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Research Paper

Why 100% Adoption Rate is Unachievable even with 100% Subsidy? A study on adoption of Micro Irrigation Systems (MIS) among small and marginal farmers in Southern India

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ABSTRACT

Micro Irrigation systems have been at the forefront in policy making because of its significant impact on saving water resource, enhanced agricultural productivity and enriched nutritional quality. Considering the importance of MIS, this study has been undertaken in Coimbatore district of Tamil Nadu, India to determine why MIS have not been adopted to the expected level among small and marginal farmers when the state government provides 100% subsidy and to find out the reasons for discontinuation of the technology. Employing Logit model, it is found that the adoption of the technology is significantly influenced by farming experience and years of education of the farmers, income from non-farm and off-farm activities and area under wider spaced crops. Factors like negative perception towards the technology and non-availability of technical support leads to dis-adoption of the technology. Modifying the specifications on subsidy will result in increased adoption and also decreased dis-adoption of the technology.

HIGHLIGHTS

- An 100% subsidy is given to small and marginal farmers of Tamil Nadu for using drip and sprinkler adoption rate among farmers is low.
- Modification in component specifications may improve adoption rate by farmers.

Keywords: Micro irrigation, adoption, dis-adoption, logit model

Water is a critical input in agriculture as it has determinant effect on yield of the crop. On an average, agriculture accounts for 70 percent of all water withdrawals globally (Bank, 2019). The per capita availability of water in India is 1545 cubic meters as of 2011 census which declined from 5177 cubic meters in 1951 which is about 70 percent decline in 60 years (Dubbudu, 2016). The rising demand is likely to push our country to water scarce category if drastic measures of conservation and its efficient use is not promoted and adopted.

With the advent of Green revolution area under

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irrigation increased tremendously as it helped farmers to use improved production techniques like high yielding varieties, fertilizers, etc., effectively. Of the net irrigated area 47.79 percent is irrigated by groundwater which leads to groundwater depletion. Surface methods like flood and furrow irrigation causes high wastage of water leading to crisis. The Micro Irrigation (MI) technologies such as drip and sprinkler are the key interventions in water saving and improving crop productivity.

The benefits of using MIS are increased water use efficiency, reduced tillage requirements, increased crop yield and quality, increased fertilizer use efficiency (Sivanappan, 1994; R. Namara *et al.* 2004; Narayanamoorthy 2006). The irrigation efficiency of drip irrigation method (DIM) is 90 percent while in surface method of irrigation it is only 35 to 40 percent (Irrigation and Drainage, 1994).

Using DIM had significant effect on farming systems such as resource saving, reduced cost of cultivation, increased crop yield and farm profitability (D Suresh Kumar and Palanisami, 2010). Non conducive to flow irrigation, need for wells and tube wells, need for pressurizing devices, poor quality of groundwater, pre determined cropping pattern and small farm holding size limits the adoption of Micro Irrigation Systems in various states of India (Kumar, 2016).

A study by Palanisami and Raman (2012) revealed that majority of the adopters of MIS in Tamil Nadu was large farmers. Large farmers adopted drip widely as it is capital intensive and adoption of MIS has increased cropped area and irrigated area (D Suresh Kumar and Palanisami, 2010). Access to credit and subsidy had increased adoption of MIS among small and marginal farmers across the country (Kumar, 2016). Kulecho and Weatherhead (2005) found that many farmers, particularly small farmers discontinue the use of drip irrigation due to lack of maintenance, unreliable water supply and irrelevant cultural background.

Pradhan Mantri Krishi Sinchayee Yojna (PMKSY) was launched in 2015, integrating micro irrigation in the flagship scheme as an integral component. The Government of Tamil Nadu gives 100% subsidy to small and marginal farmers for installing MIS. Area under Micro Irrigation in Tamil Nadu is 0.5 mha which is 10.4% of total area under MI in India, in which 82% (0.41 mha) of area is under drip irrigation and 18% (0.09 mha) of area is covered by sprinkler (GOI, 2019).

Thus, finding out why MIS is not being adopted widely by small and marginal farmers even with 100% subsidy is an important research issue. To solve the issue aroused, a study was conducted to examine the factors influencing the adoption of MIS by small and marginal farmers and analyze the determinants of farmer's decision to discontinue MIS. More distinctively the paper aims to (i) analyze the factors influencing small and marginal farmers' decision to adopt and not to adopt MIS and their relative importance (ii) determine the factors that cause the farmers to discontinue the technology.

Methodology

The study was conducted in Coimbatore district of Tamil Nadu between December 2019 and February 2020. Coimbatore district was purposively selected for the study as it has the highest proportion (155.65%) of area covered under micro irrigation to the total potential area in the year 2018-2019. The major crops cultivated in the district are coconut, banana, sorghum, maize, groundnut, vegetables and pulses.

The study was undertaken in two blocks of Coimbatore district – Annur and Thondamuthur. The blocks of Annur and Thondamuthur have 68.67 percent and 49.40 percent of net irrigated area under MIS respectively. The data for this study was obtained from primary survey of 120 farmers by multi stage random sampling procedure.

Logistic regression

To identify the factors influencing the adoption of a new technology logistic regression model (Logit) can be used (Aldrich and Nelson 1984; Feder, Just, and Zilberman 1985). MIS adoption is a discrete dichotomous choice variable represented by a value of 1 if a farmer uses MIS and 0 otherwise.

$$L_i = L_n\left[\frac{pi}{1-pi}\right] = zi = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \ldots \beta_n x_n$$

Table 1: General description and farming characteristics of sample farmers

Particulars	Adopters	Non-adopters	Dis-adopters	All farmers
Age (years)	51.88	50.05	55.14	51.72
Farming experience (years)	26.47	27.78	31	27.39
Education (years)	10.87	5.47	10.93	10.18
Average land holding (Hectares)	1.45	1.25	1.46	1.45
Cropping intensity (Percentage)	144.20	125.85	148.08	146.21
Gross irrigated area (Hectare)	1.79	1.20	1.51	1.60
Average area irrigated with tube well (Hectare)	1.64	0.93	1.27	1.38
Irrigation intensity (Percentage)	140.95	139.54	145.19	145.62
Major crops grown	Banana, areca nut, coconut, vegetables	Vegetables, fodder crops, banana, cotton and oil seeds	Banana, areca nut, coconut	Banana, areca nut, coconut, fodder crops, cotton, vegetables

Source: *Farm household survey during December 2019-February 2020.*

Where L_i is log of the odds ratio, which is not only linear in X, but also linear in the parameters. *pi* is the probability of adopting given technologies, then $1 - p_i$ represents the probability of not adopting.

RESULTS AND DISCUSSION

General description and farming characteristics of respondents

Analysis of the data showed the average age of the farmers was 52. Young farmers tend to adopt the technology quicker than others. Highly educated farmers were progressive in decision making to adopt a new technology. Cropping intensity and irrigation intensity were higher for adopters compared with non-adopters as water saved from using MIS helped in increasing cropped area and irrigated area.

Adoption of MIS

It was found that variables such as education, farming experience, income from off-farm and non-farm income and depth of the well owned by farmers, area under closely spaced crops are significant determinants of MIS adoption.

MISADOPT = –17.588 + 1.156 EDU + 0.161 EXP + 1.549 INOF – 0.161 SUBCON + 0.016 DEPW – 1.179 ACLOSE + 0.397 AWIDE

Table 2: Factors influencing adoption of Micro Irrigation Systems (MIS)

Variable	Regression coefficients	Z value	S.E
Constant	-17.588***	9.533	5.691
EDU	1.156***	7.426	0.424
EXP	0.161*	3.275	0.089
INOF	1.549**	4.189	0.757
SUBCON	-0.790	2.354	0.005
DEPW	0.016***	8.516	1.471
ACLOSE	-1.179**	5.424	0.515
AWIDE	0.397	0.049	1.053

Note: **** , ** and * indicate values are significantly different at 1%, 5% and 10% levels.*

Highly educated farmers were progressive in adopting a new technology. The higher the farming experience, higher will be the insight of farmers on significant effects of the technology which aids in taking decisions regarding adoption of new technology.

The regression result indicated that farmers with off-farm and non-farm income have positive and significant effect on adoption of MIS due to the effects of higher income on financial liquidity which is needed for risk-taking nature of the farmers.

Depth of tube wells has significant impact on likelihood of adopting the technology. This reveals that as the wells get deeper, the farmers are forced to spend more

money for pumping. Farmers owning deeper wells were motivated to use the technology more.

In the present study, the area under wider crops like coconut and areca nut has a positive influence as it is highly beneficial to wider spaced crops. But area under closely spaced crops like vegetables, fodder and cotton has negative effect on adoption which explains that pre-determined cropping pattern of non-adopters restricts them to use MIS and shift to other high valued crops

Why 100% Subsidy did not help?

In Coimbatore district, about 78% of small and marginal farmers using MIS have availed subsidy in which 84% of them have paid additional amount even for 100% subsidy. The state government have specifications on the components, their spacing and quality for MIS that is given under subsidy. The registered companies can provide components only according to these guidelines which are not feasible for the farmers. The farmers are thus pushed to pay an extra fare to get MIS in accordance with their needs. For an example a marginal farmer cultivating 0.88 ha of vegetables gets ₹ 95,545 as subsidy with the spacing of 1.2m*0.6m while the actual spacing he needed was 0.9m*0.6m for which he has to pay ₹ 52,308 in addition to subsidy. This makes the fellow farmers who lack the adequate capital to develop a negative attitude towards the scheme and decides not to adopt the technology. As the subsidy is directly given to the firms, they intend to make profit by convincing farmers to adopt the technology but fail to give further services for maintenance.

The table 3 clearly brings out the effectiveness of subsidy to small and marginal farmers. Only 3.75% of farmers have installed MIS without paying additional amount while the remaining 96.25% of farmers incurred additional cost to install MIS according to their needs.

Dis-adoption of Micro Irrigation Systems

An important issue that remains unresolved among policy makers and development personnel is why small and marginal farmers discontinue using Micro Irrigation systems even though they are provided with 100% subsidy. Based on Rasouliazar and Fe'li (2011), a forward step-wise logistic regression was used to identify the factors responsible for farmers' decision to discontinue the technology (Table 4).

DISADOPT = –31.644 + 0.041 EXP + 2.241 INOF + 5.558 NEGPERCEP + 4.996 WATER – 1.243 SUBAVAIL – 1.025 TECHSUPPORT

The variables like experience, quality of water available, technical support received and subsidy availed were not significant factors for dis-adoption of MIS. More experienced farmers may have low uncertainty about new technology, but they are unwilling or unable to invest a new technology in their entire farm (Moser and Barrett, 2003). Farmers with higher experience are less likely to dis-adopt the technology.

Negative perception of farmers towards MIS was measured by constructing an index based on the reported disadvantages of using the technology. Farmers with stronger negative perception towards MIS are

Table 3: PMKSY scheme details of Coimbatore district for 2018-2019

Sl. No.	Farmers' category	Total number of beneficiaries	Farmers who paid additional amount to subsidy	Farmers who availed only subsidy	Additional amount paid by the farmers (in Rs)
1	Medium and Large farmers	473	468	5	1,64,04,013
2	Small and marginal farmers	586	564	22	1,74,55,985
3	SC/ST farmers	7	6	1	1,48,492
	TOTAL	**1066**	**1038**	**28**	**3,40,08,490**

Source: *Deputy Directorate of Horticulture, Coimbatore.*

Table 4: Factors influencing dis-adoption of technology

Variable	Regression coefficients	Z value	S.E
Constant	-31.644*	0.687	16.362
EXP	0.041	0.177	0.097
INCOME	2.241*	2.859	1.326
NEGPERCEP	5.558**	3.891	2.818
WATER	4.996	2.305	1.783
SUBAVAIL	-1.243	1.783	3.291
TECHSUPPORT	-1.025	0.113	3.053

Note : **** , ** and * indicates values are significantly different 1%, 5% and 10% levels.*

more likely to dis-adopt the technology. The negative externalities cited by farmers were reduced yield of crops, induced laziness in farmers as manual work is greatly reduced and the frequent need to change laterals damaged by animals and clogging due to salt water.

Access to subsidy is measured in terms of whether the farmer have availed subsidy for installing MIS in their field. It is a dummy variable, which takes a value of 1 if farmer has availed subsidy and 0 if not. There is negative influence of subsidy on discontinuation of technology. Farmers who have availed subsidy are less likely to dis-adopt the technology than those who have not availed subsidy. Among adopters those who have not availed subsidy during MIS installation on their farms have availed subsidy for replacement of components after few years. The dis-adopters reported that components were not provided based on their needs within the subsidy amount and had to pay additional amount to get components according to their needs.

A dichotomous variable that takes a value of 1, if water quality is poor with high salinity or hardness (Calcium and Magnesium content is more than 150 mg/L) and 0, if water used is of good quality is taken. It is found that quality of water used in irrigation has a positive influence on dis-adoption as poor quality of water results in failure of the system.

Farmers who install drip or sprinkler irrigation system in their field for the first time require training in working with the components. Technical assistance from private drip companies can help farmers to use the technology for a longer period. Hence it has a negative influence on dis-adoption as it helps farmers to continue the usage of MIS.

CONCLUSION

A number of studies focused on determining the factors influencing adoption and non-adoption of drip and sprinkler irrigation systems while the study also focused on the causes of dis-adoption. The study substantiates that education of the farmer, contact with extension personnel and income from non-farm and off-farm activities, depth of well owned, area under wider spaced crops have positive and significant influence on farmers' decision to adopt the technology, while experience of the farmers had no considerable effect on adoption and dis-adoption. The reason for poor response from more experienced farmers could be attributed to the strict adherence to old practices Additional income from off-farm and non-farm activities motivates the farmers to bear the risk of adopting new technology.

Negative perception towards Micro Irrigation technologies had significant impact on farmers' decision to discontinue the technology. Creating awareness on advantages of using MIS through meetings, exhibitions and contact with extension personnel would create positive attitude towards the technology among farmers. More number of training and demonstration trials on different types of MIS and their utilization on field should be explained so that large number of farmers adopt and continue using the technology

The subsidy provided to farmers had negative effect on dis-adoption indicating that subsidy helps farmers in

continued use of technology. But 100% subsidy had not encouraged new adopters to the expected level as the specifications of components provided under subsidy were not feasible to farmers. They were forced to pay additional amount to get the components of system they needed which most of the small and marginal farmers were unable to do so. Thus modifying the specifications on subsidy will result in increased adoption and also decreased dis-adoption of the technology.

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