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Study on the Adoption of Micro Irrigation System over the currently practiced conventional methods of Irrigation systems in Vavuniya District, Sri Lanka

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Abstract

An adequate water supply is vital for plant growth where various metabolic activities are carried out in order to satisfy the demand of foods for the growing population. However, rainfall pattern in Sri Lanka recognized as bimodal and nowadays it has been varied due to the climate's changes. Therefore, rainfall is insufficient to fulfill the plant's need and there must be additional water from proper irrigation systems for the successful continuation. For that, farmers have adopted various methods of irrigation system in order to irrigate their plants however; those have both advantages and disadvantages, as well. Hence, there are needs to choose the right method which fit a lot to the local circumstances. Micro-irrigation also called as localized, low-volume, low-flow, or trickle irrigation, is an irrigation method with lower water. Therefore, this current study was formulated to understand the current status of the Micro Irrigation System and the factors influencing on the adoption of new technology in Pampamadu area of the Vavuniya District, Sri Lanka. At the study location 150 fruits and vegetable farmers from 14 GN Divisions were randomly selected and the collected data were interpreted through the SPSS for its valid responses.

According to the results obtained through the study, only 15% of the respondents have adopted MIS for their fruits and vegetable cultivation. Nearly 60% and 80.5% of the respondents were within the age range of 36-55 years in Non-MIS and MIS adaptation in fruits and vegetable cultivation. However, 60.9% (MIS) and 48.8% (Non-MIS) of those were solely (100%) devoted to farming activities. In MIS adaptation, 25.4% of the total was accomplished with Higher Education and 55.7% were succeeded with Tertiary Level of education which was comparatively lower in Non-MIS adoption, as well. However, all the respondents used rain water in *Maha* Season for their paddy cultivation. Among the Non-MIS adoption, 74.8% of the respondents used energy sources (electricity - 65.26%, solar power -6.3% and fuel -28.4% and man power - 25.2%) for the irrigation purposes where 65.2% had better awareness on MIS. And also, lack of knowledge and lack of capital were with the responds of 9.5% and 43.3%, respectively. On the other hand, 47.9%, 21.7% and 30.4% practiced Drip system, Sprinkler System and both sprinkler and drip irrigation, respectively in the whole of MIS adoption. As the whole, more than 82.6% of the MIS adopted farmers benefited through the MIS techniques. Though the study location supplies more fruits and vegetable to the people, farmers who adopted MIS faced difficulties on finding spare parts (90%) while the system is under reparation. As being only few people adopted the system, it is obvious for lack of spare parts options within the study location and farmers need to travel far for obtaining the spare parts as well. Finally, it should be countered and

encouraged towards both MIS and Non- MIS adopted farmers to obtain more benefits in all the season of the country.

Key Words: Awareness, Dry Zone, fruits and vegetable famers, MIS Techniques, surface irrigation

1 Introduction

Though the investments are higher on establishing infrastructure on proper irrigation, most of the developing nations experience from acute water shortages resulting mainly from the mismanagement of the available water resources. As being one of the developing countries, most of the territorials in Sri Lanka are belonged to long lasting dry spell where prevailing seasonal or year-round severe water scarcities are common (Amarasinghe, *et al.,* 1999 and NDP, 2020). And also, challenges are mainly on improving the efficiency of agricultural water use so as to increase or maintain crop yield while at the same time allowing the reallocation of water from agriculture for increased urban, domestic and industrial use. However, continuous challenge leads threatening to satisfy the demand of foods and economic level over growing population. These are commonly emerged due to the developed potential water resources which are technologically more complex, economically less attractive and often less environment friendly.

Most of the famers in Sri Lanka follow conventional open canal irrigation even though the efficiency under gravity method of irrigation is generally less than 50% due to conveyance losses and poor farm water management. However, it can be improved by proper land leveling and preparation, the planning of advanced techniques in the determination of irrigation such as irrigation frequency, quantities and stream size, installation of water measurement and regulation systems, supply of water according to crop requirement etc. and by reusing water for irrigation (Sivanappan, 1994 and Loucks & Beek, 2017). Therefore, Micro Irrigation Technologies (Drip/Sprinkler) are used in several countries in order to reduce the losses at distribution and at the farm water management level where the efficiency rate increases up to 90% (UNECE, 2015). Further, the government of Sri Lanka and various donor agencies have invested considerable sums of money on the development of micro irrigation projects on a pilot basis. However, the success of these investments primarily depends on the number of incentives received for both the government and the private users to save water and increase farm income. Micro irrigation can play an integral role in the management of crops to obtain maximum yield from lesser quantities of water, chemicals and fertilizers compared to other forms of irrigation. Another objective of the micro irrigation programs implemented by various agencies is to protect ground water depletion through excessive extraction of water for irrigation (Ram Fishman, *et al.*, 2015).

In Sri Lankan context, the topography and farming practices are very diverse in nature; farmers are usually not familiar with the use of micro irrigation or other water efficient technologies (Aheeyar, 2005). For dissemination of the new technologies among farmers, their risk-taking capacity in the cultivation of crops under this MIS as well as farmers' attitudes, knowledge and skills in using MIS need to be addressed. Also, for further promotion of this technology among the Sri Lankan farming community, conducting an economic appraisal of these investments is relevant and needed. Vavuniya District is very much popular in Agriculture in Northern Province of Sri Lanka where engagement of traditional farmers who are lack in new technology and its adaptation. Here, Low country fruits and vegetable crops are cultivated mostly under the surface irrigation including well water systems. Moreover, micro irrigation system (MIS) is not popular among the farmers in Vavuniya District due to the lack of knowledge and its functional benefits. Therefore, this current study was formulated to understand the

current status of the Micro Irrigation System and the factors influencing on the adoption of new technology in one of the DS Division named as Pampamadu area of the Vavuniya District, Sri Lanka.

1.1 Objectives

The following objectives were concentrated more on this study.

1. To assess the level of success of micro irrigation in saving water and improving farmers' income.
2. To identify problems and constraints in adopting existing micro irrigation technologies.
3. To make necessary recommendations for the future promotion of micro irrigation programs in the study area.

2. Materials and methods

Study was carried out in different aspects in order to reach the study objectives as well.

2.1 Location of study area

The study was conducted in 14 GN Divisions of Pampamadu AI range in Vavuniya District, Sri Lanka where 7451 families occupied with the total area of 86.11 km^2.

2.2 Sampling procedure

Sample frame was prepared by using database of the fruit and vegetable cultivation farmers from the Pampamadu AI range where the major divisions of fruits and vegetable cultivation in Vavuniya District were selected for this study. As the whole, 150 farming families were randomly selected for this study.

2.3 Method of Data Collection

Primary data were collected from farmers using pretested structured questionnaires. Questionnaire was designed to collect data on farmer's awareness and adoption of micro irrigation system in Pampamadu AI range during the period of July to December, 2017. Details on the socio-economic information of the farmers, cultivation information, irrigation methods, adoption of micro irrigation system, problems faced by the farmers in the study area were collected in the study. And also, few data were collected by personal interview with Agriculture instructors who are working in the region. Secondary data were collected from Department of Agriculture, Agricultural Development Authority, Divisional Secretariat Vavuniya Tamil division, census and statistical report and published literatures in order to get the additional required information.

2.4 Data Analysis

The completed questionnaires were checked and the data were entered in the Excel data sheet where data were confined to estimate frequencies and descriptive statistics in SPSS Software.

3. Results and discussions

This section represents the major finding of farmers' adaptation of MIS towards their fruit and vegetable cultivation in 14 GN Divisions of Pampamadu AI range, Vavuniya Tamil Divisional Secretariat Divisions in Vavuniya District. According to the total number of farmers, 15% of the farmers adopted

MIS and 85% (127 respondents) did not adopt that system. It was the overview of the current trend regarding the adoption pattern in Vavuniya District, Sri Lanka.

3.1 Socioeconomic characteristic of the farmers

Study shows that most of the Non-adoptive MIS fruits and vegetable farmers (93%) were men and rest of the farmers were female where the age categories fell down as 19.4%, 32.3%, 31.5%, 14.5% and 2.4% with the age ranges of 26-35, 36-45, 46-55, 56-65 and 66-75 years, respectively. According to this nature, more than 60% of the total representatives in Non-MIS were within the range of 36-55 years, as well. However, MIS adoptive fruits and vegetable farmers (15%) were nearly 80.5% with the age category of 36-55 years. And also, 60.9% and 48.8% of the total were solely engaged with farming activities in MIS adoptive and Non-adoptive categories where rest of the head counts were devoted with government, private sectors, daily wages, own business and household works.

Education and the literacy rate contribute more on adopting different techniques especially on irrigation (Faisal *et al.,* 2013). It is one of the fundamentals in most of the studies too. While considering the education level of the respondents, 25.4% and 55.7% of the respondents in MIS Adaptation have followed higher education and tertiary level of education, respectively. However, it was comparatively lower in Non-MIS adaptive farmers. Further, income level of the fruits and vegetable farmers who adopt MIS showed the range between Rs. 20,000 - Rs. 40,000 which was nearly 69%. However, around 61% of the total Non-MIS farmers gained income between the ranges of Rs. 10,000 - Rs. 20,000.

3.2 Data on cultivation pattern, land ownership and available labor force

The study indicated that the cultivation of fruits and vegetable was typically higher in *Yala* Season where farmers were familiarized with the micro irrigation system. However, in both seasons the fruits and vegetable cultivation was optimum among the farmers who adopt Micro Irrigation System. Although, the cultivation was done in their own lands, the availability of the labor force was not sufficient for most of the Non-MIS adopting farmers. However, most of the MIS adopting farmers represented sufficient number of labor force while both categories experinced the food shortage for their own consumptions. It meant that they do the paddy cultivation only in the *Maha* Season which provides the adequate amount of water for their cultivation of the farmers who have their own cultivable land for paddy. On the other hand, they need to pay or consume the vegetables from the outside while the scarcity of the resources occurs.

3.3 Irrigation methods

According to the data, whole numbers of MIS adopting and non-adopting vegetable farmers depend on the agricultural wells and tube wells. At the same time, few farmers among the Non-MIS adopted depend on rainfall during *Maha* Season. Because, Vavuniya District is located in Dry Zone of Sri Lanka where the precipitation is virtually non-existent in the climate of Dry Zone in Sri Lanka and the annual rainfall ranges between 1900 mm – 2500 for short period with long dry spell. Generally, average temperature is 28 ^{0}C (82.4 °F) and shows seasonal variation. Surface water sources were highly used by most of the farmers who cultivate paddy in Vavuniya District during the period of March to October. Ground water sources were highly used by the MIS adopting fruit and vegetable farmers while some rain fed cultivation farmers did not use any water sources too.

Most of farmers in both categories were with insufficient irrigation water for their vegetable cultivation. However, the amount of the water was insufficient to the farmers who practiced the MIS was comparably

lower while comparing with the farmers who were not with the MIS. It is obvious that, water use efficiency was greater in MIS adopting farmers compared to the non-MIS adopting farmers. Therefore, water requirement is less in MIS adopting farmers (Manero, 2008).

3.4 Unique features of the Non-MIS adopting farmers

3.4.1 Type of energy sources

Using energy source is another issue for the irrigation practices where 74.8% of the respondents used energy sources for their irrigation purposes including electricity (65.26%), solar power (6.3%) and fuel (28.4%), as well. However, rest of them 25.2% used man power for the irrigation purposes. It is common that the man power consumes more time comparing with other energy sources. Vavuniya District is located in Dry Zone where the development activities are fairly acceptable one and also, fruit and vegetable cultivation is commonly done based on the irrigation and fertilizer which are the crucial part of the yield performance too.

3.4.2 Awareness on micro irrigation system

Most of the fruit and vegetable farmers in the Pampamadu AI range were not well adopted MIS. However, most of the respondents mentioned that they have better awareness regarding the Micro Irrigation System where the higher percentage was occupied with somewhat known range (65.2%) which might also be a reason to the non-adoption of MIS system at study area.

3.4.3 Factors influencing on lack of practicing MIS

According to the analyzed data, several factors influenced the farmers for their lack of interest on the practice of MIS. Among the total, most of the farmers did not adopt MIS where 16.54% had been affected by more than one factor mentioned as lack of knowledge (9.5%) and lack of capital (43.3%). Other than this, lack of quality water (8.66%), scaring on the new technology (2.36%) and lack of willingness to follow the new technology and break the tradition (12.6%), as well. However, higher cost for energy sources, higher cost for labor, insufficient water, higher amount of required water, degraded quality of water and higher maintenance cost were with the value of 14.2%, 6.5%, 10.5%, 16.1%, 4% and 8.1%, respectively. Those were the problems faced by the respondents through the currently practiced irrigation system.

3.5 Unique features of the MIS adopting farmers

Among the farmers who adopt MIS, nearly 47.9% practiced Drip system and 30.4% of farmers practiced both sprinkler and drip irrigation systems. Further, only few farmers practiced Sprinkler irrigation system in Pampamadu AI range with the respondents' value of 21.7%.

Table 1: Ways of gathering information

How do you know about MIS	Percent (%)
Learned in school	8.7
From Other People	13.0
News paper	13.0

Through Radio	8.7
Through TV	13.0
Through Internet	4.3
Through Agriculture Officer	17.4
Through Private company	21.7

The present study revealed that the private companies played a major role in adopting MIS in the study area. Around 17.4% of the total respondents gathered knowledge and information via the agricultural officers and it was followed by newspaper and articles (13%). Additionally, learned in school (8.7%), via other people (13%), through radio (8.7%), through television (13%) and via internet (4.3%) were other sources of medium used for understanding the MIS system. They have good understanding on the impacts of micro irrigation system with the support of the organization or companies. Mainly they provide the information on the micro irrigation systems, types of crop which can be cultivated under micro irrigation system and providing training opportunities about micro irrigation system.

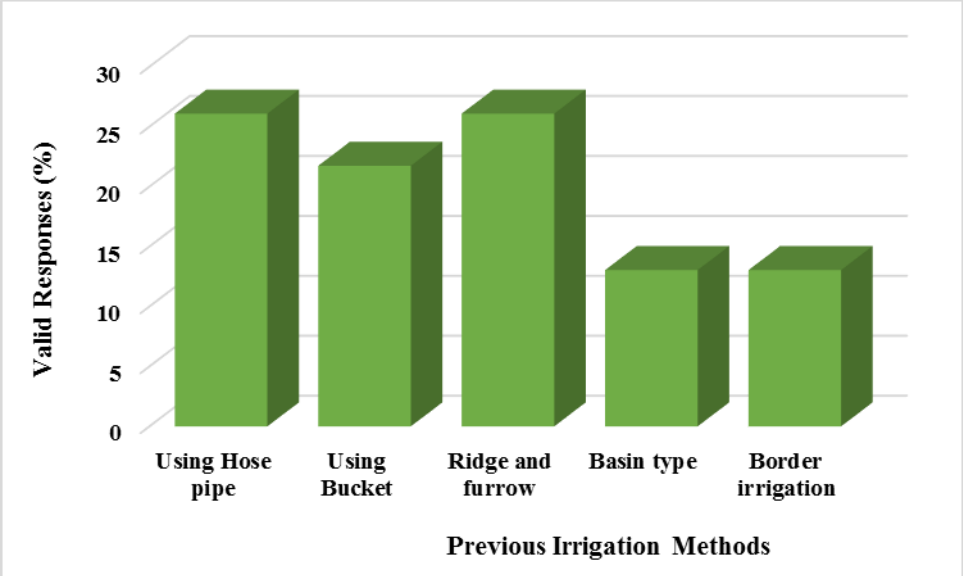

Figure 1: Previous irrigation methods

3.5.1 Facts behind the adaptation of new techniques

According to the analysis, influencing factors are higher in adoption of MIS in Pampamadu AI range in Vavuniya. The combinations of the following facts were the leading reasons to the greatest movement towards the MIS. It promoted to disseminate the extension services (11.5%) which were given by the Agricultural Departments and other organization. Further, this new technique reduced the cost for labors (3.8%) and water requirement (11.5%). In addition, some farmers (7.7%) reported that the yield has been increased by adopting MIS.

3.5.2 Benefits of adopting MIS

High water usage efficiency was the major advantage to the farmers who adopted MIS where less amount of water was utilized to larger extent of land area. As well as, nearly half of farmers (50%) reported about the lower labor cost as an advantage and the total mentioned that once the MIS System is established it would be easier to maintain their whole farming system. Further, respondents stated that the MIS as a profitable system and fertilizer would be applied through micro irrigation system which is another advantage achieved by farmers through MIS.

Higher initial cost was the major disadvantage among the micro irrigation system adopted farmers. Technical knowledge required for maintaining and higher price of MIS parts were another disadvantage. However, respondents expressed that once the MIS equipment got damaged or failure, they were needed to take them far for repairing. It was one of the disadvantages in adopting MIS system at the study location.

3.5.3 Limitation in using MIS

According to the study, most of the farmers (19.2%) faced problems regarding the availability of poor-quality water. The company who establishes MIS services provides very less service to solve problems and higher cost involved in solving problems were with the value of 19.2% and 15.4%, respectively.

According to the Study, large number of (30.8%) micro irrigation system was introduced by Government. while private company took part a small percentage (23.1%), as well. There are more than 10 companies involved in the micro irrigation business as suppliers in Sri Lanka such as Brownand Company, Irritech (Pvt.) Limited, Sewa Lanka Foundation (NGO), Wimaladharma Brothers, Agri World (Pvt.) Ltd, CIC Fertilizer (Pvt.) Ltd and Citi Gardens. Analyzed data depict that most of the farmers (82.6%) adopting micro irrigation system had received proper training about MIS. Mostly, facilitated training programs were conducted by the Government (57.9%), Non-Governmental Organization (15.8%), private organization (21.2%) and rest were learnt by their own. Most of the respondents gained practical knowledge about MIS through training programme regarding the identification of the components of MIS and their functions, designing and establishment and maintenance of MIS. Farmers who were trained by the government have participated in 7 days workshop about MIS in FMTC (Farm Mechanization Training Center) at Anuradhapura.

Table 2: Limitations in using MIS

Limitations	Percent (%)
Poor water quality	19.2
Designing difficult in sloppy area for me	7.7
Technology needed	11.5
Higher cost	15.4
Traditional thinking not allowed	7.7
Service from company is poor	19.2
More than above one limitation	15.3

3.6 Profits through adopted MIS techniques

Among the total number of farmers, 82.6% of them were with many benefits over the adoption of the micro irrigation system such as reduced labor cost, time saving, higher irrigation efficiency, etc. About 73.9% of farmers' profit (family income) was increased through the adoption of the MIS. On the other hand, most of the factors on fruits and vegetable cultivation affected the family income such as current market price and cost of inputs.

Table 3: Ways to increase the micro irrigation adoption

Ways to Improve MIS adaptation	Percent (%)
By improving extension services	26.1
Subsidies by organization or government	21.7
Supply loan for the establishment of MIS	17.4
Organize field visit for encourage to farmers	13.0
Facilitate training program to farmers	21.7

At the present study, Pampamadu AI range was selected as being dominant to supply more Agricultural products to the markets in the Vavuniya District, Sri Lanka. According to the soil conditions of the land, almost all the area was occupied with reddish brown soil and Low Humid Clay Soil type which benefits the vegetable cultivation with different varieties. Department of Agriculture denoted the soil type as Reddish-brown soil where varieties used by the farmers differed with the person to person. It was not common to the respondents who adopt MIS System and non-MIS adopting system along with the variety and soil type of farming systems. Not only that, environmental factors (Temperature, rain fall, humidity) and management factors (Fertilizer application, watering, land preparation, etc.) were also contributing more on the income level of the farmers in Pampamadu AI range, Sri Lanka. Those were the reasons for the different level of income gained by the population within the district as well.

4. Conclusion

According to the study, most of the fruit and vegetable farmers in Pampamadu AI range in Vavuniya District were not adopting micro irrigation system and mainly underground water was used as the water sources. Among Non-MIS adopting farmer's major irrigation method was surface irrigation using hosepipes. And also, lack of knowledge and capitals were identified as the major constrains of farmers who were not adopting MIS. Further, agricultural officers and private companies were mostly involved to create awareness and encouragement on micro irrigation systems for the adoption of MIS. Farmers' adoption was increased since last two years and government and non-government organizations have introduced the MIS to farmers. Reduction of labor cost, increased crop quality and the higher water use efficiency were the major advantage on adopting MIS and higher initial cost was the major disadvantage for adopting the MIS.

5. Recommendations

The following recommendations are suggested to improve farmers' adoption on micro irrigation system.

1. Department of agriculture should provide instructions regarding micro irrigation technology via the regular extension services and facilitate the training programme for fruit and vegetable cultivation farmers in Pampamadu AI range in Vavuniya District.
2. Establish coordination between farmers and bank (Government and private) and companies to provide loans for farmers who preferred establish micro irrigation system with minor interest.
3. Equipment price of micro irrigation systems and spare parts prices should be reduced and supplied as subsidies for establishing micro irrigation system as well as government should involve for making availability of MIS spare parts at local markets like other product.
4. Less number of fruit and vegetable farmers using micro irrigation system in Pampamadu AI range in Vavuniya District. Therefore, farmers should be encouraged through field visited to MIS practicing cultivatable area and encourage younger farmers by supplying knowledge about new technology.
5. After establish micro irrigation system services should be provided continually by the established organization.

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