hectare with a drip irrigation system were presented in the table 2.

Table-2
Cost of cultivation of tomato per hectare with drip irrigation system

(Per hectare)

S. No	Particulars	Amount (Rs)	Per cent
1	Preparatory works	8118.31	1.96
2	Hired human labour	56652.97	13.66
3	Seed or Saplings	15942.43	3.85
4	Staking and Mulching	76723.41	18.51
5	Plant Protection Chemicals	60835.57	14.67
6	Manures	27421.44	6.61

7	Fertilizers	9448.00	2.28
8	Weeding and Intercultural activities	7213.60	1.74
9	Depreciation on Implements and farm buildings @ 10 %	14208.40	3.43
10	Interest on working capital @ 12 %	31489.42	7.60
	Cost A1	316323.23	
11	Rent paid for leased in land	8269.56	1.99
	Cost A2= (Cost A1+12)	324592.79	
12	Interest on Value of owned fixed capital assets @ 15 % (Excluding land)	22378.20	5.40
	Cost B1= (Cost A1 +13)	338701.43	
13	Rental value of owned land (net of land revenue)	20387.38	4.92
	Cost B2= Cost B1+14	359088.81	
14	Imputed value of family labour	17825.99	4.30
	Cost C1= Cost B1+15(Family Labour)	356527.42	
	Cost C2= Cost B2+15 (Family Labour)	376914.80	
15	Value of management input at 10 % of Total cost (C2)	37691.48	9.09
	Cost C3 (Total Cost)= Cost C2+15	414606.28	100.00

Source: Data from field survey

From table- 2 it can be seen that the total cost of cultivation of tomato with a drip irrigation system was Rs. 414606.28. In the total cost of cultivation, the cost for Staking and Mulching accounted highest with 18.51 percent followed by the cost forPlant Protection Chemicals with 14.67 and Hired human labour with 13.66 percent and percent respectively. The cost of family labour accounted for 4.30 percent. Cost on Weeding and Intercultural activities found to be the least at 1.74 percent of the total cost of production.

Table - 3
Capital Cost, Yield, Production Cost andReturnsof Drip Irrigated tomato

(Per hectare)

S. No	Particulars	Quantity (Kgs)	Amount (Rs)
1	Capital cost of drip set (Without subsidy)	-	243143
2	Production cost (Cost of cultivation)	-	414606.28
5	Yield	53358.59	-
3	Gross value of production	-	1316889.92
4	Net Profit	-	902283.64
5	Price Per kg	-	24.68
5	Cost of Production Per kg	-	7.77
6	Profit Per kg	-	16.91

The gross value of production of tomato cultivation with the Drip Irrigation System was Rs. 1316889.92 per hectare. The Net profit was Rs. 902283.64 for a yield of 53358.59Kgs per hectare and the cost of production per kg was around Rs. 7.77 respectively. The average price per kg of tomato was Rs. 24.68, which

was calculated with the prevailing market price over the period and the Net profit per kg of cultivation was Rs.16.91 respectively.

Investment analysis

The economic feasibility of the investments in the cultivation of tomato with the Drip Irrigation System was measured with NVP and BCR and the results are presented in the table 4.

Table – 4
Economic feasibility of the investments in the cultivation of tomato with Drip Irrigation System

(Per hectare)

S. No	Particulars	With Subsidy	Without Subsidy
1	NPV		
	Discounted @ 10%	1979419.51	1759708.53
	Discounted @ 12%	1879622.22	1664075.58
	Discounted @ 15%	1744277.40	1534692
2	BCR		
	Discounted @ 10%	2.51	2.15
	Discounted @ 12%	2.50	2.14
	Discounted @ 15%	2.49	2.11

The Net Present Value and Benefit Cost Ratio for the investments made on the drip set were estimated with and without subsidies for three discount rates of 10, 12, and 15% respectively, to evaluate the sensitivity of investment to changes in capital costs. Tomato cultivation with a subsidized Drip Irrigation System was positive and more profitable than without subsidy. Even though the investments made without subsidy were viable, the NVP for subsidized drip-irrigated tomato cultivation was more profitable with Rs. 1979419.51, Rs. 1879622.22 and 1744277.40 at 10, 12 and 15 percent of discount rates. Whereas, the BCR was 2.51, 2.50 and 2.49 for with subsidy and 2.17, 2.15 and 2.13 for without subsidy respectively for the same discount rates. The BCR was higher with subsidy than the BCR calculated without subsidy.

Break Even Analysis

It found the point of output at which there is no profit no gain in the production of tomato with the adoption of the Drip Irrigation System.

Table - 5
Break-even point for Tomato Cultivation with Drip Irrigation System

S. No	Break event point	Value
1	In terms of quantity(Kgs)	12509.11
2	In terms of sales value(Rs)	308855.31

From the Break-even analysis it is found that the farmer has to produce 12509.11Kgs of tomato and have to sell their produce for Rs. 308855.31 through drip-irrigated cultivation of tomato in a crop period to attain no loss or no profit. The production level above the break-even point will be profitable to the farmers.

Constraints in the adoption of Drip Irrigation System

The sample respondents' responses regarding the constraints in the adoption of drip irrigation systems were analysed and the ranks of the constraints are presented in the table

S. No	Constraints	Numbers in Responsive Priorities					Total (recorded) Responses	RPI	Rank
		I	II	III	IV	V			
1	High Investment cost without subsidy	24	13	8	3	2	50	0.58	1
2	Clogging of drippers	15	20	7	6	2	50	0.56	2
3	Irregular supply of electricity	10	16	12	7	5	50	0.51	3
4	No timely financial assistance	5	9	14	10	12	50	0.49	4
5	Damaging of Drip set by rodents	10	8	14	11	7	50	0.48	5
6	Lack of proper technical skill and training	9	11	13	10	7	50	0.47	6
7	Disadvantage of performing intercultural operations	9	10	8	11	12	50	0.46	7
	Total						350		

High investment cost without subsidy on the Drip Irrigation System for farmers whose lands do not cover under subsidized irrigation schemes is the first prioritized constraint with 0.58 score in the adoption of Drip Irrigation. Clogging of drippers was found to be the second most serious problem for the adopters with a Response Priority Index (RPI) score of 0.56 followed by Irregular supply of electricity with 0.51 score,No timely financial assistance with 0.49 score, Damaging to Drip set by rodents with 0.48 score, Lack of proper technical skill and training with 0.47 andat last rank Disadvantage of performing intercultural operations with 0.46 score were the seven major constraints found in the study area.

Conclusion

From the analysis made on the investment of Drip Irrigation System for the cultivation of tomato, it has been found that the investments are viable. Cost and returns from the analysis found that drip-irrigated tomato cultivation is remunerative and profitable to the farmers. The results of the constraint analysis

made with the Response Priority Index on adopters of the Drip Irrigation System in the cultivation of tomato in the study area revealed that there is a need for skill development by farmers for effective management of the Drip Irrigation system and optimum uses of inputs. Providing subsidized drip sets was the main factor for the adoption of drip irrigation systems in the study area. A proper training programme in the maintenance of drip sets is very essential for the farmers and also providing timely technical support is needy.

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