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RESEARCH ARTICLE :

Impact of micro irrigation on sugarcane productivity and profitability in northern Karnataka

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SUMMARY : The study was conducted in four districts of northern Karnataka namely, Belagavi, Vijayapura, Bidar and Kalaburgi to know the impact of micro irrigation on sugarcane productivity and profitability over the conventional method of irrigation. 120 farmers practicing drip irrigation and 120 farmers practicing conventional method of irrigation in cultivation of sugarcane were selected purposively for the study and thus the total sample size was 240. Purposive multistage random sampling procedure was followed for the selection of the samples. The results of the study revealed that the highest yield was obtained in case of drip irrigated farms (164.77 t/ha) compared to conventional irrigated farms (130.27 t/ha). Among the two methods of irrigation, the total cost incurred in case of conventional method of irrigation was highest (Rs. 180304.07/ha) as compared to cost incurred in cultivation of sugarcane under drip irrigation (Rs. 146007.96/ha). The irrigation method wise analysis of gross returns indicated that the gross returns obtained per hectare in case of drip irrigated farms was high (Rs. 297720.98/ha) compared to conventional irrigated farms (Rs. 230856.55/ha). With respect to net returns also, the per hectare net returns obtained in drip irrigated farms was high (Rs. 151713.02/ha) as compared to conventional irrigated farms (Rs. 50552.49/ha). Thus the cultivation of sugarcane crop in the study area was found to be highly profitable under drip irrigation as also supported by a high magnitude of returns per rupee investment (2.04) compared to sugarcane cultivation under conventional method of irrigation (1.28).

KEY WORDS :
Drip irrigation, Conventional method of irrigation, Yield, Total cost, Net returns

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BACKGROUND AND OBJECTIVES

Water is gradually becoming a scarce resource worldwide especially in developing countries like India. With the increasing need of providing food and water security for an ever increasing population, the availability, usability and affordability of water is becoming a major challenge. Efficient use of this resource is essential. However, this requires innovation and more precision in its utilisation, especially where it is used in abundance like agriculture.

In furrow irrigation, the water is applied to the top end of each furrow and flows down the field through gravity. In this method, water can take a considerable period of time to reach the other end, meaning water has been

infiltrating for longer period of time at the top end of the field. This results in poor uniformity with high application at the top end and lower application at the bottom end. The conventional method of irrigation not only reduces crop production and damage soil fertility but also causes ecological hazards like water logging and salinity. The application of irrigation water by conventional method causes up to 30 per cent loss of water through deep percolation depending on the soil type. Thus to overcome these problems of conventional method of irrigation and to improve water use efficiency to achieve more crop per drop, the adoption of micro irrigation gains greater attention.

Karnataka is one among the major sugarcane and sugar producing states in the country as the sugarcane is being cultivated in large areas since many years for manufacture of jaggery, khandsari and white sugar. It is also a major provider of livelihood to millions of agricultural families and their dependence particularly in rural areas. In the light of the above and considering the relevance of micro irrigation system in sugarcane production in the state, the present paper is proposed to evaluate the profitability of micro irrigation system over the conventional method of irrigation in cultivation of sugarcane in the study area.

RESOURCES AND METHODS

Sampling procedure:

The purposive multistage random sampling was followed for the selection of districts, taluks, villages and micro irrigation beneficiary farmers. The farmers practicing conventional methods of irrigation were selected from the selected villages randomly. Belagavi, Vijayapura, Bidar and Kalaburgi districts were selected purposively for the detailed study. From each selected district one major taluk in terms of number of beneficiaries covered (drip irrigation) under the project were selected purposively. The taluks selected were Gokak from Belagavi district, Indi from Vijayapura district, Bhalki from Bidar district and Afzalpur from Kalaburgi district.

Three villages from each taluk based on the availability of beneficiaries practicing both drip irrigation for raising the sugarcane were selected purposively for the study. From each selected village 10 farmers practicing drip irrigation and 10 farmers practicing conventional method of irrigation (furrow) were selected purposively. Thus sample size was 120 in each irrigation method and thus making the total sample size of 240.

Analytical tool used:

Budgeting technique was followed for estimating the cost and returns in the production of sugarcane under different irrigation methods and tabular analysis was used to analyse the averages.

OBSERVATIONS AND ANALYSIS

The results obtained from the present study as well as discussions have been summarized under following heads:

Input use pattern and output obtained in sugarcane cultivation under drip irrigation and conventional method of irrigation :

Inputs used and output produced per hectare of sugarcane cultivation in the study area are depicted in Table 1.

It can be observed from the Table 1 that, the average per hectare utilisation of sets among the different irrigation methods was highest in case of conventional method of irrigation (7.59 t/ha) compared to drip irrigation (6.00 t/ha). The average per hectare utilisation of human labour was also highest in case of conventional method of irrigation (317.99 man days) compared to drip irrigation (231.47 man days). Similarly the highest bullock and tractor labour used under conventional method of irrigation was highest (6.90 pair days and 11.44 hours, respectively) compared to drip irrigation (4.57 pair days and 8.52 hours, respectively). The reason behind the utilisation of more human labour under conventional method of irrigation was due to the fact that the conventional method of irrigation required more number of weeding operations and more labour for irrigation compared to drip irrigation. The findings of the study are also in conformity with the findings of the Prajapati *et al.* (2013).

It could also be observed from the Table 1 that the use of farm yard manure, chemical fertilizers and plant protection chemicals was also highest under conventional method of irrigation (19.96 t/ha, 12.10 q/ha and 3.86 lit/ha, respectively) compared to drip irrigated farms (13.67 t/ha, 10.81 q/ha and 2.93 lit/ha, respectively). The highest yield was obtained in case of drip irrigated farms compared to conventional irrigated farms. It was 164.77 t/ha under drip irrigated farms and 130.27 t/ha under

conventional irrigated farms. This might be due to the fact that application of water through drip irrigation was uniform and regular, application of water directly to root zone hence avoid water contact with the leaves and hence less susceptible for weeds, pests and diseases and there was no soil erosion and there was no loss of soil fertility and also due to the other advantages of drip irrigation over the conventional method of irrigation. The findings of the study are also in conformity with the findings of the Enda Antony and Singandhupe (2004); Narendra and Agrawal (2005); Bhosale and Bhande (2007); Patil *et al.* (2009); Gholap *et al.* (2011); Kaushal *et al.* (2012); Birbal *et al.* (2013); Thirumalaikumar *et al.* (2014) and Omotayo *et al.* (2015).

Cost involved in cultivation of sugarcane under drip irrigation and conventional method of irrigation :

The costs incurred in cultivation of sugarcane under drip and conventional methods of irrigation were analysed and are presented in Table 2.

It could be noticed from the Table 2 that the total variable cost incurred per hectare under conventional method of irrigation was highest (Rs. 149105.21/ha) compared to drip irrigated farms (Rs. 105527.64/ha). The distribution pattern of operational cost under various inputs revealed that the cost of human labour was highest in case of conventional method of irrigation (Rs. 64418.81/ha) compared to drip irrigation (Rs. 43727.78/ha). Whereas bullock labour cost was highest in case of conventional method of irrigation (Rs. 6367.15/ha) followed by drip irrigation (Rs. 4220.40/ha). The cost of tractor labour and sets was also highest in case of conventional method of irrigation (Rs. 9340.63/ha and Rs. 18971.72/ha, respectively) compared to drip irrigation (Rs. 6958.68/ha and Rs. 15700.00/ha, respectively).

It could also be observed from the table that expenditure on farm yard manure, chemical fertilizers and plant protection chemicals applied per hectare in the study area was more under conventional method of irrigation (Rs. 19958.33/ha, Rs. 18961.04/ha and Rs. 1332.98/ha, respectively) and was less in drip irrigated farms (Rs. 13632.50/ha, Rs. 13432.72/ha and Rs. 951.87/ha, respectively).

The irrigation method wise analysis indicated that the fixed cost incurred per hectare in case of drip irrigated farms was highest (Rs. 40480.32/ha) compared to conventional irrigated farms (Rs. 31198.86/ha). Among the different components of fixed cost, rental value of the land was highest in both the methods of irrigation (Rs. 20000/ha in each method) followed by cost of irrigation which is nothing but amortised cost of irrigation structure (Rs. 13712.78/ha and Rs. 5732.95/ha under drip and conventional method of irrigation, respectively). The other components like land revenue, depreciation charges

Table 1 : Input use pattern and output obtained in sugarcane cultivation under drip irrigation and conventional method of irrigation in the study area (Per ha)

Sr. No.	Particulars	Units	Drip irrigation (n=120)	Conventional method of irrigation (n=120)	Difference
1.	Human labour	Man days	231.47	317.99	-86.52
2.	Bullock labour	Pair days	4.57	6.90	-2.33
3.	Machine labour	Hours	8.52	11.44	-2.92
4.	Sets	Tonnes	6.00	7.59	-1.59
5.	Farm Yard Manure	Tonnes	13.67	19.96	-6.29
6.	Chemical fertilisers				0.00
	Urea	Quintals	4.70	5.38	-0.68
	DAP	Quintals	3.55	5.31	-1.76
	MOP	Quintals	2.56	1.42	1.14
	Total	Quintals	10.81	12.10	-1.29
7.	Plant protection chemicals				0.00
	Pesticide	Litres	1.64	2.02	-0.38
	Herbicide	Kg	1.29	1.84	-0.55
	Total	Litres/kg	2.93	3.86	-0.93
8.	Main product	Tonnes	164.77	130.27	34.50
9.	By-product	Tonnes	5.73	4.24	1.49

and interest on fixed cost are of minor importance.

Among the two methods of irrigation, the total cost incurred in case of conventional method of irrigation was highest (Rs. 180304.07/ha) as compared to cost incurred in cultivation of sugarcane under drip irrigation (Rs. 146007.96/ha). This might be due to the fact that as we already discussed the sugarcane cultivation under the conventional method of irrigation required more units of inputs compared to sugarcane cultivation under drip irrigation. Hence, cost of cultivation under conventional

Table 2 : Cost involved in cultivation of sugarcane under drip irrigation and conventional method of irrigation in the study area (Per ha)

Sr. No.	Particulars	Drip irrigation (n=120)			Conventional method of irrigation (n=120)			Difference
		Quantity	Value (Rs.)	Per cent to total cost	Quantity	Value (Rs.)	Per cent to total cost	Value (Rs.)
	Variable cost							
1.	Human labour (man days)	231.47	43727.78	29.95	317.99	64418.81	35.73	-20691.03
2.	Bullock labour (pair days)	4.57	4220.40	2.89	6.90	6367.15	3.53	-2146.75
3.	Machine labour (hours)	8.52	6958.68	4.77	11.44	9340.63	5.18	-2381.95
4.	Sets (tonnes)	6.00	15700.00	10.75	7.59	18971.72	10.52	-3271.72
5.	FYM (tonnes)	13.67	13632.50	9.34	19.96	19958.33	11.07	-6325.83
6.	Chemical fertilisers (quintals)							
	Urea	4.70	3349.61	2.29	5.38	3870.00	2.15	-520.39
	DAP	3.55	8128.94	5.57	5.31	11705.21	6.49	-3576.27
	MOP	2.56	1954.17	1.34	1.42	3385.83	1.88	-1431.66
	Total	10.81	13432.72	9.20	12.10	18961.04	10.52	-5528.32
7.	Plant protection chemicals (kg or litres)							
	Pesticide (litre)	1.64	616.87	0.42	2.02	741.75	0.41	-124.88
	Herbicide (kg)	1.29	335.00	0.23	1.84	591.23	0.33	-256.23
	Total	2.93	951.87	0.65	3.86	1332.98	0.74	-381.11
8.	Interest on working capital @ 7 %	-	6903.68	4.73	-	9754.55	5.41	-2850.87
	Sub total	-	105527.64	72.28	-	149105.21	82.70	-43577.57
	Fixed cost							
1.	Land revenue	-	30.00	0.02	-	30.00	0.02	0.00
2.	Rental value of the land	-	20000.00	13.70	-	20000.00	11.09	0.00
3.	Depreciation	-	2400.37	1.64	-	2093.18	1.16	307.19
4.	Cost of irrigation	-	13712.78	9.39	-	5732.95	3.18	7979.83
5.	Interest on fixed capital @ 12 %	-	4337.18	2.97	-	3342.73	1.85	994.45
	Sub total	-	40480.32	27.72	-	31198.86	17.30	9281.46
	Total cost of cultivation	-	146007.96	100.00	-	180304.07	100.00	-34296.11

Table 3 : Returns from cultivation of sugarcane under drip irrigation and conventional method of irrigation in the study area (Per ha)

Sr. No.	Particulars	Drip irrigation (n=120)	Conventional method of irrigation (n=120)	Difference
1.	Yield			
	Main product (tonnes)	164.77	130.27	34.50
	By-product (tonnes)	5.73	4.24	1.49
2.	Market price			
	Main product (Rs.)	1772.08	1739.58	32.50
	By-product (Rs.)	1000.00	1000.00	0.00
3.	Gross returns (Rs.)	297720.98	230856.55	66864.43
4.	Total cost (Rs.)	146007.96	180304.07	-34296.11
5.	Net returns (Rs.)	151713.02	50552.49	101160.53
6.	B:C ratio	2.04	1.28	0.76

method of irrigation was more compared to drip irrigation in production of sugar cane in the study area. The findings of the study are also supported by the findings of the Shivakumar *et al*. (2000); Narayanmoorthy and Deshpande (2001); Shirahatti *et al.* (2001); Singadhupe *et al.* (2002); Thamban *et al.* (2006); Namara *et al.* (2007); Shashidhara *et al.* (2007); Chandrakanth *et al.* (2012); Chandrakanth *et al.* (2013) and Sharma *et al.* (2013).

Returns from cultivation of sugarcane under drip irrigation and conventional methods of irrigation :

The returns obtained from sugarcane cultivation under drip and conventional method of irrigation is presented in Table 3.

The irrigation method wise analysis of gross returns indicated that the gross returns obtained per hectare in case of drip irrigated farms was high (Rs. 297720.98/ ha) compared to conventionally irrigated farms (Rs. 230856.55/ha). With respect to net returns also, the per hectare net returns obtained in drip irrigated farms was high (Rs. 151713.02/ha) as compared to conventionally irrigated farms (Rs. 50552.49/ha). This was due to the fact that the sugarcane productivity as well as the price of the output was highest and cost of cultivation was less under drip irrigation compared to the conventional method of irrigation in cultivation of sugarcane. Thus, the cultivation of sugarcane crop in the study area was found to be highly profitable under drip irrigation as also supported by a high magnitude of returns per rupee investment (2.04) compared to sugarcane cultivation under conventional method of irrigation (1.28). The results of the study are also supported by the findings of the Narayanamoorthy (2005); Narayanamoorthy (2008); Jalajakshi and Jagadish (2009); Jayapiratha *et al.* (2010); Narayanamoorthy (2010) and Jisnu *et al.* (2014).

Conclusion:

The results of the study revealed that the highest yield was obtained in case of drip irrigated farms compared to conventional irrigated farms. Among the two methods of irrigation, the total cost incurred in case of conventional method of irrigation was highest as compared to cost incurred in cultivation of sugarcane under drip irrigation. The irrigation method wise analysis of gross returns indicated that the per hectare net returns obtained in drip irrigated farms was high compared to conventional irrigated farms. Thus, the cultivation of sugarcane crop in the study area was found to be highly profitable under drip irrigation. Hence, the farmers are advised to adopt drip irrigation in cultivation of sugarcane in the study area to gain more productivity and more profitability.

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