Madras Agric. J., 99 (10-12): 891-895, December 2012
https://doi.org/10.29321/MAJ.10.100221

Drip Irrigation - An Approach to Improve Water Use Efficiency

T. Rathakrishnan* and S.R. Padma
Directorate of Students Welfare,
Tamil Nadu Agricultural University, Coimbatore - 641 003

Micro-irrigation is introduced primarily to save water and increase the water use efficiency in agriculture. Reduction in water consumption due to drip method of irrigation over the surface method of irrigation varies from 30 to 70 percent for different crops and productivity gain due to use of micro-irrigation is estimated to be in the range of 20 to 90 percent for different crops. The study was undertaken in Madurai district to study the intensity of adoption of drip irrigation, factors favouring adoption and the constraints faced by the respondents to adopt the technology. The major factors favouring adoption were water scarcity, high weed menace by conventional method of irrigation, less cost of cultivation, reduced labour requirement as reported by majority of respondents. The constraints experienced by majority of respondents were high initial cost of investment, delay in getting loan, and salt encrustation on drippers.

Key words: Drip irrigation, intensity of adoption, factors favouring adoption, constraints

In spite of the largest irrigated area in the world, India too has started facing severe water scarcity in different regions. Owing to various reasons the demand for water for different purposes has been continuously increasing in India, but the potential water available for future use has been declining at a faster rate (CWC, 2005). The agricultural sector (irrigation), which currently consumes over 80 percent of the available water in India, continues to be the major water-consuming sector due to the intensification of agriculture (Iyer, 2003). Though India has the largest irrigated area in the world, the coverage of irrigation is only about 40 per cent of the gross cropped area as on today. One of the main reasons for the low coverage of irrigation is the predominant use of flood method of irrigation, where water use efficiency is very low due to various reasons. Available estimates indicate that water use efficiency under flood method of irrigation is only about 35 to 40 per cent because of huge conveyance and distribution losses (Rosegrant and Mark, 1997; INCID, 1994).

Recognizing the fast decline of irrigation water potential and increasing demand for water from different sectors, a number of demand management strategies and programmes have been introduced to save water and increase the existing water use efficiency in Indian agriculture.

One such method introduced relatively recently in Indian agriculture is micro-irrigation, which includes both drip and sprinkler method of irrigation. Micro-irrigation (MI) is proved to be an efficient method in saving water and increasing water use efficiency as compared to the conventional surface method of irrigation, where water use efficiency is only about 35-40 percent. Under micro-irrigation, unlike Flood Method of Irrigation (FMI), water is supplied at a required interval and quantity using pipe network, emitters and nozzles. Therefore, the conveyance and distribution losses are reduced completely which result in higher water use efficiency under Micro Irrigation. (Narayanamoorthy, 1997)

Drip irrigation is the slow drop by drop localized application of water at a grid just above the soil surface. There are also subsurface drip systems; in which drip irrigation laterals are buried 20 to 60 centimeters below the soil surface. The efficiency under drip irrigation has been estimated to be as high as 80 to 90 percent. Drip system also permits the use of fertilizers and other soluble nutrients along with irrigation water and is considered to be the most efficient and economical method of fertilizer application.

A slow watering process intended to deliver water and nutrient to the root area of the plant in quantities matching its evaporation requirements as closely as possible and at a rate close to what the soil will absorb is drip irrigation defined by Tobey (1981).

Micro irrigation has varied utilities like controlled and directed water supply to root zones, fertigation and reduced labour cost, reduced evaporation rate etc, despite it has not been adopted very widely by the farmers due to various factors. It is therefore necessary to know the extent to which this management technology has reached and adopted by the farmers and bring out the challenges faced by the farmers.

This study aimed to bring out all the said issues in the adoption of drip irrigation technology in Madurai District and focuses on the intensity of

*Corresponding author email: extensionratha@gmail.com.

adoption of drip irrigation technology by the farmers, various factors favouring adoption, constraints faced by the farmers, and the suggestions were made to increase the adoption.

Materials and Methods

Madurai district was selected for the study by purposive sampling based on more area covered under micro irrigation (359.84 ha) and more number of crops irrigated under drip in Southern Part of Tamil Nadu. Out of 6 taluks in Madurai district (Thirumangalam, Usilampatti, Vadipatti, Melur, Madurai South, and Madurai North), Vadipatti and Madurai South taluk were deliberately selected by considering the maximum area under drip, maximum number of adopters and maximum number of crops cultivated under drip in these two taluks. The two blocks viz., Allanganallur and Vadipatti in Vadipatti taluk and in Madurai south taluk the only block viz., Thirupparamkuntram were taken for the study. The village wise list of drip users in Vadipatti and Alanganallur blocks was obtained from Department of Agricultural Engineering, Madurai. Eight villages in Vadipatti taluk and 7 villages South taluk were selected. The villages were selected by purposive sampling based on more number of adopters in these villages. The respondents from the villages were selected randomly. Both adopters and non-adopters were the respondents of the present study. Thirty adopters and thirty non adopters in each taluk were selected. Thus the total number of respondents selected from two taluks were 120.

The study conducted to measure the intensity of adoption and the factors favouring the same have been analysed and the results are discussed and presented.

Results and Discussion

Intensity of adoption

Intensity of adoption in the present study referred to the extent to which the drip irrigation technology was utilized by the respondents. The overall intensity of adoption by the respondents was analyzed and furnished in Table 1.

The intensity of adoption was high with 36.66 percent followed by 33.33 percent under low and 30.01 percent under medium levels. This might be due to the fact that installation of drip system requires high initial cost and also this technology is not suitable to all types of crops. Further this technology also possesses some technological constraints such as salt encrustation, clogging of emitters etc and that could be stated as reasons by one third of the sample.

Relationship between the characteristics of the respondents with intensity of adoption

This part deals with association and contribution of selected independent variables with dependent variable. Correlation and Multiple Regression were used to study the relationship and the contribution of independent variables respectively.

Table 1. Distribution of respondents according to their intensity of adoption (n=60)

Sl. No.	Category	Respondents	
		No	%
1.	Low	20	33.33
2.	Medium	18	30.01
3.	High	22	36.66

Association of characteristics with intensity of adoption

Correlation analysis was performed to find out the association of characteristics towards intensity of adoption. It could be seen from the Table 2 that out of 13 variables studied, the variables viz., Educational Status, (X_2) Farming Experience (X_3), Irrigation intensity (X_4), Farm power status (X_5), Training participation (X_6), Risk orientation (X_7), Credit Orientation (X_8), Economic motivation (X_9), Innovativeness (X_{10}), Scientific Orientation (X_{11}),

Table 2. Correlation analysis of characteristics with adoption (n=60)

Sl. No.	Variable	'r' value Intensity of adoption
X_1	Age	0.233*
X_2	Educational status	0.367**
X_3	Farming experience	0.268**
X_4	Irrigation intensity	0.455**
X_5	Farm power status	0.298**
X_6	Training participation	0.366**
X_7	Risk orientation	0.282**
X_8	Credit orientation	0.314**
X_9	Economic motivation	0.540**
X_{10}	Innovativeness	0.416**
X_{11}	Scientific orientation	0.672**
X_{12}	Attitude towards drip irrigation	0.491**
X_{13}	Perception on attributes of drip irrigation	0.555**

**Significant at one percent level of significance

*Significant at five percent level of significance

Attitude (X_{12}), Perception on attributes of drip irrigation (X_{13}), exhibited positive and significant association with intensity of adoption at one per cent level of significance, Age (X_1) exhibited a positive and significant association with adoption at five per cent level of significance. Intensity of adoption was the function of Respondents' educational status; farming experience, farm power status, irrigation intensity, training participation, risk orientation, credit orientation, economic motivation, innovativeness, scientific orientation, attitude and perception on attributes of drip irrigation.

Contribution of characteristics of respondents towards adoption intensity

Multiple regression analysis was performed to find out the extent of contribution of profile characters

towards adoption intensity of drip irrigation technology. The results are presented in Table 3.

Table 3. Multiple regression of independent variables with intensity of adoption

Variable No.	Variable	Regression Co-efficient	Standard error	't' value
X_1	Age	1.065	3.004	0.355^{NS}
X_2	Educational status	1.205	2.651	0.455^{NS}
X_3	Farming experience	0.047	0.317	0.149^{NS}
X_4	Irrigation intensity	0.242	0.114	2.122*
X_5	Farm power status	0.403	0.658	0.613^{NS}
X_6	Training participation	8.380	3.349	2.502**
X_7	Risk orientation	0.157	0.373	0.420^{NS}
X_8	Credit orientation	5.963	2.151	2.772**
X_9	Economic motivation	0.659	0.365	1.804^{NS}
X_{10}	Innovativeness	4.496	2.158	2.083*
X_{11}	Scientific orientation	1.164	0.312	3.725**
X_{12}	Attitude towards drip irrigation	0.314	0.149	2.106*
X_{13}	Perception on attributes of drip irrigation	0.568	0.257	2.210*

R^2 =0.679 'F' value = 17.229 **

**Significant at one percent level of significance
*Significant at five percent level of significance
NS – Non significant

'F' value was found to be highly significant at one percent level of significance. The R^2 value indicated that the thirteen variables put together accounted for 67.90 percent of variation in the dependent variable of intensity of adoption.

Above table also indicates that variables namely training participations, (X_6) credit orientation (X_8), Scientific orientation (X_{11}) were found to have positive significant influence on adoption at one percent level of significance and Irrigation intensity (X_4), innovativeness (X_{10}), attitude (X_{12}), perception on attributes of drip irrigation (X_{13}) were found to have positive significant influence on adoption at five percent level of significance. The remaining variables showed non-significant contribution towards adoption.

The strength of variables can be explained as an unit increase, in irrigation intensity (X4) training participation (X_6), credit orientation (X_8), innovativeness (X_{10}), scientific orientation (X_{11}), attitude (X_{12}), perception on attributes of drip irrigation (X_{13}) would bring increase of 0.242, 8.380, 5.963, 4.496, 1.164, 0.314 and 0.568 units in adoption intensity of the respondents respectively.

Factors favouring adoption of drip irrigation technology

There are various factors which favour the adoption of drip irrigation technology by the farmers

a. Situational factors

Among the situational factors water scarcity, (93.34 percent), high weed infestation (83.34 percent) and heavy conveyance loss (75.00 percent) were expressed as major factors served as favourable for adoption of drips. The other factors viz., low water holding capacity of the soil, saline water, power fluctuation, more disease incidence, undulating landscape, heavy conveyance loss were not expressed by majority of the sample despite served as favourable causes for adoption.

b. Economic factors

Less labour requirement influenced majority (88.33 per cent) of drip users. More than three- fourth of the drip users (80.00 per cent) said that through drip irrigation cost of cultivation of the crops get reduced which facilitated them to adopt drip irrigation technology. More than half of drip users (56.67 per cent) expressed that yield was increased to a considerable extent in drip irrigation.

Table 4. Distribution of respondents according to their acceptance towards various factors favouring adoption (n=60)

Sl.No	Factors	No	%
A.	**Situational Factors**		
1.	Low water holding capacity of the soil	5	8.33
2.	Water scarcity	56	93.34
3.	Saline water	4	6.67
4.	High weed menace	50	83.34
5.	More disease incidence	5	8.33
6.	Undulating landscape	6	10.00
7.	Power fluctuation	18	30.00
8.	Heavy conveyance loss	45	75.00
B.	**Economic factors**		
9.	Yield increase	34	56.67
10.	Increased profit	29	48.33
11.	Less cost of cultivation	48	80.00
12.	Less labour requirement	53	88.33
13.	Time saving	12	20.00
14.	Savings in fertilizer	12	20.00
15.	Availability of subsidy	30	50.00
16.	Availability of loan	15	25.00
17.	Increase in area under irrigation	20	33.33
C.	**External factors**		
18.	Officials of agricultural department	4	6.66
19.	Officials of agricultural engineering department	16	26.66
20.	Drip manufacturers	2	3.33
21.	Company representatives	22	36.67
D.	**Social factors**		
22.	To become an innovator		
23.	To be role model	3	5.00
24.	Influenced by successful drip users	28	46.67
25.	Pressure from peers	18	30.00
26.	Prestige	2	3.33

"Availability of subsidy" was influenced nearly 50.00 percent of drip users to adopt drip irrigation. Half of drip users (48.33 percent) expressed that drip irrigation increased their profit and hence they adopted this technology.

Availability of bank loan(25 per cent), time saving (20.00 percent), saving in fertilizer (20.00 percent) were the other factors which influenced them to adopt drip irrigation.

c. External factors

Representatives of drip companies (36.67 percent), Officials of agricultural engineering department (26.66 percent) were the important influential factors for adoption of drip irrigation.

d. Social factors

About 46.67 Percent of adopters were motivated by successful drip users to adopt this technology. More than one-fourth of the drip users expressed that they were influenced by their peer group members to adopt drip irrigation technology. A very meagre proportion expressed that their willingness to be an innovator and a role model (5.00 percent), and for the sake of prestige (3.33 percent) were the factors that influenced them to adopt drip irrigation technology.

On the whole, Water scarcity, less labour requirement, and high weed menace were considered by the drip users as the most influential factors for adopting drip irrigation.

Constraints faced by the respondents

Economic constraints

High investment cost was reported as major constraint by 78.33 per cent and 100.00 per cent of adopters and non adopters followed by delay in getting subsidy by 50 .00per cent and 73.00 percent of adopters and non adopters respectively.

About 46.20 and 68.00 per cent of adopters and non-adopters respectively found it difficult to meet different officials for getting loan. Difficulty in getting loan was expressed by 41.22 per cent and 76.84 per cent of adopters and non adopters. About 43.66 per cent of adopters and 61.31 per cent of non adopters respectively indicated that the cost of the drip system was raised by the company while realizing or issuing the subsidy.

Table 5. Distribution of respondents according to the constraints in adopting drip technology

Sl. No	Constraints	Adopters n = 60		Non adopters n = 60	
A.	**Economic constraints**	No	%	No	%
1.	High investment cost	47	78.33	60	100.00
2.	Delay in getting subsidy	30	50.00	43	73.00
3.	Meet different officials for getting loan	29	46.20	40	68.00
4.	Hike in the price of the drip system while availing subsidy.	32	53.36	22	36.60
5.	Difficulty in getting subsidy	26	43.66	37	61.31
6.	Difficulty in getting loan	25	41.22	46	76.84
B.	**Technological constraints**				
7.	Clogging of emitters	46	76.00	37	61.53
8.	Salt encrustation	52	83.78	46	76.00
9.	Poor quality of the material	17	26.74	13	21.60
10.	Damage due to rats and rodents	27	44.44	16	26.61
11.	Difficulty in taking up intercultural operations	26	43.11	35	58.36
12.	Damage of laterals, microtubes due to falling of nuts and leaves	19	33.21	12	20.18
13.	Frequent cleaning of filters	49	82.35	34	57.67
14.	Poor service by dealers	31	51.56	44	73.30
C.	**General constraints**				
15.	Hard to operate the system by illiterate people	18	28.15	36	66.87
16.	Irregular supply of electricity in these areas	12	20.80	11	18.21
17.	Not suitable to all type of crops	44	74.31	48	80.10

Technological constraints

Clogging of emitters as a constraint was reported by 76.00 and 61.53 per cent of adopters and non adopters. Salt encrustation as a constraint was expressed by 83.78 per cent and 76.00 percent of adopters and non adopters respectively. This was due to the salty nature of irrigation water and the adopters proclaimed that they used to overcome this problem by acid treatment.

Poor quality of the drip material was listed as a constraint by 26.74 percent and 21.60 percent of adopters and non adopters respectively. Majority of the drip users used to get high quality drip system from very familiar drip irrigation companies.

Damage by rodents was one of the constraints of 44.44 percent and 26.61 percent of adopters and non adopters. The adopters overcome this problem by keeping their field clean without much weed infestation. For coconut growers damage of laterals due to falling of nuts was reported by minimum percent of respondents. Frequent cleaning of filters as a constraint was experienced by 82.34 percent and 57.67 per cent of adopters and non-adopters respectively. Poor service of dealers was felt as a constraint by 51.56 per cent of adopters and 73.70 percent of non adopters.

General constraints

“Hard to operate the system by illiterate people” was reported by 28.15 per cent of adopters and 66.87 per cent of non adopters.

"Not suitable for all crops" as a constraint was reported by 74.31 percent and 80.10 percent of adopters and non adopters respectively. It is interpreted from the above finding that majority of the non adopters reported high initial cost as major constraint.

Conclusion

Drip irrigation systems normally place the water directly into the soil, or onto the soil surface, reducing the risk of runoff and thereby improving water application efficiency. The choice of the most suitable type of drip system depends mainly on the soil type Drip irrigation systems, however, are not suitable for all crops and soil types.

Water quality is an equally important consideration when determining whether a drip irrigation system is feasible. Surface water can contain organic debris, algae, moss, bacteria, small creatures, weed seeds, and soil particles that can clog the emitters. Clogging is the most serious technical problem in drip irrigation systems. However, properly designed and maintained filtration systems generally protect the system from most clogging. In general, adequate filtration, line flushing, and chemical treatment prevent most clogging. In addition, not all conventional fertilisers, herbicides, fungicides, and pesticides are compatible with drip irrigation. Farmers need to consider alternative means preferably, integrated pest management practices.

For drip irrigation to improve water use efficiency on farms, it is crucial to provide regular system maintenance. This will include checking visually the system and the emitter discharge, removing and cleaning the filters and valves, checking the pressure system and the water flow rates. So, the drip users considering all the said guidelines in mind while adopting the drip system so that they can utilise this widely and efficiently without facing any hurdles.

References

CWC 2005, Water and Related Statistics, Ministry of Water Resources, Central Water Commission (CWC), Government of India, New Delhi.

INCID. 1994, Drip Irrigation in India. Indian National Committee on Irrigation and Drainage, New Delhi.

Narayanamoorthy, A. 1997. "Drip Irrigation: A Viable Option for Future Irrigation Development, Productivity, Vol.38, No.3, October-December, pp. 504-511.

Iyer, R. 2003, Water: Perspectives, Issues and Concerns. Sage Publications,New Delhi.

Rosegrant, W. Mark. 1997. Water Resources in the Twenty-First Century: Challenges and Implications for Action, Food and Agriculture, and the Environment Discussion Paper 20, International Food Policy Research Institute, Washington D.C., U.S.A., March.

Tobey Sam, 1981, Drip irrigation: What, Why and How? *Irrigation Journal*, **34**: 26-35.

Received: September 4, 2012; Accepted: December 26, 2012