International Journal of Agriculture, Environment and Biotechnology
Citation: IJAEB: 9(4): 617-624 August 2016
DOI Number: 10.5958/2230-732X.2016.00080.2

AGRICULTURAL ECONOMICS

Financial feasibility of drip irrigation system in grape cultivation

Bheemanagouda. O. Patil* and Rajendra. S. Poddar

Department of Agricultural Economics, University of Agricultural Sciences, Dharwad-580 005, Karnataka, India

*Corresponding author: bheemagriecon@gmail.com

Paper No. 483 Received: 13-2-2016 Accepted: 8-8-2016

Abstract

This study was undertaken to assess the financial feasibility of drip irrigation system in grape cultivation in Bijapur district of Karnataka. Primary data were collected from 120 grape cultivators in Bijapur and Indi taluks. The Total investment on drip irrigation system amounted to ₹ 61,050/ha and annual working cost was worked at ₹ 17,141/ha. Total cost in production of grape under drip and furrow irrigation was ₹ 5,01,297/ha and ₹ 5,48,708/ha, respectively. Additional returns in drip irrigation over furrow irrigation method were worked out at ₹ 56,829/ha. At 11.75 per cent discount rate, the NPV of investment on drip irrigation system was ₹ 1,15,433.10, BC ratio, IRR and Pay Back Period were 1.89, 46.87 per cent and 1.07 years, respectively. Other than these there was savings in labour and material costs. These indicators showed the financial feasibility of the drip irrigation system. Delay in sanctioning of loans and approval of subsidy; improper disbursement of subsidy, lack of technical support were some problems faced by farmers in adoption of drip irrigation system. Since there are high dividends from micro irrigation, there is a need for larger quantum of subsidy especially for the small and marginal farmers. Procedures for approval and subsidy disbursement need to be simplified in terms of number of documents, number of days required for approval etc with the help of modern information and communication technology tools.

Highlights

- The additional net return under drip system was ₹ 56,829/ha and about 38% costs can be saved
- The investments on drip system were financially feasible.
- Clogging of emitters, delay in sanctioning of loans and delay in approval of subsidy were major problems in the study area

Keywords: Grapes, drip irrigation, feasibility, constraints, subsidy

With growing multi sectoral demand for water and limited supply there are signs of water scarcity in the country which may aggravate in future. Added to this the water use efficiency of different irrigation systems in the country is very low. The irrigation efficiency in our country is of the order of only 25% to 35% in most irrigation system. It means that, there is an urgent need for ensuring efficient use of water for irrigation. Technological innovations have found out many water saving techniques in the past few years. Drip and sprinkler are such techniques which serve the purpose better. At present, around 3.5 1akh ha area is under drip irrigation with the efforts of the Government of India, while it was only 40 ha in 1960 (Anon 2012b). The awareness has grown tremendously. In India adoption of micro irrigation is growing with annual average growth rate of 16-17 percent (Chakrawal 2010). Drip irrigation come as boon to horticultural crops where there is a need for continuous supply of water to the root zone.

This system has been successful in almost all the wide spaced crops. Grape is one such horticultural crop with tremendous potential for production and exports from India. World production of grapes is about 67 mt from 7.23 mha in 2010-11. The area under grape in India accounts to 1.11 lakh hectare with an annual production of 12.31 lakh tonnes at productivity level of 11.1 tonnes per hectare. India ranks tenth in area under grape. Karnataka ranks second in area under grapes with an area of 18,100 hectares producing 3,30,300 t. with a productivity of 18.3 t/ha. Bijapur district ranks first in area under grapes with an area of 6,137 ha and an annual production of 73,644 t. Due to various measures taken by the central and state governments along with the support of drip manufacturers, the area under drip irrigation has increased substantially in the recent years. However, the achievement seems to be less compared to its potential that exists in India (Srivastava *et al.* 2012).

As part of efforts to enhance productivity of horticultural crops and improve water use efficiency, Government of Karnataka, with assistance from the Central Government, has been promoting drip irrigation in the state by providing subsidy. But, the general opinion of the farming community in the district especially grape growers is that the programme has not made desired progress. This needs to be assessed to document constraints and to suggest modifications to existing policies to enhance productivity and economic conditions of the farmers. Hence, the study is carried out with the objectives such as, to know financial feasibility of drip irrigation system in grape cultivation and to document constraints in adoption of drip irrigation system in grape cultivation.

Materials and Methods

The study was undertaken in Bijapur district of Karnataka during the agriculture year 2012-13. The district falls under the Agro Climatic Zone III- (Northern Dry Zone) of Karnataka. Net area irrigated in the district accounts for 27 per cent of net area under cultivation. Major horticulture crops grown in Bijapur district are grapes, pomegranate and lemon.

Sampling process

Bijapur district was selected purposively for the study as large scale cultivation of grape is concentrated in Bijapur district. The number of drip irrigation units adopted was also more in the district. In Bijapur district, two taluks namely Bijapur and Indi were selected for the study based upon the area under grape and drip system adoption. A list of three villages with substantial area under grape was selected from each taluk. Further, among the selected villages, 20 farmers who have adopted drip irrigation system were selected randomly. Thus, total size of the sample selected for the study was 120.

Nature and sources of data

Primary data

The present study is entirely based on the primary data. Primary data pertaining to on-farm investment details, details on yields and returns from the grapes and constraints in adoption of drip irrigation system were collected through pre-tested questionnaire**.** Majority of the respondents did not maintain records of the expenditure and income from grape cultivation. Hence, data collected were based on memory of the respondents. In order to assess the additional benefits accrued from drip irrigation over furrow irrigation system, comprehensive estimates of cost of cultivation of grapes under furrow irrigation system were obtained, by computing with current factor prices, from past studies due to the non availability of area under furrow irrigation system for grapes in Bijapur district.

Analytical tools and techniques employed

Tabular presentation

Tabular analysis was adopted also for analyzing the cost per hectare incurred on installation and maintenance of on-farm drip irrigation system. Simple statistical tools like averages and percentages were used to compare, contrast and interpret results properly.

Financial feasibility analysis

Financial feasibility analysis was carried out to evaluate feasibility of investment on drip irrigation system. The discounted cash flow techniques which have an advantage of reducing cash flow to a single point of time were used to facilitate the test of feasibility. Project appraisal techniques were used in the present study. In the present study, a discount

factor of 11.75 per cent was used to discount the net cash inflows representing the opportunity cost of capital.

1. **Net Present Value (NPV):** Net present value represents the discounted value of the net cash inflows to the project.

$$NPV = \sum_{i=1}^{n} Y_i (1+r)^{-i} - I$$

Where,

Y_i = Refers to the net cash inflows in the n^{th} year
r = Refers to the discount rate
I = Initial investment
i = Years of life period 1, 2..... n.

In order to consider the investment worthiness, the net present value should be positive and of higher magnitude before alternative opportunities considered.

2. **Benefit Cost Ratio (BCR):** The Benefit Cost Ratio (BCR) was worked out by using the following formula discounted net cash flows The ratio must be more ≥ 1 for an enterprise to be considered worthwhile. This technique also ranks the project investment for selection.

$$\text{B: C ratio} = \frac{\text{Discounted net cash flows}}{\text{Initial investment}}$$

The net cash inflows were discounted to determine the present worth following the interpolation technique.

3. **Internal Rate of Return (IRR):** The rate of discount at which the net present value of the project is equal to zero is Internal Rate of Return (IRR) to the project. The net cash inflows were discounted to determine the present worth following the interpolation technique.

$$\textbf{IRR} = \text{Lower discount rate} + \text{Difference between the two discount rates} \left(\frac{\text{Present worth of cash flows at lower discount rate}}{\text{Absolute difference between present worth of cash flows stream at the two discount rate}} \right)$$

If the project being analyzed has Internal Rate of Returns which is more than the ruling rate of interest, then the investment in the project could be feasible.

4. **Pay Back Period (PBP):** Payback period represents the length of time required for the stream of cash proceeds produced by the investment to be equal to the original cash outlay.

Results and Discussion

Investment on on-farm drip irrigation system in grape cultivation

The total cost of installation of drip irrigation system was calculated at ₹ 61,050/ha (Table 1). Cost of installation of drip irrigation system was high because of higher prices of each component of the system. The cost of laterals contributed to a major share of the total investment on drip irrigation structure (27%). The laterals are the PVC (Poly vinyl chloride) tubes which run along the rows of the lines, which receive water from sub-main pipe and supply it to the plants through emitters. Hence, major portion of the money had to be spent on the laterals. The next single large item contributing to the total investment cost was the cost on sub-main pipe, accounting for 20 per cent. The sub-main pipes used were also of PVC and they ran the entire breadth of the vineyard. The expenditure on main pipes and emitters or drippers came next in the order of importance in investment on drip irrigation structure accounting for 15 per cent and 11 per cent, respectively. Considering the pressure at the beginning of discharge of the pump, main pipes are generally large (75 mm) pipes, which cost more as compared to normal PVC pipes (63 mm sub-main pipes). Hence, the farmer had to invest more money on main pipes. Micro tubes are less costly compared to the drippers but drippers are more efficient and durable. Hence in the study area most of the farmers were using drippers. On the whole, it could be observed that the investment cost of drip irrigation structure was very high. These results were in agreement with the findings of Manish (2003).

Table 1: Cost of Installation of drip irrigation system for grape orchard

SI. No	Particulars		Investment	
		Quantity	Cost (₹/ha)	Percentage
1	PVC pipes			
a)	Main line pipes (75mm)	38	9375	15.36
b)	Sub-main line pipes (63mm)	61	12500	20.48
2	Laterals	9 (bundles)	16625	27.23
3	Drippers	3000	6600	10.81
4	Screen filter	1	2700	4.42
5	Control valves	10	2100	3.44
6	Flush valves	10	300	0.49
7	Complete venture assembly	1	2350	3.85
8	Connectors	38	112.5	0.18
9	By-pass assembly	1	900	1.47
10	GTO set	250	1500	2.46
11	T- joints	10	750	1.23
12	L- bow	50	1000	1.64
13	End caps	10	300	0.49
14	Accessories		337	0.55
15	Installation charge		3600	5.90
	Total Cost		**61050**	**100.00**

The average annual working cost of drip set was found to be ₹ 17,141/ha (Table 2). In this the share of operating and maintenance cost was about 23 per cent which was much lower in comparison with fixed cost of about 77 per cent of total working cost in grapes. It could be due to permanent placement of drip irrigation set for grapes. Among the annual fixed cost, interest on fixed capital accounted maximum 42 per cent in comparison with depreciation on investment (35%) of the total annual working cost of drip irrigation system. It could be because of higher rate of interest (@ 11.75%) charged by the financial institutions (banks) on fixed capital of drip irrigation system.

Economic and financial feasibility analysis of investment on drip irrigation system in grape cultivation

The cost and return structure per hectare of grapes under drip irrigation and furrow irrigation systems have been worked out to know the additional benefits from drip irrigation system. This information is used to work out discounted cash flows for financial feasibility.

The yield of grapes in both the irrigation methods was more or less same where yields obtained were 30.12 t/ha and 29.83 t/ha from vineyards under drip and furrow irrigation system, respectively (Table 3 and Figure 1). Gross returns per hectare obtained from grapes under drip and furrow system of irrigation amounted to ₹ 9,71,660/ha and ₹ 9,62,243/ha, respectively. Since grape yield in both drip and furrow methods of irrigation was almost similar, there was not much difference in gross returns as the price/kg of grape was the same (₹ 32.25/kg). Total costs incurred in production of grapes under drip irrigation method were ₹ 5,01,295/ha and ₹ 5,48,707/ha under furrow irrigated vineyards. This difference in the costs under both irrigation methods was mainly due to savings in labour costs on operations (about 28%) and material costs (about 10%).

Table 2: Annual working cost of drip irrigation system for grape orchard

Sl. No	Items	Cost (₹/ha)	Percentage
A	**Annual Fixed Cost**		
1	Depreciation on investment	6078	35.45
2	Interest @11.75 %	7173	41.83
	Sub-Total (Total Fixed Cost)	13251	77.28
B	Annual Operating and Maintenance Cost		
1	Electricity charges	1940	11.36
2	Repair and maintenance of drip irrigation system	1750	10.20
3	Miscellaneous	200	1.15
	Sub- Total (Total Operating Cost)	3890	22.72
	Total Cost (A+B)	**17141**	**100.00**

Table 3: Economics of grape cultivation under drip and furrow* irrigation methods

Sl. No	Particulars	Method of Irrigation	
		Drip	Furrow*
1	Average yield (t/ha)	30.12	29.83
2	Average price (₹/kg)	32.25	32.25
3	Total Returns (₹/ha)	971660	962243
4	Total cost (₹/ha)	501295	548707
5	Net returns (₹/ha)	470365	413536
6	Additional returns in drip irrigation over furrow irrigation method (₹/ha)	56829	

**Note*: Comprehensive estimates from previous studies

Table 4: Percentage cost savings under drip irrigation system over furrow irrigation

Sl. No	Particulars	Cost (₹/ha)		% saving of costs under drip system
A	**Labour Costs**	**Furrow System**	**Drip System**	
1	Inter cultivation	2955	2625	11.17
2	Application of fertilizers	5370	4400	18.06
3	Application of PPC	17730	16000	9.76
4	Weeding	31636	22500	28.88
5	Irrigation	21982	12000	45.41
	Total of Labour Cost(A)	**79673**	**57525**	**27.80**
B	**Material costs**			
1	Manures	54044	52500	2.86
2	Fertilizers	31749	25625	19.29
3	Plant Protection Chemicals	105799	96250	9.03
4	Micro nutrients	11220	7775	30.70
	Total Material Cost(B)	**202812**	**182150**	**10.19**

Among the labor costs under different operations highest per cent cost savings was under irrigation operation (45%) followed by weeding (29%), application of fertilizers (18%) and so on. Among the material costs the highest cost savcing was from micronutrients (31%) followed by fertilizers (19%), plant protection chemicals (9%) and so on (table 4) (Kumar and Shreeshail 2013). The net returns from grape.

It is evident that the initial investment made was ₹ 61,049/ha for drip irrigation system in grape orchard and the average annual working cost was ₹ 17,141/ha (Table 5). Further, it can also be seen that the annual working cost of drip irrigation system in grape orchard remained constant from first year to tenth year. The returns from grape orchard under drip irrigation system started flowing from second year (₹ 53,217) till sixth year (₹ 59,990) and remained constant up to tenth year. Accordingly, the net cash flows of grapes production under drip irrigation system which were negative (₹ 17,141) in the first year started increasing from second year (₹ 36,075) and till sixth year (₹ 42,849) which was maximum net cash flow. And the net cash flow was same during the last four years economic life of drip irrigation system (up to 10th year). Drip irrigation system is an investment yielding returns over time and cash flows can change over the time. Since the system involves the fixed capital, it is necessary to take into account the income streams for the whole life span of drip investment.

The NPV criterion helps to evaluate the benefits accrued and costs incurred during the project life. The present value of the net cash flows at 11.75 per cent discount rate was worked out to ₹ 1,15,433/ ha. This positive net present value of drip irrigation system for grapes clearly indicated that investment on drip irrigation system was financially feasible (Table 6). The outcome of this study was in line with findings of Lokesh (1995) and Narayanamurthy (2005).

Table 5: Cash flow analysis of grapes under drip irrigation method

Years	Out flows (₹)	Inflows (₹)	Net cash flows (₹)	Discount Factor (r) at 11.75 %	Net Present Value
0	-61049	0	-61049	1	-61049
1	17141	0	-17141	0.8949	-15338.7
2	17141	53217	36076	0.8008	28888.39
3	17141	53862	36721	0.7166	26313.09
4	17141	54185	37044	0.6412	23753.51
5	17141	59667	42526	0.5738	24401.52
6	17141	59990	42849	0.5135	22001.66
7	17141	59990	42849	0.4595	19688.29
8	17141	59990	42849	0.4112	17618.16
9	17141	59990	42849	0.3591	15387.04
10	17141	59990	42849	0.3213	13769.16
			Total		**115433.1**

Table 6: Financial feasibility analysis of investment on drip system in grape cultivation

Sl. No	Particulars	Units	Value
1	Net Present Value @ 11.75%	₹/ha	115433
2	Benefit cost Ratio @ 11.75%	₹	1.89
3	Pay Back Period	Years	1.07
4	Internal Rate of Return	Per cent	46.87

Benefit-Cost ratio is another tool for appraising the worthiness of investments. The BCR indicated expected returns for each rupee of investment in drip irrigation system for grapes. The BCR for the drip irrigation system in grapes was 1.89 at 11.75 per cent discount rate (Table 6). It may be recalled

that even though the investment on drip irrigation system was high (₹ 61,049/ha) the rewards were commensurate with investment requirement.

The formal selection criterion of IRR is to accept the projects with IRR more than the opportunity cost of capital. The IRR for drip irrigation system for grapes was found to be 46.87 per cent, which was higher than the discount rate (11.75%) considered in the analysis (Tabl 6). The IRR represents the average earning power of money invested on drip irrigation system for grapes during its life span. Since IRR was more than the discount rate, investment on drip irrigation system for grapes in Bijapur district was financially viable. This finding was in line with the findings of Anand *et al.* (1998) and Malik, *luhack* (2002).

The payback period to recover initial investment made on drip irrigation system for grapes was 1.07 years, which suggested that the time required to recover initial investment made on drip irrigation system was quite short. The time being short, risks involved in recovery of the initial investments were also low and the farmers can be assured of recovering their investment (Table 6).

Constraints in adoption of drip system for grapes

As drip irrigation is an innovation, it was considered important to study constraints or problems related to its adoption. The major constraints expressed by the grape growers in adoption of drip irrigation system were classified into four categories based on the number of responses and are presented in Table 7. The opinion survey revealed that about 96 per cent farmer respondents encountered the problems of emitter clogging in adoption of drip irrigation system. It was found during informal discussion with growers that the causes of clogging were sand/soil particles in water, growth of algae in the system and salts. Application of unspecified fertilizers through drip irrigation was also one of the reasons for clogging of the drip system. This clogging disturbs the operation of the drip system and reduces uniformity of water application. About 93 per cent farmers faced the problem of delay in sanctioning of loans followed by delay in approval of subsidy (90%) as perceived by the farmers in the study area. Delay in sanctioning of loans may be explained by the fact that the process involved lengthy paper work. The delay in approval of subsidy was mainly due to the cumbersome procedure to obtain the loan especially in case of poor and marginal farmers. Secondly, the pace at which files move from desk to desk in clearance of subsidy is very slow. And, last, farmers expressed corruption at different strata of government hierarchy as the main hurdle in availing benefit of subsidy. These results were in line with the results obtained by Narayanamurthy (2005) and Aravind Kumar (2013).

Table 7: Constraints in adoption of drip system for grapes

Sl. No	Particulars	Number of farmers	Percentage
1	Clogging of emitters	115	95.83
2	Delay in sanctioning of loans	112	93.33
3	Delay in approval of subsidy	108	90.00
4	Poor quality of product	106	88.30
5	High cost of project	104	86.60
6	Improper dispersement of subsidy	98	81.60
7	Problems in installation	96	80.00
8	Damage by cattle/rodents	72	60.00
9	Lack of awareness about fertigation	42	35.00

About 86 per cent of farmers encountered the problem of high cost of drip system followed by insufficient quantum of subsidy and improper disbursement of subsidy (82%), installation of drip irrigation system(80%), damage by cattle/rodents (60%), lack of awareness about fertigation (35%).

The process involved a huge amount of paper work, with the government approval needed at each stage before the money could be released. At the end of a lengthy procedure farmers get only 30-35 per cent of the total subsidy actually sanctioned to them. The problem of installation of drip system could be due to improper design of drip system in field. This was because the manufacturers or dealers in drip system were only eager to sell the system to the farmer with scant regard for suitability of the system to the field requirements. The problem of rodent damage was reported because quite often the water from drippers was a source of drinking water for the rodents and the rodents sometimes bite the drippers and pipes leading to blockage of system which causes improper irrigation water distribution. The above results are in agreement with findings of Uday *et al.* (2007), Aravind Kumar (2013).

Conclusion

The results of the study have convincingly shown that the investments on drip irrigation system in grapes are financially feasible. Further, the growing scarcity of farm labour guides us to adopt improved farm technologies like micro irrigation. Drip irrigation helps in reducing labour requirement to a greater extent in grapes cultivation. Hence, special efforts are needed to popularize the drip irrigation scheme. To provide further impetus to water saving efforts especially in water scarcity regions in Bijapur district, Government of Karnataka can promote the new generation of irrigation technology involving subsurface drip irrigation (SDI), where the irrigation can be applied below the soil surface (Anonymous 2012). This method results in even higher levels of water use efficiency through reduced runoff, evaporation and other parameters, and provides nutrients to plants while maintaining a dry soil surface. Farmers in the study felt that there was a long delay in disbursement of subsidy amount because of lengthy official procedures. Therefore, these procedures have to be simplified in terms of number of documents, number of days required for approval. And time schedule need to be formulated for disbursal of subsidies by the Government agencies. The manufacturers or dealers in drip irrigation systems are eager only to install drip irrigation system without regard for subsequent problems or operational difficulties or follow up. Therefore, it should be made mandatory on the part of the manufacturers/dealers to attend to necessary operational difficulties, prompt repairs and maintenance of the system for a period of at least two years from the date of installation. This helps save lot of farmers' energy and efforts and loss.

References

Anand, T.N., Lakshminarayan, M.T., Manjunatha, B.N. and Prasanna Kumar, G.T. 1998. Comparison of Economics of Drip and Surface Irrigation System in Grape. *Agriculture Finance* **30**(4): 3-5.

Anonymous, 2012b. Drip Irrigation Technology to Save Water and Enhance Crop Yields, Indian Agricultural Research Institute, New Delhi, Accessed on 6. 06. 2012 from *http : //www. iari. res. in/index. php?option= com_content&view =article&id=194&Itemid=1241.*

Anonymous, 2012a. Draft National Water Resources Policy. Accessed on 5. 06. 2012 from *http : //mowr. gov. in/writereaddata/ linkimages/DraftNWP2012 _English9353289094. pdf.*

Aravind Kumar, 2013. An Economic evaluation of micro irrigation in Bijapur district of Karnataka, *M. Sc. (Agri.) Thesis,* University of Agricultural Sciences, Dharwad (India).

Chakrawal, P. 2010. Business Opportunities in Micro-Irrigation Systems in India, *Agriculture Finance* **35**(3): 31-33

Lokesha, 1995. Study on investment in drip irrigation : An analysis of its impact on coconut. *M. Sc. (Agri.) Thesis,* Univ. Agril. Sci., Bangalore, Karnataka (India).

Malik, D.P. and Luhach, M.S. 2002. Economic Dimensions of Drip Irrigation in Context of Fruit Crops, *Intl. Workshop on Economics of Water and Agriculture*, Jerusalem, Israel dated December 18-20.

Manish, L.M. 2003. Comparative economics of drip vis-à-vis conventional method of irrigation for grape cultivation in Osmanabad district of Maharashtra. *M. Sc. (Agri.) Thesis,* Mahatma Phule Agric. Univ., Rahuri (India).

Narayanmoorthy, A. 2005. Economics of drip irrigation in sugarcane cultivation : case study of a farmer from Tamil Nadu. *Indian Journal of Agricultural Economics* **60**(2): 235-248.

Shreeshai, B.R. 2013. Impact assessment of water management practices of Malaprabha command are- An economic analysis, *M. Sc. (Agri.) Thesis,* University of Agricultural Sciences, Dharwad, Karnataka (India).

Srivastava, S.K., Rai, B. and Kumar, S. 2012. Role of Micro-Irrigation in Improving Food Productivity. *India Water Week 2012* – Water, Energy and Food Security : Call for Solutions, 10-14 April 2012, New Delhi.

Singh, A. and Singh, C.S. 2005. Drip irrigation- A Promising Approach for Water Scarcity Areas. *Agro India,* pp. 36-38.

Uday, R., Bhosale and Bhande, S.R. 2007. Analytical Study of Drip Irrigation System Installed for Grape Orchards. *Agriculture Finance* **30**(3): 16-19.