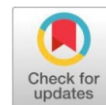


Original Research Article

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Exploring the Adoption Levels and Challenges of Drip Irrigation Practices Among Sugarcane Farmers in Mandya and Nagamangala Taluks of Karnataka State, India


 Vinaykumar R¹, Suresh D. K², Praveen P³, Sanketh C.V^{*4} and Lakshminarayana M. T⁵
¹Project Planning and Monitoring Cell (PPMC) and Nodal Agricultural Education Cell (NODAE)- ICAR, V.C. Farm, Mandya, Karnataka, India

²ICAR-Krishi Vigyan Kendra, V.C. Farm, Mandya, Karnataka, India

³Department of Agricultural Engineering, College of Agriculture, V.C. Farm, Mandya, Karnataka, India

⁴Department of Agricultural Extension, College of Agriculture, V.C. Farm, Mandya, Karnataka, India

⁵Department of Social Sciences and Languages, College of Agriculture, V.C. Farm, Mandya

ABSTRACT

Water scarcity and poor irrigation methods pose significant challenges for agriculture in India, especially in the case of sugarcane, which requires substantial water. Hence, the present study was conducted in Malavalli and Nagamangala taluks of Mandya district in Karnataka state during 2024-2025 to analyse the technology adoption and constraints of sugarcane growers in drip irrigation. This research, highlighted a lack of technical knowledge, significant upfront costs and insufficient extension services as key barriers to implementing drip irrigation practices among sugarcane farmers. Despite these challenges, this study made important contributions by evaluating the adoption rates of 15 drip irrigation practices, pinpointing key information sources utilized by farmers, and exploring the direct and indirect impacts of eight socio-economic factors on adoption rates through path. hundred sugarcane growers were personally interviewed using a pre-tested schedule. It was found that 35, 33 and 32 per cent of the sugarcane growers belonged to medium, low and high level of adoption of drip irrigation management practices. Agricultural scientists, Agricultural extension officers and Krishi Vignan Kendras were consulted by the majority of the sugarcane growers to obtain the information on drip irrigation management practices. high initial expenses for installation of drip irrigation system (90%) and frequent clogging of drippers and microbes (82%) were the constraints faced by over 80 per cent of the sugarcane growers in drip irrigation management practices.

Keywords: Water Scarcity, Drip irrigation, Adoption, Challenges, Krishi Vignan Kendras, information, Drippers, microbes, Sugarcane growers, Constraints

Introduction

Water is one of the most crucial and precious natural resources, vitally important for agricultural development and our daily needs. It is an indispensable resource that permits every aspect of human society and affects every man, woman and child. It is the most essential natural resource that limits agricultural productivity and sustainable agriculture. As a result, water management technologies must be implemented in order to utilize existing water resources in a sustainable manner. [2]. Intensified agriculture and outgrowing population are depleting the already scarce resource, "the water." Although water is manageable resource yet, it is often used in crop production quite which initially enters the lands and finally becomes available for crop use in fields. The solution to the water-related problems is to evaluate the existing irrigation system so as to reduce the losses of this precious commodity and thereby increase its efficient use. For increasing the agricultural production, the importance of irrigation is fully realized, but the proper use of water is seldom practiced in our country.

*Corresponding Author: **Sanketh C. V.**

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The regularized and controlled irrigation increases crop production, reduces water cost, conserves soil, covers more area under irrigation, and thus, brings prosperity at home [9].

Drip irrigation system (DIS) controls the time of application, amount of water and place of application of water. DIS is far superior to other traditional methods like surface irrigation because it provides precisely the required amount of water, checks wastage. Secondly, it provides the condition that is created in surface irrigation, due to which there is a gap of 24 hours before plants can actually utilize the irrigation water. This system also permits the use of fertilizers, pesticides and other water-soluble chemicals along with water. It has been found that fertigation is the most economic method of fertilizer application specially when applied through drip system and it leads to 40-50 per cent savings on nutrient application. Disease spread is also less in those places where drip system is being practiced with application of this technology [3].

Sugarcane is a major cash crop in India which has an unique role in sustaining agro industrial economic growth. Sugarcane being a long duration crop produces huge amount of biomass and requires large quantity of water (1100-2200mm) and is mostly grown as an irrigated crop using surface irrigation. The drip irrigation adoption in sugarcane increases water use efficiency (60-200%), saves water (20-60%), reduces fertilization requirement (20-33%) through fertigation, produces better quality crop and increases yield (7-25%) as compared with

conventional irrigation. In addition, it requires low energy, minimum maintenance and less expense on layouts *etc.*, hence drip irrigation system is becoming more popular in sugarcane cultivation because of its efficiency[7]. In this backdrop, the present study was carried out with the following specific objectives:

1. To analyse the extent of adoption of drip irrigation management practices followed by sugarcane growers
2. To know the sources consulted by the sugarcane growers for obtaining information on drip irrigation management practices
3. To find out the direct, indirect and largest indirect effects of profile characteristics of sugarcane growers on the adoption of drip irrigation management practices
4. To document the constraints faced by the sugarcane growers in the adoption of drip irrigation management practices.

Methodology

The present study was conducted in Malavalli and Nagamangala taluks of Mandya district in Karnataka State during 2024-2025. Five villages were randomly selected for the study from the two sampled taluks. From each village, ten sugarcane growers were randomly selected for the study. The total sample consisted 100 sugarcane growers from five villages of Malavalli and Nagamangala taluks. Data was collected from 100 sugarcane growers using a pre-tested interview schedule. The details about the number of sugarcane growers sampled for the study are as follows:

Table 1: Details of taluks, villages and number of sugarcane farmers sampled for the study

District	Taluk	Village name	Sugarcane growers
Mandya	Malavalli	1. Kandigaala	20
		2. Purigali	20
		3. Thalagaradhi	20
	Maddur	1. Devalapura	20
		2. Raghurampura	20
Total	2	5	100

Adoption of drip irrigation management practices is operationally defined as the extent of recommended drip irrigation management practices followed by the sugarcane growers'. A set of 15 drip irrigation management practices [7] in sugarcane cultivation were presented to sugarcane growers. A score of one and two was assigned to the sugarcane growers who had adopted and non-adopted for each of the drip irrigation management practices, respectively. The minimum and maximum scores one could get was 15 and 30, respectively. Further, the respondents were grouped into low, medium and high adoption level based on mean (15.86) and half standard deviation (1.43) as measure of check.

Table 2: Adoption of specific drip irrigation management practices by sugarcane growers (n= 100)

Sl. No.	Particulars	Sugarcane growers			
		Adoption		Non-adoption	
		No.	%	No.	%
1.	Cleaning of filter once in a week	90	90.00	10	10.00
2.	Application of irrigation water during evening or night	100	100.00	0	0.00
3.	Regular use of pressure gauge	10	10.00	90	90.00
4.	Sand filter used for separation of impurities in water	20	20.00	80	80.00
5.	Guf plug used for closing of unwanted holes on the laterals	95	95.00	05	05.00
6.	Use of HCL acid for declogging of emitters	20	20.00	80	80.00
7.	Use of 15-20 ppm HCL acid for declogging of emitters	20	20.00	80	80.00
8.	Application of zinc phosphate for control of rat to protect laterals	60	60.00	40	40.00
9.	Use of 100 per cent water soluble fertilizer for fertigation	95	95.00	05	05.00
10.	Installation of emitters across the slope	30	30.00	70	70.00
11.	Installation of ventury tank/pump before the filter tank	53	53.00	47	47.00
12.	Chlorination and acid treatment before reuse of drip irrigation system	31	31.00	69	69.00
13.	Application of 1:10 or 1: 15 proportion of fertilizer and water for fertigation	70	70.00	30	30.00
14.	Regularly cleaned the fertilizer tank	80	80.00	20	20.00
15.	Testing the quality of water	10	10.00	90	90.00

Adoption category	Criteria	Score
Low	< (Mean-½SD)	<14.43
Medium	(Mean±½SD)	14.43-17.29
High	>(Mean+½SD)	>17.29

Open ended questions were asked to sugarcane growers for knowing the information source consulted [9] and constraints in the drip irrigation management practices [3].

Information regarding eight profile characteristics (independent variables) of sugarcane growers were collected using a structured schedule with suitable scales. Ex-post facto research design was adopted for conducting the study. The collected data was analyzed using frequency, percentage, mean, standard deviation, and path analysis. Path analysis was employed to find out the direct, indirect and largest indirect effects of independent variables (profile characteristics of sugarcane growers) on dependent variable (adoption of drip irrigation management practices).

Results and Discussion

1. Adoption of specific drip irrigation management practices followed by sugarcane growers

The results in Table 2 reveals that cent per cent of the sugarcane growers had applied irrigation water during evening or night (100.00 %), whereas a majority of sugarcane growers had used gulf plug for closing unwanted holes of the laterals (95.00 %), used 100 per cent water soluble fertilizer for fertigation (95.00 %), cleaned filter once a week (90.00 %), regularly cleaned the fertilizer tank (80.00 %), applied 1:10 or 1:15 proportion of fertilizer and water for fertigation (70.00 %), applied zinc phosphate for control of rat to protect laterals (60.00 %) and installed ventury tank/pump before the filter tank (53.00 %).

Table 2 also reveals that a majority of sugarcane growers had not adopted regular use of pressure gauge (90.00 %), tested the water quality (90.00 %), sand filter used for separation of impurities in water (80.00 %), or used HCL acid for declogging of emitters (80.00 %), used 15-20 ppm HCL acid for declogging of emitters (80.00 %), installed emitters across the slope (70.00 %) and chlorination and acid treatment before reuse of drip irrigation system (69.00 %). It can be concluded from the above results that lack of awareness about drip irrigation management practices among sugarcane growers has contributed to non-adoption of several drip irrigation management practices. Similar results were reported by [10] and [1].

2. Overall adoption of drip irrigation management practices by sugarcane growers

A perusal of Table 3 reveals that more than one-third of sugarcane growers belonged to medium level of adoption, while 33.00 and 32.00 per cent of sugarcane growers were belonging to low and high levels of overall adoption of drip irrigation management practices, respectively. It is inferred from the results that over three-fourth of the sugarcane growers (77.00 %) were belonging to medium to low level of overall adoption of drip irrigation management practices and the results are in line with the [5].

Table 3: Overall adoption of drip irrigation management practices followed by sugarcane growers (n=100)

Sl. No	Adoption category	Sugarcane growers	
		No.	%
1.	Low (less than 14.43 score)	32	32.00
2.	Medium (14.43 to 17.29 score)	35	35.00
3.	High (more than 17.29 score)	33	33.00
Total		100	100.00

Mean=15.86; Standard deviation= 2.86

3. Source consulted by sugarcane growers for obtaining information on drip irrigation management practices

Among the formal sources, a majority of sugarcane growers consulted agricultural scientists (69.00 %), agricultural extension officers (68.00 %) and Krishi Vigyan Kendra (67.00 %) for obtaining technical know-how information on drip irrigation management practices, whereas less number of sugarcane farmers consulted service co-operative society (48.00 %) and village level workers (36.00 %) for gathering information on drip irrigation management practices (Table 4). In respect of informal sources, the results in Table 4 also revealed that less number of sugarcane growers consulted progressive farmers (38.00 %), local leaders (18.00 %), relatives (13.00 %), friends (12.00 %), and neighbours (10.00 %) for obtaining information on drip irrigation management practices. With regard to the mass media use less than one-third of the sugarcane growers had consulted/read/viewed/listened/ visited exhibition (32.00 %), printed literature (22.00 %), agricultural fair (22.00%), internet (21.00 %), television (21.00 %), newspaper (18.00 %) and radio (3.00 %) for obtaining information on drip irrigation management practices. The above research results reveals that the sugarcane growers had consulted a variety of sources for getting information on drip irrigation management practices and results were in concordance with [6].

Table 4: Source consulted by sugarcane growers for obtaining information on drip irrigation management practices (n= 100)

Sl. No.	Name of the sources		Sugarcane growers	
			No.	%
A.	Formal sources			
	1.	Village Level Worker	36	36.00
	2.	Agricultural Extension Officer	68	68.00
	3.	Agricultural Scientist	69	69.00
	4.	Krishi Vigyan Kendra	67	67.00
B.	5.	Service Co-operative Society	48	48.00
	Informal sources			
	6.	Neighbors	10	10.00
	7.	Friends	12	12.00
	8.	Relatives	13	13.00
C.	9.	Progressive farmers	38	38.00
	10.	Local leaders	18	18.00
	Mass Media			
	11.	Radio	03	03.00
	12.	Television	21	21.00
	13.	Newspaper	18	18.00
	14.	Printed literature	22	22.00
	15.	Exhibition	32	32.00
	16.	Agricultural Fair	22	22.00
	17.	Internet	21	21.00

4. Direct, indirect and largest indirect effects of profile characteristics (independent variables) of sugarcane growers on the adoption of drip irrigation management practices

The path co-efficient of profile characteristics (independent variables) of sugarcane growers with respect to their direct effects, total indirect effects and largest indirect effects channelled through other independent variables on adoption of drip irrigation management practices are presented in Table 5. Ranking variables based on their direct effect on the adoption of drip irrigation management practices revealed that extension participation (X8), extension agency contact (X7), management orientation (X4) and attitude towards farming (X2) occupied first four ranks in that order; whereas economic motivation (X5), innovativeness (X3), mass media participation (X6) and education (X1) obtained the last four ranks in the order of importance. As regards to total indirect effects channelled through other variables for each of the independent variables, it was found to be quite substantial. Ranking of these effects revealed that extension participation (X8), management orientation (X4), extension agency contact (X7) and economic motivation (X5) occupied the first four ranks which had the highest total indirect effect on the adoption of drip irrigation management practices in the descending order of magnitude. On the other hand, attitude towards farming (X2), innovativeness (X3), mass media participation (X6) and education (X1) occupied the last four ranks in the order of magnitude.

The first largest indirect effect channelled through is extension participation (X8) in the case of five variables and the remaining three variables channelled through attitude towards farming (X2), mass media participation (X6), and extension agency contact (X7). The second largest indirect effect channelled through extension agency contact (X7) in case of four variables, closely followed by management orientation (X4) and extension participation (X8). However, the third largest indirect effect has been channelled through management orientation (X4) in case of five variables, closely followed by attitude towards farming (X2) and extension agency contact (X7). The total residual effect was found to be 0.398.

Extension participation and extension agency contact had direct, indirect and largest indirect effects on the extent of adoption of drip irrigation management practices. Participation in extension activities such as, group discussions, general meetings, demonstrations, training programmes, farmer field school, field days, krishi melas, etc., would promote the acquisition and consequent adoption of drip irrigation management practices. Regular participation in extension activities has influenced the sugarcane growers to adopt a greater number of drip irrigation management practices. Extension agency contact would help the sugarcane growers to expose them to latest drip management technologies promoted by the extension workers. Frequent contact with the extension workers has also motivated the sugarcane growers to adopt more number of drip irrigation management practices. Therefore, extension participation and extension agency contact were found to be not only having major direct effect on the extent of adoption level, but also through indirect and largest indirect effects influencing the adoption of drip irrigation management practices. Hence, extension participation and extension agency contact are the dominant variables through which other variables can influence the adoption level of drip irrigation management practices and the results are in line with the [8], [12] and [4].

Table 5: Direct, indirect and largest indirect effects of profile characteristics (independent variables) of sugarcane growers on the adoption of drip irrigation management practices (n=100)

Sl. No	Profile characteristics/ variables	Direct effect	Rank	Total indirect effect	Rank	Three largest indirect effect channeled through
X1	Education	0.0212	8	0.0111	8	0.129 X8 0.018 X7 0.015 X4
X2	Attitude towards farming	0.0792	4	0.0418	5	0.078 X8 0.038 X7 0.026 X4
X3	Innovativeness	0.0514	6	0.0319	6	0.239 X8 0.079 X4 0.051 X7
X4	Management orientation	0.0800	3	0.0761	2	0.497 X7 0.052 X8 0.016 X2
X5	Economic motivation	0.0612	5	0.0571	4	0.032 X8 0.015 X7 0.010 X4
X6	Mass media participation	0.0411	7	0.0219	7	0.576 X2 0.014 X8 0.004 X4
X7	Extension agency contact	0.0801	2	0.0689	3	0.183 X8 0.046 X4 0.041 X2
X8	Extension participation	0.0926	1	0.0822	1	0.197 X6 0.023 X7 0.020 X4

Residual effect: 0.398

5. Constraints faced by the sugarcane growers in the adoption of drip irrigation management practices

The constraints faced by majority of sugarcane growers in the adoption of drip irrigation management practices includes; heavy initial investment for installation of drip irrigation system, frequent clogging of drippers and microbes (90.00 %), expensive equipment parts of drip irrigation system (82.00 %), inadequate and uncertainty in power supply (81.00 %), requires time to time attention for minor repairs (75.00 %) and delay in sanctioning of loan/subsidy (62.00 %).

Less than half of the sugarcane growers faced the constraints such as; lack of technical know-how on drip irrigation system (41.00 %), frequent water leakages in the system (35.00 %), difficulty in inter culturing (31.00 %), difficulty in weeding within the rows (30.00 %), improper pressure hinders water pressures (22.00 %), lack of follow-up services of drip irrigation agencies/dealers (21.00 %), non-availability of spare parts at right time (18.00 %), clumsy procedure for getting loan/subsidy (11.00 %) and difficulty to keep optimum water pressure (10.00 %) and the similar results were presented by [11].

Table 6: Constraints faced by sugarcane growers in the adoption of drip irrigation management practices (n=100)

Sl. No.	Constraints*	Sugarcane growers	
		No.	%
1.	Heavy initial investment for installation drip irrigation system	90	90.00
2.	Expensive equipment/spare parts of drip irrigation system	82	82.00
3.	Lack of credit facilities	20	20.00
4.	Regular time to time attention for minor repairs	75	75.00
5.	Frequent clogging of drippers and microbes	90	90.00
6.	Lack of technical know-how on drip irrigation management practices	41	41.00
7.	Improper pressure hinders discharge rate	22	22.00
8.	Frequent water leakages in the system	35	35.00
9.	Difficult to keep optimum water pressure	10	10.00
10.	Difficulty in weeding within the rows	30	30.00
11.	Difficulty in inter culturing	31	31.00
12.	Inadequate and uncertainty in power supply	81	81.00
13.	Non-availability of spare parts at right time	18	18.00
14.	Clumsy procedure for getting loan/subsidy	11	11.00
15.	Delay in sanction of loan/subsidy	62	62.00
16.	Lack of follow-up service by drip irrigation agencies/dealers	21	21.00

*Multiple response

Conclusion

The results revealed that more than three-fourths of sugarcane growers (67.00 %) were belonging to low to medium level of adoption of drip irrigation management practices. Extension participation and extension agency contact of sugarcane growers had direct and indirect effects on the adoption of drip irrigation management practices. Lack of technical know-how on drip irrigation management practices was the major constraint faced by 41 per cent of the sugarcane growers. Therefore, the Farm Universities, ICAR institutions, Department of Agriculture and other concerned agencies may organise more number of extension activities (demonstrations, farmers' field

school, field days, visit to progressive farmers fields, discussion meetings etc.) to create awareness among the sugarcane growers about the improved drip irrigation management practices. The constraints faced by the sugarcane growers in drip irrigation management practices need to be addressed by the Farm Universities, Krishi Vignana Kendras etc., to increase the adoption level of drip irrigation management practices.

Future scope of the study

The current research lays the groundwork for subsequent investigations into the adoption of drip irrigation by sugarcane farmers. Future inquiries might consider:

- The long-term effects of adoption on crop yield, farmer income, and water conservation.
- Experimental initiatives such as educational programs, mobile advisory services, or on-farm training sessions to boost adoption rates.
- Comparative analyses across various crops or regions to pinpoint optimal practices in drip irrigation. Assessment of how effective government subsidies and credit programs are in promoting technology adoption.
- The use of ICT tools and digital platforms to enhance awareness and provide real-time guidance on the maintenance and management of drip irrigation systems.

Conflict of interest

The authors declare that there is no conflict of interest regarding the publication of this research. The study was conducted objectively and independently, with no financial or personal relationships influencing the findings or interpretations.

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