Study Number - 190

Improving Water Use Efficiency in India's Agriculture: The Impact, Benefits and Challenges of Micro-Irrigation under the Pradhan Mantri Krishi Sichai Yojana: Per Drop More Crop (PMKSY-PDMC) in Sikkim

Debajit Roy

Debanshu Majumder

Study sponsored by Ministry of Agriculture and Farmers Welfare
Government of India, New Delhi

Agro-Economic Research Centre
(For the States of West Bengal, Sikkim and Andaman & Nicobar Islands)
Visva-Bharati, Santiniketan
West Bengal
2020

Study Number - 190

Improving Water Use Efficiency in India's Agriculture: The Impact, Benefits and Challenges of Micro-Irrigation under the Pradhan Mantri Krishi Sichai Yojana: Per Drop More Crop (PMKSY-PDMC) in Sikkim

Debajit Roy

Debanshu Majumder

Study sponsored by Ministry of Agriculture and Farmers Welfare
Government of India, New Delhi

Agro-Economic Research Centre
(For the States of West Bengal, Sikkim and Andaman & Nicobar Islands)
Visva-Bharati, Santiniketan
West Bengal
2020

Citation:

Roy, D and Majumder, D. (2020). Improving Water Use Efficiency in India's Agriculture: The Impact, Benefits and Challenges of Micro-Irrigation under the Pradhan Mantri Krishi Sichai Yojana: Per Drop More Crop (PMKSY-PDMC) in Sikkim; Study No.-190, Agro-Economic Research Centre (For the States of West Bengal, Sikkim and Andaman & Nicobar Islands), Visva-Bharati, Santiniketan, West Bengal; pp-xxiii+74

Project Team:

Field Survey

Dr. Debajit Roy
Mr. Debanshu Majumder
Dr. Ranjan Kumar Biswas
Mr. Kali Sankar Chattopadhyay
Prof. Manesh Choubey

Data Analysis, Drafting and Report Writing

Dr. Debajit Roy
Mr. Debanshu Majumder

Logistics and Secretarial Services

Mr. Munshi Abdul Khaleque
Mr. D. Mondal
Mr. Nityananda Maji
Mr. D. S. Das

Team Leader

Dr. Debajit Roy

State Project Coordinator

Prof. Bidhan Chandra Roy, Hony. Director, Agro-Economic Research Centre (For the States of West Bengal, Sikkim and Andaman & Nicobar Islands), Visva-Bharati, Santiniketan, West Bengal -*731235*

Central Project Coordinator

Prof. V. P. Gandhi, Center for Management in Agriculture (CMA), Indian Institute of Management, Ahmedabad, Vastrapur, Ahmedabad – 380015

PREFACE

The present study entitled "*Improving Water Use Efficiency in India's Agriculture: The Impact, Benefits and Challenges of Micro-Irrigation under the Pradhan Mantri Krishi Sichai Yojana: Per Drop More Crop (PMKSY-PDMC) in Sikkim*" was undertaken at the instance of the Directorate of Economics and Statistics, Ministry of Agriculture, Government of India, Krishi Bhavan, New Delhi as a coordinated study, where the task of coordination has been entrusted with the CMA, IIM, Ahmedabad. This report has been an individual centre's report on the study concerned carried out in Sikkim and prepared by our centre, AERC, Visva-Bharati, Santiniketan.

As improving water-use efficiency in farming is expected to play a key role in bringing about growth in Indian agriculture, there are policy efforts to promote micro irrigation through schemes like PMKSY-PDMC (Pradhan Mantri Krishi Sinchayee Yojana-Per Drop More Crop). However, the results of such efforts are yet to be enumerated, and it is here that the present study intends to assess the impact and challenges of micro irrigation in the state of Sikkim.

The study has been primarily entrusted with Dr. D. Roy and Mr. D. Majumder, while Dr. R. K. Biswas and Mr. K. S. Chattopadhyay provided immensely valuable assistance in data collection and processing under the active supervision of the undersigned. Extensive support has also been obtained from Prof. Manesh Choubey of Sikkim University. I take this opportunity to convey my sincere thanks to the officials of the Agriculture and Horticulture Department of Government of Sikkim. Special mention should be made of Mr. Padam Subba, Principal Director, Dept. of Horticulture; Mr. Bhim Dahal, Addl. Director, Dept. of Horticulture; Mr. Jiwan Kr. Chettri, Addl. Chief Engineer, Dept. of Agriculture and Horticulture; and Mr. Dikendra Bhujel, Jt. Director (South District), Dept. of Horticulture for their immense cooperation in course of field survey. I offer my deepest thanks to all of them.

On behalf of this centre, the undersigned takes the opportunity to thank the study coordinator, viz. Center for Management in Agriculture (CMA), Indian Institute of Management, Ahmedabad, for their painstaking work on coordination of this immensely important study across the individual centers, especially for organizing the entire study design with detailed chapterization and table formats.

Sd/-

Santiniketan
Date: 30.09.2020

(B C Roy)
Professor & Director
A.E.R.C., Visva-Bharati

EXECUTIVE SUMMARY

1: BRIEF INTRODUCTION OF THE STUDY

India has a population of nearly 130 crore and it is expected to rise at a steady pace in the coming years. To keep up with growth in population, agricultural production has to increase in order to meet the ever growing demand created with this population increase. In order to meet the future demand for food in a sustainable manner, each farm is required to have access to irrigation. It is here that the Pradhan Mantri Krishi Sinchayee Yojana (PMKSY) is conceived in the year 2015 by the Government of India as an umbrella scheme for coverage of more and more area under assured irrigation as early as possible. Among the components of the PMKSY scheme, the PDMC component aimed at increasing on-farm water-use efficiency by using suitable water conveyance and precision water application devices like drips, sprinklers, pivots and rain-guns in the agricultural farms. Like other states in the country, the Pradhan Mantri Krishi Sichai Yojana (PMKSY) has also been implemented in the state of Sikkim, which is helping in the development of irrigation infrastructure, by supplementing existing irrigation facilities. It is here that this study tries to examine the impact of the component Per Drop More Crop (PDMC) of Pradhan Mantri Krishi Sichai Yojana (PMKSY) in the state of Sikkim.

2: OBJECTIVES OF THE STUDY

The main objective of the study is to analyze the various benefits of micro irrigation to the farmers including in input use, costs and returns. Specifically, the objectives are to examine the following:

1. to examine the savings of various inputs such as water, fertilizers, power, pesticides and labour;
2. to examine the enhancement of productivity, quality and other benefits in selected agriculture/ horticulture crops including water-intensive crops such as sugarcane and banana, and if there is employment generation due to MI;
3. to examine the adoption of MI including some of its determinants/ features such as need/ importance of subsidy, culture of water conservation, issues of fragmented land holdings, capital cost, maintenance cost and the distribution of subsidy;
4. to study overall impact on farmer incomes and the cost-benefit in selected crops; and

5. to identify any issues/problems in the benefit transfer work flow and monitoring by the implementing agency.

3: METHODOLOGY OF THE STUDY

The present study has been conducted based on both primary and secondary data. For collection of primary data in Sikkim, a multi-stage stratified random sampling method has been adopted. As such, in the first stage, two districts from Sikkim, namely districts East and South, have been selected in consultation with the officials of the Department of Agriculture and Horticulture of Government of Sikkim. While selecting the districts, scale of adoption of micro irrigation has been considered as a major determinant in the district selection process. In the second stage, two blocks from each of the selected districts have been selected following similar criteria, viz. scale of adoption of micro irrigation in the blocks. Next, lists of farmers of each block have been collected and the farmers were stratified into two categories based on adoption of micro irrigation i.e. adopters and non-adopters. Lastly, from each of the selected districts, 48 micro irrigation adopter farmers and 12 non-adopter farmers have been selected randomly spread more or less evenly across the respective blocks of the districts. Thus, a total of 120 farmers have been selected to form the sample size of the study of which 96 are adopters of micro irrigation and 24 are non-adopter farmers. The secondary data has been collected from the Department of Agriculture and Horticulture, Government of Sikkim.

4: MAJOR OBSERVATIONS OF THE STUDY

After a detailed analysis of various aspects of adoption of micro-irrigation system in the state of Sikkim, as described in the present study, some important concluding observations come out, which may be outlined as follows-

4.1: PROFILE OF MICRO-IRRIGATION ADOPTION IN THE STATE

- The implementation of PDMC-MI, PMSKY is executed through Horticulture Department, Govt. of Sikkim. The PDMC-OI, PMSKY Programme is executed by Agriculture Department, Govt. of Sikkim.
- The study finds that since 2015-16 funds allocated for *PMKSY-PDMC in Sikkim has increased over time at an annual growth rate of 6.69 percent*.

Year-wise Growth of Micro-Irrigation in the State

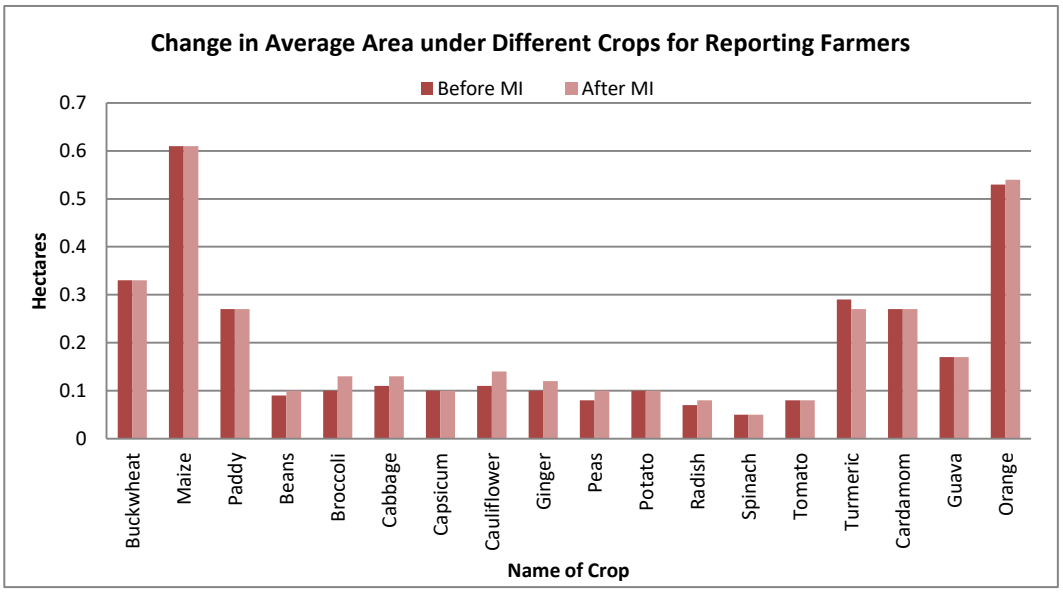
Year	Funds allocated/ received under PMKSY-PDMC (Rs. In Lakh)	Area under Micro Irrigation (MI) (in Ha)	Number of Beneficiaries	MI as % of total irrigated area
2014-15	Nil	Nil	Nil	Nil
2015-16	413.42	772.50	2083	4.29
2016-17	NA	NA	NA	NA
2017-18	436.00	663.60	1659	3.36
2018-19	2018.22	2524.00	6010	11.89
2019-20	1200.76	1724.00	4270	7.20
Annual Growth Rate				6.69

Source: Department of Horticulture, Govt. of Sikkim

- A district-wise breakup of area under MI during 2018-19 reveals that area under micro irrigation was highest in the East district followed by West, South and North.
- Among the various crops that were receiving micro irrigation of *various kinds vegetables including Peas and Beans accounted for 47.55 per cent of total area under micro irrigation in 2018-19.* Buckwheat, Barley and oil crops accounted for over 17 per cent while Cardamom plantation including Cardamom nursery had a share little over 12 per cent. Orchards, however, had 5.12 per cent share of total micro irrigation in that year.

4.2: CROPPING PROFILE AND CHANGES

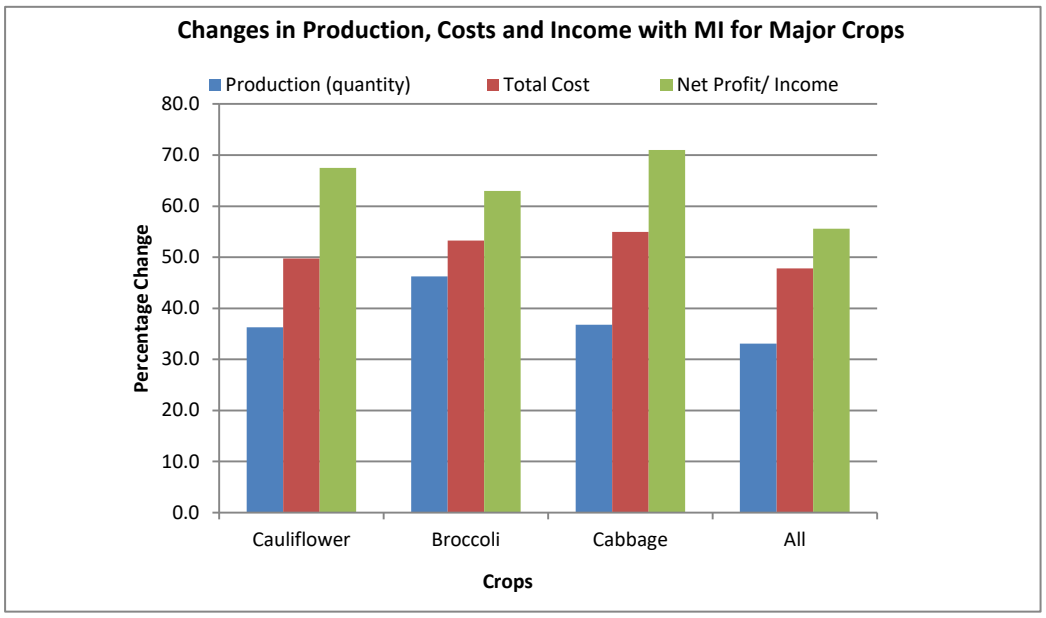
- With the introduction of micro-irrigation, *there has been a marked shift in the cropping pattern in favour of major vegetable crops like cauliflower, broccoli, cabbage, peas and beans by bringing in new land under cultivation*, irrigated through sprinkler irrigation method.



- Along with increase in area under cultivation, *the major vegetable crops in the Rabi season has also witnessed an increase in their yields* due to the introduction of micro-irrigation techniques.

4.3: CHANGES IN INCOMES AND FARM ECONOMICS WITH MICRO IRRIGATION

- In case of production of major vegetable crops, viz, cauliflower, broccoli and cabbage, it has been observed that while *production of broccoli increased by 46.23 per cent, that of cauliflower and cabbage comes out to be 36.26 percent and 36.75 per cent respectively*.
- Though total costs of cultivation for cabbage, broccoli and cauliflower increased by 54.96 per cent, 53.26 per cent and 49.75 per cent respectively, the corresponding *increase in profit stands much higher at 71.01 per cent, 67.48 per cent and 63.01 per cent respectively*.
- Similarly, decrease in labour cost as proportion of total cost comes out to be 6.14 per cent for cauliflower, 7.99 per cent for broccoli and 2.25 per cent for cabbage.



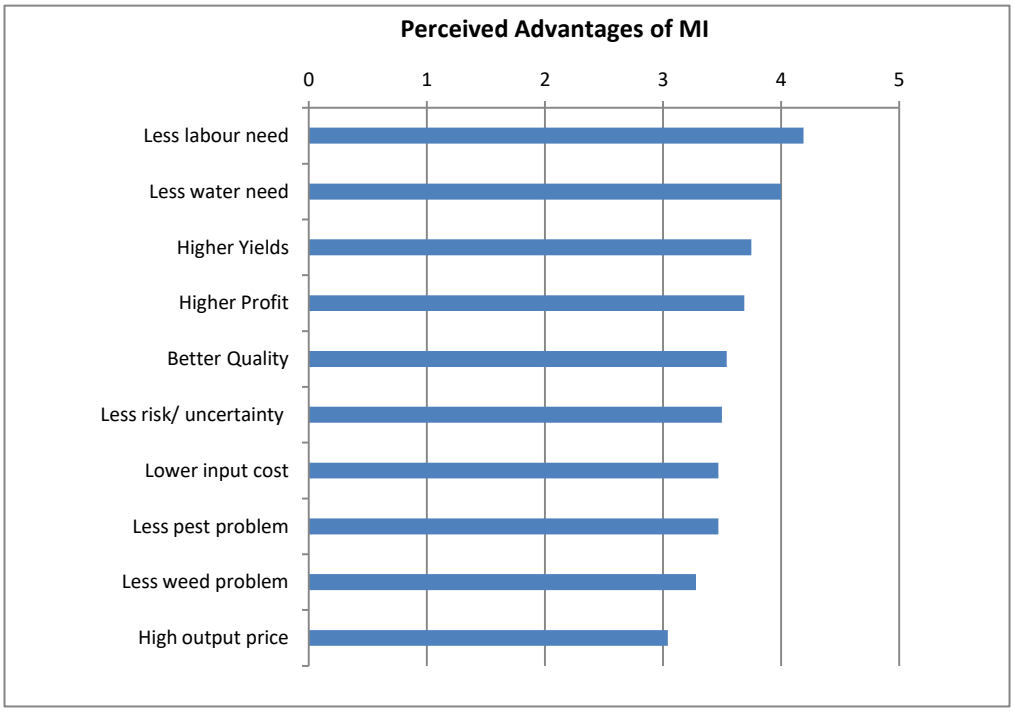
- Findings relating to farm-economics before and after the introduction of micro-irrigation thus indicate that, adoption of micro-irrigation comes out to be a profitable notion, which in turn induced an increase in the area under cultivation, higher yield and lower costs of account of labour power in particular. Thus, *micro-irrigation comes out to be a high-yielding, labour-saving and cost-efficient technology with positive acreage effect*.

4.4: Capital and Maintenance Cost of Micro Irrigation

- In the state of Sikkim that these concerns regarding *initial capital costs/investments remain largely inapplicable, as there has been 100% subsidy assistance* for adopting micro-irrigation for the adopter farmers, and they did not have to pay any money or take any loan for installation of micro-irrigation.

4.5: Factors and Determinants Affecting Micro-Irrigation Adoption

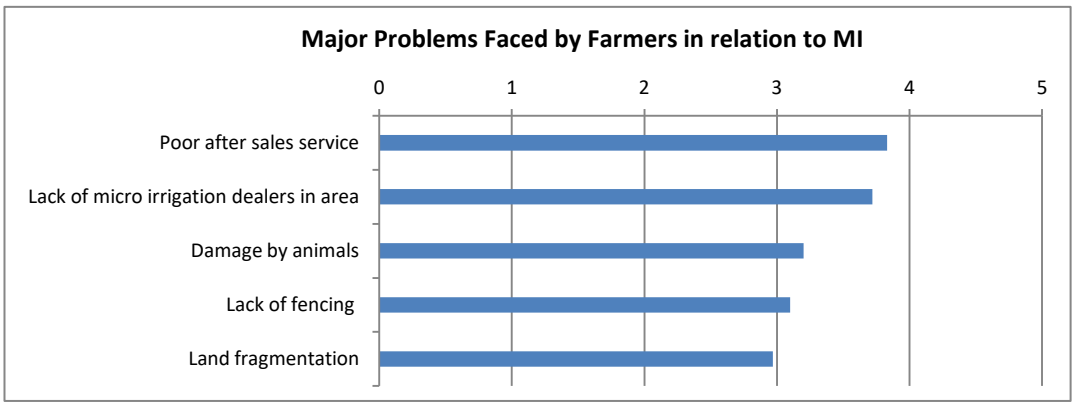
- In case of agronomic potential as a determinant of adoption of micro-irrigation, a large section of adopters agreed on the point that *MI had a positive impact in reduction of labour, water usage, and yield* as well.
- In view of agro-economic potential of micro irrigation, a sizeable proportion (over 97 per cent) of MI adopters were of the opinion that *subsidy on micro irrigation played the most important role in adoption of MI*.
- On the effective demand side, we observed that the *easy technology, available subsidy and availability of information regarding MI got priority in the responses* (respective mean values of response score were 3.84, 3.79 and 3.70) as determining factors of MI adoption.
- On the supply side, there were fewer complaints as regards to the quality of the instruments that were being provided as *82.3 per cent was in agreement that the kits being provided were good and reliable*.



- The *strongest advantage of MI, as perceived by the adopters, had been lesser usage of labour in MI and reduction in water usage*.
- On the whole, *implementation of MI had been advantageous to 90.6 per cent of adopters*.

4.6: LARGER IMPACT AND PROBLEMS OF MICRO-IRRIGATION

- It is found that *MI has had a positive impact in improving the condition of the village* as a whole as confirmed by 62.5 per cent of the respondents.
- *Impact of MI was significantly higher among the lowland farmers*, as perceived by the respondents, than their upland counterpart, which might have been due to an increase in water pressure by gravity pull as water went down the hilly terrain in Sikkim.
- Apart from young people, the *MI has been observed to have a positive impact across caste and gender of the respondents*. No discriminatory nature of programme implementation in view of caste/age/gender/economic position of the family is observed.
- There seemed to have little problem with quality of the MI equipments or high maintenance cost. However, there have been a *very poor after sales services provided by the MI dealers*.

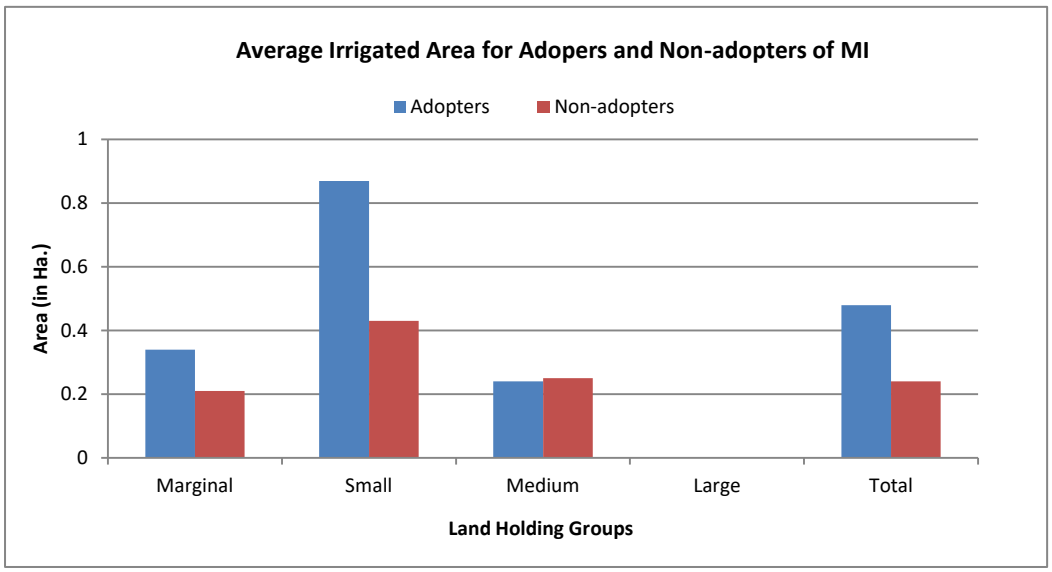


4.7: OVERALL ASSESSMENT OF THE PERFORMANCE OF MICRO-IRRIGATION

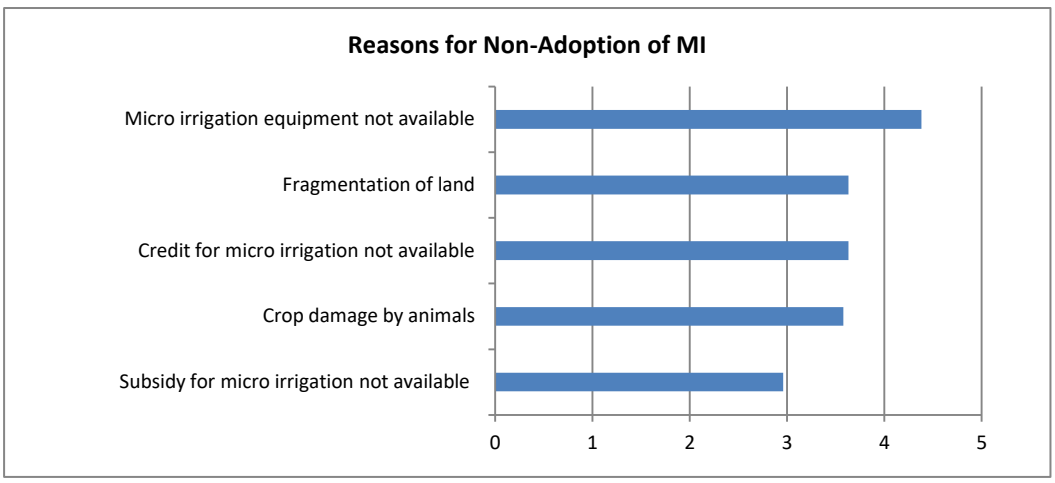
- The general opinion regarding the overall performance of micro irrigation and *its role in improving water use efficiency were considered to be 'good' by a majority of adopters*.
- As regards to increase in income and profit the respondents answered in positive. However, *an overwhelming majority of the adopters (more than 92 per cent) agreed to continue with MI*.
- It turned out that provision of *better marketing arrangement and better training for micro irrigation is considered to be beneficial for earning more profit from MI*.

4.8: NON-ADOPTERS OF MICRO-IRRIGATION: PROFILE AND ISSUES

- *There has not been much difference between socio-economic profiles and cropping profile of the sample pool of adopters vis-à-vis non-adopters*, except for the fact that average availability of irrigation is far less for the non-adopters as compared to the adopters of MI.
-



- The non-adopter farmers' response regarding non-adoption of micro-irrigation indicates that though they consider micro-irrigation as a suitable, profitable technique involving low operating cost and a ready market for output; the *non-availability of micro-irrigation equipments, credit for installation of MI and lack of government subsidy are the prominent reasons behind non-adoption on micro-irrigation*.



4.9: Specific Major Problem, Needs, Innovations and Suggestions

- *The major problems in the adoption of MI as perceived by the adopters relates to scarcity of water flow, followed by crop damage by wild animals and clogging of feeder pipes.*
- The most common *recommendation/suggestion was towards making provision for more MI clusters and setting up of micro irrigation at a larger scale* within the village cluster itself.

4.10: Work Flow and Monitoring by the Implementing Agency

- The implementation of PDMC-MI is executed through Horticulture Department, while the PDMC-OI Programme is executed by Agriculture Department *as per GoI guidelines* through online registration of beneficiaries, DBT and installation by certified companies.

5: Policy Recommendations

Based on the major observations of the study as stated earlier, a few policy recommendations may be sketched out as follows-

- As MI system has come out to be very effective in hilly slopes of a state like Sikkim, policies like *PDMC should be implemented proactively in hilly states* to reap out the benefits of MI.
- The agro-climatic condition of hilly state like Sikkim comes out to suit horticulture, particularly vegetables, enhancing area, productivity and reducing costs. As such, policies on *MI system should target expansion of area, particularly in hilly states*.
- The provision of 100 per cent subsidy comes out to have a significant and determining role in the adoption of MI. As such, while promoting MI system, the State and the Central *Government should continue subsidizing the initial costs of installation of MI*.
- In the absence of after-sales service by the MI equipment suppliers, there *should be training camps to impart basic knowledge on maintenance* of the MI kits provided.
- The government should step-in and form SHGs/ FPOs to *facilitate easy transportation and arrange for marketing of the crop output* to ensure reasonable price.

Agro-Economic Research Centre
(For the States of West Bengal, Sikkim and Andaman & Nicobar Islands)
Visva-Bharati, Santiniketan
West Bengal-731235

E-mail: dir.aerc@visva-bharati.ac.in **Phone:** +91-03463-261447 **Web:** www.visva-bharati.ac.in