

FACTORS AFFECTING AND CONSTRAINTS FACED BY BANANA GROWERS IN ADOPTION OF DRIP IRRIGATION TECHNOLOGY

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ABSTRACT

This study identifies the factors influencing and constraints faced by farmers in the adoption of drip irrigation technology for banana cultivation, as India is the largest producer of bananas globally. The analysis revealed that younger, educated farmers with larger farm sizes and greater farming experience were more likely to adopt the drip irrigation method. In contrast, larger family size had a negative impact on the adoption decision. The Odds Ratios (OR) for key variables—age (0.99), literacy level (1.40), farming experience (1.07), and farm size (1.20)—highlight the extent to which a one-unit change in these variables influences the likelihood of adopting drip irrigation. Among the benefits, respondents ranked “less water requirement” as the most important reason for adopting the technology, followed by “reduced labour requirement” and “higher and better-quality yield.” On the other hand, the major constraints to adoption included fragmented land holdings, inadequate or inconsistent electricity supply, high initial capital investment, problems caused by rodents or pigs, and clogging of drippers. In light of these findings, it is recommended that drip irrigation companies focus on developing cost-effective systems, while government agencies should continue their intensive efforts to promote the adoption of drip irrigation through awareness campaigns, subsidies, and infrastructure support.

Keywords: adoption, capital, drip, odd ratio, water

INTRODUCTION

Banana “Apple of Paradise” is one of the most important commercial tropical fruits traded in India. Its year-round availability, affordability, varietal range, low price, taste, nutritive and medicinal value makes it the favourite fruit among all class of people (Sondarva *et al.*, 2019). Banana is cultivated in about 120 countries. India is the world’s largest producer of banana, with about 37.61 million tonnes production (27% share) www.fao.org. In the year 2022-23, globally 139 million tonnes of banana are produced. Other leading producers are China mainland, Uganda, Philippines, Ecuador, Brazil, Indonesia, Colombia, Cameroon and Tanzania *etc.* The major producing states in India during the year 2022-23 are Maharashtra (17.37%), Andhra Pradesh (15.50%), Tamil Nadu (12.55%), Uttar Pradesh (11.14%) and Gujarat (10.66%) (Anonymous, 2023b). In Gujarat, major banana producing districts are Narmada, Chhota Udepur, Anand and Bharuch, which together contributes 84.27 per cent of total production and 84.70 per cent of total area,

respectively during the year 2023-24 (Anonymous, 2023a).

During the last decade, production and productivity has considerably increased with appreciable area expansion due to the growing awareness of banana in nutrition, high economic returns, and its export potential (Gulkari and Chauhan, 2019), so there is greater need of promotion of innovative drip cultivation technology among the banana growers. The consequent effects of drip irrigation system are reflected in terms of generating more income in banana by saving of water, labour, fertilizers and plant protection measures, improving yields and quality of produce which ultimately improving the overall economic condition of banana growers (Natwadia *et al.*, 2023).

Therefore, it is very much necessary to explore the various factors influencing the adoption of this technique and also to identify the constraints which faced by the farmers in adoption and non-adoption of this technology. So, an attempt has been made here with the following objectives.

OBJECTIVES

- (1) To identify the factors influencing drip irrigation technology in banana crop
- (2) To study the benefits of adoption and constraint faced by growers in non-adoption of the drip technology in banana crop

METHODOLOGY

This study was confined to middle Gujarat region only. In Gujarat, Ahmedabad, Anand, Dahod, Kheda, Panchmahal, Botad, Mahisagar, Chotta Udepur and Vadodara are covered under middle Gujarat region.

In middle Gujarat, Anand and Chhota Udepur was purposively selected, as they are the major growing as well as producing districts of banana in Gujarat. All the talukas of Anand and Chhota Udepur districts were listed along with their area under banana crop. Looking to the relative share of each taluka to the total banana area in the district, 2 talukas from each district was selected. In order to select villages, two villages randomly from each taluka were selected. Thus, in total eight villages were selected for the study. Further, 15 drip and 15 conventional banana growers from each selected village were selected randomly. Thus total 240 banana growers comprising of 120 drip and 120 conventional irrigated farmers formed an ultimate sample for this study.

The primary data regarding socio-economic characteristics, and constraints faced by growers *etc.* were collected by using pre-tested interview schedule. For this study, data was collected for the year 2022-23, compiled, systematically analysed and presented in tabular form. Logit model was used to study farmer's adoption of drip by using SPSS.

Logistic Regression Model

A logistic regression model was used empirically to quantify the relative influence of various factors in the decision of the respondents to adopt drip method or traditional method of banana cultivation. It was assumed that the probability of a farmer adopting drip method (L_i) depends on the attributes like Age of the respondent (years), education level (years), Family size (No.), Experience (years) and Farm size (ha). The index variable Z_i indicates whether a farmer is adopting drip method or not has been expressed as a linear

function of the independent variables.

Thus, the logit regression model was specified as following Equation:

$$L_i = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + U_i$$

Where,

X_1 = Age of the respondent (years),

X_2 = Education level (years)

X_3 = Family size (No.)

X_4 = Experience (years)

X_5 = Farm size (ha)

β_0 = Constant and

U_i = Error-term

The index variable Z_i is a dichotomous variable, *i.e.* it takes the value of one if a respondent is adopting drip technology ($Z_i=1$) and takes the value zero otherwise ($Z_i=0$); Z_i has been shown to be logarithm of odds ratio.

Garrett Ranking Technique

The Garrett ranking technique was used to study the opinions of the farmers regarding the adoption of drip and the reasons for non-adoption of the drip technology by other farmers. The percent position of each rank was worked out by using following Equation:

$$\text{Per cent position} = \frac{100 (R_{ij}-0.5)}{N_j}$$

Where,

R_{ij} = Rank given for the i^{th} items by the j^{th} individual, and

N_j = Number of items ranked by the j^{th} individual.

The per cent position of each rank was converted into scores by referring to the table given by Garrett and Woodworth (1971).

RESULTS AND DISCUSSION

The results of factors affected adoption of drip irrigation technology by the sampled farmers are discussed herewith.

Table 1: Logistic regression results for adoption of drip method of banana cultivation

(n=240)

Sr. No.	Particulars	B	Std. Error	Significance	Expectations β
1	Age (years)	-0.01**	0.01	0.05	0.99
2	Education (years)	0.32***	0.06	0.00	1.38
3	Family size (No.)	-0.18*	0.10	0.07	0.84
4	Experience (years)	0.07**	0.03	0.01	1.07
5	Farm size (ha)	0.19***	0.07	0.01	1.21
6	Constant	-2.95*	1.37	0.03	0.05
-2Log Likelihood		271.03			
Percentage Correct		72.90			
Chi square (χ^2)		61.68**			
Count R ²		0.73			
No. of observations		240			

Source: Field Survey

***significant at 1 per cent **significant at 5 per cent * significant at 10 per cent

Logistic regression model

The level of Count R² obtains is 0.73, which indicate good predictive ability of model. The χ^2 value is 61.68 and significant at 5 per cent. Age has negative and significant (5 per cent level) impact on the decision of adopting new technology and education of the respondents having positive and highly significant (at 1 per cent level) impact on the adoption of new technology. It reveals that younger and educated farmers were more likely to adopt drip method of cultivation. Experience (positive and significant) and farm size have (positive and highly significant) impact on the adoption of drip method, which further indicated that farmers with large size of farm and more experience are more likely to adopt drip method. Family size has negative impact on the

decision of adoption of this method.

The OR (odd ratio) of variable age was 0.99 representing the influence of age on the adoption decision by 0.99 times for unit increase in age. The variable literacy level has 1.38 OR it means rate of adoption increases by 1.4 times as education level increases by one year. Similarly, in case of experience, the rate of adoption increases by 1.07 times, as a unit increase in experience. Regarding farm size OR was 1.21, representing as a unit increase in this variable, rate of adoption increases by 1.21 times.

Benefits for adoption of drip technology

The reasons for adoption of drip technology by farmers were ranked by using Garrett's ranking technique.

Table 2: Benefits due to adoption of drip technology

(n=240)

Sr. No.	Particulars	Per cent position	Score	Rank
1	Less water requirement	10.05	75	I
2	Less labor requirement	19.34	67	II
3	High and good quality yield	30.46	60	III
4	Less weed problem	47.87	51	IV
5	Less problem for inter-cultivation	65.72	42	V
6	Less occurrence of pest & diseases	76.02	36	VI
7	High input use efficiency	85.66	29	VII
8	Early maturity	98.01	11	VIII

Source: Field Survey

Among the eight identified benefits, the foremost reason was "less water requirement," which received the highest score (75) and was ranked first, indicating its critical importance in water-scarce regions. This was followed by "less labour requirement" (score: 67), highlighting the system's ability to reduce labour dependency. "High and good quality yield" ranked third (score: 60), reflecting improved productivity under drip irrigation. Other notable benefits

included "less weed problem" (rank IV), "less problem for inter-cultivation" (rank V), and "less occurrence of pest and diseases" (rank VI), showing the system's contribution to better crop management. Additionally, "high input use efficiency" and "early maturity" were ranked seventh and eighth, respectively, indicating they were considered less influential but still valuable. These findings are consistent with those reported by Fazely *et al.* (2024); Mohanty *et*

al. (2024); Sharma *et al.* (2024), for cucumber cultivation under drip irrigation in greenhouses, supporting the broader applicability of these advantages.

Constraints in adoption of drip technology

The data presented in Table 3 highlights the key constraints faced by farmers in adopting drip irrigation technology. The most critical issue identified was fragmented land holdings, which received the highest score (77) and ranked first, indicating that land fragmentation poses a significant barrier to the installation and efficient operation of drip systems. This was followed by inadequate or interrupted electricity supply, ranked second with a score of 65, underscoring the importance of a reliable power source for operating drip systems. The third major constraint was the

lack of an owned source of irrigation (score: 59), which limits farmers' ability to control water availability. High initial capital investment ranked fourth (score: 47), reflecting the financial burden associated with the setup of drip systems. The fifth constraint, with a score of 41, was the problem of damage caused by rodents and pigs, which can lead to frequent maintenance and system inefficiency. The cost of soluble fertilizers used in drip systems was also seen as a challenge, ranking sixth with a score of 28. Lastly, other issues such as the use of low-quality pipes and clogging of drippers were ranked seventh (score: 16). These findings are consistent with those reported by Kumar *et al.* (2024) and Natwadia *et al.* (2022), indicating that both infrastructural and economic factors (Vinaya and Shivamurthy, 2021) significantly hinder the widespread adoption of drip irrigation technology among banana farmers.

Table 3: Constraints for adoption of drip technology

(n=240)

Sr. No.	Particulars	Per cent position	Score	Rank
1	Fragmented land holding	8.33	77	I
2	Inadequate or interrupted electricity supply	21.96	65	II
3	Not owned source of irrigation	32.24	59	III
4	High initial capital investment	55.87	47	IV
5	Problem of rodents/pigs	67.32	41	V
6	Costlier soluble fertilizers	86.89	28	VI
7	Others (low quality pipes/clogging etc.)	96.07	16	VII

Source: Field Survey

CONCLUSION

This study identifies the factors influencing and constraints faced by farmers in adopting drip irrigation technology in banana cultivation, with India being the largest global producer. In this study, it is concluded that younger farmers with small family size were more likely to adopt drip method of cultivation. Experience (positive and significant) and farm size have (positive and highly significant) impact on the adoption of drip method, which further indicated that farmers with large size of farm and more experience are more likely to adopt drip method.

The key benefits driving adoption in this study were less water and labor requirements followed by improved yield quality. Major constraints identified in the study area were fragmented land holdings, unreliable electricity, high initial costs, and issues like rodent damage and dripper clogging. So, with these findings, to promote wider adoption, the government and extension agencies must intensify awareness efforts, ensure reliable electricity, and encourage financial institutions to offer better credit support. Additionally, companies should focus on reducing installation costs

through affordable technology development.

CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

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