REPORT NO.153

IMPROVING WATER USE EFFICIENCY IN INDIA'S AGRICULTURE : THE IMPACT, BENEFITS AND CHALLENGES OF MICRO-IRRIGATION UNDER THE PRADHAN MANTRI KRISHI SINCHAYEE YOJANA: PER DROP MORE CROP (PMKSY-PDMC) IN TELANGANA STATE

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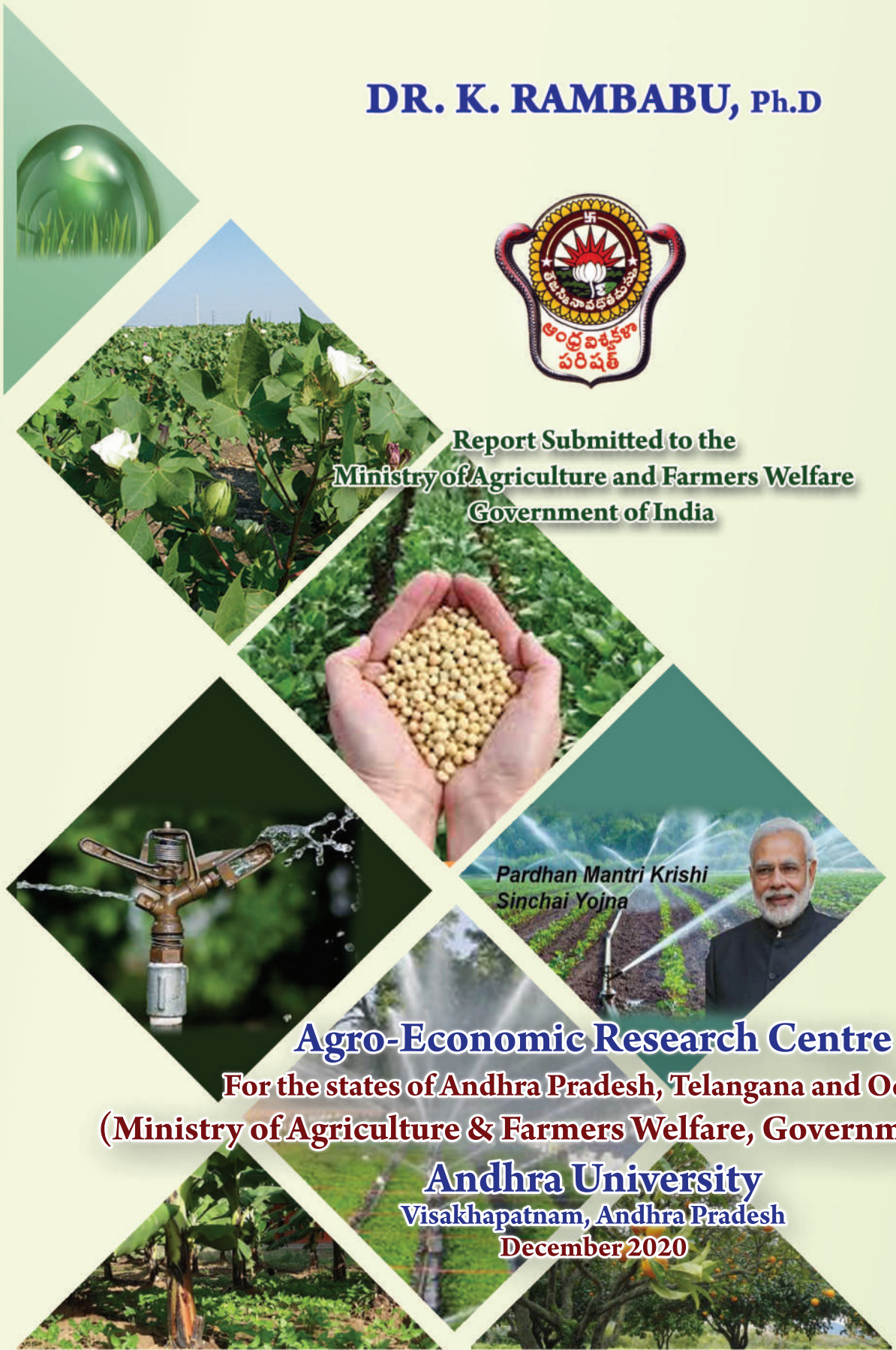

Report Submitted to the
Ministry of Agriculture and Farmers Welfare
Government of India

Agro-Economic Research Centre
For the states of Andhra Pradesh, Telangana and Odisha
(Ministry of Agriculture & Farmers Welfare, Government of India)
Andhra University
Visakhapatnam, Andhra Pradesh
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Improving Water Use Efficiency in India's Agriculture: The Impact, Benefits and Challenges of Micro-Irrigation under the Pradhan Mantri Krishi Sinchayee Yojana: Per Drop More Crop (PMKSY-PDMC) in Telangana State

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PREFACE

In the present conditions of Indian agriculture, it is necessary to increase agricultural production per unit volume of water, per unit area of cropped land, per unit of time. Effective utilization of every drop of water through micro irrigation is imperative for improving crop productivity, production and to achieve sustainable improvement in living standards of small and marginal farmers of state by improving the water use efficiency through micro irrigation and farmers can get assured additional income.

The government of India has been implementing centrally sponsored scheme on micro irrigation with the objective to enhance water use efficiency in the agriculture sector by providing appropriate technological intervention like drip and sprinkler irrigation technologies. The scheme PMKSY focuses on micro level storage structures, efficient water conveyance and application, precision irrigation systems, topping up of input cost beyond MGNREGA permissible limits, secondary storage water lifting, devices, extension activities, coordination and management being implemented by DAC & FW.

The present report focuses on the performance of the farmers in the light of PMSKY/PDMC scheme. It is observed that all the farmers are inclined to get subsidies of 75 percent of amount by government. Moreover, majority of the farmers opined that easier process for getting subsidy must be improved for the adoption of micro irrigation.

In this connection, I thank the Ministry of Agriculture & Farmer's Welfare, Government of India, for assigning the study to Agro-Economic Research Centre, Waltair. I also thank all the officials of Telangana state MIP Deputy Director, Smt. Bhagya Lakshmi and other officers and the staff for their continuous co-operation and help while conducting the study in the selected districts of Telangana. I appreciate the author and research team for taking meticulous care at every stage of field work and analysis of the study. I also thank Smt. P. Malathi for neat typing of the report. I hope that this report will be useful for the policy makers and researchers.

Honorary Director

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EXECUTIVE SUMMARY

1. Introduction:

The increase in need for crop production for the growing population is causing the rapid expansion of irrigation throughout the country. In the present conditions of Indian agriculture, it is necessary to increase agricultural production for unit volume of water, per unit area of cropped land, per unit of time. To meet the food needs of the growing population the agricultural production needs to be boosted by following better soil-water management techniques that could provide the arid and semi-arid lands, better access to irrigation water without actually increasing stress on available water resources using pressurized resurveyed irrigation system. Effective utilization of every drop of water through micro irrigation is imperative for improving crop productivity, production and to achieve sustainable improvement in living standards of small and marginal famers of state by improving the water use efficiency through micro irrigation and farmers can get assured additional income.

The Government of India has been implementing centrally sponsored scheme on Micro Irrigation with the objective to enhance water use efficiency in the agriculture sector by providing appropriate technological intervention like drip & Sprinkler irrigation technologies. As indicated above, the centrally sponsored scheme on micro irrigation (CSS) was launched by the department of Agriculture & Co-operation, Ministry of Agriculture in 2006. In June, 2010 it was up scaled to National Mission on Micro Irrigation (NMMI) which continued till the year 2013-14. From 1st April, 2014 NMMI was subsumed under National Mission on sustainable Agriculture (NMSA) and implemented as "On Farm Water Management (OFWM) during the financial year 2014-15. From Ist April 2015 Micro Irrigation component of OFWM has been subsumed under Pradhan Mantri Krishi Sinchayee Yojana. It is implemented as a centrally sponsored scheme on Micro Irrigation during the financial year 2015-216 as per the same pattern of assistance & cost norms as were prevailing under OFWM, until revised.

The major objective of PMKSY is to achieve convergence of investments in irrigation at the field level, expand cultivable area under assured irrigation, improve on farm water use efficiency to reduce wastage of water, enhance the adoption of precision irrigation and other water saving techniques (More crop per drop), enhance recharge of aquifers and introduce sustainable water conservation practices by exploring the feasibility of reusing treated municipal waste water for peri-urban agriculture and attract greater private investment in precision irrigation system.

2. Objectives of the study:

The main objective of the study is to analyse the various benefits of MI to the farmers including in input use, costs and returns. Specifically, the objectives would be 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 across states.

(4) To study overall impact on farmer incomes and the cost-benefit in selected crops.

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

3. Methodology & Major Findings of the Study:

The main purpose of the study is to increase the area under micro irrigation technology to enhance water use efficiency properly. The secondary objective includes increasing the productivity and income of the farmers through precise water

management. The study was executed in the two districts namely Nizamabad and Nalgonda in Telangana State with 120 farmers, of which 48 adopters of micro irrigation and 12 non-adopters from each district. The study adopted Multi-stage Stratified random sampling method in those two districts which have highest crop area. The study considered various micro irrigation variables like land particulars, water sources, water situation for farming, type of soil, type of terrain, rainfall situation, experience in micro irrigation, Government support in the form of subsidy etc. The study also considered cropping profile and changes and different types of crops like Cotton, Bengal gram, Sweet orange, Soyabean, Banana and Sugarcane. The study also made comparative analysis between micro irrigation and non-micro irrigation with regard to inputs of irrigation, changes in production, total sales revenue, cost of irrigation.

The study adopted Gandhi, Vasanth P (2014) model of micro irrigation which identifies determinants of factors effecting the adoption of micro irrigation based on primary data collected from beneficiary farmers on a five-point scale. The study also collected the perceptions of farmers towards advantages and disadvantages of micro irrigation, impact of micro irrigation, major problems faced by farmers in relation to micro irrigation and the perception od overall assessment of micro irrigation on a five-point scale with identified parameters. The study also recorded expectations of farmers towards increase and adoption of micro irrigation. The study also identifies the reasons for non-adoption of micro irrigation from the non-beneficiary farmers.

The main conclusions of the study are, the per holding total micro irrigated area of beneficiary farmers is reported to be 2.89 hectares. Across the groups, the micro irrigated area ranged between 0.88 hectares in case of marginal farmers to 2.89 hectares in case of medium farmers. On an average, the per holding area under drip irrigation of beneficiary farmers is reported to be 1.09 hectares, while the area under sprinkler irrigation is reported to 1.29 hectares.The changes in production, incomes and costs which have come through the adoption of micro irrigation for crops, Soya bean, cotton, Bengal gram, Banana, Sweet Orange and Sugarcane. The per holding area under drip irrigation varied from 0.57 (100 %) hectares in case of maize (inter crop) to 2.11(100 %)) hectares in case of banana.

On the other hand, the crops that are grown under sprinkler irrigation are soya bean, Bengal gram and groundnut. The per holding area under sprinkler irrigation ranged between 3.20 (95%) hectares in case of Bengal gram and 3.94 (100%) hectares in case of groundnut. The crops that are reported under non-micro irrigation are soya bean, cotton, Bengal gram. Moreover, the crops that are reported under fertigation are cotton, watermelon, chillies and banana.Among the 40 reporting farmers of cotton crop, 37.50 % of farmers reported fertigation, while among the rabi crops like watermelon and chilli crops about 42.86% of farmers and 40% of reporting farmers reported fertigation respectively.

In order to identify the determinants/ factors effecting adoption of Micro irrigation the model proposed by Gandhi,Vasanth P. (2014)[1] was used along with scale and factors mentioned in it. The mean value of all agro - economic potential is reported to be 2.92 to 4.38. The mean value of all agro-economic potential facts is reported to be around 4. The mean values of the factors contributing for effective demand varied from 2.53 in case of getting finance to 4.11 in case of availability of information on micro irrigation. The mean values of these two factors varied between 3.13 and 3.68. The mean values of the above factors ranged between 1.59 in case of arrangement by dealers for subsidy to 3.68 percent in case of the provision of quality products of dealers.

The major problems that are faced by the farmers in relation to micro irrigation mainly four problems are identified those are lack of micro irrigation dealers in area (mean was noticed as 3.61), poor after sales service (3.91), lack of credit(3.46) and damage by animals(3.01). However, the farmers disagree with the conditions of problems like unreliable electricity supply (Mean value was notice as 1.99), lack of knowledge/training for micro irrigation (1.94), low output price/profitability (1.92), poor marketing managements (1.94) and land fragmentation (1.89).Out of the total sample of non-adopters, 67 percent of farmers agreed that due to non-availability of micro irrigation equipment they could not adopt micro irrigation on their farms. Similarly, 50 percent of farmers expressed the view that the reason for non-adoption of micro irrigation is due to non-availability of

[1]Gandhi, Vasanth P. (2014), "Growth and Transformation of the Agribusiness Sector: Drivers, Models, and Challenges", Indian Journal of Agricultural Economics, Vol.69, No.1, Jan-Mar.

subsidy and credit. On the other hand, the reason for non-adoption of micro irrigation is due to high operating and high investment cost respectively. Moreover, 62.50 percent of farmers disagreed for the adoption of micro irrigation due to in sufficient subsidy. About 50 percent of farmers reported that due to non-availability of information and lack of fencing protection are the reasons for non-adoption of micro irrigation on their farm. Across the reasons, it is observed that the percentage of farmers disagreed for various reasons ranged between 29.17 percent in case of not suitable for their land and 87.50 percent in case of high operating cost of micro irrigation.

4. Policy Suggestions:

- ✓ The subsidy must be introduced to all groups of farmers besides the farmers involved in the benefit schemes.
- ✓ The present subsidy system must be maintained continuously and the amount of subsidy must be reduced in accordance with the increase in extent of land.
- ✓ Provision of subsidy on irrigation equipment to all groups of farmers.
- ✓ Credit facility must be provided with low rates of interest.
- ✓ The farmers must be arranged in groups and according to the capacity of discharge of water from each bore well.
- ✓ More pipes should be given to farmers for micro irrigation.
- ✓ Renewal period should be reduced to three years instead of five years
- ✓ The Government should be able to provide micro irrigation as demanded by farmers
- ✓ Immediate sanction of drip/sprinkler within a month after applying for micro irrigation
- ✓ GST percentage on micro irrigation equipment's should be reduced.

CHAPTER - I

1.0 Introduction:

The increase in need for crop production for the growing population is causing the rapid expansion of irrigation throughout the country. In the present conditions of Indian agriculture, it is necessary to increase agricultural production for unit volume of water, per unit area of cropped land, per unit of time. To meet the food needs of the growing population the agricultural production needs to be boosted by following better soil-water management techniques that could provide the arid and semi-arid lands, better access to irrigation water without actually increasing stress on available water resources using pressurized resurveyed irrigation system. Effective utilization of every drop of water through micro irrigation is imperative for improving crop productivity, production and to achieve sustainable improvement in living standards of small and marginal famers of state by improving the water use efficiency through micro irrigation and farmers can get assured additional income.

Minor irrigation techniques are expected to lead various benefits including enhanced water use efficiency, increase in irrigated area with given quantity of water resources, enhanced productivity, labour cost savings, electricity savings and lesser pumping hours. An impact evaluation study conducted by global agri system (June 2014) observed that Maharashtra has shown greatest increase in irrigated area under Micro Irrigation (MI) system.

1.1. Pradhan Mantri Krishi Sinchanyee Yojana: (PMKSY): The Government of India has been implementing centrally sponsored scheme on Micro Irrigation with the objective to enhance water use efficiency in the agriculture sector by providing appropriate technological intervention like drip & Sprinkler irrigation technologies. As indicated above, the centrally sponsored scheme on micro irrigation (CSS) was launched by the department of Agriculture & Co-operation, Ministry of Agriculture in 2006. In June, 2010 it was up scaled to National Mission on Micro Irrigation (NMMI) which continued till the year 2013-14. From 1st April, 2014 NMMI was subsumed under National Mission on sustainable Agriculture (NMSA) and

implemented as "On Farm Water Management (OFWM) during the financial year 2014-15. From Ist April 2015 Micro Irrigation component of OFWM has been subsumed under Pradhan Mantri Krishi Sinchayee Yojana. It is implemented as a centrally sponsored scheme on Micro Irrigation during the financial year 2015-216 as per the same pattern of assistance & cost norms as were prevailing under OFWM, until revised.

The major objective of PMKSY is to achieve convergence of investments in irrigation at the field level, expand cultivable area under assured irrigation, improve on farm water use efficiency to reduce wastage of water, enhance the adoption of precision irrigation and other water saving techniques (More crop per drop), enhance recharge of aquifers and introduce sustainable water conservation practices by exploring the feasibility of reusing treated municipal waste water for peri-urban agriculture and attract greater private investment in precision irrigation system.

1.2 Pradhan Mantri Krishi Sinchayee Yojana (PMKSY) has been conceived by amalgamating several on-going schemes viz.

- Accelerated Irrigation benefit programme (AIBP) of the Ministry of Water Resources, River Development and Ganga Rejuvenation (Ministry of Water Resources (MOWR, RD and GR)
- Integrated Watershed Management Programme (IWMP) of Department of Land Resources (DOLR).
- And on farm Water Management (OFWM) of Department of Agriculture & Co-operation (DAC).

The scheme is implemented by Agriculture, Water resources and Rural development Ministries. The details of activities of these departments are:

a) **Ministry of Rural Development**: This is to mainly undertake rain water conservation, construction of farm ponds, water harvesting structures, small check dams and contour bunding etc.

b) **Ministry of Water Resources, River Development and Ganga Rejuvenation**: This is to undertake various measures for creation of assured irrigation sources, construction of diversion canals, field channels, water diversion/lift irrigation/ including development of water distribution systems.

c) **Ministry of Agriculture**: This is to promote efficient water conveyance and precision water application devices like Drips, Sprinklers, pivots and rain guns in the farm JalSinchan, Construction of Micro Irrigation Structures to supplement source creation activities, extension activities for promotion of scientific moisture conservation and agronomic measures.

The programme architecture of PMSKY is to adopt a decentralised state level planning and project execution structure that will allow states to draw up their own irrigation development plans based on District Irrigation Plan (DIP) and State Irrigation Plan (SIP). It will be operative as convergence platform for all water sector activities including drinking water and sanitation MGNREGA, application of science and technology etc., through comprehensive plan. State level sanctioning Committee (SLSC) chaired by the Chief Secretary of the State will be vested with the authority of oversee its implementation and sanction projects.

The programme is supervised and monitored by an inter-ministerial National steering Committee (NSC) is constituted under the chairmanship of Prime Minister with Union Ministers from concerned ministries. A National Executive Committee (SEC) is constituted under the chairmanship of Vice-Chairman, NITI Aayog to oversee programme implementation, allocation of resources inter-ministerial monitoring and performance assessment, addressing administrative issues.

1.3 Per Drop More Crop: (Component of PMKSY):

The Scheme PMKSY focuses on micro level storage structures, efficient water conveyance and application, precision irrigation systems, topping up of input cost beyond MGNREGA permissible limits, secondary storage water lifting devices, extension activities, coordination and management being implemented by DAC & FW.

1.3.1 Programme Architecture:

The broad institutional structure as per PMKSY guidelines are:

a. National Steering Committee (NSC) under the chairmanship of Hon'ble Prime Minister with Union Ministers from concerned ministries and Vice chairman, NITI

Aayog as members to provide general policy strategic directions for programme implementation and overall supervision addressing national priorities etc.,

b. National Executive Committee (NEC) under the Chairmanship of Vice chairman, NITI Aayog with secretaries of concerned miniseries/departments and chief secretaries of selected states as members to oversee program implementation, allocation of resources, inter-ministerial coordination monitoring and performance assessment, addressing administrative issues etc.

c. PMKSY Mission Directorate has been established in Ministry of Water Resources, River Development & Ganga Rejuvenation for mission mode implementation of 99 major and medium irrigation projects. The mission is also responsible for overall coordination & outcome focused monitoring of all components of PMKSY for achieving its target.

d. State level Sanctioning Committee (SLSC) under the chairmanship of Chief Secretary of the state to sanction projects and activities as recommended by IDWG.

e. Inter Departmental working Group (IDWG) under the chairmanship of Agriculture production Commission/Development Commissioner with secretaries of line departments as members. States, if they feel, may take the advice/ input of MI manufacturers by inviting representatives from manufacturers/micro irrigation industries as special invitee.

f. District level implementation Committee (DLIC) under the chairmanship of collector/district magistrate/CEO of Zillaparished/PD DRDA, Joint Director/Deputy Director of line departments in the district and progressive farmers, representatives of MI industry, and leading NGO as members to oversee PMKSY implementation and inter departmental coordination.

Nodal Department: State Agriculture Department generally is the nodal department for implementation of PMKSY (per drop more crop). However, state government is free to identify the nodal department based on the established institutional setup and mandate of the department. All communications between Ministry of Agriculture & State Government are through the nodal department.

States are free to identify dedicated implementing agencies; departments for implementations of per drop more crop (micro irrigation).

District & State Irrigation Plants (DIPs & SIPs): District Irrigation Plants (DIPs) are the corner stone for planning and implementation of different components of PMKSY which identify gaps in irrigation infrastructure after taking into consideration, the District Agriculture Plans (DAPs) vis-à-vis irrigation infrastructure currently available and resources that would be added from on-going schemes, both state & central. The annual action plans for per drop more crop (micro irrigation) are drawn from DIPS and implemented in conjunction with water the sources created under PMKSY in cluster mode for holistic development as far as possible.

1.4 Objectives of Per Drop More Crop (Micro Irrigation):

The main objectives of per drop more crop (Micro Irrigation) are:

a) to increase the area under micro irrigation technologies to enhance water use efficiency in the state,

b) to increase productivity of crops & income of farmers through precision water management,

c) to promote micro irrigation technologies in water intensive/consuming crops like sugarcane, banana, cotton etc, and give adequate focus to extend coverage of field crops under micro irrigation technologies,

d) to make potential use micro irrigation systems for promoting fertigation,

e) to promote micro irrigation technologies in water scarce, water stressed and critical ground water blocks/ districts,

f) to link tube well/ river lift irrigation projects of micro irrigation technologies for best use of energy both for lifting and pressurized irrigation as far as possible,

g) to establish convergence and synergy with activities of on-going programmes and schemes, partially with created water source for its potential use, integration of solar energy for pressurised irrigation etc.,

h) to promote, develop and disseminate micro irrigation technology for agriculture & horticulture development with modern scientific knowledge and

i) to create employment opportunities for skilled and unskilled persons, especially unemployed youth for installation and maintenance of micro irrigation systems.

1.5 Review of Literature:

D. Suresh Kumar and K. Palani Swami (2010) in their article they concluded that the drip method of irrigation has been found to have significant impact on resources saving cost of cultivation, yield of crops and farm profitability. Hence, the policy should be focused on promotion of drip irrigation in those regions where scarcity of water & labour is alarming and where shift towards wider spaced crops is taking place.

Dr.Khadija Priyan and Ratan Sarvan Panchal (2017) attempted a paper on micro irrigation. Their paper assesses the current status & technologies of micro irrigation and evaluating the future prospects of micro irrigation adoption in India. The rationale of the paper is to appraise micro irrigation as an innovative technology for sustainable agriculture in India and its significant impact on water productivity & land productivity.

Vanessa Meadu (2019) has taken up a study which demonstrates how rice and wheat can be grown using 40% less water. The author says that the researchers tested a range of existing solution to determine the optimal mix of approaches that will help farmers save water and money. The author further says that the researchers found that rice and wheat grown using a sub-surfaced drip fertigation system combined with conservation agriculture approaches used at least 40% less water and need 20% less nitrogen based fertilizer for the same amount of yield under flood irrigation, and still be cost effective for farmers.

Sub-surfaced Drip fertigation system involve below ground pipes that deliver precise doses of water and fertilizer directly to the plants' route/zone, avoiding evaporation from the soil. The proposed system can work both rice & wheat crops without the need to adjust pipes between rotation, saving money and labour.

A. Narayana Murthy, N. Devika and Bhattarai (2016) say that there is a need of emergence of small scale irrigation technology to conserve scarce water

resources. They further say that drip irrigation allows farmers to cultivate crops without moisture stress even under water scarce conditions, thereby increasing farm productivity. The discounted cash flow analysis shows that the investment in drip irrigation for green chilli cultivation is economically viable even without the state subsidy. Despite such favourable outcomes poor awareness prevailing among small farmers prevents adoption of drip irrigation. The authors suggest that there is a need to spread the benefits of vegetable crops under drip irrigation through a quality extention network on a continuous basis through various means. It would curtail the distress of the small farmers as well.

Arjesh Kumar Madhok says that with the operation of Micro Irrigation Fund (MIF) with these expected that the states which are lagging behind in adoption of Micro Irrigation would also be encouraged to take the advantage of the fund to incentivizing farmers has been done by the good performance sates. Besides, community driven and innovative projects to be taken up by the states to bring additional coverage of micro irrigation.

Catherine Elizabeth Boone Gypson (2016), in his paper on "More Crop Per Drop: benchmarking on farm irrigation water use for crop production" says that the frame work presented in his study provides a utility to support future research on irrigation water use, specially with regard to tracking implementation and effectiveness of new irrigation technologies, management practices, and efforts by cooperative educational extension services.

Mereditch Giordano and others in their paper on "Beyond" "More Drop Per Crop" they conclude that a focus on agricultural water productivity has brought greater attention to water scarcity and management issues and their complexity. There exists now a strategic opportunity to combine the lessons from this large body of research to tackle challenges, improve methods and application, and this contribute to food and water scarcity, economic growth and poverty alleviation goals.

Dr.VibhaDhawan (2017) in his paper on "Water and Agriculture India" says that improvement of policies, strategies and regulatory measures to prevent the

water use should be taken into consideration. Awareness and orientation of water users in the agriculture sector to switch to more water efficient methods can help the country against water scarcity. Moreover, enforcement of best practices can help present policy makes and planners to enhance governance structures to further understand key indicators that can assist in data-driven decision-making. These challenges can be better implicated, provided there are favourable policies and mechanisms that encourage the agriculture sector to increase water use efficiency.

Sarah Carriger and Domitille Valle in their article "More Crop per Drop' say that water saving measures at the field level, include land levelling farm channel and good puddling and bund maintenance. Minimizing turn-around time between wet land preparation and transplanting and also save water by reducing the time when no crop is present, therefore minimizing water loss.

Pankajyagi and Manish Singh (2019), they concluded in their paper that adoption of an integrated approach which takes into account soil-water-crop-climate-resources management and farm mechanisation, planning & implementation of location specific, cost effective and energy, efficient sustainable, interventions/ strategies are the pathways to enhance crop water and energy productivity.

Dr. Kadija Priyan and Ratan Charan Panchal (2017) in their paper on "micro Irrigation: an efficient technology for India's sustainable agricultural growth "they said that the rationale of their paper is to apprise micro irrigation as an innovative technology for sustainable agriculture in India and its significant impact on water productivity and land productivity.

N. Dinesh Kumar and Jos C. Van Dam in their paper on "Improving water Productivity in Agriculture in India: beyond "More Crop per Crop", they concluded that in medium & long term, electricity and water pricing policies have to be made more efficient so as to expand the opportunities for Water Productivity (WP) improvements without increasing farming risks, domestic and regional food insecurity and unemployment. Only this can link WP improvements to raising the income of the farming households.

Kartikeyan GM and Sureshi (2019). A in their paper on "A study on Understanding the adoption of water saving technology : A case study of Drip Irrigation: they studied about the factors that drives the adoption of Drip Irrigation in Errode district in Tamilnadu, India.The authors say that despite many advantages on the drip irrigation of many farmers in the district have not adopted to the drip irrigation, so the findings also analyse the reasons for the farmers to not adopt drip irrigation, including financial constraints, water scarcity, no subsidy from the government, damages by the animals, high maintenance cost and lacking technical skills etc.

1.6 Objectives of the study:

The main objective of the study is to analyse the various benefits of MI to the farmers including in input use, costs and returns. Specifically, the objectives would be 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 across states.

(4) To study overall impact on farmer incomes and the cost-benefit in selected crops.

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

1.7 Selection of the State and Methodology:

The Ministry of Agriculture, Government of India asked its Agro-Economic Research Centres (AERC) to take up an evaluation study on PMKSY in their respective states. The Agro-Economic Research Centre, Andhra University, Waltair has taken up the evaluation study in Telangana state taking 2019-2020 as the reference year.The present undertaken study based on both primary and secondary data. For collection of primary data in Telangana, a multi-stage stratified random sampling method has been adopted. In the first stage two districts from Telangana, namely Nizamabad and Nalgonda have been selected on the basis of highest crop area has been considered as a major determinant while selection of the above said districts. In the second stage, two mandals from Nizamabad district and four mandals from Nalgonda districts have been selected based on the same criteria i.e., highest crop area. In the final stage, the selection of farmers in selected villages has been based on scale of adoption of micro irrigation. From each of the selected districts, 48 micro irrigation adopted farmers and 12 non-adopted farmers have been selected randomly spread more or less evenly across the respective villages 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 district hand book of statistics, published of Directorate of Economic and Statistics, Telangana State.

1.8 Chapter Scheme of the Report:

The study report is divided into five chapters. The first chapter being the introductory chapter, the second chapter presents the review of earlier works. The third chapter presents the profile of micro irrigation adoption in the state, while the fourth chapter deals with the performance of sample farmers in the selected districts. Finally the fifth chapter provide the summary and conclusions of the study.

CHAPTER - II

Profile of Micro Irrigation in the state of Telangana

2.0. Introduction:

Telangana state is the 28th state of India. It borders Maharashtra state on the north-east, Karnataka on west and Andhra Pradesh on East and south. This state is the Land locked state endowed with bountiful resources, fertile soils, and diversified cropping pattern. Agriculture is a way of life, a tradition that has shaped the culture and economic life of the people of Telangana.

The total geographical area of the state is 272.96 lakh acres and the land use pattern of Telangana state during 2019-2020 is as follows:

Table 2.1

Land Utilization Particulars 2019-2020

S.No.	Category	Area in lakh acres	% of total geographical area
1	Total Geographical Area	276.96	100.00
2	Forest	66.67	24.07
3	Barren & Uncultivable land	15.00	5.42
4	Land put to non-agricultural uses	20.61	7.44
5	Cultivable waste land	4.44	1.60
6	Permanent pastures & other grazing lands	7.39	2.67
7	Land under misc. tree crops, groves not included in net sown area	2.77	1.00
8	Other fallow lands	18.56	6.71
9	Current Fallow lands	26.37	9.52
10	Net Area Sown	115.15	41.57
11	Gross Area Sown	142.68	NIL

2.1. Irrigated Area:

The Gross area irrigated in the state during the year 2019-2020 has increased to 31.31 lakh hectares from 25.29 lakh hectares in 2014-15, showing an increase of 44.52% and the net irrigated area in the state has increased to 54.16 lakh hectares from 36.70 lakh hectares which is an enhancement of 48.80%. The intensity of irrigation for 2019-2020 is 1.42.

2.1.1 Micro Irrigation:

Effective utilization of every drop of water through micro irrigation is imperative for improving crop productivity, production and to achieve sustainable improvement in living standards of small & marginal farmers of the state by improving the water use efficiency through micro irrigation and farmers can get assured additional income. Micro irrigation Project (MIP) a unique & comprehensive project launched in November 2003, with an objective of enhancing crop productivity by improving the water use efficiency through micro irrigation systems. In the context of Andhra Pradesh Reorganization Act, 2014, a new state of Telangana came into existence on 22nd June, 2014. Accordingly, Telagana Micro Irrigation was carved out of Andhra Pradesh, Micro Irrigation Project with an objective of enhancing the crop productivity by improving the water use efficiency through micro irrigation systems.

2.2. Profile of Micro Irrigation Adoption in the State:

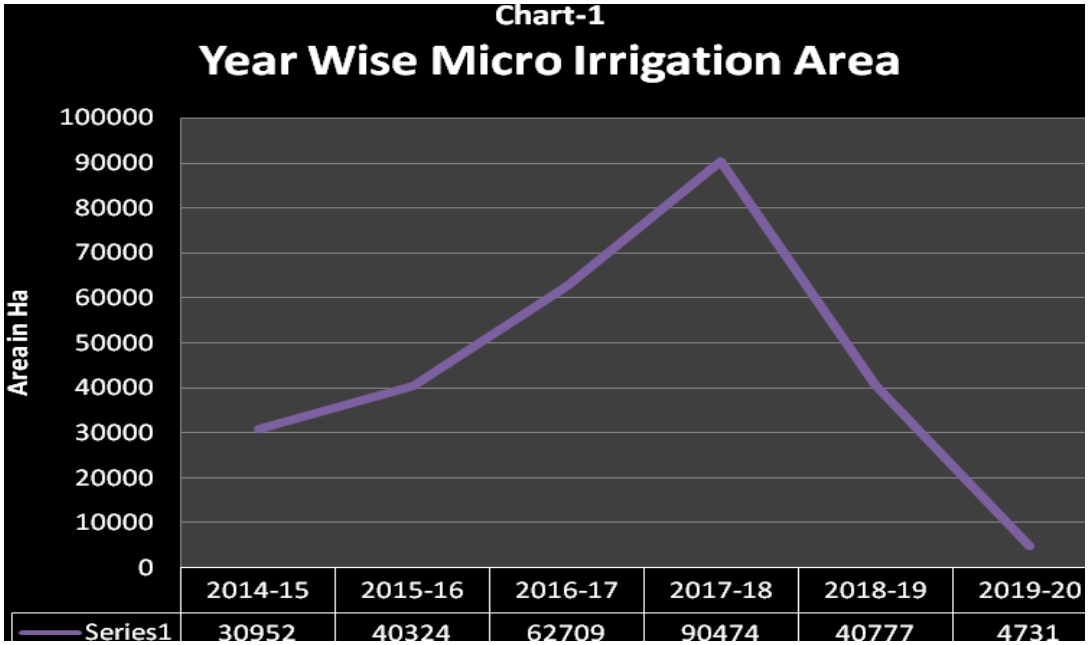
The details of year wise growth of micro irrigation in the state from 2014 – 15 to 2019-2020 are presented in the following table 2.2

The allocation of funds under PMKSY/PDMC has increased from 240.92 crores in 2014-15 to 517.7crores in 2017-18. During 2018-19 the allocation of funds was only 247 crores due to diversion of funds to other irrigation projects. Accordingly, the area under micro irrigation has also increased from 0.31 lakh hectares to 0.90 lakh hectares during 2017-18. Owing to insufficient funds the area under micro irrigation has come down to 0.40 lakh hectares during 2018-19. Accordingly, the number of beneficiaries also has come down to 0.37 lakhs. This has reflected in the percentage of micro irrigation in total irrigated area from 2014-15 to 2018-19. Prior to 2019-20 the state government used to take NABARD loans for the purpose of extending more loans to the drip and sprinkler farmers, During this particular year somehow did not get financial assistance from NABARD that's why the area under micro irrigation as been drastically decreased in 2019-20. The annual growth rates are also calculated upto 2018-19 from 2014-15.

Table 2.2: Year- wise growth of micro-irrigation in the state

Year	Funds allocated/ received under PMKSY-PDMC (Rs. In Crores)	Year to Year % of Change	Area under Micro Irrigation (MI) (ha)	Year to Year % of Change	Number of Beneficiaries	Year to Year % of Change	Gross Irrigated Area (lakhs Ha)	Year to Year % of Change	MI as % of total irrigated area
2014-15	240.9	-	30952	-	31277	-	25.29	-	1.22
2015-16	322.32	33.8	40324	30.28	39545	26.43	20.28	-19.81	1.99
2016-17	472.3	46.53	62709	55.51	55121	39.39	30.08	48.32	2.08
2017-18	517.7	9.61	90474	44.28	83458	51.41	31.64	5.19	2.86
2018-19	247	-52.29	40777	-54.93	37596	-54.95	23.91	-24.43	1.71
2019-20	16.17		4731		1745	-	31.31	30.95	-
Annual Growth rate	5.77		13.16		11.45		3.28		

Source: TSMIP, Telangana, Hyderabad



2.3 District-wise Adoption of Micro Irrigation 2018-19:

Among the districts Mahaboobnagar occupied the first position (6.53%) followed by Vikarabad, Adilabad, Sangareddy, Wagangal., Kurnool and Narayanpet districts in adoption of micro irrigation, out of the total gross irrigated area of 23.91 lakh hectares of the state. The details are presented in the table 2.3

Table 2.3
District-wise MI adoption (2018-19)

Sr. No.	District Name	Area under Micro Irrigation	Gross Irrigated Area (Ha)	MI as % of total irrigated area
1	Adilabad	2298	62058	3.70
2	Komarambheem	198	14584	1.36
3	Mancherial	961	71223	1.35
4	Nirmal	1510	103568	1.46
5	Nizamabad	3156	260765	1.21
6	Jagtial	826	185197	0.45
7	Peddapalli	402	123851	0.32
8	Jayashankar	1193	65778	1.81
9	Bhadradri	619	88596	0.70
10	Mahabubabad	764	112669	0.68
11	Warangal rural	1068	160161	0.67
12	Warangal urban	439	72098	0.61
13	Karimnagar	446	141823	0.31
14	Rajanna	289	48226	0.60
15	Kamareddy	1901	103159	1.84
16	Sangareddy	2220	71252	3.12

Sr. No.	District Name	Area under Micro Irrigation	Gross Irrigated Area (Ha)	MI as % of total irrigated area
17	Medak	746	51932	1.44
18	Siddipet	2037	95096	2.14
19	Jangaon	1086	60678	1.79
20	Yadadri	418	98955	0.42
21	MedchalMalkajgiri	87	10982	0.79
22	Rangareddy	1387	54556	2.54
23	Vikarabad	1717	39725	4.32
24	Mahabubnagar	1966	30109	6.53
25	Jogulamba	2202	89948	2.45
26	Wanaparthy	2903	102417	2.83
27	Nagarkurnool	2815	90261	3.12
28	Nalgonda	3077	216358	1.42
29	Suryapet	606	195258	0.31
30	Khammam	1044	210349	0.50
31	Mulug	428	59472	0.72
32	Narayanpet	1174	40268	2.92
	TELANGANA STATE	**41983**	**2391372**	**1.76**

Source: TSMIP, Telangana, Hyderabad

2.4. Crop-wise Adoption of Micro Irrigation (2018-19):

Out of the total micro irrigated area of 40,777 hectares, green chillies, Tomato, Mango, Sugarcane, Maize and Cotton occupied major percentages respectively. All are mostly commercial crops. Other Non-horticultural crops reported to be 32.39% of gross micro irrigated area. The crop wise details are presented in the following table 2.4

Table 2.4

Crop-wise adoption of MI (2018-19)

Sr. No.	Crop Name	Area under Micro Irrigation	Percent
1	Bajra (Pearl millet)	1	0.002
2	Cotton	1194	2.928
3	Maize/Corn	2043	5.010
4	Sugarcane	2677	6.565
5	Aonla/Amla	0	0.000
6	Banana	75	0.184
7	Ber	27	0.066
8	Cashewnut	40	0.098
9	Coconut	17	0.042
10	Custard Apple	39	0.096
11	Fig	13	0.032
12	Grapes	17	0.042

Sr. No.	Crop Name	Area under Micro Irrigation	Percent
13	Guava	689	1.690
14	Lime/Lemon/Citrus	238	0.584
15	Mango	4013	9.841
16	Orange	0	0.000
17	Papaya	0	0.000
18	Pomegranate	71	0.174
19	Sapota	19	0.047
20	Water Melon	1	0.002
21	French Beans	18	0.044
22	Beetroot	55	0.135
23	Bitter Gourd	0	0.000
24	Bottle Gourd	17	0.042
25	Brinjal	189	0.463
26	Cabbage	228	0.559
27	Carrot	145	0.356
28	Cauliflower	93	0.228
29	Cucumber	19	0.047
30	Ginger	19	0.047
31	Green Chillies	6610	16.210
32	Leafy Vegetables	523	1.283
33	Okra/Ladyfinger/Bhindi	123	0.302
34	Onion	149	0.365
35	Peas	5	0.012
36	Potato	173	0.424
37	Radish	6	0.015
38	Ridge/Sponge Gourd	0	0.000
39	Sweet Potato	4	0.010
40	Tapioca / Cassava	4	0.010
41	Tomato	4213	10.332
42	Turmeric	3294	8.078
43	Rose	9	0.022
44	Garlic	3	0.007
45	Agroforestry Species	491	1.204
46	Red Chillies	0	0.000
47	Jasmine	0	0.000
48	Cocoa	0	0.000
49	Oil palm	0	0.000
50	Jamun	0	0.000
51	Drumstick	0	0.000
52	Mulberry Plant	0	0.000
53	Other Horticulture Crops	7	0.017
54	Other Non-Horticulture Crops	13206	32.386
	Total of Telangana	40777	100

Source: TSMIP, Telangana, Hyderabad

2.5 The Physical and Financial Targets & achievements of Micro irrigation in Telangana.

These details are presented from the year 2015-16 to 2019-2020. Glancing over the table, it is understood that the financial and physical targets have increased from year to year i.e. from 205-16 to 2016-17. During 2017-18 and 2018-19 there observed a steep decline in both the years in achieving financial and physical targets. Since the full allocations of funds are not released during 2019-2020, accordingly the financial and physical targets resulted in a negative situation. These details are presented in the following table 2.5

Table 2.5

Per Drop – More Crop Micro Irrigation Target & Achievements in Telangana State

Area in Hectares&Rs. in Lakhs

Year	Target						Achievement							
	Physical			Financial			Physical				Financial			
	Drip	Sprinkler	Total	Drip	Sprinkler	Total	Drip	Sprinkler	Total	Diff	Drip	Sprinkler	Total	diff
2015-16	29475.00	10145.00	39620.00	8506.55	769.00	9275.55	31188.00	8676.00	39864.00	0.62	9726.48	513.84	10240.32	10.40
2016-17	44179.80	14554.96	58734.76	15031.40	1168.68	16200.08	51340.90	10639.12	61980.02	5.53	15626.40	867.81	16494.21	1.82
2017-18	90222.00	34801.00	125023.00	24342.00	2875.00	27217.00	55749.00	33725.00	89474.00	-28.43	12003.60	2321.85	14325.45	-47.37
2018-19	88500.00	29500.00	118000.00	27810.40	2198.00	30008.40	28145.00	12236.00	40381.00	-65.78	6959.13	853.71	7812.84	-73.96
2019-20	80215.00	28410.00	108625.00	24854.00	2116.75	26970.75	4255.00	476.00	4731.00	-95.64	886.98	33.60	920.58	-96.59

Source: Report of Task Force on Micro Irrigation (MI), Government of India

2.6. Conclusions:

The allocation of funds under PMKSY/PDMC increased from 24.92 crores in 2014-15 to 51.77 crores in 2017-18. During 2018-19 the allocation of funds was only 247 crores due to diversification of funds to other irrigation projects. Accordingly, the area under micro irrigation has also increased from 0.31 lakh hectares to 0.90 lakh hectares during 2017-18. Owing to insufficient funds, the area under micro irrigation has come down to 0.40 lakh hectares during 2018-19. Accordingly, the number of beneficiaries has come down to 0.37 lakhs. This has reflected in the percentage of micro irrigation in total irrigated area from 2014-15 to 2018-19. Among the districts Mahaboobnagar occupied the first position in district wise adoption of micro irrigation during 2018-19. Other Non-horticultural crops reported to be 32.39 percent of gross micro irrigated area. During 2017-18 and 2018-19 there observed a steep decline in both the years in achieving financial and physical targets. Since the full allocations of funds are not released during 2019-20, accordingly the financial and physical targets resulted in a negative situation.

CHAPTER – III
ADOPTION OF MI UNDER PMKSY/PDMC SCHEME OF SAMPLE FARMERS

3.1 Adoption of MI under PMKSY/PDMC scheme of Sample farmers:

This chapter deals with the sample farmers performance in adopting the micro irrigation scheme.

3.1.1. Profile of Sample Farmers:

As mentioned in the introductory chaptertwo districts viz, Nizamabad and Nalgonda districts are selected for the purpose of the study from the state of Telangana. Two crops namely Soya bean &Cotton which are widely grown in these two districts respectively are taken for the analysis. In each district a sample of 48 beneficiaries & 12 non-beneficiaries are selected from 3 villages for each crop. Thus, a total of 120 sample farmers are taken for the analysis of the study. In Nizamabad district, out of 48 adopters only one adopter has two typed of irrigation drip and sprinkler, whereas Nalgonda district all 48 adopters have reported to be practised drip irrigation only. The details are presented in the following table 3.1

Table 3.1
Sample coverage of Beneficiary Farmers

Sr. No.	District surveyed	No. of Village	No. of Farmers surveyed	Drip	Sprinkler	Micro-Irrigation (Both)	Non-Adopters
1	NIZAMABAD	7	60	9	38	1	12
2	NALGONDA	10	60	48	0	0	12

Source: Field Data

3.1.2 Age of Adopters:

Out of 96 beneficiaries 32.39 percent have reported under the age group of 40—50 followed by 3.25 percent of farmers reported under the age group of 32-40. The details are presented in the following Table 3.2

Table 3.2
Age of adopters

Age	Number	Percent
Under 20	0	0.00
20-30	12	12.50
30-40	30	31.25
40-50	31	32.29
50-60	15	15.63
Above 60	8	8.33

Source: Field Data

3.1.3 Education of Adopters:

Out of 96 beneficiary farmers, 30.21 percent of farmers are illiterates. 19.79 percent of farmers reported to be studied X^{th} standard. 14.58 percent of farmers have completed middle school education and 11.46 percent reported to have completed primary education and the same percentage (11.46) of farmers reported to have completed graduation. The details are presented in the following table 3.3

Table 3.3
Education of adopters

	Number	Percent
Illiterate	29	30.21
Primary	11	11.46
Middle	14	14.58
10thStd	19	19.79
12thStd	9	9.38
Graduate	11	11.46
Post-Graduation	3	3.13
Technical	0	0.00

Source: Field Data

3.2 Land and Water sources in Relation to Micro Irrigation:

3.2.1 Land Particulars (per holding):

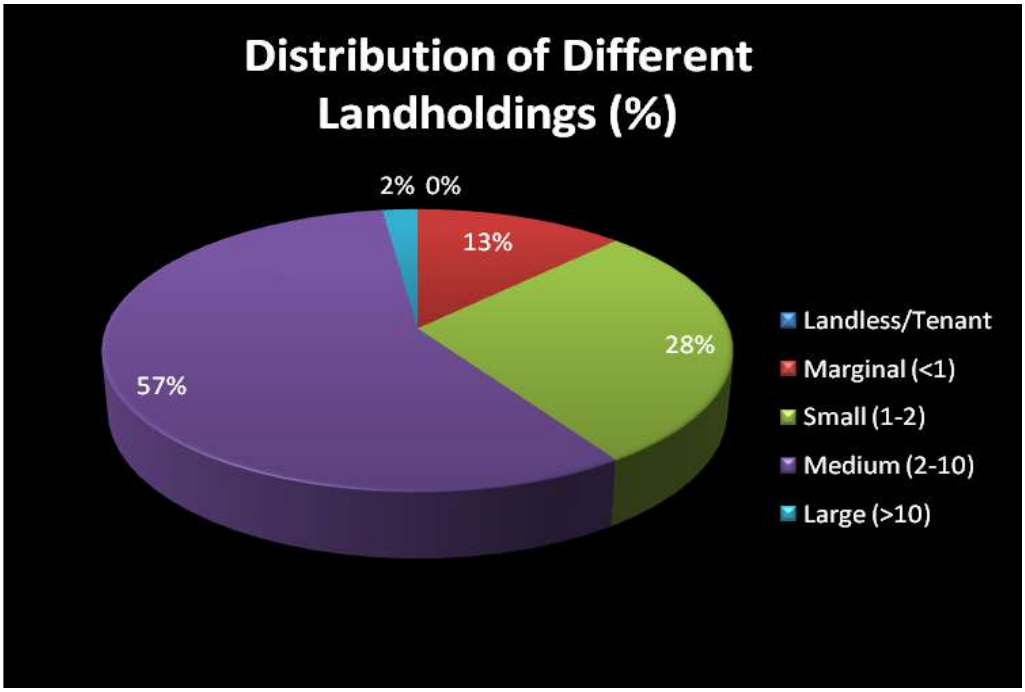
Out of 96 beneficiary farmers, 57.29 percent of farmers have reported under the size group of 2-10 hectares (medium). 28.13 percentage of farmers have reported to be under the size group of 1-2 hectares (small). Moreover, 12.50 percent of farmers have reported under the size group of below one hectare and 2.08 percent of farmers have reported under the size group of more than 10 hectares (large). On an average, the total operated area is reported to be 4.07 hectares. Across the groups, the per holding area has varied from 0.95 hectares in case of marginal farmers to 12.14 hectares in case of large farmers. The per holding total micro irrigated area of beneficiary farmers is reported to be 2.38 hectares. Across the groups, the per holding area has varied from 0.95 hectares in case of marginal farmers to 12.14 hectares in case of large farmers. The per holding total micro irrigated area of beneficiary farmers is reported to be 2.89 hectares. Across the groups, the micro irrigated area ranged between 0.88 hectares in case of marginal farmers to 2.89 hectares in case of medium farmers. On an average, the per holding area under drip irrigation of beneficiary farmers is reported to be 1.09

hectares, while the area under sprinkler irrigation is reported to be 1.29 hectares. The details are presented in the following Table 3.4

Table 3.4
Land Area (Hectares)

Group (ha)	Number of Farmers	Per cent (%)	Area Operated in Hectares - Average					
			Total Area Operated	Micro-Irrigated area			Non-Micro Irrigated	Un-Irrigated
				Total	Drip	Sprinkler		
Landless/Tenant	0	0.00	0.00	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00
Marginal (<1)	12	12.50	0.95	0.88 (92.63)	0.61 (64.21)	0.27 (28.42)	0.07 (7.37)	0.00
Small (1-2)	27	28.13	2.42	2.05 (84.71)	0.61 (25.21)	1.44 (59.50)	0.37 (15.29)	0.00
Medium (2-10)	55	57.29	5.28	2.89 (54.73)	1.44 (27.27)	1.45 (27.46)	1.51 (28.60)	0.87
Large (>10)	2	2.08	12.14	1.52 (12.52)	0.51 (4.20)	1.01 (8.32)	10.63 (87.48)	0.00
Total	96	100.00	4.07	2.38 (58.48)	1.09 (26.78)	1.29 (31.70)	1.20 (29.48)	0.50

Source: Field Data
Note: figures in brackets are percentages to Total Area Operated



3.2.2 Water Sources:

Among the total beneficiary farmers (96), 98.96 percent of the farmers are dependent on tube wells. Negligible percent of farmers reported that they are to be

dependent on other sources (canal, well and river lift). The details are follows in the table 3.5

Table 3.5
Water sources

Source	Number	Percent (%)
Canal	6	6.25
Canal-Lift	0	0.00
River-Lift	1	1.04
Tubewell	95	98.96
Well	1	1.04
Tank	0	0.00
Pond	0	0.00
Farm Pond	0	0.00
Check dam	0	0.00
Percolation Tank	0	0.00

Source: Field Data

3.2.3 Water Situation for Farming:

About 71.88 percent of beneficiary farmers reported that they have no scarcity of water for farming. Moreover, 14.58 percent of farmers reported to have scarcity of water occasionally and 12.05 percent of farmers reported to have scarcity of water for farming. Negligible percent of farmers reported to have excess water. The details are presented in the following table 3.6

Table 3.6
Water situation for farming

Water situation	Number	Percent (%)
Excess water	1	1.04
No scarcity	69	71.88
Occasional scarcity	14	14.58
Scarcity	12	12.50
Acute scarcity	0	0.00

Source: Field Data

3.2.4 Type of Soil:

Around 54 percent of farmers reported to have heavy soils, while around 42 percent of farmers reported to have medium soils. Negligible percentage (4.16) of farmers reported to have light soils. The details are presented in the following table 3.7.

Table 3.7
Type of Soil

Soil	Number	Percent (%)
Light	4	4.16
Medium	40	41.67
Heavy	52	54.17

Source: Field Data

3.2.5 Type of Terrain:

Of the Total farmers, 87.50 percent of farmers, reported to have flat terrain, while 12.50 percent of farmers reported the terrain with up and downs. The details are presented in the following Table 3.8.

Table 3.8
Type of Terrain

Terrain	Number	Percent (%)
Flat	84	87.50
Up & Down	12	12.50
Hilly	0	0.00

Source: Field Data

3.2.6 Rainfall Situation (2019-20):

About 78.13 percent of farmers reported to have received average rainfall during 2019-20, while 13.54 percent of farmers reported to have received low rainfall. Only 8.33 percent of farmers reported to have received heavy rainfall during the year. The details are presented in the following table 3.9

Table 3.9
Rainfall situation (2019-20)

Rainfall	Number	Per cent (%)
Very heavy	0	0.00
Heavy	8	8.33
Average	75	78.13
Low	13	13.54
Very low	0	0.00

Source: Field Data

3.2.7: Year started using Micro Irrigation:

About 33.33 percent of farmers started using micro irrigation three years ago, while 21.17 percentage of farmers reported to have started micro irrigation two years ago. Nearly 17 percent of farmers reported to have started using micro

irrigation five years ago. The average of years using micro irrigation is reported to be 2.77. The details are presented in the following table 3.10.

Table 3.10
Year started using micro-irrigation

When started using micro-irrigation	Number	Percent (%)
Current Year (2019-20)	1	1.04
Last Year (2018-19)	13	13.54
2 years ago	28	29.17
3 years ago	32	33.33
5 years ago	16	16.67
10 years ago	6	6.25
More than 10 years	0	0.00
Overall Average	**2.77**	

Source: Field Data

3.2.8 Whether availed Subsidy:

Out of 96 beneficiary farmers, 96.88 percent of farmers availed the facility of subsidy. The details are presented in the following table 3.11.

Table 3.11

Whether Availed of Subsidy

Availed of subsidy	Number	Percent (%)
Yes	93	96.88
No	3	3.13

Source: Field Data

3.3 Cropping Profile and Changes:

3.3.1: Cropping Profile with micro irrigation:

The major crops that were grown by farmers under drip irrigation are cotton, water melon, chillies, vegetables, cucumber, maize, banana, sweet orange and sugarcane.

The per holding area under drip irrigation varied from 0.57 (100 %) hectares in case of maize (inter crop) to 2.11(100 %)) hectares in case of banana. On the other hand, the crops that are grown under sprinkler irrigation are soya bean, Bengal gram and groundnut. The per holding area under sprinkler irrigation ranged between 3.20 (95%) hectares in case of Bengal gram and 3.94 (100%) hectares in case of groundnut. The crops that are reported under non-micro irrigation are soya

bean, cotton, Bengal gram. Moreover, the crops that are reported under fertigation are cotton, watermelon, chillies and banana.

Among the 40 reporting farmers of cotton crop, 37.50 % of farmers reported fertigation, while among the rabi crops like watermelon and chilli crops about 42.86% of farmers and 40% of reporting farmers reported fertigation respectively. Similarly, among nine reporting farmers of banana crop, 11.11% of farmers reported fertigation. The details are presented in the following Table 3.12

Table 3.12
Cropping profile and area with micro-irrigation

Sr. No	Crop name	Season Kharif/ Rabi/ other	No. of farmers reporting	Area - average in hectares (based on reporting farmers)					
				Area under the crop	Drip area	Sprinkler area	Irrigated Non-Micro area	Un-irrigated area	Fertigation (%)
1	Soya been	Kharif	38	3.50	0.00 (0.00)	3.31 (95.00)	0.19 (5.00)	0.00 (0.00)	0.00
2	Cotton	Kharif	40	3.40	1.87 (55.0)	0.00 (0.00)	0.47 (14.00)	1.12 (33.00)	37.50
3	Bengal Gram	Rabi	35	3.38	0.00 (0.00)	3.20 (95.00)	0.15 (4.00)	0.02 (1.00)	0.00
4	Ground nut	Rabi	4	3.94	0.00 (0.00)	3.94 (100.0)	0.00 (0.00)	0.00 (0.00)	0.00
5	water million	Rabi	7	1.15	1.15 (100.0)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	42.86
6	Chilli	Rabi	5	1.54	1.54 (100.0)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	40.00
7	Vegetables	Rabi	5	0.97	0.97 (100.0)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00
8	cucumber	Rabi	1	0.81	0.81 (100.0)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00
9	Maize (Inter Crop)		4	0.57	0.57 (100.0)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00
10	Banana	others	9	2.11	2.11 (100.0)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	11.11
11	Sweet Orange	others	8	0.94	0.94 (100.0)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00
12	Sugar cane	others	2	0.71	0.71 (100.0)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00

Source: Field Data

Note: In case of intercropping, write both crop names
Figures in brackets are percentages to area under the crop

3.3.2 Cropping Profile before Micro Irrigation:

The crops like Soya bean, Cotton, Paddy (Kharif), Groundnut, Bengal gram, Paddy (Rabi) have reported comparatively higher irrigated area than other crops.

The average area per reporting farmer ranged between 0.91(100%)in case of vegetables to 4.03(100%) in case of Paddy before adoption of micro irrigation. The details are presented in the following table 3.13

Table 3.13

Cropping profile and area before micro irrigation

Sr. No.	Crop name	Season Kharif/Rabi/ other	No. of farmers reporting	Area – average in hectares for reporting farmers		
				Total area	Irrigated area	Un-irrigated area
1	Soya	Kharif	38	2.13	1.84 (86.40)	0.30 (14.10)
2	Cotton	Kharif	46	2.96	1.76 (59.50)	1.24 (41.90)
3	Paddy	Kharif	27	2.99	2.99 (100.0)	0.00 (0.00)
4	black gram	Kharif	2	1.62	0.00 (0.00)	1.62 (100.0)
5	jowar	Kharif	1	0.41	0.00 (0.00)	0.41 (100.0)
6	Ground nut	Rabi	4	2.33	2.33 (100.0)	0.00 (0.00)
7	Ground nut	Rabi	4	2.33	2.33 (100.0)	0.00 (0.00)
8	Bengal Gram	Rabi	36	2.39	1.97 (82.4)	0.42 (17.6)
9	Chilli	Rabi	3	1.21	1.21 (100.0)	0.00 (0.00)
10	Redgram	Rabi	1	0.81	0.00 (0.00)	0.81 (100.0)
11	black gram	Rabi		1.62	1.62 (100.0)	0.00 (0.00)
12	paddy	Rabi	11	4.03	4.03 (100.0)	0.00 (0.00)
13	Vegetables	Rabi	4	0.91	0.91 (100.0)	0.00 (0.00)
14	Green gram	Rabi	1	0.81	0.00 (0.00)	0.81 (100.0)
15	Maize (inter crop)		6	1.99	1.99 (0.00)	0.00 (0.00)
16	Banana	Others	8	2.08	2.08 (100.0)	0.00 (0.00)
17	Sweet Orange	Others	8	0.94	0.94 (100.0)	0.00 (0.00)
18	Sugarcane	Others	5	1.17	1.17 (100.0)	0.00 (0.00)

Source: Field Data

Note: In case of intercropping, write both crop names together.
Figures in brackets are percentages to total area under the crop

3.3.3. Changes in area and Yield due to micro irrigation:

3.3.3.1 Changes in area due to micro irrigation:

The farmers have reported that there is a large increase in the area of chillies, Bengal gram, soya bean and watermelon crops due to adoption of micro irrigation. On the other hand, 71.43% of farmers growing watermelon reported that there is a substantial change in the increase in the area of watermelon crop due to adoption micro irrigation. The farmers growing vegetables, maize (inter crop) and sweet orange reported that there was no change in the area due to adoption of micro irrigation. The percentage of farmers reporting 'no change' in area varied from 14.29% in case of watermelon to 100% in case of vegetables, maize and sweet orange crops.

3.3.3.2 Change in Yield due to Micro Irrigation:

All the farmers growing groundnut and vegetables reported that there is a large increase in yield due to micro irrigation. On the other hand, the increase in yield ranged between 12.50% in case of sweet orange and 100% in case of watermelon, cucumber and maize (inter crop) crops. Much difference is not observed in case of mean valuesof area and yield of reported crops. The details are presented in the following table 3.14

Table 3.14

Change in area and yield due to Micro irrigation

Sr. No.	Crop name	No. of farmers reporting	Change in Area due to Micro Irrigation (%)						Change in Yield due to Micro Irrigation (%)					
			5	4	3	2	1	Mean	5	4	3	2	1	Mean
1	Soya been	38	15.79	32.18	52.63	0.00	0.00	3.54	26.32	73.68	0.00	0.00	0.00	4.15
2	Cotton	40	0.00	25.00	67.50	7.50	0.00	3.18	42.50	57.50	0.00	0.00	0.00	4.43
3	Bengal Gram	35	22.86	22.86	54.29	0.00	0.00	3.50	40.00	60.00	0.00	0.00	0.00	4.17
4	Ground nut	4	0.00	33.33	66.67	0.00	0.00	3.33	100.00	0.00	0.00	0.00	0.00	5.00
5	water million	7	14.29	71.43	14.29	0.00	0.00	4.00	0.00	100.00	0.00	0.00	0.00	4.00
6	Chilli	5	40.00	20.00	40.00	0.00	0.00	4.00	40.00	60.00	0.00	0.00	0.00	4.40
7	Vegetables	5	0.00	0.00	100.00	0.00	0.00	3.00	100.00	0.00	0.00	0.00	0.00	5.00
8	cucumber	1	0.00	100.00	0.00	0.00	0.00	4.00	0.00	100.00	0.00	0.00	0.00	4.00
9	Maize (Inter Crop)	4	0.00	0.00	100.00	0.00	0.00	3.00	0.00	100.00	0.00	0.00	0.00	4.00
10	Banana	9	0.00	22.22	77.78	0.00	0.00	3.22	44.44	55.56	0.00	0.00	0.00	4.44
11	Sweet Orange	8	0.00	0.00	100.00	0.00	0.00	3.00	87.50	12.50	0.00	0.00	0.00	4.88
12	Sugar cane	2	0.00	0.00	50.00	50.00	0.00	2.50	0.00	100.00	0.00	0.00	0.00	4.00

Source: Field Data

Scale: Large Increase =5 Increase =4 No Change =3 Decrease =2 Large Decrease =1

3.4. Changes in Incomes and Farm Economics with Micro Irrigation:

3.4.1 Changes in Production, Income, Input and Costs with Micro Irrigation for Major Crops (per hectare):

The changes in production, incomes and costs which have come through the adoption of micro irrigation for crops, Soya bean, cotton and Bengal gram are presented in the following Table 3.15(a). The per hectare of net profit of Bengal gram increased by more than 401 percent by adoption of micro irrigation when compared to without micro irrigation followed by the other crops like soyabean (401 percent)and Cotton (348.3 percent) . The per hectare total sales revenue of soyabean increased by 214.5 percent when the farmers practiced micro irrigation followed by cotton (198.4percent) and Bengal gram (292percent).

The changes in production, incomes and costs which have come through the adoption of micro irrigation for crops, Banana, Sweet orange and Sugar cane are presented in the following Table 3.15(b). While collecting primary data for crops like Banana and Sugar cane, the reported farmers are found to be very low due to low farming in the study area; this should be treated as a limitation while doing analysis.The per hectare of net profit of Sweet orange increased by more than 294.12 percent by adoption of micro irrigation when compared to without micro irrigation followed by the other two crops i.e., Banana (286.9 percent) and Sugarcane (241.97) percent. The per hectare total sales revenue of banana increased by 212 percent when the farmers practiced micro irrigation followed by sweet orange (173 percent) and sugarcane (196 percent).

The changes in production, incomes and costs which have come through the adoption of micro irrigation for crops, Soya bean, cotton, Bengal gram, Banana, Sweet Orange and Sugarcane are presented in the following Table 3.15(c) The per hectare net profit of all crops increased by 383.32 percent through the adoption of micro irrigation. The per hectare total sales revenue of all crops increased by 242 percent when the farmers practiced micro irrigation when compared to without practicing micro irrigation.

On the whole, it is observed that the farmers are inclined to grow commercial crops than other food grain crops. It is observed that after the adoption of micro irrigation the numbers of irrigations per hectare were increased due to less number of pumping hours except in case of sweet orange crop. Moreover, the per hectare number of man days have been increased due to adoption of micro irrigation except in case of banana, sweet orange and sugarcane crops. The labour costs have increased in case of all crops due to adoption of micro irrigation. The paid up charges towards water have been reported only in case of two crops Soya bean and Bengal gram crops. Glancing over the mentioned tables, it can be observed that in spite of increased input costs the farmers are inclined to adopt micro irrigation with a view to obtain better incomes.

Table 3.15(a)
Changes in production, incomes, inputs and costs with micro-irrigation for major crops

Item (approp. units)	Crop-1 Soya been		Crop-2 Cotton		Crop-3 Bengal gram	
	No. reporting -38		No. Reporting-40		No. reporting -35	
	With MI	Without MI	With MI	Without MI	With MI	Without MI
	Average for reporting farmers					
Production	22.63	13.18	30.35	19.14	23.89	11.07
Price	3482	2789	5033	4020	4291	3166
Total Sales Revenue	78814	36749	152731	76944	102500	35063
Cost of Production						
Seeds/Plants cost	3374	2551	5985	5215	4011	2303
Fertilizer cost	3645	2274	7108	11678	4492	2474
Farm Yard Manure/Organic cost	1474	441	2141	392	250	192
Pesticides cost	7579	3593	8744	12231	7741	3391
Cost of Irrigation						
Electricity cost	23	16	53	45	25	21
Diesel cost	744	746	0	0	909	574
Water Charges paid	223	0	0	0	250	0
No of irrigations	5	4	12	7	6	5
Hours of pumping	15	20	12	21	18	24
Farm power & Equipment cost	6672	5233	10419	7446	6715	4582
Total man-days	40	33	85	57	46	35
Labour cost	14589	7171	29872	13998	16753	6165
Marketing cost	0	69	0	0	0	89
Other costs						
1.	1301	480	1875	1094	1453	335
2.	0	0	0	0	0	0
Total Cost	39624	22575	66197	52100	42599	20125
Net Profit/ Income	39190	14175	86534	24844	59902	14938

Source: Field Data

Note: MI=Micro-irrigation

Table 3.15(b)
Changes in production, incomes, inputs and costs with micro-irrigation for major crops

Item (approp. units)	Crop4 Banana		Crop-5 Sweet Orange		Crop-6 Sugarcane	
	No. reporting -9		No. reporting -8		No. reporting -2	
	With MI	Without MI	With MI	Without MI	With MI	Without MI
	Average for reporting farmers					
Production	67.59	49.37	140	107	123.24	70.60
Price	8944	5778	20125	15125	3095	2750
Total Sales Revenue	604496	285245	2817500	1624425	381426	194162
Cost of Production						
Seeds/Plants cost	50613	41867	101500	101500	23063	16016
Fertilizer cost	52392	45633	200533	237733	35915	23352
Farm Yard Manure/Organic cost	18481	4669	146800	146800	0	0
Pesticides cost	13328	5744	202280	258000	7535	3846
Cost of Irrigation						
Electricity cost	53	54	512	547	211	110
Diesel cost	0	0	0	0	0	0
Water Charges paid	0	0	0	0	0	0
No of irrigations	111	106	48	55	52	45
Hours of pumping	20	35	18	31	21	30
Farm power & Equipment cost	20873	19018	5067	5067	6338	4725
Total man-days	282	318	733	733	160	212
Labour cost	103312	38645	151600	185467	105352	62363
Marketing cost	0	0	0	0	0	0
Other costs						
1.	33880	21024	5333	8000	50880	20879
2.	0	0	0	0	0	0
Total Cost	292931	176654	813625	943113	229296	131291
Net Profit/ Income	311565	108592	2003875	681312	152130	62871

Source: Field Data

Note: MI=Micro-irrigation

Table 3.15(c)

Changes in production, incomes, inputs and costs with micro-irrigation for major crops

Item (approp. units)	All Crops/Total	
	No. Reporting-96	
	With MI	Without MI
	Average for reporting farmers	
Production	25.12	12.98
Price	0	0
Total Sales Revenue	159037	65633
Cost of Production		
Seeds/Plants cost	7321	5100
Fertilizer cost	9820	8914
Farm Yard Manure/Organic cost	3881	2582
Pesticides cost	10901	8344
Cost of Irrigation		
Electricity cost	35	32
Diesel cost	397	223
Water Charges paid	114	0
No of irrigations	12	7
Hours of pumping	12	14
Farm power & Equipment cost	6811	4213
Total man-days	69	49
Labour cost	21970	10157
Marketing cost	0	812
Other costs		
1.	2925	582
2.	0	0
Total Cost	64449	40958
Net Profit/ Income	94588	24676

Source: Field Data

Note: MI=Micro-irrigation

3.5: Capital and Maintenance Cost of Micro Irrigation:

3.5.1. Initial Capital Cost/Investment in Micro Irrigation:

Out of 96 reporting beneficiary farmers 59.37 percent of farmers used drip irrigation, while 40.63 percent used sprinkler irrigation sets. Moreover, out of the per holding total costs of Rs.1.53 lakhs, 85.14 percent of amount was given as subsidy for drip irrigation sets. Similarly, out of the total cost of Rs.0.18 lakhs, 68.11 percent of amount was given as subsidy for sprinkler irrigation reported farmers. The reporting farmers using pump sets were not given any subsidy amount. Similarly, those who dug tube wells were also not given any subsidy amount. Moreover, 1.75 percent of reporting drip irrigation farmers borrowed the amount for purchasing drip irrigation set. On other other hand, among 38 reporting farmers, 13.16 percent of farmers borrowed loan amount for purchasing pump sets. About 11.11 percent of farmers, out of 36 reporting farmers borrowed loan for digging tube wells. The details are presented in the following table 3.16

Table 3.16
Initial Capital Cost/Investment in Micro Irrigation

Item	No. reporting	Average for all reporting farmers			Percent reporting loan as source of funds
		Amount Paid (Rs.)	Subsidy Amount	Total Cost	
1. Drip irrigation Set/Kit	57	22667	129881(85%)	152548	1.75
2. Sprinkler irrigation Set/Kit	39	5736	12254(68%)	17990	0.00
3. Pumps (Avg.____5____hp)	38	33184	0.00	33184	13.16
4. Tube well cost (only if addl. For MI)(Avg.depth-154ft)	36	26278	0.00	26278	11.11

Source: Field Data

3.5.2: Annual Replacement/Maintenance Cost of Micro Irrigation:

The per holding amount of ten reporting farmers for maintenance/cost of filters is reported to be Rs.10.37 while the per holding maintenance cost for pipes for 21 reported farmers is Rs.1433. Moreover, the per holding replacement cost of

valves reported by 7 farmers is accounted to be Rs.814. The details are presented in the following Table 3.17

Table 3.17

Annual Replacement/Maintenance Cost of Micro Irrigation

Item	No. Reporting	Average for all reporting farmers			Percent reporting loan as source of funds
		Amount Paid (Rs.)	Subsidy Amount	Total Cost	
1. Filters (Cyclone, Disc, others)	10	1032	0	1032	0.00
2. Pipes (Micro, Distribution, Drip, PVC, PE, others)	21	1433	0	1433	0.00
3. Valves	7	814	0	814	0.00
4. Any other maintenance/ replacement/repairs	0	0.00	0.00	0.00	0.00

Source: Field Data

3.5.3 Top Three Companies as source of equipment/parts/service:

Out of 96 beneficiary farmers, 38.54 percent of farmers reported to have obtained micro irrigation initial capital items from Jain company, followed by 31.21 percent of farmers from NetafimCompany. On the other hand, 20.83 percent of farmers utilized micro irrigation initial capital items from Kumar Company, while only 10.42 percent of farmers have utilized the micro irrigation items from other companies. Moreover, out of 32 number of beneficiary farmers 34.38 percent of farmers obtained micro irrigation maintenance from Jain Company and 25 percent of farmers from Kumar company, while 18.75 percent of farmers obtained maintenance from Netafim company. The micro irrigation maintenance for about 21.88 percent of farmers is extended by other companies. It seems that there are three major companies Jain, Netafim and Kumar which supplied micro irrigation initial capital items for micro irrigation maintenance than other companies. The details are presented in the following table 3.18

Table 3.18

Three Companies as source of equipment/parts/service

Micro-irrigation Set/Kit/Initial Capital Items			Micro-irrigation maintenance		
Company/Brand Name	**Number reporting**	**Percent**	**Company/Brand Name**	**Number reporting**	**Percent**
Jain	37	38.54	Jain	11	34.38
Netafim	29	30.21	Kumar	8	25.00
Kumar	20	20.83	Netafim	6	18.75
Others	10	10.42	Others	7	21.88
Total	96	100.00	Total	32	100.00

Source: Field Data

3.6. Factors and Determinants effecting micro irritation adoption:

3.6.1. Determinants/ Factors effecting Adoption of Micro Irrigation:

In order to identify the determinants/ factors effecting adoption of Micro irrigation the model proposed by **Gandhi,Vasanth P. (2014)[1]** was used along with scale and factors mentioned in it. The model consists of five components namely Agronomic Potential, Agro Economic Potential, Effective Demand, Aggregate Supply and Distribution. The analysis per individual component as follows:

3.6.1.1: Agronomic Potential:

About 62.50 percent of farmers agreed that micro irrigation increased yield/output, while 37.50 percent of farmers strongly agreed about the increase in yield through microirrigation. Nearly 60.42 percent of farmers agreed that micro irrigation saves water, while 39.58 percent of farmers strongly agreed that micro irrigation reduces water use. Moreover, 52.08 percent of farmers agreed that micro irrigation reduces fertilizer use, while 18.75 percent of farmers strongly agreed that micro irrigation reduces fertilizer use. On the other hand, 23.96 percent of farmers disagreed that micro irrigation reduces fertilizer use. Nearly 42.71 percent of farmers agreed that micro irrigation reduces pest problems/pesticide use, while 20.83 percent of farmers strongly agreed that micro irrigation reduces pesticide use. On the other hand, 25 percent of farmers disagreed that micro irrigation reduces pest problems/pesticides use. Nearly 50.21 percent of farmers agreed that micro

[1]Gandhi, Vasanth P. (2014), " Growth and Transformation of the Agribusiness Sector: Drivers, Models, and Challenges", Indian Journal of Agricultural Economics, Vol.69, No.1, Jan-Mar.

irrigation reduces weed problems, while 30.21 percent of farmers disagreed the statement. About 27.08 percent of farmers agreed that micro irrigation reduces labour use, while 52.08 percent disagreed that micro irrigation reduces labour use.The details are presented in the following table 3.19(a).

3.6.1.2: Agro Economic Potential:

Among the beneficiary farmers of 96, 56.25 percent have agreed that capital cost of micro irrigation is not high. Nearly 61.46 percent of farmers agreed that micro irrigation raising output quality/profit. Nearly 38.54 percent of farmers agreed that micro irrigation reduces input use/costs, while 39.58 percent farmers disagreed the statement. Moreover, 77.08 percent of farmers opined that micro irrigation increases profitability/income. About 58.33 percent of farmers agreed that subsidy on micro irrigation is important, while 31.21 percent of farmers strongly agreed the statement. The mean value of all agro-economic potential facts is reported to be around 4.The details are presented in the following table 3.19(b).

3.6.1.3: Effective Demand:

Of all beneficiary farmers, 62.50 percent of farmers stated that information on micro irrigation is easily available. Similarly, 84.38 percent of farmers reported that micro irrigation technology is easy to understand and operate. About 60.42 percent of farmers agreed that subsidy is easy to get for micro irrigation and 59.38 percent of farmers reported that finance is easy to get for micro irrigation. Around 90 percent of farmers agreed that electricity supply is available for micro irrigation, while 71.88 percent of farmers agreed that water supply is sufficient for micro irrigation. The mean values of the factors contributing for effective demand varied from 2.53 in case of getting finance to 4.11 in case of availability of information on micro irrigation.The details are presented in the following table 3.19(c).

3.6.1.4. Aggregate Supply:

Around 56 percent of farmers agreed that there are a large number of companies supplying micro irrigation equipment, while about 35.42 percent of farmers disagreed the statement. Around 64 percent of farmers agreed that the quality and reliability of the micro irrigation equipment is good, while around 15 percent of farmers strongly agreed the statement. The mean values of these two

factors varied between 3.13 and 3.68.The details are presented in the following table 3.19 (d)

3.6.1.5: Distribution:

About 59.38 percent of farmers disagreed that there are a number of micro irrigation dealers is located nearby the village, while 25 percent of farmers agreed that there are no much number of micro irrigation dealers nearby the village. Nearly 67 percent of farmers reported that the dealers provide good quality products, while 17.71 percent of farmers disagreed the statement. Around 80 percent of farmers reported that the dealers charge a reasonable price, while 56.25 percent of farmers disagreed that the dealers arrange for subsidy. About 20.83 percent of farmers agreed that the dealers provide after sales service, while the rest of the beneficiary farmers disagreed the statement. The mean values of the above factors ranged between 1.59 in case of arrangement by dealers for subsidy to 3.68 percent in case of the provision of quality products of dealers. The details are presented in the following table 3.19 (e).

Table 3.19(a)
Determinants/factors affecting the adoption of micro irrigation

Factors	Strongly Agree (%) 5	Agree (%) 4	Partially Agree /Disagree (%) 3	Disagree (%) 4	Strongly Disagree (%) 1	Mean	No. reporting
Agronomic Potential							
1. Micro irrigation increases yield/output	37.50	62.50	0.00	0.00	0.00	4.38	96
2. Micro irrigation saves water/ reduces water use	39.58	60.42	0.00	0.00	0.00	4.40	96
3. Micro irrigation reduces fertilizer use	18.75	52.08	0.00	23.96	5.21	3.55	96
4. Micro irrigation reduces pest problems/ pesticide use	20.83	42.71	0.00	25.00	11.46	3.36	96
5. Micro irrigation reduces weed problem	9.38	55.21	0.00	30.21	5.21	3.33	96
6. Micro irrigation reduces labour use	14.58	27.08	0.00	52.08	6.25	2.92	96

Source: Field Data

Table 3.19(b)
Determinants/factors affecting the adoption of micro irrigation

Factors	Strongly Agree (%) 5	Agree (%) 4	Partially Agree /Disagree (%) 3	Disagree (%) 4	Strongly Disagree (%) 1	Mean	No. reporting
Agro-Economic Potential							
1. Capital cost of micro irrigation is not high	17.71	56.25	0.00	25.00	1.04	3.65	96
2. Micro irrigation raises output quality/profit	37.50	61.46	0.00	1.04	0.00	4.35	96
3. Micro irrigation reduces input use/costs	21.88	38.54	0.00	39.58	0.00	3.43	96
4. Micro irrigation increases profitability/incomes	77.08	22.92	0.00	0.00	0.00	4.77	96
5. Subsidy on micro irrigation is substantial /important	30.21	58.33	0.00	11.46	0.00	4.07	96

Source: Field Data

Table 3.19 (c)
Determinants/factors affecting the adoption of micro irrigation

Factors	Strongly Agree (%) 5	Agree (%) 4	Partially Agree /Disagree (%) 3	Disagree (%) 4	Strongly Disagree (%) 1	Mean	No. reporting
Effective Demand							
1. Information on micro irrigation is easily available	29.17	62.50	0.00	7.29	1.04	4.11	96
2. Micro irrigation technology is easy to understand and operate	12.50	84.38	0.00	3.13	0.00	4.06	96
3. Subsidy for micro irrigation is easy to get	1.04	60.42	0.00	30.21	8.33	3.16	96
4. Finance for micro irrigation is easy to get	0.00	31.25	0.00	59.38	9.38	2.53	96
5. Electricity supply for micro irrigation is available/reliable	7.29	89.58	0.00	3.13	0.00	4.01	96
6. Water supply for micro irrigation is sufficient	1.04	71.88	0.00	16.67	10.42	3.36	96

Source: Field Data

Table 3.19 (d)
Determinants/factors affecting the adoption of micro irrigation

Factors	Strongly Agree (%) 5	Agree (%) 4	Partially Agree /Disagree (%) 3	Disagree (%) 4	Strongly Disagree (%) 1	Mean	No. reporting
Aggregate Supply							
1. There are a large number of companies supplying micro irrigation equipment	2.08	56.25	0.00	35.42	6.25	3.13	96
2. The quality and reliability of the micro irrigation equipment is good	15.63	63.54	0.00	14.58	6.25	3.68	96

Source: Field Data

Table 3.19 (e)
Determinants/factors affecting the adoption of micro irrigation

Factors	Strongly Agree (%) 5	Agree (%) 4	Partially Agree /Disagree (%) 3	Disagree (%) 4	Strongly Disagree (%) 1	Mean	No. reporting
Distribution							
1. There are a number of micro irrigation dealers located nearby	1.04	25.00	0.00	59.38	14.58	2.39	96
2. The dealers provide good quality products you can trust	12.50	66.67	0.00	17.71	3.13	3.68	96
3. The dealers charge a reasonable price	1.04	80.21	0.00	16.67	2.08	3.61	96
4. The dealers arrange for subsidy/credit	0.00	1.04	0.00	56.25	42.71	1.59	96
5. The dealers provide after-sales service	0.00	20.83	0.00	46.88	32.29	2.09	96

Source: Field Data

3.6.2 Perceived advantages and disadvantages of micro irrigation:

The perceived advantages and disadvantages of micro irrigation are presented in the following table 4.20. Of the beneficiary farmers 87.50 percent of farmers reported that there is an advantage of easy marketing of output due to micro irrigation. Nearly 84.38 percent of farmers reported that better quality of output can be achieved through micro irrigation. 62.50 percent of farmers reported the advantage of achieving higher yield through micro irrigation. On the other hand, 77.08 percent of farmers reported to have the strong advantage of getting higher profits through micro irrigation. The percentage of farmers reported various advantages through micro irrigation varied from 22.92 percent in case of higher profit to 87.50 percent in case of easy marketing of output.

Disadvantages:

On the other hand, 62.50 percent of farmers reported to have the disadvantages in getting employment for youth due to micro irrigation. Nearly 52.08 percent of farmers reported that there is the disadvantage of using less labour which in turn effect on youth employment. The mean values varied from 2.45 in case of employment for youth to 4.38 in case of higher yields. The details are presented in the following table 4.20

Table.3.20

Perceived Advantages and Disadvantages of Micro-Irrigation

Item	Strong Advantage (%) 5	Advantage (%) 4	No Difference (%) 3	Disadvantage (%) 2	Strong Disadvantage (%) 1	Mean	No. reporting
Advantages							
Higher Yields	37.50	62.50	0.00	0.00	0.00	4.38	96
Better Quality	28.13	70.83	0.00	1.04	0.00	4.26	96
High output price	35.42	51.04	0.00	13.54	0.00	4.08	96
Lower input cost	21.88	38.54	0.00	39.58	0.00	3.43	96
Less water need	19.79	60.42	0.00	9.38	10.42	3.70	96
Less weed problem	9.38	55.21	0.00	30.21	5.21	3.33	96
Less pest problem	20.83	42.71	0.00	25.00	11.46	3.36	96
Less fertilizers need	18.75	52.08	0.00	23.96	5.21	3.55	96
Easy marketing of output	10.42	87.50	0.00	2.08	0.00	4.06	96
Higher Profit	77.08	22.92	0.00	0.00	0.00	4.77	96
Less risk/ uncertainty	14.58	84.38	0.00	0.00	1.04	4.11	96
Disadvantages							
Less labour need	14.58	27.08	0.00	52.08	6.25	2.92	96
Employment for youth	1.04	26.04	0.00	62.50	10.42	2.45	96

Source: Field Data

3.7. Larger Impact and Problems of Micro Irrigation:

3.7.1: Larger Impact of Micro Irrigation:

The impact of micro irrigation on various factors is presented in the following table 3.21. About 75 percent farmers reported the positive impact of micro irrigation on village as a whole and water conservation/availability. 83.33 percent of farmers reported that there is a larger positive impact of micro irrigation on upland farmers. 69.79 percent of farmers reported that there is a larger positive impact of micro irrigation on woman and upland farmers. About 79.17 percent of farmers reported that a larger positive impact of micro irrigation on environment. Nearly 12.50 percent of farmers reported to have no impact of micro irrigation on upper castes. Moreover, 26.04 percent of farmers reported to have negative impact of micro irrigation on upper castes. The mean values of impacts of micro irrigation on various factors varied from 1.96 in case of upland farmers to 4.25 in case of water conservation/availability.

Table 3.21
Larger Impact of Micro Irrigation

Impact on	Substantially positive (%) 5	Positive (%) 4	No Impact (%) 3	Negative (%) 2	Substantially Negative (%) 1	Mean	No. reporting
Larger impact							
1. Village as a whole	25.00	75.00	0.00	0.00	0.00	4.25	96
2. Water conservation/availability	25.00	75.00	0.00	0.00	0.00	4.25	96
3. Women	5.21	69.79	6.25	18.75	0.00	3.61	96
4. Upper Caste	0.00	61.46	12.50	26.04	0.00	3.35	96
5. Lower Caste	3.13	65.63	8.33	22.92	0.00	3.49	96
6. Labour/Poor	18.75	59.38	6.25	15.63	0.00	3.81	96
7. Young farmers/Youth	8.33	66.67	1.04	22.92	1.04	3.58	96
8. Lowland farmers	4.17	69.79	2.08	23.96	0.00	3.54	96
9. Environment	20.83	79.17	0.00	0.00	0.00	4.21	96
Smaller impact							
10. Upland farmers	6.25	83.33	6.25	4.17	0.00	1.96	96

Source: Field Data

3.7.2 Major Problems faced by Farmers in Relation to Micro Irrigation:

The major problems that are faced by the farmers in relation to micro irrigation are presented in the following table 3.22. Among the problems, four problems are identified those are lack of micro irrigation dealers in area (mean was noticed as 3.61), poor after sales service (3.91),lack of credit(3.46) and damage by animals(3.01) followed by poor quality of micro irrigation equipment, high cost of maintenance of micro irrigation, inadequate water, poor water quality, difficulty in obtaining government subsidy and support, lack of own wells/tube wells, high cost of wells, water table going down fast, lack of government support, difficulty in getting government support and lack of fencing are the some more problems which hindered improvement of micro irrigation facilities. However, the farmers disagree with the conditions of problems like unreliable electricity supply (Mean value was notice as 1.99), lack of knowledge/training for micro irrigation (1.94), low output price/profitability (1.92), poor marketing managements (1.94) and land fragmentation (1.89). The mean values of the problems explained by the farmers ranged between 1.89 in case of land fragmentation to 3.46 in case of lack of credit.

Table 3.22
Major problems faced by farmers in relation to micro-irrigation

Problems	Strongly Agree (%) 5	Agree (%) 4	Partially Agree/Disagree (%) 3	Disagree (%) 2	Strongly Disagree (%) 1	Mean	No. of reporting
Mean value 3 and above							
Lack of micro irrigation dealers in area	14.58	59.38	0.00	25.00	1.04	3.61	96
Poor after sales service	32.29	46.88	0.00	20.83	0.00	3.91	96
Lack of credit	8.33	60.42	0.00	31.25	0.00	3.46	96
Damage by animals	0.00	53.13	0.00	41.67	5.21	3.01	96
Mean value between 2 and 3							
1. Poor quality of micro irrigation equipment	6.25	13.54	0.00	63.54	16.67	2.29	96
2. High need/cost of maintenance in micro irrigation	1.04	21.88	0.00	55.21	21.88	2.25	96
3. Inadequate water	10.42	16.67	0.00	71.88	1.04	2.64	96
4. Poor water quality	0.00	32.29	0.00	53.13	14.58	2.50	96
5. Difficulty in obtaining government subsidy & support	8.33	30.21	0.00	60.42	1.04	2.84	96
6. Lack of own wells/tube wells	1.04	18.75	0.00	66.67	13.54	2.27	96
7. High cost of wells/tube-wells	0.00	37.50	0.00	46.88	15.63	2.59	96
8. Water table going down fast	12.50	28.13	0.00	46.88	12.50	2.81	96
9. Lack of government support	0.00	29.17	0.00	67.71	3.13	2.55	96
10. Difficulty in getting government support	2.08	38.54	0.00	57.29	2.08	2.81	96
11. Lack of fencing	3.13	27.08	0.00	64.58	5.21	2.58	96
12. Other (Specify)	6.25	13.54	0.00	63.54	16.67	2.29	96
Mean value below 2							
13. Unreliable electricity supply	0.00	3.13	0.00	89.58	7.29	1.99	96
14. Lack of knowledge/training for micro irrigation	0.00	3.13	0.00	84.38	12.50	1.94	96
15. Low output price/profitability	0.00	13.54	0.00	51.04	35.42	1.92	96
16. Poor marketing arrangements	0.00	2.08	0.00	87.50	10.42	1.94	96
17. Land fragmentation	0.00	8.33	0.00	63.54	28.13	1.89	96

Source: Field Data

3.8. Overall Assessment of the Performance of Micro Irrigation:

3.8.1. Overall Assessment of Micro Irrigation by the Farmers:

About 66.67 percent of farmers expressed that the adoption of micro irrigation is good and they decided to continue to use micro irrigation. Moreover, 65.63 percent of farmers are inclined to expand micro irrigation use. Around 60 percent of farmers felt good about the overall performance of micro irrigation. On the other hand, 32.29 percent of farmers expressed their opinion that the adoption of micro irrigation is somewhat poor towards the performance on reducing input costs (such as fertilizers, pesticides, labour and electricity). The details are presented in the following table 3.23

Table 3.23

Overall assessment of micro-irrigation by the farmers

Item	Excellent (%) 5	Good (%) 4	Satisfactory (%) 3	Somewhat Poor (%) 2	Very Poor (%) 1	Mean	No. reporting
Overall performance of micro irrigation	37.50	60.42	2.08	0.00	0.00	4.35	96
Performance on Improving Water Use Efficiency	54.17	44.79	1.04	0.00	0.00	4.53	96
Performance on reducing input cost (such as Fertilizers, Pesticides, Labour, Electricity)	14.58	37.50	15.63	32.29	0.00	3.34	96
Performance on increasing incomes/Profits	52.08	45.83	2.08	0.00	0.00	4.50	96
Will you adopt/continue to use micro irrigation?	33.33	66.67	0.00	0.00	0.00	4.33	96
Will you expand micro irrigation use?	33.33	65.63	0.00	1.04	0.00	4.31	96

Source: Field Data

3.8.2 Suggestions for increasing the adoption and impact of Micro Irrigation:

Nearly 73.96 percent of farmers agreed that the improvement of water availability is necessary for increasing the adoption of micro irrigation. About 66.67 percent of farmers expressed their view for better micro irrigation

technology/equipment for increasing the adoption of micro irrigation. About 61.46 percent of farmers opined that easier process for getting subsidy must be improved for the adoption of micro irrigation. Moreover, 60 percent of farmers reported to introduce the lower price of micro irrigation and more government assistance. The percentage of farmers who disagreed are varied from 8.33 in case of more subsidy/government assistance to 64.58 percent in case of more loans/credit. These inferences that the farmers disagreed to have more loan facility than the other facilities. The details are presented in the following table 3.24.

Table 3.24
Suggestions for increasing the adoption and impact of micro irrigation

	Strongly Agree (%) 5	Agree (%) 4	PartiallyAgree/ Disagree (%) 3	Disagree (%) 2	Strongly Disagree (%) 1	Mean	No. reporting
1. Better micro irrigation technology/equipment	25.00	66.67	0.00	8.33	0.00	4.08	96
2. Lower price of micro irrigation	5.21	60.42	0.00	34.38	0.00	3.36	96
3. More subsidy/ government assistance	31.25	60.42	0.00	8.33	0.00	4.15	96
4. Easier process for getting subsidy/government assistance	19.79	61.46	0.00	18.75	0.00	3.82	96
5. More loans/ credit	5.21	30.21	0.00	64.58	0.00	2.76	96
6. Improve water availability	10.42	73.96	0.00	15.63	0.00	3.79	96
7. Better training for micro irrigation	2.08	46.88	0.00	43.75	7.29	2.93	96
8. Provision/support for farm fencing	4.17	45.83	0.00	48.96	1.04	3.03	96
9. Better marketing arrangements	4.17	50.00	0.00	44.79	1.04	3.11	96

Source: Field Data

3.9. Non-Adopters of micro irrigation: Profile and Issues:

3.9.1 Sample Coverage of Non-Adopters:

As said earlier, two districts Nizamabad and Nalgonda are taken for the analysis of the study. 12 sample farmers of non-adopters of micro irrigation are taken from seven villages in Nizamabad districts and 12 sample farmers are selected from four villages in Nalgonda district. Of the total farmers selected in each district, 91.67 percent of farmers are having irrigated area. These details are presented in the following Table 3.25.

Table 3.25

Sample coverage of non-adopters

Sr. No.	District Name	No. of Village	No. of Farmers surveyed	With irrigation	Without irrigation
1	Nizamabad	7	12	11	1
2	Nalgonda	4	12	11	1

Source: Field Data

3.9.2. Age Profile of Non-Adopters:

Among the age groups, 33.33 percent have come under the age group of 40-50, while 25 percent of farmers of each group of persons reported 30-40 and 50-60 age group. Moreover, 8.33 percent of farmers from 20-30 age group and above 60 years age groups respectively. In the case adopters also a similar trend observed. These details are presented in the following table 3.26

Table 3.26

Age profile of non-adopters

	Number	**Percent**
Under 20	0	0.00
20-30	2	8.33
30-40	6	25.00
40-50	8	33.33
50-60	6	25.00
Above 60	2	8.33

Source: Field Data

3.9.3 Education Profile of Non-Adopters:

Among the selected non-adopters of micro irrigation, 50 percent are illiterates, where as in adopters it is only 30.2 percent. The remaining 50 percent of farmers varied from 4.17 percent farmers have reported middle school education

and graduation to 20.83 percent of farmers reported the educational qualification of Xth standard. But in the case adopters it is about 45 percent. These details are presented in the table 3.27

Table 3.27
Education profile of non-adopters

	Number	Percent
Illiterate	12	50.00
Primary	3	12.50
Middle	1	4.17
10thStd	5	20.83
12thStd	2	8.33
Graduate	1	4.17
Post-Graduation	0	0.00
Technical	0	0.00

Source: Field Data

3.9.4. Land Profile on Non-Adopters:

Among the total selected farmers, 41.67 percent are small farmers. About 37.50 percent of farmers have reported as marginal farmers and 20.83 percent of farmers have reported from the size group of 2-10 hectares. In the case of adopted farmers, 57.29 percent of farmers have reported under the size group of 2-10 hectares (medium). 28.13 percentage of farmers have reported to be under the size group of 1-2 hectares (small). The average irrigated area is reported to be 0.51 hectares and 1.69 hectares as un irrigated area in the case of adopters. The average irrigated area varied from 0.09 hectares in case of marginal farmers to 1.54 hectares in case of medium farmers in the case of non-adopters. On the other hand, the average unirrigated area varied from 0.83 hectares in case of marginal to 2.27 hectares in case of medium farmers in non-adopters. The details are presented in the following table 3.28

Table 3.28
Land profile of non-adopters

	Number	Percent	Total Area Average	Area irrigated Average	Area unirrigated Average
Landless/Tenant	0	0.00	0.00	0.00	0.00
Marginal (<1)	9	37.50	0.92	0.09	0.83
Small (1-2)	10	41.67	2.55	0.38	2.16
Medium (2-10)	5	20.83	3.80	1.54	2.27
Large (>10)	0	0.00	0.00	0.00	0.00
Total	24	100.00	2.20	0.51	1.69

Source: Field Data

3.9.5 Water Sources and Situation:

Water Source:

Among the non-adopters of micro irrigation 95.83 percent of farmers reported to have tube well irrigation, while 4.17 percent of farmers reported well irrigation.

Water Situation:

Out of the total sample farmers, 37.50 percent of farmers reported to have scarcity of water, while 37.50 percent reported no scarcity of water. The remaining 25 percent of farmers reported to have scarcity of water occasionally. In the case of adopters, 98.96 percent of farmers dependent on tube wells. The details are presented in the following table 3.29.

Table 3.29
Water sources and situation

Water source	**Number**	**Percent**
Canal	0	0.00
Canal-Lift	0	0.00
River-Lift	0	0.00
Tube well	21	87.50
Well	1	4.17
Tank	0	0.00
Pond	0	0.00
Farm Pond	0	0.00
Check dam	0	0.00
Percolation Tank	0	0.00
Others	0	0.00
Water situation		
Excess water	0	0.00
No scarcity	9	37.50
Occasional scarcity	6	25.00
Scarcity	9	37.50
Acute scarcity	0	0.00

Source: Field Data

3.9.6 Cropping Profile of Non-Adopters:

The major crops that are grown by the non-adopters of micro irrigation are Soyabean, paddy, cotton, Bengal gram, maize, vegetables and banana. Of the total cropped area, 29.18 percent of area was utilized for cotton crop. The other two major contributions to gross cropped area are Bengal gram and soya bean contributed major percentage of average irrigated area than other crops. The

average irrigated area ranged from 0.11 hectares of Kharif paddy to 1.35 hectares in case of maize crop. On the other hand, the major un-irrigated areas are reported by cotton and Bengal gram crops. In the case of adopters, the per holding area under drip irrigation varied from 0.57 (100 %) hectares in case of maize (inter crop) to 2.11(100 %)) hectares in case of banana. On the other hand, the crops that are grown under sprinkler irrigation are soya bean, Bengal gram and groundnut. The per holding area under sprinkler irrigation ranged between 3.20 (95%) hectares in case of Bengal gram and 3.94 (100%) hectares in case of groundnut. The details are presented in following table 3.30.

Table 3.30

Cropping profile of non-adopters

Sr. No.	Crop name	Season	No. of farmers reporting	Average total area	Average irrigated area	Average un-irrigated area
1	Soya been	kharif	10	1.38	1.01	0.37
2	Paddy	Kharif	10	0.11	0.11	0.00
3	Cotton	Kharif	14	1.18	0.64	0.55
4	Bengal Gram	Rabi	9	1.64	0.92	0.72
5	Paddy	Rabi	8	0.37	0.37	0.00
6	Maize	Rabi	3	1.35	1.35	0.00
7	Vegetables		3	0.47	0.47	0.00
8	Banana		1	2.02	2.02	0.00

Source: Field Data

Note: In case of intercropping, write both crop names together.

3.9.7 Reasons for Non-Adoption:

Out of the total sample of non-adopters, 67percent of farmers agreed that due to non-availability of micro irrigation equipment they could not adopt micro irrigation on their farms. Similarly, 50 percent of farmers expressed the view that the reason for non-adoption of micro irrigation is due to non-availability of subsidy and credit. On the other hand, the reason for non-adoption of micro irrigation is due to high operating and high investment cost respectively. Moreover, 62.50 percent of

farmers disagreed for the adoption of micro irrigation due to in sufficient subsidy. About 50 percent of farmers reported that due to non-availability of information and lack of fencing protection are the reasons for non-adoption of micro irrigation on their farm. Across the reasons, it is observed that the percentage of farmers disagreed for various reasons ranged between 29.17 percent in case of not suitable for their land and 87.50 percent in case of high operating cost of micro irrigation. All the above details can be seen in the following table 3.31

Table 3.31
Reasons for Non-Adoption

Item	Strongly Agree (%) 5	Agree (%) 4	Partially Agree/ Disagree (%) 3	Disagree (%) 2	Strongly Disagree (%) 1	Mean	No reporting
1. Micro irrigation equipment not available	16.67	50.00	0.00	25.00	8.33	3.42	60
2. High investment cost of micro irrigation	0.00	25.00	0.00	75.00	0.00	2.50	60
3. High operating cost of micro irrigation	0.00	4.17	0.00	87.50	8.33	2.00	60
4. Subsidy for micro irrigation not available	0.00	50.00	0.00	45.83	4.17	2.96	60
5. Subsidy for micro irrigation not sufficient	4.17	29.17	0.00	62.50	4.17	2.67	60
6. Credit for micro irrigation not available	0.00	50.00	0.00	37.50	12.50	2.88	60
7. Not enough information about micro irrigation not available	4.17	8.33	0.00	50.00	37.50	1.92	60
8. Micro irrigation is not profitable	0.00	0.00	0.00	33.33	66.67	1.33	60
9. No market for micro irrigation crops	0.00	0.00	0.00	25.00	75.00	1.25	60
10. Micro irrigation is not suitable to crops grown	0.00	0.00	0.00	45.83	54.17	1.46	60
11. Micro irrigation is not suitable for your land	0.00	4.17	0.00	29.17	66.67	1.42	60
12. You prefer traditional irrigation	0.00	12.50	0.00	45.83	41.67	1.83	60
13. Inadequate water availability	8.33	33.33	0.00	41.67	16.67	2.75	60
14. Fragmentation of land	0.00	4.17	0.00	33.33	62.50	1.46	60
15. Crop damage by animals	0.00	25.00	0.00	54.17	20.83	2.29	60
16. Lack of fencing protection	0.00	16.67	0.00	50.00	33.33	2.00	60

Source: Field Data

3.10 Summary:

The per holding total micro irrigated area of beneficiary farmers is reported to be 2.89 hectares. Across the groups, the micro irrigated area ranged between 0.88 hectares in case of marginal farmers to 2.89 hectares in case of medium farmers. On an average, the per holding area under drip irrigation of beneficiary farmers is reported to be 1.09 hectares, while the area under sprinkler irrigation is reported to 1.29 hectares.

Among the total beneficiary farmers, 98.96 percent of the farmers are dependent on tube well. Moreover, 14.58 percent of farmers reported to have scarcity of water occasionally and 12.05 percent of farmers reported to have scarcity of water for farming.

The per holding area under drip irrigation varied from 0.57 (100 %) hectares in case of maize (inter crop) to 2.11(100 %)) hectares in case of banana. On the other hand, the crops that are grown under sprinkler irrigation are soya bean, Bengal gram and groundnut. The per holding area under sprinkler irrigation ranged between 3.20 (95%) hectares in case of Bengal gram and 3.94 (100%) hectares in case of groundnut. The crops that are reported under non-micro irrigation are soya bean, cotton, Bengal gram. Moreover, the crops that are reported under fertigation are cotton, watermelon, chillies and banana. Among the 40 reporting farmers of cotton crop, 37.50 % of farmers reported fertigation, while among the rabi crops like watermelon and chilli crops about 42.86% of farmers and 40% of reporting farmers reported fertigation respectively.

The farmers have reported that there is a large increase in the area of chillies, Bengal gram, soya bean and watermelon crops due to adoption of micro irrigation. On the other hand, 71.43% of farmers growing watermelon reported that there is a substantial change in the increase in the area of watermelon crop due to adoption micro irrigation. The farmers growing vegetables, maize (inter crop) and sweet orange reported that there was no change in the area due to adoption of micro irrigation. The percentage of farmers reporting 'no change' in area varied from 14.29% in case of watermelon to 100% in case of vegetables, maize and sweet orange crops.

The changes in production, incomes and costs which have come through the adoption of micro irrigation for crops, Soya bean, cotton, Bengal gram, Banana, Sweet Orange and Sugarcane are presented. The per hectare net profit of all crops increased by 383.32 percent through the adoption of micro irrigation. The per hectare total sales revenue of all crops was increased by 242 percent when the farmers practiced micro irrigation when compared to without practicing micro irrigation. On the whole, it is observed that the farmers are inclined to grow commercial crops than other food grain crops. It is observed that after the adoption of micro irrigation the numbers of irrigations per hectare were increased due to less number of pumping hours except in case of sweet orange crop. Moreover, the per hectare number of man days have been increased due to adoption of micro irrigation except in case of banana, sweet orange and sugarcane crops. The labour costs have increased in case of all crops due to adoption of micro irrigation. The paid up charges towards water have been reported only in case of two crops Soya bean and Bengal gram crops. Glancing over the mentioned tables, it can be observed that in spite of increased input costs the farmers are inclined to adopt micro irrigation with a view to obtain better incomes.

In order to identify the determinants/ factors effecting adoption of Micro irrigation the model proposed by Gandhi,Vasanth P. (2014) was used along with scale and factors mentioned in it. The mean value of all agro economic potential is reported to be 2.92 to 4.38.The mean value of all agro-economic potential facts is reported to be around 4. The mean values of the factors contributing for effective demand varied from 2.53 in case of getting finance to 4.11 in case of availability of information on micro irrigation. The mean values of these two factors varied between 3.13 and 3.68. The mean values of the above factors ranged between 1.59 in case of arrangement by dealers for subsidy to 3.68 percent in case of the provision of quality products of dealers.

Among the beneficiary farmers 87.50 percent of farmers reported that there is an advantage of easy marketing of output due to micro irrigation. Nearly 84.38 percent of farmers reported that better quality of output can be achieved through micro irrigation. 62.50 percent of farmers reported the advantage of achieving higher yield through micro irrigation. On the other hand, 77.08 percent of farmers reported to have the strong advantage of getting higher profits through micro

irrigation. On the other hand, 62.50 percent of farmers reported to have the disadvantages in getting employment for youth due to micro irrigation. Nearly 52.08 percent of farmers reported that there is the disadvantage of using less labour which in turn effect on youth employment.

The major problems that are faced by the farmers in relation to micro irrigation mainly four problems are identified those are lack of micro irrigation dealers in area (mean was noticed as 3.61), poor after sales service (3.91),lack of credit(3.46) and damage by animals(3.01). However, the farmers disagree with the conditions of problems like unreliable electricity supply (Mean value was notice as 1.99), lack of knowledge/training for micro irrigation (1.94), low output price/profitability (1.92), poor marketing managements (1.94) and land fragmentation (1.89).

The major crops that are grown by the non-adopters of micro irrigation are Soyabean, paddy, cotton, Bengal gram, maize, vegetables and banana. Of the total cropped area, 29.18 percent of area was utilized for cotton crop. The other two major contributions to gross cropped area are Bengal gram and soya bean contributed major percentage of average irrigated area than other crops. The average irrigated area ranged from 0.11 hectares of Kharif paddy to 1.35 hectares in case of maize crop. On the other hand, the major un-irrigated areas are reported by cotton and Bengal gram crops. In the case of adopters, the per holding area under drip irrigation varied from 0.57 (100 %) hectares in case of maize (inter crop) to 2.11(100 %)) hectares in case of banana. On the other hand, the crops that are grown under sprinkler irrigation are soya bean, Bengal gram and groundnut. The per holding area under sprinkler irrigation ranged between 3.20 (95%) hectares in case of Bengal gram and 3.94 (100%) hectares in case of groundnut.

CHAPTER – IV

SUMMARY AND CONCLUSIONS

4.1. Introduction:

To meet the food needs of the growing population the agricultural production need to be boosted by following better soil water management techniques that could provide the arid and semi-arid lands, better access to irrigation water without actually increasing stress on available water resources using pressurised resurveyed irrigation system. Effective utilization of every drop of water through micro irrigation is imperative for improving crop productivity, production and to achieve sustainable improvement and living standards of small and marginal farmers of state by improving the water use efficiency through micro irrigation and farmers can get assured additional income.

4.1.1 The major objective of PMSKY is to achieve convergence of investments in irrigation at the field level, expand cultivable area under assured irrigation, improve on farm water use efficiency to reduce wastage of water, enhance the adoption of precision irrigation and other water saving techniques (More Crop Per Drop), enhance recharge of aquifers and introduce sustainable water conservation practices by exploring the feasibility of reusing treated municipal waste water for peri-urban agriculture and attract greater private investment in precision-irrigation system.

4.1.2 Objectives and Methodology: Selection of Sample

4.1.3.A Objectives:

The main objective of the study is to analyse the various benefits of MI to the farmers including in input use, costs and returns. Specifically, the objectives would be 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 across states.

(4) To study overall impact on farmer incomes and the cost-benefit in selected crops.

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

4.1.3. b. Methodology:

The Ministry of Agriculture, Government of India asked its Agro-Economic Research Centres (AERC) to take up an evaluation study on PMKSY in their respective states. The Agro-Economic Research Centre, Andhra University, Waltair has taken up the evaluation study in Telangana state taking 2019-2020 as the reference year. The present undertaken study based on both primary and secondary data. For collection of primary data in Telangana, a multi-stage stratified random sampling method has been adopted. In the first stage two districts from Telangana, namely Nizamabad and Nalgonda have been selected on the basis of highest crop area has been considered as a major determinant while selection of the above said districts. In the second stage, two mandals from Nizamabad district and four mandals from Nalgonda districts have been selected based on the same criteria i.e., highest crop area. In the final stage, the selection of farmers in selected villages has been based on scale of adoption of micro irrigation. From each of the selected districts, 48 micro irrigation adopted farmers and 12 non-adopted farmers have been selected randomly spread more or less evenly across the respective villages 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 district hand book of statistics, published of Directorate of Economic and Statistics, Telangana State.

4.2. Micro Irrigation in the State of Telangana:

In Telangana state the allocation of funds under PMKSY/PDMC increased from 24.32 crores in 2014-15 to 51.77 crores in 2017-18. During 2018-19 the allocation of funds to other irrigation projects. Accordingly, the area under micro irrigation has also increased from 0.31 lakh hectares to 0.90 lakh hectares during 2017-18. Owing the insufficient funds, the area under micro irrigation has come down to 0.40 lakh hectares during 2018-19. Accordingly, the number of beneficiaries has come down to 0.37 lakhs. This has reflected in the percentage of micro irrigation total irrigated area from 2014-15 to 2018-19. Among the districts Mahaboobnagar occupied the first position in district wise adoption during 2018-19. Other Non-horticultural crops reported to be 32.39 percent of gross micro-irrigated area. During 2017-18 and 2018-19 there observed a steep decline in both the years in achieving financial and physical targets. Since the full allocations of funds are not released during 2019-20, accordingly the financial and physical targets resulted in a negative situation.

4.3 Adoption of MI under PMKSY/PDMC Scheme of Sample Farmers:

- With regard to educational status of the beneficiary and non-beneficiary of micro irrigation out of 96 beneficiary farmers, 30.21 percent of farmers are illiterates. 19.79 percent of farmers reported to be studied X^{th} standard. 14.58 percent of farmers have completed middle school education and 11.46 percent reported to have completed primary education and the same percentage (11.46) of farmers reported to have completed graduation. Among the selected non-adopters of micro irrigation, 50 percent are illiterates, where as in adopters it is only 30.2 percent. The remaining 50 percent of farmers varied from 4.17 percent farmers have reported middle school education and graduation to 20.83 percent of farmers reported the educational qualification of X^{th} standard.

- The per holding total micro irrigated area of beneficiary farmers is reported to be 2.89 hectares. Across the groups, the micro irrigated area ranged between 0.88 hectares in case of marginal farmers to 2.89 hectares in case of medium farmers. On an average, the per holding area under drip irrigation of beneficiary

farmers is reported to be 1.09 hectares, while the area under sprinkler irrigation is reported to 1.29 hectares.

- Among the total beneficiary farmers, 98.96 percent of the farmers are dependent on tube well. Moreover, 14.58 percent of farmers reported to have scarcity of water occasionally and 12.05 percent of farmers reported to have scarcity of water for farming.

- Negligible percentage of farmers reported to have light soils. About 78.13 percent of farmers reported to have received average rainfall during 2019-20, while 13.54 percent of farmers reported to have received low rainfall. The average of years using micro irrigation is reported to be 2.77.

- The per holding area under drip irrigation varied from 0.57 (100 %) hectares in case of maize (inter crop) to 2.11(100 %)) hectares in case of banana. On the other hand, the crops that are grown under sprinkler irrigation are soya bean, Bengal gram and groundnut. The per holding area under sprinkler irrigation ranged between 3.20 (95%) hectares in case of Bengal gram and 3.94 (100%) hectares in case of groundnut. The crops that are reported under non-micro irrigation are soya bean, cotton, Bengal gram. Moreover, the crops that are reported under fertigation are cotton, watermelon, chillies and banana. Among the 40 reporting farmers of cotton crop, 37.50 % of farmers reported fertigation, while among the rabi crops like watermelon and chilli crops about 42.86% of farmers and 40% of reporting farmers reported fertigation respectively.

- The farmers have reported that there is a large increase in the area of chillies, Bengal gram, soya bean and watermelon crops due to adoption of micro irrigation. On the other hand, 71.43% of farmers growing watermelon reported that there is a substantial change in the increase in the area of watermelon crop due to adoption micro irrigation. The farmers growing vegetables, maize (inter crop) and sweet orange reported that there was no change in the area due to adoption of micro irrigation. The percentage of farmers reporting 'no change' in area varied from 14.29% in case of watermelon to 100% in case of vegetables, maize and sweet orange crops.

- The changes in production, incomes and costs which have come through the adoption of micro irrigation for crops, Soya bean, cotton, Bengal gram, Banana, Sweet Orange and Sugarcane are presented. The per hectare net profit of all crops increased by 383.32 percent through the adoption of micro irrigation. The per hectare total sales revenue of all crops was increased by 242 percent when the farmers practiced micro irrigation when compared to without practicing micro irrigation. On the whole, it is observed that the farmers are inclined to grow commercial crops than other food grain crops. It is observed that after the adoption of micro irrigation the numbers of irrigations per hectare were increased due to a smaller number of pumping hours except in case of sweet orange crop. Moreover, the per hectare number of man days have been increased due to adoption of micro irrigation except in case of banana, sweet orange and sugarcane crops. The labour costs have increased in case of all crops due to adoption of micro irrigation. The paid-up charges towards water have been reported only in case of two crops Soya bean and Bengal gram crops. Glancing over the mentioned tables, it can be observed that in spite of increased input costs the farmers are inclined to adopt micro irrigation with a view to obtain better incomes.

- Out of 96 reporting beneficiary farmers 59.37 percent of farmers used drip irrigation, while 40.63 percent used sprinkler irrigation sets. Moreover, out of the per holding total costs of Rs.1.53 lakhs, 85.14 percent of amount was given as subsidy for drip irrigation sets. Similarly, out of the total cost of Rs.0.18 lakhs, 68.11 percent of amount was given as subsidy for sprinkler irrigation reported farmers. The reporting farmers using pump sets were not given any subsidy amount. Similarly, those who dug tube wells were also not given any subsidy amount. Moreover, 1.75 percent of reporting drip irrigation farmers borrowed the amount for purchasing drip irrigation set. On other other hand, among 38 reporting farmers, 13.16 percent of farmers borrowed loan amount for purchasing pump sets. About 11.11 percent of farmers, out of 36 reporting farmers borrowed loan for digging tube wells.

- In order to identify the determinants/ factors effecting adoption of Micro irrigation the model proposed by Gandhi,Vasanth P. (2014) was used along with scale and factors mentioned in it. The mean value of all agro economic potential is reported to be 2.92 to 4.38.The mean value of all agro-economic potential facts is reported to be around 4. The mean values of the factors contributing for effective demand varied from 2.53 in case of getting finance to 4.11 in case of availability of information on micro irrigation. The mean values of these two factors varied between 3.13 and 3.68. The mean values of the above factors ranged between 1.59 in case of arrangement by dealers for subsidy to 3.68 percent in case of the provision of quality products of dealers.

- Among the beneficiary farmers 87.50 percent of farmers reported that there is an advantage of easy marketing of output due to micro irrigation. Nearly 84.38 percent of farmers reported that better quality of output can be achieved through micro irrigation. 62.50 percent of farmers reported the advantage of achieving higher yield through micro irrigation. On the other hand, 77.08 percent of farmers reported to have the strong advantage of getting higher profits through micro irrigation. On the other hand, 62.50 percent of farmers reported to have the disadvantages in getting employment for youth due to micro irrigation. Nearly 52.08 percent of farmers reported that there is the disadvantage of using less labour which in turn effect on youth employment.

- The major problems that are faced by the farmers in relation to micro irrigation mainly four problems are identified to be the major problems those are lack of micro irrigation dealers in area (mean was noticed as 3.61), poor after sales service (3.91),lack of credit(3.46) and damage by animals(3.01). However, the farmers disagree with the conditions of problems like unreliable electricity supply (Mean value was notice as 1.99), lack of knowledge/training for micro irrigation (1.94), low output price/profitability (1.92), poor marketing managements (1.94) and land fragmentation (1.89).

- The major crops that are grown by the non-adopters of micro irrigation are Soyabean, paddy, cotton, Bengal gram, maize, vegetables and banana. Of the

total cropped area, 29.18 percent of area was utilized for cotton crop. The other two major contributions to gross cropped area are Bengal gram and soya bean contributed major percentage of average irrigated area than other crops. The average irrigated area ranged from 0.11 hectares of Kharif paddy to 1.35 hectares in case of maize crop. On the other hand, the major un-irrigated areas are reported by cotton and Bengal gram crops. In the case of adopters, the per holding area under drip irrigation varied from 0.57 (100 %) hectares in case of maize (inter crop) to 2.11(100 %)) hectares in case of banana. On the other hand, the crops that are grown under sprinkler irrigation are soya bean, Bengal gram and groundnut. The per holding area under sprinkler irrigation ranged between 3.20 (95%) hectares in case of Bengal gram and 3.94 (100%) hectares in case of groundnut.

- Out of the total sample of non-adopters, 67percent of farmers agreed that due to non-availability of micro irrigation equipment they could not adopt micro irrigation on their farms. Similarly, 50 percent of farmers expressed the view that the reason for non-adoption of micro irrigation is due to non-availability of subsidy and credit. On the other hand, the reason for non-adoption of micro irrigation is due to high operating and high investment cost respectively. Moreover, 62.50 percent of farmers disagreed for the adoption of micro irrigation due to in sufficient subsidy. About 50 percent of farmers reported that due to non-availability of information and lack of fencing protection are the reasons for non-adoption of micro irrigation on their farm. Across the reasons, it is observed that the percentage of farmers disagreed for various reasons ranged between 29.17 percent in case of not suitable for their land and 87.50 percent in case of high operating cost of micro irrigation.

4.4. Policy Suggestions:

- ✓ The subsidy must be introduced to all groups of farmers besides the farmers involved in the benefit schemes.
- ✓ The present subsidy system must be maintained continuously and the amount of subsidy must be reduced in accordance with the increase in extent of land.
- ✓ Provision of subsidy on irrigation equipment to all groups of farmers.

- ✓ Credit facility must be provided with low rates of interest.
- ✓ The farmers must be arranged in groups and according to the capacity of discharge of water from each bore well.
- ✓ More pipes should be given to farmers for micro irrigation.
- ✓ Renewal period should be reduced to three years instead of five years
- ✓ The Government should be able to provide micro irrigation as demanded by farmers
- ✓ Immediate sanction of drip/sprinkler within a month after applying for micro irrigation
- ✓ GST percentage on micro irrigation equipment's should be reduced.

References

1. D Suresh Kumar, department of Agricultural Economics, Tamilnadu Agricultural University, Coimbatore – 641003, Tamilnadu 2. K. Palani Swani, International Water Management Institute, Patancheru, 502324, Andhra Pradesh "Impact of Drip Irrigation on farming System"; evidence from Southern India, Agricultural Economic Research Review, Volume no-23, July to December, 2010 pp 265-272.

2. Dr.Khadija Priyan and Ratan Sarvan Panchal, Micro irrigation: An Efficient Technology for India's Sustainable Agricultural Growth. Kalpa publication in civil Engineering, Volume 1, 2017, Pages 398-402.

3. VenessaMeadu, March 21, 2019- Innovative Irrigation promises "More Crop-Per Drop for India's water stressed Cereals", a study demonstrates how rice & wheat can be grown using 40% less water, CIMMYT International Maize and wheat improving Centre.

4. A. Narayana Murthy, N. Devika&Bhattarai-"More crop and Profit Per Drop of water: Drip irrigation for Empowering distressed small Farmers", research article first published in January 27, 2016, Sage Journal.

5. Arjesh Kiumar Madhok: Deputy Director, CWC- Project appraisal

6. CatherineElizabeth Boone Gypson (2016): More Drop Per Crop benchmarking on farm irrigation water use for crop production" University of Nabraska, USA – Linconl.

7. Mereditch Giordano et.al- "Beyond" "More Crop per Drop" evolving thinking on agricultural water productivity" international water management Institute (IWMI) research report no.169 year

8. Dr.VibhaDhawan (2017) –Water and Agriculture in India – Background paper for the South Asia Expert panel during the global forum for Food and Agriculture (GFFA) 2017,oav German Asia-Pacific Business Association, German Agribusiness Alliance and Teri.

9. Sarah Carriger is a science writer and communications consultant. Domitille Valle is an assessment facilitator at the water management institute and this article is based on Rice feeding the billions "(authors BAMbourman, R. Barker, E Humphoreys and TP Tuong), which is chapter 15 of the book Water for food,, Water for life: a Comprehensive assessment of water management in Agriculture.;

10. Director (RFS), email- PankajTyagi99@gov.in department of Agricultue, Cooperation and Farmers welfare, Ministry of Agriculture & Farmers Welfare Krishi Bhavan, New Delhi consultant (RFS) & Manish Singh swc@gmail.com: Contact No.9880404700 & 8840133534 3rd World Irrigation Forum (WIF3) 1-7 September, 2019 Bali Indonesia.

11. Department of Civil Engineering GH patel College of Engineering and Technology, VallabhVidya Nagar, India. Khadeejapriyan@gcet.ac.in, ratanpanchali@gcet.ac.inKalpa publications in Civil Engineering volume 1, 2017, pages 398-402.

12. IWWI-TATA Water Policy Program, Hyderabad India 2. Agro-Hydrology and Ground Water Management, Faculty of Environmental Science, Wageningen University &Research Centre, Wagaringen, the Netherlands.

13. Karthikeyan GM 2nd year student, Department of Management, AmrithaVishwaVidyapeetham, Kollam, India. Suresh A. Asst. Professor, Dept. of Management, AmrithaVishwaVidyapeetham, Kollam, India. Suresh is a management enthusiast and is a faculty associate at Amritpuri campus" Study on understanding the adoption of water saving technology. A case study of drip irrigation.International Journal of Recent Technology and Engineering. (IJRTE) ISSN:2277-3878 vol-7, issue-6, March 2019.

14. Gandhi, Vasanth P. (2014), " Growth and Transformation of the Agribusiness Sector: Drivers, Models, and Challenges", Indian Journal of Agricultural Economics, Vol.69, No.1, Jan-Mar.

Review of the Report

(I) Title of the Draft Study Report Examined:

Impact Evaluation Study on Per Drop More Crop component of Pradhan Mantri Krishi Sinchayee Yojana (PMKSY) (for Telangana)

(II) Date of Receipt of the Draft Report: October 8, 2020

(III) Date of Dispatch of Comments: December 21, 2020

Comments from Centre for Management in Agriculture, Indian Institute of Management Ahmedabad. Project Coordinator: Prof. Vasant Gandhi

(IV) A. General Comments

1. Given its topic and objectives, this is an important study for India's agriculture, the government, and the efficient use of scarce natural resources. Water use efficiency and productivity are poor in India and there is a great need and scope for improvement. Micro irrigation is a very promising and highly efficient water saving technology. With the need for and the government objective of substantially increasing its use, it is very important to understand the factors affecting its adoption, the impact, and the performance of the PMKSY-PDMC scheme for its promotion in helping the adoption of micro irrigation in the state of Telangana.

2. The study objectives are appropriate and include examining the adoption of micro irrigation, and its efficiency in saving water and other inputs. They also include examining the impact of micro irrigation on crop productivity, input use, incomes and development in Telangana, also touching upon the constraints faced by the non-adopters of micro irrigation.

3. The presentation of the study and findings is acceptable.

4. The title of report may be edited slightly to bring it in line with that in the proposal: Improving Water Use Efficiency in India's Agriculture: The Impact, Benefits and Challenges of Micro-Irrigation under the Pradhan Mantri Krishi Sinchayee Yojana: Per Drop More Crop (PMKSY-PDMC) in Telangana.

B. Comments on the Methodology and Analysis Presentation

1. Kindly make and include a brief executive summary of the report in the beginning. This is necessary and will help the readers to get a quick idea.

2. Kindly divide chapter 1 into two chapters- 1 and 2. In chapter 2, along with the literature review kindly include objectives, methodology and a brief outline of the scheme (mentioned in PDMC proposal). Please refer to the chapter outline sent to you.

3. Chapter 1-Page 1– 2nd Paragraph- Please move the references to the end of the manuscript. Add a separate section for the references.

4. Chapter 1-Page 2- Section 1.2 should have a subtitle and make it bold.

5. Chapter 1 page 6: Please describe in greater detail the basis of selection of the two sample districts, the sample blocks and villages.

6. Page 7-11- Please move the references to the end of the manuscript. Add a separate section for the references.

7. Page 14- For Table 3.2, A line chart for area under Micro irrigation can be created to show the trends and changes over the years.

8. Page 22- A pie chart can be created for Table 4.4. It will help reader to understand the distribution of different landholdings.

9. Page 22 – Table 4.4- irrigation – give percentages

10. Page 22 – Table 4.5- Remove "others".

11. Page 24- Table 4.10- The Table shows variation. Some explanation can be added as to why regarding increase/decrease in a particular year. It may be related to table 3.2.

12. Tables on pages 26-27 – please also give results in terms of percentage of the row totals- instead of average area.

13. Page 31- Table 4.15- Please divide into two Tables – it is too big. Keep the first three crops in one Table. The sample size of the crops 4-6 is very low and this should be stated as a caution for interpretation.

14. Page 31- Table 4.15- This is the most important Table. Please thoroughly discuss the results. You can discuss the changes between MI No-MI part by part such as production to sales revenue, main input costs, irrigation costs, other costs-total cost-profit. This can be done for each crop, as well as for all crops.

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24. Page 44: Please remove the other rows. Kindly add no. of reporting farmers.

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27. Page 52-53- Short summary is given, explaining all the aspects covered in the chapter. It would be more suitable if these explanations given in the relevant sections.

28. Page 53-59: Many sentences mentioned are repeated. Please change the language from the lines mentioned in earlier chapters. Some of the section can be combined into single paragraphs and sub-headings can be given.

29. Page 58- Policy Suggestions – Please combine similar bullet points. Please try and make sure that you give findings/ conclusions with respect to each of the objectives of the study.

Other Comments on the presentation of report

A. Table and Figure presentation:

1. Please add an Executive Summary. It is necessary and useful for the readers to get a quick picture A list of acronyms may be added.

2. A list of figures can added.

3. You can add some pictures/ field pictures on the cover.

B. Other issues:

1. Chapter 1-Page 1–2nd Line- Remove unnecessary space before "In the present…". Kindly check for the similar issue in subsequent paragraphs.

2. Page 28- 11th line- add space between "value and of".

3. Do have repeat Header Rows in every multipage Table.

4. Kindly do a spell check of the entire report to remove spelling and spacing issues.

(V) Overall View on Acceptability of the Report

The report addresses the objectives, is useful and should be accepted. The authors may address the suggestions and comments given above which will help to further improve the report.

Action Taken

1. Kindly make and include a brief executive summary of the report in the beginning. This is necessary and will help the readers to get a quick idea.

   Suggestion Incorporated

2. Kindly divide chapter 1 into two chapters- 1 and 2. In chapter 2, along with the literature review kindly include objectives, methodology and a brief outline of the scheme (mentioned in PDMC proposal). Please refer to the chapter outline sent to you.

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30. **General Comments**: Suggestion accepted and incorporated

In-Charge Head

V. Krishna Mohan

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