The Pharma Innovation Journal 2023; 12(3): 1122-1124

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2023; 12(3): 1122-1124

www.thepharmajournal.com
Received: 27-01-2023
Accepted: 28-02-2023

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Factors influencing the adoption of drip cum plastic mulch and drip irrigation systems in red chilli cultivation in Bhadradri Kothagudem district of Telangana state

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Abstract
Irrigation plays an important role in raising and stabilizing the yield and maintaining quality of a crop like red chilli. The present study is an attempt to analyze the factors influencing the farmer's adoption of different methods of utilizing the irrigation potential which helps to conserve water, increase water use efficiency and to reduce water use per hectare in line with the government's motto of "More crop per drop". Primary data from 180 sample farmers (@ 30 each from drip cum plastic mulch, drip and conventional systems) in six villages of Bhadradri Kothagudem district were collected. The Binary logit model was used to analyze the factors affecting farmers adoption of red chilli related improved technology consisting of drip irrigation and plastic mulches. Water conservation by using drip irrigation method is the practice of using water efficiently to reduce unnecessary water usage. Mulching is another important practice to conserve water. Micro-irrigation and fertigation are major methods to replace the conventional method of irrigation systems to achieve higher yields in red chilli cultivation. The use of drip cum plastic mulch irrigation system in red chilli cultivation has been a recent development in major chilli growing districts of Telangana such as Khammam, Bhadradri Kothagudem and Warangal etc. The education level, farm size, family size etc., have positively influencing the probability for adopting drip irrigation system and drip cum plastic mulch irrigation system in red chilli cultivation.

Keywords: Water conservation, mulching, logit model

1. Introduction
India is the world's largest producer, consumer and exporter of chilies. India is the world leader in chilli production followed by China. Telangana ranked fourth in chilli area and second in chilli production and productivity i.e., 3.85 lakh acres, 7.19 lakh tonnes and 1865 Kg per acre respectively (2nd advance estimates) during 2021-22. Chilli area and production in Telangana account for 22% and 38% of all India area and production respectively. The major chilli growing districts are Khammam, Mahabubabad, Gadwal, Suryapet and Warangal (Rural). According to the 1st advance estimates, Telanganachilli production is at 3.70 lakh tonnes for 2022-23 as against 7.16 lakh tonnes in 2021-22.
Population, household size, growth and affluence effect how much water is consumed. Climate change has increased pressure on natural water resources especially in manufacturing and agricultural irrigation. Water is a very important part in irrigation. Plants always take a lot of ground water thus ground water should be replenished. For crop irrigation, optimal water use efficiency means minimizing losses due to evaporation or surface drainage while maximizing the production. The key methods of water conservation are Drip and drip cum mulch irrigation systems.
In this context this study explores different factors influencing the increasing the returns of red chilli in Bhadradri Kothagudem district in drip cum plastic mulch, drip irrigation and conventional irrigation systems with the following specific objective,

1. To examine the factors influencing the adoption of drip cum plastic mulch and drip irrigation systems in red chilli cultivation along with cost economies of different methods of irrigation.

2. Materials and Methods
Bhadradri Kothagudem district is one of the major red chilli growing district in Telangana state and most of the farmers are practicing drip cum plastic mulch and drip irrigation technologies in cultivation of red chilli.

Multistage stratified random sampling procedure was adopted for the study. The selection of district, mandals, villages and respondents was done as explained below. At the district level, purposive sampling technique was adopted based on the highest number of farmers in the three strata adopted for the purpose of the study. The three strata were drip cum plastic mulch, drip irrigation and conventional irrigation systems.
Similarly at the mandal and village level purposive sampling technique was adopted based on the area covered under above three strata of irrigation considered. Subsequently, after selection of the villages, the farmers practicing three methods of irrigation under drip cum plastic mulch, drip irrigation and conventional irrigation systems were identified. Among them simple random sampling technique was adopted to select the farmer respondents. Primary data from 180 sample farmers (@ 30 each from drip cum plastic mulch, drip and conventional systems) in six villages of Bhadradri Kothagudem district were collected. Survey method was employed to collect the data from red chilli growers.
The primary data pertaining to the production aspects of red chilli such as fixed and variable costs of inputs, management practices, farming experience and resource endowment etc. were collected directly from the farmer respondents with the help of specially designed schedules by personal interview and presented at current prices to estimate costs and returns.

2.1 Tabular analysis
The data collected were subjected to conventional tabular analysis to work out the cost of cultivation per hectare, cost of production per quintal, gross and net returns under different methods of irrigation.

2.2 Binary Logit regression model
The Binary logit model is to analyze factors affecting farmers adoption of red chilli related improved technology consisting of drip irrigation and plastic mulches. The logit model predicts the logit of the response variable (adoption of drip cum plastic mulch irrigation system) from the independent variables. Logit form of regression model is used to analyze adoption of red chilli related technologies as the following equation,

$$\text{Logit } (Y) = ß_0 + \varepsilon ß_1 X_1 + \varepsilon ß_2 X_2 + \ldots\ldots\ldots + \varepsilon ß_6 X_6 + i$$

Where,
Y = dependent variable (adoption of drip cum plastic mulching) with 1 for adopters and 0 for non-adopters.
$ß_0$ = intercept
$ß_1$ to $ß_k$ = coefficients of independent variables
X_1 to X_6 = independent variables (Age of household head, education of household head, experience in farming, size of land holding, number of family members, access to credit and member of any organization)
i = error term

3. Result and Discussions
3.1 Cost Economics of different methods of Irrigation
The total cost of cultivation (Cost C) was estimated at Rs. 4,02,894, Rs. 3,66,463 and Rs. 3,03,160 per ha. Under drip cum plastic mulch, drip and conventional irrigation systems respectively. In Drip cum Plastic Mulch Red chilli the variable cost and fixed cost were Rs. 2,31,830.30 and Rs. 1,71,063.70 per hectare. In case of Drip irrigated red chilli variable cost and fixed cost were 2,23,415.97 and 1,43,047.49. In case of Conventional irrigated red chilli variable cost and fixed cost were 2,21,891.69 and 81,268.33.

Table 3.1: Cost economics of Red Chilli cultivation under different methods of irrigation systems

SL. No.	Particulars	Drip cum plastic mulch irrigation system	Drip irrigation system	Conventional irrigation system
1	Variable cost (Rs. /ha)	2,31,830.30	2,23,415.97	2,21,891.69
2	Fixed cost (Rs. /ha)	1,71,063.70	1,43,047.49	81,268.33
3	Total Cost of cultivation (Cost C) (Rs. /ha)	4,02,894.00	3,66,463.46	3,03,160.02
4	Yield (q per ha)	65.91	49.50	39.62
5	Avg. Farm harvest Price (Rs. per q)	12,316.67	11,010.09	11,005.80
6	Value of gross output (Rs. /Quintal)	8,11,791.72	5,44,999.50	4,36,049.80
7	Net returns (Rs. /Quintal)	3,68,608.32	1,41,889.70	1,32,889.78
8	Cost C3	4,43,183.40	4,03,109.80	3,33,476.02

Source: Estimated from primary data

As a whole, adoption of drip cum plastic mulch and drip irrigation system was found to be expensive (Rs. 4, 43,183.40 and Rs. 4, 03,109.80). Total cost of cultivation for drip cum plastic mulch was nearly 24.75 percent higher than the conventional red chilli, primarily an account of depreciation on drip and purchase of plastic mulch. The yield was 65.91 q/ha. Under drip cum plastic mulch irrigation technology, while that under the drip and conventional irrigation methods were only 49.50 q/ha and 39.62 q/ha. Respectively. The value of gross output was Rs. 8, 11,791.72 /ha. under drip cum plastic mulch irrigation technology, while under the drip and conventional irrigation methods it was only Rs. 5,44,999.50 /ha and Rs. 4,36,049.80 /ha. Respectively. Thus, per hectare net profit was also higher in drip cum plastic mulch method as compared to drip and conventional methods of red chilli cultivation. This was due to reduced use of important resources (human and bullock labour, seeds etc.), higher yield and high price obtained due to the high quality of produce under drip cum plastic mulch red chilli cultivation.

3.2 Factors influencing the adoption of drip irrigation system
One of the key objectives of the study was to understand the factors affecting probability of farmers for being an adoption of drip irrigation system. For this a Binary logit model was estimated by using dependent variable as binary (1 for adopters of drip and drip cum mulch and 0 for non-adopters / conventional farmers) with a set of dependent variables. Accordingly Logit model for pooled sample farmers were estimated and presented in the Table 4.2.

Table 3.2: Estimated logit model on factors affecting the probability of adoption of drip system in red chilli cultivation

S. No.	Particulars	Estimated co-efficients	Standard error	Probability level at significant
1.	Intercept	-0.925	3.15	0.769
2.	Age	0.042	0.068	0.533
3.	Education	0.591	0.239	0.013*
4.	Farm size	0.657	0.214	0.002**
5.	Family composition	-0.631	0.250	0.011*
6.	Member of any organization	0.610	0.510	0.231
7.	Access to credit	-0.493	0.372	0.185
8.	Experience in farming	0.011	0.052	0.827

(Note: Estimated based on the primary data on 180 sample farmers (n=180))
*Significant at 10% level of significance
** Significant at 5% level of significance
*** Significant at 1% level of significance

As expected the education level has positively influenced the probability for adopting drip irrigation system in red chilli cultivation. This implied that if the farmer's education level was high, there is a more probability to adopt the drip irrigation system which was considers being relatively more knowledge intensive.

Similarly results also indicated that the large farmers were expected to adopt the drip irrigation system more than the small and marginal farmers as shown from the significant and positive relationship between farm size and adoption of the drip irrigation system.

The family size also positively influencing the adoption rate of drip irrigation system. This means farmer with more number of family members was likely to adopt drip irrigation system more than other farmers with less number of family members in expectation of higher returns for feeding his family members.

And other factor accessing to credit was also positively influencing to adopt drip irrigation system although it was not significant.

4. Conclusion

Total cost of cultivation, yield, gross returns and net returns for drip cum plastic mulch was nearly 24.75 percent, 39.88 percent, 46.28 percent and 72.17 percent higher than the conventional red chilli. The education level, farm size and family size have positively influenced the probability for adopting drip irrigation system in red chilli cultivation as revealed from estimates of Binary logit model. Therefore, Dripcum Plastic mulch irrigation method was cost effective and profitable method than conventional irrigation method in red chilli.

5. Policy Implications

a) Subsidy may be extended to mulch in addition to drip system as followed in Gujarat and Rajasthan gives more technical and economic benefits to farmers.
b) Proper awareness has to be created about the importance of drip cum mulch irrigation system in terms of water conservation, fertigation, preventing evaporation losses, weed control and labour saving.
c) Post installation services of drip system have to be strengthening by TSMIP (Telangana State Micro Irrigation Project) to overcome the technical problems during the crop period.
d) The benefits of cultivating red chilli under drip irrigation method need to be propagated through quality extension net work on a continuous basis. Door darshan, All India Radio and the News Media should be used to propagate the concept of drip cum plastic mulch on a regular basis.

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