

Problems and Factors Influencing the Adoption of Micro Irrigation System in Crop Cultivation in Manmunai South Eruvil Pattu DS Division, Batticaloa

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Abstract- This study was done to determine the factors influence the adoption of MIS and the problems faced by the farmers in practicing MIS for vegetable cultivation at three major vegetable cultivating GN divisions such as Cheddipalayam, Kaluthavalai and Kaluwanchikudy in Batticaloa district. A field survey was done with randomly selected 50 MIS and 75 non-MIS adopting farmers using structured questionnaire, direct observations as well as personal interview. Results indicated that all the selected MIS adopters are much educated with advanced level (54%) and 48% of them get higher income (>30000Rs) than non-MIS adopters. As far as the MIS adopters are concerned, 100% of farmers use sprinkler system only. It is also revealed that extent of crop cultivated under MIS is very less than the areas irrigated with non-MIS. Less labour cost (14%), support by NGOs (20%), high yield (12%), less water demand (8%) and wide extension services are the (8%) reasons behind the shift from non-MIS to MIS. However, lack of capital, knowledge and poor water quality are the major factors influencing on the adoption MIS in the study area. Therefore, the study suggests that regular extension services, training programs and supply of subsidies for establishing MIS will motivate the farmers for the adoption of MIS in the study area.

Keywords: Micro irrigation system, sprinkler irrigation, water use efficiency

I. INTRODUCTION

Despite a large amount of public investment on irrigation infrastructure, Sri Lanka suffers from acute water shortages resulting mainly from a poor management of water resources. Most of the dry zone districts in Sri Lanka face either seasonal or year round severe water scarcities (Amarasinghe, Mutuwatta, and Sakthivadivel., 1999, p 21-23). Therefore, it is a challenge to improve the agricultural water use efficiency to increase or maintain crop yield. One of the methods available

to improve the efficiency of water usage is the adoption of micro irrigation technologies to reduce losses at distribution and farm water management level. In India, it was found that the efficiency of the farm irrigation system was about 90 percent under a properly designed and managed drip irrigation system, 70 percent under sprinkler irrigation and only about 45 percent in the case of surface irrigation methods (Sivanappan, 1994, p.49-58). It is reported that the large scale adoption of water intensive cropping pattern acts as one of the major determinants in achieving higher agricultural growth rate in the North Gujarat and increasing the cropping intensity (Shah, 2009, p1-13; Viswanathan and Pathak, 2014, p. 380-432).

Batticaloa district is one of the important districts in Eastern province which contribute a lot to the agriculture sector of the nation. For an example paddy contributes nearly 4.9% to gross domestic production (District Secretariat, 2013). Since this district experienced prolong dry season (April to October) there is a huge problem of water scarcity for cultivation. Therefore, efficient use of water is essential to overcome the water scarcity problem to a certain extent. One of the technological interventions in agriculture to increase the water use efficiency is the adoption of micro-irrigation technologies. However, most of the farmers are still practicing the traditional surface irrigation and only few are adopting MIS. Therefore, this survey is intended to identify the factors influencing on the adoption of MIS and the constraints related with the adoption of MIS in selected GN divisions of Manmunai South Eruvilpattu D.S Division.

II. MATERIALS AND METHODS

A. Location and description of study area

Batticaloa district occupies the central part of Eastern province, Sri Lanka. It covers the land area of 2610 km² and the internal waterway of 244

km² (District Secretariat, 2016). The district accounts for 4.35% of the country total land area where the total population is 588 202. Batticaloa district is located in the dry zone of Sri Lanka experiences prolong dry season during the months of April to October.

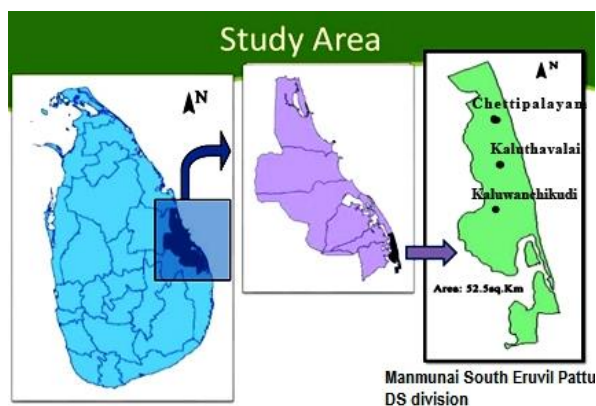


Figure 1: Location of the study area

B. Sampling and data collection

A field survey was done with randomly selected 50 MIS and 75 NON MIS adopting farmers from 3 major agricultural villages namely Cheddipalayam, Kaluthavalai and Kaluwanchikudy in Manmunai South Eruvil Pattu DS division during September 2017 to December 2017.

Primary data were collected from the farmers using pretested structured questionnaire, direct observation and personal interviews. Questionnaires were designed to collect data on factors influencing and the problems associated with the adoption of MIS in the study area. Further, socio economic condition of the farmers, cultivation information, existing irrigation methods and suggestions were also collected in the survey. Information on extent and limitations of cultivation were also collected by personal interview with Agriculture instructors who are working in the region. Secondary data were collected from Department of Agriculture and District Secretariat Office Batticaloa. Census and statistical report and published literatures were also used to get additional required information.

C. Data Analysis

The completed questionnaires were checked and entered in the MS Excel 2007 to get descriptive statistics. Data were analyzed using SPSS software (version 19.0) for Windows.

III. RESULTS AND DISCUSSION

The survey conducted among the randomly selected 75 NON MIS adopters and 50 MIS adopters revealed that all MIS adopters are also practicing surface irrigation methods along with MIS. Lack of MIS units supply to cover the total land and higher cost of MIS unit are the predominant reasons for practicing surface irrigation methods along with MIS in the study area.

i. Socioeconomic characteristic of the vegetable farmers in study area

Table 1: Socio economics status of the farmers

Category	NON MIS adopting farmers (%)	MIS adopting farmers (%)
Age (in years)		
21 - 40	14.7	36.0
41 - 60	54.7	46.0
61 - 80	30.7	18.0
Sex		
Male	93.3	100.0
Female	6.7	0
household size		
0-3	9.3	14.0
4-7	88.0	84.0
8-11	2.7	2.0
Occupation		
Government	13.3	18.0
Private	5.3	6.0
Own business	5.3	12.0
Farmer	72.0	60.0
Other (daywage)	4.1	4.0
Education level		
Higher	4.0	12.0
Advanced	29.0	54.0
Secondary	54.7	34.0
Primary	12.3	0
Monthly income		
<Rs.10000	13.3	6.0
Rs.10000-20000	22.7	4.0
Rs.20000-30000	44.0	42.0
Rs.30000-40000	13.3	36.0
Rs.40000-50000	6.7	12.0

The analyzed data showed that most of the vegetable farmers were within the age category of 41- 60 years, include 54.7% of NON MIS adopters and 46% of MIS adopters. Also noted that, no any female famers were practicing MIS and for some

extent (6.7%) female farmers were engaged in agriculture with surface irrigation. In Nepal, the micro irrigation concept among poor women vegetable farmers is already established where, the main inducing factor for the new micro irrigation investment decision is not so much based on water scarcity but on generating significant household income (Shah and Keller, 2002, p. 165-183). Among the studied farmers, majority of the households were with the family size of 4-7. However, only one or two members are involved in farming activities in most families. Most of the farmers are doing Agriculture as full time occupation and 60% of the fulltime farmers are practicing MIS. In order to reduce the labour cost, increase the production and water use efficiency they installed MIS at their farm with the support of NGOs and Government.

Compared to NON MIS adopters, most of the MIS adopters were with higher educational background with advanced level (54%), considerable percentage of farmers completed higher studies (Table 1). However, most NON MIS farmers were with secondary education level (54.7%) while 29 percent of young NON MIS farmers also completed the advanced level. The educational background is playing major role in acceptance and implementation of new technologies for the production (Nagendran, Sugirtharan and Amuthenie, 2018, p 20-22)

As far as the monthly income level is concerned, it was higher among MIS adopting farmers than NON MIS adopters in the study area. The larger area under the MIS reduces the cost for labour, energy and increased yield that leads to higher income. The reduction of fertilizer requirement may also increase the income level through MIS which restrict nutrient leaching from the root zone. These results are in line with the results of Aheeyar, Manthirithilake and Pathmarajah., (2016, p 4-11) who reported that adoption of MIS has increased the net sown area and cropping intensity, resulting in significant economic returns and welfare gains at the Kalpitiya area and Polonnaruwa district.

ii. Type of water source for irrigation

Around 86% of the MIS adopters and 75% of the NON MIS adopters in the study area were using ground water from open wells and tube wells for irrigation. Tube wells are used by 57.1% of MIS adopters and 39.3% by NON MIS adopters. Most

of the (76%) MIS adopters responded with sufficient water for irrigation while 62.7% of the NON MIS adopters reported about insufficient water for irrigation. Udagedara and Sugirtharan (2018, p.1-11) also reported that, water use efficiency is greater in MIS and wastage is high in surface irrigation methods in Polonnaruwa district, Sri Lanka. Therefore, it is possible to overcome the water scarcity problem to certain extent by adopting the MIS at the study area.

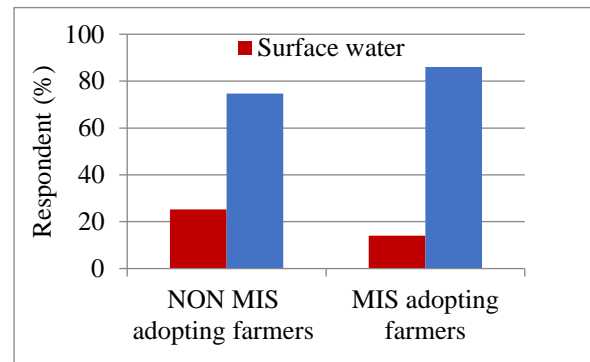


Figure 2: Type of water source used for irrigation

Study further revealed that, very few MIS adopters (14%) were using surface water from small ponds and tanks for irrigation purpose.

iii. Farmer's awareness on micro irrigation system

Most of the NON MIS adopters (53.3%) were not known about the MIS and 46.7% were known about the MIS. Of which, 80%, 5% and 15% of the NON MIS adopters are somewhat known, well known and very well known about MIS respectively. Lack of extension services, traditional attitudes and lack of enthusiasm were the main reasons for the lack of awareness. However, many young farmers are interested to update the modern irrigation technologies like sprinkler and drip irrigation systems at their farms.

iv. Sources of awareness on MIS

The study further revealed that, around 20% of the total people got to know about MIS through other people. Mostly, the MIS adopters were found in the young aged group. Hence, they were more enthusiastic and prefer to update with modern technologies. The leading farmers who were already practicing MIS in their field disseminate the information to others and promote the MIS system. About 18% of the respondents were aware about the MIS through private companies, 14% and 16% through internet and via agricultural officers respectively. In addition, about 12%, 8%,

6% and 6% of farmers gained information about MIS through television, school, radio, and newspapers respectively. The private companies also created awareness on the impacts of MIS, types of crop which can be cultivated under MIS and provide training opportunities in some places of the study area.

v. *Factors influencing on the adoption of MIS in the study area*

There are several factors influenced the farmers towards the adoption of MIS (Table 2). Based on the study, 65.3% of NON MIS adopting farmers stated more than one reason such as lack of capital, do not like to change the traditional method and water quality related problems for non adopting the MIS at their agricultural land. Apart from this, perception of farmers about MIS in a wrong way made them not to adopt MIS.

Table 2: Reason for non adoption of MIS

Factors	Percentage (%)
Lack of knowledge	4.0
Lack of capital	5.3
Water quality problems	8.0
Do not like to change from traditional method	12.0
Other	5.3
More than above one factors	65.3

As the study sites are located in the coastal region there is a possibility for the salt water intrusion when extracting the water from ground because most of the MIS users were dependent on the ground water for irrigation. Initial investment for establishing the MIS to field is also another constraint among the farmers. About 12% of the farmers don't like to change from traditional method of irrigation because they believed that they can't recover from any damages by adopting any new method of irrigation due to their poor economic status, which led to the non-adoption of MIS.

It is also observed that, among the farmers who adopted MIS, 100% of farmers were irrigating the crops only through sprinkler system. There were no any farmers found with the drip irrigation system. Lack of awareness on drip irrigation and the management problems with the clogging might also be the reason for not adopting drip in that area.

vi. *Organizational support to establish MIS*

About 58.7% of the total respondents mentioned that, they preferred to adopt MIS, if any organization supports to establish MIS at their farms.

Table 3: Organizational support to establish MIS

(Question: Will you adopt MIS, if any organization supports to establish MIS in you farm?)	Percent (%)
Yes	58.7
No	41.3
If no why?	
Lack of knowledge	54.8
Need to maintain continuously	16.1
Traditional thinking	19.4
Non reliability on Modern irrigation	9.7

Meanwhile 41.3% of farmers were not ready to change the irrigation type even they got support from any organization. Lack of knowledge (54.8%), requirement of continuous maintenance (16.1%), traditional way of thinking (19.4 %) and non reliability on modern irrigation were the reasons behind this (Table 3).

vii. *Vegetable cultivation under MIS in Study area*

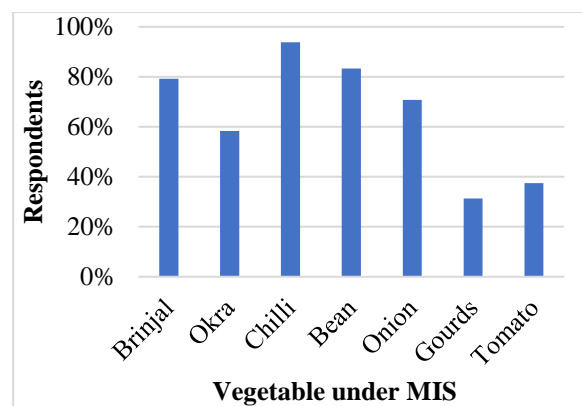


Figure 3: Vegetable cultivation under the micro irrigation system

Figure 3 depicted that, approximately 94% of MIS adopting farmers cultivated chilli under the MIS. Brinjal (79.2%), beans (83.3%), onion (70.8%), okra (58.3%), tomato (37.5%) and gourds (31.3%) were the other crops found with MIS. The majority of MIS farmers had not changed their traditional crops with the availability of MIS technology. Tomato crop is the less preferred crop in the study area under MIS as less market price and the management difficulties of that crop. The

total area of chilli cultivation was about 65 acres from which only about 27.65 acres were with MIS. About 17.5 acres of brinjal cultivated land was adopted with MIS in the study area. The MIS also installed to cultivate onion (16.5acres), bean (13.75 acres), okra (11.25acres), gourds (4.5 acres).

viii. *Irrigation methods used before adopting MIS in the study area*

Table 4: Previous irrigation methods

Method of irrigation	Percent (%)
Surface irrigation using Hosepipe	44.0
Surface irrigation using Bucket	8.0
Ridge and furrow	30.0
Basin type	6.0
Border irrigation	12.0

Table 4 shows that around 44% of the total respondents had used hose pipe as one of the irrigation tools before adopting MIS which was followed by ridge and furrow (30%), border irrigation (12%), using bucket (8%), and basin type (6%). High labour cost and insufficient water for irrigation and land preparation are the major factors influenced the farmers on the adoption of MIS from the above mentioned surface irrigation methods (Table 4) in the study area.

ix. *Farmer’s view on advantages and disadvantages of adopting MIS*

Table 5: Advantages and Disadvantages of adopting MIS

	Percent (%)
Advantages of MIS	
High water use efficiency	16.0
Low labour cost	22.0
High profit	12.0
Easy to maintain	8.0
Ease of Fertilizer application	10.0
Uniform application, suitable for sandy soil	6.0
More than above one factor	26.0
Disadvantages of MIS	
High initial cost	26.0
Need technical skills	6.0
Difficult to repair	8.0
Traditional thinking not allowed	4.0
Poor service from company	6.0
Difficult in cultivation practices	10.0
More than above one factor	40.0

Most (40%) farmers came out with more than one disadvantage (Table 5). Higher initial cost of establishment was the major problem reported by farmers in relevant to MIS system. Some farmers (10%) stated that, having sprinklers inside the field is difficult to do some cultivation practices like weeding, hoeing etc. Most of the farmers change the main crop and substitute with other crops once after the harvest. Therefore, ploughing and other land preparation for next cropping becomes difficult when the sprinklers are installed at the field.

It was also observed that, main lines of the sprinklers are installed within the soil in some fields. In such conditions farmers mentioned that, it is very difficult for them to find the location of the problem/leakages happened in the water delivery system.

x. *General opinion of MIS adopting farmers*

General opinion of the MIS adopting farmers in the study area is given in Table 6 with its valid percentages.

- 1- Definitely true
- 2- True most of time
- 3- Neutral
- 4- Somewhat false
- 5- definitely false

Table 6: General opinion of MIS adopting farmers

Information	Percent (%)				
	1	2	3	4	5
S ₁ .Yield increased	54	46	0	0	0
S ₂ .Crop quality increased	50	34	16	0	0
S ₃ .Less water needed	56	20	18	6	0
S ₄ .Less electricity consumption	64	20	16	0	0
S ₅ .Fertigation possible so low cost for fertilizer application	50	26	24	0	0
S ₆ .Fertilizer wastage less	36	22	18	16	8
S ₇ Irrigation easy	84	16	0	0	0
S ₈ . Time saving	70	20	10	0	0

S₁: Most of the respondents (54%) have got increased yield due to the timely application of required amount of water and fertilizer. Therefore, crops gained water in all growth stages

which led to less wilting and shows optimum growth performance.

S₂: About half of the studied farmers mentioned as definitely true about the increased crop quality with high water use efficiency than surface methods.

S₃: Nearly 56% of farmers mentioned that it is definitely true because it is apparent that the MIS avoid unnecessary loss of water compared with surface irrigation methods.

S₄: Most of the farmers (64%) were reported definitely true on less electricity for pumping than surface method of irrigation

S₅: Around 76% were mentioned about the easiness of fertilizer application to the crop because they are applying fertilizer with the irrigation water through sprinkler irrigation system. During the field visit, it is also noticed that most of the farmers used fertigation techniques to apply fertilizer for their field this leads to lower the cost for fertilizer application

S₆: 58% of the farmers stated that fertilizer wastage is less in MIS. Actually, many farmers were not satisfied on the amount of fertilizer applied through MIS because, they used to apply fertilizer directly to the root zone in the surface irrigation methods. Education and awareness training for farmers on this issue will rectify this problem.

S₇: About 84% of farmers were definitely true on the statement of easy irrigation. It is obvious that time and human power is saved by water application through MIS.

S₈: About 70% of the farmers were mentioned that definitely true on time saving. Most of the farmers saved valuable time by adopting MIS and utilizing that time for other farming practices. This may also help them to reduce the cost of production.

xi. Yield variation according to irrigation system

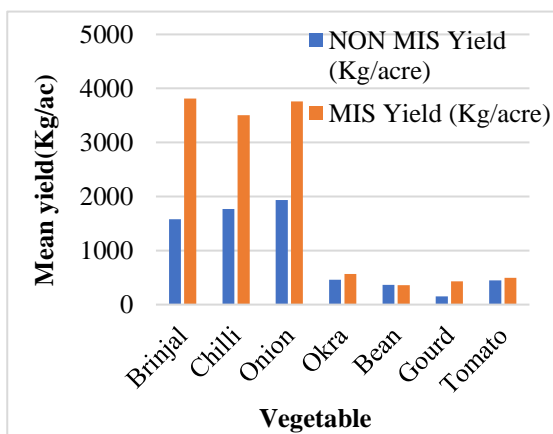


Figure 4: Yield variation according to irrigation system

According to the Figure 4, mean yields of most of the vegetables under MIS are higher than NON MIS. Increase in yield subjects to MIS adoption varies with types of crop. Rabbinge (2000, p22-206) also reported that the use of MIS increased the crop yield by 20-90%. Higher yield was also reported by the MIS adopted vegetable farmers at Polonaruwa district, Sri Lanka (Udagedara and Sugirtharan, 2018, p 1-11). Several factors such as fertilizer, pest attack, water stress, soil type, etc. may also contribute for this variation in the yield. This result gives an idea of which crop is suitable under MIS in the study area. Especially in MIS system, most of the time, root zone remains wet due to the slow rate of water application; adequate water supply to crops leads to reduced water stress thus increased the yield. Therefore, when proper measures are taken to improve the farmers' adoption on MIS more yield and income would be generated.

IV. CONCLUSION

Adoption of MIS in the study area is low due to lack of capital, high initial cost for the system and lack of spare parts availability in market. Further, education, age, gender, economic status, lack of knowledge, occupation and water resources are the determining factors for the adoption of micro irrigation system. Though, MIS is practiced in study area, the extent to which is shifted to MIS is very much less. But the yield gained is greater from MIS adopted farms than NON MIS farms. Motivation through raising awareness about advantages and effectiveness of MIS, valuable instruction and training on MIS, regular extension services and technical support can increase the extent of MIS in the study area. And this adoption of MIS will help to save water and increase cultivable area to produce more food and contribute to supply the food requirement of the Batticaloa district.

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TRACK - CROP SCIENCE AND TECHNOLOGY
