GOVERNMENT OF KARNATAKA

THE IMPACT OF PER DROP MORE CROP COMPONENT OF PMKSY ON COVERAGE OF AREA UNDER MICRO IRRIGATION (MI), INCENTIVISATION OF SUITABLE CROP PATTERN, CROP PRODUCTIVITY, COST SAVINGS AND WATER USE EFFICIENCY (2016-17 TO 2018-19) FOR ACHIEVING TARGETS UNDER SDG-6

ಕರ್ನಾಟಕ ಮೌಲ್ಯಮಾಪನ ಪ್ರಾಧಿಕಾರ
Karnataka Evaluation Authority

KARNATAKA EVALUATION AUTHORITY
DEPARTMENT OF PLANNING, PROGRAMME MONITORING AND STATISTICS
GOVERNMENT OF KARNATAKA
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DR. D. L. MAHESWAR (RTD. V. C, U. H. S, BAGALKOT)

DR. VEERABASWANT REDDY

THE ENERGY AND RESOURCES INSTITUTE (TERI)

DEPARTMENT OF AGRICULTURE, HORTICULTURE AND SERICULTURE

KARNATAKA EVALUATION AUTHORITY
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Foreword

Karnataka has the second largest area under rainfed agriculture after Rajasthan in the country. Out of 10.10 M ha of cropped area, 64.2% is rainfed and two-third of cropped area suffering frequent droughts. Micro Irrigation has proved to be promising technology for improving the resource use efficiency (specifically water), productivity, and income of farmers.

The study on Impact Evaluation of Pradhan Mantri Krishi Sinchayee Yojana (PMKSY-Per Drop More Crop) of Karnataka from 2016 to 2019, implemented by the Department of Horticulture, Agriculture and Sericulture, has been evaluated by The Energy and Resources Institute (TERI). The study mainly focused on functioning and performance of drip and sprinkler irrigation on functionality of the equipment, resource use, productivity, income, and employment.

To achieve objectives, both secondary and primary data has been used. Secondary data on physical and financial information by districts analysed for assessing the physical and financial performance. Primary farm household data has been collected from 3690 beneficiaries and 40 non-beneficiaries of micro irrigation from 10 districts located in 10 Agro-climatic zones viz., Belagavi, Bidar, C. R Nagar, Haveri, Kalaburgi, Kolar, Mysuru, Shivamogga, Tumakuru and Uttara Kannada.

Results have demonstrated that the PMKSY-PDMC has been able to increase the cropping area, productivity of water, crop productivity, and income of farmers. Further, the incremental benefits are relatively higher with respect to water scarce regions. The results have shown that micro irrigation has not only increased more crop per drop of water but also provided them with more value per drop of water. Furthermore, crop pattern changes also have been noticed from low value crops to high value crops.

The study has proposed strengthening single window model, Karnataka Antharaganga Micro Irrigation Corporation (KAMIC) Limited for further improving the efficacy of the micro irrigation program in Karnataka and convergence with the irrigation related schemes like PM-KUSUM, National Horticulture Scheme, Rashtriya Krishi Vikas Yojana, Jal Jeevan Mission, and Integrated Scheme on Oilseeds, Pulses, and Oil palm. Additionally, post-installation services, training and maintenance and insurance should be made mandatory for sustaining the benefits throughout the economic life of the equipment.

I am sure that the findings of evaluation report and recommendations will provide useful insights for improving the efficacy of the PMKSY-PDMC scheme. The guidance from the Director (Evaluation) throughout the study and inputs from the ACEO-KEA and experts is greatly appreciated and acknowledged.

The study received support and guidance of the Additional Chief Secretary Planning, Programme Monitoring and Statistics Department, Government of Karnataka. The report was approved in 51st Technical Committee Meeting. The review of the draft report by KEA, members of the Technical Committee, and an Independent Assessor, has provided useful insights and suggestions to enhance the quality of the report. I duly acknowledge the assistance rendered by all in successful completion of the study.

Chief Evaluation Officer
Karnataka Evaluation Authority

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THE TEAM

TERI

Core team member : Dr. D. L. Maheswar, Consultant TERI (Principal investigator)
Dr. Veerabaswant Reddy, Fellow, TERI (Co-principal investigator)
Mr. T. Senthil Kumar, Fellow, TERI
Dr. K. N. Krishnamurthy, Consultant TERI
Mr. K. M. Girish
Ms. Amulya. G. Consultant TERI
Ms Christina De Souza
Dr. Devika Dinesh Joshi
Ms Asha L Giriyan

Reviewer : Sri. D. N. Narasimha Raju, IAS (Retd.) former Director TERI, SRC
Dr G Narsimha Rao Director, TERI SRC, Bengaluru

Secretarial support : Ms. Madhura
Ms. Jyothi
Ms. Christina
Ms. Manjula
Mr Roopa C

IT support : T. Saravana

Accounts Support : Mr J Narsimha Murthy senior manager (Accounts)
Ms Uma Maheshwari

Field Enumerators
Mr. Sachin Hatte, Bidar
Mr. Basavaraj Hiremath, Kalaburgi
Mr. Suresh, Athani, Belagavi
Mr. Nagaraj Pujar, Khanapur, Belagavi
Mr. Basavaraj, Savadathi, Belagavi
Mr. Iswargouda Patil, Haveri
Mr. S. S. Salimath, Hirekerur
Mr. Manjunath K. T, Kolar
Mr. Manjunath, Gundlupete, Chamarajanagar
Mr. Gnanendra Kumar, Shivamogga
Mr. Arjun, Mysuru
Mr. Shashidhar, K. T. Tumakuru

Field coordinators
Mr. Anandaiah
Mr. Suresh Sajjan

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ABBREVIATIONS

AAP	Annual Action Plan
ADA	Assistant Director Agriculture
BIS	Bureau of Indian Standards
CTF	Central Quality Testing Facility
DAC&FW	Department of Agriculture, Cooperation & Farmers Welfare
DBT	Direct Benefit Transfer
DDH	Deputy Director of Horticulture
DDS	Deputy Director of Sericulture
DAP	District Agriculture Plan
DI	Drip Irrigation
DIP	District Irrigation Plan
DMIC	District Micro Irrigation Committee
DOA	Department of Agriculture
DOH	Department of Horticulture
DOS	Department of Sericulture
FGD	Focus Group Discussion
FWUE	Field Water Use Efficiency
GOI	Government of India
HDPE	High Density Poly Ethylene
hp	horse power
IA	Implementing Agency
ICAR	Indian Council of Agriculture Research
ICT	Information and Communication Technology
IN-RIMT	Indian Resources Information and Management Ltd.
IWMI	International Water Management Institute
JDA	Joint Director of Agriculture
JDH	Joint Director of Horticulture
JDS	Joint Director of sericulture
KAMIC	Karnataka Antharagange Micro Irrigation Corporation
KEA	Karnataka Evaluation Authority
KBY	Krishi Bhagya Yojana
KJA	Karnataka Jnana Aayoga
KW	Kilo Watt
LDPE	Low Density Poly Ethylene
LF	Large Farmers
M & E	Monitoring and Evaluation
MF	Marginal Farmers
MFs	Medium Farmers

MI	Micro Irrigation
MIDH	Mission for Integrated Development of Horticulture
MIF	Micro Irrigation Fund
MIS	Micro Irrigation System
NFSM	National Food Security Mission
NMMI	National Mission on Micro Irrigation
NMSA	National Mission on Sustainable Agriculture
NWM	National Water Mission
NWP	National Water Policy
OFWM	On Farm Water Management
PFDC	Precision Farming Development Centers
PMKSY-PDMC	Pradhan Mantri Krishi Sinchayee Yojana-Per Drop More Crop
PPMSD	Planning, Programme, Monitoring and Statistics Department
PRIs	Panchayati Raj Institutions
R&D	Research and Development
RKVY	Rashtriya Krishi Vikas Yojana
SADH	Senior Assistant Director of Horticulture
SAU	State Agriculture University
SC	Schedule Cast
ST	Schedule Tribe
SCP	Special Component Plan
SDG	Sustainable Development Goals
SEO	Sericulture Extension Officer
SF	Small Farmer
SI	Sprinkler Irrigation
SMIC	State Micro Irrigation Committee
SPV	Special Purpose Vehicle
TOR	Terms of References
TSP	Tribal Sub-Plan
TERI	The Energy and Resources Institute
WUE	Water Use Efficiency

GLOSSARY

Cash crops	Sugarcane
Cereals	Jowar, Maize, Paddy, Savi (rainfed paddy local), Wheat
Fiber crops	Cotton
Flowers	Marigold, Rose, Jasmine, Chrysanthemum, Tube rose
Fruits	Banana, Mango, Papaya, Pomegranate, Watermelon, Grapes, Jackfruit
Millets	Ragi, Bajra
Oil seeds	Ground nut, Soya bean, Sunflower
Plantation crops	Arecanut, Coconut
Pulses	Bengal gram, Black gram, Cowpea, Green gram, Horse gram, Redgram
Mulberry	Mulberry
Spice	Chilly, Coriander, Pepper, Turmeric, Onion, Ginger
Vegetables	Beans, Brinjal, Carrot, Knol-khol, Cucumber, Potato, Tomato, Ridge gourd & Cabbage

EXECUTIVE SUMMARY

Water is fundamental for sustaining a quality life, as well as economic and social development of human society. Efficient water use and food production are flagged as the two most important issues for world peace and social security in the 21st century and water scarcity poses serious threats to rural livelihoods and food security. It has been estimated that by 2025, 1/3rd of the world population will face absolute water scarcity and whereas, in India 54 percent area faces high to extremely high-water stress (Seckler, et. al., 1999 and Vibha Dhavan, 2017). Agriculture accounts for a majority of global freshwater and In India approximately 90 percent of annual freshwater withdrawals for agriculture, including ground water, which expanded rapidly in the last few decades.

In India, out of 142 M ha of arable lands, 60 percent (85.2 M ha) is rainfed. Karnataka has the second largest area under rainfed agriculture characterized by highest concentration of drought prone area after Rajasthan in the country. With 10.10 M ha of cropped area in Karnataka state, only 35.8 percent is irrigated and the rest 64.2 percent is rainfed. This indicates 2/3rd cropped area is still under dry land agriculture and relying on monsoon and suffering frequent droughts (< 750 mm of rainfall) KMIP, 2017 and KJA, 2019. Thus, the demand for irrigation water is increasing, as irrigation is very critical input for enhancing agricultural productivity and farmer's income. Meanwhile, groundwater exploitation in the state is highly skewed, exploiting more intensively in semi-arid districts of North and South interior Karnataka. The stage of groundwater development in the state is around 65 percent. However, in over exploited area it is around 125 percent as against 87 percent in critical areas implying distorted development. Currently, more than half of the state's cultivated area is under critical to over-exploited category (Suresh Kumar 2019). Overall, 44 of the 176 talukas in the state have been declared as 'over exploited', 14 are in the 'critical' category and 21 are in the 'semi-critical1' category with regard to groundwater exploitation (KJA, 2019). Though the trend in the growth of number of borewells as well as area irrigated by borewells is increasing, the area irrigated per bore-well is increased from 0.9 to

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1 Ground water status categorized based on ground water development- a) stage of ground water development, and b) long-term of pre and post monsoon water levels.1. 'Safe' areas which have ground water potential for development (>70% and <=90%); 2. 'Semi-critical/critical' areas where cautious groundwater development is recommended >90% and <=100%; 3. Over-exploited' areas, where there should be intensive monitoring and evaluation and future ground development be linke (>100%)

1.47 ha. The increasing probability of borewell failure to the tune of 0.4 and the unsustainable groundwater use necessitates demand management and supply augmentation measures for improved Water Use Efficiency (WUE) in agriculture sector. Thus, given the climate change scenario and increased demand for water from competing sectors and absolute scarcity & variability in water availability necessitate technological, institutional and policy interventions for equitable and sustainable use of water for agriculture.

Thus, Department of Agriculture, Cooperation & Farmers Welfare (DAC&FW) has launched a centrally sponsored scheme on Micro Irrigation in 2005-06 which was subsequently converted as National Mission on Micro Irrigation (NMMI) in 2010-11. During 2014-15, the scheme was subsumed as On Farm Water Management (FWM) component of National Mission for Sustainable Agriculture (NMSA) and further subsumed under Per Drop More Crop (PDMC) Component of The Pradhan Mantri Krishi Sinchayee Yojana (PMKSY) during 2015-16 with the objective to provide end-to-end solutions in irrigation supply chain in India. Recently, the Task Force on Micro Irrigation 2004, had estimated a potential of 69.5 m ha under micro irrigation, whereas the area covered by 2018-19 is only about 11.58 m ha (16.6 percent), Whereas Karnataka achieved yearly 11 percent, 17 percent, 23 percent and 20 percent during 2015 to 2019 covering 30 districts through line Departments like Horticulture, Agriculture and Sericulture by providing varying levels of subsidy extending up to 90 percent of the cost of irrigation system.

However, there is a new debate concerning the impact of MI systems at various levels of water use for consideration of "water-saving" and also on the status of the resource and there might be increase in crop output but no net water saving may result. Thus, PMKSY-PDMC scheme requires evaluation to find out impact of the scheme at the ground level of MI Technology vis-a-vis resource conservation through strengthening the state Micro Irrigation Policy/ guideline, other claimed benefits and also to suggest the activities requiring more focus and attention to ensure that more benefits accrue to farmers in the next phase of implementation of the scheme. In this context TERI took an impact evaluation of PMKSY-PDMC scheme implemented during 2016-17 to 2018-19 in Karnataka with an aim of determining the potential benefits from the use of MI systems in sample study area

Specific objectives of the study

1. To review the scheme implementation as per the guidelines.
2. To assess the impact of the scheme on: crop diversification, crop production, productivity, energy saving, water saving and income of the farmers across the regions and categories
3. To assess promotion of MI technologies in water scarce, water stressed and critical ground water districts (over exploitation, critical, semi critical and safe zone).
4. To examine quality and functional status of the MI system.
5. To gauge the extent of awareness and knowledge on water management, its technology and adaptation.
6. To assess training needs and training impact in maintenance of maintenance of MI system.

Present study is a multi-dimensional impact assessment which involved typology, spatio-temporal, social and farm size, institutional and economic, techno-feasibility of MI system towards meeting the objectives of the scheme. A multi-stage- proportionate random sampling design was adopted for selection of taluks and beneficiaries. With the pre-identified 10 districts viz., Belagavi, Bidar, C. R Nagar, Haveri, Kalaburgi, Kolar, Mysuru, Shivamogga, Tumakuru and Uttara Kannada, representing 10 agro-climatic zones, further taluks were selected by classified into high, moderate and low groups of beneficiaries considering ground water exploitation status Viz., safe, semi critical/ critical and over exploitation. From each sample taluk 5 to 6 gram panchayaths (GP) were classified into best, moderate and average level of MI installation.

The selection of the sample beneficiaries has been made randomly representing various category (marginal, small, medium and large farmer), social group (General, OBC, SC and ST) and gender (male and female). Besides this, non-beneficiaries were also selected to identify reasons for their non-participation in the programmes and also to compare with MI beneficiaries. Total number samples are 3730 selected who benefited during 2016-17 to 2018-19. Out of which, 3690 beneficiaries and 40 were non-beneficiaries. Based on proportionate sample distribution further, highest (70%) sample beneficiaries were drawn from agriculture and medium (27%) from horticulture and minimum (3%) from sericulture. Additionally, 20 FGDs (10 drip and 10 sprinkler) and 20 (10 drip and 10 sprinkler) case studies were conducted to capture success or failure of the program across drip and sprinkler beneficiaries. Both qualitative and quantitative data was collected through primary and secondary information. Secondary information was collected from Department of Agriculture, horticulture, sericulture and supportive literature review through extensive desk. Primary data collection was majorly through participatory tools such as questionnaire survey, FGDs and key stakeholders' consultative interactions were adopted.

All the primarily processed quantitative data was analyzed for assessing interrelationships by using relevant statistical approach like comparative, average, mean, range, percentage, grading and correlation. Impact of micro irrigation was estimated by using opinion survey data captured before and after the scheme implementation for beneficiaries, and after adoption of MI by the beneficiaries (adopters) Vs non-beneficiaries(non-adopters) of the MI system. The important variables evaluate are changes in land use, cropping pattern, crop diversity and cropping intensity production /unit area. Further change with respect, water (acre inches), energy, labour saving, employment generation and income were worked out for beneficiary and non-beneficiary, various crops, district and farmer category. Further analyzed impact of training on adoption, functioning status and productivity of different forming community. Key findings and observations are highlighted under the following sub heads:

Process and Implementation of Micro Irrigation

- Funds are allocated in the proportion of 50: 40 between center and state for MI scheme under PMKSY-PDMC program. However, state extended his share through convergent of other scheme and provide up to 90% subsidy for 0.1-2 ha micro irrigation for all community.
- The selection of beneficiaries is done on the principle of "first come first serve", social group norms and ground water exploitation status (Over exploitation-I, Critical/Semi critical-II and Safe zone-III beneficiaries).
- Application of farmer friendly ICT technology is required to be developed for real time tracking of the status and its monitoring. The currently adopted HASIRU IT application initiated by the nodal department (DOH) needs to be extensively popularized.
- The inadequacies and deviation of the PMKSY-PDMC GOI guidelines during the execution of MI especially with respect to planning (DIP & DAP), implementation (scheme convergence, post installation service, training) and technologies (designing,

solar pump, quality inspection) to be addressed at various levels for effective promotion of the scheme.

- It was noticed that there lies a weak linkage between dealers and farmers and also between field assistant and farmer after installation of MI and financial commitment
- KAMIC structuring appears to be in line with the GGRC model to function as the nodal agency for all matters related to micro irrigation promotion in Karnataka. The pros and cons of the proposed mechanism yet to be realized at field for any further refinements. The inclusion and updating are based on the analysis of similar institutional mechanisms operative in other governmental system.

Physical and Financial Performance of MI Scheme

Physical performance of MI scheme

- As on 2020, the 5 years of cumulative area covered under PMKSY-PDMC is 43.12 Lakh ha at national level and in Karnataka 8.12 Lakh ha which accounts for 18 percent of the national achievement (Anon, 2020).
- MI area coverage between the years 2016-17 to 2017-18 was remarkable both at national and state level, as this coverage represents increase of 24.8 percent and 69.3 percent in state, respectively. While marginally increased to the tune of 10.4 percent (10, 48,934 to 11, 58,519 ha) at national level while in Karnataka it was reduced to percent of 0.5 (236107 to 234853 ha) in Karnataka between 2017- 18 to 2018-19.
- Growth of both drip and sprinkler irrigation area coverage between the years 2016-17 to 2017-18 was remarkable, as this coverage represents 44.2 percent (0.46 to 0.67 lakh ha) and 82.1 percent (0.92 to 1.68 lakh ha). However, during 2017- 18 to 2018-19, a marginal (0.67 to 0.76 lakh ha) increase up to 14.3 percent in drip and reduced 6.4 percent (1.68 to 1.58 lakh ha) in sprinkler. The variation in area coverage of MI (drip and sprinkler) in both national and state level during 3 consecutive years may be due to variation in allocation of matching fund, awareness and market value of product. Thus, a stronger push and appropriate fund allocation and monitoring system is needed to meet the target and achievement.
- With respect to district wise, the percentage to the total area of MI, maximum 7.8 percent (0.51 lakh ha) MI area was found in Belagavi followed by Kalaburgi district 7.4 percent (0.50 lakh ha) and minimum of 0.2 percent (0.015 lakh ha) area noticed under Dakshina Kannada which is still 23.23 lakh ha area is under potential to expand

micro irrigation system in the state. The growth rate of MI in north west and north eastern transitional zone evident that MI is adopted extensively in areas of water intensive crop and acute water scarcity. Thus, programme is implemented efficiently and meeting the guideline (priority given to water intensive crop and water scarcity/dry land area) and objectives.

- Cumulatively a maximum of 16336.2 ha drip irrigated area coverage is noticed in Belagavi district followed by Vijayapura 13863.9 ha, Kolar 13303.1 ha, Davanagere 12262.7 ha and Tumakuru 10905.9 ha. The lowest area coverage is observed in Kodagu 200.4 ha. With respect to sprinkler system among the different districts, the maximum area under sprinkler irrigation is seen in Kalaburgi (39263 ha), Mysuru (29850.6 ha), Belagavi (28479.4 ha) and Shivamogga (22954.2 ha) districts. The lowest area coverage was observed in Bengaluru urban (833.2 ha).

Financial performance of MI Scheme

- Public investment and area covered with micro irrigation has shown a consistent increase was observed with 19.3 percent increased (1489 crores to 1777 crores) between 2016-17 to 2018-19 at national level and 60% percent (227 to 376 crores) at the state level.
- It is seen that the allocations as well as the expenditure recorded a consistent increase during the period 2016-17 to 2018-19 period. The average annual growth of allocation of grants was 77.6 percent Rs 48578.8 lakh to Rs 86263.3 lakh) 2017-18 and 14.2 percent Rs 98485.0 lakhs during 2018-19, while the expenditure grew by 38.6 percent (Rs 51349.9 lakhs to Rs 71154.9 lakhs) and 18.4 percent (Rs 71154.9 lakhs to Rs 84220.0 lakhs), respectively.

Performance of MI scheme (Micro analysis)

- Out of the total 3690 beneficiaries, the beneficiary covered under drip and sprinkler irrigation is 44.7 percent and 55.3 percent, respectively. The percentage of MI area coverage during sample survey to the total area (6515.3 acre) covered under MI in sample district is about 43.0 percent drip and 57.0 percent sprinkler. In the overall scenario it is observed that the percentage of drip irrigation installation gradually improved from 2016-17 to 2018-19 compared to sprinklers. year wise increment was noticed 20 percent from 2016-17 to 2017-18 and 18.3 percent from 2017-18 to 2018-

19 in drip installation. However, it was declined to 28 percent in sprinkler from 2016-17 to 2017-18 and escalated to 36 percent from 2017-18 to 2018-19.

- On cross sectional analysis of total MI Installation, it is observed that a maximum beneficiary with drip irrigation was recorded in Belagavi and Chamarajanagar and with less installation in among Mysuru and Shivamogga beneficiaries. However, under, sprinkler irrigation maximum coverage was noticed in Mysuru and Shivamogga and least in Chamarajanagar and Belagavi.
- In the overall sample, more than 50 percent of the beneficiaries were from the general category, 29.6 percent of the beneficiary from OBC category, 7.5 percent and 6.3 percent of the beneficiaries represented SC and ST categories. The study shown the dominance of male farmer beneficiaries (84.9%) compared to female beneficiaries. Overall, nearly two thirds of the beneficiaries were exposed to education while one third are yet to be educated. The predominance of agriculture-based occupation (88.5%) found to be the lead adopters of MI systems compared to other occupations. The proportions of milch animals are dominant as compared to drought animals and small ruminants among both beneficiaries and non-beneficiaries.
- In the sample size (out of 3690) it was observed that, medium category of farmer accounted maximum 67.8 percent, whereas 23.2 percent farmers are reported to be under small, 6.5 percent marginal and 2.4 percent under large farmer category.
- The assessment study covered more than 40 crops with the classification of 12 major crop categories. Drip irrigation, prominently used for horticulture, fibre, cash crops and mulberry. Whereas, the sprinkler irrigation system is widely used in field crops (cereals, pulses, millets and oil seeds).
- This impact assessment study in different districts has properly covered with principal crops which were predominant to agro-climatic zone coupled with ground water status. With respect to spread of crops, it could be noted that cereals (Paddy) in Uttara Kannada, pulses in Kalaburgi, oil seeds in Haveri, millets in Kolar and Mysuru, cash crops (Sugarcane) in Belagavi, fibre crops (Cotton) in Haveri, fruit crops in Chamarajanagar, plantation crops in Shivamogga, spices in Mysuru and Chamarajanagar, flower crops in Belagavi, vegetables in Kolar and mulberry in Kolar are dominated and found to be potential for promoting MI irrigation.
- Awareness on PMKSY-PDMC among beneficiaries and non-beneficiaries, on an average 85.5 percent (out of 3690) farmer are aware about PMKSY-PDMC scheme among beneficiaries and 75.5 percent (out of 40) among non-beneficiaries. With

respect to district-wise awareness levels among beneficiaries, Kalaburgi district farmers have well aware of the scheme and least awareness about PMKSY PDMC program was noticed in Belagavi district farmers.

- Awareness on PMKSY-PDMC among the gender found male is 85 percent and in female it was only 15 percent. Further information access and knowledge about PMKSY-PDMC among farmers category was medium sized farmers (66.7%), and least was observed with large farmers (2.4%). Among various social groups, general/other category beneficiaries have better knowledge and well aware of the scheme which account to 57.2 percent, followed by OBC and least was noticed among with SC and ST beneficiaries which accounts only 6 and 7 percent, respectively. Thus, a special drive is needed on wider publicity to make them aware about the benefits and operation of the scheme. From this study it could be inferred that the overall trend of generating awareness through all the lead sources must need to be enhanced significantly to ensure greater influence for MI adoption.
- The major (15.9%) sources and awareness is through neighbouring farmer. Towards the shortlisted 13 reasons for non-adoption of MI system, primarily the reasons are pertaining to lack of clarification in subsidy issues (12%), followed by lack of technical guidance and labour scarcity (9.7% each). However, average willingness to adopt MI system was 65 percent.
- A majority of 86.3% of the MI systems (both drip and sprinkler) supported under the scheme are functional enough to enable crop production as a sustainable technological investment. Maximum functioning of the MI installation was observed in Uttara Kannada (97.1%) and minimum functioning of MI system was noticed in Haveri (59.7%). The non-functionality of the MI units is mainly due to beneficiaries have sold the units to others due to drying of water sources and damage of the units chocking of the system.
- In the current study it is observed that 64.5 percent of the beneficiaries have invariably installed the various types of filters, whereas 35.5 percent of the beneficiaries have failed to install the filters. Owing to the economic cost, accessibility and easy maintenance many of the beneficiaries have adopted screen filter (69%) followed by sand filter (15%) and hydro cyclone filter (10%).
- In the present study it is observed that maximum proportion of farmers have expressed the lifespan of MI is between 3-5 years (36.3%), followed by 2-3 years (32.8%). This variation in the lifespan of the MI system largely depends on quality of the material,

maintenance and designing of the system. Among various district it is noted that the beneficiaries in Uttara Kannada (71.1%) have expressed lifespan of the system is 3-5 years compared to other districts. This particular issue calls for review of the policy to re extend the benefits after a set standard of lifespan. Few interactions and discussion with micro irrigation system manufactures and agencies the average life span of the micro irrigation system may last for about 8 years subjected to quality and maintenance of the system. It is also noticed that on a conservative estimate the life span of MI equipment in general is about 5 years.

- It is a noteworthy observation that, the average participation of the beneficiary in PMKSY-PDMC-Scheme was higher up to 71.7 percent across all districts and being maximum in Shivamogga (90.7%) and Kolar (90.1%) and least was in Belagavi (41%).
- On an average, cost of MI installation is about Rs 24291/acre of which drip irrigation is about Rs.31161/-acre and sprinkler is about Rs. 17421/- acre. The investment for drip irrigation is found be to be 78.8 percent more compared to sprinkler irrigation. In field observation it is noted that the MI investment is maximum (Rs 40832/acre) of drip irrigation in kolar and Rs 23298/acre for sprinkler in Belagavi. whereas, in mulberry crop it was Rs 82920/ acre which is higher than other agriculture and horticultural crops. With respect to subsidy availed by various beneficiaries, maximum subsidy availed by medium size farmers (47.5%) followed by large farmers (23.6%) and small farmers (19.4%) and minimum was observed among marginal farmers (9.6%). Maximum (55%) beneficiaries have availed their subsidy between 6-12 months which is a long duration, total deviating the specified norms and thus it is a demotivating factor which needs to be addressed at all levels of scheme implementation. Only 31.2 percent of the beneficiaries the DBT system is functioning while 69.3 percent gets streamed through other non-considerate modes of disbursements and 59 percent of the subsidy disbursement channelized through MI agency.
- Convergence of PMKSY-PDMC with MGNREGA, NHM, Krishi Bhagya, Ganga Kalyan, NFSM, and ISOPHOM, found very marginal (only 31%). Among all scheme, maximum (62.9%) convergence was found with NSFM scheme which provides several crop productions inputs along with demonstration and training and minimum with ISOPHOM (1.7%) scheme. An average maximum convergence of the scheme noticed with NFSM programme in Kalaburgi district (91.1%), Bidar (82.6%) and

Kolar (77.6%), while the other scheme enabled included NMH Ganga Kalyan and Krishi Bhagya scheme intermediately.

- Popular programs like soil health testing have enabled a maximum number of farmers to test their soils to supplement benefit of micro-irrigation to the extent of 62.3 percent, while 37.7 percent requires guidance to reap better out come out of MI investment.
- It can be clearly observed that medium size farmers have adopted maximum (47.2%) MI system followed by small farmer (24.4%) and marginal farmer (19.2%). Whereas least MI adoption was observed with large farmers that is only 9.1 percent.
- Medium size farmer category in Uttara Kannada district beneficiaries have highest adoption rate (53.8%) followed by Chamarajanagar and Shivamogga district beneficiaries. However, least (37.5%) adoption rate was noticed with Bidar district beneficiaries. Under small farmer category, farmers belong to Tumakuru district have maximum adaptation of MI followed by Bidar which is accounted 34.5 and 31.5 percent respectively whereas, least adoption rate was noticed with Kalaburgi district farmers (16.3%). In marginal and large farmers category, Shivamogga and Uttara Kannada beneficiaries have accounted maximum of 28.2 and 17.6 percent respectively and minimum adoption rate was observed in Kalaburgi district (14.7%) and Mysuru district (3.2%)
- The study also revealed that training significantly influenced on their knowledge and interest towards technology which leads to increase in adoption of MI system among medium and small farmer as compared to other farming community.
- Greater interest in the MI adoptability to the extent of 42,2 percent, 26.8 percent, 16.5 percent and 14.2 percent respectively found with general/ OBC, SC and ST category. The proportion of MI adoption with respect to gender, the ratio between the genders is almost 1/3rd. Male gender representation is recorded at 72.6 percent, and female gender representation is only 27.4 percent.
- One of the prime reasons for adoption of MI system by beneficiaries is quite acceptable due to the fact that MI is water saving technology and found on an average 14.6%. Among various districts Tumakuru, Chamarajanagar and Mysuru district beneficiaries expressed MI adoption is mainly due to its purpose as a water saving technology.
- PMKSY PDMC scheme although envisages effective implementation of the scheme by gathering decadal experiences still not able to minimize/reduce certain critical

constrains which calls for a careful review of the implementation norms and procedures. Around, 63.7% beneficiaries, expressed that an inadequate power supply has found to have affected the MI installation. Further, administrative procedural anomalies have also affected the subsidy claims to the extent of 52.2 percent beneficiaries which is alarming to note and calls for drastic measures in the system and to comfort the claiming procedure. The other reflections factors area delay in system installation (43.7%), differences in quality material supply by (43.10%), cumbersome procedures (42.4%), difficulty during inter-cultivation (41.5%), quality issues of MI components (34.8%), lack of guidance in utilizing and managing the system (34.1%), difficulty in maintaining proper pressure (31.3%) and clogging of emitters and laterals (25.70%). For all the above constraints, appropriate orientation and training has to be done among various beneficiaries.

- M I irrigation Systems supported under the scheme are functional enough to the extent 86.3 percent both under drip and sprinkler. Maximum functioning of the MI installation is observed in Shivamogga and Uttara kannada (97.1%) followed by Tumakuru and Kalaburgi. The coefficients of the independent variables (training) is positive and significant influenced among medium farmers in improving functioning status than other category of farmers.
- Failure to extent post installation services by MI agencies up to an extent of 79 percent is quite alarming and warranting on the part of the public sector to insist for a conditional post installation service support system. Among the district in study area, Uttara kannada district beneficiaries suffered heavily without the maintenance support to an extent of 96.9 percent followed by Belagavi (88.3%). With respect maintenance support for drip and sprinkler irrigation it is observed up to 72.9 and 83.3 percent, respectively due to lack of post installation services by MI agency was common in Uttara kannada district.
- Bneficiaries farmers have been experienced the post installation services with in time span of 3 to 5 months (45%) and the major districts are like Shivamogga, Chamarajanagar, and Belagavi. Further it was noticed that 41 percent beneficiaries received services within two months, and 13 percent beneficiaries within 6 months.
- Borewells are the predominant source of water by beneficiaries as well as non-beneficiaries in all the districts which accounts to 94.0 and 97.5 percent respectively, followed by open well. However, least was noticed with farm ponds. Among districts, under MI beneficiaries, C.R. Nagar, Mysuru and Shivamogga district beneficiary

have completely relied on borewell sources of water. Use of open well as water source for irrigation was found to be limited to only 30 percent and that to majority of them are belongs to Bidar district. In all district farmers are heavily dependent deep ground water for their agriculture which leads ground water depletion in future and it requires urgent attention to rejuvenate at individual level by promoting rainwater harvesting structure around borewells.

- A maximum (85%) depth of open well found between 25 to 50 ft. With respect borewells, more than 500 to 750 ft depth were most common with 48% beneficiaries followed by 250 to 500 ft depth which accounts with 34 percent of beneficiaries and only 2 percent farmers have borewell depth of more than 100ft. Similar trend was also observed with non-beneficiaries.
- The average depth (460.8 ft) of water table can be seen under MI beneficiaries land and 520 ft under non-beneficiaries. Among various district, maximum (604.8 ft) deep borewells are observed in the Kolar district beneficiaries land, followed Shivamogga (547.7ft) and minimum depth of water table borewell (361 ft) noticed in Mysuru. Average water yield of borewell is 2.1 inch under beneficiary land and 2.0 inch in non-beneficiaries. The study results showed that on an average grass irrigated area per borewell is 9.5 acre in MI beneficiaries and 9.5 5.96 acre under non-beneficiaries. This indicates maximum cultivable area was facilitated by borewell found among MI beneficiaries compared to non-beneficiaries. Among various district under MI beneficiaries, gross irrigated area per borewell found maximum (13.2 acre) in Kolar followed by Mysuru (12.8 acre) and minimum (6.4 acre) gross irrigated per borewell noticed under Haveri district. While among non-beneficiaries, maximum (7.02 acre) gross irrigated per borewell found in Kolar and Haveri MI beneficiaries and minimum of 4.35 acre per borewell in Bidar district beneficiaries land. Overall study results indicates that deeper bore wells implies declining dependency of farmers on surface water schemes and increasing dependency on ground water schemes for meeting their minor irrigation needs. So, in order to decrease the dependency of farmers on ground water and to reduce the further depletion of ground water, surface water sources need to be restored through convergence of various scheme in order to continue to derive irrigation benefits from them.

Impact Evaluation

Land use change

Micro irrigation is being practiced in different parts of the sample districts which leads to change in land use system. Out of 6515.3 acres surveyed in the sample districts, it was noticed that a maximum 76% (4920.0 acres) of rain fed and 24% (1594.0 acre) flood irrigated area has been converted to MI. Among districts, conversion MI from rain fed area was noticed is maximum (99% out 641 acres) in Kolar, moderate range of enhanced MI area was observed in Belagavi (63% out of 786.8 acres) and least in Uttara kannada (13% out of 810.4 acres) as these areas are generally rainfall predominant districts. Likewise, the conversion of MI from flood irrigation practices in the survey district changed up to 24% on an average, wherein maximum conversion was observed in Uttara kannada (87% out of 810.4 acres), moderate in Shivamogga (49% out of 699.2 acre) and least was in Kolar (2%, out of 641.6 acres).

Crop diversification

It is found that the tendency of retention of the crop as per the approval was found to be at an average of 61.5% (out of 3690 beneficiaries), being maximum (90.9%) in Uttara kannada and lowest in Mysuru (35.6%). During the course field survey, it was observed that the beneficiaries have switched over to new crops mostly high value crops with the adoption of MI which might be due to subsequent decision of the beneficiary from the production and profit point of view.

With respect to introduction of new crop, average 1.3 percent (out of 370) of beneficiaries with an area of 78.2 acres being maximum (4.3 percent) in Belagavi district, followed by an area expansion of up to 35.6 acres in Kalaburgi distric (9% out of 370 beneficiaries).

Cropping intensity

The average increase in cropping intensity was observed in 34.0 percent of beneficiaries. Maximum extent of cropping intensity was noticed with medium farmers (38%), followed by small farmers (28.1%) and minimum was with large farmers (22.7%). It is also found that the tendency of kharif farmers adopting the practice was found to be at 36.1% (1063 to 1514), being maximum among medium farmers (42.9%) and lowest (23.1%) in small farmers (39 to 48 farmers).

Productivity enhancement

Introduction of micro irrigation has generated benefits in terms of enhancement of the average productivity in agriculture, horticulture and sericulture crops as compared to before installation of MI, and similarly between beneficiaries and non-beneficiaries. Commonly 12 agricultural crops have been identified for assessing the changes. Among various crop, cotton has recorded a greater to an extent of 44.8 percent (14.5 qt/acre to 21.0 qt/acre) followed by sugarcane with 44.4 percent (450 qt/acre to 650 qt/acre) increase and least of 161.8 percent with ragi (9.5 qt/acre to 11.1 qt/acre) as compared to before installation of MI.

Subsequently, beneficiaries have recorded for highest productivity in ground nut crops 78.6 percent (7qt/acre to 12.5 qt/acre) compared and non-beneficiaries and least increase in productivity found with sunflower (5.9%, from 18qt/acre to 17 qt/acre). Among the various districts, in Bidar district highest productivity (72.4%) under sugarcane and minimum increase in productivity was noticed with cotton crop in C. R. Nagar which about only 8.0 percent. The differential response of expressing the productivity enhancement with MI adopters before and after and also compared to non-beneficiaries is obviously due to application of water through drip irrigation and sprinkler enabled optimum moisture nearby root system which enhanced the healthy crop growth and development leading to higher productivity per acre.

In horticulture crop, productivity level in turmeric crops was raised to 52.0 percent as compared to before adoption of MI. However, among MI adopter and non-adopters, a higher positive growth rate of productivity is observed in the case of arecanut (56.7%) under MIS adopters as compared to the non-adopters. Average productivity of the turmeric has increased by 69.0 percent in C. R Nagar, followed by banana 64.7 percent in Kalaburgi due to MI installation. This may be due to drip irrigation technique ensures optimum moisture around the root system and this enables healthy growth of crop and yield.

Mulberry is a perennial commercial crop, where the leaf biomass is the principal source of food to silkworms. The mulberry plant growth and leaf yield was responded significantly well, both spatially, temporally, among beneficiaries and non-beneficiaries. By adopting MI, the percent of biomass productivity found highest up to 40.0 percent as compared to conventional practices, and 43.8 percent increment in productivity among MI adopters as compared to non-adopters. Among various district, after adoption of MI, the percentage of increase in average productivity of leafy biomass was maximum (59.1%) in Mysuru district followed by Uttara kannada district and C. R Nagar as compared to before MI adoption with a minimum productivity increase in leafy biomass was seen in Haveri district (24.6%). It may be concluded that MI adopters are getting adequately compensated for the investments that they make to adopt the MI and many of the crops grown under MI have resulted in higher productivity than those crops grown with conventional method. Performance in term of productivity varies from district to district even for the same crop due to varied reasons like agro-climatic conditions, planting material, cultivation practices, soil productivity, irrigation system adopted and etc.

Among farm holding category, adoption of micro irrigation was benefited more with medium category farmers in agriculture and horticulture crops while, marginal category farmers benefited with sericulture crop as compared other category of farmers. In agriculture crops, maximum (66.7%, 7.5 to 12.5 qt/acre) productivity was observed in medium category farmers with black gram, and horticulture crops. A maximum of 66.2 percent (23.1 qt/acre to 38.4 qt/acre) crop productivity with turmeric in medium category farmers, and in mulberry 50.0 percent (114 qt/acre to 171 qt/acre) was observed with marginal farmers. Thus the adoption of micro irrigation system found more effective in enhancing the productivity among marginal, small and medium farmers than large farmers.

Net water saving

The focus PMKSY-PDMC scheme is to ensure provide end-to-end solutions in the irrigation supply chain, from source to field application with the vision of “Prathi Jaminige Neeru (Har Khet Ko Pani) and “More crop per drop (Parthi Hanigu Hechina Bele).

Micro irrigation intervention, average net water saving was observed in the study area is 4.2-acre inches after installation of MI as compared to before under beneficiaries and 0.9-acre inches among beneficiaries and non-beneficiaries. With respect to ground water zone, with the installation of MI system showed a maximum (39%; 10.8 to 6.5 acre inches) water saving in over exploitation zone followed semi critical/critical zone (33.3%; 12.3 to 8.2 acre inches) and under safe zone (31%; 14.2 to 9.8 acre inches) after installation of MI as compared to before installation of MI system under beneficiaries. Water saving interventions through micro irrigation appears to be productive in over exploitation (18% saving 7.9 to 6.5 acre inches) zone, followed by safe ground water zone (10% saving 10.9 to 9.8 acre inches) and it is quite marginal in the semi critical zone (only 5% saving -8.6 to

8.2 acre inches) among beneficiaries compared to non-beneficiaries.

With agricultural crops, both sprinkler and drip irrigation system are supported under the scheme. Predominantly three major crops Viz. sugarcane, paddy and cotton are supported with drip irrigation system, while rest of the crops- mainly the mulberry and horticultural crops are mainly supported with sprinkler irrigation system.

In general, beneficiaries with the installation of MI it was found that a maximum water saving was observed in paddy (72.0%; 61.8 to 17.2 acre inches) followed by sugarcane (62.0%; 32.1 to 12.2 acre inches), and least water saving was noticed in maize (10.0%; 1 to 0.9 acre inches) crop as compared to before installation of MI. Similar trend of observation was noticed among beneficiaries and non-beneficiaries. Maximum percentage of water saving noticed in paddy (66.8% 51.8 to 17.2 acre inches), followed by sugarcane and minimum of 18.2 percent (1.1 to 0.9 acre inches) water saving found with black gram. It is observed that the range of percent of water saving varies from 10 percent (1 to 0.9 acre inches) to 73.8 percent (66.1 to 17.3 acre inches) which is noticed with maize and paddy in Haveri district. Higher percent of water saving in various crops is due to efficient use of both sprinkler and drip irrigation and proved the fact that micro irrigation adoption as the best water saving approach than conventional irrigation practices.

Common 10 horticulture crops were classified in to 4 groups viz. fruits, plantation crops, spices and vegetables. Drip installation is a common practice under horticulture crops which is well suited and this is mainly due to this nature of crop density and spacing of crops.

The comparative water saving before and after the installation of drip within beneficiaries as well as among beneficiaries and non-beneficiaries showed a positive growth under almost all the crops as compared to the conventional irrigation method. It is important to note that the installation of drip system resulted in a maximum (55.3%; 28.4 to 12.7 acre inches) water saving under banana crop followed by 55.1 percent (28.3 to 12.7 acre inches) in arecanut and minimum (35.6%; 21.6 to 13.9 acre inches) water saving was noticed under mango as compared to before installation of drip system of irrigation. However, among beneficiaries and non-beneficiaries, a maximum (50%; 3.2 to 1.6 acre inches) percent of water saving was noticed in beans crop and minimum (16%; 16.6 to 13.9 acre inches) water saving found in mango under beneficiaries as compared to the non beneficiaries.

Survey results describes that average maximum (68.9%; 4.5 to 1.4 acre inches) water saving was noticed in Kolar with onion followed by arecanut (62.2%) in Shivamogga and minimum water saving (17%; 4.1 to 3.4 acre inches) was noticed in Kalaburgi district farmers. Performance in terms of water saving varies from district to district, even for the same crop due to varied reasons like agro-climatic conditions, planting material, cultivation practices, soil productivity, irrigation system adopted, etc.

Field study results indicated that the percent of water saving in mulberry was found to be maximum up to 42.6 percent (14.8 to 8.5 acre inches) as compared to conventional practices, and only 4.9 percent (8.9 to 8.4 acre inches) increment in water saving among MI adopters as compared to non-adopters. Among districts, the percentage of water saving was maximum (50% each; 16.0 to 15.2 and 8.0 to 7.6 acre inches) in Mysuru and Shivamogga followed by Tumakuru and Uttara kannada as compared to before installation of MI, with a minimum water saving was seen in Haveri district (21.4%; 11.2 to 8.8 acre inches).

Differential water saving among various group of farmers under agriculture, a maximum water saving up to 77.9 percent (59.5 to13.5 acre inch) was observed under paddy with small farmers and minimum of 8.3 percent (1.2 to 1.1 acre inches) in maize with large farmer category. With respect to horticulture crops, a maximum 72 percent (25 to 7 acre inches) water saving was observed with arecanut in medium farmers, and minimum of 17.0 percent (4.1 to 3.4 acre inches) in onion with small farmers. In mulberry, maximum changes in productivity of 57.05 percent (15.6 to 6.7 acre inches) with medium farmers 20.91 percent (11 to 8.7 percent) with marginal farmers was observed.

Fertilizer saving

As a production input, fertilizer application (FYM+ NPK) is a critical activity. The average reduction/saving of fertilizer usage was 23.3 percent after installation of MI. Maximum saving was noticed among beneficiaries in Belagavi (30.5%: 13.2 to 9.1 qt/acre), followed by Mysuru (29.5%: 9.8 to 6.9) and least in Uttara Kannada (17.6%: 10.5 to 8.7 qt/acre). Among beneficiaries and non-beneficiaries an average of 16.3 percent (with a range of 13.4 to 22.2 %) saving was observed with Uttara Kannada recording the highest savings (22.2%: 11.2 to 8.7 qt/acre) followed by Belagavi (19.2%: 11.4 to 9.1 qt/acre) and Shivamogga for the lowest of (13.4%: 11.3 to 9.7 qt/acre) after installation of MI.

Crop category wise fertilizer saving observed maximum under jowar (33.3%), followed by cotton (30.0%) while black gram and ragi recorded minimum (11.1% each) as compared to before installation of MI. Among beneficiaries and non-beneficiaries, maximum percent of fertilizer saving was noticed in cotton (53 %) cultivation, followed by Bengal gram (44%) and minimum saving of 24 % was recorded in maize. The district-wise and crop-wise fertilizer saving were recorded between 4.5 to 57.5 percent, with the lowest in green gram in Tumakuru and highest with jowar at Belagavi district beneficiaries.

Comparative analysis of fertilizer savings before and after the installation of drip system within beneficiaries, as well as among beneficiaries and non-beneficiaries shown a reduction in all horticulture crops. Installation of drip irrigation system resulted in maximum fertilizer savings of 32.4 percent (3.7 to 2.5 qt/acre) for beans, followed by Banana (31.3%: 16 to 11 qt/acre) and least being 15.9 percent 22 to 18 qt/acre) in arecanut. Among beneficiaries and non-beneficiaries, a maximum of 63.3 percent (5.5 to 2.0 qt/acre) of fertilizer saving was recorded under tomato cultivation and a minimum of 21.9 percent (3.2 to 2.5 qt/acre) for onion crop with beneficiaries.

Survey results have described the fact that average maximum (52%: 2.5 to 1.2 qt/acre) fertilizer saving under tomato cultivation in Belagavi and followed by 50.0 percent (4.0 to 2.0 qt/acre) in beans at Tumakuru and a minimum of 5 percent (20.0 to 19.0 qt/acre) for arecanut at Shivamogga in comparison to the conventional practice.

Under mulberry crop, after installation of the MI system, an average fertilizer savings of 11.1 percent (9.0 to 8.0 qt/acre) as compared to before installation under beneficiaries and 33.3 percent saving among beneficiaries and non-beneficiaries. Among various districts, beneficiaries belongs to Tumakuru showed maximum (36.8%: 9.5 to 6.0 qt/acre) savings of fertilizers as compared before installation of MI and least (4.5% 11.0 to 10.5 qt/acre) was noticed in Belagavi.

With respect to various group of farmers a maximum (57.1%: 14 to 6 qt/acre) fertilizer saving was observed under medium category farmers with jowar crop before adoption of MI, while it was minimum (4.5%: 5.5 to 5.25 qt/acre) with groundnut with large farmers. Among horticulture crops, maximum fertilizer saving 42.8 percent (14 to 8 qt/acre) with banana under medium category farmers and minimum of 13.3 percent (3 to 2.6 qt/acre) reduction in fertilizer usage with onion under large category of farmers. In mulberry, a maximum fertilizer (only FYM) saving of 22.2 percent (9 qt/acre to 7 qt/acre) was observed with marginal farmers, and a minimum of 4.5 percent (11 to 10.5 qt/acre) with large category farmers.

Micro irrigation as technology has been popularly known for reduced consumption of fertilizer, however, its potential to reduce fertilizer consumption is really a boon to soil health. Supply of excessive fertilizers mostly followed during conventional cultivation practice which leads to pollutes the farming land hence adoption of MI technology holds greater scope in checking the excessive supply of chemicals to the soil.

Labour saving

The average labour saving before and after installation of MI is about 23 percent, whereas among beneficiaries and non-beneficiaries it is 4.0 percent. A maximum of 25 percent each labour savings was recorded in C. R Nagar, Kolar and Uttara kannada and least Kalaburgi district beneficiaries (21%; 37 to 30) with MI installation. Among beneficiaries and non-beneficiaries maximum (7%; 28 to 26) labour saving was noticed in Bidar district followed by Uttara Kannada and least of 2 percent (31 to 30) in Kalaburgi district beneficiaries.

Crop-wise labour reduction shown a maximum 26 percent (55 to 41) in paddy followed by bengal gram and soybean, with 25 percent (24 to 18 and 28 to 21) savings each and ragi with a minimum 13 percent (31 to 27) of labour reduction after installation of MI. While under beneficiaries and non-beneficiaries maximum labour saving of 38 percent (29 to 18) each in tomato and bengal gram was observed, with minimum 12 percent (17 to 15) in green gram. Labour savings following the implementation of MI practice was observed maximum in soyabean (38.8 %) cultivation in C R Nagar, followed by sunflower (38.5 %) in Kalburgi and minimum in green gram (5.6 %) at C. R Nagar districts.

Efficient use of water management is key to efficient agricultural practices but involves substantial labour work. MI technology is a planned motorized system of water monitoring system built with due consideration of crop tillage and cultivation mechanism. Hence, possess great potential to reduce labour work compared to conventional system of operation.

Under horticulture crops, a maximum of 36.4 percent labour (55 to 35) saving was noticed under tomato, followed by arecanut (35%; 55 to 36), onion (33%; 57 to 38) and least was in grapes (12% 33 to 29) within beneficiaries (before and after). While under beneficiaries and non-beneficiaries, maximum labour saving (40%; 55 to 33) was noticed in beans, followed by 38 percent (56 to 35 and 58 to 36) each in tomato and areacnut with a minimum labour savings of 21percent (42 to 33) in banana. Installation of drip irrigation helped a maximum (57.8%: 65 to 41.2 No/acre) labour saving under tomato in Mysuru district, followed 47.2% percent (53.0 to 28.0 no/acre) labour saving under turmeric in Shivamogga, and minimum (7.5%; 40.0 to 37.0) labour saving under banana in C. R. Nagar.

Horticultural practices are known to be labour intensive, requires regulation of water distribution manually under conventional irrigation system which demands greater labour work. With installation of drip irrigation, direct supply of water to root coverage area without any excess flow as it could be in the case of conventional flood irrigation method is greatly avoided. Furthermore, automatized system of water supply with well controlled water monitoring system have regulated optimum supply of water for cultivation.

In mulberry crop the range of labour saving was noticed from 17 percent (48 to 40) with the installation of MI (before and after) and the percent labour saving up to 23 percent (52 to 40) between beneficiaries and non-beneficiaries was recorded. In Mysore and Tumakuru districts it is noticed that a highest labour savings in mulberry cultivation was 23.6 and 23.5 percent respectively while in Belagavi district it is noticed for a minimum labour savings of 3.6 percent. As in the case of horticulture crops, mulberry also requires regular distribution of water through manually created channels, however with drip irrigation system these routine work is avoided minimizing the labour requirement.

With respect to farmers category, under agriculture crops, a maximum (57.1%: 14 to 6 qt/acre) labour saving was observed under medium category farmers with bengal gram, while it was minimum (6.6%: 30 to 28 No/acre/year) with jowar with large farmers. Under horticulture crops, a maximum 47.1 percent (53 to 28 No/acre/year) labour saving was with tomato under medium category farmers and minimum of 7.5 percent (40 to 37 No/acre/year) reduction in labour usage with banana under large category of farmers. In mulberry, labour saving of 30.9 percent (55 to 38 No/acre/annual) was observed with marginal farmers and minimum of 5.7 percent (42 to39.6 No./acre/year) with small category farmers.

Energy saving

Beneficiaries who have installed MI have indicated the adequacy of power supply up to 33.6 percent (out of 3690), whereas, with non-beneficiaries it was 57.5 percent (out of 40). Among different districts, Belagavi (71.8%) and Kolar (71.5) beneficiaries expressed their suffering highest power shortage. Whereas, under non-beneficiaries, Shivamogga farmers facing a maximum (75%) shortage of power followed by Belagavi, Bidar, Kalaburgi, Mysuru, and Tumakuru (50% each). Thus, there is urgent need to take step towards sufficient power supply for effective utilization of MI system and on other side it was also found that there is potential scope to promote renewable energy (solar) among beneficiaries and non-beneficiaries, by integrating energy conservation schemes.

There are 10187 bore wells found in the study area and majority (48.4%) of the beneficiaries are using pump sets of capacity ranging between 5-10 hp for their irrigation purpose. Among various districts, Shivamogga district has maximum (71.4%) beneficiaries installed with 5.5-10 hp pump sets followed by Tumakuru district beneficiaries (57.1%) and minimum 12.5 percent in Bidar. The variations in the capacities of installed pump sets as attributed to the depth of water, extent of land irrigated, type of MI system installed and cropping pattern.

Savings of electricity with the installation of MI was significantly high ranging from 24 to 28 percent with an average saving of 26 percent before and after installation of MI within beneficiaries. Whereas among beneficiaries and non-beneficiary energy consumption range from 7 to 10.2 percent. The maximum percent of saving in energy consumption was observed in Bidar (10.2%; 23.6 to 21.2 Kw/h/acre) followed by Kalaburgi (9.3%; 24.9 to 22.6 Kw/h/acre) and minimum energy saving was expressed by Tumakuru beneficiaries which is accounted to only 7.0 percent (30.5 to 28.4 Kw/h/acre).

The results of the comparative energy saving before and after the installation of MI with beneficiaries, as well as among beneficiaries and non-beneficiaries showed positive growth under almost all the crops (agriculture, horticulture, and sericulture) as compared to the conventional irrigation method.

Energy savings following to the implementation of MI practice was observed to be maximum in sugarcane (35.3%; 110.5 to 71.5 Kw/h/acre) cultivation, followed by ground nut (31.4%; 17.5 to12.0 Kw/h/acre) and minimum in black gram (11.1%; 9.0 to 8.0 Kw/h/acre). Subsequently, among beneficiaries and non-beneficiaries a maximum energy savings was noticed in sugarcane and soyabean (36.4% each 112.5 to 71.5 and 30 to 7Kw/h/acre) cultivation and minimum of 17.5 percent (57 to 47.0 Kw/h/acre) in maize cultivation. Sugarcane is known to be water intense crop and excessive water supply through flood irrigation is the common practice among non-adopters, reduction in energy consumption under sugar cane cultivation is mainly due to adoption of drip irrigation system.

With respect to crop and district wise maximum energy savings of 53.1 percent (25.6 to 12 Kw/h/acre) under soyabean cultivation in Tumakuru and followed by 50 percent (8 to 4 Kw/h/acre) under ragi cultivation and lowest of 4.8 percent (8.3 to 8.7 Kw/h/acre) for paddy cultivation at Shivamogga district. Sprinkler technology enables a greater area of distribution optimal supply of water in short duration of pumping time, in contrast to flood irrigation. Thus, MI technology has contributed for greater energy savings in the crop production.

The results of the comparative energy saving before and after the installation of drip within beneficiaries, as well as among adopters and non-adopters showed increasing trend under almost all the crops as compared to the conventional irrigation method. Installation of drip resulted maximum (33.3% each 12.0 to 8.0 and 52.5 to 35.0 Kw/h/acre) energy saving under arecanut and coconut followed in chilly 28.0 percent (25.0 to 18.0 Kw/h/acre) and minimum (18.2%; 11.0 to 9.0 Kw/h/acre) energy saving under onion as compared to conventional method. Similar trend was seen among adopter and non-adopters. Survey results describes that average maximum (71.7%: 12 to 3) energy saving was noticed in Shivamogga district under sugarcane cultivation followed by chilly (58.7%) in Kolar and minimum energy saving (5.9%) was noticed in Belagavi under grapes cultivation.

Energy saving in mulberry was found up to be 27.3 percent (16.5 to 12.0 Kw/h/acre) as compared to conventional practices within beneficiaries (before and after MI adoption) and 29.3 percent (17 to 12 Kw/h/acre) increment in energy saving among MI adopters as compared to non-adopters. With respect to district wise, the percentage of energy saving noticed to be highest in Kolar (44.9%: 18.3 to 10.2 Kw/h/acre) followed by Uttara kannada (39.5%: 19 to 11.5 Kw/h/acre) with a minimum energy savings of 12.8 percent (21.8 to 19 Kw/h/acre) in C. R Nagar district as compared to before installation of MI as compared to before installation of MI.

Among various farmer category, under agriculture crops, a maximum (49%: 98 to 50 Kw/h/acre) energy saving was observed under medium category farmers with sugarcane while it was minimum (8.6%: 52 to 47.5 Kw/h/acre) with maize with small farmers. Under horticulture crop, maximum energy saving ranged from 44.7 percent (55.2 to 30.5 Kw/h/acre) with coconut under medium category and minimum of 12.0 percent (58 to 51 Kw/h/acre) reduction in energy usage with tomato under large category of farmers. In mulberry, labour saving of 28.4 percent (15 to 8 Kw/h/acre) was observed with medium farmers and minimum of 18.1 percent (15.4 to 12.6 Kw/h/acre) with small category farmers.

Performance in terms of energy saving varies from district to district, even for the same crop due to varied reasons like agro-climatic conditions, planting material, cultivation practices, soil productivity, irrigation system adopted, etc. have rendered water usage efficient implementation of MI technology and hence, reduction in energy consumption.

Employment generation

Changes in the man days or labour utilization before and after MI intervention at pre-harvest and post-harvest stages were studied. Study results reveals that during pre-harvest stage on an average increased man day was 10.8 percent being maximum in Kalaburgi (16.9%), followed by Tumakuru (14.8 %) and least was in Chamarajanagar (5.5%). Likewise, with respect to post-harvest activities the average percent increase of man days was 26.3% in the study area, maximum (36.1%) being in Haveri and followed by Tumakuru and Belagavi (31.3% and 31.1% respectively) and least in Mysuru (15.4%).

Increase in farm income

Adoption of MI is quite prominently noticed in increasing of farm income (gross income) before and after adoption of MI within beneficiaries. The average increase in gross income/acre was 30 percent under beneficiaries as compared to before adoption of MI. The maximum 42.9 percent (Rs 83245 to Rs 118942 per acre) gross increase in farm income has been reported in Belagavi and minimum increase in gross income/acre by 17.8 percent (Rs 61847 to Rs 72833 per acre) in Mysuru. Similar trend of increasing in farm level income per acre was found among beneficiaries as compared to non-beneficiaries. The average enhancement of gross income among beneficiaries as compared to non-beneficiaries is 26.1%. The maximum increase in gross income has been reported in Bidar 46.6% (Rs 84000/acre to Rs 118942/acre) followed by Belagavi (Rs 49600/acre to Rs 72692/acre).

Adoption of MI is quite prominently noticed in increasing of farm income of various farmers category. By adoption of MI showed average increase in gross income/acre, ranging from 6.1% to 39.7 percent (Rs 71245 to RS 115838/ acre) as compared to before adoption of MI. The average maximum gross increase in farm income has been reported among medium farmers (Rs 82945 to 115838/acre) followed by small (Rs 50708 to Rs 6641/ acre) and marginal farmers, however least was noticed in large farming (Rs 67146 to Rs 71245/acre).

The participation in training on MI technology really helps in enhancing the net household income among small, medium and marginal farmers however not much directly influenced on net income of large farmers.

Social and Environmental benefits of MI installation

- Micro-irrigation scheme implementation has resulted in inclusive development of beneficiary contributing for their infrastructure, livestock, household assets and education enhancement, sequentially. From the field study it was noticed the infrastructure improvement (47%) was observed to be a most significant social impact followed by livestock (20%), household assets (19%) and education (14%) support as general phenomena by adoption of MI.
- Among various district beneficiaries in Haveri, Shivamogga and Belagavi beneficiaries have registered higher percent of social benefits than other districts in terms of infrastructure and minimum was noticed in Bidar. However, livestock support was obtained maximum in Bidar, Mysuru and Chamarajanagar by adopting MI. Were expressed positive response towards gaining household assets benefit by adopting MI in Kalaburgi and Uttara Kannada and least among Tumakuru and Haveri beneficiaries. Similarly, the family members like children getting into the academics through MI support in education front to the extent of 35 percent in Kolar and 33 percent Bidar beneficiaries.
- Overall average 68.6% labour migration was reduced by adoption of MI. Among various district, maximum reduction in labour migration was observed in Shivamogga (98.4%) district followed by followed by Uttara Kannada (90.3%). However, no changes have been noticed in Kalaburgi district.
- Agricultural water management tend to possess several heavy and hard activities causing stress and strain to human labour, which is very predominant with irrigation practice. A transition from traditional flood irrigation towards MI irrigation resulted in the reduction of labour drudgery especially in water management which sustained human energy for productive activities. In the present analysis, it was found that the average reduction of labour drudgery of 57.9 percent by adopting MI. With respect individual component, drip adoption reduced labour drudgery by 64.5 percent and 52.5 percent by sprinkler adoption. Among the districts maximum reduction in labour drudgery was noticed in Chamarajanagar, Kalburgi and Belagavi districts, owing to

the dependence of higher population on agricultural labour. The shifting, shuffling and insertion of sprinkler jets calls for additional drudgery, hence which is not so in-case of drip system.

- It is heartening to note that the 75.4 percent beneficiaries have expressed installation of MI system as a practice to overcome water scarcity. However, still 24.6 percent of beneficiaries substituting water through purchasing or shared by neighbour. Among various district Mysuru and C. R. Nagar beneficiaries expressed that installation of MI helped maximum (94.3% each) to overcome water scarcity during critical period and minimum was in Bidar (45.9%).
- In this study it is noted that the 72.1 percent farmers have experienced the incremental population of earth worms and 77.5 percent reduced soil cracking with MI adoption.

Training and Capacity Building

- The training and capacity building is an integral component of the PMKSY-PDMC initiatives. In the present study the level of beneficiary participation, stakeholder engagement, frequency, seasonality, topic covered, usefulness in building the knowledge and skill in MI system management. The study results highlighted that a majority around 87.4 percent of beneficiaries across all districts not had training program, thus highlighting the need for interventions to strengthen the training and capacity building component of the program.
- As business traders, the MI agencies have taken maximum initiative to the extent of 41 percent which is a dominant approach in organising the training program. Followed by the involvement of governmental staff to an extent 25 percent, RSK with 17 percent share, SAUs/KVKs with 12 per cent share and NGOs/CBOs with 5 per cent.
- The dominant mode of training was through demonstrations (71) and one day training program was most popular and only 31 percent expressed timing as convenient.
- 72 percent farmers expressed principal topic covered in the training is irrigation practices. In terms of gaining knowledge and skill enhancement, 33 per cent of respondents rated the training program to be very good, 47 per cent rated it to be good and 20 per cent rated it as medium/average. Since the program is a more technically oriented one, any improvement in the wisdom and skill matters the sustainable outcome from the program and investment. Among participated beneficiaries more

than 82 percent of the farmer beneficiaries have expressed their enhanced knowledge and skill due to training,

Focus Group Discussion (FGD)

MI a uniform water distribution technology has become an agricultural practice through the MI system to support crop production and area expansion dimensions in both flat and uniform terrains like in northern Karnataka and with undulating terrains in coastal southern Karnataka districts also. Irrespective of soil types and texture, the MI practices are found to be an adoptive one in all parts of the state- [Hunsaghatta, Tumakuru and Mudapali, Uttara Kannada]

Cereal crops like paddy, maize, groundnut, soybean, pluses, and closely spaced vegetables have been the choicest crops for sprinkler adaption, while perennial crops including widely spaced row crops like various fruits, plantation crops, spices and row crops like vegetables and flower crops are with the drip system, which is being very well acclimatized as a most viable irrigation practice by the farming communities across the land holding size. [Morkandi, Bidar and Hulidevanhalli, Kolar]

A common voice of adoption of MI system enabling the farmers in stabilizing their crops and yield was observed in most of the districts of study. Simultaneously, the financial improvements are received as MI scheme compensated the initial investment. Owing to soil physiography in district like Chamarajanagar has been observed to be a marginal exception: [Maddur, Chamarajanagar and Hulidevanhalli, Kolar]

Prevalent of seasonal drought in districts like Tumakuru and Kolar during 2018-2019, and with unsettled rainfall pattern decreasing up to 30-40% of the total rainfall in North Karnataka region, the MI system sustained as a boon for crop production. [Morkandi Bidar and Hulidevanhalli, Kolar]

Borewell has been the major source of irrigation across the state and the number of bore-wells would vary with land size. Cultivators with up to 2-3 acres would own one bore-well while in land holding of 10-12 acres up to six bore-wells. [karadaggi, Haveri and B Matagere Mysuru]

Affluence of revenue out come with MI practice has been well relished by the farmers and it tempted them dug borewells up to a maximum depth 800-1400 above at Kolar/Tumakuru and minimum record of 600-1200 ft at Shivamogga/ Uttar Kannada: [Mydholalu, Shivamogga and Hunsaghatta, Tumakuru]

In general, during summer season and in dry regions crops face shortage of water and farmers would like to avoid cultivation of crops which yield on lesser water. In case scarcity of water, farmers would request and trade the water from the neighbouring land holder in return of sharing some produce, out of gratitude. [Tengli, Kalaburgi and Adahalli, Belagavi]

It has been a conscious suggestion by farmers for joint inspection by field implementing officials of Revenue, Irrigation and Electricity Departments towards confirming the water source, water Output, power supply before launching the program for efficient utilization of Government subsidy. [Morkandi, Bidar]

Irregular time of power-supply has forced farmers to accommodate unconventional irrigation timings and this has also led to the use of condenser for power extraction as an illegally compromised plan. [Maddur, Chamarajanagar and Hunsaghatta, Tumakuru]

Farmers reported to have not provided with any organized training apart from providing one onsite demo at few places of study area. Lack of training has been the major bottle neck. [Matagere, Mysuru and Mudapali, Uttara Kannada]

Recommendations

Short term

1. To trace the entire process from the stage of application to installation till subsidy transfer, IT applications like Geo-tagging and referencing for real-time monitoring are to intensified for clarity and transparency.
2. Proper verification mechanism of field documents verification for ownership, water sufficiency, electricity connection and any parallel installations to avoid duplication of scheme benefits.
3. Seasonal and year-round crop planning advisories to be formulated and trained the farmers for the best and efficient utilization of MI installation during peak and other follow-on seasons.
4. Focused training to farmers on the maintenance and post-installation services of micro-irrigation system and to instill confidence of the technology through regional institutional training-cum- services centers are to be arranged.

5. Innovative low-cost micro irrigation systems having a longer lifespan are to be promoted for enhancing the technology adoption with suitable quality control regulations on materials.
6. Direct Benefit Transfer (DBT) model to be rationalized (instead of Direct Beneficiary Transfer) and uniformly adopted in all the major implementing departments to enhance transparency.
7. Mandating the MI system for heavy water-consuming crops like sugarcane, banana, and vegetables with special subsidy incentives.
8. Enforcing regulatory measures to the unapproved agencies, distributors and dealers to avoid supply of sub-standard components through exclusive autonomous institutions like KAMIC.
9. The officials who are involved in promoting micro-irrigation technology have inadequate knowledge and skills about the technical and related details. Therefore, the state government extension staffs need to undergo refresher courses and exposure visits to have basics and advances in micro-irrigation.
10. MI system manufacturers should be involved intensively in promoting micro-irrigation technology through demonstrations at farmers' fields and strategic locations and provide advisories on agronomic packages for large scale adoption.
11. Designing the subsidy provisions ranging from 45 % to 90% to vulnerable categories to enhance the adoption of micro-irrigation with marginal and small land holders.
12. In order to encourage adoption of micro irrigation and its promotion among the poor and marginal farmers, a special scheme could be introduced that links the bank loan facility for digging wells with electricity connection for pump sets.
13. Operationalizing the KAMIC institutional mechanism on a priority basis for improved expansion of micro irrigation schemes.

Medium term

1. The system suppliers should make supply provisions for acid treatment to the growers as part of their after-sales service obligation.
2. Dovetailing other schemes such as Raita Surya, Krishi Bhagya and Ganga Kalyan Yojane and ISOPHOM, NFMS for MI to enhance the socio-economic benefits.
3. The inclusion of insurance to be mandated that it can be a useful tool to absorb some adoption risks for the farmers to some extent.

4. Institutionalization of external (third-party) concurrent monitoring and evaluation as an integral part of scheme implementation.
5. To install more vigilant, follow up by MI supply agencies on warranty and after-sales services it is proposed that 10 percent of the subsidy may be released after one year subject to satisfactory performance of the system as certified by the beneficiary.
6. Establishment of a comprehensive testing of all types of equipment, devices, machines used in micro irrigation systems using state-of art technology in a Central Testing Facility Laboratory (CTFL).
7. Relaxation of the land ceiling to 10 ha in a faced and seniority method for availing renewed subsidy to expand coverage under micro irrigation.
8. Integration of credit assistance as a component to the ongoing scheme system to be developed to enhance the investment support.

Long term

1. Formulation of a revised State Irrigation Act (aquifer and recharge status) for achieving water use efficiency and to address SDG 6 objective.
2. Awarding an industry infrastructure status to micro-irrigation sector for larger benefits of the multiple stakeholders and promotion of agrarian sector in the state.
3. Public Private Partnership mode for water harvesting and utilization plan on a comprehensive and block basis to be developed with farming communities.
4. Integrated watershed development and Krishi Bhagya with Per Drop More Crop scheme are critical in transforming rained agriculture and also in facilitating adoption of diversified livelihood options among smallholder, marginal holders and rural youth.
5. MI technology enhancement towards its adoption for cultivation of water intensive crops
6. Establishment MI technology skill development centre in PPP model for farmers.
7. Incentivisation of a farm rainwater harvesting for MI practitioners.
8. Identification of and promotion MI technology among canal bank farm lands
9. Water conservation to be promoted based on collective community investments for judicious use of resources.

INTRODUCTION

1.1 Background

Efficient water use and food production are flagged as the two most important issues for world peace and social security in the 21st century. The population increase by 2050 will pose huge demand for more food and water. Hence, the scientific challenge arises for increasing the world food production by 50 percent by 2030 and 100 percent by 2050 from the current production levels. Meanwhile, water scarcity poses serious threats to rural livelihoods and food security. It has been estimated that by 2025, 1/3rd of the world population will face absolute water scarcity and amongst the worst hit areas would be the semi-arid regions of Asia (Seckler et.al., 1999), whereas, in India 54 percent area faces high to extremely high-water stress (Vibha Dhavan, 2017).

Agriculture accounts for a majority of global freshwater withdrawals and more than 2/3rd of the groundwater withdrawals is for irrigation (WWDR, 2012). In India, approximately 90 percent of annual freshwater withdrawals for agriculture and groundwater irrigation has been expanded at very rapid pace since 1970 and now accounts for 60 percent of the total irrigated area in India and 56 percent Karnataka (CWC 2020 and Nagaraj 2020). Much of the available irrigation water in India is applied through the conventional surface irrigation methods, which involve huge conveyance and distribution losses resulting in low overall irrigation efficiencies (35-40%) and reduce the anticipated out comes from investments in the water resources, but also create environmental problems (water logging, soil salinity, depleting sub subsurface water).

- *Efficient water use & food production are flagged as vital issues for world peace & social security in the 21st century*
- *Water scarcity poses serious threats to rural livelihoods & food security. By the year 2025, 1/3rd of the world population will face absolute water scarcity & India alone face 54% area high to Extremely high-water stress.*
- *MI technology is scientific water saving technology & major relief for drought prone areas of the country & state & emerged as key player for the future agriculture.*

In India, out of 142 million ha of arable lands, 60 percent (85.2 million ha) is rainfed. Karnataka has the second largest area under rainfed agriculture characterized by highest concentration of drought prone area after Rajasthan in the country. With 10.10 million hectares of cropped area in Karnataka state, only 35.8 percent is irrigated and the rest 64.2 percent is rainfed this indicates 2/3rd cropped area is in the semi-arid zone is still under dryland agriculture and relying on monsoon and suffering frequent droughts (< 750 mm of rainfall) (KMIP, 2017 and Karnataka Jnana Aayoga, 2019). Thus, the demand for irrigation water is increasing, as irrigation is very critical input for enhancing agricultural productivity and farmer's income. Tapping all available sources of surface and ground water, Karnataka's demand for water is expected to grow by 50 per cent by 2030, and the state needs to find solutions to address the incremental water requirement of roughly 650 TMC over the next 18 years (Water Resource Group, Karnataka 2010). As evident from the study by Nagaraj (2020), out of the total irrigated area in the state, around 56 percent is from groundwater and the remaining is from canal and tank irrigation. This indicates groundwater exploitation in the state is highly skewed, exploiting more intensively in semiarid districts of north and south interior Karnataka. The stage of groundwater development in the state is around 65 percent. However, in over exploited area it is around 125 percent as against 87 percent in critical areas implying distorted development. Currently, more than half of the state's cultivated area is under critical to over-exploited category (Suresh Kumar 2019). Overall, 44 of the 176 taluks in the state have been declared as 'over exploited', 14 are in the 'critical' category and 21 are in the 'semi-critical' category with regard to groundwater exploitation (Karnataka Jnana Aayoga, 2019). Though the trend in the growth of number of borewells as well as area irrigated by borewells is increasing (Fig 1.1), the area irrigated per borewell is marginally increased from 0.9 ha 1.47 ha/borewell.

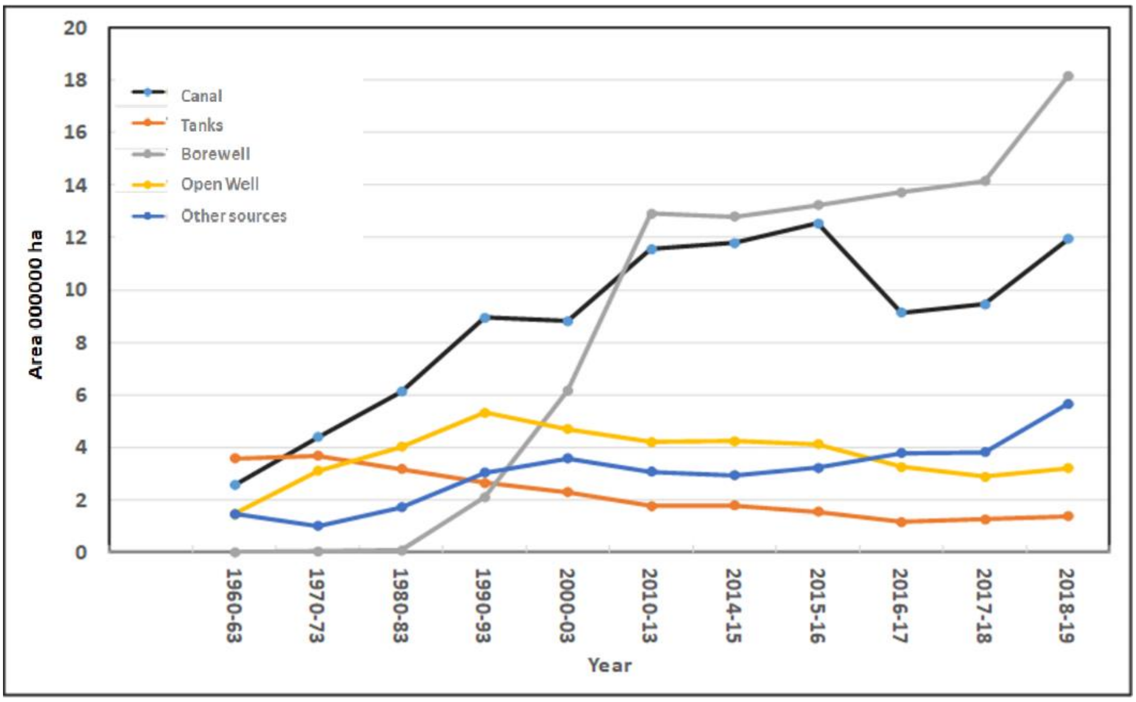


Fig 1.1: Trends of irrigation area under different sources in Karnataka
Source: Directorate of Economics & Statistics, 2013 to 2019

The growth in borewell witnessed a remarkable growth rate of 11.3 percent per annum from 1970-71 to 2018-19 which creating a profound impact on groundwater resource extraction (Fig 1.2). Thus, there is a heavy pressure on groundwater extraction for agriculture use leading to over exploitation of the fragile resource. Meanwhile, increasing probability of borewell failure to the tune of 0.4 and the unsustainable groundwater use necessitates demand management and supply augmentation measures for improved Water Use Efficiency (WUE) in agriculture sector. Thus, given the climate change scenario and increased demand for water from competing sectors and absolute scarcity necessitate technological, institutional, and policy interventions for equitable and sustainable use of water for agriculture.

The concept of Water Productivity (WP) helps to understand whether water resources in agriculture are used efficiently. WP is a simple and attractive indicator to assess whether intended irrigation related performance of functioning of the irrigation systems. Farmers are more interested in the wide range of irrigation results (e.g., nutrition, income, jobs) rather than on how efficient that production is acquired. Water productivity (WP) in Karnataka is around 0.24 kg/m3 with mainly surface irrigation (Sharma et al., 2018).

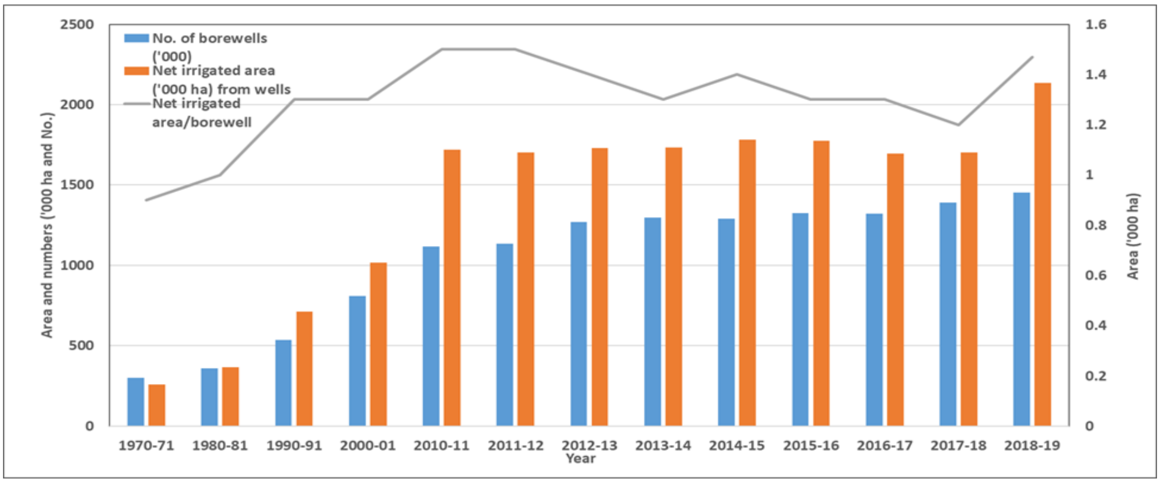


Fig 1.2: Trend in number of borewells and area irrigated per borewell in Karnataka

Source: Computed from Annual Season and Crop Reports, Directorate of Economics & Statistics

In response to these conditions, policymakers, researchers, non-governmental organisation (NGOs) & farmers are increasingly pursuing various innovative, technical, institutional and policy interventions to enable the efficient, equitable and sustainable utilization of scarce water resources. Water saving approaches mediated through Micro-Irrigation (MI) is one of the technological interventions in agriculture, horticulture and sericulture that have a substantial impact on WUE. The WUE of protective irrigation source through small water harvesting structures in rainfed areas can be enhanced by integrating them to MI systems and provide lifesaving irrigation (80-90%) over conventional flood irrigation. MI techniques not only help in water saving, but also in reducing fertilizer usage, labour expenses and other inputs and input costs, besides sustaining soil health, appreciable crop productivity and income enhancement.

1.1.1 History and genesis of the scheme

- *Micro irrigation Scheme emerged in the Year 2005-06*
- *National Mission on Micro Irrigation (NMMI)- 2010-11*
- *Farm Water Management (FWM)-2014-15*
- *National Mission for Sustainable Agriculture (NMSA) & subsumed Per Drop More Crop (PDMC) Component of The Pradhan Mantri Krishi Sinchayee Yojana (PMKSY)-2015-16.*
- *Estimated Potential micro irrigation area (India)-69.5 m ha*
- *Achievement: 5.73 million ha in the year, 2015-16*
- *8.4 million ha 2016-17, 11.58 million ha during 2018-19*
- *Karnataka achieved yearly 11%, 17%, 23% and 20% during 2015 to 2019.*

(MIDH-2018-19)

Department of Agriculture, Cooperation and Farmers Welfare (DAC&FW) has been playing an important role since VIIIth plan for the promotion of improved irrigation methods like drip and sprinkler irrigation. Considering the importance of efficient water management in India, DAC&FW launched the centrally sponsored scheme on Micro Irrigation (MI) during 2005-06, which is subsequently converted as National Mission on Micro Irrigation (NMMI) in 2010-11. During 2014-15, the scheme was subsumed as On Farm Water Management (FWM) component of National Mission for Sustainable Agriculture (NMSA) and further included under Pradhan Mantri Krishi Sinchayee Yojana (PMKSY) as component of Per Drop More Crop (PDMC) from 2015-16.

The Pradhan Mantri Krishi Sinchayee Yojana (PMKSY) of Per Drop More Crop component was launched on 1st July, 2015 with the following objective to achieve convergence of investments in irrigation sector at field level. The scheme aims at providing end-to-end solutions in irrigation supply chain in India, viz., water resources, distribution network, farm level applications and improving water use efficiency. This can be accomplished by effective utilization of the resources of both PMKSY- PDMC and Micro Irrigation Fund (MIF). The Task Force on irrigation 2004 had estimated potential of micro irrigation is about 69.5 M ha, whereas the area covered by 2018-19 is only about 11.58 M ha (16.6%).

While, yearly achievements in Karnataka are 11 percent (2015-16), 17 percent (2016-17), 23 percent (2017-18) and 20 percent (2018-19). However, the Group of Secretaries of Government of India, 2017, emphasized on bringing additional of 10 million ha under micro irrigation over the period of 5 years (2017-18 to 2021-22), which would require an additional annual coverage of about 1 M ha compared to the present pace of implementation (Grant Thornton, 2016).

Programme (PMKSY-PDMC) Objectives

- *Enhancing WUE through Increase the area under MI-technologies*
- *Increase crop productivity & farmer income by adoption of precision water management.*
- *Promote MI- technologies in water intensive/consuming crops (sugarcane, banana, cotton etc).*
- *Promoting fertigation through MI-system.*
- *Promote MI- technologies in water scarce, water stressed and critical ground water districts*
- *Convergence and create synergy with ongoing scheme (energy and water) for optimum utilisation of energy and water*
- *Promote, develop and disseminate MI technology with modern scientific knowledge.*
- *Create employment opportunities for skilled and unskilled persons, especially unemployed youth for installation and maintenance of MI-system.*

Sources: PMKSY-PDMC Implementation guidliance, 2017

Achieving efficient use of water has become a prime goal in the current agriculture practice. Thus, improving the performance of both irrigated and rainfed agriculture production through efficient use of water and investments for smarter water-saving technology are urgently needed. With this objective, the MI program under PMKSY is implementing since from 2015-16 in 30 districts by Government of Karnataka (GoK) through line departments like horticulture, agriculture and sericulture by providing varying levels (from 50%) of subsidy extending up to 90 percent of the cost of irrigation.

According to records of department of agriculture and horticulture, a cumulative area of 0.94 M ha has been brought under MI ever since it was initiated in 1991-92 in Karnataka. The area covered under MI after launching National Mission on Micro Irrigation (NMMI) i.e., from 2005-06 to 2013-14 was 0.6 M ha. Around 13 districts of the state fall below the state average with respect to percent of MI area covered as a percent to Net Irrigated Area (NIA). The percentage cover of MI area to NIA of the Eastern Dry Zone (of which some of the most vulnerable districts are a part of), is only around 8 per cent (GGGI, 2015). However, during the last four years from 2014-15 to 2017-18, the expenditure under the scheme is increasing annually and is currently doubled compared to initial year. Similarly, the area coverage is tripled with over 2.5 times increase in number of farmers gaining benefits under the scheme.

Since inception of PMKSY-PDMC scheme, by end of 2017-18 the MI coverage in Karnataka was 1.4 M ha which stand 2nd dry region in the country after Rajasthan and is implemented the MI system to save water, power and labour and also help farmers to cope with the economic scarcity of groundwater (KMIP, 2015 and KMIP, 2018). During, 2018-19 1.6 M ha (horticulture 5.8 lakh ha + non-horticulture 10.63 lakh Ha.) has been brought under MI by providing subsidy of Rs. 4018.1 crore (horticulture Rs. 2027.8 crore + Non¬ horticulture Rs.1990.2 crore) to Rs 11.6 lakh (horticulture Rs 4.96 lakh + Non-horticulture Rs. 6.66 lakh). Meanwhile, the potential for MI in Karnataka is estimated in the range of 2.2 to 2.7 M ha of state’s net irrigated area. However, potential is more often a dynamic statistic determined by crop choices, market price influences and resource availability and with the current target of achieving 5 lakh ha/annum coverage, it would take a very long time to realise the potential estimates of MI in Karnataka.

MI technology is recognized and often promoted as water saving technologies, farmers adopt it for a variety of reasons like expanding irrigated area, undertaking pre-monsoon sowing, saving labour, energy, fertilizer and other input costs, improving productivity and enhancing net farm incomes. However, there is a new debate concerning the impact of MI systems at various levels of water use for consideration of "water-saving” and also on the status of the resource and there might be increase in crop output but no net water saving may result. Thus, PMKSY-PDMC scheme requires evaluation to find out extent of impact of MI scheme at the ground level viz. water use efficiency, productivity enhancement (per drop more value of production), energy saving and farm income. In this context TERI took impact evaluation of PMKSY-PDMC for period of three years (2016-17 to 2018-19) in 10 sample districts covering 10 agro-climatic zones of Karnataka. primarily the impact evaluation intended to assess the following:

a. scheme implementation as per guidelines, status of achievement against target, conditions that are favourable for MI system adoption
b. field level and aggregate level impacts of systems installation on area expansion, crop diversification, crop production and productivity, water use, and income,
c. examining the quality and functional status of installed equipment and materials, extent of institutional support and capacity building.

1.2 Purpose and scope of evaluation study

PMKSY-PDMC is a multi-stakeholder scheme, wherein every stakeholder plays a crucial role in its implementation. Farmer (beneficiary) is the key stakeholder of the scheme and it involves primarily implementing agency, manufacturers of MI systems, field technical expert of agriculture, horticulture and sericulture departments, Panchayath Raj Institution (PRI), members of supervisory committees at taluk, district, and state, officials of financing institutions, experts from state agricultural universities. The main purposes of the study include:

1) to assess the performance and implementation status of MI system in different district of Karnataka
2) to assess farmers eligibility to access benefits, adherence to guidelines
3) stakeholder's participation to derive benefits, transparency and scheme performance
4) avail benefits of the scheme in terms of increasing the farm income, its spread and adaptation across farming community, social groups and gender with fulfilment of scheme the aim/objectives
5) effectiveness of PMKSY-PDMC scheme in water use efficiency across major crops and productivity
6) to assessing the efficiency of the scheme in energy saving and farm employment generation.

1.3 Scope of the study

Present scope of the study involves multi-dimensional impact assessment which involved typology, social and farm size, institutional and economic, techno feasibility of MI system towards meeting the objectives of the scheme. The broad scope of the study includes to review the scheme implementation process and examine extent of scheme (PMKSY-PDMC) objective have met in particularly crop diversification, crop productivity, energy saving, water use efficiency, employment and farm income of the farmers across district and crops as compared to traditional practices. Further, study included assessing promotion of MI technology in water scarce/ water stressed/critical ground water districts and gauge the extent of awareness and knowledge on water management, its technology and adoption, examining quality and functional status of the MI system. The findings of the study offer scope for improving the exiting program as well as leads to modification of the scheme for the next phase in designing modalities for improving program efficiency.

1.1.2 Specific objectives of evaluation study include

1. to review the scheme implementation as per the guidelines.
2. to assess the impact of the scheme on: crop diversification, productivity, energy saving, water management and income of the farmers across the regions and categories
3. to assess promotion of MI technologies in water scarce, water stressed and critical ground water districts (over exploitation, critical, semi critical and safe zone).
4. to examine quality and functional status of the MI system.
5. to gauge the extent of awareness and knowledge on water management, its technology and adaptation.
6. to assess the training needs and training program of clarity on technology adoption, its usefulness and maintenance of MI system.

1.1.3 Proposed hypothesis of the evaluation study are

1. Change in land use, cropping pattern and cropping intensity through adoption of micro irrigation as compared to before adoption among beneficiaries (adopters) and with non-beneficiaries (non-adopters).
2. Increase in production and productivity of crops by adopting micro irrigation system among beneficiaries as compared to before adoption and with non-beneficiaries.
3. Increase in water use efficiency through adoption of micro irrigation system as compared to conventional irrigation practices among beneficiaries and with non-beneficiaries.
4. Increase the farm income by reducing input cost of agriculture through micro irrigation system as compared to conventional practices.
5. Higher adoption rate with large farmers as compared to medium, small and marginal farmers category.

6. Decrease in labour dependency in irrigation management through adoption of MI system.
7. Likelihood of a farmer adoption to micro irrigation systems will increase with increase in communication/ training and post installation services
8. Transparent disbursement system of subsidy increases the adoption rate of MI system.
9. Relatively lesser energy consumption compared to conventional irrigation practice.

1.4 Outline of the study report

Chapter-I, provide a general introduction, the background to the study, history and genesis of the scheme, programme objectives, purpose and scope of the evaluation, specific objectives of the study and proposed hypothesis.

Chapter-II, provide a detailed literature review on the work undertaken by a number of researchers in different states and agro-climatic conditions.

Chapter III, highlights evaluation methodology consisting of research design, evaluation process, log frame theory, input advocacy and implementation, output efficiency analysis, impact factors evaluation matrix, study area, sample design and size, data collection process (primary and secondary) and data analysis approach,

Chapter IV, provide a detailed result of the analysis of the secondary and primary data with respect to process, impact, capacity building through macro analysis, micro analysis, case study and FGDs analysis, relevance to SDG goal 6 including discussion of the study results.

Chapter-V, highlights the findings and the insights obtained through the analyses of data.

Chapter-VI, includes recommendations to the scheme (PMKSY-PDMC) in the form of short term, medium term and long term.

An executive summary is also reported by consolidating the findings of the evaluation study.

REVIEW OF LITERATURE

2.1 Review of past studies, evaluation reports and their findings

A critical review of several research studies has been made in this chapter to highlight the historical prospective of micro irrigation, micro irrigation policy in India and Karnataka, impact evaluation, utility and adoption of micro irrigation technology for higher production/unit area, water productivity and saving and economic gain. A review of evidences from several studies on micro irrigation strongly suggests significant benefits of financial, economic as well as social aspects besides, its production and productivity benefits.

The expansion of micro irrigation in the country has also been accompanied by the accumulation of a large body of research. The literature on the adoption of micro irrigation in general, and drip irrigation in particular in India has focused primarily on impacts on production and income at the farm level (Kumar and Palanisami, 2011; Narayanamoorthy, 2004; Palanisami et al., 2002). Under drip irrigation, yield increases up to 88 per cent and reduction in water applied between 36 and 68 per cent in various crops have been reported (National Committee on the Use of Plastics in Agriculture (NCPA, 1990). Positive benefit-cost ratios (BCR) have been reported for a variety of crops, with widely spaced in orchard crops showing the best results (INCID 1994; Narayanamoorthy, 2008a; Reddy and Reddy 1995). Gains in water use efficiency arising from drip irrigation also enable the expansion of irrigated area and by reducing need for weeding and savings in fertigation leading to substantial reductions in cost of cultivation (INCID, 1994; Shah and Keller, 2002; Singh and Jain, 2003). Drip irrigation results in considerable savings in energy (Global Agri system, 2014; Narayanamoorthy, 1996) and labour have also been reported (Kumar and Palanisami, 2011; Narayanamoorthy, 2016). Given the slow spread of drip irrigation researchers identified the physical, socio-economic, and politico-institutional constraints on the spread of micro-irrigation (Kumar et al. 2008a). Research has identified factors that affect adoption such as socio-economic characteristics of farmers (caste, education, landholding size), crop choice. (Namara et al. 2007; Palanisami et al. 2011) as well as barriers and constraints to adoption the such as high capital costs, lack of credit, and low levels of awareness (Dhawan 2000; Kumar, 2016, Narayanamoorthy, 1997, Sivanappan

1988). To encourage the adoption of drip irrigation and responding to the high capital costs associated with adoption, subsidy schemes have been in place in the country for many decades, beginning from 1982 (Narayanamoorthy and Deshpande, 1997). More recently, the National Mission on Micro-Irrigation (NMMI) launched in 2009 aimed to bring an additional 2.85 m ha under micro-irrigation (GGGI, 2015). This programme was later subsumed under the National Mission for Sustainable Agriculture (NMSA) 2014-15 and then the Pradhan Mantri Krishi Sinchai Yojana (PMKSY) in 2015-16 (Kapur et al, 2016).

2.2 Historical perspectives of micro irrigation

Micro – irrigation technology was first undertaken in Germany in the 1860s where water was pumped through clay pipes for irrigation. Research done by E.B. House at Colorado State University in 1913 concluded that the technology was too expensive to be used commercially and no further studies were done till the 1920s (CICR Report, 2011). Use of perforated pipes (Germany, 1920s) was one of the major breaks through in the industry. However, current micro – irrigation technology relates to the work of Symcha Blass of Israel, in the 1930s. Later the drip irrigation concept spread to Australia, North America and South Africa during late 1960s and eventually throughout the world. The development of LDPE (Low density poly ethylene), HDPE (High density poly ethylene) and LLDPE (Low linear density poly ethylene) in 1977, suitable and economical material, resulted in the sudden growth of micro irrigation industry. The large-scale use of drip irrigation system started in 1970s in Australia, Israel, Mexico, New Zealand, South Africa and USA to irrigate vegetables and orchards and its coverage was reported as 56,000 ha (Kulkarni et al., 2006). Whereas, in India, the area covered under drip irrigation has increased from 1500 ha in 1985 to 70,859 ha in 1991-92 and further to 0.5 million ha in 2003 (INCID 1994; GOI 2004 as mentioned in Narayanamoorthy, 2005). The most recent data collected by ICID shows that an area of 1.32 million ha (6.5% of total irrigated area) was under micro irrigation in 2008 which increased to 1.89 million ha (8.1% of total) in 2010 and it was 4.3 million ha by 2019. Micro irrigation in general and drip irrigation in particular has often had to overcome the general conclusion from earlier experiences that costs outlay, even of small systems, is too high relative to the benefits and the little scientific irrigated agricultural technology is being applied in most irrigation schemes. (Dittoh et.al, 2010).

The real thrust on promoting MI adoption in India started with the recommendations of the Report of the Task Force on Micro Irrigation in 2004. The report sought to increase the emphasis on MI technology and recommended a Centrally Sponsored Scheme (CSS), which was later launched by the Ministry of Agriculture in 2006. However, in Karnataka, the MI scheme was introduced as early as 1991-92 for horticultural crops and from 2003-04 for agricultural crops, with significant progress achieved by 2005-06, it was scaled up as National Mission on Micro Irrigation Scheme in 2006-07. In 2010, CSS on MI was scaled up to National Mission on Micro Irrigation (NMMI), which continued until 2013-14. From 2014, NMMI was subsumed under the National Mission on Sustainable Agriculture (NMSA) and implemented as- On Farm Water Management (OFWM) during the FY 2014-15. From April 2015, the MI component of OFWM has been subsumed under the Pradhan Mantri Krishi Sinchayee Yojana (PMKSY) which has been implemented in FY 2015-16.

The Ministry of Agriculture and Farmers Welfare, Government of India, has launched the PMKSY to address India’s key agricultural challenges in the 21st century to improve water use efficiency (Per Drop More Crop and Income). It aims to harness the potential of agriculture by effective use of water (irrigation) for improving efficiency, sustainability, equity and resilience at the farm level, especially in rainfed, marginal and fragile areas, using an integrated approach. PMKSY with Per Drop More Crop (PDMC) component which is aimed at increasing on-farm water-use efficiency by using suitable water conveyance and precision water application devices like drips, sprinklers, pivots and rain-guns in the agricultural farms (Jal Sinchan). NITI Ayog (2017) has reiterated the stand of achieving a target of 100 lakh ha under PMKSY for the period 2015-16 to 2019-20. Extensive as well as intensive research are being continued for addressing several agronomic and economic attributes in various parts of the globe. While, the challenge of overcoming the technical impediments are still under the critical focus of researchers and promoters

2.3 Micro irrigation Policy in India and Karnataka

Micro-irrigation systems (MIS) have been at the forefront of policy-making and social research in exploring determinants that could potentially impact the adoption of MIS technologies in the field to fulfil the basic aim of enhanced agricultural productivity and enriched nutritional quality of the produce with optimal utilisation of water and input cost.

Suresh Kumara and Palanisami, (2010), on evaluation of MI program in south India, suggested the policy focus may be tilted towards the promotion of drip irrigation in those regions where scarcity of water and labour is alarming and where shift towards wider spaced crops is taking place. Further, the National Water Policy (NWP), 2012 states that water saving in irrigation is of utmost importance and the Goal 4 of National Water Mission (NWM), 2008 of India highlights the objective to improve water use efficiency at least by 20 percent in all sectors, including domestic, industrial, agricultural and commercial. This objective can be significantly supported urgent need to manage irrigation water efficiently and the adoption of micro irrigation systems is the need of the hour. Recently, critical review of MI policy in 13 states by TERI, (2019) suggested for a greater focus on increasing availability of water and simplifying the process of availing incentives/subsidies to farmers for adoption of micro irrigation systems to promote the initiative under PMKSY scheme. Additionally, national scale evaluation by the planning commission in 2014 suggested, on integrated scheme of micro irrigation has elaborated several facets of the scheme in the country involving all category of stakeholders and provided and recommendations for streamlining the guidelines, including economic dimensions of variables and case study analysis for improved investment decisions by Governments and stakeholders.

A similar study on MI in Karnataka by Centre for Budget and Policy Studies during 2013 suggested improvised sample methodology, and beneficiary schedules for future monitoring and evaluation studies. Parallelly, Karnataka ground water regulations authority, observed that 70 percent of the over exploited areas in Karnataka call for development of a national water policy for shaping the economy of marginal and small farmers (Krishna Kumar et al., 2004). Thus, Karnataka with its progressive policies has decided to revisit and renew its efforts for MI promotion through the implementation of a new, improved micro irrigation policy Karnataka’s New Micro Irrigation Promotion Policy 2017. The availability of cheap labour and disguised unemployment also work to dampen the incentive for adoption of drip irrigation technology. Government extension systems at the same time have not been of much help to the cause of this technology. A group of researchers has believed for a long time that a huge crevice exists between the policy and the farmers necessities with respect to the adoption and use of drip irrigation technology (IWMI Policy Briefing 23).

The Karnataka micro irrigation policy 2017 document aimed at streamlining the process associated with MI to achieve higher agriculture productivity with conservation of water. It envisions large scale adoption of MI by incentivisation through technology-based interventions and robust institutional frame work with well-designed software support. In its mission to create additional area of 18 Lakh hectors in five years, the exiting gaps in adoption leading to designed strategies of multi department integration and programme conversions. Policy harmonised the procedures across departments with a common institutional frame work (KAMIC), power connectivity with uniform subsidy structure in the entire state for general (45 to 90%), socially vulnerable groups (55 to 90%). It has suggested for a third-party concurrent inspections and advanced computerisation with GPS integration and other scheme for with differential extent and years. Innovative applications of solar power utilisation, coordination for research data management, fertigation and precision farming techniques have been encouraged for fulfilling the core objectives of water saving and enhanced production and income per unit area.

On institutional systems, evidential studies conducted on the spread and economics of MI in India by Palani Sami et al., (2011) suggested the formulation of a Special Purpose Vehicle (SPV) to streamline the scheme implementation for greater coordination and efficiency. Also, several study reports have recommended setting up an autonomous, single- window, SPV similar to the Gujarat Green Revolution Company (GGRC) with an aim to bring 2nd Green Revolution in the state by saving of water, electricity and enhancing agriculture productivity resulting in the farmers prosperity at large (GGGI, 2015) in Gujarat. Similarly, the Karnataka Antharaganga Micro Irrigation Corporation (KAMIC) in Karnataka which could also act as the nodal agency for all micro irrigation promotion policies and schemes. The KAMIC would imbibe the best features from the subsidy delivery mechanisms followed in well performing states. A comparison of the subsidy delivery mechanisms in Gujarat, Andhra Pradesh and Karnataka gives a good idea on the features and design elements that Karnataka could adopt to implement a successful micro irrigation promotion program. In order to facilitate the participation of private sector and to integrate various government subsidies at the farm level, with the objective to promote participatory farming at scalable levels and increase farmer's income by employing more efficient means of irrigation, NITI Aayog in 2017 has prepared Draft Model Public Private Partnership Policy Guidelines in Integrated Micro-Irrigation in India. National water policy 2012, highlighted to improve the water use efficiency by 20 percent in agricultural sector, on the reason that MI contributes to 50 to 95 percent water use efficiency, with an average increased income of 46.8 percent. FICCI (2019) reported that the average scheme operational duration is about five months per year, thus loosing cropping season and unable to realize real MI benefits. Although national and state micro irrigation policies have critically considered the fact of covering maximum potential area under irrigation, the predominant impact practical implementation still following a lucid stream owing several political, economic and environmental issues.

2.4 Micro irrigation adoption and impact

Micro irrigation adoption

Micro-irrigation technologies are supported largely for one or more types of profits including saving water in irrigated agriculture and averting the impending water crises (Narayanmoorthy, 2003; Polak et al., 1997, Shah and Keller 2002), as a strategy to increase income and reduce poverty among the rural poor; to enhance the food and nutritional security of rural households (Bilgi, 1999); and as means to extend the limited available water over a large cropped area (Palanisami et al., 2012). The financial paybacks have been proved in many studies. Puran et al., (2010) have reported that the incremental increase in irrigated areas was about three-fold and the decline in labour use per hectare was by 78 percent. Also, the economic returns to farmer investments in micro-irrigation technologies are substantial (Dhawan, 2002). Financial resources and crop suitability are the stimulus for adoption of drip irrigation. Though a key argument is that membership in a high caste group, poverty index and share of income from off-farm and non-farm activities, have a significant effect on the decision regarding the adoption of micro-irrigation technology (Namara, 2005).

The constraints in MI system adoption in several studies have indicated the following reasons which include: i) lack of independent source of water and pressurizing device for many farmers; ii) poor quality of groundwater in many semi-arid and arid regions; iii) the mismatch between water delivery schedules and irrigation schedules required in MI systems in surface irrigation systems; iv) cropping systems that dominate field crops in semi-arid regions; v) dominance of small and marginal farmers, and small plot sizes; vi) low opportunity costs of pumping groundwater due to lack of well-defined water rights; vii) negative technical externalities in groundwater use; viii) poor extension services; and ix) poor administration of subsidies.

However, the farmers on the other hand, have different priorities and concerns to solutions and technologies that would provide them assured returns, lower costs, simple technology, generic applicability and higher and better yields with lesser pumping hours (Verma, 2003). Hence, there are obvious gaps between what the market demands and what the industry has to offer. Several studies have highlighted the fact of bridging these gaps through shifting from “water saving” to “income enhancing” mode, shifting micro-irrigation technologies from investment mode to input mode, proving special incentives for “first movers” and from custom-made solutions or package kits to farmer-assembled systems. Hence, it substantiates for a more focused approach on promotion of micro irrigation for water intensive/guzzling crops to minimise water requirement.

Study of Suresh Kumar (2014) revealed that adoption of drip irrigation technology increased the net sown area, net irrigated area and there by helped in achieving higher cropping intensity and irrigation intensity. Further, noticed that huge initial investment and occurrence of small size of land holding are the major constraints in the adoption of drip technology. Other reported reasons include unsuitable cropping pattern, lack of access to subsidy and no technical support for follow up action. Cropping pattern with high income crops decides the adoption and suitability of drip irrigation, the widespread adoption of micro irrigation could be promoted.

In a study covered with 143 public tube wells on which micro-irrigation system was implemented by the Gujarat Water Resource Development Corporation (GWRDC). The results suggest that subsidy significantly influenced the increasing adoption of MIS in recent years and the benefits of MIS largely confined to the specific season and cropping patterns. By and large, the poor state of adoption of MIS in India has been attributed to several factors and constraints, including physical, socio-economic, financial, institutional, pricing, subsidies, extension service, and policy-related ones (Narayanamoorthy 1997; Kumar 2002; Kumar et al. 2008). While examining the MI adoption determinants, Samara et al (2007) have observed that awareness or knowledge does not guarantee actual adoption, unless the technologies are made accessible to the farmers through devising institutional support system.

IWMI itself has set up an experiment in north Gujarat to facilitate large scale adoption of water saving technologies. It is revealed that, unless these technologies are adopted at a significant scale, their impact on sustainability of groundwater irrigation might not be meaningful (Kumar et al., 2008). Farmers who adopt micro-irrigation might use the ‘saved’ water to increase their area under irrigation or to sell excess water to the non-pump owners. Moreover, even if total pumping by a few farmers reduces in absolute terms, it would mean better water availability to all farmers (including non-adopters) and the basin level pumping might not reduce, hence there is a strong need to try out these technologies in more crops.

As per the relevant survey in the past, the major constraints in adoption of drip irrigation are non-availability of spare parts and skilled labour and maintenance of the filters is a major aspect to be taken care of for proper functioning of the drip system (CIIE IIM Ahmedabad-2016-17). A study by Krishna Reddy et. al., 2017 reported that unequal discharge distribution of emitters of drip irrigation systems revealed that there were some maintenance problems of installed systems in farmers fields was not economically feasible. In semi-arid regions where water resources are scarce, irrigation water use efficiency is an important issue. Although sub surface drip irrigation is a very efficient irrigation method, it has had relatively limited expansion due to several disadvantages such as the clogging of emitters and the difficulty of detecting leakages and repairing them in Spain (Juan Martínez et al 2014). The MI adoption rate is an index to reflect the area coverage, its promotion in the field with crops and farmers calls for further focused plans including implementations and policy refinements.

Micro irrigation impact

On general insights on the micro irrigation technology, it is observed that, over the years, government as well as various non-government agencies have been promoting micro irrigation as a ‘New Concept in Agriculture’ through a “Package Solution” focusing on several components such as water saving, positive Net Present Value (NPV), good payback period and Internal Rate of Return (IRR), customized and highly sophisticated technology, higher yields and better quality of output, and labour saving (Verma, 2003). Such approaches have brought significant economic and social benefits to the farmers in several folds including increase in crop yields during kharif, rabi and summer seasons, considerable savings in energy consumption, reduction in the use of chemical fertilizers and pesticides, reduction in cost of weeding, reduction in groundwater over-extraction and reduction in water scarcity induced labour migration. Specific studies on the impact of MIS undertaken by various researchers are summarised in the following Table.2.1:

Table 2.1: Summary review of past studies on impact of micro irrigation in India

Researchers/ Authors	Study Area/ region	Water saving (%)	Energy saving (%)	Fertilizer saving (%)	Cost saving (%)	Additional area under irrigation (%)	Yield (Qt)/ income (Rs) increase
Kapur et al. 2015	Maharashtra	50-90	30.5	28.5	30-45	31.9	42.4-52.7
Raina et al. 2011	H. P	30-35			41.37		
Narayanamoorthi, 2003, 2005, 2006, 2008, 2018	Maharashtra, India	12-84 and 8-60			50		114
Reddy et al., 2017	Guntur, AP				25-40	55-60	
Wrachienb et al. 2014	Maharashtra	37					19-29
Paul et al. 2013	Bhubaneswar, Odisha					54	57
Biswas et al. 2015	Gazipur, Bangladesh	50					25-27
Kumar et al. 2016	Moradabad, Uttar Pradesh	35					
Bhaskar et al. 2005	Maharashtra	40-50					30-100
Tiwari et al. 2014	Kharagpur, India						21.05
Chandrakanth et al, 2013	Karnataka						65
Priyan and Panchal, 2017	India	50-90	30.5	28.5			
Panigrahi et al, 2010	Odisha				17.9		15.4
Chandran and Surendran, 2016	Kerala						13-47
Bhamoriya and Mathew, 2014	Gujarat			20			20-30
NCPAH, 2014	India	25-40	30-40	20	40	30	30
Jha et al. 2017	Punjab	40-42					9.13
Vanitha and Mohandass, 2014	Tamil Nadu	50		100			19.05
Rao, et al. 2017	MP		40				11.03

Source: Review papers

In line with the findings of numerous other studies indicated that micro irrigation technologies resulted in a significant productivity improvement and hence, economic gain over the traditional method of surface irrigation. It has shown that the productivity gain in drip irrigation systems is significantly higher than that of other conventional irrigation system (Regassa, et. al., 2005).

The efficiency gains from the adoption of micro irrigation (sprinkler and drip irrigation) using data from a farm survey in the water-scarce, drought-prone Bundelkhand region of Uttar Pradesh study results showed gains in significantly improves yield (21%), water productivity (34%), and technical efficiency (20%) with savings in water (15%) and diesel (8%) (Kishor Prabhath 2019.).

Similarly, Mahesh Babu (2018) has designed a study to assess the impact of Andhra Pradesh Micro Irrigation Project (APMIP), on the beneficiaries, which revealed that majority of APMIP beneficiaries have benefitted with an increase in irrigated area, increase in yield level, decrease in labour usage, decrease in cost of cultivation, increase in income, increase in cropping intensity, and increase in generation of assets. Yield improvement due to micro irrigation has been reported 5-10 percent in cotton, 15-42 percent in castor, 20-66 percent in groundnut and 20-26 percent in potato. Similar yield improvement in other principal crops is to the tune of 30-105 percent was also reported in the study conducted by Bhaskar, (2010). Based on the MI adoption in farms covering the three seasons of kharif, rabi, and summer in Gujarat, it has been observed that the micro-irrigation systems can also bring about dynamic changes in the entire farming system in terms of crop diversification in favour of high valued/ horticultural crops as well as an increase in milk production (Kumar et al. 2008; Kumar 2009)

Empirical evidences around the world suggest that MI saves water up to 40 to 80 percent and enhances WUE and physical impact of water saving technology (Palanisami et al. 2011; Saleth and Amarasinghe 2010). Apart from this, a large number of other benefits are also reported such as reduced tillage requirement, energy use, labour cost, reduction in cost of well deepening and incidence of well failures, and increase in crop yields and fertilizer use efficiency (Bahinipati and Viswanathan 2016; Kumar and Palanisami 2011; Kumar 2007, 2013; Kumar et al. 2004; Narayanamoorthy 2004, 2005; Palanisami, Palanichamy, and Shanmugam 2002).

The results of several experiments conducted on mulberry crop indicated that drip system performed well as compared to sprinkler and furrow method. Further, maximum irrigation water savings of 61.2 percent in drip and 32.7 percent in sprinkler was observed as against conventional practice (Rajaram and Qadri. 2014).

The sprinkler and drip irrigation techniques are water-saving, cost, effective and efficient in comparison to surface irrigation through flooding or furrow system. Economically, viability as indicated by the higher values of NPV, IRR, and BC ratios indicate better economic viability of sprinkler and drip irrigation, and hence emphasis on the adoption of these water saving techniques should be encouraged to make use of already scarce water resource most efficiently (Luhach, et al 2004).

The sustainability for the irrigation systems was assessed using water-related indicators (water use efficiency, irrigation water use efficiency, and water footprint), biomass (crop growth rate, relative growth rate, harvest index, and yield response factor), and energy indicators (energy footprint, performance, and energy cost footprint) and the economic-based indicators (water productivity and economic water footprint) for the economic aspect (Eros Borsato 2019).

An elaborate survey by IIM, Ahmedabad in 2016 have indicated and estimation of the total nitrogenous fertilizers saving has been found to be about 25 percent through adoption of micro irrigation (Biswas 2010). The survey on the labour saving indicated widely varying figures but most of the farmers have experienced the labour savings to the extent of around 35 percent.

INRIMT (2011) reported that MIS has opened opportunity for fertigation, minimizing labour and scope for intercropping while, it was noticed that up to 39 percent have noticed clogging of micro tube as the major limitation in MI system. The estimated savings in energy use varied between 69 kw hr/ha in mini sprinkler irrigated potato and 3,030 kw hr/ha in banana. The total savings in energy was estimated to the tune of around 70 percent of the total estimated energy savings in cotton (CIIE IIM Ahmedabad-2016-17).

The benefit-cost analysis of micro-irrigation systems such as drips and sprinklers were extensively analysed for various crops (Palanisami et al. 2002; Kumar et al. 2004; Narayanamoorthy 2004). Suresh Kumar and Palanisami (2011) have made a comparative economics analysis of high valued crops focussing on economic and social cost benefits of micro-irrigation systems.

MI policy review study by TERI (2019) has presented an overall improvement of 29.6 percent increase in farmers income. Indian Council of Food and Agriculture (ICFA) study results shows that farmers have an increase in income ranging from 24.5 to 70.5 percent, with an average increase in income of about 46.8 percent after micro irrigation systems adoption. Further, benefit cost ratio also shows that horticulture crops seem to be more profitable as compared to vegetable crops in majority of the states. The benefit-cost ratio (BCR) for the PMKSY at macro level would be about 9.2:1. For individual farmers', the benefit would vary from Rs 3,000 to Rs 1,50,000 / ha / yr. with different technologies. The social benefit-cost ratio (SBCR) ranged from 4.33 to 5.19 at 2 percent discount rate under different scenarios across regions.

Several studies have assessed the technical and economic feasibility of drip irrigation in a number of crops and have proven its potential to save water and energy, and to increase crop yields. The findings indicate that in vegetable, besides savings in water (40%) and electricity (629 kwh/acre), the drip irrigation reduces the use of other inputs. such as fertilizers (31%), and enhances crop yield by 52 percent. Narayanamoorthy et. al., (2018) have reported that the application of drip irrigation in brinjal resulted in 54 percent higher net returns over the conventional method of irrigation, proving that benefit-cost ratio in drip irrigation is quite attractive making it a viable option for sustainable management of irrigation water.

Singh et. al., (2015) found that higher total income and education level increase the likelihood of MIS adoption and agricultural water management, and therefore special training programmes on installation, as well as repair and maintenance and inferred that the total cultivable area is also one of the important determinants in MIS adoption. Capacity building program on drip irrigation (TNDRIP) was undertaken in certain regions of the Indian State of Tamil Nadu during 2009-2010. An assessment of the impact of the program in terms of effective use of drip irrigation and increased crop yields during 2011. The results had indicated that the drip capacity building program resulted in a yield increase of up to 12.1 t/ha in banana, 40.6 t/ha in sugarcane and 2.6 t/ha in turmeric (Kuppannan Palanisami et al, 2014). Muralidharan et al., (1994) highlighted the socio-economic and water-saving benefits of MI across category of farmers in Kolar district Karnataka.

In Karnataka, Meti, (2012) conducted a study on banana crop and indicated various constraints of adopting drip irrigation which included: complicated application process for loan, delays in processing, non-availability of soluble fertilizers, inadequate supply of electricity, chocking of laterals and drippers, high capital investments, inadequate follow up services by the drip agencies, non- availability of quality materials and damage of laterals by rodents. The study proposed for the review of policy and implementation strategies for better penetration of MI technology, with further engineering approaches to keep water productivity more relevant as on economic criteria.

Chandrakanth et. al., (2013) in their study have apparently shown that the farmers of eastern dry agro-climatic zone (kolar and Chikkaballapura districts) of Karnataka, have impressively demonstrated that drip irrigation is adopted to cultivate even narrow spaced crops due to the rising cost of groundwater due to negative externalities and further, it was established that variables such as cropping intensity, water used (acre inches) and net returns per acre inch of water as the discriminant variables. An evaluation of micro irrigation scheme in Karnataka implemented during the period 2007- 08 to 2009-10 was conducted by IN-RIMT, (2011) it was found that inefficient conventional methods of conveyance water adopted in irrigation has resulted not only in wastage of water but also to several ecological problems like water logging, salinization and soil degradation rendering agriculture lands unproductive.

In mulberry crop, Sudhakar et. al., (2018) noticed the substantial improvement in mulberry biomass growth and yield along with economy of irrigation water by adoption of micro irrigation as compared to conventional irrigation. Similarly, in a micro irrigation approach in mulberry crop studied by Rajaram and Qadri (2014) indicated an improved the water use efficiency without affecting the leaf productivity and enhanced the cost benefit ratio. Further, in their study, it was found that rice and wheat grown using a sub-surface drip fertigation system, and combined with conservation agriculture approaches zero tillage, retaining residues on soil surface and dry seeding used at least 40 percent less water than flood irrigation for the same number of yields, reduction in dependence on ground water, fertilizer reduction by 20 percent through sub-surface drip fertigation system with significant savings in input costs and labour. The analysis of the results demonstrates that farmers who adopted the MI system under the state subsidy programme were compensated for the investments they had made in the MI system. Even so, while their adoption of MI system has been quite impressive during the two seasons, the use of MI system for growing summer crops was found to be much lower and highly restricted to a few crops. Further, Rajaram and Quadri (2014) have estimated the water requirement of mulberry to the tune of 1.5-to-2.0-acre inches water per irrigation at an interval of 6 to12 days depending upon the type of soil and seasons, and this practice enabled them to harvest maximum of leaf yield with eight numbers of irrigations.

Khadeeja and Panchal (2017) assessed the average penetration level of MI in the country as 5.5 percent, while Karnataka has 8.5 percent and emphasised that economic considerations are to be incorporated with more engineering approaches to keep water productivity more relevant in economic criteria. Wani et, al., (2016), have conducted a study on PMKSY on enhancing the impact through demand driven innovations and suggested productivity of rainfed agriculture can be doubled by adopting science led interventions, improving knowledge delivery systems using ICT, skill development for building the capacity of all stakeholders by adopting value-chain approach through consortium, convergence, collective action and training. Implemented program positively noticed by enhanced ground water availability which is increased from 3.5 m to 6.0 m due to various soil and water conservation interventions and due to the increased availability of water resources, the entire watershed area transformed from degraded to productive land mass. The cropping intensity increased from 85 to 150 percent, and large number of farmers shifted from low water requiring crops to high value crops (Bt. cotton and vegetables). In addition, the environmental benefits such as improved water quality (pesticide residues free), increased water availability round the year, reduced runoff (30 to 40%), reduced soil loss (from 10 t/ ha to 2 t/ha) was realised. Thus, the better usage of information technology applications in enhancing the water uses efficiency to be focussed in implementing MI programs during 21 centuries. Devising crop specific packages in addition to uniform and general technologies would critically contribute as game changer plan in extension of MI technology.

EVALUATION METHODOLOGY

3.1 Research design, evaluation process, log frame theory and evaluation matrix

The core team involved in the evaluation overviewed the frame work of partners/stakeholders with respect coordination, roles and responsibilities in the conduct of the evaluation of the study. A skeletal plan is formulated and presented in Fig. 3.1 for a common understanding between the assignor (KEA) and the consultant (TERI). Frequent reviews pertaining to the delivery of responsibilities and the results were made in the agreed system to ensure timeliness of the reporting and generation of quality results.

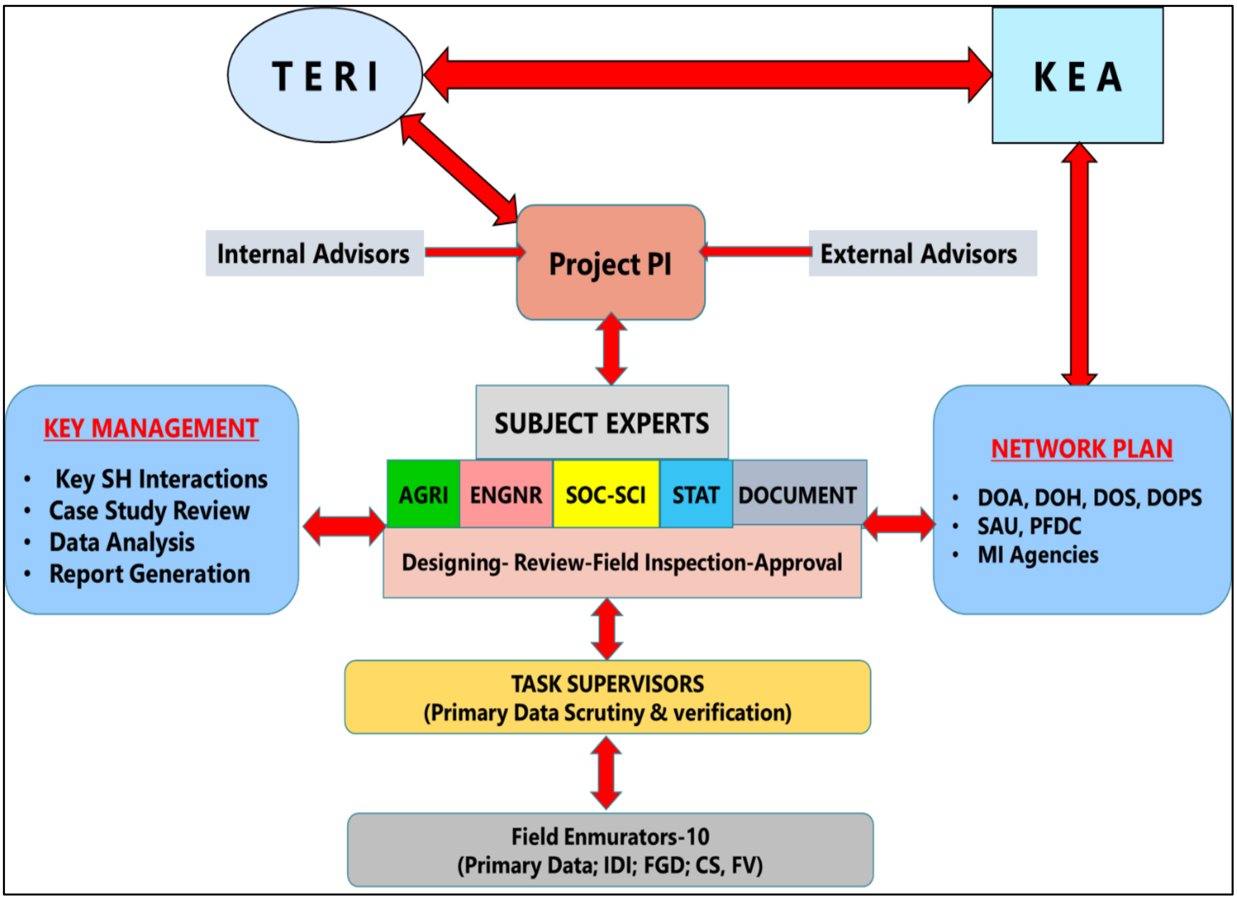


Fig: 3.1: Skeletal plan of PMKSY-PDMC scheme evaluation

DOA: Dept of Agriculture, DOH: Dept of Horticulture, DOS: Dept of Sericulture, PPMSD: Planning, Programme, Monitoring and Statistics Department, Government of Karnataka, SAU: State Agriculture Universities.

3.2 Evaluation process

The interrelationship of inputs to outputs in the evaluation study was meticulously assessed and appropriate processes and procedures were put in place as detailed in the Fig. 3.2

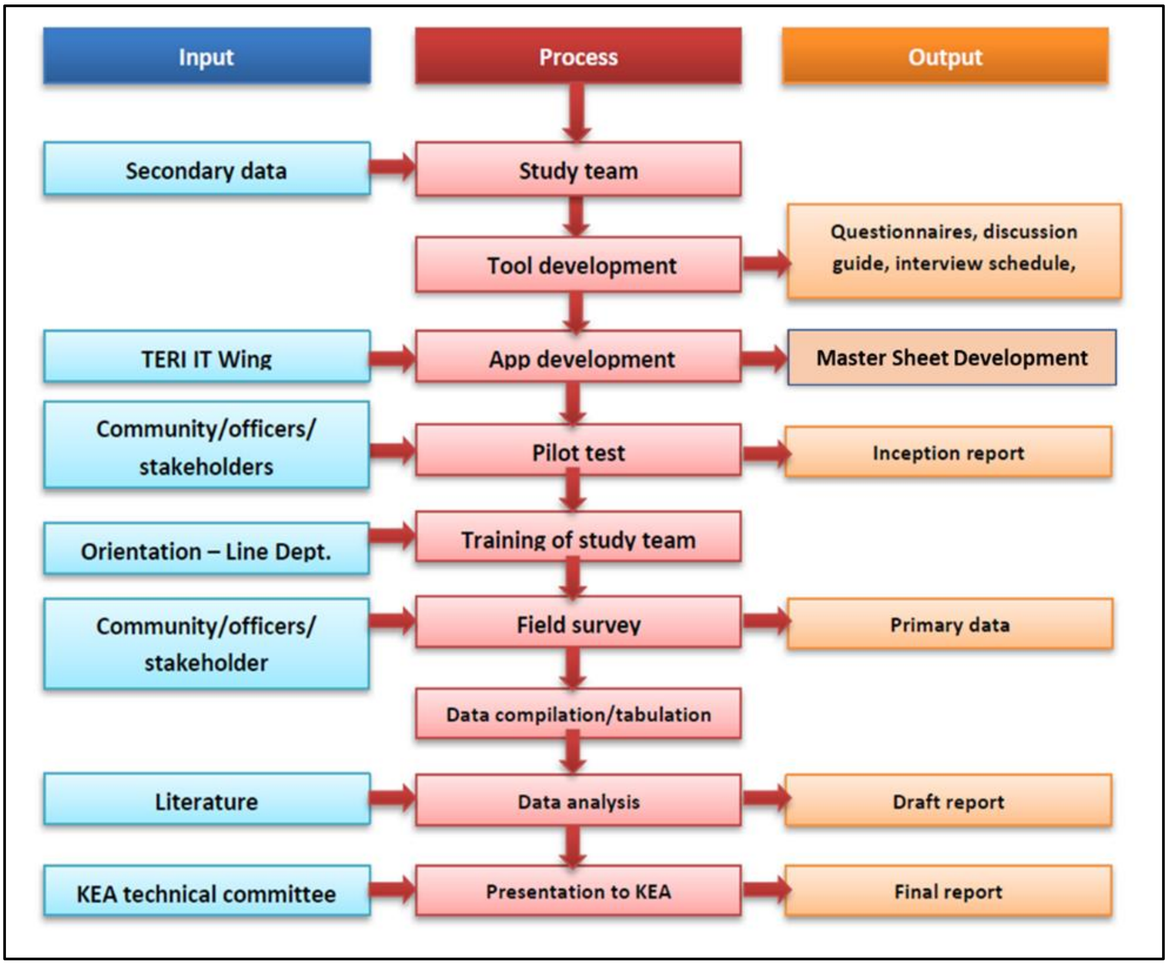


Fig 3.2: Flow of the evaluation process

3.3 Log frame theory (Input- Output- Outcome and Impact)

In a nutshell, the foremost questionable issues and challenges of the evaluation playing a crucial role include: limitation of technological capacities at the state, districts, taluk implementing mechanism, MI system manufacturers and dealers, and other stakeholders, wide spread delays in disbursement of subsidies and thus affecting the overall purpose and goals of the scheme. Knowledge on the role and capacities of different stakeholders to execute their respective functions, awareness about different parameters of the scheme among beneficiary community, limited use of technology at the grass root level, involvement of SF and MF, SC/ST category of farmers, Identification of barriers and challenges, hindrances that farmers are facing, and providing policy insights for improved implementation of the scheme are the other special operational challenges, which are thoughtfully assessed, and realities are proposed to be brought out in the study. Evaluation questions/issues as enumerated in TOR (Annexure-1) are elaborated pertaining to inputs-adequacy, implementation, efficiency/ output and impact are intensely explored from the context of realizing circumstantial responses during survey, interview, meta-data analysis and meta-data analysis.

3.3.1 Input adequacy and implementation

Critical reviews and analysis for the basis of financial allocation to potential component to set targets, its utilization and performance, pattern of sanction and release by the State Micro Irrigation Committee (SMIC) at the state level was undertaken. Further, scheme followed the norms of beneficiary identification including social and vulnerable categories and timeline linked activities starting from designing, online registration, field inspection, procedures of documentation and filing and updating, official validation, approval for installation, online disbursement of subsidies spatially Direct Benefit Transfer (DBT) model Vs Direct Beneficiary Transfer were reviwed.

The functioning of various committees and its coordination across different stakeholders, nature of involvement/participation of Panchayati Raj Institutions (PRIs), government officials and institutions in the preparation of model action plan documents (DIPs and AAPs), promoting the scheme, identification of priority component /areas, role of implementing agency (IA), following the norms of decentralized system, consideration of ground realities, its review and approval at various stages were examined.

Further, information on companies involved in installation, duration of installation, post installation services and functioning of structures, maintenance, satisfaction of farmers was collected from field. Additionally, levels of knowledge and awareness, training impact, topics coverage, methodology adopted, level of participation by the beneficiaries and intend to technology adoption was reviewed.

3.3.2 Output and outcome

Adoption rate to sprinkler and drip irrigation across agro-climatic zones and farmer groups and factors influencing it, was assessed based on crop component, availability water, awareness of the technology.

Benefits of the scheme leading to changes in the cropping pattern, new crop introduction, additional area expansion, adoption of training knowledge, monitoring and support for maintaining the installations, was assessed through- type and number of such trainings, coverage of relevant topics and its effectiveness, and coverage of target groups, including guidance, post installation services, and levels of accessibility of department and MI companies for maintenance and timeliness to provide services were examined.

3.3.3 Impact factors (Agronomic and Economic parameters)

Scheme performance assessed with regard to impact important indicators including; MI adaption rates, increasing water use efficiency/waster saving, productivity, farm income, cost savings in irrigation, fertilizer consumption, energy consumption and employment generation were assessed within and among beneficiaries. A summary of evaluation matrix was developed based on the scheme objectives and issues on key performance indicators including input, output, outcome and impact are given in the following table which enabled a systematic approach to address the objectives of the assignment.

Objective 1: Implementation and performance as per guidelines, land size, crop priorities and beneficiary selection

Sl No	Input	Output	Outcome	Impact
1	• Land holding size	• Extent and No. of beneficiary covered • Area conversion	• Adaptation rate (Across ACZ, farmer and social groups)	• Zone / district wise Scheme benefits
2	• Crop category (cereals, fibre flower, fruit crops, millet, mulberry, oil seeds plantation, pulses, spice vegetable)	• Change in crop pattern	• Trend of crops wise area coverage	• Change towards cropping pattern, crop diversity
3	• Category of beneficiary selection	• Land holding size, social groups and gender	• Fulfilment of scheme norms. • Increase in participation	• Social justice, equity and relevance of scheme objectives

Objective-2 Promotional plans of MI technologies in water scarce / water stressed/ Districts

Sl. No	Input	Output	Outcome	Impact
1	• Involvement of stakeholder • Need based assessment • Type of MI system • Awareness creation • Training and capacity building	• No. of PRA organized • Level of stake holder participation • No. of farmers Intend to adopt MI technology • Skill enhancement • Number of demonstrations, visits and training programmes	• Improvement in crop production and productivity • Reduction in water usage • Trend of crop wise MI adopt • Better management • Increase durability of usage of MI system	• Water saving/ conservation • Increase in water use efficiency

2	• Water scarce/water stressed /districts • Rainfed and irrigated area covered	• Rainfed area coverage and crop shift • No of district covered under ground water classification • Spreading of MI System	• Extent of MI adaption to crop suitability	• Crop demand-based adaption of MI system • Reduce in crop failure

Objective 3: Assessment of scheme impact on crop diversification, production, productivity, energy saving, water management and farm income

Sl No	Input	Output	Outcome	Impact
1	• Crop diversification (Crop types, Introduction of new crops)	• Changes in cropping system and Pattern • high-value crops and traditional crops • Increase in crop yield	• Changes in cropping intensity, density • Crop integration • increases productivity and income	• Reduction in the risk of crop failure • Environmental benefits • Value added crops
2	• Crop production components: (Seeds, fertilizers/pesticide), water energy, Labour)	• Incremental yield • Gross and net production • Employment generation and farm income/acre	• Agronomic and economic benefits	• Socio-economic improvements, assets generation
3	• Water Management (Sources of water, Type of irrigation)	• Quantity of water usage	• Changes in Irrigation extent • Crop category wise water use efficiency	• Enhanced irrigation area enhanced crop growth and vegetation

Objective 4: Inspection on the quality and functional status of MI installations

Sl No	Input	Output	Outcome	Impact
1	• Beneficiary opinion on lifespan of the system • Easiness in operation • Local company or BSI standard • Visual Inspection of material quality, (pump, pipe, filter, valves, dripper lines) • Maintenance support	• Quality standards • No. of years functioning of MI system and maintenance quality	• Design, quality Post installation services	• System stability • System performance • Multi crop adoptability

3.4 Evaluation matrix

A detailed evaluation matrix was developed based on the scheme objectives and evaluation questions and same was illustration is given below Table 3.1.

Table 3.1: Summary of evaluation matrix on key performance indicators (input, output, outcome and impact)

Sl No	Key Issues	Indicators	Variables	Data Collection Methods	Information Source(s)	Analysis Methods
	A- Inputs-Adequacy and implementation					
1	• Analysis of physical and financial performance	• Physical and financial target and achievement with respect component • Allocation ratio as per state and central govt norms, allocation of budget as per component potential	• Physical and financial target and achievement, spatial allocation spatial distribution (Sources: DOA, DOH, DOS)	• Secondary Data: Performance reports, SMIC and DMIC proceedings, Policy Documents; MI Evaluation Reports; Audit Reports of Line Depts, PPMSD 2016-17,17-18,18-19)	• DoH, DoA, DoS (JDA, DDH, ADS)	• Meta-analysis Descriptive statistics
2	• Identification of beneficiaries across social groups and awareness, training,	• Category wise identification beneficiary, awareness about the scheme, capacity building programs	• No. of in-house/ practical trainings provided, No. of exposer visits, category and genders wise farmer participation, level of skill enhancement, subject covered), effectiveness, utilization/adaption of training benefits, installation of ventury and pressure gauge,	• Primary data collection through field survey Secondary data from respective department	• Field beneficiary /verification, DoH, DoA, DoS (JDA, DDH, ADS)	• Inferential statistical by opinion survey tools
3.	• Provision and release of subsidies under General, OBC, SC, ST	• Exiting provision and release pattern of subsidy under General, OBC, SC, ST percent allocation, subsidy distribution pattern among various group, time take for release of subsidy	• Across land holding size farmers, social groups	• Primary data collection through field survey Secondary data from respective Department	• Field beneficiary/verification, DoH, DoA, DoS (JDA, DDH, ADS)	• Inferential statistical by opinion survey tools

Sl No	Key Issues	Indicators	Variables	Data Collection Methods	Information Source(s)	Analysis Methods
4	• Allocation of micro irrigation systems as per timeline.	• Type of micro irrigation system and time line of implementation	• component wise allocation of drip/sprinkler, target and achievement MI System (Drip and Sprinkler: with respect to farmer category	• Secondary data: Year-wise, type of MI system, component- wise, beneficiary category	• DoH, DoA, DoS (JDA, DDH, ADS) Year Wise approved report from DOPS	• Inferential statistical by opinion survey tools
5.	• Preparation of District Irrigation Plans (DIP) and Annual plans	• DIPs, AAP of irrigation formation and approval, convergence with on-going schemes of State and central	• Number and type of scheme convergence, No. of DIP, annual action plans, method of adaptation in preparation of DIP and annual action plan	• Primary data collection through field survey secondary data from respective department	• Field beneficiary/verification, key stakeholders' consultations DoH, DoA, DoS	• Inferential statistical by opinion survey tools
6	• Establishment and functioning of various committees and coordination across different stakeholders.	• Involvement of state and district review committee, representation of major key stakeholders in committees, involvement with farmers organization (Water user groups)	• Target no. of reviews/meetings, active or Inactive of committee, committee's performance as per guideline, coordination level (issues solved/solution provided in the meetings), No. of committees formed at state, district and taluka level, functioning of state level technical support groups	• Secondary data from respective department	• DoH, DoA, DoS (JDA, DDH, ADS)	• Inferential statistical by opinion survey tools
	B- **Output efficiency analysis**					
1	• MI adoption rates	• Adaptation by various category of farmers region, crops	• No. of farmers adaptation, category farmers, type of MI system, adaption	• Primary data collection through field survey Secondary data from respective Department	• Field beneficiary/verification, DoH, DoA, DoS (JDA, DDH, ADS)	• Inferential statistical by opinion survey tools and Descriptive

Sl No	Key Issues	Indicators	Variables	Data Collection Methods	Information Source(s)	Analysis Methods
2	• Training, monitoring and support for maintaining the structures	• Coverage of relevant topics and its effectiveness, and coverage of target groups, demonstration visits, post installation services	• Number of training programs duration, topics covered, reading material support, training institutions, accessibility, frequency of services	• Primary data collection through feedback from beneficiary and trainers	• Field beneficiary/ and Key person interview DoH, DoA, DoS (JDA, DDH, ADS)	• Inferential statistical by opinion survey tools and descriptive
3	• Incentivization and changes in cropping pattern	• Crop based subsidy availment	• No of farmers adaptation, category farmers, Type of MI System,	• Primary data collection through field survey	• Field beneficiary	• Inferential statistical by opinion survey tools and descriptive
4	• Documentation of cases of success and failure and FGDs	• Impact of MI on success and failure	• Review and documentation of success and failure	• Primary data collection through field survey	• Field beneficiary	• Descriptive
5	Changes in cropping pattern crop yields	• Level of change in cropping pattern, level of change in crop yield	• Changes in crop combinations, changes in crop yield district wise	• Primary data collection through field survey	• Field beneficiary	• Inferential statistical by opinion survey tools
	C- Impact factors (Agronomic, Economic and performance of MI system)					
1	• Adaptation rate of MI	• Adaptation rate as indicated in the form of adaption Index	• Area coverage (ha and percent), with MI systems (Drip, Sprinkler): agro-climatic zone, and Farmer groups (Land holding size, social groups, and gender)	• Primary data collection through field survey Secondary data from respective Department	• Field beneficiary/verification, DoH, DoA, DoS (JDA, DDH, ADS)	• Inferential statistical by opinion survey tools
2	• Water use efficiency and irrigation savings	• Area coverage, changes in production	• District wise and crop wise water saving, area covered	• Primary data collection through field survey	• Field beneficiary/verification	• Output and cost benefit analysis
3	• Savings on energy consumption percentage	• Energy consumption, area coverage by irrigation	• Number of hours of pump running, volume of water	• Primary data collection through field survey	• Field beneficiary/verification	• Inferential statistical by opinion survey tools

Sl No	Key Issues	Indicators	Variables	Data Collection Methods	Information Source(s)	Analysis Methods
			discharge per hour, Sources of energy			
4	• Savings on fertilizer consumption percentage	• Quantity consumption of fertilizer	• Crop wise quantity of usage per acre	• Primary data collection through field survey	• Field beneficiary/verification	• Inferential statistical by opinion survey tools
5	• Increase in productivity of crops	• Crop-wise changes in unit production	• Crop yield/acre	• Primary data collection through field survey	• Field beneficiary /verification	• Inferential statistical by opinion survey tools
	• Employment generation	• No of Man days	• District and crop wise No. of man days created (Pre harvest and Post harvest)	• Primary data collection through field survey	• Field beneficiary /verification	• Inferential statistical by opinion survey tools
6	• Increase in farm Income	• Changes in farm income	• Total cost of production and net income per acre district	• Primary data collection through field survey	• Field beneficiary/verification	• Inferential statistical by opinion survey tools
7	• Soil health Improvement	• Earth worm population, Soil surface cracking	• Occurrence Soil cracking and earth worms	• Primary data collection through field survey	• Field beneficiary/verification	• Inferential statistical by opinion survey tools

Descriptive Statistics includes: Describing and Summarizing Data for understanding the results and presenting in the form of GIS Maps, Histogram, Scatter Plot, Measures of Central Tendency: Mean, Median, Mode. Measures of Dispersion: 1. Range 2. Variance 3. SD, Inferential Statistics: Making Predictions and Inferences from the Data. T and F Tests, Regression, Correlation Matrix, Factor Analysis

3.5 Study area

Karnataka state has about 101.34 lakh ha of net cultivable area (53.1% of total geographical area) out of which 35.8 percent (36.59 lakh ha) is under irrigation and the remaining 63.4 percent (63.41 lakh ha) is under rainfed farming. Climate of the state exhibits greatest extremes due to its geographic location and variation in topography. The annual rainfall across the state ranges from as low as 450 mm (North Eastern plane) to as copious as 4009 mm (Coastal area). Around 80 percent of rainfall it is received during the southwest monsoon, 12 percent in the post monsoon period, 7 percent during summer and 1 percent in winter. The highest recorded temperature was 45.6 °C at Raichur and the lowest recorded temperature was 18°C at Bidar. There are varied types of soil orders are recognized, based on differences in soil formation processes, as reflected in the nature and sequence of soil horizons. Black soils are found in northern Karnataka whereas red and red loamy soils are prominent in southern Karnataka. Laterite soils are found in malnad and coastal areas of the state. An impact evaluation study of the PMKSY-PDMC implemented during 2016 to 2019 was conducted in ten districts of various agro climatic zones through primary survey and secondary field data, during March 2020 to June 2020 (Fig. 3.3). Brief characteristic of 10 sample districts is given in following Table. 3.2

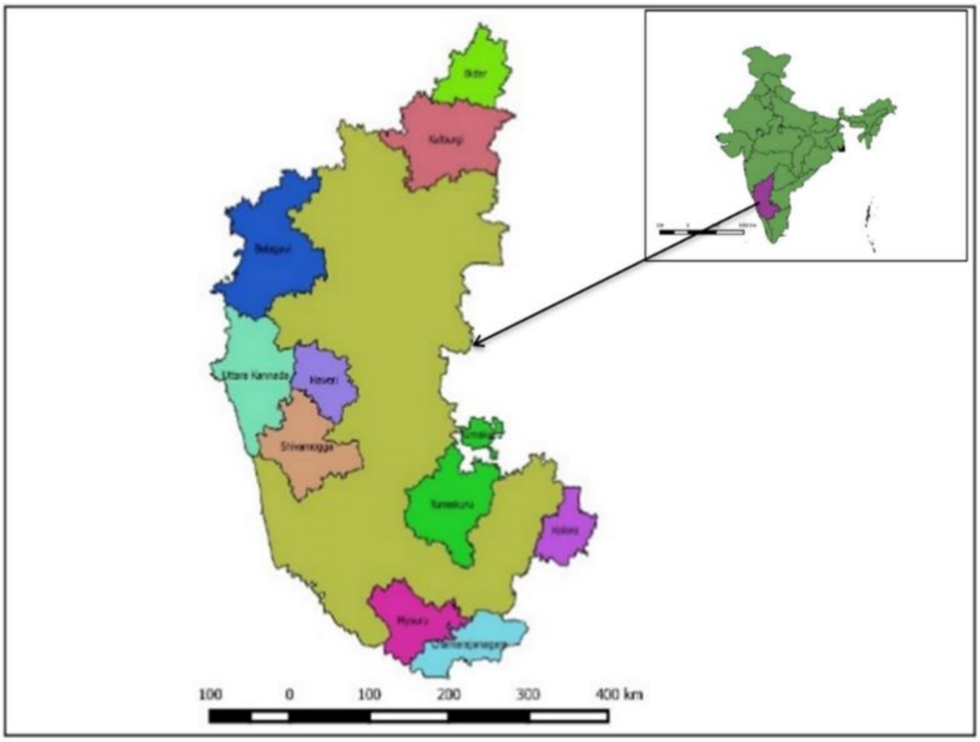


Fig 3.3: Agro-climatic zone wise distribution of sample districts for the Impact evaluation study of PMKSY-PDMC scheme.

Table 3.2: Agro-climatic characteristics of the study area

District / ACZ	Taluk	GW-Status	Coordinates	Elevation (m. a.s. l) mt	Soil Type	Topography	Temperature	Principal Crops	Avg. Rainfall (mm)/Year
Belagavi / ND	Athani	OE	16.7261°N, 75.0611°E	590	Medium-Deep Black Laterite, Red and Sandy	Plain and partly hilly	36.0^0C Max 12.1^0C Min	Sugarcane, grapes	541
	Khanapur	S	15.6407°N, 74.5170°E	649				Paddy	1969
	Savadathi	OE	15.7522°N, 75.1253°E	610				Maize	594
Bidar / NET	Basavakalyan	S	17.8721°N, 76.9470°E	621	Deep Black, Medium Shallow, Red Soil	Plain and Partly Hilly	39.0^0C Max 15.0^0C Min	Sugarcane	553
	Bhalki	SC/C	18.0504°N, 77.2184°E	587				Jowar	540
	Humnabad	S	17.7683°N, 77.1313°E	638				Mango	544
C.R Nagar / SD	Gundalpet	OE	11.8083°N, 76.6927°E	816	Medium deep, red clayey soils	Undulating and mountainous with north – south	35.7^0C Max 19.7^0C Min	Ragi	771
	Kollegal	SC/C	12.1537°N, 77.1111°E	587				Coconut	802
	Yelandur	SC/C	12.0491°N, 77.0305°E	555				Vegetable	877
Haveri / NT	Savanur	S	14.9725°N, 75.3356°E	573	Black, Red, Sandy loams, Sandy soils	Plain Terrain	31.0^0C Max 19.0^0C Min	Maize	706
	Siggaon	S	14.9914°N, 75.2217°E	601				Jowar, Maize	837
	Hirekeruru	SC/C	14.4555°N, 75.3951°E	619				Chilly	856
Kalaburgi / NED	Aland	S	17.5676°N, 76.5662°E	480	Deep black soils	Plain Terrain Partial Flat and Hilly	35.1^0C Max 23.3^0C Min	Jowar	813
	Chitapur	S	17.1182°N, 77.0830°E	403				Red gram	840
	Kalaburgi	S	17.3297°N, 76.8343°E	454				Banana	823
Kolar / ED	SrinivasPura	OE	13.3305°N, 78.2077°E	819	Red loamy soil to red sandy soil and lateritic	Rolling, undulating, and gently sloping	34.0^0C Max 15.0^0C Min	Ragi	745
	Kolar	OE	12.9585°N, 78.2710°E	849				Chilly	735
	Malur	OE	13.0037°N, 77.9383°E	909				Tomato	693
Mysuru / ST	Nanjanagudu	S	12.1160°N, 76.6782°E	656	Deep red clayey soils	Rolling, undulating, and gently sloping	30.9^0C Max 21.0^0C Min	Paddy	711
	Mysuru	SC/C	12.1873°N, 76.3637°E	763				Paddy	823

District / ACZ	**Taluk**	**GW-Status**	**Coordinates**	**Elevation (m. a.s. l) mt**	**Soil Type**	**Topography**	**Temperature**	**Principal Crops**	**Avg. Rainfall (mm)/Year**
	H.D Kote	S	12.0880°N, 76.3280°E	694				Cotton	832
Shivamogga / Hilly	Thrithalli	S	13.6895°N, 75.2450°E	591	Red Sandy, Black Soils, Red loamy and Lateritic gravelly soils	Mountains Plane	35.8^{0}C Max 22.0^{0}C Min	Arecanut, Coconut	556
	Bhadravathi	S	13.8276°N, 75.7064°E	597				Arecanut, paddy	859
	Shivamogga	S	14.0086°N, 75.1545°E	569				Maize, paddy	979
Tumkur / CD	Madhugir	OE	13.7764°N, 77.2526°E	787	Red clay, loamy alluvial	Rolling, undulating, and gently sloping	35.0^{0}C Max 25.0^{0}C Min	Coconut	829
	Pavaghada	SC/C	14.1430°N, 77.6776°E	846				Maize	763
	Tiptur	OE	13.1716°N, 76.6157°E	862				Coconut	713
Uttar Kannada / Coastal	Mund-god	S	14.5371°N, 74.9841°E	564	Medium black soils. Laterite and red lateritic also	Mountain with ridge valley, plan undulating	33.9^{0}C Max 22.8^{0}C Min	Maize, paddy	1555
	Sirsi	S	14.6196°N, 74.8441°E	611				Paddy, Areacnut	2379
	Haliyal	SC/C	15.4054^{0}N, 74.7564^{0}E	559				Paddy maize	1873

Note: OE: Over exploitation, S: Safe, SC/C: Semi critical/Critical.

ACZ: Agro Climatic Zone, ND: Northern Dry Zone, NET: North Eastern Transitional Zone, SD: Southern Dry Zone, NT: Northern Transitional Zone, NED: North Eastern Dry Zone, ED: Eastern Dry Zone, ST: Southern Transitional Zone, Hilly: Hilly Zone, CD: Central Dry Zone, Coastal: Coastal Zone m a.s.l.: Mean above sea level

3.6 Sample design and size

An abstract of projected component wise distribution of sample beneficiaries in each district and taluks with control beneficiaries are presented in Table 3.3 and Fig 3.4 and Fig. 3.5. A multi-stage- proportionate random sampling design was adopted for selection of taluks and beneficiaries. With the pre-identified 10 districts viz Belagavi, Bidar, C. R Nagar, Haveri, Kalaburgi, Kolar, Mysuru, Shivamogga, Tumakuru and Uttara Kannada representing 10 agro-climatic zones. Further three taluks from each district have been classified into high, moderate and low groups of beneficiaries considering ground water exploitation status as safe, semi critical/ critical and over exploitation zone.

In each taluk, Gram Panchayath (GP) were selected on the basis of coverage in area under irrigation which is taken as a proxy of development of micro irrigation infrastructure. From, each sample taluk 5 to 6 GPs were classified into best, moderate and average level of MI installation (50:25:25 ratio) were selected randomly among those where MI systems (Drip and Sprinkler) have been installed. Further, villages have been selected on the basis of area coverage of agriculture, horticulture and sericulture sector.

The selection of the sample beneficiary/adopters has been made randomly representing various categories such as : operational land holding size (marginal, small, medium and large), social group (General, OBC, SC and ST) and gender (male and female). Besides this, control sample as non-beneficiaries/non-adopters were also selected to identify reasons for their nonparticipation in the programmes and also to compare with benefits drawn by adopters. This in fact facilitated the impact evaluation study, based on ‘with and without’ approach. The control respondents were selected in the same village where (farm land) the project intervention was not taken place.

Total number of beneficiary/adopters samples is around 3690 which represented 4 percent of total beneficiary (9414) and non-beneficiaries/ non-adopters is about 40 which represent 1 percent of the total beneficiaries. Based on proportionate sample distribution further, highest (70%) sample beneficiaries were drawn from agriculture and medium (27%) from horticulture and minimum (3%) from sericulture. Additionally, 20 FGDs (10 drip and 10 sprinkler) and 20 (10 drip and 10 sprinkler) case studies were conducted to capture success or failure and specialities of the program across drip and sprinkler beneficiaries.

Table 3.3: Component-wise distribution of the sample across the agro-climatic zones and district. - (in No.)

Sl. No	Agro Climatic Zone	District	Total Beneficiaries (No)	Component-wise Samples (No.)			Sample size (No.)	Control (1% non-beneficiary)	Total No. of Samples (Treatment+ Control	Taluk selection (Over-exploited-1, Critical/semi-critical-1 and safe-1)	Case study (Drip and sprinkler) (1+1) per district	FGDs
				Horticulture	Agriculture	Sericulture						
1	ND	Belagavi	15798	64	306	6	376	4	380	3	2	2
2	NET	Bidar	6397	42	318	4	364	4	368	3	2	2
3	SD	C. R Nagar	4475	205	157	8	370	4	374	3	2	2
4	NT	Haveri	12360	78	293	4	375	4	379	3	2	2
5	NED	Kalaburgi	9219	68	297	5	370	4	374	3	2	2
6	ED	Kolar	6202	160	151	51	362	4	366	3	2	2
7	ST	Mysuru	13592	68	304	4	376	4	380	3	2	2
8	Hilly	Shivamogga	11559	96	278	1	375	4	379	3	2	2
9	CD	Tumakuru	10506	157	193	22	372	4	376	3	2	2
10	Coastal	Uttara Kannada	4033	58	287	5	350	4	354	3	2	2
		Total	**9414**	**996**	**2584**	**110**	**3690**	**40**	**3727 (Rounded off to 3730)**	**30**	**20**	**20**
		Percent (%)		**27**	**69**	**3**		**1**				

ACZ: Agro Climatic Zone, ND: Northern Dry Zone, NET: North Eastern Transitional Zone, SD: Southern Dry Zone, NT: Northern Transitional Zone, NED: North Eastern Dry Zone, ED: Eastern Dry Zone, ST: Southern Transitional Zone, Hilly: Hilly Zone, CD: Central Dry Zone, Coastal: Coastal Zon

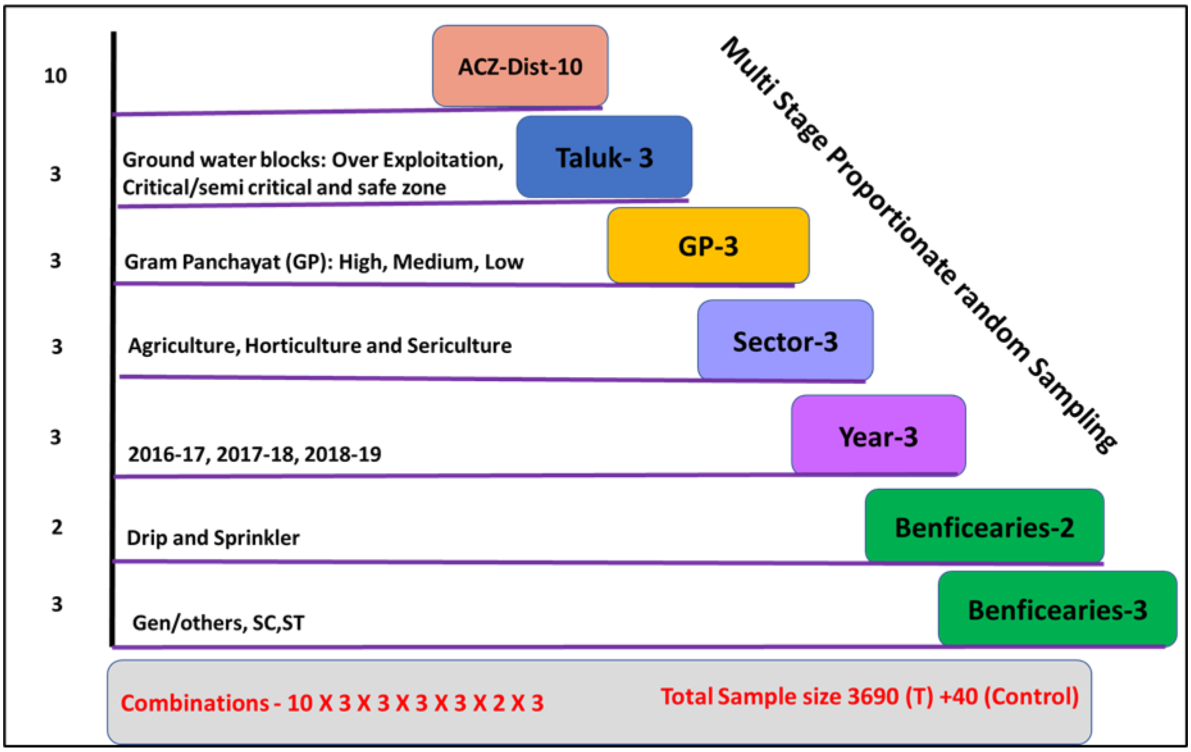


Fig 3.4: Flow chart of multistage proportionate random sampling of beneficiary selection

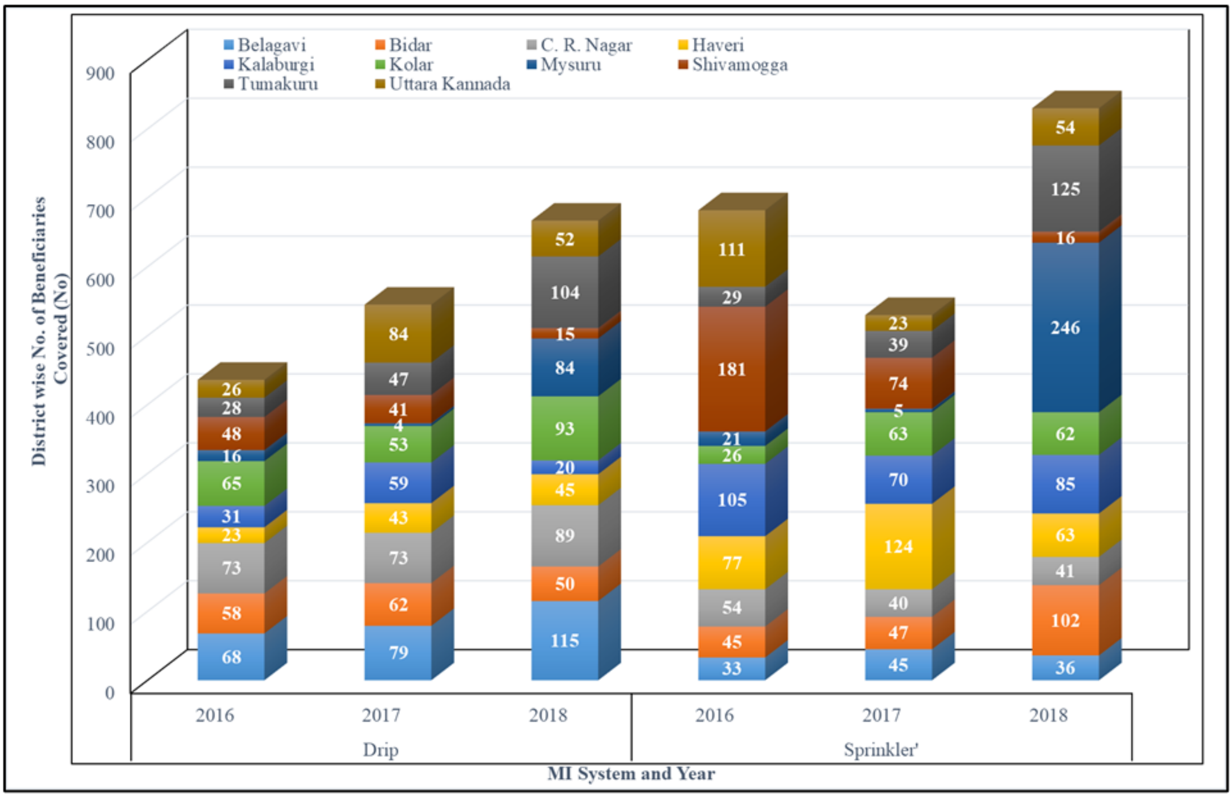


Fig: 3.5: Spatio-temporal distribution of MIS beneficiaries in the evaluation study districts

3.7 Data collection

The data sets and types for both primary and secondary data collection were undertaken by choosing appropriate tools which includes,

- Secondary data/ desk review
- Primary data from beneficiaries
- Focus group discussions from group of beneficiaries
- Consultation with stakeholders involved in implementation of PMKSY-PDMC
- Institutional mapping and network

3.7.1 Secondary data collection

The evaluation team, after procuring the relevant information/documents have been reviewed keeping the scope and objective of evaluation in view. The desk review has helped in preparing a checklist for state, district, taluk authorities. Also, it is helped in planning the field visits to the districts for eliciting information from the government authorities, district level officers and beneficiaries.

Initial extensive desk work was carried out on collecting review literature, especially collecting district report, annual report of departments published articles, case study, successes story, previous, monitoring and evaluation reports, policy documents, audit reports. Further, secondary data collection with reference to the program target and achievement (physical and financial), coverage (area expansion, production productivity) farmers groups, social groups was collected mainly from government records at state, district, taluk level departments of agriculture, horticulture, sericulture and planning and statistics, irrigation, state remote sensing centers. A meta-data analysis is adopted for data examination pertaining to previous research, and thus to determine the trends and views to formulate suitable approach and plans of the evaluation study. mapping and analysis of institutional structures and functionality enabled the implementation and promotion of the scheme, limitations encountered with respect to selection, transparency, distribution and coverage of various beneficiaries, an outline of an implementation process was prepared to assess the integration of stakeholders and factors including process influencing results and goals.

3.7.2 Primary data collection

Majorly participatory tools such as, questionnaire and opinion survey were used for primary data collection. These tools were enabling in collection of quantitative and qualitative data on various parameters. The field survey was designed in such a way that collecting primary data on various program components from key stakeholders with respect to the scheme objectives and issues. The process of adoption of the above indicated tools is briefed as below:

3.7.3 Questionnaire survey

Questionnaire survey is an important tool that was used to document the impact information, especially to create quantitative database. A survey questionnaire was developed to elicit opinion-based information (based on their perceived experiences with the scheme) from beneficiaries and non-beneficiaries.

Basic demographic details of beneficiaries with historic data on land use pattern, crop diversification, participatory roles, adoption, impact of MI system on crop productivity, water, energy, fertiliser and labour saving, Employment generation and increase in farm income. Also, opinion on training and demonstrations, incentivization to socially vulnerable groups, pattern of subsidy disbursement, post-installation services and other related feedback/responses accrued by the scheme were collected. Further, sets and sub-sets of questionnaires were devised to generate quantified data on various impact parameters and indicators from major implementing departmental personnel and MI agency representatives. Besides, state and district level monitoring committee opinion and views on scheme implementation was consolidated and analysed appropriately.

3.7.4 Focus Group Discussion (FGD) and Stakeholder consultation

The FGDs were conducted among beneficiaries to avoid hesitation and providing real information which is difficult in front of officials and MI agency. A good (average 25) representation of beneficiaries including general, OBC, SC, ST, and gender was ensured. The FGDs were organised with a proper information protocol devised to document relevant information which could be used for analysis. In each sample district, two FGDs were carried out, one with sprinkler and drip irrigation beneficiaries and collective information was noted through a discussion guide developed for each of the FGDs.

In addition, the key stakeholders interactive consultations were conducted for gathering feedback and response towards the scheme objectives and implementation was analysed from qualitative information. The qualitative data is collected through active participation of stakeholders and all relevant respondents. This exercise was administered to nodal officer of the horticulture, agriculture and sericulture at state, district, taluk levels, collaborating institutions, and MI agencies to elicit their views, experiences, problems, possible solutions, suggestions for improvement and prospects of micro irrigation scheme.

3.7.5 Case studies

Every programme related to the agriculture water management and capacity building of farmer group will have innovative or outstanding achievements, or in some cases, failures, and specialities which are important learning experiences. Hence case studies serve as useful tool to showcase these experiences. During these interactions, information was sought on specific cases/instances where micro irrigation system has led to enhanced outcome in the implementation or had adverse impacts. Representative case studies were conducted in all the sample districts covering three sectors. Case studies have been documented to highlight outstanding impact on MI adaption, convergence, social gains, gender participation, and impact.

3.8 Questionnaire design

Tools and techniques for data collection

The following tools were formulated for each of the above methodology and also to ensure participation of all groups of stakeholders in the study. All the tools were pre-tested for relevance and suitable modifications were done prior to the actual primary data collection.

i. *Interview schedule/Questionnaire for Survey*: Interview schedules were primarily administered to elicit information from various beneficiaries. A Kannada version of the questionnaire was adopted to capture the primary data.

ii. *Checklist for formal/ Informal Interview:* A checklist was prepared to aid in the formal interview and was conducted with the state nodal officer of horticulture, agriculture and sericulture, district level authorities, taluk level officials, MI agency representatives and other stakeholders to understand the overall operational mechanism.

iii. *Case Studies*: Based on interaction with district/ taluka level implementing officers a guideline was developed to gather information on the success/ failure issues and this was developed into a case study.

3.9 Quality measures

Specific protocols were designed at two different stages to meet the quality standards for our services. This includes:

Quality assurance protocols for pre-data collection: All the research tools were tested in a pretesting exercise to ascertain their suitability in the context of our study. Specific training has been given to the field team to enhance their subject knowledge that they were able to understand the objective behind each question. A virtual debriefing was carried out with all enumerators after the pilot test for sharing learning from the pilot test and modifying the tools to make it more relevant and effective.

Quality assurance protocols during data collection and processing: Data was collected using field format and has been regularly be uploaded and stored in a master sheet to safeguard against any accidental loss/damage of data. Once the data has been stored in computer accessible form, validity checks, range checks and consistency checks were made to identify any issue in the data collected. Apart from this, back-checks of 10 percent of the respondents were conducted by the technical expert to ensure accuracy of the data collected by the enumerators.

3.10 Data analysis approach

Proposed study involves the real time assessment of both quantitative and qualitative parameters including key performance indicators. All the primarily processed quantitative data was analyzed for assessing interrelationships by using relevant statistical approach like comparative, average, mean, range, percentage, grading. Impact of micro irrigation was estimated by using data captured before and after the scheme implementation for beneficiaries, and after adoption of MI by the beneficiaries/adopters Vs non-beneficiaries/non-adopters of the MI system.

Variables evaluated before and after, with and without MI installation (opinion survey):

1. Impact of MIS on agriculture practices: Changes in Land use, cropping pattern and diversity, impact of MIS on crop yield/unit area and cropping intensity among farmer category (Marginal, Small medium and Large farmers)
2. Water saving (Acre inches): Crop and district wise water saving was estimated by using following equation
    a. Net water saving=Water Yield (Inches) X 1000 X No. of hours of irrigation X no times of irrigation
    Additionally crop wise and farmer category wise water saving was estimated
3. For estimating the water saving in mulberry cultivation, the concept of more crop and income per drop of water was estimated considering the leaf yield. Mulberry foliage yield was considered as interface yield while cocoon yield (end use product) was considered for end use pricing.
4. Input saving:

$$Energy\ saving = \ (Pump\ capacity\ (HP) X\ 0.75KW)\ X\ Duration\ of\ pump\ running\ \left(\frac{hr}{day}\right)$$

Fertiliser: Crop and district wise reduction of dependency and fertiliser saving/acre was assessed (Qt/acre)

Crop and farmer category reduction of dependency or fertiliser saving/acre was assessed (Qt/acre)

Labour saving: Crop and district also crop wise farmer category wise labour saving was assessed in particularly involvement in agriculture water management

5. Employment generation: Crop and district wise number of man days engaged in the pre and post harvesting practices of agriculture production.
6. Assessment of impact on productivity and farm income: Indicator used to assess district wise and farmer category (Marginal, Small, Medium and Large farmers) wise net gain of farm income/acre through productivity enhancement were worked out for different beneficiary and non-beneficiary.
7. Correlations between training- MI adoption, productivity major crops and functional status of MI was estimated across the categories of farmers.

RESULTS AND DISCUSSION

4.1 Process and Implementation of Micro Irrigation

A critical analysis of the present pattern of various procedures and processes with the key institutions and actors at differential levels (from initiation of application to till complete implementation) and its strategic linkages were critically identified and illustrated in the Fig. 4.1 and sequentially briefed as below:

1. Funds are allocated in the proportion of 50: 40 between centre and state for MI scheme under PMKSY-PDMC program. However, state extended his share through convergent of other scheme and provide up to 90% subsidy for 0.1- 2 ha Micro Irrigation.
2. State Micro-Irrigation Committee (SMIC) submit its State Action Plan (SAP) to GOI for financial assistance.
3. State funds are allocated to each sector separately by SMIC and District Micro Irrigation Committee (DIMC) in accordance with the demand by the three major sectors
4. Selection of MI company for material supply will be done at state / GoI level
5. Funds are allocated to each taluk sector developmental office
6. Panchayati Raj Institutions (PRI's) and Govt. agencies promote the MI programme.
7. Farmer makes a decision to apply subsidy for MI
8. It was noticed that there lies a weak linkage between dealers and farmers after installation of MI and financial commitment.
9. It was noticed that there lies a weak linkage between field assistant and farmer after installation of MI and financial commitment spatially in MI system maintenance.

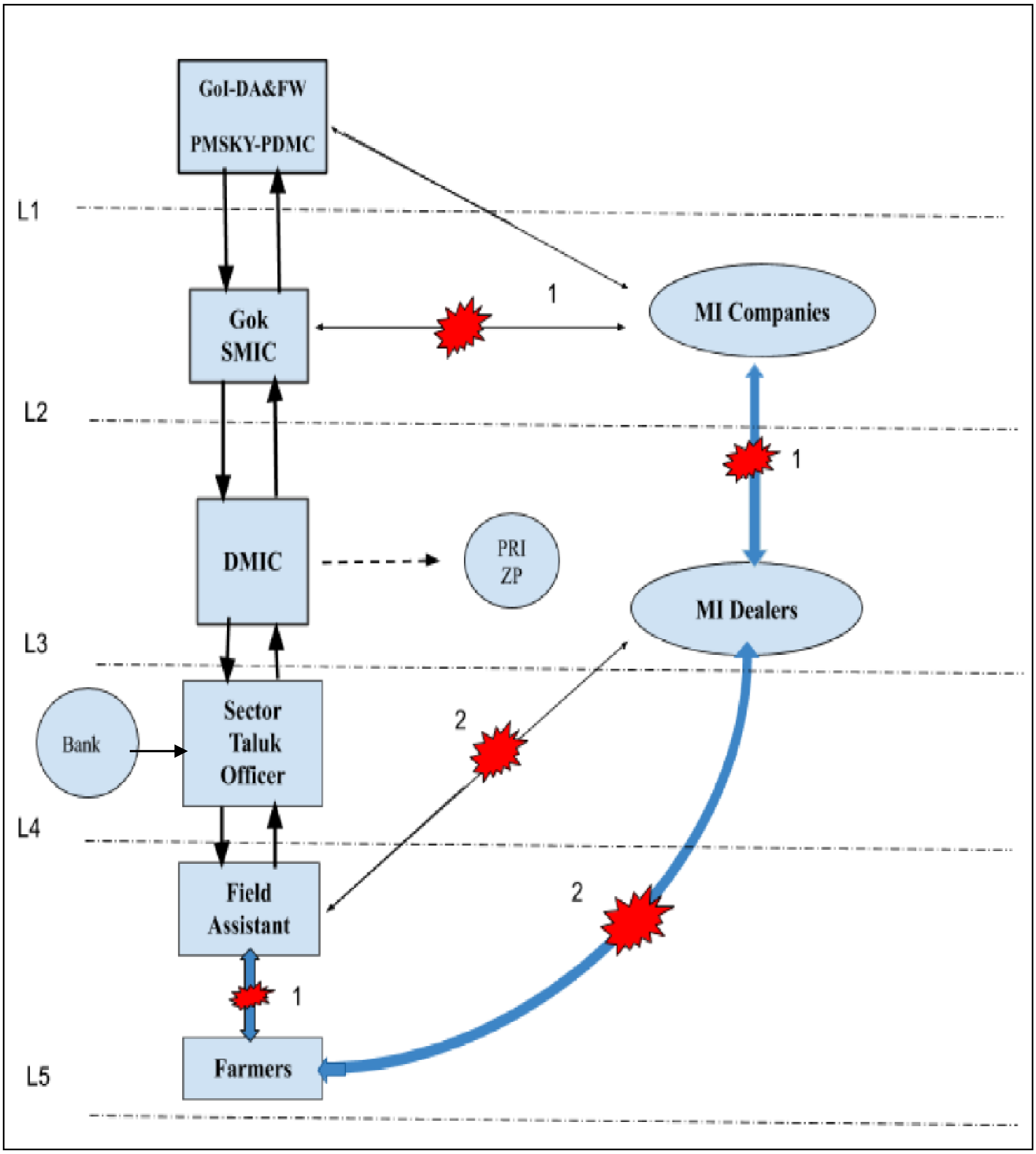


Fig 4.1: Institutional linkage of PMKSY PDMC Implementation mechanism

L-1: GOI Level; L-2: State Level; L-3: District level; L-4 Taluk Level; L-5 Field level

✸Critical link

Selection of beneficiaries- The beneficiary selection is done on the principle of "first come first serve" and he/she should hold assured water sources certificate issued by nodal person of revenue department (Village Accountant). The implementing officials will verify and categorized based on social group norms and guideline and on ground water exploitation status (over exploitation, critical, semi critical and safe zone in the selection of beneficiaries).

Further, tentatively selected farmers need to submit documents which he/she uploaded in the IT applications App to concerned department. The required documents include (a) Voter's ID or Aadhar card for identification (b) land records (RTC/Pani) (c) bank passbook bank account details (d) gram panchayat certificate on water source and –proof of residence. Once the name of farmer comes in the selected list of beneficiaries, a message is sent on his/her mobile number. The message is also communicated through traditional means such as through dealer or a field assistant, and on the department notice board. Farmers are given a week's time to inform his or her consent for availing benefits. If the farmer does not reply during this period, then other farmers in the list are selected automatically for the benefit. A model operational guideline followed by the government department is described in Fig. 4.2:

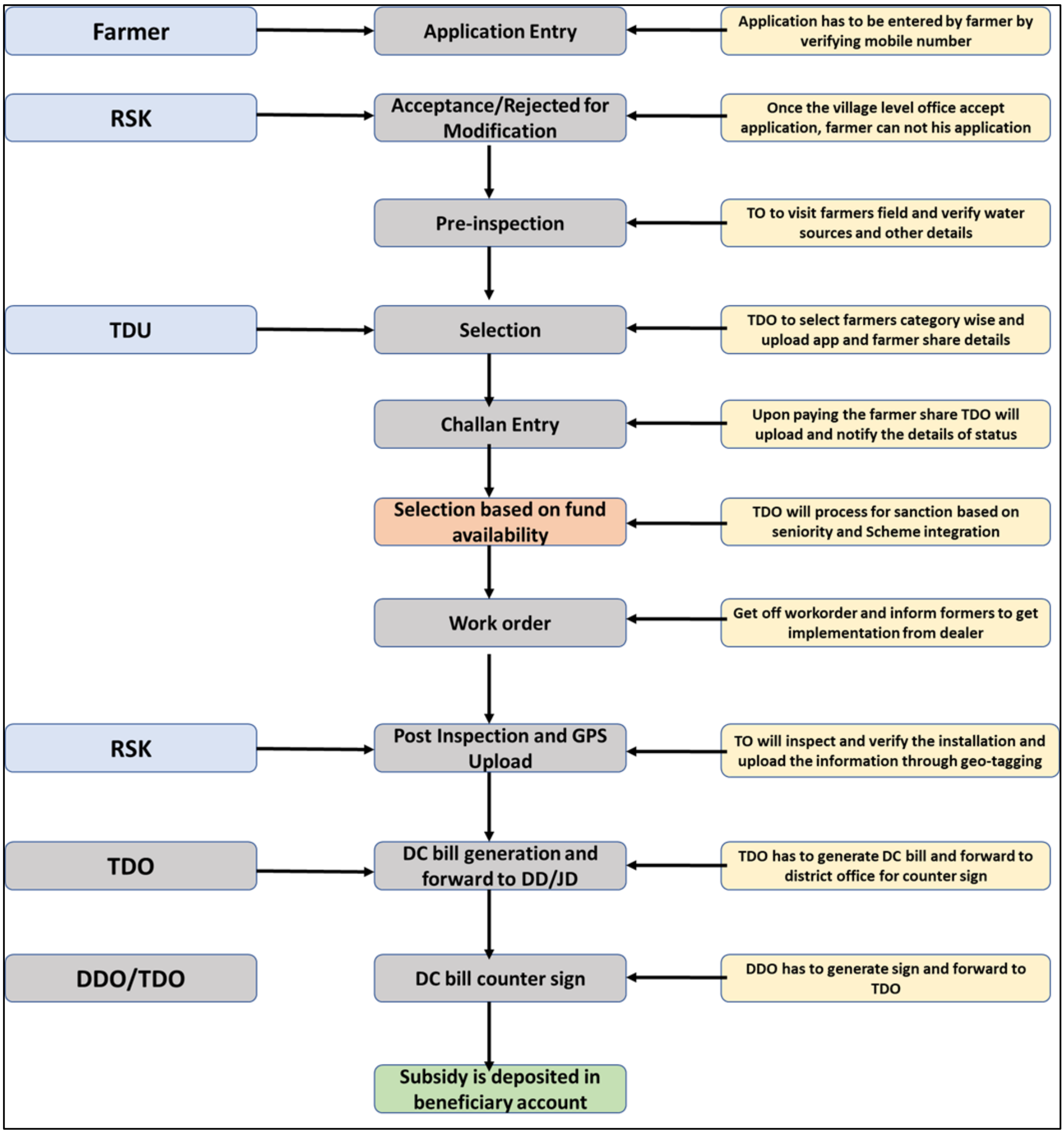


Fig 4.2: Schematic flow of PMKSY-PDMC implementation process
RSK: Raitha Samparka Kendra, TDO: Taluk Development officer, DDO: Deputy director

The relevance of the preparedness and execution of a few critical milestones in the MI implementation is critically observed by comparing MI policy document 2017, MI guidelines 2017 and field observations on its deviations and in adequacies and proposed suggestions are presented respectively, in Table 4.1, 4.2 and 4.3. Formulation of the District Irrigation Plan (DIP) is although a basic documentary guiding milepost, the integration of line departmental projections with the irrigation details is observed to be very preliminary, being side-lined due to the necessity of structured guidelines. DMIC's existence has to be improvised with review-able components like integration, relocation to potential zones, priority assessment, corrections, budget support, various partners performance, guiding for transparency, and social and technical audits. The convergence of credit support from financing institutions and convergence efforts of related governmental schemes for a complementary support to the MI scheme necessitates greater attention. Similarly, the need for technical refreshing to departmental personnel observed to be emphasized for effective training and extension involvement. The R & D inputs relevant to the development of an irrigation package of practice w.r.t type of crops, season, growth conditions, crop age, and the growth phase is to be systematically synergized as a feasible ready reckoner.

Table 4.1: District-wise status of operationalization of MI milestones in implementing departments

Sl. No	Indicators	Districts									
		Belagavi	**Bidar**	**C. R Nagar**	**Haveri**	**Kalaburgi**	**Kolar**	**Mysuru**	**Shivamogga**	**Tumakuru**	**Uttara Kannada**
1	Year wise Preparation and approval DIP	Partial	Partial	Partial	Partial	Partial	Partial	Partial	Partial	Partial	Partial
2	Functioning of DMIC	Marginal	Marginal	Marginal	Marginal	Marginal	Marginal	Marginal	Marginal	Marginal	Marginal
3	Mode of application	Web portal									
4	Selection of Beneficiary	First come first serve and own water sources									
5	Convergence with other schemes	Marginal	Marginal	Poor	Marginal	Marginal	Marginal	Poor	Poor	Poor	Poor
6	Timely release of budget	Not regular	Not regular	Not regular	Not regular	Not regular	Not regular	Not regular	Yes	Yes	Yes
7	Submission of UC	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
8	Credit mobilization	Marginal	Marginal	Marginal	Marginal	Marginal	Marginal	Marginal	Marginal	Marginal	Marginal
9	Conduct of training and extension programs	Marginal	Marginal	Poor	Poor	Good	Marginal	Good	Marginal	Poor	Marginal
10	Availability of technical expertise	Minimal	Minimal	Minimal	Minimal	Minimal	Minimal	Minimal	Minimal	Minimal	Minimal
11	Development of irrigation package	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
12	Training for Staff	Poor	Poor	Poor	Poor	Poor	Poor	Poor	Poor	Poor	Poor
13	Training for Youth	No	No	No	No	No	No	No	No	No	No

Sl. No	**Indicators**	**Districts**									
		Belagavi	**Bidar**	**C. R Nagar**	**Haveri**	**Kalaburgi**	**Kolar**	**Mysuru**	**Shivamogga**	**Tumakuru**	**Uttara Kannada**
14	R & D initiation	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
15	Dedicated Department for MIS implementation	Horticulture -Only Drip; Agriculture-Both Drip and Sprinkler, Sericulture- Only Drip									
16	Subsidy limit (%) and land ceiling	Subsidy: Up to 2 ha: 90 percent; 2-5 ha: 50 percent; Land ceiling: 5 ha									
17	Provision of margin money	Farmer contribution									

DIP: District irrigation plan, DMIC: District micro irrigation committee, MIS: Micro irrigation system HASIRU/FRUITS: Horticulture Application for Scheme Implementation and Regulating Utilization of Funds/ Farmer Registration andUnified Beneficiary Information System Sources: Field survey

Table 4.2: Observations on deviations and inadequacies (as field realities) in PMKSY-PDMC guidelines

Sl No	Stipulated Provision as per guidelines	Findings in the field and suggestions
1	Inter-Departmental Working Group (IDWG) of line departments	Weak bondage in all sample district which needs to be streamlining with a mandatory plan for coordination between revenue, ground water, energy, ZP/TP and implementers (Agri/Horti/Seri)
2	District Level Implementation Committee (DLIC) involving progressive farmers, the representative of MI industry, and leading NGO as members to oversee PMKSY implementation and inter-departmental coordination	Non-functioning of the DIC in all sample district calls for catalytic interventions through systematic supervision and review
3	District Irrigation Plans (DIPs) are the cornerstone for planning and implementation of different components of PMKSY to identify gaps in irrigation infrastructure after taking into consideration the District Agriculture Plans (DAPs)	Year wise DIP preparation requires updating in all sample districts and to be practice as mandatory plan
4	The annual action plans for Per Drop More Crop (Micro Irrigation) to be drawn from DIPs and implemented in conjunction with the water sources in cluster mode for holistic development.	Only, annual action plan for target prepared based on gross irrigated area in all the sample district. However, preparation of annual action plan has to developed based on aquifer recharge capacity and matching to need of the beneficiaries
5	Cluster approach adoption in irrigation chain development, to have effective integration of source, connectivity, distribution and application.	Yet to be absorbed as part of planning in all the sample district hence suggested for integration with water and other resources

Sl No	Stipulated Provision as per guidelines	Findings in the field and suggestions
6	Promotional efforts for fertigation	Very poorly addressed in all the district (1.5% of 3690 beneficiary), among district, famers belong to Chamarajanagar (38.2%) and Kalaburgi (34.5%), followed by, Shivamogga, Belagavi and Uttara kannada, hence it requires promotional activity like training, subsidy support for liquid fertiliser (organic and inorganic)
7	Integration of micro-irrigation with solar pumping units	Very marginally advised in all sample district and need to be promoted, effort to educate on solar power schemes (Surya mitra) and mandatory integration
8	More focus and priority be given for promoting micro-irrigation technologies in water-scarce, water-stressed and critical groundwater blocks/districts	Taluk selection in all sample district is based on ground water condition. However, needs to be promoted rain water harvesting structures and less water demand crops
9	PFDCs, ICAR, CIPET, ATMA, etc and other reputed NGOs may be involved in planning, implementation, demonstration, training and evaluation under the scheme.	Being very marginal practiced in all the sample district and need to be promoted in a proactive manner by the implanting departments
10	To encourage a group of farmers small farm holdings to avail the benefits of drip irrigation through a common water source	Being hardly promoted. However, during critical period water sharing between farmers is common practice in Tumakuru, Kolar, and Chamarajanagar at minimal cost. Thus, requires community approach through water users association and FPOs

Table 4.3: Salient features of the MI policy 2017, Karnataka and suggestive inputs from the evaluation study

Sl. No	Features	Scope under 2017 KMIP	Suggestions
A	**Administration**		
1	Institutional mechanism	• Autonomous unit • Exclusive technical man power support	• KAMIC single window institutional approach to be strengthened and operationalized.
2	Administration	• Improvised decentralized system is incorporated	• Strengthening of bottom-up approach to be promoted • Administrative management system to be streamlined with a prominent department handling large number of farmers and stakeholders
3	Autonomy	• Inadequately addressed	• Flexibility in budget relocation between sectors and its operating system to be streamlined
B	**Implementation**		
1	Coordination with Departments & Implementing agency	• Depts. of Horticulture, Agriculture and Sericulture, Water Resources Department and Irrigation Corporations • KAMIC: Nodal Agency	• 2017 KMIP provisions are to be promoted as it provides related departments representation in the supervisory committees at various levels.
2	Beneficiary selection	• Transparent mechanism with IT and GPS application	• 2017 KMIP proposal to be promoted with reviewed institutional framework, and implementation
3	Promotion of MI technologies	• Emphasized on fertigation	• Promotion micro sprinkler irrigation

Sl. No	Features	Scope under 2017 KMIP	Suggestions
			• Promotion of Low-cost investment MI system
4	Subsidy model and disbursement	• Per unit are consideration	• Subsidy per unit is to be considered. • Mandating of DBT system for subsidy releases
5	Extent of subsidy	• Area ceiling limit 5 ha • Maximum subsidy provision: 45% in command areas, and 90%to SC/ST and general category farmers in water scarcity areas not exceeding 2.0 ha.	• Indicated subsidy provisions are to be continued as per the exiting norms • Subsidy eligibility to be considered after 5 years
6	Convergence initiatives	• Mandatory convergence with Krishi Bhagya and Ganga kalyan scheme	• Mandatory convergence with community based irrigation projects, Jal Jeevan Mission (JJM), solar power programs and Integrated Scheme on Oilseeds, Pulses, and Oil palm
C	**Management**		
1	Regulatory measures	• Improvised regulation on: • Electrification • Crops coverage, • Drilling of borewells • Installation of solar power supply	• 2017 KMIP proposals are to be continued
2	Monitoring and evaluation	• Independent third-party involvement	• Concurrent system of monitoring and evaluation from independent external source to be mandated

Sl. No	Features	Scope under 2017 KMIP	Suggestions
3	Training and capacity building initiatives	• Adequately focused on farmers and officials	• Detailed end to end solution providing, exposures to officials • Technical orientation on system utilisation and maintenance
4	Monitoring system of MI companies/ suppliers	• Improvised approach	• KAMIC to develop measures on verification, certification and penalties
5	New Initiatives	• Promoting routine technologies	• Promotion of PPP models • Designing of year round cropping plan • Unified MI plan for multiple crop production • MI integration with rain water harvesting structures
6	Community based irrigation system	• Adequately addressed	• Mandatory convergence with community based irrigation projects,
7	IT application	• Data management and Information system well designed	• Farmer friendly and stakeholder friendly, digital application to be promoted (similar to FRUIT and HASIRU)
8	Research initiatives	• Addressed on innovation in MI models and practices	• Exclusive research from SAUs and PFDCs for introduction of new crops, development of cropping plan for agro-climatic zones and best irrigation package of practices.

Status of functionality of KAMIC in implementing MI scheme

Karnataka state has emerged with a vibrant institutional mechanism and structure Karnataka Antharagange Micro Irrigation Corporation (KAMIC) after an in-depth comparative analysis of institutional models of Gujarat (GGRC) and Andhra Pradesh (APMIC) states, for effective implementation, monitoring and evaluation of micro-irrigation systems. KAMIC structuring appears to be in line with the GGRC model to function as the nodal agency for all matters related to micro irrigation promotion in Karnataka. The focused objective of KAMIC strives to minimize transaction costs for beneficiary farmers and micro irrigation suppliers and to promote as an industry with due participatory responsibilities to all stakeholders. The study has critically analysed the operational consequences of the - KAMIC mechanism, and proposed an updated structure on realization of the field realities of the program implementation in the following illustration (Fig: 4.3). The pros and cons of the proposed mechanism is yet to be realized at field for any further refinements. The Best practices and takeaways for adoption in Karnataka include:

1. KAMIC institutional framework, with single window approach focusing on intervention in place through public private partnership (PPP) mode for overall improvement in the quality of the service at a least or nil cost to the Government
2. Promotion of intervention through major policy decision by issuing a unique registration code in the State.
3. Additional involvement of Department monitoring to Water Resources / Irrigation Department with crop experts integration system.
4. Delegation of authority and responsibility for implementation of the Social to a Corporate body like KAMIC with relatively higher autonomy in its functioning and decision making.
5. Simple and flexible single window approach: Farmer comfort from application to sanctioning through choose of MIS supplier and type of MI System, free access to quality product linked and system design as per cropping pattern and as per topography of agriculture field.
6. Transparency in scheme implementation: A state-of-art IT web-based application has to be put in place to provide advice on MI system and crop water management.
7. A multi stage monitoring and control system Third Party inspection at farmers Micro Irrigation system installed on his field with concurrent evaluation of MI Scheme.

8. Other services: Warranty and Guarantee of MI Components for five years, inbuilt agronomic as well as system maintenance advisory services through SMS services, inbuilt insurance of the MI system, effective complaint redressal system and toll-free helpline number, with promotion of water-soluble fertilizers.

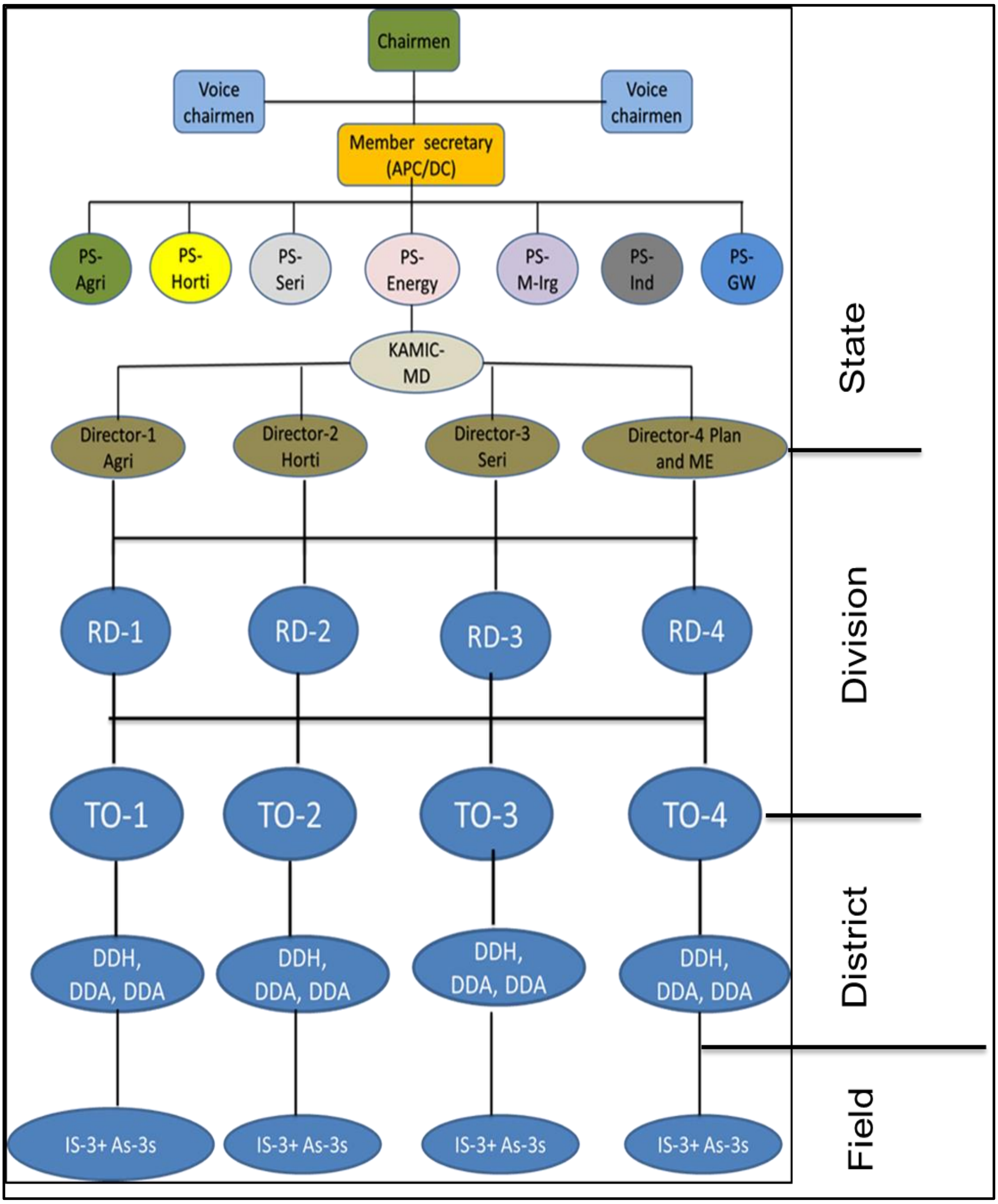


Fig 4.3: Schematic flow of proposed KAMIC operation

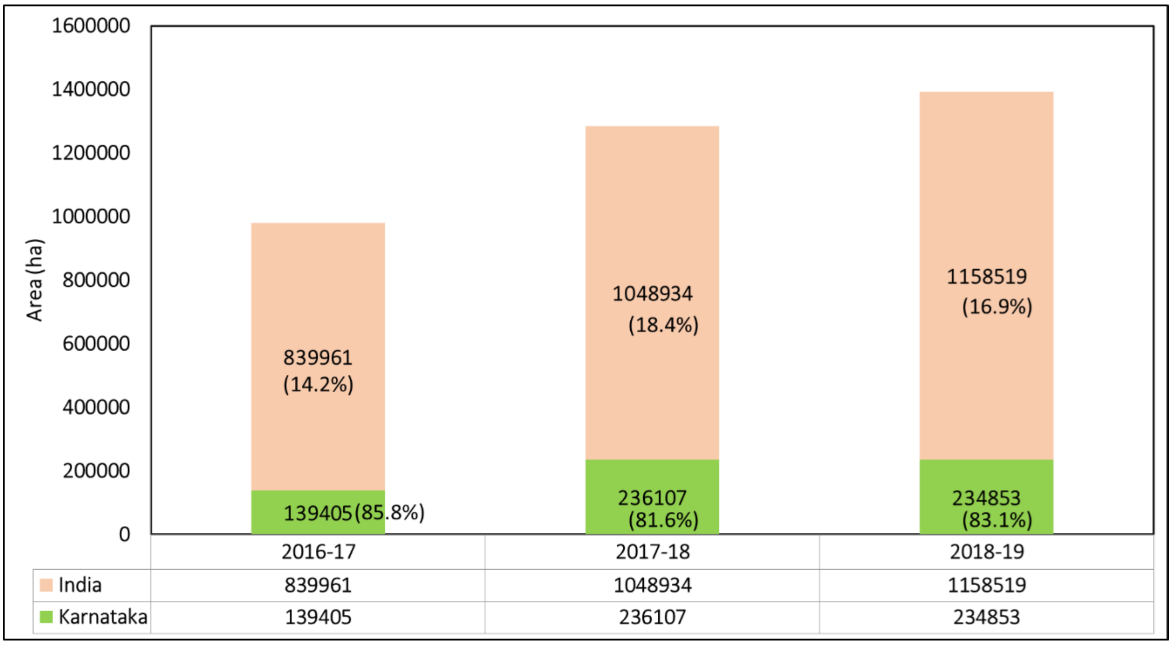
DC: Development commissioner, PS: Principal Secretary, MD: Managing director, RD: Regional director, TO: Technical officer, DDH: Deputy Director of Horticulture, DDA: Deputy Director of Agriculture, DDS: Deputy Director of Sericulture, IS: Implementing staff AS: Assistants

4.2 Performance of MI Scheme (Macro analysis)

4.2.1 Physical performance

One of the key objectives of current study is to assess the year-wise achievement of both physical and financial performance of MI in India, as well as in Karnataka. Additionally, this sub chapter presents evidence on spatio-temporal variation under micro irrigation (both drip and sprinkler) achievement and year wise financial allocation, release, expenditure in Karnataka.

MI in India is popularized with an investment and subsidy component by both the GoI and state governments. As on 2020, five years of cumulative area covered under PMKSY-PDMC is 43.12 Lakh ha at national level and in Karnataka 8.12 Lakh ha which accounts for 18 percent of the nation's achievement (Anon, 2020). The year-wise achievement of MI under PMKSY-PDMC programme at national and state level for the study period (2016-17 to 2018-19) is presented in Fig 4.4. This indicates that MI technology has gained immense popularity amongst the farmers as compared to conventional method of irrigation due to higher input and output use efficiencies. With respect to year-wise progress, during 2016-17, the area covered under MI was 8,39,961 ha at national level, and 139405 ha in the state. MI area coverage between the years 2016-17 to 2017-18 was remarkable both at national and state level, as this coverage represents increase of 24.8 percent and 69.3 percent in the state, respectively. While marginally increase to the tune of 10.4 percent (10,48,934 to 11,58,519 ha) at national level, while in Karnataka it was reduced to 0.5 percent (236107 to 234853 ha) between 2017- 18 to 2018-19. The variation in area coverage of MI in both national and state level during the three consecutive years appears to be due to variation in the allocation of matching funds, awareness and market value of product. Thus, a stronger push and appropriate fund allocation and monitoring system is needed to meet the set targets and to make achievement.

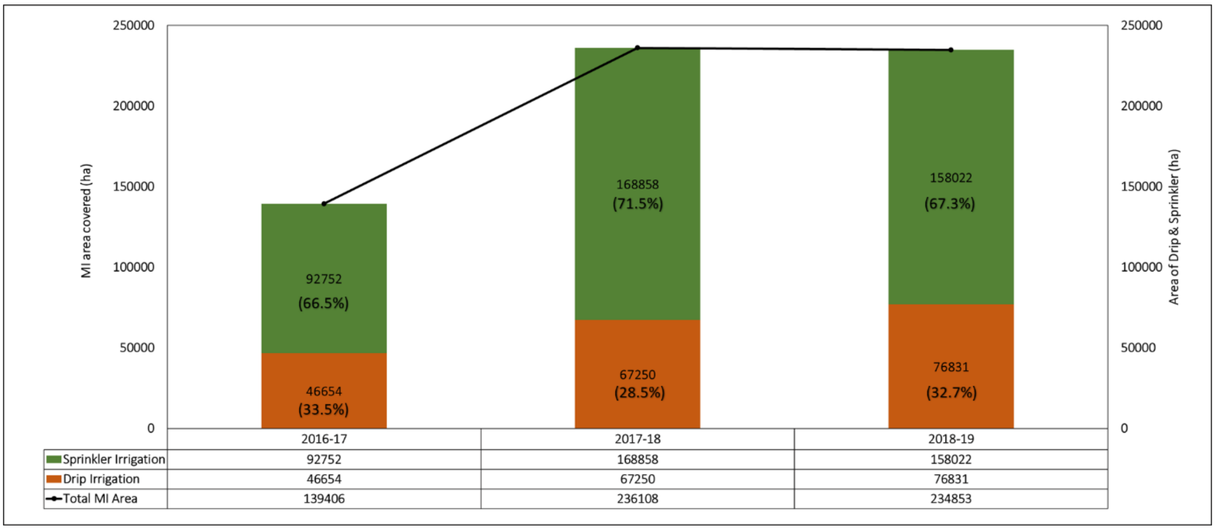


	2016-17	2017-18	2018-19
🟧 India	839961	1048934	1158519
🟩 Karnataka	139405	236107	234853

Fig 4.4: Physical achievement of PMKSY-PDMC scheme in India and Karnataka (2016-17 to 2018-19)

Source: PMKSY-PDMC web portal

Micro irrigation system broadly classified in to two types, namely -drip and sprinkler. Year-wise progress of both drip and sprinkler in Karnataka is presented in Fig 4.5. Out of 6.1 Lakh ha, drip irrigation area has covered 31.2 percent (1.9 lakh ha), while sprinkler area covered 68.8 percent (4.19 lakh ha). This indicates sprinkler has gained wide popularity amongst the agriculture crop growers (cereals, pulses and oil seeds etc) as compared to conventional method of irrigation. Growth of both drip and sprinkler irrigation area coverage between the years 2016-17 to 2017-18 was remarkable, as this coverage represents 44.2 percent (0.46 to 0.67 lakh ha) and 82.1 percent (0.92 to 1.68 lakh ha) respectively. However, during 2017- 18 to 2018-19, a marginal (0.67 to 0.76 lakh ha) increase up to 14.3% in drip and reduction of 6.4% (1.68 to 1.58 lakh ha) in sprinkler has been noticed. The variation in area coverage of drip and sprinkler during two consecutive years (between 2017-18 and 2018-19) is majorly attributed to variation in allocation of matching funds, awareness, and shift in cropping pattern. Thus, a stronger push and appropriate fund allocation/ convergence along with robust monitoring system is needed to meet the target and achievement.



	2016-17	2017-18	2018-19
🟩 Sprinkler Irrigation	92752	168858	158022
🟧 Drip Irrigation	46654	67250	76831
—●— Total MI Area	139406	236108	234853

Fig 4.5: Year wise and system wise area covered under PMKSY-PDMC scheme in Karnataka

Source: PMKSY-PDMC web portal

4.2.1.1 District wise performance of Micro Irrigation (MI) scheme in Karnataka

Spatio temporal progress and percentage of share of MI to the total achievement is presented in Table 4.4 and Fig. 4.6. The cumulative total of area covered under MI (sprinkler and drip) between 2015-17 to 2018-19 is 6.70 lakh ha in the state of Karnataka. The percentage to the total area of MI, maximum 7.5% (0.51 lakh ha) MI area was found in Belagavi followed by Kalaburgi district 7.4% (0.50 lakh ha) and minimum of 0.2% (0.015 lakh ha) area noticed under Dakshin Kannada which is still 23.23 lakh area is under potential to expand micro irrigation system in the state. The growth rate of MI in North west and north eastern transitional zone evident that MI is adopted extensively in areas of water intensive crop and acute water scarcity. Thus, programme is implemented efficiently and meeting the guideline (priority given to water intensive crop and water scarcity/dryland area) and objectives.

Table 4.4: District and Year wise MI installation in Karnataka

District	Area achievement (ha)					
	2015-16	**2016-17**	**2017-18**	**2018-19**	**Total (ha)**	**% To the total MI**
Bagalkot	2935.9	5488.2	12569.7	13893.4	34887.3	5.2
Bellary	1223.1	12420.5	7679.3	7349.8	28672.8	4.3
Belagavi	5942.0	10755.5	17464.4	16595.6	50757.6	7.5
Bengaluru rural	1360.8	1289.3	2201.4	1511.7	6363.2	0.9
Bengaluru urban	436.4	635.4	985.9	816.6	2874.4	0.4
Bidar	2722.7	8122.9	8637.7	9962.8	29446.2	4.4
Chamarajanagar	1856.2	2747.9	4286.4	3023.1	11913.7	1.8
Chikkaballapur	2411.0	3113.9	3994.0	4060.3	13579.2	2.0
Chikkamagaluru	2234.7	4818.	8765.7	5414.4	21233.3	3.1
Chitradurga	4885.8	10083.	9596.1	5858.9	30424.7	4.5
Dakshin kannad	135.3	358.5	617.9	476.9	1588.7	0.2
Devanagari	3166.2	5854.0	14494.6	12241.0	35755.8	5.3
Dharwad	1817.0	4084.4	5344.9	6052.5	17298.9	2.6
Gadag	1760.1	3203.7	4739.8	4804.9	14508.6	2.2
Hassan	2380.3	3825.8	11385.5	8174.7	25766.4	3.8
Haveri	3195.8	5743.1	12880.3	12403.8	34223.2	5.1
Kalaburgi	3106.4	8217.7	15043.9	23733.2	50101.2	7.4
Kodagu*	101.2	85.9	954.7	2211.8	3353.7	0.5
Kolar	2913.1	2686.8	6874.1	6025.3	18499.5	2.7
Koppal	1766.5	3352.3	5513.1	6507.5	17139.5	2.5
Mandya	1793.3	2631.7	8425.5	10571.9	23422.5	3.5
Mysuru	2807.5	10173.0	14522.8	13328.2	40831.6	6.1
Raichur	1011.8	2640.0	4879.3	7141.0	15672.2	2.3
Ramanagara	1076.6	1580.5	4414.8	5640.7	12712.7	1.9
Shivamogga	2071.6	6618.9	12628.2	9217.0	30535.9	4.5
Tumakuru	2340.2	2921.8	10617.7	8754.8	24634.6	3.7
Udupi	454.9	494.6	1082.5	880.2	2912.4	0.4
Uttara kannada	395.5	1420.8	4235.2	3629.7	9681.2	1.4
Vijayapura	4419.0	6151.7	12732.9	16527.6	39831.3	5.9
Yadgir	1499.1	7883.2	8538.6	8043.1	25964.2	3.8
Total	**64219.9**	**139405.5**	**236108.2**	**234853.2**	**674586.8**	

*Net area is excluding paddy Sources: *Karnataka at Glance 2019-20, and PMKSY PDMC web portal*

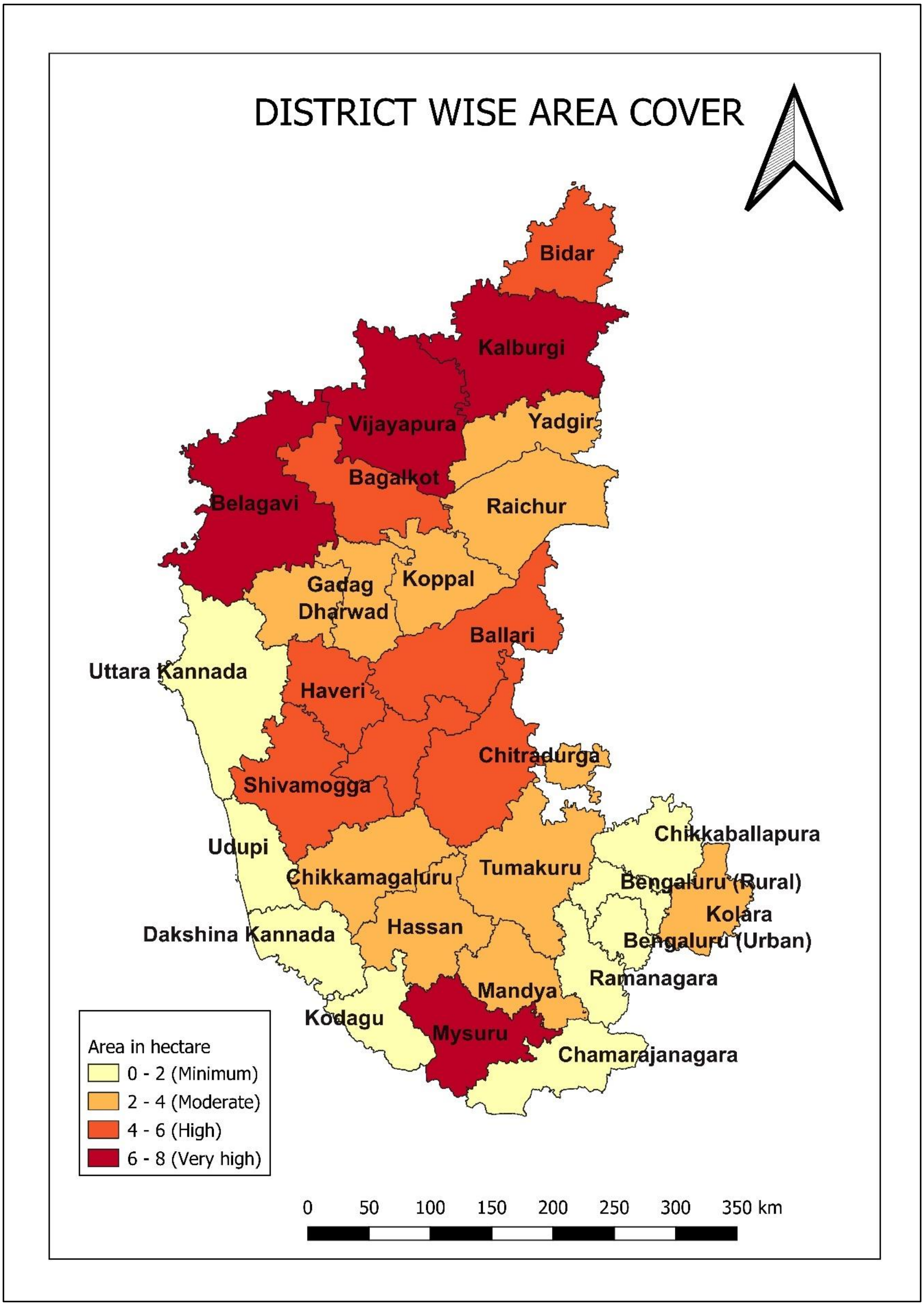


Fig 4.6: District wise percentage of total MI coverage in Karnataka.

4.2.1.1.1 Drip irrigation area coverage

Fig 4.7 illustrates the trend of drip irrigation area coverage among the districts of the state representing different agro-climatic zones. Cumulatively, a maximum drip irrigated area coverage is noticed in Belagavi district (16336.2 ha) followed by Vijayapura (13863.9 ha), Kolar (13303.1 ha), Davanagere (12262.7 ha) and Tumakuru (10905.9 ha). The lowest area coverage is observed in Kodagu (200.4 ha), Dakshin Kannada (458.9 ha) and Udupi (644.67 ha) district owing pre-dominant regular rains. The conversion of area in to drip irrigation is due to area extensive cultivation of water intensive crop like sugarcane, paddy, pomegranate, vegetables mulberry, arecanut, and other commercial crops like cotton, chilly, turmeric and ginger.

4.2.1.1.2 Sprinkler irrigation area coverage

Similarly, the area coverage under sprinkler irrigation is depicted in Fig 4.8. Among the different districts, the maximum area under sprinkler irrigation is seen in Kalaburgi (39263 ha), Mysuru (29850.6 ha), Belagavi (28479.4 ha) and Shivamogga (22954.2 ha) districts. While lowest area coverage was observed in Bengaluru urban (833.2 ha), Bengaluru rural (1267.9 ha) and Dakshin kannada (994.4 ha). The maximum is coverage in sprinkler is mainly due to extensive cultivation of closely spaced agriculture crops like cereals, pulses, oil seeds. Generally, these indicated crops have a greater sensitive to the drought, which can be substantially over come by sprinkler irrigation during water stressed period.

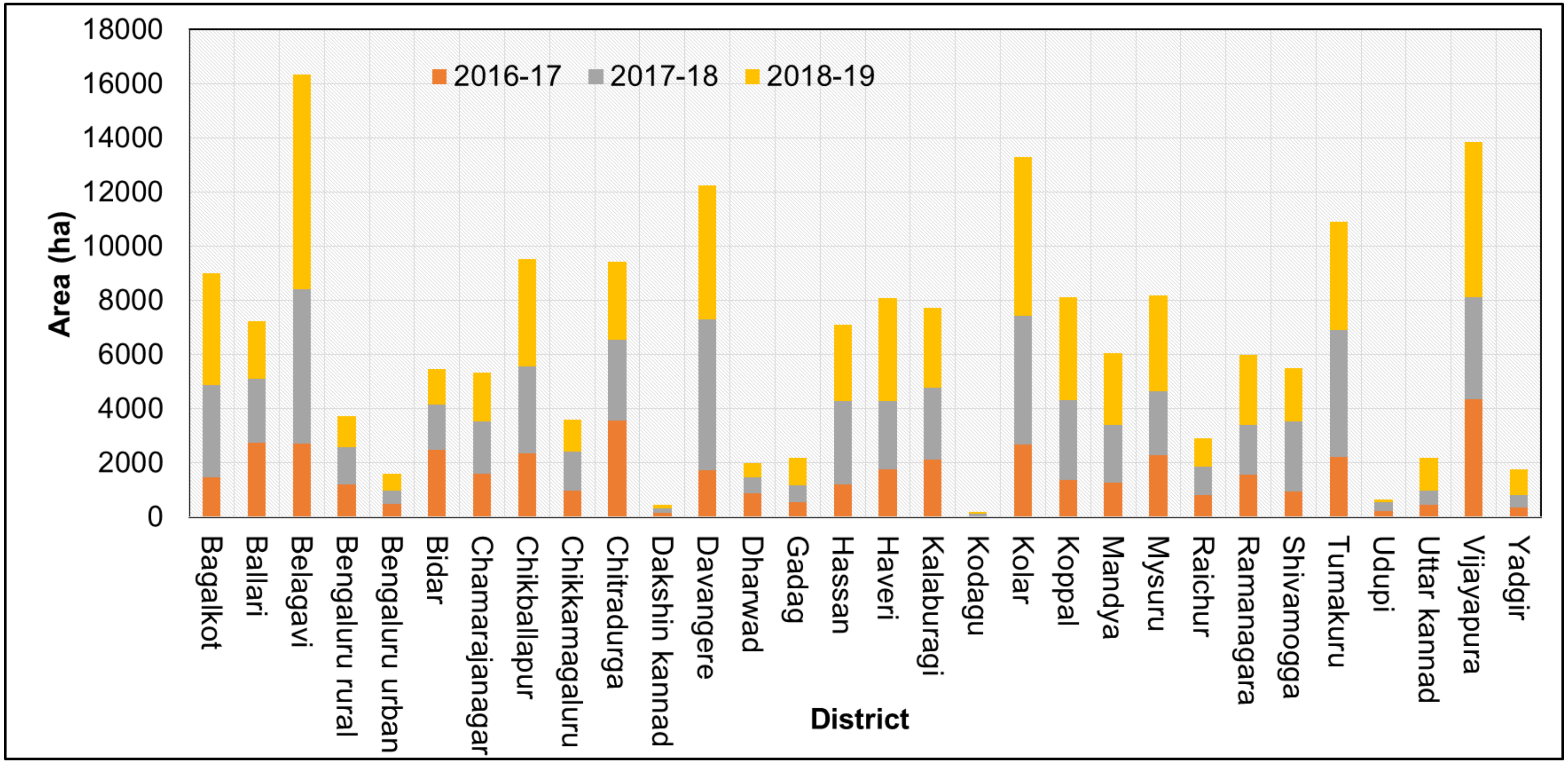


Fig 4.7: District- wise Year wise area coverage under drip irrigation system under PMKSY-PDMC scheme in Karnataka (2016-19)

Source: PMKSY-PDMC web portal

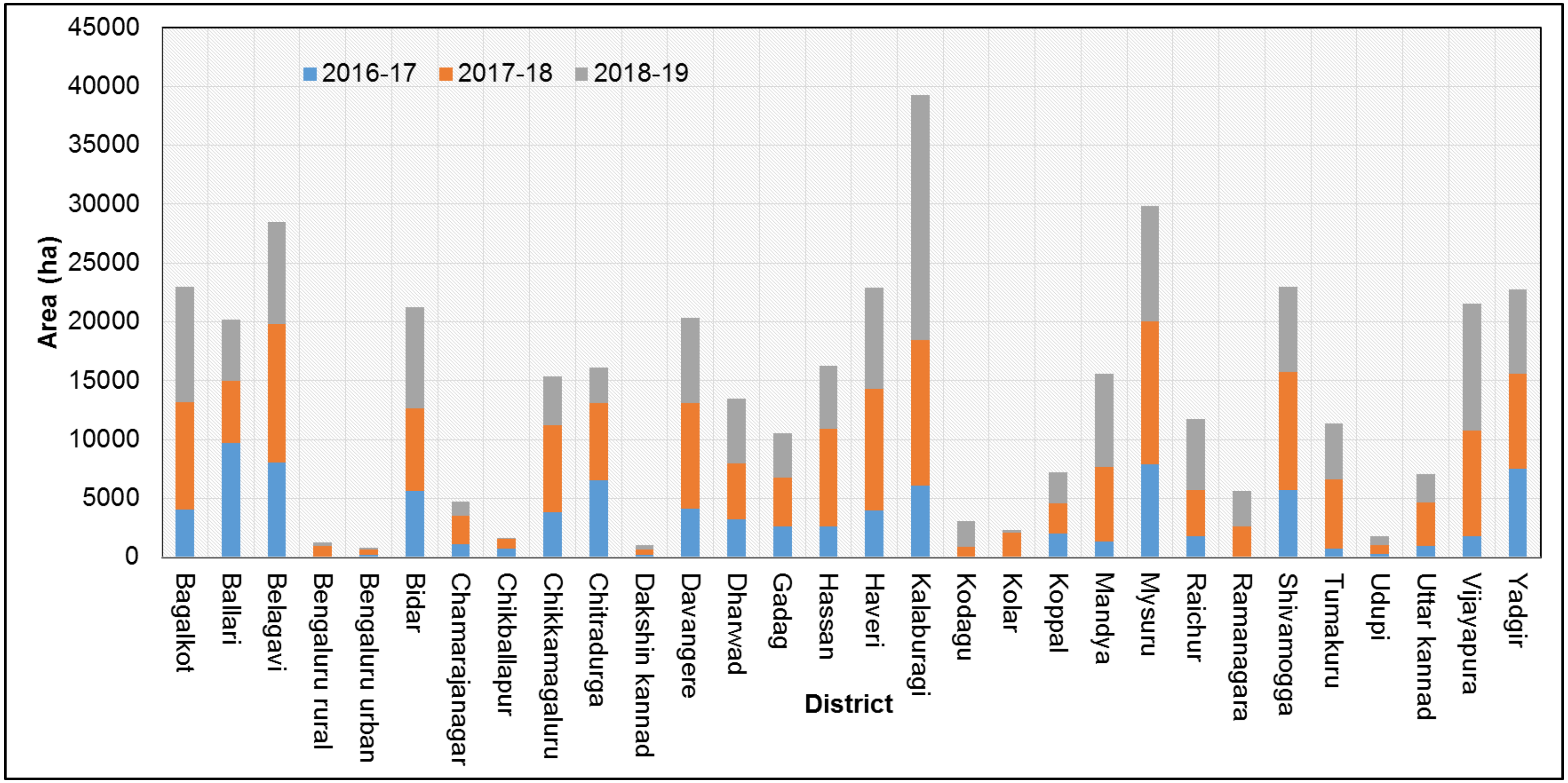
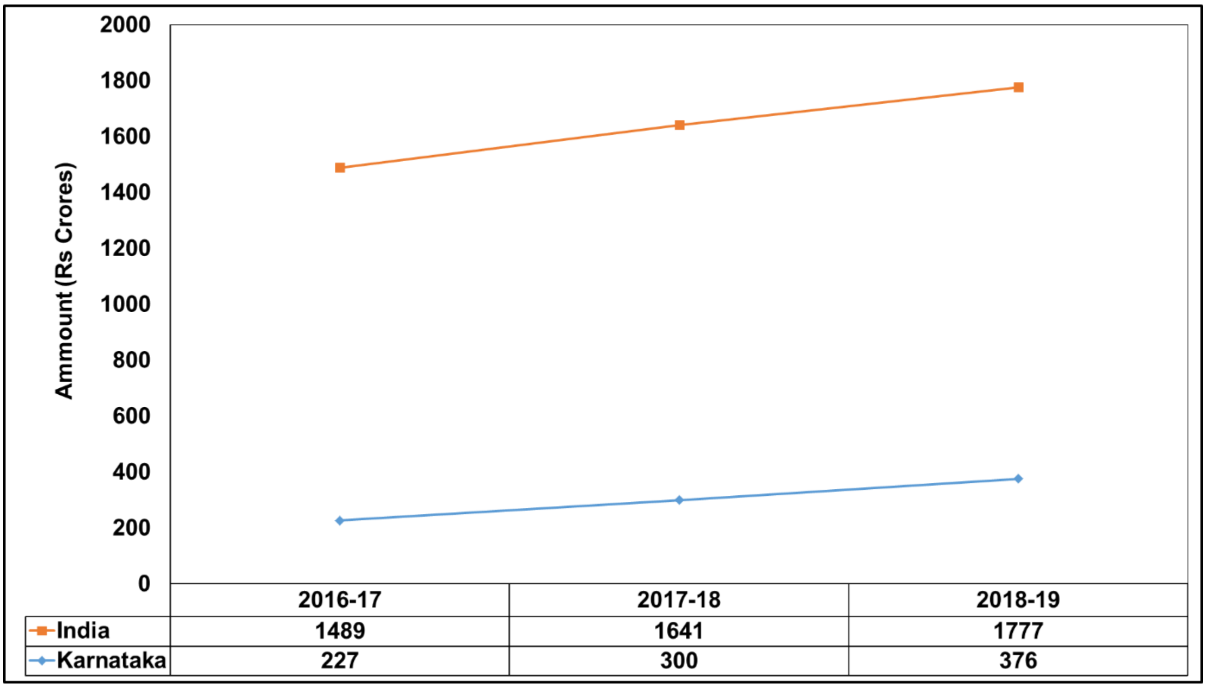


Fig 4.8: District- wise Year wise sprinkler irrigation system coverage under PMKSY-PDMC scheme in Karnataka (2016-19)

Source: PMKSY-PDMC web portal

4.2.2 Financial performance

With respect to the financial performance on micro irrigation a consistent increase was noticed from 2016 to 2019. From Fig 4.9, it can be seen that trend of investment under MI shown an incremental growth of up to 19.3 percent at national level, from the year 2016-17 to 2018-19, and similar trend was also observed with 60% percent from 2016-17 to 2018-19 in Karnataka. This growth is augmented by the enhanced allocation of budget during the corresponding years with appreciative adoptive interest by the beneficiaries.



	2016-17	2017-18	2018-19
India	1489	1641	1777
Karnataka	227	300	376

Fig 4.9: Financial progress of PMKSY-PDMC scheme in India and Karnataka (2016-17 to 2018-19)

Source: PMKSY-PDMC web portal

The summary of financial performance of the micro irrigation scheme in Karnataka was analysed by compiling the shared expenditures data of nodal department (Horticulture) and presented in Table 4.5. An amount of Rs. 206724.81 Lakhs has been spent recording an average expenditure of 91.2 percent over the three-year (2016-17 to 2018-19) period. It is seen that the allocations as well as the expenditure recorded a consistent increase during the period 2016-17 to 2018-19 period. The average annual growth of allocation of funds was 77.6 percent during 2017-18 and 14.2 percent during 2018-19, while the expenditure grew by 38.6 and 18.4 percent respectively. The average utilization against the release of fund during three consecutive year (2016-17 to 20118-19) is about 96.4 percent. However, the utilisation against the allocation showed a consistent increase up to 91.2 percent.

Table 4.5: Expenditure under PMKSY-PDMC scheme in Karnataka **(**Rs in lakhs)

Year	**Allocation (Rs)**	**Release (Rs) (including OB)**	**Expenditure (Rs)**	**Utilization to Allocation (%)**	**Utilization to Releases (%)**
2016-17	48578.8	54286.5	51349.9	105.7	94.6
2017-18	86263.3	72982.5	71154.9	82.5	97.5
2018-19	98485.0	86719.6	84220.0	85.5	97.1
Total	**233327.1**	**213988.6**	**206724.8**		
Average (Rs. In lakhs)	**77775.7**	**71329.5**	**68908.2**	**91.2**	**96.4**
Avg. annual growth rate (%) 2017-18	**77.6**	**34.4**	**38.6**		
Avg. annual growth rate (%) 2018-19	**14.2**	**18.8**	**18.4**		

Source: Data from nodal department (Horticulture)-2018-19

4.3 Performance of PMKSY-PDMC Scheme (Micro analysis)

4.3.1 Beneficiaries covered under sample survey

District wise beneficiaries covered under drip and sprinkler is presented in Table 4.6. Out of 3690, the beneficiary covered under drip and sprinkler irrigation is 44.7 percent and 55.3 percent respectively. Among various districts, maximum drip irrigation beneficiaries are noticed in Belagavi (69.7% out of 376) followed by Chamarajanagar (63.5% out of 370) and Kolar (58.3% out of 362) and minimum numbers was in Shivamogga and Mysuru (27.7% each out of 376) district. Likewise, a maximum beneficiary up to 72.3 percent each was noticed in Mysuru and Shivamogga followed by Kalaburgi and Haveri (70.3% each) and a minimum of 30.3 percent in Belagavi district with sprinkler irrigation.

Table 4.6: Beneficiaries coverage in the study area

District	Beneficiaries		
	Sample size (No.)	**Drip (%)**	**Sprinkler (%)**
Belagavi	376	69.7	30.3
Bidar	364	46.7	53.3
C. R. Nagar	370	63.5	36.5
Haveri	375	29.7	70.3
Kalaburgi	370	29.7	70.3
Kolar	362	58.3	41.7
Mysuru	376	27.7	72.3
Shivamogga	375	27.7	72.3
Tumakuru	372	48.1	51.9
Uttara Kannada	350	46.3	53.7
Total	**3690**	**-**	**-**
Average -%		**44.7**	**55.3**

Sources: Field survey

4.3.2 Area covered under sample survey to the achievements of MI system

The extent of area coverage under drip and sprinkler irrigation in the study area is widely varied between the districts. District wise total area covered under sample survey is given in below Table 4.7. Among the 10 districts the lowest to highest area coverage under MI is in the following series: Uttara Kannada, C. R. Nagar, Belagavi, Haveri, Shivamogga, Kolar, Tumakuru, Mysuru, Bidar and Kalaburgi. The area coverage in these districts possesses a strong bearing with respect to the water intensive crops and potential area available for MI adoption. The percentage of MI area coverage during sample survey to the total area covered under MI in sample district is about 1.0. However, it is about 1.4 percent with respect to drip and 0.8 percent in sprinkler. Whereas, sample area coverage to the state MI is about 0.4 percent, in which drip 0.6 percent and 0.4 percent under sprinkler.

Table 4.7: Type of MI installation and area covered under survey.

District	ACZ	District Total area of MI (2015-16 to 2018-19)					Sample area surveyed for evaluation				
		Drip (ha)	**%**	**Sprinkler (ha)**	**%**	**MI (Both) (ha)**	**Drip (ha)**	**%**	**Sprinkler (ha)**	**%**	**MI (Both) (ha)**
Belagavi	ND	16336.2	36.5	28479.5	63.5	44815.7	221.8	69.4	98.0	30.6	319.8
Bidar	NET	5463.5	20.4	21260.0	79.6	26723.5	77.0	41.6	108.0	58.4	185.0
C. R. Nagar	SD	5349.3	53.2	4708.1	46.8	10057.5	173.3	53.0	153.6	47.0	327.0
Haveri	NT	8101.0	26.1	22926.4	73.9	31027.4	97.2	31.1	215.3	68.9	312.5
Kalaburgi	NED	7731.9	16.5	39263.0	83.5	46994.9	44.2	28.0	113.4	72.0	157.6
Kolar	ED	13303.1	85.4	2283.2	14.6	15586.3	157.4	60.6	102.4	39.4	259.8
Mysuru	ST	8173.5	21.5	29850.7	78.5	38024.2	49.5	21.2	184.0	78.8	233.5
Shivamogga	Hilly	5510.0	19.4	22954.3	80.6	28464.3	68.1	24.0	215.8	76.0	283.9
Tumakuru	CD	10905.9	48.9	11388.5	51.1	22294.5	132.4	52.6	119.2	47.4	251.6
Uttara Kannada	Coastal	2191.2	23.6	7094.5	76.4	9285.7	122.2	37.1	206.8	62.9	329.0
Total		**83065.7**		**190208.2**		**273273.9**	**1143.2**		**1516.5**		**2659.7**
Average -%			**30.4**		**69.6**			**43.0**		**57.0**	
Are coverage in state		**190734.5**		**419632.3**		**610366.8**					
% Sample area coverage in study district		**1.4**		**0.8**		**1.0**					
% Sample area coverage in state		**0.6**		**0.4**		**0.4**					

ACZ: Agro Climatic Zone, ND: Northern Dry Zone, NET: North Eastern Transitional Zone, SD: Southern Dry Zone, NT: Northern Transitional Zone, NED: North Eastern Dry Zone, ED: Eastern Dry Zone, ST: Southern Transitional Zone, Hilly: Hilly Zone, CD: Central Dry Zone, Coastal: Coastal Zone Sources: Field study

4.3.3 Demographic profile (Sample beneficiaries and non-beneficiaries)

Social groups covered

Table 4.8 shows the proportion of distribution of the MI components across the social groups among beneficiaries and non-beneficiaries. Under MI beneficiaries, more than 50 percent of the beneficiaries were from the general category, 29.6 percent of the beneficiaries belongs to OBC category, 7.5 percent and 6.3 percent of the beneficiaries represented SC and ST category. This indicates PMKSY-PDMC scheme is extended to all the categories of the farmers. However, it is slightly less to the total allocation of SC/ST farmers (as per scheme guidelines SC; 16% / ST; 18%). Similar trend was also noticed with non-beneficiaries which is 47.5 percent are general, 30 percent OBC, 17.5 percent SC, and 5 percent ST, respectively. These figures reflect that general category farmers have shown maximum interest in MI adoption compare to SC/ST. Meanwhile, the lower participation of scheduled caste and scheduled tribe may be due to less aware about the program and thus special efforts need to be made through awareness program and this might certainly generate interest to avail the existing benefits of the scheme.

Table 4.8: Social category wise distribution of beneficiaries and non-beneficiaries

Districts	**Beneficiaries**					**Non-Beneficiaries**				
	Sample size (No.)	**Social group (%)**				**Sample size (No.)**	**Social group (%)**			
		Gen	**OBC**	**SC**	**ST**		**Gen**	**OBC**	**SC**	**ST**
Belagavi	376	22.0	51.0	10.0	17.0	4	25.0	25.0	25.0	25.0
Bidar	364	59.0	31.0	06.0	04.0	4	75.0	00.0	25.0	00.0
C. R. Nagar	370	64.0	21.0	12.0	04.0	4	75.0	25.0	00.0	00.0
Haveri	375	20.0	66.0	06.0	08.0	4	50.0	50.0	00.0	00.0
Kalaburgi	370	49.0	35.0	15.0	02.0	4	50.0	25.0	25.0	00.0
Kolar	362	70.0	19.0	08.0	04.0	4	50.0	25.0	00.0	25.0
Mysuru	376	65.0	23.0	01.0	11.0	4	00.0	50.0	50.0	00.0
Shivamogga	375	68.0	21.0	10.0	01.0	4	50.0	25.0	25.0	00.0
Tumakuru	350	85.4	12.0	02.3	00.3	4	75.0	25.0	00.0	00.0
Uttara Kannada	372	72.0	17.0	05.0	05.0	4	25.0	50.0	25.0	00.0
Total	**3690**	**-**	**-**	**-**	**-**	**4**	**-**	**-**	**-**	**-**
Average -%		**57.4**	**29.6**	**07.5**	**05.6**		**47.5**	**30.0**	**17.5**	**05.0**

Sources: Field study

Gender pattern coverage

The coverage of number of male and female beneficiaries in the survey is presented following Table 4.9. It may be seen from the above that proportion of male among the entire sampled respondent is higher percent in case of beneficiaries (84.9%) and in non-beneficiaries (70%). The proportion of female accounts only 15.1 percent and 30 percent with beneficiaries and non-beneficiaries respectively. This may be due to the fact that in most cases, the land is generally in the name of head of the family and being a patriarchic society land ownership rests with the male gender. Thus, it requires special emphasis has to be given for female in forth coming activity. With respect to district-wise gender analysis, it was found that the male category of beneficiaries was maximum in Belagavi, followed by Haveri and Tumakuru and minimum of 75.5 percent male in Bidar. Under non-beneficiaries, except Belagavi and Bidar, male dominated (75%) MI ownership found with other districts. The average family size among beneficiaries and non-beneficiaries is about 3/family. The family size varies from 2.8 (C. R Nagar, Haveri and Shivamogga) to 3.3 Mysuru and Uttara kannada under beneficiaries and in non-beneficiaries it was 2.1 (Tumakuru) to 4.1 (Belagavi). This phenomenon is almost a prevalent scenario in Karnataka as the average family size is about 4.6.

Table 4.9: Gender and family size of beneficiaries and non-beneficiaries in the study area

Districts	**Beneficiaries**						**Non-Beneficiaries**					
	Sample size (No.)	**Gender** (%)		**Avg. Family size (No.)**			**Sample size (No.)**	**Gender** (%)		**Avg. Family size (No.)**		
		M	**F**	**M**	**F**	**Avg.**		**M**	**F**	**Med**	**F**	**Avg.**
Belagavi	376	96.0	04.0	3.2	2.8	3.0	4	50.0	50.0	4.0	4.3	4.1
Bidar	364	75.5	24.5	3.3	2.8	3.1	4	50.0	50.0	3.3	1.8	2.5
C. R. Nagar	370	80.8	19.2	3.3	2.3	2.8	4	75.0	25.0	2.8	2.3	2.5
Haveri	375	93.9	06.1	2.7	2.9	2.8	4	75.0	25.0	2.8	4.0	3.4
Kalaburgi	370	85.9	14.1	2.9	2.8	2.9	4	75.0	25.0	4.3	2.8	3.5
Kolar	362	85.1	14.9	3.4	2.9	3.2	4	75.0	25.0	3.8	2.8	3.3
Mysuru	376	81.9	18.1	4.2	2.4	3.3	4	75.0	25.0	2.8	2.3	2.5
Shivamogga	375	80.0	20.0	2.7	2.8	2.8	4	75.0	25.0	2.5	3.5	3.0
Tumakuru	350	92.9	07.1	3.6	2.5	3.1	4	75.0	25.0	2.3	2.0	2.1
Uttara Kannada	372	77.2	22.8	4.0	2.5	3.3	4	75.0	25.0	2.3	2.5	2.4
Total	**3690**	**-**	**-**	**3.3**	**2.7**	**3.0**	**40**	**-**	**-**	**3.1**	**2.8**	**2.9**
Average -%		**84.9**	**15.1**					**70.0**	**30.0**			

M: Male, F: Female Sources: Field study, Avg: Average

Education pattern

Table 4.10 presents the overall educational profile of the beneficiaries and non-beneficiaries in the study area. A 10 district overall educational profile indicates nearly two thirds of the beneficiaries are literate while one third is illiterate among MI beneficiary. The higher proportion of literate among beneficiaries in most of the district as compared to nonbeneficiaries clearly indicates that educated and informed farmers are more likely to adopt MI Systems. The average literate among non-beneficiary was only 63 percent. In most of the sampled area, both beneficiaries and nonbeneficiaries are literates except in Belagavi where about 59.8 percent literates under beneficiaries and 25% among non-beneficiaries. Exposure to education enabling the beneficiaries to appreciate and adopt the MI program is a worthy note.

Table 4.10: Educational status of beneficiaries and non-beneficiaries

Districts	**Beneficiaries**			**Non-Beneficiaries**		
	Sample size (No.)	**Educational level (%)**		**Sample size (No.)**	**Educational level (%)**	
		Literate	**illiterate**		**Literate**	**illiterate**
Belagavi	376	59.8	40.2	4	25.0	75.0
Bidar	364	78.6	21.4	4	50.0	50.0
C. R. Nagar	370	82.4	17.6	4	75.0	25.0
Haveri	375	88.3	11.7	4	100.0	00.0
Kalaburgi	370	70.3	29.7	4	75.0	25.0
Kolar	362	75.7	24.3	4	75.0	25.0
Mysuru	376	74.5	25.5	4	25.0	75.0
Shivamogga	375	73.1	26.9	4	50.0	50.0
Tumakuru	350	82.6	17.4	4	100.0	00.0
Uttara Kannada	372	78.0	22.0	4	50.0	50.0
Total	**3690**	**-**	**-**	**40.0**	**-**	**-**
Average -%		**76.3**	**23.7**		**63.0**	**38.0**

Sources: Field study

Occupational profile

Table 4.11 describes the district wise primary and secondary occupation of the beneficiaries and non-beneficiaries. During the study, it was noticed that primary occupation of beneficiaries is on-farm activity (agriculture) and found an average to the tune of 88.5 percent under beneficiaries and 11.5 percent as off-farm activity. Similarly, non-beneficiaries also engaged primarily with agriculture (87.8%) and only 12.2 percent in off-farm activities. Thus, the predominance on the agriculture dependent activities found as the centric livelihood activity in the study area. This indicates there is scope for improving technical skill in MI management in the families which depends on agriculture as main occupation

Table 4.11: Occupational profile of beneficiaries and non-beneficiaries

District	**Beneficiaries**			**Non-Beneficiaries**		
	Sample size (No.)	**On farm (%)**	**Off farm (%)**	**Sample size (No.)**	**On farm (%)**	**Off farm (%)**
Belagavi	376	91.8	08.2	4	80.0	20.0
Bidar	364	85.2	14.8	4	90.0	10.0
C. R. Nagar	370	91.9	08.1	4	95.0	05.0
Haveri	375	89.3	10.7	4	75.0	25.0
Kalaburgi	370	83.8	16.2	4	83.0	17.0
Kolar	362	90.9	09.1	4	85.0	15.0
Mysuru	376	82.7	17.3	4	95.0	05.0
Shivamogga	375	86.7	13.3	4	90.0	10.0
Tumakuru	350	92.9	07.1	4	95.0	05.0
Uttara Kannada	372	90.6	09.4	4	90.0	10.0
Total	**3690**	**-**	**-**	**40**	**-**	**-**
Average -%		**88.5**	**11.5**		**87.8**	**12.2**

Sources: Field study

Livestock profile

Table 4.12 provides the distribution of livestock among beneficiaries and non-beneficiaries in the study area. The proportion of milch animal is dominant as compared to drought animals and small ruminants among both beneficiaries and non-beneficiaries. Average milch animals were found among beneficiaries is 71.0 percent and it was noticed 57.5 percent among non-beneficiaries. Whereas, draught and small ruminants are 25.3 and 37.5 percent and 3.6 and 5.0 percent respectively. The average household livestock owned by a beneficiary is 1.5 draughts, 2 milch and 8 small ruminants and with non-beneficiary it is 1.9 draughts, 2.1 milch and 8.4 small ruminants. These facts are almost (state average 4.6) in line with the average livestock size of the state.

Table 4.12: Overview of livestock status in the study area

District	**Beneficiaries**				**Non-beneficiaries**			
	Sample size (No.)	**Drought (%)**	**Milch (%)**	**Small Ruminants (%)**	**Sample size (No.)**	**Drought (%)**	**Milch (%)**	**Small Ruminants (%)**
Belagavi	376	26.0	72.5	1.5	4	25.0	75.0	0.0
Bidar	364	53.0	43.7	3.3	4	25.0	50.0	25.0
C. R. Nagar	370	12.5	83.0	4.5	4	25.0	50.0	25.0
Haveri	375	39.1	58.2	2.7	4	75.0	25.0	0.0
Kalaburgi	370	48.7	47.0	4.3	4	50.0	50.0	0.0
Kolar	362	11.8	84.5	3.7	4	25.0	75.0	0.0
Mysuru	376	13.5	80.1	6.4	4	25.0	75.0	0.0
Shivamogga	375	17.0	80.3	2.7	4	25.0	75.0	0.0
Tumakuru	372	19.0	77.0	4.0	4	50.0	50.0	0.0
Uttara Kannada	350	12.5	84.4	3.1	4	50.0	50.0	0.0
Total	**3690**	**-**	**-**	**-**	**40**	**-**	**-**	**-**
Average -%		**25.3**	**71.0**	**3.6**		**37.5**	**57.5**	**5.0**

Sources: Field study

Land holding size (Operational land size)

The benefit of the PMKSY-PDMC scheme is extended to all category of farmers (irrespective size of holding) with the maximum ceiling limit of 5 ha/farmer. As per the norms, at least 33 percent of the allocation is to be utilized for the small, marginal and women farmers. Similarly, the quantum of the subsidy is higher for small and marginal farmers. The small and marginal (up to 2 ha) farmers are eligible for subsidy up to 90 percent of the cost of MI system (drip/ sprinkler) and the remaining 10 percent matching amount to be borne by the beneficiary. However, in the case of more than 2 ha area, subsidy assistance is only 50 percent of the cost of the system which is shared by the implementing department and remaining balance amount should be borne by beneficiary. Keeping the above factor in view, the sample beneficiaries were categorized into four groups based on their land holdings such as marginal farmer (< 2.5-acre), small farmer (2.5 to 5 acre), medium farmer (medium and semi medium farmer clubbed; 5 to 25 acre) and large farmer (> 25 acre). The results on distribution of the farmers according to their land holding category have been presented in the Table 4.13 for both beneficiaries and non-beneficiaries.

In the study area it was observed that, medium category of farmer accounted for 67.8 percent where as 23.2 percent farmers are reported to be under small, 6.5 percent marginal and 2.4 percent under large farmer category under beneficiaries. Among non-beneficiaries marginal size farmers are comprised up to 50 percent followed by medium category farmer (40%) and small farmers (10%). The distribution of large farmers among non-beneficiaries is not observed in the study area.

With respect to size and distribution of operational land holding in the study area also seen that medium farmers accounted maximum (75.8%) followed by small farmers (12.7%), large farmer (9.4%) and marginal farmers (2.3%). Similarly, in non-beneficiaries, maximum is with medium farmers (54.1%) followed by marginal (37.1%) and small farmers (8.8%). These facts reveal that beneficiaries having a medium size of landholdings are predominantly involved in availing the scheme benefits than the small and marginal holding beneficiaries. Thus, it needs to be re-looked on implementation strategy more specifically identification of farmers. This will not only increase the area under MI and improve the water use efficiency, but will also contribute significantly towards food security on sustainable basis among various farming community.

Table 4.13: Distribution of number of farmers, land holding and area covered under MI system across sample districts

Farmer category	Belagavi	Bidar	C. R. Nagar	Haveri	Kalaburgi	Kolar	Mysuru	Shivamogga	Tumakuru	Uttara Kannada
Beneficiary	**Beneficiaries (%)**									
Marginal farmer	4.5	11.8	3.2	12.3	7.3	4.1	6.1	5.1	7.3	3.7
Small farmer	16.0	40.4	20.5	21.1	19.2	24.0	22.9	15.2	36.3	16.9
Medium farmer	76.9	44.2	74.1	63.2	71.6	69.3	69.4	77.6	54.0	77.7
Large farmer	2.7	3.6	2.2	3.5	1.9	2.5	1.6	2.1	2.4	1.7
Total number	376	364	370	375	370	362	376	375	372	350
Area covered										
Marginal farmer	1.2	4.6	0.8	4.0	2.3	0.7	1.8	1.5	2.5	0.9
Small farmer	7.6	25.7	9.7	10.8	10.4	11.6	14.1	8.2	20.6	8.0
Medium farmer	82.1	52.4	82.5	72.9	80.4	78.8	77.4	82.2	65.6	84.3
Large farmer	9.1	17.2	7.0	12.2	6.9	8.9	6.6	8.1	11.3	6.7
Total Land (Acre)	2904.4	1955.4	2970.7	2748.7	2675.9	2620.3	2364.5	2631.9	2213.5	2729.9
Avg. land holding size (Acre)										
Marginal farmer	2.0	2.1	2.1	2.4	2.3	1.3	1.9	2.0	2.0	1.9
Small farmer	3.7	3.4	3.8	3.8	3.9	3.5	3.9	3.8	3.4	3.7
Medium farmer	8.3	6.4	8.9	8.5	8.1	8.2	7.0	7.4	7.2	8.5
Large farmer	26.4	25.9	26.1	25.9	26.4	26.0	26.1	26.6	27.9	30.7

Farmer category	**Belagavi**	**Bidar**	**C. R. Nagar**	**Haveri**	**Kalaburgi**	**Kolar**	**Mysuru**	**Shivamogga**	**Tumakuru**	**Uttara Kannada**
Non-beneficiary	**Non-Beneficiaries (%)**									
Marginal farmer	25.0	25.0	**0.0**	75.0	75.0	50.0	75.0	75.0	75.0	25.0
Small farmer	0.0	25.0	0.0	0.0	0.0	25.0	0.0	0.0	0.0	50.0
Medium farmer	75.0	50.0	100.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0
Large farmer	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total number	4	4	4	4	4	4	4	4	4	4
Area covered										
Marginal farmer	20.0	13.0	0.0	63.0	60.0	11.0	68.0	58.0	56.0	22.0
Small farmer	0.0	16.0	0.0	0.0	0.0	51.0	0.0	0.0	0.0	21.0
Medium farmer	80.0	70.0	100.0	38.0	40.0	38.0	32.0	42.0	44.0	57.0
Large farmer	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Land (Acre)	24.9	15.2	35.0	16.0	21.0	18.5	17.9	22.5	21.5	16.6
Avg. land holding size (Acre)										
Marginal farmer	1.8	2.0	0.0	1.5	1.5	2.0	1.3	1.9	1.5	1.8
Small farmer	0.0	5.0	0.0	0.0	0.0	4.8	0.0	0.0	0.0	3.5
Medium farmer	6.6	5.4	8.8	6.0	8.5	7.0	5.7	9.5	9.5	9.5
Large farmer	0	0	0	0	0	0	0	0	0	0

Note: Land holding information considered based on Operational land holding size
Marginal farmers (< 2.5 acre), Small farmers (2.5-to-5-acre, Medium (5.0 to 25 acre) and large framers (>25 acre)

Sources: Field study

4.3.4 Awareness of MI system

Status of awareness

The study has captured district-wise awareness on PMKSY-PDMC program and its scope among various farming community, gender and social group and sources of information among beneficiaries as well as non-beneficiaries. The following facts have been observed from the Fig 4.10 that, on an average 85.5 percent farmer are aware about PMKSY-PDMC scheme among beneficiaries, and 75.5 percent among non-beneficiaries. With respect to various district awareness levels, Kalaburgi district farmers have well aware of the scheme followed by Uttara Kannada, Kolar and Shivamogga. However least awareness about PMKSY PDMC scheme was noticed in Belagavi farmers, which accounts to 69.7 percent.

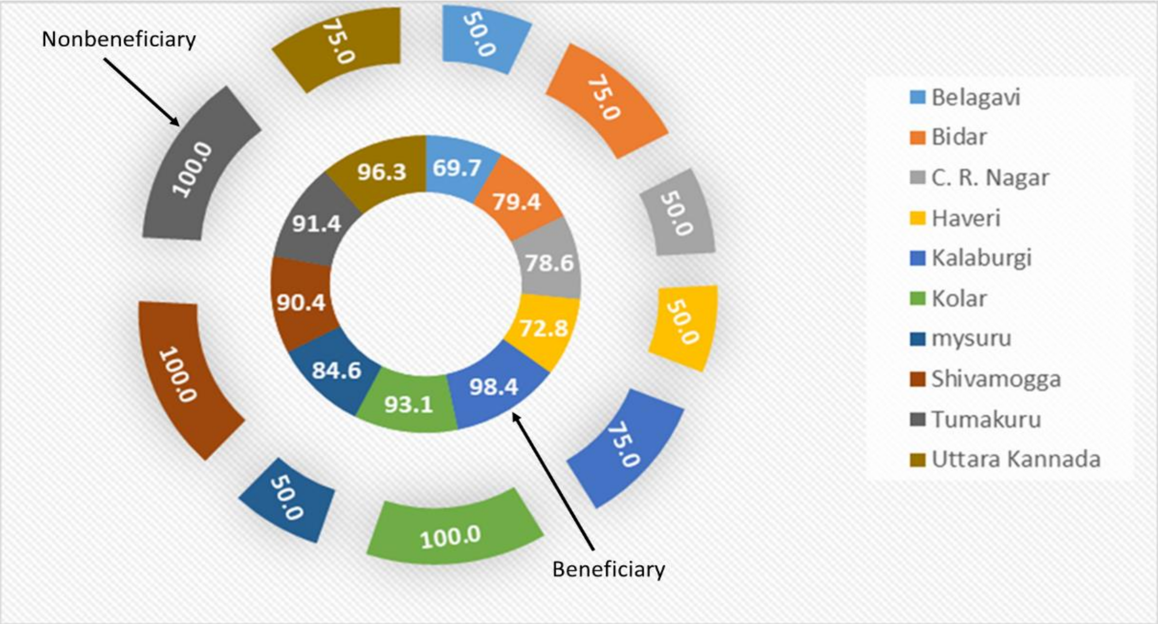


Fig 4.10: District wise awareness pattern of PMKSY-PDMC among beneficiaries and non-beneficiaries (%)

Sources: Field study

Gender wise and social category wise awareness of PMKSY-PDMC scheme is presented in Fig. 4.11. Awareness on PMKSY-PDMC scheme among the gender found lot of variation. Study results shows that male beneficiaries are well aware of the scheme than the female. The percentage of awareness in male is 85 percent and in female 15 percent. Further, information access and knowledge about PMKSY-PDMC was noticed highest in medium size (66.7%) followed by small (24.3%) and marginal (6.5%) farmers and least was observed with large farmers (2.4%). Knowledge on PMKSY-PDMC can improve the adoptability among various social groups. From the field investigations, it reveals that general/other category beneficiaries have better knowledge and well aware of the scheme which account to 57.2 percent, followed by OBC and least was noticed among with SC and ST beneficiaries which accounts only 6 and 7 percent, respectively. Thus, a special drive is needed on wider publicity to make them aware about the benefits and operation of the scheme. From the study, it could be inferred that the overall trend of generating awareness through all the lead sources such as conducting campaigns, exposure to crop demonstrations, wall paintings on the benefits of the technology and scheme, print literature publicity in kannada, canvassing success stories through media must need to be enhanced significantly to ensure greater influence for MI adoption among SC and ST.

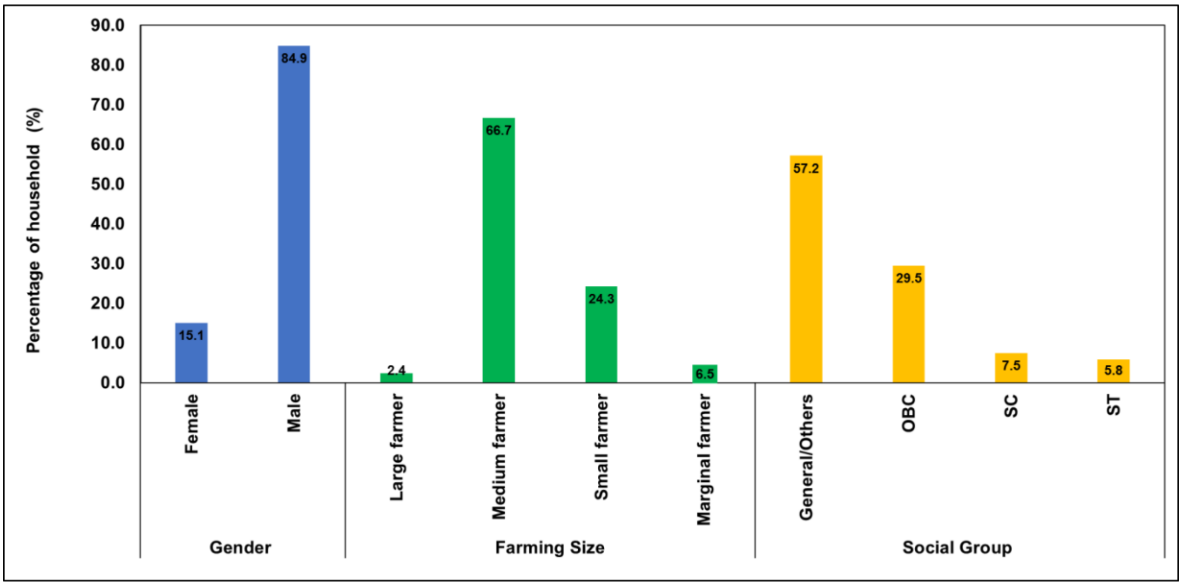


Fig 4.11: Awareness pattern of PMKSY-PDMC scheme among gender, farm size and social groups
Sources: Field study

The Table 4.14 shows that the mixed trend of opinion obtained from the beneficiaries and the major sources and awareness was through neighbouring farmer, TV/radio and newspaper which accounts 28.9 percent, 22.4 percent and 21.7 percent, respectively. Similarly, Govt officials have played a major role in disseminating information on adoption of MI support in increasing the farm income (22.3%). However, it is interesting to note that the suppliers/representatives of the manufacturers are also the major sources of sharing information on subsidy/incentives (22.5%). This may be due to the supplier of the system has their own interest in this competitive trade and motivate to facilitate the farmers in applying for the scheme benefits. NGOs and financial institutions have also played an important role in disseminating information to beneficiaries and non-beneficiaries about the MI scheme and got maximum information about the scheme (19.7% and 20.8%) and subsidy provision (19.7% and 22.6%). For disseminating information about overall advantage of scheme and its convergence with on-going activity local governing institute (Gram panchayat) have played an important role.

Table 4.14: Comprehensive information source of MI system for beneficiaries

Sl No	Source	Total responses (No.)	Type of information (%)				
			About scheme	**Subsidy provision**	**New method of cultivation**	**High income**	**Overall advantage**
1	Neighbouring farmer	7311	28.9	16.8	17.9	17.5	18.9
2	Radio/ TV	6688	22.4	20.1	19.9	19.3	18.3
3	Newspaper/ pamphlet	5136	21.7	20.9	20.0	18.9	18.5
4	Govt. officials	7786	20.6	21.0	20.1	22.3	16.0
5	Drip agencies / MI agency	4786	19.1	22.5	21.3	19.4	17.7
6	NGO	3698	19.7	19.7	22.3	19.9	18.4
7	Banks/financial institutions	4396	20.8	22.6	18.8	19.3	18.5
8	GPs	3954	19.4	18.1	19.9	19.7	22.9
9	Any others	1963	22.0	21.0	20.6	21.1	15.3
	Total	**45718**	**-**	**-**	**-**	**-**	**-**
	Average -%		**21.8**	**20.1**	**19.9**	**19.4**	**18.8**

Sources: Field study

Similar pattern of observation is noticed among nonbeneficiaries and the detail sources of scheme and its component awareness are summarized in the Table 4.15. From the following table it may be seen that the major sources of awareness for non-beneficiaries are MI dealers/agency, followed by NGO, newspapers/posters, bankers and GPs.

Table 4.15: Comprehensive information source of MI system for non-beneficiaries

Sl. No	Source	Total responses (No.)	Type of Sources (%)				
			About Programme	Subsidy provision	New method of cultivation	High income	Overall advantage
1	Neighbouring farmer	81	24.7	21.0	16.0	17.3	21.0
2	Radio/ TV	65	23.1	21.5	18.5	20.0	16.9
3	Newspaper/ pamphlet	42	21.4	19.0	26.2	16.7	16.7
4	Govt. officials	77	22.1	20.8	18.2	19.5	19.5
5	Drip agencies / MI agency	42	19.0	28.6	19.0	19.0	14.3
6	NGO	12	41.7	33.3	8.3	8.3	8.3
7	Banks/financial institutions	28	17.9	17.9	25.0	25.0	14.3
8	GPs	14	14.3	21.4	14.3	7.1	42.9
9	Any other s	11	27.3	27.3	9.1	18.2	18.2
	Total	**372**	**-**	**-**	**-**	**-**	**-**
	Average -%		**22.6**	**22.0**	**18.5**	**18.3**	**18.5**

Sources: Field study

Reasons for non-adoption of MI by non-beneficiaries

The non-beneficiaries were further asked the reasons for not adopting this technology. Key reasons of mixed responses indicated by non-beneficiaries are analysed and presented in Fig 4.12 and Table 4.16. Towards the shortlisted 13 reasons for non-adoption of MI system, primarily the reasons noticed due to lack of clarification in subsidy issues (12%) followed by lack of technical guidance and labour scarcity (9.7% each), inadequate power supply (8.7%), quality material issues (8%) and least expression was observed with the cumbersome procedure in MI sanction (6.3%). Among various districts Shivamogga and Haveri non-beneficiaries expressed lack of awareness regarding subsidies and delay in availing the subsidy amount may leads to economic burden from high capital investment thus they are set hindered to adopt the system. Further, in Haveri, Kalaburgi and Kolar district non-beneficiaries have expressed they are facing the water scarcity, and lack of technical knowledge and guidance from concerned department make them hesitant to adopt MI system. In Haveri, Shivamogga, Tumakuru and C. R Nagar district labour scarcity is the main hindrance to adopt MI system by non-beneficiaries. In C.R Nagara and

Haveri district beneficiaries have expressed their main reasons for non-adoptability of MI system being mainly due to lack of guidance, and similar expression was noticed with Bidar district non-beneficiaries.

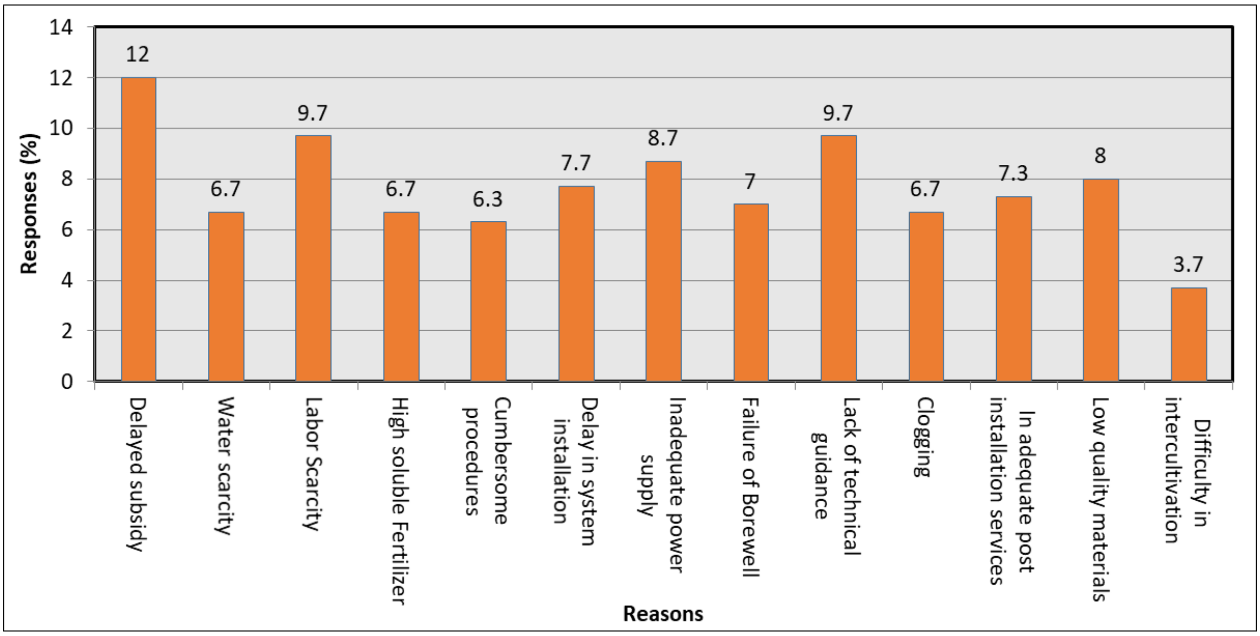


Fig 4.12: Reasons underlying non adoption of PMKSY-PDMC micro irrigation scheme (%)
Sources: Field study

Table 4.16: Reasons for non-adoption of MI among non-beneficiaries

District	**Total response (No.)**	**Type Reasons (%)**												
		Delayed subsidy	**Water scarcity**	**Labor Scarcity**	**High soluble Fertilizer**	**Cum-bersome procedures**	**Delay in system installation**	**Inadequate power supply**	**Failure of Borewell**	**Lack of technical guidance**	**Clogging**	**In adequate post installation services**	**Low quality materials**	**Difficulty in inter cultivation**
Belagavi	22	13.6	4.5	4.5	13.6	4.5	4.5	4.5	13.6	9.1	4.5	0.0	18.2	4.5
Bidar	29	10.3	6.9	6.9	10.3	6.9	6.9	6.9	10.3	6.9	6.9	6.9	10.3	3.4
C. R. Nagar	27	11.1	3.7	11.1	3.7	11.1	7.4	11.1	7.4	14.8	3.7	14.8	0.0	0.0
Haveri	21	14.3	9.5	14.3	0.0	4.8	4.8	9.5	0.0	14.3	9.5	0.0	14.3	4.8
Kalaburgi	36	11.1	11.1	8.3	8.3	5.6	5.6	5.6	8.3	11.1	11.1	8.3	2.8	2.8
Kolar	42	9.5	9.5	7.1	7.1	7.1	9.5	9.5	7.1	9.5	9.5	7.1	4.8	2.4
Mysuru	31	12.9	3.2	9.7	6.5	3.2	6.5	6.5	9.7	9.7	6.5	6.5	12.9	6.5
Shivamogga	21	19.0	0.0	14.3	4.8	4.8	9.5	14.3	0.0	9.5	0.0	9.5	9.5	4.8
Tumakuru	33	12.1	6.1	12.1	3.0	6.1	9.1	9.1	6.1	9.1	6.1	9.1	6.1	6.1
Uttara Kannada	38	10.5	7.9	10.5	7.9	7.9	10.5	10.5	5.3	5.3	5.3	7.9	7.9	2.6
Total	**300**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Average -%		**12.0**	**6.7**	**9.7**	**6.7**	**6.3**	**7.7**	**8.7**	**7.0**	**9.7**	**6.7**	**7.3**	**8.0**	**3.7**

Sources: Field study

Willingness for adoption

In order to understand willingness to non-beneficiaries for installation of micro irrigation system in their farm land, a specific question was raised during interview. The response has been compiled in the Table 4.17, which shows that average willingness to adopt MI system was 65 percent and still 35 percent were not shown interest towards adoption of MI system, which is a clear indication of the merits of the scheme and this makes a dent in the adoption process and extension of micro irrigation system among non-beneficiaries in general. Supplementing efforts are to be made in transform the unwilling portion of 35 percent non-beneficiaries through adoption of appropriate extension tools and techniques.

Table 4.17: Willingness to adopt MI system among non-beneficiaries

District	**Sample size (No.)**	**Response (%)**	
		Yes	No
Belagavi	4	75	25
Bidar	4	50	50
C. R. Nagar	4	75	25
Haveri	4	75	25
Kalaburgi	4	75	25
Kolar	4	50	50
Mysuru	4	75	25
Shivamogga	4	50	50
Tumakuru	4	50	50
Uttara Kannada	4	75	25
Total	**40**	-	-
Average -%		**65**	**35**

Sources: Field study

4.3.5 Progress of installation of MI system

Year wise progress

Year wise and district wise MI installation performance is presented in Fig 4.13 and Table 4.18. In the overall scenario it is observed that the percentage of drip irrigation installation gradually improved from 2016-17 to 2018-19. In the initial year (2016-17) it was 26.5 percent, it was noticed 33.1 percent during 2017-18 percent and by end of 2018-19 reached 40 percent. In sprinkler irrigation the installation progress was 33 percent, 26 percent and 41 percent respectively from 2016-17, 2017-18 and 2018-19. Similarly, year wise increment was noticed up to 20 percent from 2016-17 to 2017-18 and 18.3 percent from 2017-18 to 2018-19 in drip installation. However, it was declined by 28 percent in sprinkler from 2016-17 to 2017-18 and escalated to 36 percent from 2017-18 to 2018-19.

The results reveal that, in the beginning of scheme implementation, the response was good in both drip and sprinkler. During, subsequent years of installation of MI picked up in drip system while, slow down in sprinkler installation. The momentum of installation both drip and sprinkler got accelerated due to the positive perpetuation of the MI concept among farming community, social groups and driving force by the implementing department and partners during 2018-19.

On cross sectional analysis of total MI Installation, it is observed that a maximum beneficiary with drip irrigation was recorded in Belagavi and Chamarajanagar district and a lesser installation in Mysuru and Shivamogga district beneficiaries. However, under, sprinkler irrigation maximum coverage was noticed in Mysuru and Shivamogga and least in Chamarajanagar and Belagavi districts.

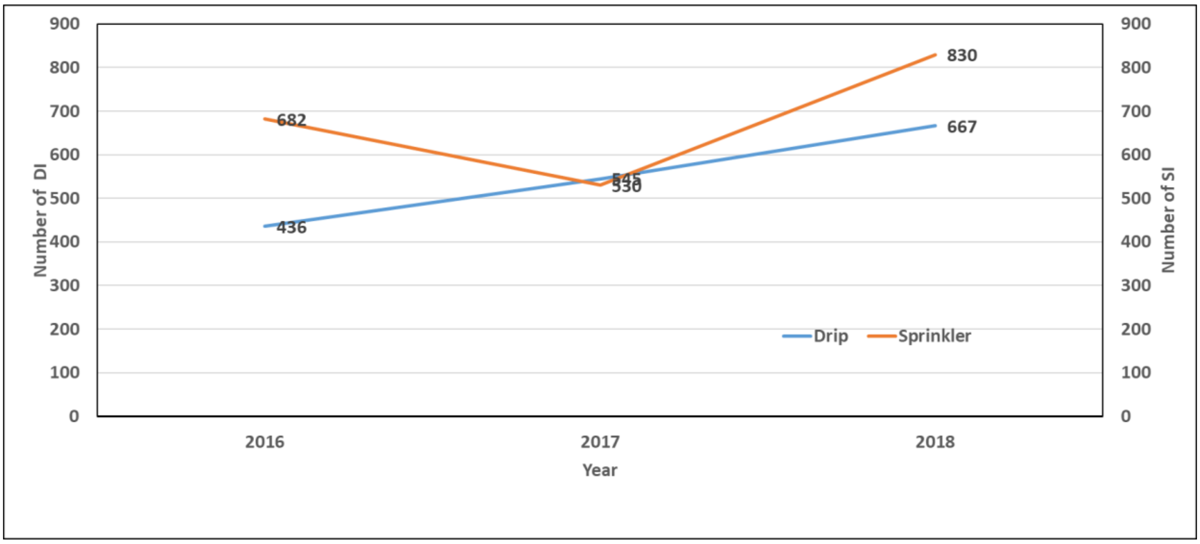


Fig: 4.13: Cumulative physical performance of MI adopters

Sources: Field study

Table 4.18: Year wise installation of MI system

District	Sample Size (No)	Drip irrigation (%)			Sample Size (No)	Sprinkler irrigation (%)			Sample Size (No.)	Beneficiaries covered			
		2016	2017	2018		2016	2017	2018		Drip (No.)	Drip (%)	Sprinkler (No.)	Sprinkler (%)
Belagavi	262	26.0	30.2	43.9	114	28.9	39.5	31.6	376	262	69.7	114	30.3
Bidar	170	34.1	36.5	29.4	194	23.2	24.2	52.6	364	170	46.7	194	53.3
C. R. Nagar	235	31.1	31.1	37.9	135	40.0	29.6	30.4	370	235	63.5	135	36.5
Haveri	111	20.7	38.7	40.5	264	29.2	47.0	23.9	375	111	29.6	264	70.4
Kalaburgi	110	28.2	53.6	18.2	260	40.4	26.9	32.7	370	110	29.7	260	70.3
Kolar	211	30.8	25.1	44.1	151	17.2	41.7	41.1	362	211	58.3	151	41.7
Mysuru	104	15.4	3.8	80.8	272	7.7	1.8	90.4	376	104	27.7	272	72.3
Shivamogga	104	46.2	39.4	14.4	271	66.8	27.3	5.9	375	104	27.7	271	72.3
Tumakuru	179	15.6	26.3	58.1	193	15.0	20.2	64.8	372	179	48.1	193	51.9
Uttara Kannada	162	16.0	51.9	32.1	188	59.0	12.2	28.7	350	162	46.3	188	53.7
Total	**1648**	**-**	**-**	**-**	**2042**	**-**	**-**	**-**	**3690**	**1648**	**-**	**2042**	**-**
Average -%		**26.5**	**33.1**	**40.5**		**33.4**	**26.0**	**40.6**			**44.7**		**55.3**

Sources: Field study

Type of MI system

In the field survey, it was observed that there are two types (Drip and sprinkler) of MI systems were installed among various beneficiaries. In drip, system emitting devices (inline or online emitters) are designed to discharge water at a prescribed rate depending on the specific requirements of various crops prominently horticulture, fibre, cash crops and mulberry. Whereas, in the sprinkler irrigation system water is discharge in the air through a set of nozzles attached to a network of High-Density Polyethylene (HDPE) pipes, simulating rainfall and are suitable where the plant density is very high. It is widely used in field crops (agriculture crops).

The beneficiaries covered under drop and sprinkler given in Fig. 4.14 and district wise proportion of beneficiaries having drip irrigation (DI) and sprinkler irrigation (SI) is presented Table 4.19. It could be noted that the drip irrigation and sprinkler irrigation was installed to an extent of 45 percent and 55 percent, respectively which means and increment of 19.3 percent increase in sprinkler to that of drip system.

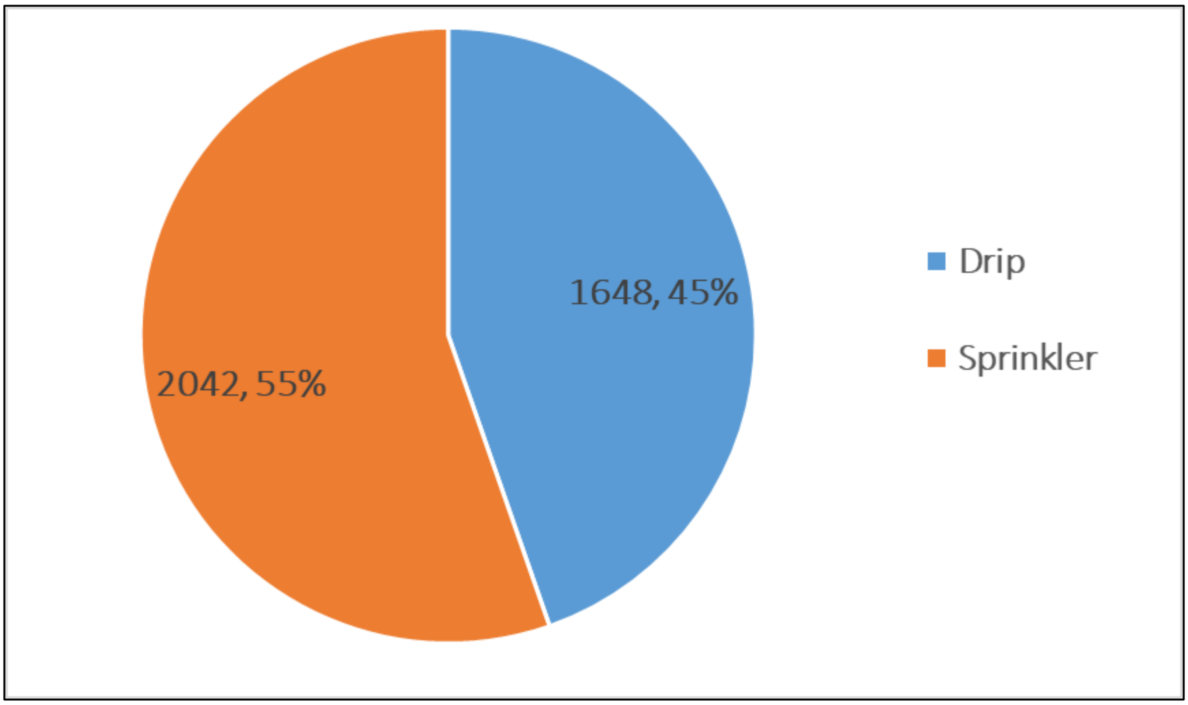


Fig 4.14: Proportion of DI and SI adopters under PMKSY-PDMC scheme (%)
Sources: Field study

Table 4.19: Proportion of farmers having drip and sprinkler systems

District	Sample Size (No.)	Beneficiaries covered			
		Drip (No.)	Drip (%)	Sprinkler (No.)	Sprinkler (%)
Belagavi	376	262	69.7	114	30.3
Bidar	364	170	46.7	194	53.3
C. R. Nagar	370	235	63.5	135	36.5
Haveri	375	111	29.6	264	70.4
Kalaburgi	370	110	29.7	260	70.3
Kolar	362	211	58.3	151	41.7
Mysuru	376	104	27.7	272	72.3
Shivamogga	375	104	27.7	271	72.3
Tumakuru	372	179	48.1	193	51.9
Uttara Kannada	350	162	46.3	188	53.7
Total	**3690**	**1648**	**-**	**2042**	**-**
Average -%			**44.7**		**55.3**

Sources: Field study

4.3.6 Technology wise area coverage

The district-wise area covered during field study under drip and sprinkler is represented in Table 4.20. The total area of MI system surveyed in the study district was an extent of 6515.0 acre in which drip irrigation area covered is about 2792.3 acres (42.9%) and sprinkler cover is 3723.0 acres (57.1%). With respect to district wise maximum area covered under drip is in Belagavi (545.9 acre), followed by Chamarajanagar (428.1 acre) and Kolar (388.0 acre) and least was in Kalaburgi (104.1 acre). Likewise, the area surveyed under sprinkler irrigation was highest (530.96 acre) in Shivamogga followed by Haveri (526.7 acre) and Uttara Kannada (508.5 acre) and lowest was in Belagavi (241.9 acre). The inference may be drawn from the field observation that the beneficiaries with predominant crops in the field demands the selection of type of micro irrigation over the conventional system.

Table 4.20: Drip and Sprinkler wise area coverage by sample beneficiaries

District	Total area surveyed (Acres)	Technology wise area coverage			
		Drip (acres)	Drip (%)	Sprinkler (acre)	Sprinkler (%)
Belagavi	786.8	544.9	69.3	241.9	30.7
Bidar	454.5	190.2	41.8	264.3	58.2
C. R. Nagar	807.6	428.1	53.0	379.5	47.0
Haveri	750.8	224.1	29.9	526.7	70.1
Kalaburgi	384.3	104.1	27.1	280.2	72.9
Kolar	641.6	388.7	60.6	252.9	39.4
Mysuru	563.2	114.8	20.4	448.3	79.6
Shivamogga	699.2	168.2	24.1	530.9	75.9
Tumakuru	616.5	327.0	53.0	289.4	47.0
Uttara Kannada	810.4	301.8	37.2	508.5	62.8
Total	**6515.3**	**2792.3**	**-**	**3723.0**	**-**
Average -%			**42.9**		**57.1**

Sources: Field study

The assessment study covered more than 40 crops with the classification of 12 major crop categories (Table 4.21). Drip irrigation, prominently used for horticulture crops, fibre, cash crops and mulberry. Whereas, in the sprinkler irrigation system is widely used in field crops (cereals, pulses, millets and oil seeds).

Table 4.21: Crop classification under MI system

Sprinkler Irrigation crops	Drip Irrigation crops
Cereals: Jowar, Maize, Paddy, Wheat Millets: Ragi Oil seeds: Groundnut, Soyabean, Sunflower Pulses: Bengal gram, Black gram, Cowpea, Green gram, Horse gram, Redgram	Cash crop: Sugarcane Fibre: Cotton Flower: Marigold, Rose flower, Jasmine, Chrysanthemum, Tube rose Fruit crop: Banana, Mango, Papaya, Pomegranate, Watermelon, Grapes Jackfruit Mulberry Plantation: Arecanut, Coconut Spice: Chilly, Coriander, Pepper, Turmeric, Ginger, Paper, Onion Vegetable: Beans, Brinjal, Carrot, Cucumber, Potato, Tomato, cabbage. Cluster bean, Knolkhol, Ridge gourd

Sources: Field study

Crop category wise percentage of area covered under drip and sprinkler is presented in Table 4.22 and Fig 4.15. Out of 6515.3-acre, cereal crop being covered maximum area (21.7%) followed by cash crops (16.1%) and plantation crops (10.50%). Pulses and millets (8.9%) equally shared and lowest area found in flowers (0.6%). This impact assessment study in the different district has properly covered with principal crops which were predominant to agro climatic zone coupled with ground water status. This substantiates the choice of crops suiting to micro irrigation system in specific agro climatic zones. With respect to the spread of crops, it could be noted that cereals (Paddy) in Uttara Kannada, pulses in Kalaburgi, oil seeds in Haveri, millets in Kolar and Mysuru, cash crops (Sugarcane) in Belagavi, fibre crops (Cotton) in Haveri, fruit crops in Chamarajanagar, plantation crops in Shivamogga, spices in Mysuru and Chamarajanagar, flower crops in Belagavi, vegetables in Kolar and Mulberry in Kolar are dominated and potential for promoting MI irrigation.

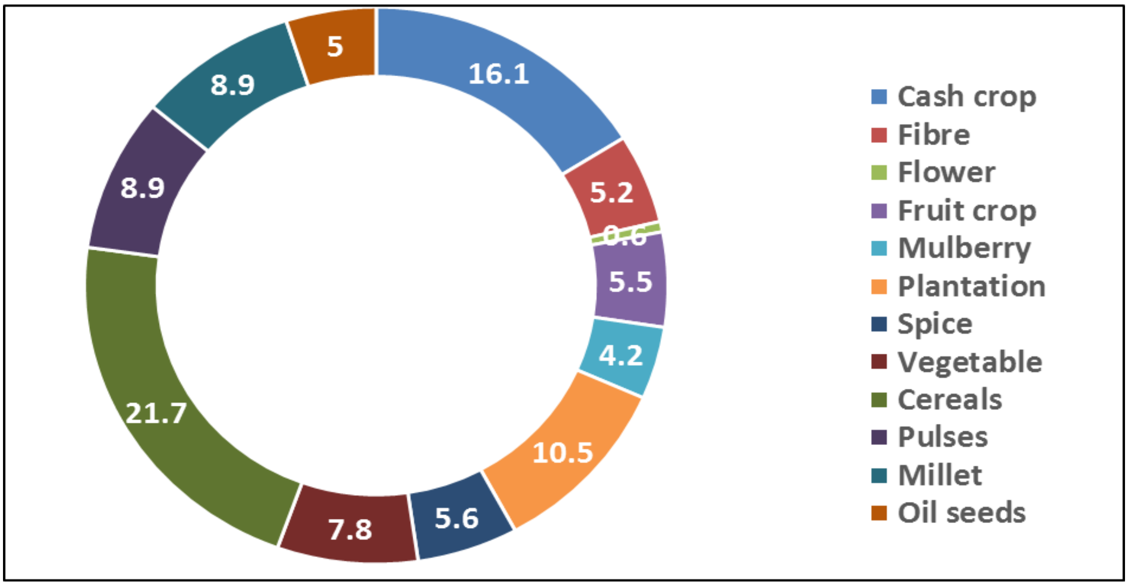


Fig 4.15: Crop wise area (%) covered under PMKSY-PDMC MI irrigation scheme in the study area

Sources: Field study

Table 4.22: Crop classification wise area covered under MI irrigation in the study area

District	**Total area surveyed (Acres)**	**Drip irrigation (%)**								**Sprinkler irrigation (%)**			
		Cash crop	**Fibres**	**Flowers**	**Fruit crop**	**Mulberry**	**Plantation**	**Spice**	**Vegetable**	**Cereals**	**Pulses**	**Millet**	**oil seeds**
Belagavi	786.8	50.7	12.5	3.4	7.2	2.0	0.0	8.4	0.0	6.9	7.9	0.0	1.1
Bidar	454.5	37.7	0.0	0.0	4.2	0.9	0.0	2.2	2.4	1.2	47.3	0.0	4.1
C. R. Nagar	807.6	19.5	0.6	0.0	15.6	2.1	0.5	13.3	5.5	22.1	7.3	11.5	2.1
Haveri	750.8	3.5	25.4	0.4	7.2	2.4	4.7	3.2	6.4	24.3	0.4	0.0	22.0
Kalaburgi	384.3	14.7	0.9	0.3	5.8	2.1	0.0	2.4	5.0	14.6	53.5	0.0	0.8
Kolar	641.6	0.0	0.0	1.3	1.1	22.0	3.4	1.4	29.5	3.8	1.6	36.1	0.0
Mysuru	563.2	2.8	6.3	0.0	0.3	0.7	1.0	24.4	4.8	29.3	1.4	24.9	4.2
Shivamogga	699.2	1.0	0.0	0.0	0.6	0.4	62.3	0.0	1.4	33.4	0.0	0.6	0.4
Tumakuru	616.5	0.0	0.0	0.0	8.3	8.3	16.6	0.3	25.5	5.3	3.3	18.1	14.2
Uttara Kannada	810.4	26.3	0.2	0.0	2.0	1.5	10.1	0.1	0.0	59.8	0.0	0.0	0.0
Total	**6515.3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Average -%		**16.1**	**5.2**	**0.6**	**5.5**	**4.2**	**10.5**	**5.6**	**7.8**	**21.7**	**8.9**	**8.9**	**5.0**

Sources: Field study

The success of scheme implementation was largely depending on the nature of active participation of beneficiaries at various stages. It is a noteworthy observation that, the average participation of the beneficiaries was higher up to 71.7 percent across all districts and being maximum in Shivamogga (90.7%) and Kolar (90.1%) and least was in Belagavi (41%). Similar trend of participation was also observed with respect to drip and sprinkler irrigation. A summary of the extract of district wise participation of beneficiaries is listed in Table 4.23.

Table 4.23: Beneficiaries participation during MI installation.

District	Sample Size (No)	MI (%)		Sample Size (No)	Drip (%)		Sample Size (No)	Sprinkler (%)	
		Yes	No		Yes	No		Yes	No
Belagavi	376	41.2	58.8	262	30.2	69.8	114	66.7	33.3
Bidar	364	79.7	20.3	170	95.3	4.7	194	66.0	34.0
C. R. Nagar	370	77.8	22.2	235	74.9	25.1	135	83.0	17.0
Haveri	375	58.9	41.1	111	72.1	27.9	264	53.4	46.6
Kalaburgi	370	73.2	26.8	110	41.8	58.2	260	86.5	13.5
Kolar	362	90.1	9.9	211	86.3	13.7	151	95.4	4.6
Mysuru	376	68.6	31.4	104	75.0	25.0	272	66.2	33.8
Shivamogga	375	90.7	9.3	104	100.0	0.0	271	87.1	12.9
Tumakuru	372	85.2	14.8	179	76.5	23.5	193	93.3	6.7
Uttara Kannada	350	51.1	48.9	162	74.7	25.3	188	30.9	69.1
Total	**3690**	**-**	**-**	**1648**	**-**	**-**	**2042**	**-**	**-**
Average -%		**71.7**	**28.3**		**70.7**	**29.3**		**72.5**	**27.5**

Sources: Field study

4.3.7 Investment and subsidy

Awareness on scheme subsidy by the beneficiaries is assessed at different level (Fully aware, partially and not aware). During field study it was noted only 45.8 percent of the beneficiaries are fully aware about transaction and transparency of subsidy. However, contrastingly a maximum (49.9%) of the beneficiaries were unaware and partially aware (4.3%) about the transparency in the subsidy/transaction which is alarming from the point of meeting the objectives of the scheme, hence to be motivated further. The detail district-wise and component-wise level of awareness on subsidy is presented in the Table 4.24.

Table 4.24: Awareness regarding transparency in subsidy claims

District	Sample Size (No.)	Drip Beneficiaries (%)			Sample Size (No.)	Sprinkler Beneficiaries (%)		
		Fully aware	Not aware	Partially aware		Fully aware	Not aware	Partially aware
Belagavi	262	84.4	13.4	2.3	114	93.0	6.1	0.9
Bidar	170	2.4	97.6	0.0	194	13.4	84.5	2.1
C. R. Nagar	235	38.3	46.8	14.9	135	51.9	25.2	23.0
Haveri	111	94.6	3.6	1.8	264	94.3	4.9	0.8
Kalaburgi	110	2.7	97.3	0.0	260	0.4	99.6	0.0
Kolar	211	68.2	24.6	7.1	151	49.7	13.9	36.4
Mysuru	104	15.4	84.6	0.0	272	17.3	82.4	0.4
Shivamogga	104	34.6	65.4	0.0	271	57.9	42.1	0.0
Tumakuru	179	42.5	57.5	0.0	193	30.6	69.4	0.0
Uttara Kannada	162	74.7	24.1	1.2	188	45.2	53.2	1.6
Total	**1648**	**-**	**-**	**-**	**2042**	**-**	**-**	**-**
Average -%		**49.5**	**46.8**	**3.6**		**42.9**	**52.4**	**4.8**
% MI		**45.8**	**49.9**	**4.3**				

Sources: Field study

The detail district wise average system costs as reported by the respondent have been compiled in the Table 4.25. On an average, cost of MI installation is about Rs 24291/-acre of which drip irrigation is about Rs.31161/-acre and sprinkler is about Rs. 17421/-acre. The investment for drip irrigation is found be to be 78.8 percent more compared to sprinkler irrigation. The maximum of drip irrigation in the estimated locations is to observed to be Rs 40832/acre in kolar and Rs 23298/acre for sprinkler at Belagavi. The higher cost incurred with drip irrigation is mainly due to installation of laterals, emitters, filters and variation in the quality material, maintenance and designing of the system according to crop water requirement/ High density planting with provisions for leads to increase the investment cost. However, investment can be reduced by supply of quality material and scientist designed based on crops water requirement, water yield and terrain. In field observation it is also noted that the investment in drip irrigation under mulberry crop is higher than other field crops and horticultural crops and found on an average of Rs 82920/-acre.

Table 4.25: Average cost of installation of MI system (Rs\acre)

District	Investment (Rs)		
	Drip	Sprinkler	Average cost of MI
Belagavi	31139	23298	27219
Bidar	29869	17452	23661
C. R. Nagar	34585	20390	27487
Haveri	30665	20509	25587
Kalaburgi	30568	15544	23056
Kolar	40832	15445	28139
Mysuru	31148	12845	21996
Shivamogga	25949	15221	20585
Tumakuru	30089	17007	23548
Uttara Kannada	26761	16502	21632
Average	31161	17421	24291

Sources: Field study rupees

The facts in the Fig. 4.16 reveal the extent of subsidy being availed by the beneficiaries belonging to different category. It is noted that maximum subsidy availed by medium size farmer (47.5%) followed by large farmers (23.6%) and small farmers (19.4%) and minimum was observed among marginal farmers (9.6%).

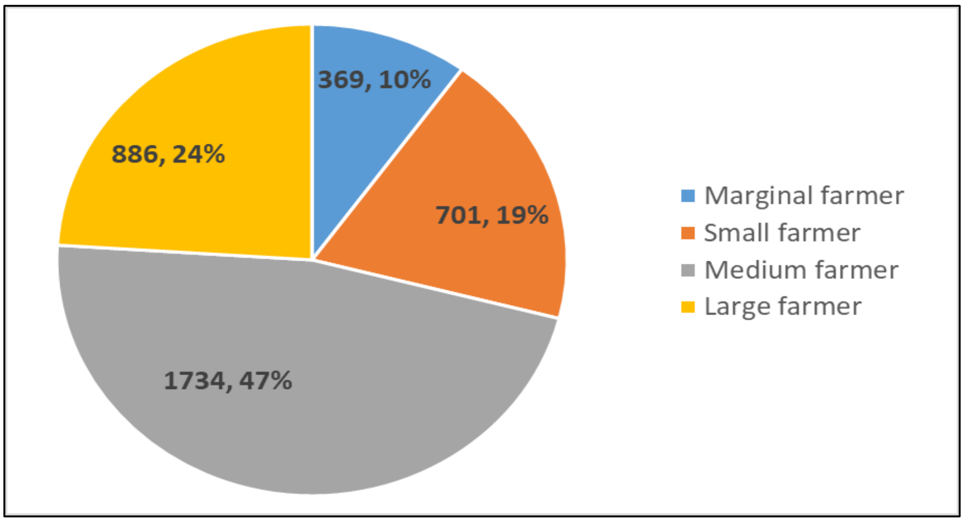


Fig 4.16: Farmer category wise subsidy availed with MI Installation
Sources: Field study

The detailed district-wise subsidy availed by the beneficiaries is presented in following Table 4.26. Subsidy availed by the beneficiaries found to be maximum in Chamarajanagar (66.4%) under medium size farmer, followed Belagavi with 66.2 percent beneficiary. However, minimum (3.5%) with small farmer of Chamarajanagar.

Table 4.26: Category wise MI subsidy availment among beneficiaries

District	Sample size (No.)	Farmer category (%)			
		Marginal farmer	Small farmer	Medium farmer	Large farmer
Belagavi	376	4.3	16.3	66.2	13.2
Bidar	364	32.4	8.8	42.3	16.5
C. R. Nagar	370	7.2	3.5	66.4	22.9
Haveri	375	12.3	20.9	33.3	33.5
Kalaburgi	370	6.6	25.0	40.2	28.2
Kolar	362	7.1	20.1	50.3	22.5
Mysuru	376	6.2	37.5	23.2	33.1
Shivamogga	375	8.7	14.9	49.2	27.2
Tumakuru	372	6.5	30.4	43.4	19.7
Uttara Kannada	350	4.5	16.2	60.2	19.1
Total	**3690**	**--**	**-**	**-**	**-**
Average -%		**9.6**	**19.4**	**47.5**	**23.6**

Sources: Field study

It could be noted from the opinion of the beneficiaries that the time taken for processing the subsidy claim ranges from as early as 1 month to as delay as over 12 months. Maximum (55%) beneficiaries have availed their subsidy between 6 to 12 months which is a long delay and totally deviating the specified norms (6 month) and thus it is demotivating factor which needs to be addressed at all levels of scheme implementation. The delay processing the subsidy claims may be due to acknowledging the fact that several small and marginal farmers may not be able to afford upfront payment which is required in the DBT model, there should be an option for Non-Direct Benefit Transfer (Non-DBT) model that is able to effectively address this issue. However, It is equally important to extend all procedures that have been adopted to clear the subsidy processes within months of time. Application of farmer friendly ICT technology is required to be developed for real time tracking of the status and its monitoring. The currently adopted HASIRU IT application initiated by the nodal department (DOH) is need to be extensively popularised. A detailed district wise time duration taken for processing the subsidy claim against installation of drip and sprinkler irrigation is presented in the following Table 4.27.

Table 4.27: Duration of processing the subsidy claims by beneficiaries (M=Month)

District	Sample size (No.)	Drip beneficiaries (%)					Sample size (No.)	Sprinkler beneficiaries (%)				
		1 M	1-3 M	3-6 M	6-12 M	>12 M		1 M	1-3 M	3-6 M	6-12 M	>12 M
Belagavi	262	6.5	8.0	27.1	58.4	0.0	114	1.8	17.5	12.3	68.4	0.0
Bidar	170	0.0	8.2	9.4	82.4	0.0	194	0.0	0.5	0.0	99.5	0.0
C. R. Nagar	235	0.4	5.1	14.9	79.6	0.0	135	0.7	4.4	3.0	91.9	0.0
Haveri	111	1.8	1.8	9.9	86.5	0.0	264	0.4	0.8	3.0	95.8	0.0
Kalaburgi	110	0.0	0.0	4.5	95.5	0.0	260	0.0	0.0	0.0	100.0	0.0
Kolar	211	1.9	44.5	47.4	5.7	0.5	151	1.3	6.0	4.6	88.1	0.0
Mysuru	104	0.0	42.3	40.4	17.3	0.0	272	0.4	28.7	17.6	53.3	0.0
Shivamogga	104	0.0	63.5	8.7	26.9	1.0	271	0.0	62.4	6.3	31.0	0.4
Tumakuru	162	0.0	6.2	93.2	0.6	0.0	188	0.0	1.6	98.4	0.0	0.0
Uttara Kannada	179	9.5	36.3	44.7	9.5	0.0	193	3.6	29.5	65.8	1.0	0.0
Total	**1648**	**-**	**-**	**-**	**-**	**-**	**2042**	**-**	**-**	**-**	**-**	**-**
Average -%		**20.1**	**19.9**	**31.6**	**45.9**	**0.1**		**0.7**	**16.9**	**20.1**	**62.3**	**0.0**
% To the MI		**1.5**	**18.2**	**25.2**	**55.0**	**0.1**						

Sources: Field study

The Fig. 4.17 depicts the mode of subsidy disbursement among beneficiaries in the study area. During survey, it was noticed that only 31.2 percent of the beneficiaries were availed subsidy through the Direct Benefit Transfer (DBT) system. While, 68.8 percent beneficiaries got through other non-considerate mode, of which 57.5 percent subsidy disbursement channelized through MI agency. This mode although appears quite easier from procedural practice by the beneficiary but it has its own built-in trade interest with the MI agency which need to be regulated. It is also quite interesting to know the practice of subsidy distribution through cheque is marginal (11.2%). Thus, launching of DBT system from Jan 2013 must be made a mandate in the transaction system of subsidy disbursement.

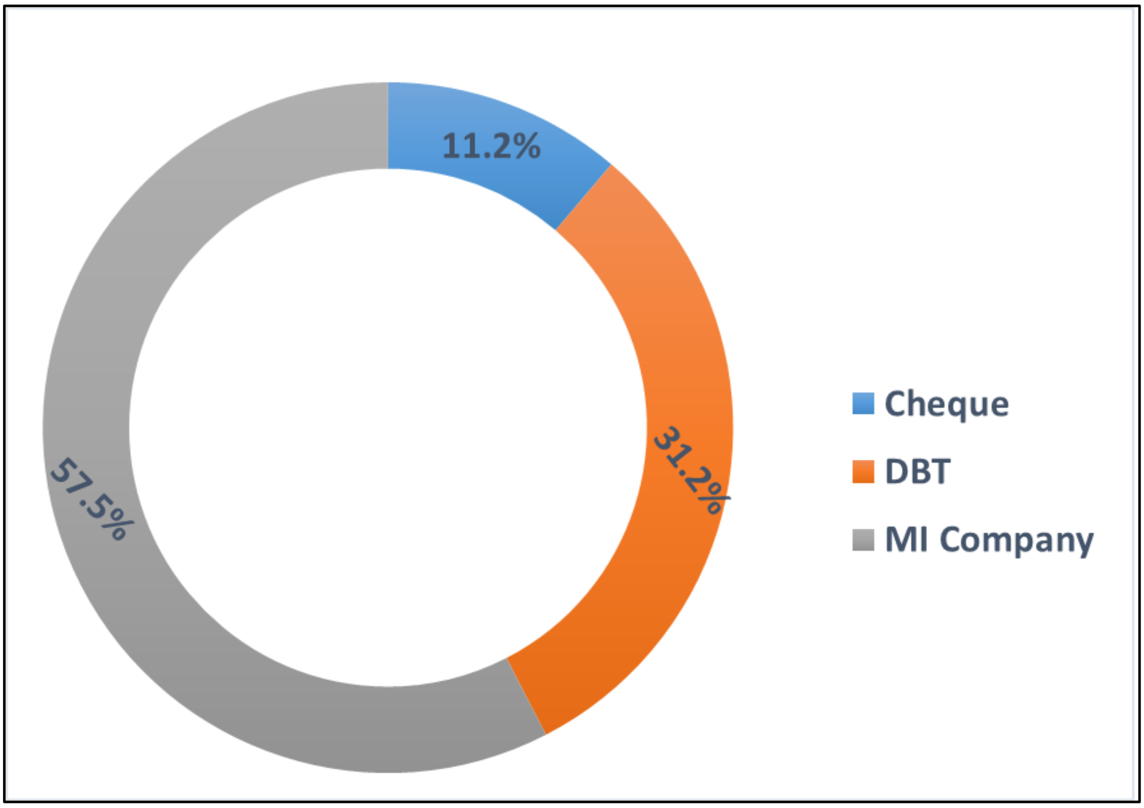


Fig 4.17: Mode of Subsidy transfer to the beneficiaries
Sources: Field study

Table 4.28 describes district wise means of subsidy transfer to beneficiaries under drip and sprinkler. The maximum number of beneficiaries have availed subsidy through MI companies followed by DBT mode in both in drip and sprinkler. With respect to district wise availment of subsidy under drip irrigation, beneficiaries belong to Kalaburgi district found maximum (89.5%) followed by Uttara Kannada (84.6 and 78.2%) have obtained subsidies through MI company and minimum (0.9%) noticed in Chamarajanagar district. With respect to sprinkler beneficiaries, 99 percent beneficiary belongs to Kalaburgi have availed the subsidy through MI and minimum 1.0 percent beneficiaries of Bidar district received through cheque mode.

Table 4.28: Mode of subsidy transfer to the beneficiaries

District	Sample size (No.)	Drip beneficiaries (%)				Sample size (No.)	Sprinkler beneficiaries (%)			
		Cheque	DBT	Can't remember	MI Company		Cheque	DBT	Can't remember	MI Company
Belagavi	262	1.1	12.2	8.4	78.2	114	1.8	10.5	0.9	86.8
Bidar	170	1.2	55.9	1.8	41.2	194	1.0	51.5	0.5	46.9
C. R. Nagar	235	1.3	36.2	0.9	61.7	135	7.4	45.9	1.5	45.2
Haveri	111	3.6	10.8	45.0	40.5	264	1.1	12.5	8.7	77.7
Kalaburgi	110	6.4	1.8	2.7	89.1	260	1.5	7.7	0.8	90.0
Kolar	211	2.8	46.9	6.2	44.1	151	3.3	18.5	9.3	68.9
Mysuru	104	1.9	33.7	1.9	62.5	272	2.2	19.9	7.4	70.6
Shivamogga	104	1.9	50.0	46.2	1.9	271	1.1	42.8	31.4	24.7
Tumakuru	179	1.1	78.2	2.2	18.4	193	3.6	58.5	6.2	31.6
Uttara Kannada	162	2.5	5.6	7.4	84.6	188	1.6	28.2	8.5	61.7
Total	**1648**	**-**	**-**	**-**	**-**	**2042**	**-**	**-**	**-**	**-**
Average -%		**2.1**	**34.0**	**9.6**	**54.2**		**2.2**	**28.9**	**8.6**	**60.2**
% MI		**2.2**	**31.2**	**9.1**	**57.5**					

Sources: Field study

Fig 4.18 describes the scenario of MI beneficiaries got benefit through convergent under various central and state department scheme. Convergence of PMKSY-PDMC with MGNREGA, NHM, Krishi Bhagya, Ganga Kalyan, NFSM, and ISOPHOM, found very marginal (only 31%) in the sample district. Thus, there is a need to revisit the planning and implementation strategies to merge PMKSY-PDMC scheme with above mentioned scheme for effective greater area coverage.

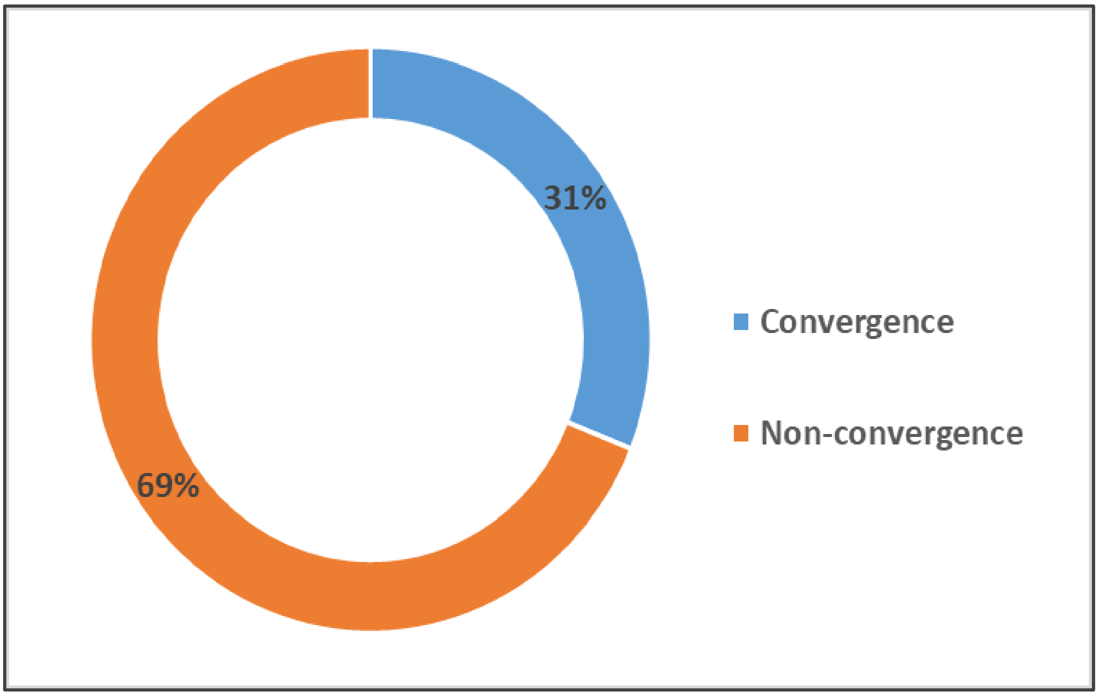


Fig 4.18: Proportion of PMKSY-PDMC scheme convergence with another scheme
Sources: Field study

Table 4.29 highlights the details government scheme convergence made under PMKSY-PDMC scheme. Among the schemes, maximum (62.9%) convergence was found with NSFM scheme which provides several crop productions inputs along with demonstration and training and minimum with (1.7%) ISOPHOM scheme. Similar trend was noticed under both drip and sprinkler irrigation. Centrally sponsored schemes like NHM and state sponsored schemes like Krishi Bhagya (farm pond) and Ganga Kalyan with pressurized bore-wells drilled under special component plan have also been dovetailed with PMKSY-PDMC scheme. This kind of convergence although enhances the total financial investment gains to the beneficiaries is quite supportive towards reaping a cumulative benefit of government supported schemes. With respect to district-wise convergence, average maximum convergence of the scheme noticed with NFSM programme in Kalaburgi district (91.1%), Bidar (82.6%) and Kolar (77.6%), the other scheme enabled include -NMH, Ganga Kalyan and Krishi Bhagya scheme intermediately, while ISOPHOM scheme has recorded less convergence under drip irrigation. Similar observation was made among sprinkler implementation but maximum convergence of NSFM was noticed in Haveri, Kalaburgi and Uttara Kannada districts.

Departmental scheme coordination: The necessity of interdepartmental coordination and program convergence was brought out in an FGD in Bidar and case study analysis in Kalburgi districts.

Table 4.29: Details of Govt. schemes convergence with MI (n =3690)

District	Sample size (No.)	Drip beneficiaries (%)						Sample size (No.)	Sprinkler beneficiaries (%)					
		MGNREGA	Krishi-Bhagya	Ganaga-kalyan	NHM	NFSM	ISOPHO		MGNREGA	Krishi-Bhagya	Ganaga-kalyan	NHM	NFSM	ISOPHO
Belagavi	69	2.9	59.4	2.9	5.8	29.0	0.0	5	0.0	60.0	0.0	0.0	40.0	0.0
Bidar	121	7.4	8.3	1.7	0.0	82.6	0.0	85	17.6	25.9	3.5	1.2	51.8	0.0
C. R. Nagar	30	0.0	3.3	33.3	26.7	33.3	3.3	30	16.7	0.0	83.3	0.0	0.0	0.0
Haveri	121	0.0	1.7	0.8	49.6	47.1	0.8	243	0.8	1.6	3.7	1.6	91.4	0.8
Kalaburgi	90	0.0	0.0	1.1	6.7	91.1	1.1	65	3.1	0.0	12.3	0.0	84.6	0.0
Kolar	67	0.0	1.5	1.5	19.4	77.6	0.0	4	0.0	0.0	50.0	25.0	25.0	0.0
Mysuru	23	8.7	26.1	34.8	13.0	8.7	8.7	128	6.3	14.8	24.2	10.2	35.2	9.4
Shivamogga	6	0.0	0.0	33.3	33.3	33.3	0.0	12	0.0	0.0	91.7	0.0	8.3	0.0
Tumakuru	25	0.0	20.0	0.0	16.0	64.0	0.0	6	33.3	0.0	50.0	0.0	16.7	0.0
Uttara Kannada	11	0.0	27.3	9.1	18.2	45.5	0.0	6	16.7	0.0	0.0	0.0	83.3	0.0
Total	**563**	**-**	**-**	**-**	**-**	**-**	**-**	**584**	**-**	**-**	**-**	**-**	**-**	**-**
Average -%		**2.3**	**12.3**	**5.0**	**18.1**	**61.5**	**0.9**		**6.0**	**8.2**	**15.8**	**3.3**	**64.4**	**2.4**
% MI		**4.2**	**10.2**	**10.5**	**10.5**	**62.9**	**1.7**							

Sources: Field study

4.3.8 Technical observation about MI system

Functioning status of MI system

Table 4.30 depicts a scenario of the field functioning of the installed MI systems. It is interesting to note that majority (86.3%) of the systems (both drip and sprinkler) supported under the scheme are functional enough to enable crop production as a sustainable technological investment. Nevertheless, the non-functioning units of 13.7 percent must also to be made functional through the obligatory and warranty conditions from the MI agencies and thus to ensure total functionality. Among various district, maximum functioning of the MI installation was observed in Uttara Kannada (97.1%) and Shivamogga (96.8%) followed by Tumakuru (95.7%) and Kalaburgi (94.9%) and minimum functioning of MI system was noticed in Haveri (59.7%). Thus, involvement and supervision by MI agencies and department field staff through appropriate awareness urgently required to enhance the functional status of MI system. In one of the impact evaluation study on “National Mission on Micro Irrigation (NMMI)” 2014 highlighted from the field investigation that more than 15 percent reported that the MI system were non-functional in Bihar, Chhattisgarh, Odisha & Uttarakhand due to crop season and fear of theft & damage from rodents. However, the two models followed (GGRC and APMP) in Gujarat and Andhra Pradesh have been seen as the most successful in terms of `capacity and quality’ of implementation. The subsidy models in Gujarat and Andhra Pradesh provide useful templates for drawing lessons for subsidy implementation. Both these models emphasize safeguarding farmers’ interests and have in place various oversight measures to this end. Some of these aspects, particularly the design features that provide incentives for the suppliers to share the transaction costs of farmers, are noteworthy. KAMIC is designed after through review of the role models.

Table 4.30: Status of MI functionality among MI beneficiaries

District	**Sample size (No.)**	**Beneficiary response (%)**	
		Functioning	**Non functioning**
Belagavi	376	72.1	27.9
Bidar	364	89.8	10.2
C. R. Nagar	370	59.7	40.3
Haveri	375	85.3	14.7
Kalaburgi	370	94.9	5.1
Kolar	362	81.2	18.8
Mysuru	376	90.7	9.3
Shivamogga	375	96.8	3.2
Tumakuru	372	95.7	4.3
Uttara Kannada	350	97.1	2.9
Total	**3690**	**-**	**-**
Average -%		**86.3**	**13.7**

Sources: Field study

Correlation of training Vs Functioning of MI system

Fig 4.19 to 4.22 shows the summary that provides the raltion ship between training and functioning of MI among various category of farmers (R2). This study reveals gradual increase in variance showed by R2 from 50, 59%, 96% and 59% meaning that the coefficients of the independent variables (training) is positive and significant influenced among medium farmers than other category of farmers. This indicated training helped farmers to copy and learn from each other the usage and manage the MI system themselves independently to minimise the risk of system failure..

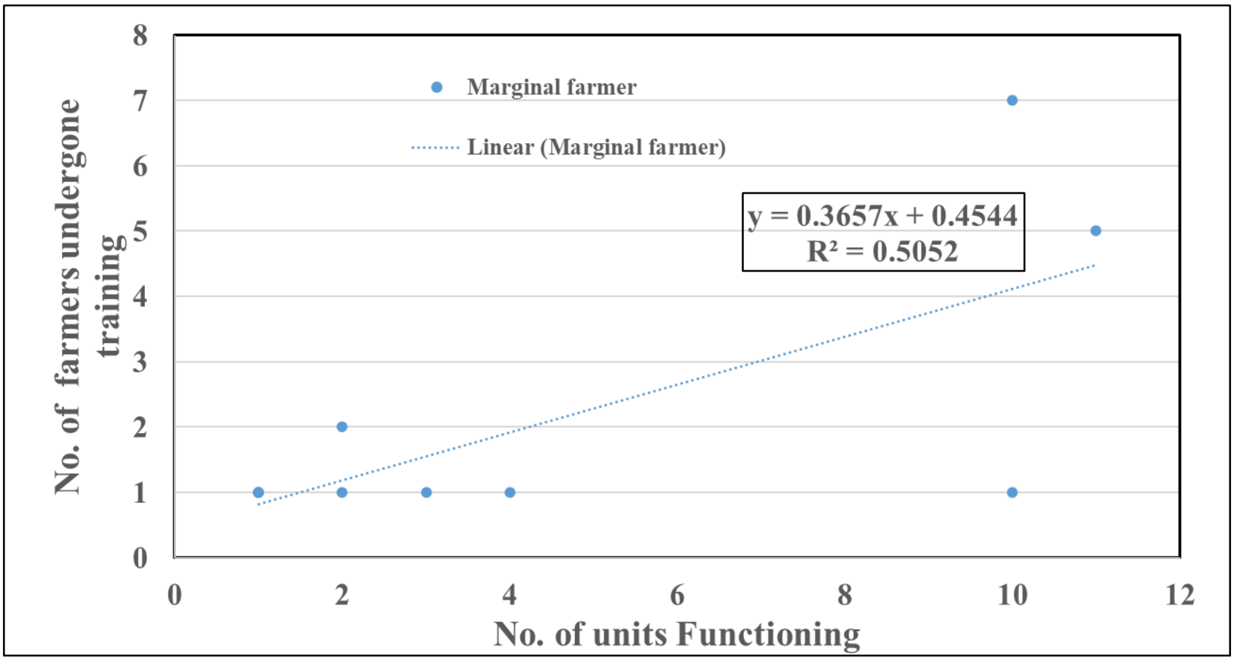


Fig 4.19: Correlation between training participants and MI functioning of marginal farmer

Sources: Field study

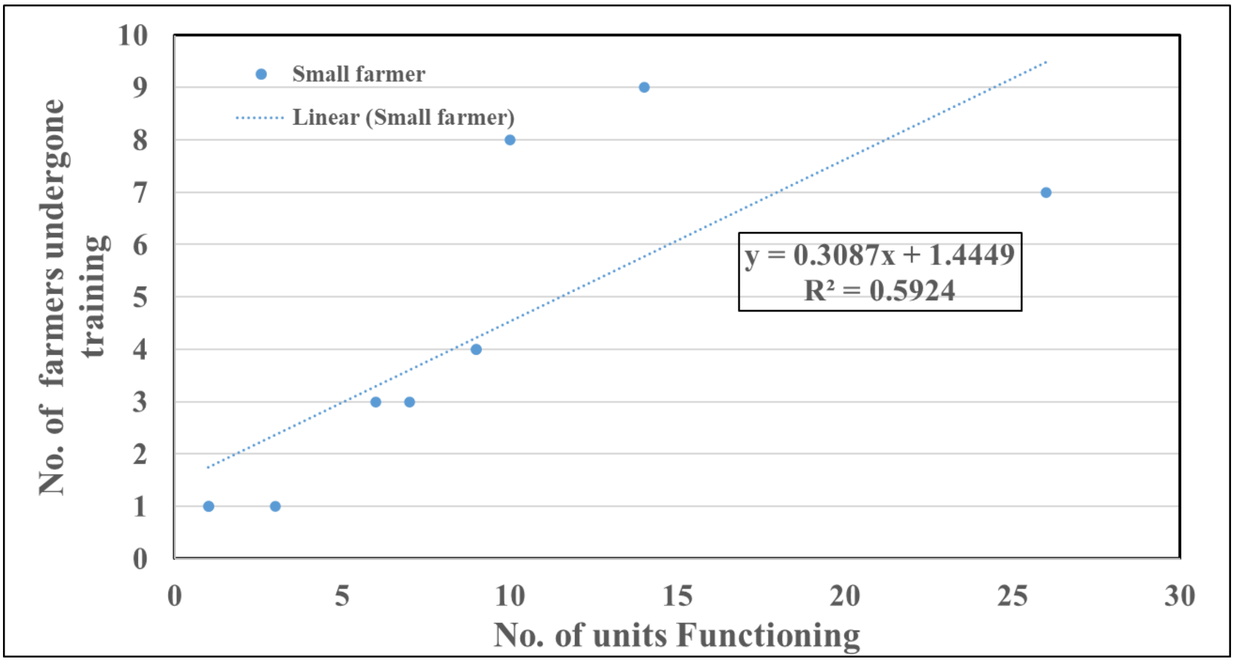


Fig: 4.20 Correlation between training participants and MI functioning of small farmers

Sources: Field study

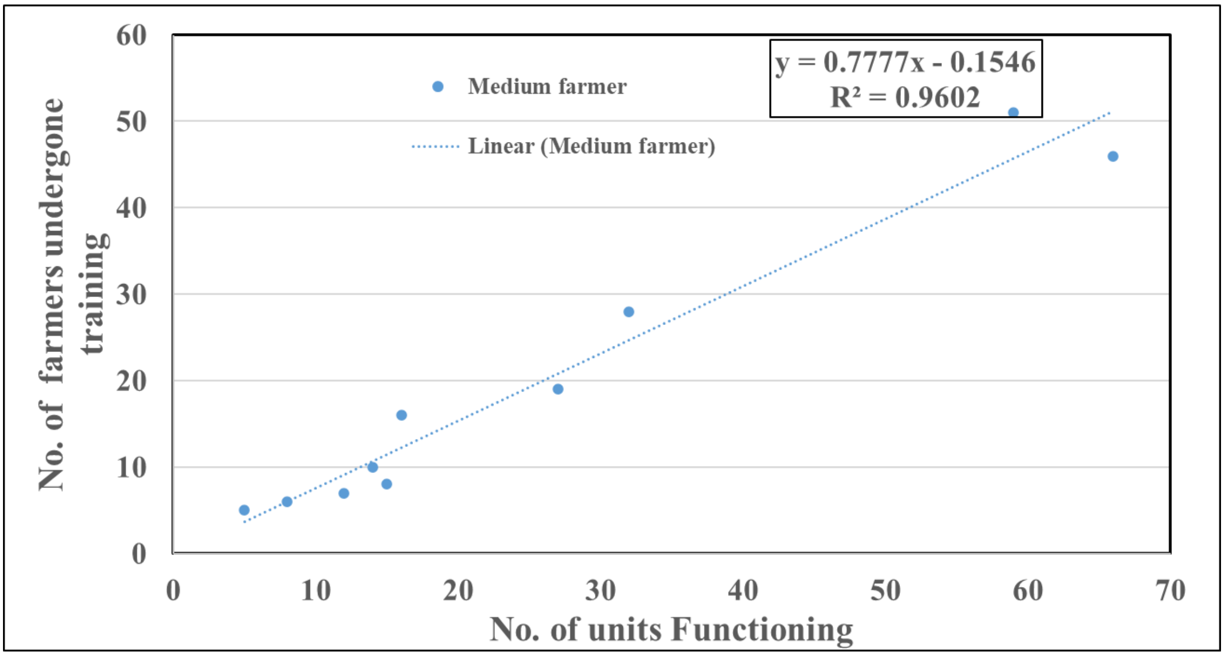


Fig: 4.21 Correlation between training participants and MI functioning of medium farmers

Sources: Field study

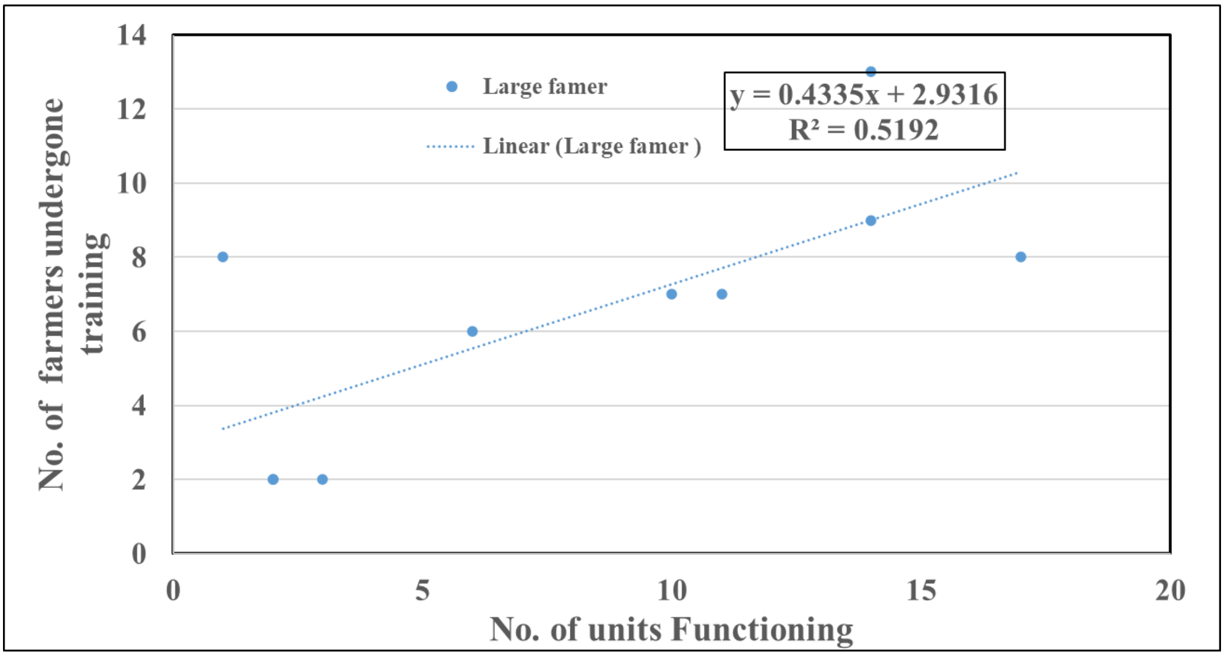


Fig: 4.22 Correlation between training participants and MI functioning of large farmers

Sources: Field study

Attributes of Non-functioning of the MI system

Fig 4.23 depicts attributes of non-functioning of MI system among beneficiaries. A classified analysis of non-functionality of the MI units indicates various reasons, of which a maximum of 38.4 percent beneficiaries has sold the units to others which is quite surprising and unsustainable practices. From field observation, it was noticed that, drying out of water sources is one of the main reasons for selling of the unit and this, calls for quick regulatory action owing to the breach of the stipulated norms and conditions. Thus, there is urgent need to take care by ensuring sufficient water sources round the year in borewell and also promote aquifer recharge structure around water sources before installation. Another strong reason for non-functioning of the unit is damage of the units (38.1%) by wild animals (wild bores) and birds (peacock). Non-functioning of the unit due to blocking/chocking is a technical issue and found to the extent of 23.2 percent in beneficiaries lands. However, these can be overcome through effective beneficiaries involvement in maintenance, creating recharge and proper protection leads to reset the system which is very well within beneficiaries reach

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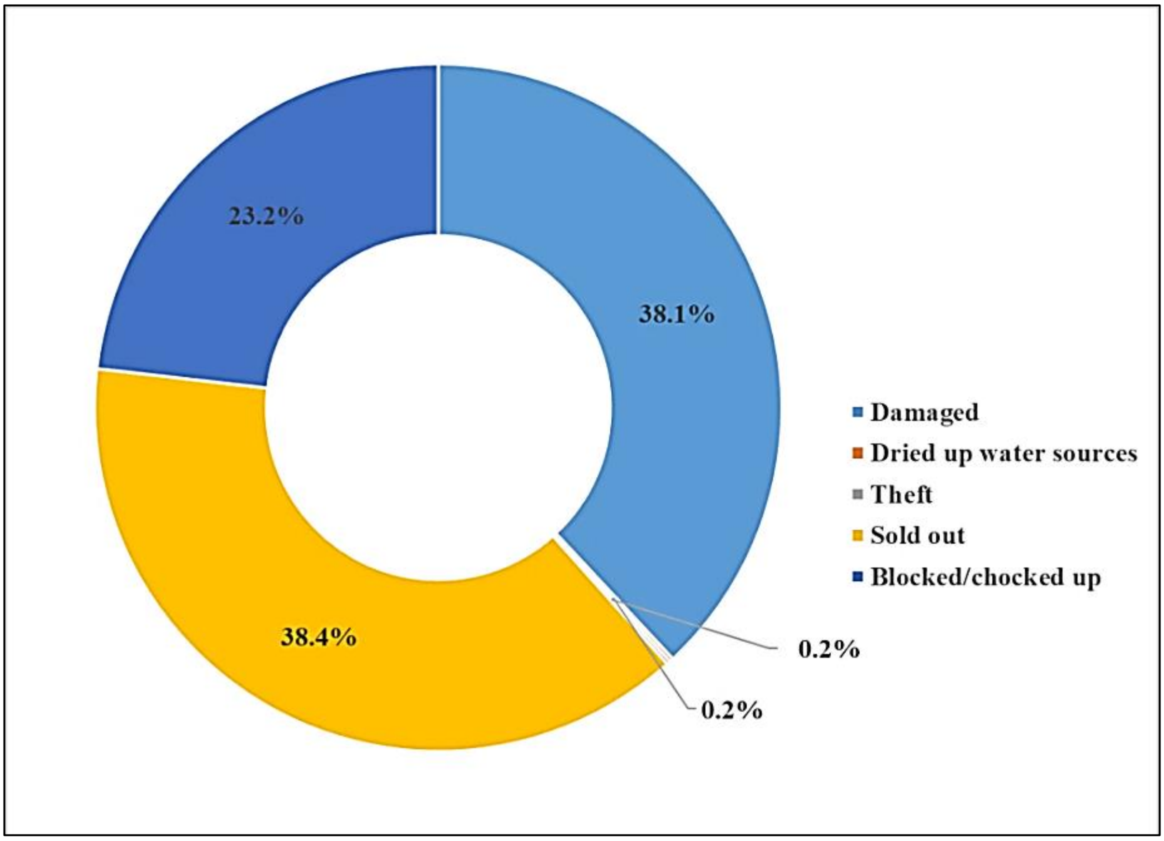


Fig 4.23: Attributes for non-functioning of MI system
Sources: Field study

Table 4.31: Assessment of various attributes for functioning of MI system (No. =3690)

SN	Attributes	Beneficiary response (%)		
		Yes	No	Don't know / partially
1	Is this design layout being as per your project proposal?	90.8	7	2.2
2	Whether various system components supplied are as per the BIS specifications	84.9	11.7	3.4
3	Have you adapted any valve system for total distribution of water? Only applicable to Drip (1648 beneficiaries)	63.7	36.3	NA
4	Have you installed any ventury? Only applicable to Drip Only applicable to Drip (1648 beneficiaries)	52.2	47.8	NA
5	Whether any Pressure Gauge is installed	51.9	48.1	NA
6	Is there, emitters used in Drip	60.1	39.9	NA
7	Is there any Filters used in MI?	64.5	35.5	NA
8	Does the installed MI system meet crops water requirement	87.2	8.8	4.0
9	Has the design suits to other crops during subsequent seasons	71.8	16.8	11.4
10	Have you taken the benefit of Warranty provisions	43.2	44.9	11.8

Sources: Field study

The above Table 4.31 attributes of the MI system were analysed and findings of the opinion survey are reported as under:

1. The success of the MI installation primarily goes with scientific manner of designing the system suiting to water yield, crop water requirement, area coverage, geographical terrain, and climate and soil type. MI as techno-economic tool invariably demands a most calculative application to match the output. In the study it was noticed that 90.8 percent expressed the design and layout of installed MI system in their field is as project proposal and match their interest. However, the remaining 9.2 percent also to be insisted for a compulsory matching to the scientific designing.
2. 84.9 percent beneficiaries expressed those installed materials are as per the BIS specifications and quite satisfactory. However, an extent 14.1 percent non-specified material supply is again an issue calls for strict vigilance and inspections.
3. Water distribution in the entire design should be uniform which could be managed at field level by the installation of specific valves either manual or sensor operative ones. Majority of the beneficiaries (63.7%) found to have installed valves which enable

them to comply the water requirement of the crop. However, 36.3 percent of the beneficiaries' have not adopted the valve system would be exposed to mechanical breakage and leakage causing malfunctioning of the entire system which need to be properly guided by the installation and supervising authorities.

4. Installation of ventury is slightly advancement in the drip system which eliminates the burden of physical application of fertilizer to the soils. During field study it was observed that, maximum (52.8%) extent of beneficiaries having not installed the venturi which calls for immediate attention and insisted for the installation of ventury system as conditional component while considering for subsidy availment.
5. The outflow of water on a uniform scale invariably requires a pressure gauge in the system. In the present study it was noticed that nearly 51.9 percent of the beneficiaries have installed the pressure gauge and 49.1 percent of the beneficiaries have not installed. Uneven power supply will hamper the uniform distribution of water both in sprinkler and drip system. Hence, it is essential to ensure installation of the pressure gauge as mandatory requirement. Normally the pressure requirement for sprinkler and drip irrigation are respectively, 16-to-40-meter head (50 psi) and 8-to-20-meter head (30 psi), which need to be trained and guided to the farmers by the installing agencies.
6. Emitters are the units which are designed to discharge a known quantum of water in a given rate of time and its presence in the system ensures perfect distribution of water. During field survey, it is found 60.1 percent of the beneficiaries using which leads to manage uniform distribution of water unlike non-adopters of emiters (39.9 %) where distribution is an issue of concern.
7. Proper functioning of the MI system particularly drip system invariably requires the installation of filter at the source of supply to filter off soil/clay particles and un-dissolved salts and other physical impurities, which later choke the final tips of emitters. Majority of the beneficiaries (64.5%) have installed the filter system which is quite encouraging. However, technical follow-up and guidance are needed to non-adopters of filters (34.5 %).
8. It is quite interesting to note maximum beneficiaries (88.2%) expressed installed MI system meet crops water requirement. While, 8.8 percent beneficiaries expressed installed system not fulfilling crop water requirement, which is again calls for review in the system design and maintenance.
9. The designed system of an initial crop and leading to subsequent crops is quite encouraging. In the current study 71.8 percent beneficiaries expressed that installed

design suits to other crops during subsequent seasons. With, 27.2 percent opined the non-suitability of the system. Thus, a technical advice on crop planning, crop rotation and year-round utilization of system required once installed to be executed from MI companies and supervisory authorities.

10. Availing material and system functioning warranty is quite low (43.2%) which need to be again initiated through orientation, training and frequent combined field inspection of agents/MI agency representative and departmental staff

Irrigation filter usage

Table 4.32 provides information on usage of filter. Clear water is crucial for proper and effective long-term operation of micro irrigation systems and in which water filtration play important role in cleaning the water. Clogging of nozzles, emitters/drippers reduce the efficiency of the MI system which ultimately results in increase in energy consumption and maintenance as well as cost of irrigation. Filters can help extend the life of the system and lower the maintenance on sprinkler system. For drip system it is necessity to prevent emitters from becoming plugged. The yield is also affected because of clogging. In drip and sprinkler irrigation system, the quality of water being pumped into the irrigation system is the most important factor in filter selection.

In the current study, it is observed that 64.5 percent of the beneficiaries have invariably installed the various types of filters, whereas 35.5 percent of the beneficiaries have failed to install the filters. With respect to district wise analysis, maximum number of beneficiaries of Shivamogga and Uttara Kannada district have installed the filters to an extent of 79.2 and 77.4 percent respectively. Thus, it could be inferred that maintenance of the MI system and its functioning will be better in these categories of beneficiaries who have installed the filters.

Table 4.32: Irrigation filter used in MIS

District	Sample size (No.)	Beneficiary (%)	
		Adopted	Not Adopted
Belagavi	376	38.3	61.7
Bidar	364	71.2	28.8
C. R. Nagar	370	59.2	40.8
Haveri	375	76.5	23.5
Kalaburgi	370	48.9	51.1
Kolar	362	64.1	35.9
Mysuru	376	64.6	35.4
Shivamogga	375	79.2	20.8
Tumakuru	372	66.4	33.6
Uttara Kannada	350	77.4	22.6
Total	**3690**	**-**	**-**
Average -%		**64.5**	**35.5**

Sources: Field study

Filtration may be accomplished through use of filters. During field visit it is observed there are four types of filters namely, sand filters, screen filter, disc filter and hydro cyclone (Table 4.33). Owing to the economic cost, and acceptability and easy maintenance many of the beneficiaries have adopted screen filter (69%) followed by sand filter (15%) and hydro cyclone filter (10%). The usage of screen filter was common in majority of the district up to the extent of over 90 percent in Belagavi, Tumakuru and Uttara Kannada. It is realised from the beneficiaries that the usage of screen filter removes many physical impurities and this could be easily cleaned by beneficiaries themselves.

Table 4.33: Type of filter used in the micro irrigation system

District	Sample size (No.)	Type of filter used by beneficiaries (%)			
		Hydro cyclone	Screen filter	Sand Filter	Disc filter
Belagavi	144	2.0	92.0	6.0	0.0
Bidar	259	19.0	56.0	18.0	7.0
C. R. Nagar	219	17.0	57.0	9.0	17.0
Haveri	287	8.0	56.0	33.0	2.0
Kalaburgi	181	0.0	55.0	45.0	0.0
Kolar	232	32.0	31.0	16.0	21.0
Mysuru	243	8.0	85.0	4.0	3.0
Shivamogga	297	6.0	74.0	15.0	4.0
Tumakuru	247	5.0	91.0	0.0	4.0
Uttara Kannada	271	2.0	90.0	7.0	0.0
Total	**2380**	**-**	**-**	**-**	**-**
Average -%		**10.0**	**69.0**	**15.0**	**6.0**

Sources: Field study

The investment by the beneficiaries as reflected in the nature of its maintenance was expressed in terms of the lifespan of the micro irrigation system Table 4.34. Longer the lifespan of the MI system better would be the economic returns to the beneficiaries. Detailed district-wise response from beneficiaries towards life span of the MI system is presented in Table 4.34. In the present study it is observed that maximum proportion of farmers have expressed the lifespan of MI is between 3 to 5 years (36.3%) followed by 2 to 3 years (32.8%). This variation in the lifespan of the MI system largely depends on quality of the material, maintenance and designing of the system. Also adequate initial and subsequent training on quality material selection, involving in designing, and demonstrations on filter cleaning, acid flushing of laterals, replacing defective/clogged emitters, improper rolling of laterals during inter cultivation will affect the life span of the system. Among various districts, it is noted that the beneficiaries in Uttara Kannada (71.1%) have expressed longer lifespan of the system compared to other districts. Thus, suitable addressing the issue through proper training and periodic follow up guidance will improve the longevity of the unit. Additionally, this particular issue calls for review of the policy to re extend the benefits after a set standard of lifespan. Few interactions and discussion with micro irrigation system manufactures and agencies the average life span of the micro irrigation system may last for about 8 years subjected to quality and maintenance of the system. It is also noticed that on conservative estimate the life span of MI equipment in general is about 5 years.

Table 4.34: Status of life span of the MI system

District	**Sample size (No.)**	**Beneficiaries response (%)**				
		1 year	**1 to 2 years**	**2 to 3 years**	**3 to 5 years**	**> 5 years**
Belagavi	376	7.2	3.5	17.8	51.1	20.5
Bidar	364	0.0	22.0	2.7	57.1	18.1
C. R. Nagar	370	0.0	27.3	33.8	10.0	28.9
Haveri	375	0.5	1.3	50.9	37.3	9.9
Kalaburgi	370	0.0	0.0	0.0	53.5	46.5
Kolar	362	1.1	14.9	20.7	17.1	46.1
Mysuru	376	0.3	5.1	63.3	0.5	30.9
Shivamogga	375	1.1	13.9	44.5	40.3	0.3
Tumakuru	372	0.3	1.6	65.3	26.6	6.2
Uttara Kannada	350	0.0	0.0	27.4	71.1	1.4
Total	**3690**	**-**	**-**	**-**	**-**	**-**
Average -%		**1.1**	**8.9**	**32.8**	**36.3**	**20.9**

Sources: Field study

4.3.9 Post installations services

Sustained operational functionality invariably calls for the support services from MI agencies by duly following the guarantee and warranty conditions, failing which the investment on this technology will become burden. Fig 4.24 describes availing of post installation services of MI system by beneficiaries. During field study it was noted that, failure to extend post installation services by MI agencies is up to an extent of 79 percent and this is quite alarming and warranty on the part of the implementation partners to insist for a conditional post installation service. However, 21 percent beneficiaries expressed they have received post installation services from MI agency and leads to adoptive mechanism in the operationalization of the scheme.

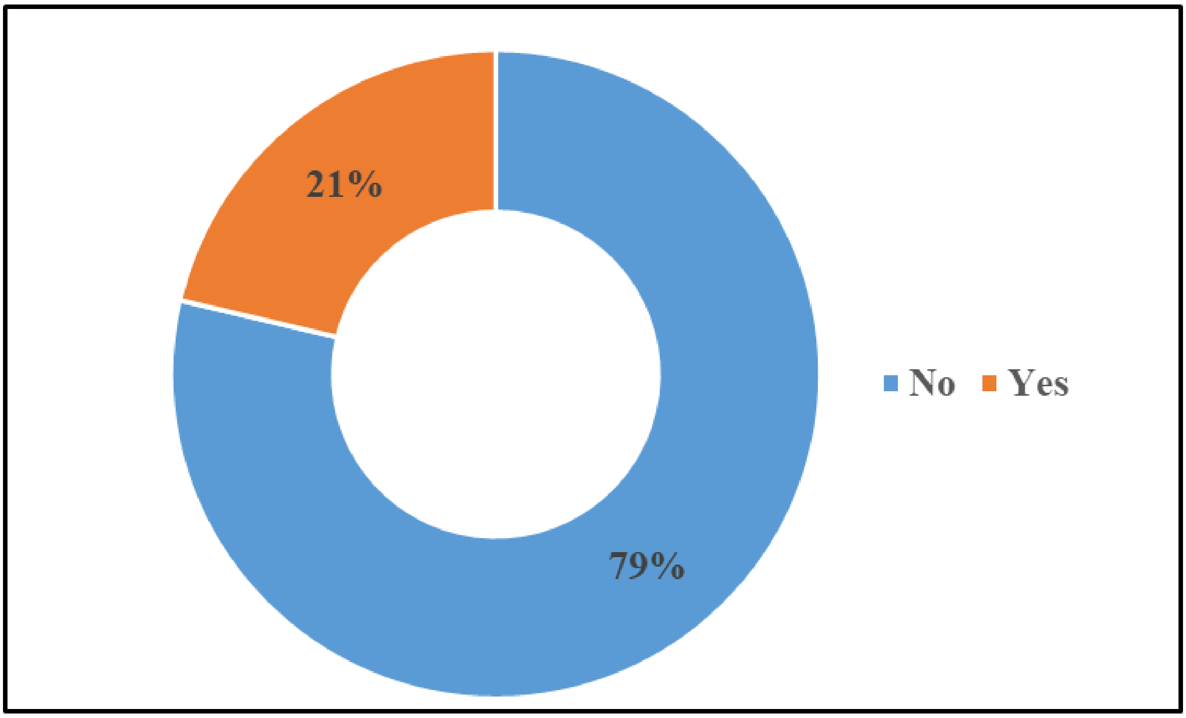


Fig 4.24: Availing of post installation services of MI system by beneficiaries
Sources: Field study

Table 4.35 describes district wise beneficiaries availed the post installation services of MI system. Among the district in study area, Uttara kannada district beneficiaries suffered heavily without the maintenance support to an extent of 96.9 percent followed by Belagavi (88.3%). With respect maintenance support for drip and sprinkler irrigation it is observed up to 72.9 and 83.3 percent respectively in the lack of post installation services by MI agency was common in Uttara kannada district.

Table 4.35: District wise and component wise availing of post installation services by beneficiaries

District	Sample size (No.)	MI (%)		Sample size (No.)	Drip (%)		Total beneficiary (No.)	Sprinkler (%)	
		Yes	No		Yes	No		Yes	No
Belagavi	376	11.7	88.3	262	16.0	84.0	114	1.8	98.2
Bidar	364	36.8	63.2	170	64.1	35.9	194	12.9	87.1
C. R. Nagar	370	18.1	81.9	235	14.0	86.0	135	25.2	74.8
Haveri	375	17.1	82.9	111	31.5	68.5	264	11.0	89.0
Kalaburgi	370	29.7	70.3	110	59.1	40.9	260	17.3	82.7
Kolar	362	33.4	66.6	211	44.5	55.5	151	17.9	82.1
Mysuru	376	14.9	85.1	104	16.3	83.7	272	14.3	85.7
Shivamogga	375	35.7	64.3	104	25.0	75.0	271	39.9	60.1
Tumakuru	372	12.4	87.6	179	10.1	89.9	193	14.5	85.5
Uttara Kannada	350	3.1	96.9	162	4.9	95.1	188	1.6	98.4
Total	**3690**	**-**	**-**	**1648**	**-**	**-**	**2042**	**-**	**-**
Average -%		**21.3**	**78.7**		**27.1**	**72.9**		**16.7**	**83.3**

Sources: Field study

From the Table 4.36 it could be noted that beneficiaries farmers have been experienced the post installation services with in time span of 3 to 5 months (45%) and the major districts are like Shivamogga, Chamarajanagar, and Belagavi. Further it was noticed that 41 percent beneficiaries received services within two months and 13 percent beneficiaries after 6 months. In drip irrigation maximum (46%) beneficiaries have availed the post installation services within 2 months whereas, with sprinkler irrigation maximum (56%) beneficiaries have availed the services within 3 to 5 Months. Un-timely supervision and rectification process may result in deviating the MI system installation. Inadequate educating on access to regional post-installation service provisions by MI agencies are the main reasons. Post installation maintenance / service support from MI companies/dealers within a period of 2 months of installation is quite encouraging while delays by 3 to 5 months and beyond 6 months may affect the performance of the system and investment. Overcoming efforts with initial training on the provisions of guarantee and warranty of the prescribed periods, details of the established regional service centers and complaint redressal system operated by the

MI companies with toll-free helpline contact details and its publicity are to be mandatorily insisted by the supervisory departments. Inbuilt agronomic as well as system maintenance advisory services through SMS services also to be integrated.

Table 4.36: District wise and component wise time span for providing post installation services

District	Sample size (No.)	MI beneficiaries (%)			Drip beneficiaries (%)			Sprinkler beneficiaries (%)		
		0-2 Month	3-5 Month	6 month and above	0-2 Month	3-5 Month	6 month and above	0-2 Month	3-5 Month	6 month and above
Belagavi	44	20.0	73.0	7.0	21.0	71.0	7.0	0.0	100.0	0.0
Bidar	134	86.0	9.0	5.0	93.0	1.0	6.0	56.0	44.0	0.0
C. R. Nagar	66	23.0	76.0	2.0	38.0	59.0	3.0	9.0	91.0	0.0
Haveri	64	53.0	23.0	23.0	26.0	37.0	37.0	86.0	7.0	7.0
Kalaburgi	110	88.0	9.0	3.0	95.0	0.0	5.0	78.0	22.0	0.0
Kolar	121	2.0	67.0	31.0	2.0	64.0	34.0	4.0	78.0	19.0
Mysuru	57	44.0	14.0	42.0	6.0	28.0	67.0	62.0	8.0	31.0
Shivamogga	134	9.0	85.0	6.0	0.0	100.0	0.0	11.0	81.0	7.0
Tumakuru	46	13.0	72.0	15.0	11.0	50.0	39.0	14.0	86.0	0.0
Uttara Kannada	11	82.0	9.0	9.0	75.0	13.0	13.0	100.0	0.0	0.0
Total	**787**	-	-	-	-	-	-	-	-	-
Average -%		**41.0**	**45.0**	**13.0**	**46.0**	**37.0**	**18.0**	**36.0**	**56.0**	**8.0**

Sources: Field study

4.3.10 Soil test

Popular programs like soil health testing have enabled a maximum number of farmers to test the soils to supplement benefits of micro-irrigation. The district-wise soil test benefit availed by beneficiaries and non-beneficiaries were presented in Table 4.37. Among beneficiaries, it is observed that 62.3 percent beneficiaries under taken soil test, while 37.7 percent beneficiaries are still required guidance to gain benefits of soil test information. Maximum numbers of beneficiaries undertaken the soil testing were represented from Tumakuru, Chamarajanagar, Shivamogga and Mysuru at 84.1, 83.5, 82.9 and 82.3 percent, respectively, and least in Bidar districts which is only 17.3 percent.

Among non-beneficiaries, a similar trend of adoption of soil test was noticed with an average 60 percent. Farmers of Kolar district have undergone 100 percent of soil test, followed by Bidar, Chamarajanagar, Mysuru, and Uttara Kannada which are equally (75%). Belagavi, Kalaburgi, Shivamogga, Tumakuru with 50 percent each, and farmers of Haveri district yet to undergo soil test. The soil test results will support towards preparation of crop planning, irrigation schedules and fertigation.

Table 4.37: District wise conduct of soil test among beneficiary and non-beneficiaries

District	Total beneficiaries (No.)	Response (%)		Total non-beneficiaries (No.)	Response (%)	
		Yes	No		Yes	No
Belagavi	376	67.0	33.0	4	50.0	50.0
Bidar	364	17.3	82.7	4	75.0	25.0
C. R. Nagar	370	83.5	16.5	4	75.0	25.0
Haveri	375	29.9	70.1	4	0.0	100.0
Kalaburgi	370	29.2	70.8	4	50.0	50.0
Kolar	362	71.8	28.2	4	100.0	0.0
Mysuru	376	75.5	24.5	4	75.0	25.0
Shivamogga	375	82.9	17.1	4	50.0	50.0
Tumakuru	372	84.1	15.9	4	75.0	25.0
Uttara Kannada	350	82.3	17.7	4	50.0	50.0
Total	**3690**	**-**	**-**	**40**	**-**	**-**
Average -%		**62.3**	**37.7**		**60.0**	**40.0**

Sources: Field study

Table 4.38 reveals the adoption of soil test recommendation (soil amendment) by the beneficiaries and non-beneficiaries. Field survey result was quite marginal to the extent of 47.6 percent have expressed fully adopted, 41.1 percent beneficiary are partially adopted, and 11.3 percent beneficiaries have not followed among beneficiaries. With respect to district-wise adoption of recommended doze, Mysuru beneficiaries showed maximum extent of 74.6 percent, followed Shivamogga (64.6%) and Kolar (56.2%) respectively, and least adoption was noticed in with Haveri beneficiaries which is only 3.6 percent. Under non-beneficiaries, category soil testing practice Shivamogga district farmers have adopted 100 percent, followed by Bidar, Mysuru and Uttara Kannada with 66.7 percent each.

However, beneficiaries belong to Kalaburgi (50%) and Bidar (33.3%) are yet to be follow-up soil test recommendations. These results revel the fact that the implications of the soil testing are yet to be operationalized at farmer's level although it is one of the mandates of the scheme.

Table 4.38: Pattern of adoption practices of soil test recommendations

District Name	**No. of farmer availed soil test**	**Beneficiaries (%)**			**No. of farmer availed soil test**	**Non-beneficiaries (%)**		
		Fully adopted	**Not adopted**	**Partially adopted**		**Fully adopted**	**Not adopted**	**Partially adopted**
Belagavi	252	33.7	28.6	37.7	2	0.0	0.0	100.0
Bidar	63	50.8	31.7	17.5	3	66.7	33.3	0.0
C. R. Nagar	309	35.6	5.2	59.2	3	33.3	0.0	66.7
Haveri	112	3.6	2.7	93.8	0	0	0	0
Kalaburgi	108	42.6	46.3	11.1	2	0.0	50.0	50.0
Kolar	260	56.2	6.9	36.9	4	0.0	0.0	100.0
Mysuru	284	74.6	7.0	18.3	3	66.7	0.0	33.3
Shivamogga	311	64.6	5.5	29.9	2	100.0	0.0	0.0
Uttara Kannada	313	36.1	8.9	55.0	3	66.7	0.0	33.3
Tumakuru	288	50.7	5.6	43.8	2	0.0	0.0	100.0
Total	**2300**	**-**	**-**	**-**	**24**	**-**	**-**	**-**
Average -%		**47.6**	**11.3**	**41.1**		**37.5**	**8.3**	**54.2**

Sources: Field study

4.3.11 Details of irrigation sources

Different water sources enabling the MI installation in different districts is presented in the comprehensive Fig 4.25 and Table 4.39. The common water bodies are found among beneficiaries and non-beneficiaries land are open well, borewell and farm ponds. However, farmers use either one sources or multiple sources for their irrigation purposes based on requirement of water and seasonal availability of water. During field study it was observed that borewells are the predominant source of water by beneficiaries as well as non-beneficiaries in all the districts which accounts 94.0 and 97.5 percent, respectively, followed by open well. However, least dependence was noticed with farm ponds. Among districts, under MI beneficiaries, C.R. Nagar, Mysuru and Shivamogga district beneficiary have completely relied on borewell sources of water. Use of open well as water source for irrigation was found limited to only 30 percent and that to majority of them are belongs to Bidar district. Use of combination of borewell and farm pond is very common practice in Kolar, Tumakuru and Haveri district where farm ponds are commonly used as water storage unit in which water usually stored by pumping water from open well or borewell which can be used further during critical period. Among non-beneficiaries, only in Belagavi and Bidar districts used open wells for irrigation practices, whereas, remaining districts are dependent on borewell as sole source.

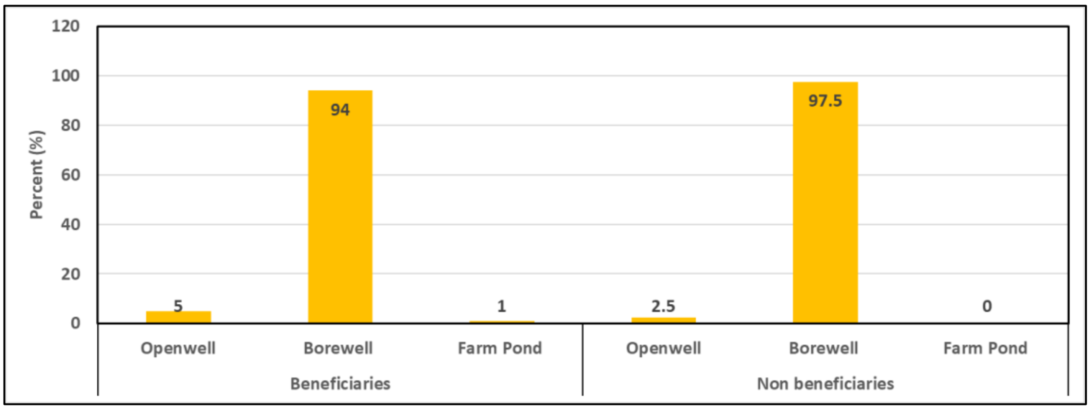


Fig 4.25: Sources of water for MI implementation
Sources: Field study

Table 4.39: Details of irrigation source for MI practices

District	Sample size (No.)	Beneficiaries (%)		
		Open well (OW)	Borewell (BW)	Farm Pond (FP)
Belagavi	376	17	83	0
Bidar	364	30	67	3
C. R. Nagar	370	0	100	0
Haveri	375	1	98	1
Kalaburgi	370	0	99	1
Kolar	362	0	93	7
Mysuru	376	0	100	0
Shivamogga	375	0	100	0
Tumakuru	372	0	98	2
Uttara Kannada	350	1	99	0
Total	**3690**	-	-	-
Average -%		5	94	1

District	**Sample size (No.)**	**Beneficiaries (%)**		
		Open well (OW)	**Borewell (BW)**	**Farm Pond (FP)**
	Non-Beneficiaries (%)			
Belagavi	4	10.0	90.0	00.0
Bidar	4	15.0	85.0	00.0
C. R. Nagar	4	00.0	100.0	00.0
Haveri	4	0.00	100.0	0.00
Kalaburgi	4	00.0	100.0	00.0
Kolar	4	0.00	100.0	0.00
Mysuru	4	00.0	100.0	00.0
Shivamogga	4	0.00	100.0	0.00
Tumakuru	4	00.0	100.0	00.0
Uttara Kannada	4	0.00	100.0	0.00
Total	**40**	**-**	**-**	**-**
Average -%		**2.5**	**97.50**	**0.00**

Sources: Field study

Table 4.40 revels that water table depth is an important criterion to consider while analysing the water usage as it helps for the selection of appropriate pump with necessary capacity. During the field study it was observed that depth of open well ranges from 10 to 100 ft and maximum open wells found in Bidar (92%) followed by Belagavi (78%) district where in depth ranges between 25 to 50 ft. With respect borewells, more than 500 to 750 ft depth were most common with 48% beneficiaries followed by 250 to 500 ft depth which accounts with 34 percent of beneficiaries and only 2 percent farmers have borewell depth of more than 100ft. Similar trend was also observed with non-beneficiaries. However, farm ponds are only 3 mt deep and helped in storing water store water for further usage. The study results showed that in all district farmers are heavily dependent deep ground water for their agriculture which leads ground water depletion in future and it required urgent attention to rejuvenate at individual level by promoting rainwater harvesting structure around borewell.

Table 4.40: Scenario of water table depth (feet) in the sample district

District	**Beneficiaries**									
	Open well (%)				**Borewell (%)**					
	Sample size (No.)	**10 - 25 ft**	**25-50 ft**	**50-100 ft**	**Sample size (No.)**	**Up to 250 ft**	**250-500 ft**	**500-750 ft**	**750-1000 ft**	**>1000 ft**
Belagavi	88	06.0	78.0	16.0	395	3.0	17.0	67.0	13.0	0.0
Bidar	163	07.0	92.0	01.0	365	7.0	61.0	26.0	2.0	4.0
C. R. Nagar	0	0.0	0.0	0.0	371	20.0	32.0	40.0	7.0	1.0
Haveri	4	25.0	50.0	25.0	385	7.0	61.0	29.0	3.0	1.0
Kalaburgi	0	0.0	0.0	0.0	385	4.0	47.0	35.0	10.0	4.0
Kolar	1	00.0	00.0	100.0	373	2.0	11.0	68.0	15.0	4.0
Mysuru	1	00.0	00.0	100.0	382	8.0	49.0	30.0	9.0	4.0
Shivamogga	0	0.0	0.0	0.0	375	2.0	13.0	78.0	8.0	0.0
Tumakuru	4	00.0	25.0	75.0	529	16.0	22.0	50.0	12.0	1.0
Uttara Kannada	0	0.0	0.0	0.0	368	11.0	29.0	52.0	6.0	2.0
Total	**261**	**-**	**-**	**-**	**3928**	**-**	**-**	**-**	**-**	**-**
Average -%		**07.0**	**85.0**	**08.0**		**8.0**	**34.0**	**48.0**	**9.0**	**2.0**
	Non-Beneficiaries									
	Open well (%)				**Borewell (%)**					
Belagavi	0	0.0	0.0	0.0	4	25.0	25.0	50.0	0.0	0.0
Bidar	3	100.0	0.0	0.0	4	0.0	50.0	50.0	0.0	0.0
C. R. Nagar	0	0.0	0.0	0.0	4	0.0	0.0	100.0	0.0	0.0
Haveri	0	0.0	0.0	0.0	4	0.0	50.0	50.0	0.0	0.0
Kalaburgi	0	0.0	0.0	0.0	4	0.0	0.0	50.0	50.0	0.0
Kolar	0	0.0	0.0	0.0	4	0.0	25.0	50.0	25.0	0.0
Mysuru	0	0.0	0.0	0.0	4	0.0	75.0	25.0	0.0	0.0
Shivamogga	0	0.0	0.0	0.0	4	0.0	0.0	75.0	25.0	0.0
Tumakuru	0	0.0	0.0	0.0	6	0.0	17.0	50.0	33.0	0.0
Uttara Kannada	0	0.0	0.0	0.0	4	0.0	50.0	25.0	25.0	0.0
Total	**3**	**-**	**-**	**-**	**42**	**-**	**-**	**-**	**-**	**-**
Average -%		**100.0**	**0.0**	**0.0**		**2.0**	**29.0**	**52.0**	**17.0**	**0.0**

Sources: Field study

From Table 4.41 it can been seen that ground water situation is alarming in study area. The average depth for sourcing water was at 460.8 ft in MI beneficiaries lands and 520 ft under nonbeneficiaries. Among various district, maximum (604.8 ft) deep borewells are observed in the Kolar district beneficiaries land, followed by Shivamogga (547.7ft) and minimum depth of borewell (361 ft) noticed in Mysuru. Average water yield of borewell is 2.1 inch under beneficiaries land and 2.0 inch in non-beneficiaries. Study results show that on an average gross irrigated area per borewell is 9.5 acres in MI beneficiaries and - 5.96 acre under non-beneficiaries. This indicates maximum cultivable area was facilitated by borewell found among MI beneficiaries compared to non-beneficiaries. Among various district under MI beneficiaries, gross irrigated area per borewell found to be maximum (13.2 acre) in Kolar followed by Mysuru (12.8 acre) and minimum (6.4 acre) gross irrigated per borewell noticed under Haveri district. While among nonbeneficiaries, maximum (7.02 acre) gross irrigated per borewell found in Kolar and Haveri MI beneficiaries and minimum of 4.35 acre per borewell in Bidar district beneficiaries land. Overall study results indicates that deeper borewells implies declining dependency of farmers on surface water schemes and increasing dependency on ground water schemes for meeting their minor irrigation needs. So, in order to decrease the dependency of farmers on ground water and to reduce the further depletion of ground water, surface water sources need to be restored through convergence of various scheme in order to continue to derive irrigation benefits from them.

Table 4.41: Ground water irrigation scenario in the study area.

District	Beneficiaries			Nonbeneficiaries		
	Avg. Depth (ft)	Average yield water (inches)	Gross irrigated area/borewell	Avg. Depth (ft)	Average yield water (inches)	Gross irrigated area/borewell
Belagavi	414.8	2.1	7.8	383.3	2.3	6.93
Bidar	368.6	2.3	10.4	456.2	2.0	4.35
C. R. Nagar	376.3	2.2	9.5	525.6	2.1	6.80
Haveri	418.0	2.1	6.4	516.7	2.1	7.02
Kalaburgi	448.3	1.8	9.7	575.8	2.0	5.64
Kolar	604.8	2.4	13.2	665.7	1.6	7.02
Mysuru	361.4	2.5	12.8	557.2	2.4	4.85
Shivamogga	547.6	2.3	7.2	512.6	2.2	6.36
Tumakuru	527.7	1.6	10.3	620.1	2.0	4.94
Uttara Kannada	540.9	2.2	7.2	389.9	1.7	5.66
Total/Average	**460.8**	**2.1**	**9.5**	**520.3**	**2.0**	**5.96**

Sources: Field study

4.3.12 Dynamics of micro irrigation adoption

One of the main objectives of the scheme is to increase the micro irrigation adoption rate among various farming community. Thus, socio-economic profile of farmers adopting micro irrigation system (MI system) is examined in the current study. From Fig 4.26 it can be clearly observed that medium size farmers have adopted maximum (47.2%) MI system followed by small farmer (24.4%) and marginal farmer (19.1%). Whereas least MI adoption was observed with large farmers that is only 9.2 percent.

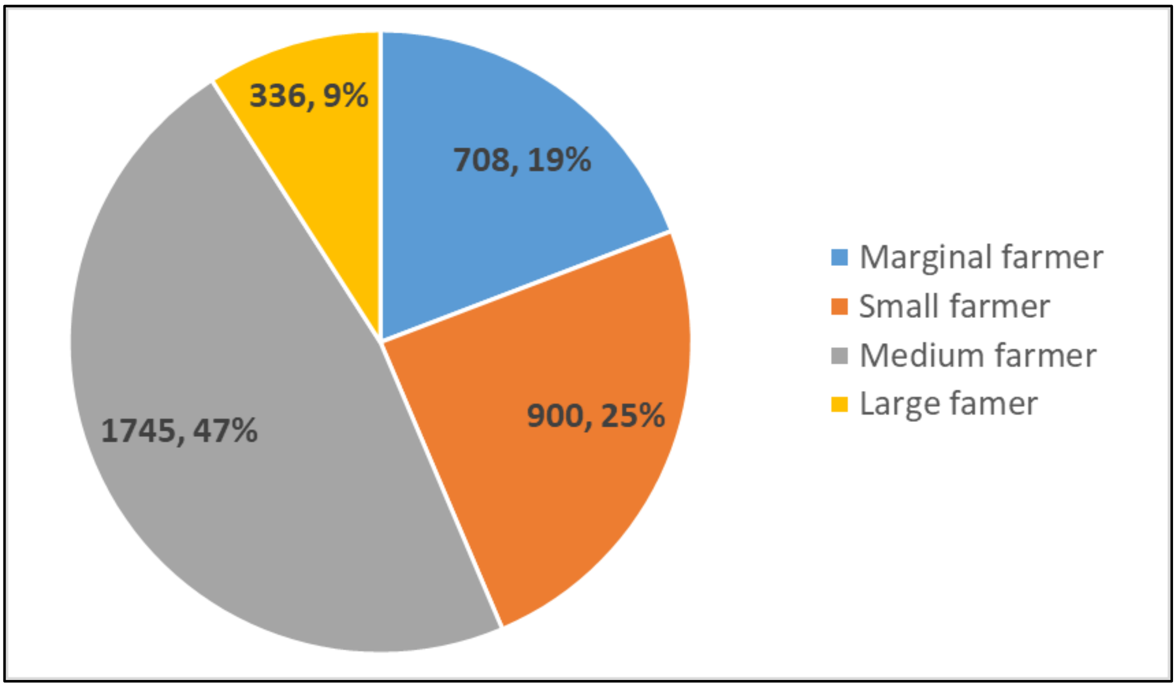


Fig 4.26: Land holding category wise adoption of MI system
Sources: Field study

District wise micro irrigation adoption by various farming community is described in Table 4.42. Within medium size category, Uttara Kannada district beneficiaries have highest adoption rate (53.8%) followed by Chamarajanagar and Shivamogga district beneficiaries. However, least (37.5%) adoption rate was noticed with Bidar district beneficiaries. Under small farmer category, farmers belong to Tumakuru district have maximum adaptation of MI followed by Bidar which is accounted 34.5 and 31.5 percent respectively whereas, least adoption rate was noticed with Kalaburgi district farmers (16.3%). In marginal and large farmers category, Shivamogga and Uttara Kannada beneficiaries have accounted maximum of 28.2 and 17.6 percent respectively and minimum adoption rate was observed in Kalaburgi district (14.7%) and Mysuru district (3.2%). This indicates concerted efforts in generating appropriate awareness from various partners on the scope and provisions of the PMKSY-

PDMC scheme, has consistently contributed towards the utilization of subsidy provisions and the technical applications leading to enhanced M I adoption by substantial number of farmers across the agro-climatic zones and with major three agrarian sectors in the state.

Table 4.42: District and farmer category wise MI adoption

Row Labels	**Sample size (No.)**	**Farmer category wise aadoption (%)**			
		Marginal farmer	**Small farmer**	**Medium farmer**	**Large famer**
Belagavi	376	14.6	24.5	48.4	12.5
Bidar	364	15.9	39.0	37.9	7.1
C. R. Nagar	370	13.0	21.9	53.0	12.2
Haveri	375	18.1	26.1	46.9	8.8
Kalaburgi	370	35.7	16.2	43.8	4.3
Kolar	362	16.9	26.5	47.2	9.4
Mysuru	376	28.2	19.7	48.9	3.2
Shivamogga	375	19.5	20.5	52.0	8.0
Tumakuru	372	14.5	34.4	41.1	9.9
Uttara Kannada	350	15.4	14.9	53.7	16.0
Total	**3690**	**-**	**-**	**-**	**-**
Average -%		**19.2**	**24.4**	**47.3**	**9.1**

Sources: Field study

Figure 4.27 to 4.30 depicts the corelation analysis of trainees and adoption of MI system among various farmers category. These figures indicate the linear relationship with R values 0.83 & 0.72 for medium and small farmers. The study revealed that training significantly influenced on their knowledge and interest towards technology which leads to increase in adoption of MI system among medium and small farmer as compared to other farming community.

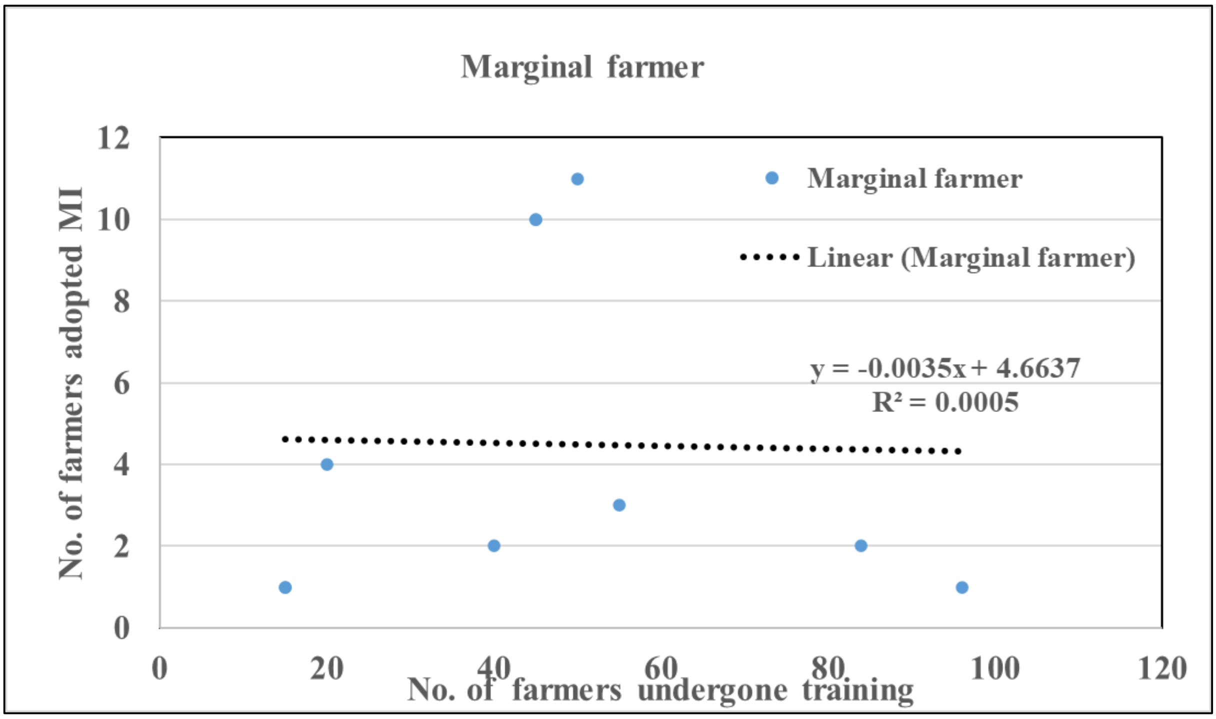


Fig: 4.27: Correlation between training participants and MI adoption of marginal farmer

Sources: Field study

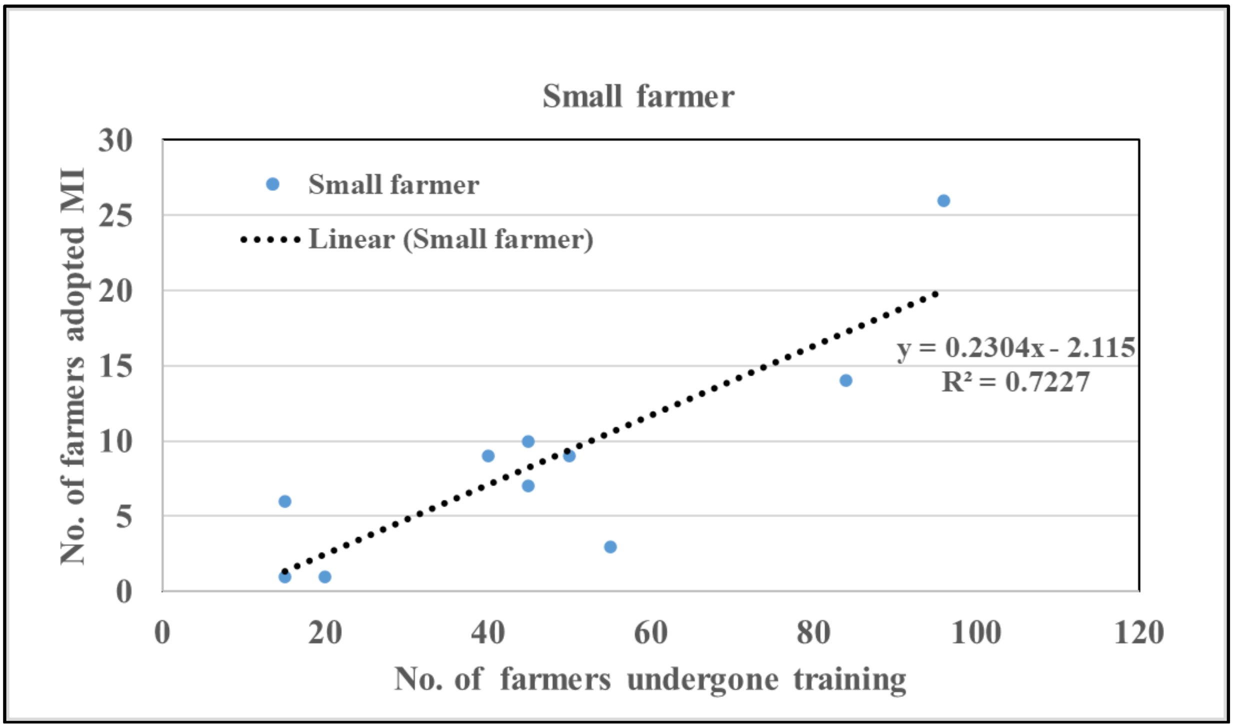


Fig: 4.28: Correlation between training participants and MI adoption of small farmer

Sources: Field study

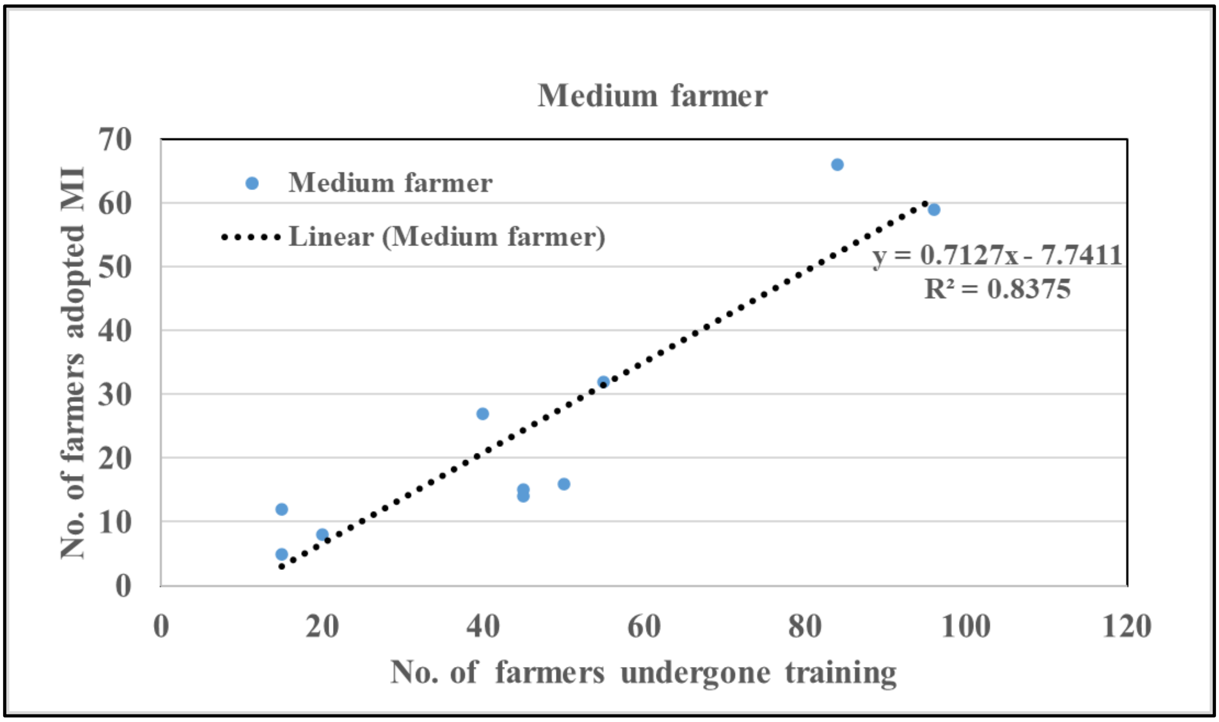


Fig: 4.29: Correlation between training participants and MI adoption of medium farmer

Sources: Field study

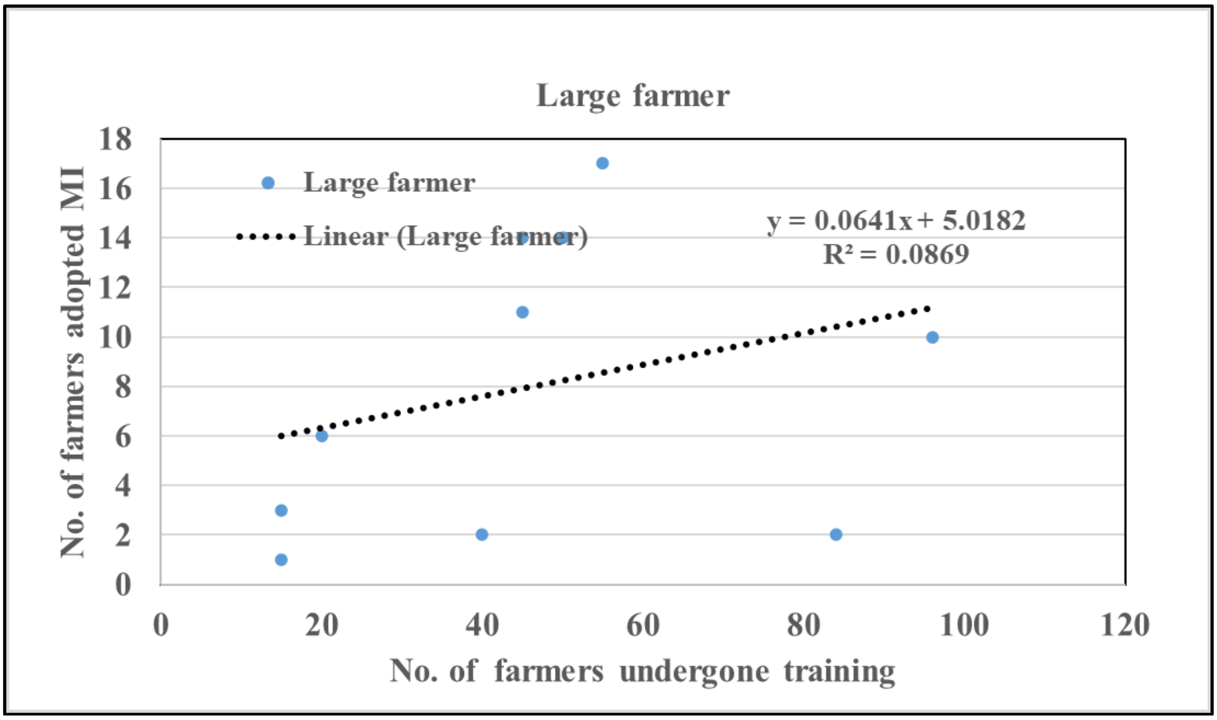


Fig: 4.30: Correlation between training participants and MI adoption of large farmer

Sources: Field study

From Fig 4.31 it is interesting to note that the beneficiaries belong to general category are benefitted more compared to other categories. Greater interest in the MI adoptability to the extent of 42,2, 26.8, 16.5 and 14.2 percent respectively found with general/ OBC, SC and ST category. The lower rate of MI adoption among socially vulnerable group may be due to inadequate awareness, lack of special drives and capacity building initiatives like training and exposure visits. Common and generalized opinion on cumbersome process, delays, high initial investment, inadequate knowledge on subsidy provisions, lack of quick and transparent responsive system with year-round production advisories and investment recovery plans with extension efforts and success stories are interrelated for low extent of adoption. However, it required relook the implementation strategy and put more effort toward promoting MI system among socially vulnerable group in upcoming MI programmes.

As evidenced in the case study analysis, the adoption of MI system is supported as a ray of hope to a socially vulnerable farmer in the Haveri district with the cotton crop.

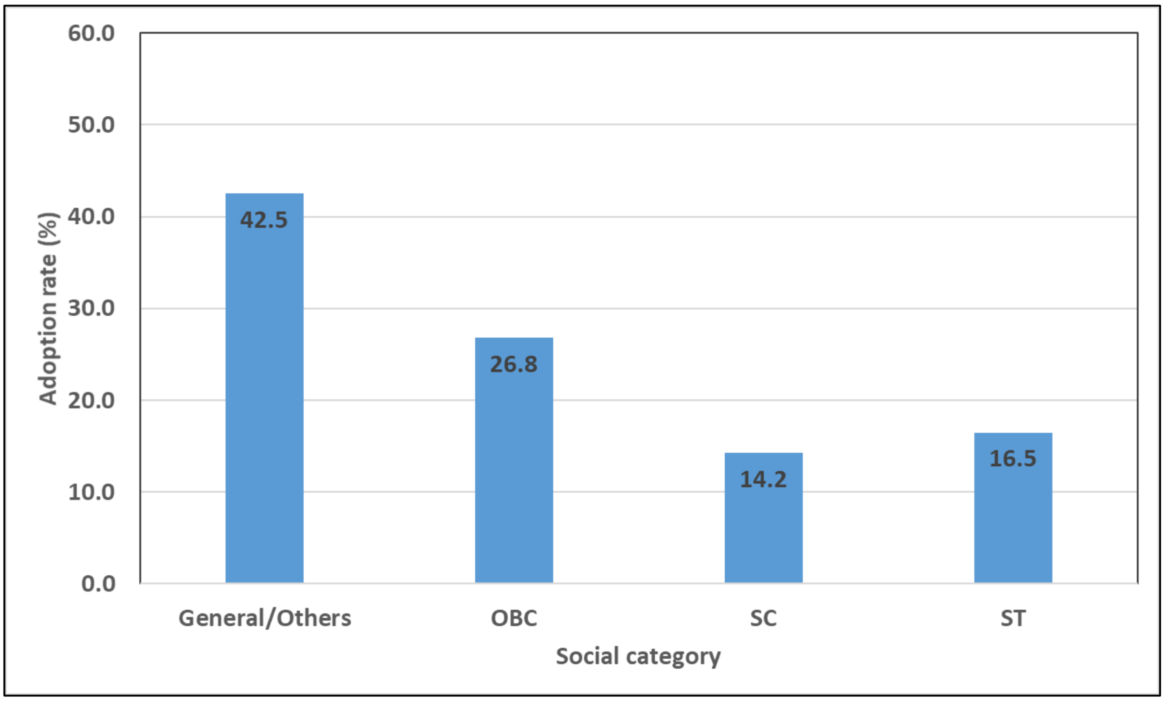


Fig 4.31: Social category wise MI adoption
Sources: Field study

Table 4.43 shows the district wise tabulated responses regarding the MI adoption by various social groups in the sample area. Out of 3690 sample, maximum (42.5%) adoption was observed with general/OBC category followed by OBC (26.8%) and least adoption was noticed in ST beneficiaries. With respect to district wise adoption rate among general category beneficiaries belongs to Uttara Kannada district showed higher adoption rate (58.4%) and least adoption rate was noticed in with Haveri district beneficiaries (24.0%). Among OBC, SC and ST category, adoption rate was maximum with Haveri (48.1%), Chamarajanagar (22.1%) and Belagavi (20.6%) beneficiaries respectively and minimum with Mysuru (19.1% and 9.8%) beneficiaries of OBC and SC category and ST category of Kalaburgi beneficiaries (11.6%). This contradicts the popular notion that only "higher caste farmers" can afford MI system. The low participation of the ST as respondents is also noticeable in the sample. This could be because of several reasons including: (i) lack of knowledge about the scheme, (ii) MIS being expensive for them even after the government subsidy provided, and (iii) due to an interplay of local dynamics, in which the caste, political as well as kinship related factors work in sharing the benefits. The surprising fact is the low participation of the scheduled castes require special incentives.

Table 4.43: District and social group wise MI adoption

Row Labels	**Sample size (No.)**	**Social category wise adoption (%)**			
		General/Others	**OBC**	**SC**	**ST**
Belagavi	376	27.4	37.5	19.8	20.6
Bidar	364	41.2	27.1	17.6	16.3
C. R. Nagar	370	46.0	21.0	22.9	19.4
Haveri	375	24.0	48.1	18.7	18.3
Kalaburgi	370	33.1	23.8	15.3	11.6
Kolar	362	46.9	23.5	17.7	15.3
Mysuru	376	47.7	19.1	9.8	16.4
Shivamogga	375	48.5	24.2	19.2	16.0
Tumakuru	372	51.8	23.3	17.4	15.6
Uttara Kannada	350	58.4	20.3	16.1	15.4
Total	**3690**	**-**	**-**	**-**	**-**
Average -%		**42.5**	**26.8**	**17.4**	**16.5**

Sources: Field study

From Fig 4.32 It is can be that, the proportion of MI adoption with respect to gender, the ratio between the genders is almost 1/3rd. Male gender representation is recorded at 72.6 percent, and female gender representation is only 27.4 percent. Therefore, to meet the goal of ‘minimum government, maximum governance’ and accelerate the rate of adoption of micro irrigation in state, there is a need to adopt ‘a different approach’. The online system will have a best practice so that the farmer can make complaints for system malfunctioning and related issues

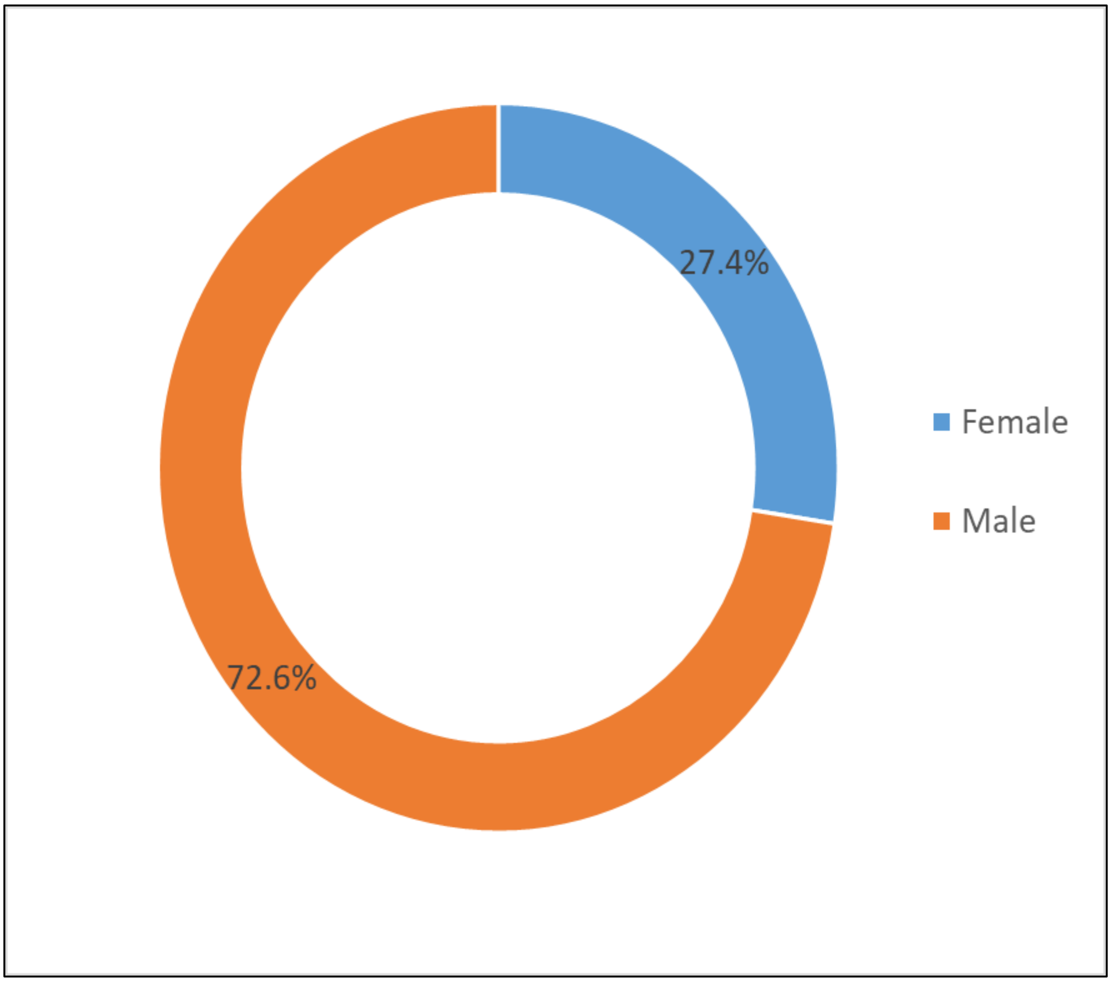


Fig: 4.32: Gender wise MI adoption pattern in the study area
Sources: Field study

Table 4.44, describes the district wise adoption of MI by male and female beneficiaries. Among male, beneficiaries belong to Belagavi district have showed maximum (79%) adoption rate compared to others district beneficiaries. Whereas, minimum adoption rate found with Tumakuru (66.1%) beneficiaries. Among female beneficiary highest adaptation of MI was noticed with Shivamogga followed by Tumakuru and minimum with Belagavi beneficiaries which is accounted 33.9, 30.9 and 20.1 percent respectively.

Table 4.44: District wise adoption of MI by different gender

District	Sample size (No.)	Gender wise adoption (%)	
		Female	Male
Belagavi	376	20.1	79.9
Bidar	364	32.5	67.5
C. R. Nagar	370	31.3	68.7
Haveri	375	23.6	76.4
Kalaburgi	370	21.9	78.1
Kolar	362	27.3	72.7
Mysuru	376	29.6	70.4
Shivamogga	375	30.9	69.1
Tumakuru	372	33.9	66.1
Uttara Kannada	350	23.0	77.0
Total	**3690**	**-**	**-**
Average -%		**27.4**	**72.6**

Sources: Field study

The below Table 4.45 shows the farmers response to various reasons for adoption of MI. One of the prime reasons for adoption of MI system by beneficiaries is quite acceptable that MI is water saving technology and found on an average 14.6%. Among various district Tumakuru, Chamarajanagar and Mysuru district beneficiaries expressed MI adoption is mainly due to a water saving technology. Owing to the financial investment support as subsidy component under the scheme has attracted an average of beneficiaries to the extent 11.3 percent. Among various district beneficiaries belongs to Haveri district found maximum interest followed by Shivamogga district and minimum response towards subsidy was noticed in Belagavi. Other strong reason which is quite realistic is proper utilization of land, labour and time saving in irrigation which accounts to 8.7 percent. It is quite interesting to note that MI adoption taken place due to high-cost fertilizer, production enhancement / yield and also cover additional area of crop which ranges 7.27 to 7.94 percent. The advice of departmental officials and towards early planting which covered up 6.8 and 6.5 percent of the preference to adopt MI systems. Similarly, MI system enabling off season production and early fruiting practice to the extent of 5.98 and 5.53 percent is also quite interesting.

Table 4.45: Reasons for adoption of MI system by beneficiaries

District	Total response (No.)	Beneficiary response (%)											
		Due to subsidy support	Effective water utilization	Labor Scarcity	High-cost Fertilizer	Off season Production	Production enhancement / yield	Dept. Officials Advice	Proper Utilization Of land	Time saving in irrigation	Early planting	Covering additional area	Early fruiting
Belagavi	2320	8.1	15.0	9.0	8.1	6.9	7.4	8.9	8.4	8.8	4.7	7.8	7.1
Bidar	2835	10.3	16.5	10.2	7.7	4.5	9.9	3.8	8.3	9.9	4.1	8.4	6.4
C. R. Nagar	2516	11.7	17.5	7.0	5.7	5.9	8.3	7.2	10.1	9.2	6.8	6.5	4.2
Haveri	1738	15.5	8.8	8.7	4.9	3.6	7.7	6.8	10.0	13.3	4.1	11.1	5.5
Kalaburgi	3458	10.6	16.6	8.2	8.9	8.1	6.2	5.9	8.8	8.5	8.0	6.5	3.6
Kolar	3280	10.6	14.8	8.3	7.5	7.7	8.8	7.2	8.2	7.1	8.5	6.9	4.3
Mysuru	3391	10.4	17.0	5.7	8.7	4.3	9.1	4.5	8.9	8.7	5.2	8.8	8.8
Shivamogga	2150	14.5	9.9	7.9	7.1	8.0	5.4	12.3	8.7	4.7	9.5	6.2	5.8
Uttara Kannada	2718	11.5	12.6	8.9	6.8	8.3	7.8	7.9	8.1	8.1	8.3	8.6	3.2
Tumakuru	3217	10.4	17.9	9.3	7.3	2.5	8.2	4.4	9.4	9.0	6.7	8.6	6.4
Total	**27623**	**--**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Average -%		**11.36**	**14.66**	**8.32**	**7.27**	**5.98**	**7.88**	**6.89**	**8.89**	**8.73**	**6.59**	**7.94**	**5.53**

Sources: Field study

PMKSY PDMC scheme although envisages effective implementation of the scheme by gathering decadal experiences, still not able to minimize/reduce certain critical constrains which calls for a critical review of the implementation norms and procedures. Table 4.46 describes district-wise difficulties faced by the farmer in adopting and maintenance of MI Scheme. 63.7% beneficiaries, have expressed that an inadequate power supply has found to be affected. Further, administrative procedural anomalies have affected the subsidy claims to the extent of 52.2 percent with beneficiaries which is alarming to note and calls for drastic measures in the system and to comfort the claiming procedure. The other reflections factors area delay in system installation (43.7%), differences in quality material supply by (43.10%), cumbersome procedures (42.4%), difficulty during inter-cultivation (41.5%), quality issues of MI components (34.8%), lack of guidance in utilizing and managing the system (34.1%), difficulty in maintaining proper pressure (31.3%) and clogging of emitters and laterals (25.70%). For all the above constraints, appropriate orientation and training has to be arranged among various beneficiaries. At the district level, it was found that Mysuru and Tumakuru have beneficiaries expressed those delays in availing the subsidies is mainly due to cumbersome procedural application and lack of guidance about the process in installation. While in Kolar district maximum beneficiaries expressed there was no much delay in the implementation of the MI system as there was only 9 percent of the claims that were delayed.

Table 4.46: Constraints of farmer in adopting and maintenance of MI Scheme

District	Sample size (No.)	Beneficiaries response (%)								
		Delay in subsidy claims	Cumbersome procedures	Quality material supply	Delay in system installation	Inadequate power supply	Lack of guidance	Clogging issues	Difficulty in maintaining proper pressure	Difficulty during inter cultivation
Belagavi	376	58.8	40.7	52.9	31.6	67.0	35.1	34.0	22.1	25.8
Bidar	364	57.1	28.8	17.6	52.5	81.9	69.2	11.3	3.6	42.9
C. R. Nagar	370	55.9	52.4	52.2	52.2	55.7	31.9	35.9	48.1	48.9
Haveri	375	45.3	57.6	50.4	36.8	68.0	13.6	17.9	23.5	24.5
Kalaburgi	370	56.2	1.6	35.9	37.6	84.6	59.2	43.5	14.6	24.9
Kolar	362	8.6	24.3	8.8	16.3	43.4	15.2	6.9	20.2	16.6
Mysuru	376	83.2	68.9	70.2	68.6	88.6	18.4	16.0	68.6	72.6
Shivamogga	375	24.0	22.9	22.7	26.9	25.3	54.7	48.3	16.0	45.6
Uttara Kannada	350	53.7	48.6	44.6	41.4	38.3	26.6	26.3	35.4	46.9
Tumakuru	372	77.7	77.4	73.9	72.8	82.3	17.5	16.4	59.9	65.9
Total	**3690**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Average -%		**52.2**	**42.4**	**43.1**	**43.7**	**63.7**	**34.1**	**25.7**	**31.3**	**41.5**

Sources: Field study

4.4 Impact Evaluation

4.4.1 Land use change

Micro irrigation is being practiced in different parts of the state since over three decades to improve the water use efficiency and crop productivity. By the adoption of MI technologies, it is possible for the beneficiaries to increase the area under cultivation by way of efficient use of water. In order to understand the additional area brought under irrigation, irrigated area before and after installation of MI was taken into consideration and accordingly district-wise percent change details are provided Table 4.47. Out of 6515.3 acre surveyed in the sample district, it was noticed that a maximum 76% (4920.0 acres) of rainfed and 24% (1594.0 acre) flood irrigated area has been converted to MI. Among districts, conversion MI from rainfed area was noticed is maximum (99% out 641 acres) in Kolar, followed by Kalaburgi and Mysuru (98% each out of 384.3, and 563.2 acre). A moderate range of enhanced MI area was observed in Belagavi (63% out of 786.8 acres) and Shivamogga (51% out of 699.2 acres) and least in Uttara kannada (13% out of 810.4 acre) as these areas are generally rainfall predominant districts. Likewise, the conversion of MI from flood irrigation practices in the survey district changed up to 24% of on an average, where in maximum conversion was observed in Uttara kannada (87% out of 810.4 acres), moderate in Shivamogga (49% out of 699.2 acre) and least was in Kolar (2%, out of 641.6 acres). These facts are reflection of desired impact as contemplated in the scheme objectives.

Among the area surveyed under drip irrigation, 77.7 percent out of 2792.3 acres of rainfed area got converted in to drip irrigation, being observed to be maximum in Haveri, Kalaburgi and Kolar districts (100% out of 224.1 acres and 95.5% out of 104.1 acres and 388.7 acres). Moderate range of conversion was observed in Shivamogga 70.8% (out of 168.2 acre) and least was in Uttara kannada (31.7% out of 327.0 acres). The facts also indicated that the conversion of flood irrigation area to drip irrigation are to the extent of 22.3% (out of 2792.3 acres) which reflects scope and opportunities of the better irrigation practices through drip irrigation as water saving technology.

Under sprinkler support, total 3723 acres area was surveyed. out of this 73.9% rainfed area is converted in the sprinkler irrigation, being maximum in Mysuru (99% out of 448.3 acres), Kalaburgi (97.3% out of 280.2 acres) and least was in Tumakuru (2% out of 508.5 acres). With respect to conversion of flood irrigation to sprinkler irrigation, maximum (98.0% out of 508.5 acres) in Tumakuru and minimum in Mysuru (0.9% out of 448.3 acres). This indicates farmer realized the importance of water in crop growth in dryland agriculture and showed maximum interest towards conversion of rainfed agriculture to MI than the continuing of flood irrigation to MI area.

Table 4.47: Changes in land use pattern due to MI installation

District	**MI system**				
	Total MI system area (Acres)	**Area before installation (Acres)**		**% Change from**	
		Flood Irrigated	**Rain fed**	**FI to MI**	**Rain fed to MI**
Belagavi	786.8	289.7	497.1	37.0	63.0
Bidar	454.5	35.7	418.8	8.0	92.0
C. R. Nagar	807.6	108.7	698.8	13.0	87.0
Haveri	750.8	57.3	693.5	8.0	92.0
Kalaburgi	384.3	8.2	376.1	2.0	98.0
Kolar	641.6	9.5	632.1	1.0	99.0
Mysuru	563.2	13.7	549.4	2.0	98.0
Shivamogga	699.2	344.7	354.4	49.0	51.0
Tumakuru	616.5	21.9	594.6	4.0	96.0
Uttara Kannada	810.4	704.8	105.5	87.0	13.0
Total	**6515.3**	**1594.4**	**4920.8**	**-**	**-**
Average -%				**24.0**	**76.0**
District	**Drip irrigation**				
	Total Drip area (Acres)	**Area before installation (Acres)**		**% Change from**	
		Flood Irrigated	**Rain fed**	**FI to DI**	**Rain fed to DI**
Belagavi	544.9	242.2	302.6	44.5	55.5
Bidar	190.2	21.8	168.4	11.5	88.5
C. R. Nagar	428.1	81.7	346.3	19.1	80.9
Haveri	224.1	0.0	224.1	0.0	100.0
Kalaburgi	104.1	0.5	103.6	0.5	99.5
Kolar	388.7	2.0	386.7	0.5	99.5
Mysuru	114.8	9.7	105.1	8.5	91.5
Shivamogga	168.2	49.1	119.1	29.2	70.8
Tumakuru	301.8	206.2	95.5	68.3	31.7
Uttara Kannada	327.0	9.5	317.5	2.9	97.1
Total	**2792.3**	**622.9**	**2169.3**		
Average -%				**22.3**	**77.7**

	Sprinkler				
District	**Total Sprinkler area (Acre)**	**Area before installation (Acre)**		**% Change from**	
		Flood Irrigated	**Rain fed**	**FI to SI**	**Rain fed to SI**
Belagavi	241.9	47.4	194.5	19.6	80.4
Bidar	264.3	13.9	250.4	5.3	94.7
C. R. Nagar	379.5	27.0	352.5	7.1	92.9
Haveri	526.7	57.3	469.4	10.9	89.1
Kalaburgi	280.2	7.7	272.5	2.7	97.3
Kolar	252.9	7.5	245.4	3.0	97.0
Mysuru	448.3	4.0	444.3	0.9	99.1
Shivamogga	530.9	295.6	235.3	55.7	44.3
Tumakuru	508.5	498.5	10.0	98.0	2.0
Uttara Kannada	289.4	12.4	277.0	4.3	95.7
Total	**3723.0**	**971.5**	**2751.5**	**-**	**-**
Average -%				**26.1**	**73.9**

Sources: Field study FI: Flood Irrigation DI: Drip Irrigation, SI: Sprinkler Irrigation

4.4.2 Crop diversification

The Table 4.48 depicts percentage of farmers retaining the crop as per approved or any changes in crop growing. It is found that the tendency of retention of the crop as per the approval was found to be average of 61.5% (out of 3690 beneficiaries), being maximum (90.9%) in Uttara Kannada and lowest in Mysuru (35.6%). With respect to area change from sanctioned crop vs changed crop. It was found that out of 6515.3-acre, 60.8% area covered with same crop as sanctioned in the scheme. With, 38.5% of area found changes in crops including introduction of new crop. With respect to district wise area retaining the sanction crops it was found that a maximum (93.1% out of 810.4 acres) in Uttara Kannada followed by 76.4 percent out of 616.5 acres in Tumakuru beneficiaries land, and minimum area observed in Mysuru 28.3 percent. Crop diversification and also the growing of large number of crops in rainfed leads to reduce the risk factor of crop failures due to drought or less rains. Further crop substitution and shift are also taking place in the areas with distinct soil problems and market demand. As a strategy, crop diversification maximizes the use of land and optimizes farm productivity and incomes increase in production of high-value crops.

Crop Diversification: MI system opportunities for crop transition from sugarcane to mulberry in Belagavi district besides input saving interventions, which was revealed in a case study analysis. A similar crop diversification practice of cultivating short-duration high-value intercrops was revealed by coconut growing farmers in Mysuru and Shivamogga districts.

Table 4.48: Changes in sanctioned crop Vs current crop diversification

District	Sample size (No.)	Beneficiaries (%)		Total area (acre)	Area (%)	
		Sanctioned crop	Change of crop		Sanctioned crop	Change of crop (including introduction of new crop)
Belagavi	376	70.7	29.3	786.8	67.4	32.6
Bidar	364	68.1	31.9	454.5	63.1	36.9
C. R. Nagar	370	47.8	52.2	807.6	51.2	48.8
Haveri	375	40.0	60.0	750.8	38.1	61.9
Kalaburgi	370	63.2	36.8	384.3	67.7	32.3
Kolar	362	67.7	32.3	641.6	67.9	32.1
Mysuru	376	35.6	64.4	563.2	28.3	71.7
Shivamogga	375	56.5	43.5	699.2	52.4	47.6
Tumakuru	372	76.6	23.4	616.5	76.4	23.6
Uttara Kannada	350	90.9	9.1	810.4	93.1	6.9
Total	**3690**	-	-	**6515.3**	-	-
Average -%		**61.5**	**38.5**		**60.8**	**39.2**

Sources: Field study

With respect to introduction of new crop, it could be seen from the Table 4.49 that maximum new crops were introduced up to (out of 376 beneficiaries) 4.3 percent beneficiaries in Belagavi district with an area expansion of up to 35.6 acre followed by Kalaburgi (9% out of 370 beneficiaries) and Kolar 7.0 percent out of 362 beneficiaries) with an area expansion of 12 and 6 acres respectively. This is fact suggests that MI systems in majority of the cases have been installed to irrigate horticultural crops. It is therefore, recommended that special drives be taken to motivate the farmers in the other districts with crops having market potentials and thus the crop diversification approach to accrue the full advantage of MI system.

Farmers also showed an increase in the new crops introduced on the farms as a direct result of adoption of micro irrigation.

Introduction of new crops

Crop category	Name of the crop
Fruits	Grapes, Jackfruit, Watermelon,
Vegetable	Beans, Cabbage, Cluster bean, knol khol, Ridge gourd
Flowers	Jasmine, Marigold, Rose flower, Tube rose
Spices	Ginger, turmeric, pepper and chili, onion

Table 4.49: Trend of introduction of new crops by MI beneficiaries

District	Total beneficiary surveyed (No.)	No. of farmer introduced new crop	% Farmers introduced new crop	Total area surveyed (Acre)	Area covered with new crops (Acre)	% Area With new crop (%)
Belagavi	376	16.0	4.3	786.8	35.6	4.5
Bidar	364	6.0	1.6	454.5	4.2	0.9
C. R. Nagar	370	0.0	0.0	807.6	0.0	0.0
Haveri	375	6.0	1.6	750.8	8.2	1.1
Kalaburgi	370	9.0	2.4	384.3	6.0	1.6
Kolar	362	7.0	1.9	641.6	12.1	1.9
Mysuru	376	0.0	0.0	563.2	0.0	0.0
Shivamogga	375	0.0	0.0	699.2	0.0	0.0
Tumakuru	372	3.0	0.8	616.5	10.0	1.6
Uttara Kannada	350	1.0	0.3	810.4	2.0	0.2
Total	**3690**	**48.0**		**6515.3**	**78.2**	
Average -%			**1.3**			**1.2**

Sources: Field study

4.4.3 Cropping intensity

The Table 4.50 revels that percentage of cropping intensity among various farmers category in the study area. The average increase in cropping intensity by number of farmers was 34.0 percent. Being maximum (38%) was noticed under medium farmers followed by small farmer (28.1%) and minimum was with large farmers (22.7%). It is also found that the tendency of kharif farmers growing was found to be average of 36.1% (1538 to 2093) being maximum (42.9 %: (1063 to 1514)) among medium farmer and lowest of 23.1 (39 to 48 farmers). Our study reveals that the MI technology increased the net sown area by irrigating crop under season and there by helps in achieving higher cropping intensity. The average increase in cropping area was found during kharif season is that 50.8% (239.0 to 326.7 acre) as compared to before adoption of MI and minimum cropping intensity noticed with rabbi crop (25.9%). With respect to season wise sowing area among various farmer category marginal farmer of rabbi season was found maximum increase during rabbi that is about 60.9% (13.3 to 21.4 acre) and it is also interesting to note that farmers have expressed adoption of MI technology enhanced the cropping area during summer season that is 36.7 percent (239.0 to 326.7 acre) s compared to before MI. For instance, among various farming category, by adoption of MI, the average percent sown area increased by 46.3 percent in medium farmers and minimum of 31.2 percent under large farming community as compared to before MI.

Table 4.50: Cropping intensity before and after MI installation among various farming

No of farmer	**Before MI**				**After MI**				**Net Change (No)**				**Change (%)**			
Farmer category	**kharif**	**Rabi**	**Summer**	**Total**	**kharif**	**Rabi**	**Summer**	**Total**	**kharif**	**Rabi**	**Summer**	**Total**	**Kharif**	**Rabi**	**Summer**	**Total**
Marginal farmer	70	12	7	89	90	15	9	114	20	3	2	25	28.6	25.0	28.6	28.1
Small farmer	39	8	6	53	48	10	8	66	9	2	2	13	23.1	25.0	33.3	24.5
Medium farmer	1063	267	8	1338	1514	329	10	1853	451	62	2	515	42.4	23.2	25.0	38.5
Large famer	366	49	17	432	441	70	19	530	75	21	2	98	20.5	42.9	11.8	22.7
Grand Total	**1538**	**336**	**38**	**1912**	**2093**	**424**	**46**	**2563**	**555**	**88**	**8**	**651**	**36.1**	**26.2**	**21.1**	**34.0**
Area Change	**Before MI**				**After MI**				**Net Change (No)**				**Change (%)**			
Farmer category	**kharif**	**Rabi**	**Summer**	**Total**	**kharif**	**Rabi**	**Summer**	**Total**	**kharif**	**Rabi**	**Summer**	**Total**	**Kharif**	**Rabi**	**Summer**	**Total**
Marginal farmer	61.1	13.3	12.0	86.4	76.6	21.4	17.5	115.5	15.5	8.1	5.5	29.1	25.3	60.9	45.8	33.6
Small farmer	86.3	48.1	22.7	157.1	127.8	62.0	27.8	217.6	41.5	13.8	5.1	60.5	48.1	28.8	22.5	38.5
Medium farmer	1579.6	579.0	158.1	2316.7	2436.6	725.1	226.4	3388.1	857.1	146.1	68.3	1071.5	54.3	25.2	43.2	46.3
Large famer	241.9	56.5	46.3	344.7	328.3	69.1	55.0	452.4	86.3	12.6	8.8	107.7	35.7	22.3	18.9	31.2
Grand Total	**1968.9**	**697.0**	**239.0**	**2904.9**	**2969.3**	**877.6**	**326.7**	**4173.6**	**1000.4**	**180.6**	**87.7**	**1268.7**	**50.8**	**25.9**	**36.7**	**43.7**

Sources: Field study

4.4.4 Crop productivity enhancement

Field observation indicates that introduction of micro irrigation has generated benefits to the farmers in terms of enhancement of the average productivity. The average productivity of agriculture, horticulture and mulberry crop is given in Table 4.51 by comparing before and after installation of MI with beneficiaries /MI adopters, and also between beneficiaries/MI adopters and non-beneficiaries/non-adopters.

Agriculture

Commonly grown 12 agricultural crops have been considered for assessing the changes in productivity before and after installation of MI, as well as between MI adopters and non-adopters. Among various crop, cotton has recorded a greater productivity with the MI installation. After installation of MI with in beneficiaries, the productivity of cotton was found to has increased to an extent of 44.8 percent (14.5 qt/acre to 21.0 qt/acre) followed by sugarcane with 44.4 percent (450 qt/acre to 650 qt/acre), increase, and least being ragi with just 16.8 percent (9.5 qt/acre to 11.1 qt/acre) as compared to before installation of MI. Cotton and sugarcane crops have been irrigated through drip irrigation in the recent past. The percentage of increase in productivity of cotton and sugarcane is mainly due to application of water through drip irrigation enabled optimum moisture nearby root system enhance healthy crop growth and development which leads to higher yield /acre.

Subsequently, among beneficiaries and non-beneficiary, beneficiaries have recorded for highest productivity in groundnut crops, to an extent of 78.6 percent (7qt/acre to 12.5 qt/acre) compared and non-beneficiaries, which is followed by green gram (64.3% from 7 qt/acre to 11.5 qt/acre) and least increase, in productivity found with sunflower (5.9%, from 18qt/acre to 17 qt/acre). The differential response of expressing the production enhancement with MI adopters is obviously due to water enabled crop growth and development. As a result of the controlled application of water during critical period improve the soil moisture and can be maintained at optimum levels, led to an increase in the productivity of the crops.

Table 4.51a provides district-wise and crop-wise productivity before and after MI installation within beneficiaries. Among the various districts in Bidar district highest productivity (72.4%) under sugarcane was recorded followed by C. R Nagar where in 63.6 percent productivity enhancement was with the installation of micro irrigation. However, minimum increase in productivity was noticed with cotton crop in C. R. Nagar which about only 8.0 percent. Performance in term of productivity varies from district to district, even for the same crop due to varied reasons like agro-climatic conditions, planting material, agronomic practices, soil productivity, system cost, and production practices method.

Horticulture

Table 4.50 presents the results of the comparative average productivity performance of horticulture crops before and after the installation of drip within beneficiaries, as well as the productivity between beneficiaries / MI adopters and non-beneficiaries/non-adopters. In the horticulture crops, a positive growth rate is observed for almost all the crops after installation of MI when compared to the conventional irrigation method. It is important to note that, with Installation of MI, percent of productivity in turmeric crops was raised to 52.0 percent as compared to before adoption of MI. However, among MI adopter and non-adopters, a higher positive growth rate of productivity is observed in the case of arecanut (i.e., 56.7%) under MIS adopters as compared to the non-adopters. Based on the above results, it may be observed that MI adopters are getting adequately compensated for the investments that they make to adopt the MI and many of the crops grown under MI have already resulted in higher productivity than those grown with conventional method. This may be due to drip irrigation technique ensures optimum moisture around the root system and this enables healthy growth of crop and yield.

A detailed crop wise and district-wise change in productivity before and after MI installation within beneficiaries is given in Table 4.51b. Survey results depicts that the average productivity of the turmeric has increased by 69.0 percent followed by banana 64.7% percent in Kalaburgi after installation MI. While, in Shivamogga minimum (11.9%) increase in productivity was noticed under grapes. Performance in term of productivity varies from district to district, even for the same crop due to varied reasons like agro-climatic conditions, planting material, cultivation practices, soil productivity, irrigation system adopted, etc. Productivity of turmeric and banana crop increase substantially under drip irrigation is affected to few important reasons. First, the moisture stress for crop under drip irrigation is avoided because of its ability to supply the required quantity of water at the required time. Second, the supply of water only at the root zone of the crop prevents water flow to other parts of the land, leading to a considerable reduction in weed growth. Third, the supply of water at regular intervals also allows the crop to absorb the fertilizers without any big losses through leaching and evaporation.

Increase in productivity of turmeric crop may be due to resulting in an increase in the primary and secondary root system, leading to increase moisture content in the fingers which would have determine the rhizome weight and that in turn have decided the rhizome yield (number and weight of mother rhizomes, primary and secondary fingers). While, increase in banana productivity is due to sufficient availability and utilization of moisture resulting in more cells and their enlargement expansion which eventually increased the flowering and fruit yield.

Sericulture

Mulberry is perennial commercial crop, where the leaf biomass is the principal source of food to silkworms. Thus, in the present study main emphasis has been given to assess the average biomass productivity changes before and after installation of MI within beneficiaries and also beneficiaries /MI adopters and non-beneficiaries/non adopters. The temporal (before and after MI) and spatial (district wise) variation in productivity of mulberry biomass is presented in Table 4.50 and 4.51b. Field study results reveals that the mulberry plant growth and leaf yield was responded significantly well, both spatially, temporally, among beneficiaries and non-beneficiaries. By adopting MI, the percent of biomass productivity found highest up to 40.0 percent as compared to conventional practices, and 43.8 percent increment in productivity among MI adopters as compared to non-adopters. It is noticed that adopting drip irrigation leads to water infiltration towards down word flow instead upward flow due to gravitational forces of the soil and moisture regimes are exactly remaining near to the rhizosphere zone leading to constant availability of soil moisture thereby significantly influence the spatial distribution of crop roots and the efficiency of nutrition and water adsorption, but also directly affect the plant growth, leaf quality and yield.

Among various district, after adoption of MI, the percentage of increase in average productivity of leafy biomass was noticed maximum (61.3%) in Mysuru district followed by Uttara kannada district and C. R Nagar as compared to before MIS. Whereas, minimum productivity increase in leafy biomass was seen in Haveri district (24.6%). Performance in term of productivity varies from district to district, even for the same crop due to varied reasons like agro-climatic conditions, cultivation practices, planting material, soil productivity, irrigation system adopted, etc**.**

Farmer category wise productivity enhancement

It could be observed from the Table 4.51c that increase in crop productivity has been observed with respect to different crops among various group of farmer under agriculture horticulture and sericulture due to the adoption of Micro irrigation. Under agriculture crops a maximum (**66.7**%: 7.5 to 12.5 qt/acre) productivity was observed under medium category farmers with black gram followed by same category of farmer with groundnut crop that is 57.0 (8.6 to 13.5 qt/acre) percent as compared to before adoption of MI, while it was minimum (8.2%: 9.7 to 10.5 qt/acre) with groundnut with large farmers. Under horticulture crops, maximum crop productivity ranged from 66.2 percent (23.1 qt/acre to 38.4 qt/acre) with turmeric under medium category farmers and minimum of 14.9% (19.5 to 22.4 qt/acre) increase in crop productivity with Arecanut under large category of farmers. In mulberry maximum change in productivity of 50.0 percent (114 qt/acre to 171 qt/acre) was observed with marginal farmers and minimum of 25.1 percent (171 to 214 qt/acre) with large category farmers. From the above analysis the crop productivity with adoption of micro irrigation was benefitted more with medium category farmers in agriculture and horticulture crops. While, marginal category farmers benefitted with sericulture crop as compared other category of farmers. The increase in productivity under medium category farmers could be due to higher rate MI adoption, functioning status, use of improved verity of seeds and supplementation of irrigation during critical crop growing seasons.

MI system opportunities for crop transition from sugarcane to mulberry in Belagavi district besides input saving interventions, which was revealed in a case study analysis. A similar crop diversification practice of cultivating short-duration high-value intercrops was revealed by coconut growing farmers in Mysuru and Shivamogga districts.

Table 4.51: Crop wise productivity change (Before and After MI and beneficiaries and Non beneficiaries)

Crop Category	Crop Name	Beneficiaries				Non beneficiaries	Net change (qt/acre) (Beneficiaries vs Non beneficiaries)	Change % to the Beneficiaries vs Non beneficiaries
		BMI (qt/acre)	AMI (qt/acre)	Net change (qt/acre)	% Change	Conventional irrigation (qt/acre)		
Agriculture								
Cash crop	Sugarcane	450.0	650.0	200.0	44.4	420.0	230.0	54.8
Cereals	Jowar	9.5	12.0	2.5	26.3	9.0	3.0	33.3
	Maize	14.0	18.0	4.0	28.6	13.0	5.0	38.5
	Paddy	30.0	40.0	10.0	33.3	28.0	12.0	42.9
Pulses	Bengal gram	11.0	15.0	4.0	36.4	10.0	5.0	50.0
	Black gram	8.5	11.5	3.0	35.3	9.0	2.5	27.8
	Green gram	8.5	11.5	3.0	35.3	7.0	4.5	64.3
	Redgram	15.0	18.5	3.5	23.3	13.0	5.5	42.3
Oil seeds	Groundnut	9.5	12.5	3.0	31.6	7.0	5.5	78.6
	Soyabean	8.0	11.0	3.0	37.5	9.0	2.0	22.2
	Sunflower	15.0	18.0	3.0	20.0	17.0	1.0	5.9
Millet	Ragi	9.5	11.1	1.6	16.8	10.0	1.1	11.0
Fiber	Cotton	14.5	21.0	6.5	44.8	13.0	8.0	61.5

Crop Category	**Crop Name**	**Beneficiaries**				**Non beneficiaries**	**Net change (qt/acre) (Beneficiaries vs Non beneficiaries)**	**Change % to the Beneficiaries vs Non beneficiaries**
		BMI (qt/acre)	**AMI (qt/acre)**	**Net change (qt/acre)**	**% Change**	**Conventional irrigation (qt/acre)**		
Horticulture								
Fruit crops	Banana	210.0	294.0	84.0	40.0	200.0	94.0	47.0
	Grapes	310.0	395.0	85.0	27.4	280.0	115.0	41.1
	Mango	32.0	45.0	13.0	40.6	40.0	5.0	12.5
Plantation crop	Arecanut	17.0	23.5	6.5	38.2	15.0	8.5	56.7
	Coconut	50.5	63.0	12.5	24.8	44.0	19.0	43.2
Spices	Chilly	28.0	40.0	12.0	42.9	28.0	12.0	42.9
	Onion	68.0	90.0	22.0	32.4	66.0	24.0	36.4
	Turmeric	25.0	38.0	13.0	52.0	35.0	3.0	8.6
Vegetable	Tomato	90.0	120.0	30.0	33.3	83.0	37.0	44.6
	Beans	70.5	98.4	27.9	39.6	78.0	20.4	26.2
Sericulture								
Mulberry	Mulberry	150.0	210.0	60.0	40.0	146.0	64.0	43.8

Sources: Field study AMI: After MI installation/ BMI: Before MI installation

Table 4.51a: Crop and district wise average productivity of agriculture crops (Qt/acre)-Before and After MI installation

Crop	**MI status**	**Belagavi**	**Bidar**	**C. R. Nagar**	**Haveri**	**Kalaburgi**	**Kolar**	**Mysuru**	**Shivamogga**	**Tumakuru**	**Uttara Kannada**
Sugarcane*	BMI	505	435	385	-----	-----	-----	440	-----	-----	487.3
	AMI	725	750	630	------	------	------	575	------	------	570
	% Change	**43.6**	**72.4**	**63.6**	-----	-----	-----	**30.7**	-----	-----	**17.0**
Jowar	BMI	10.5	8.3	-----	9.3	9.7	-----	-----	-----	-----	-----
	AMI	13.6	10.6	------	11.8	12.6	------	------	------	------	------
	% Change	**29.5**	**27.7**	-----	**26.9**	**29.9**	-----	-----	-----	-----	-----
Maize	BMI	18.5	-----	10.5	15.5	-----	-----	9	16.6	-----	11.5
	AMI	21.3	------	15.6	23.5	------	------	12.5	22.3	-----	18.5
	% Change	**15.1**	-----	**48.6**	**51.6**	-----	-----	**38.0**	**34.3**	------	**60.9**
Paddy*	BMI	35	-----	29.5	28	-----	------	31	33	-----	24.8
	AMI	42.5	------	44.5	41.6	------	-----	45	40	-----	30
	% Change	**21.4**	-----	**50.8**	**48.6**	-----	-----	**45.2**	**21.2**	------	**21.0**
Bengal gram	BMI	11.5	9.1	-----	9	13.5	------	-----	-----	-----	-----
	AMI	15.2	12.5	------	12.5	19.6	-----	------	------	-----	------
	% Change	**32.2**	**37.4**	-----	**38.9**	**45.2**	-----	-----	-----	------	-----
Black gram	BMI	-----	10.5	9	-----	-----	------	6.5	-----	-----	-----
	AMI	------	13.5	11	------	------	-----	10	------	-----	------
	% Change	------	**28.6**	**22.2**	-----	-----	-----	**53.8**	-----	------	-----
Redgram	BMI	-----	14.1	-----	14.5	15.3	------	-----	-----	-----	-----
	AMI	------	16.6	------	18.8	19.7	-----	------	------	-----	------

Crop	**MI status**	**Belagavi**	**Bidar**	**C. R. Nagar**	**Haveri**	**Kalaburgi**	**Kolar**	**Mysuru**	**Shivamogga**	**Tumakuru**	**Uttara Kannada**
	% Change	-----	**17.7**	-----	**29.**	**28.8**	-----	-----	-----	------	-----
Green gram	BMI	9.7	8.5	7.7	9.7	9.6	------	7.1	-----	6.7	-----
	AMI	14.6	10.5	10.5	11.5	14.5	-----	9.8	------	9.1	------
	% Change	**50.5**	**23.5**	**36.4**	**18.6**	**51.0**	-----	**38.0**	-----	**35.8**	-----
Cotton*	BMI	18.2	8	12.5	19.4	17.9	------	-----	-----	-----	12.9
	AMI	28.6	12	13.5	29.5	26.6	-----	------	------	------	18.5
	% Change	**57.1**	**50.0**	**8.0**	**52.1**	**48.6**					**43.4**
Groundnut	BMI	8.82	-----	7.02	8.12	7.92	-----	-----	-----	8.12	-----
	AMI	13.02	------	10.92	9.92	9.92	------	------	------	10.72	------
	% Change	**47.6**	-----	**55.6**	**22.2**	**25.3**	-----	-----	-----	**32.0**	-----
Soyabean	BMI	16.7	19.7	14.8	-----	-----	-----	13.2	13.2	12.2	-----
	AMI	17.7	24.2	19.2	------	------	------	16.2	16.2	15.2	------
	% Change	**6.0**	**22.8**	**29.7**	-----	-----	-----	**22.7**	**22.7**	**24.6**	-----
Sunflower	BMI	16	13	-----	15	16	-----	-----	-----	-----	12.5
	AMI	18.9	15.9	------	21.5	18.9	------	------	------	------	13.9
	% Change	**18.1**	**22.3**	-----	**43.3**	**18.1**	-----	-----	-----	-----	**11.2**
Ragi	BMI	BMI	-----	-----	7.9	-----	-----	7.9	9.5	10	12.7
	AMI	AMI	-----	-----	9.3	-----	-----	9.6	12	12	14
	% Change	% Change	**----**	**----**	**17.7**			**21.5**	**26.3**	20%	**10.2**

Sources: Field study AMI: After MI, BMI: Before MI, * Crop irrigated under Drip irrigation

4.51b: Crop wise and district wise average productivity of Horticulture and Sericulture (Qt/acre)- Before and After MI installation

Crop Name	**MI status**	**Belagavi**	**Bidar**	**C. R. Nagar**	**Haveri**	**Kalaburgi**	**Kolar**	**Mysuru**	**Shivamogga**	**Tumakuru**	**Uttara Kannada**
Arecanut	BMI	-----	-----	-----	-----	-----	-----	-----	18.4	12.3	19.5
	AMI	-----	-----	-----	-----	-----	-----	-----	22.7	19.5	28
	% Change	**-----**	**-----**	**-----**	**-----**	**-----**	**-----**	**-----**	**23.4**	**58.5**	**43.6**
Coconut	BMI	-----	-----	42.5	45.6	-----	-----	45	60	75	35
	AMI	-----	-----	55	53	-----	-----	68	73	88	44
	% Change	**-----**	**-----**	**29.4**	**16.2**	**-----**	**-----**	**51.1**	**21.7**	**17.3**	**25.7**
Banana	BMI	185	-----	212	176	170	175	265	250	260	196
	AMI	285	-----	330	215	280	225	350	330	315	315
	% Change	**54.1**	**-----**	**55.7**	**22.2**	**64.7**	**28.6**	**32.1**	**32.0**	**21.2**	**60.7**
Grapes	BMI	340	-----	-----	295	-----	-----	-----	295	-----	-----
	AMI	450	-----	-----	405	-----	-----	-----	330	-----	-----
	% Change	**32.4**	**-----**	**-----**	**37.3**	**-----**	**-----**	**-----**	**11.9**	**-----**	**-----**
Mango	BMI	-----	-----	-----	35	-----	-----	29	-----	-----	-----
	AMI	-----	-----	-----	47	-----	-----	43	-----	-----	-----
	% Change	**-----**	**-----**	**-----**	**34.3**			**48.3**	**-----**	**-----**	**-----**
Beans	BMI	56	-----	89.25	-----	55	88	75	67	65	----
	AMI	75	-----	125	-----	65	130	110	85	98.5	-----

Crop Name	**MI status**	**Belagavi**	**Bidar**	**C. R. Nagar**	**Haveri**	**Kalaburgi**	**Kolar**	**Mysuru**	**Shivamogga**	**Tumakuru**	**Uttara Kannada**
	% Change	**33.9**	**-----**	**40.1**		**18.2**	**47.7**	**46.7**	**26.9**	**51.5**	
Chilly	BMI	26.5	-----		29	27.1	29.5	-----	-----	-----	-----
	AMI	38.6	-----	-----	46	33.5	45	-----	-----	-----	-----
	% Change	**45.7**	**-----**		**58.6**	**23.6**	**52.5**	**-----**	**-----**	**-----**	**-----**
Onion	BMI	73.5	-----		75.6	56	65.2	-----	-----	-----	-----
	AMI	91.4	-----	-----	95.6	84.5	87.4	-----	-----	-----	-----
	% Change	**24.4**	**-----**		**26.5**	**50.9**	**34.0**	**-----**	**-----**	**-----**	**-----**
Turmeric	BMI	26.7	27	19	20	-----	29.5	31.5	25	-----	-----
	AMI	34.8	37.6	32.1	32	-----	42.5	45.7	35	-----	-----
	% Change	**30.3**	**39.3**	**68.9**	**60.0**	**-----**	**44.1**	**45.1**	**40.0**	**-----**	**-----**
Tomato	BMI	93.5	-----	81.5	79.5	-----	99.5	93.5	-----	92.5	-----
	AMI	130	-----	105	90	-----	149	140	-----	105	-----
	% Change	**39.0**	**-----**	**28.8**	**13.2**	**-----**	**49.7**	**49.7**	**-----**	**13.5**	**-----**
Sericulture											
Mulberry	BMI	123.5	143.5	188.5	173.5	121.5	201.5	108.5	208.5	122.5	109.5
	AMI	175	199	255	218	180	270	175	289	175	165
	% Change	**41.7**	**38.7**	**35.3**	**25.6**	**48.1**	**34.0**	**61.3**	**38.6**	**42.9**	**50.7**

Source: Field study AMI: After MI installation/ BMI: Before MI installation * Crop irrigated under Drip irrigation

Table 4.51c: Crop wise comparative productivity status with farmer categories (Qt/acre)- Before and After MI installation

Crop	**Agriculture**					**Crop**	**Horticulture and Sericulture**				
	MI status	**MF**	**SF**	**MeF**	**LF**		**MI status**	**MF**	**SF**	**MeF**	**LF**
Sugarcane*	BMI	421.5	443.5	466.5	362.5	Arecanut	BMI	21.5	14.4	12.3	19.5
	AMI	606.7	661.75	693.7	532.75		AMI	28.7	20.5	18.4	22.4
	Net saving	**185.2**	**218.25**	**227.2**	**170.25**		**Net saving**	**7.2**	**6.1**	**6.1**	**2.9**
	% Change	**44.0**	**49.2**	**48.7**	**47.0**		**% Change**	**33.5**	**42.4**	**49.6**	**14.9**
Jowar	BMI	9.4	9.3	8.3	9.3	Coconut	BMI	45	61	45.5	47.6
	AMI	11.2	10.6	12.7	11.8		AMI	58	74.5	63	58
	Net saving	**1.8**	**1.3**	**4.4**	**2.5**		**Net saving**	**13**	**13.5**	**17.5**	**10.4**
	% Change	**19.1**	**14.0**	**53.0**	**26.9**		**% Change**	**28.9**	**22.1**	**38.5**	**21.8**
Maize	BMI	18.5	12.6	10.5	17.9	Banana	BMI	208.5	211.7	216.5	206
	AMI	21.3	17.5	16.3	20.3		AMI	301	288	298	288
	Net saving	**2.8**	**4.9**	**5.9**	**2.4**		**Net saving**	**92.5**	**76.3**	**81.5**	**82**
	% Change	**15.1**	**38.9**	**55.2**	**13.4**		**% Change**	**44.4**	**36.0**	**37.6**	**39.8**
Paddy*	BMI	35	29.5	28	27.8	Grapes	BMI	290	342	298	308
	AMI	42.5	42.3	41.6	32.4		AMI	349	426	412	391
	Net saving	**7.5**	**12.8**	**13.6**	**4.6**		**Net saving**	**59**	**84**	**114**	**83**
	% Change	**21.4**	**43.4**	**48.6**	**16.5**		**% Change**	**20.3**	**24.6**	**38.3**	**26.9**
Bengal gram	BMI	10.5	9.1	10.2	13	Mango	BMI	31	29.9	30.5	36.5

Crop	**Agriculture**					**Crop**	**Horticulture and Sericulture**				
	MI status	**MF**	**SF**	**MeF**	**LF**		**MI status**	**MF**	**SF**	**MeF**	**LF**
	AMI	13.4	12.3	14	16.7		AMI	42.2	43.1	44	49.5
	Net saving	**2.9**	**3.2**	**3.8**	**3.7**		**Net saving**	**11.2**	**13.2**	**13.5**	**13**
	% Change	**27.6**	**35.2**	**37.3**	**28.5**		**% Change**	**36.1**	**44.1**	**44.3**	**35.6**
Black gram	BMI	8.4	8.3	7.5	8.5	Chilly	BMI	26.5	27.4	31	29.5
	AMI	10.5	11.8	12.5	9.5		AMI	35.7	39.5	45.2	39.6
	Net saving	**2.1**	**3.5**	**5**	**1**		**Net saving**	**9.2**	**12.1**	**14.2**	**10.1**
	% Change	**25.0**	**42.2**	**66.7**	**11.8**		**% Change**	**34.7**	**44.2**	**45.8**	**34.2**
Redgram	BMI	8.5	7.8	9.6	9	Onion	BMI	76.5	57.4	59.5	78.6
	AMI	10.5	11.5	13.5	12.5		AMI	93.9	80.3	85.2	100.3
	Net saving	**2**	**3.7**	**3.9**	**3.5**		**Net saving**	**17.4**	**22.9**	**25.7**	**21.775**
	% Change	**23.5**	**47.4**	**40.6**	**38.9**		**% Change**	**22.8**	**40.0**	**43.3**	**27.7**
Green gram	BMI	16	9.3	15.6	18.3	Turmeric	BMI	22.9	31.1	23.1	22.9
	AMI	19	13.4	21	22		AMI	37.3	40.6	38.4	35.7
	Net saving	**3**	**4.1**	**5.4**	**3.7**		**Net saving**	**14.4**	**9.5**	**15.3**	**12.8**
	% Change	**18.8**	**44.1**	**34.6**	**20.2**		**% Change**	**62.9**	**30.5**	**66.2**	**55.9**
Groundnut	BMI	9.4	8.3	8.6	9.7	Tomato	BMI	96.3	101.8	79.8	81.8
	AMI	12.5	11.4	13.5	10.5		AMI	124.7	126.7	115.7	112.7
	Net saving	**3.1**	**3.1**	**4.9**	**0.8**		**Net saving**	**28.4**	**24.9**	**35.9**	**30.9**

Crop	**Agriculture**					**Crop**	**Horticulture and Sericulture**				
	MI status	**MF**	**SF**	**MeF**	**LF**		**MI status**	**MF**	**SF**	**MeF**	**LF**
	% Change	**33.0**	**37.3**	**57.0**	**8.2**		**% Change**	**29.5**	**24.5**	**45.0**	**37.8**
Soyabean	BMI	9	8	8.5	9.5	Beans	BMI	51.8	87.4	77.4	65.4
	AMI	12	10	12.5	11.3		AMI	73.4	128.4	108.4	83.4
	Net saving	**3**	**2**	**4**	**1.8**		**Net saving**	**21.6**	**41**	**31**	**18**
	% Change	**33.3**	**25.0**	**47.1**	**18.9**		**% Change**	**41.7**	**46.9**	**40.1**	**27.5**
Sunflower	BMI	10.3	18.3	15.6	17.3	**Sericulture**					
	AMI	12.3	21	21.4	21.4	Mulberry	BMI	114	141	174	171
	Net saving	**2**	**2.7**	**5.8**	**4.1**		AMI	171	204	251	214
	% Change	**19.4**	**14.8**	**37.2**	**23.7**		**Net saving**	**57**	**63**	**77**	**43**
Ragi	BMI	8.5	8.9	9.7	10.6		**% Change**	**50.0**	**44.7**	**44.3**	**25.1**
	AMI	9.5	10.5	13.2	12.4						
	Net saving	**1**	**1.6**	**3.5**	**1.8**						
	% Change	**11.8**	**18.0**	**36.1**	**17.0**						
Cotton*	BMI	9.3	9.5	18.7	17.5						
	AMI	11.6	11.3	25.3	22.7						
	Net saving	**2.3**	**1.8**	**6.6**	**5.2**						
	% Change	**24.7**	**18.9**	**35.3**	**29.7**						

Source: Field study AMI: After MI installation/ BMI: Before MI installation, * Crop irrigated under Drip irrigation, MF: Marginal farmer, SF: Small farmer, MeF: Medium famer LF: Large farmer

Table 4.51d to 4.51g depicts the corelation matrix of training impact on major crop yield among various farmer category. The study revealed participation in training on MI technology really helps in enhancing the crop yield except Bengalgram and mulberry crop among small farmer, Tomato and Banana crop among medium farmer, Bengal gram and Banana among marginal farmers and Redgram, Paddy, Maize, Cotton, Chilly, Bengal gram, Areca nut among large farmer. not much directly influenced on productivity. Among sprinkler and drip training on micro irrigation found more effective in enhancing the productivity among marginal, small and medium farmers than the large farmers.

Table 4.51d: Correlation matrix of crop yield vs training of small farmer

Small farmer	***Training***	*Tomato*	*Sugarcane*	*Redgram*	*Ragi*	*Paddy*	*Mulberry*	*Maize*	*Cotton*	*Coconut*	*Chilly*	*Bengal gram*	*Banana*	*Arecanut*
Training	**1**													
Tomato	**0.103**	1												
Sugarcane	**0.270**	-0.159	1											
Redgram	**0.283**	-0.212	0.011	1										
Ragi	**0.169**	-0.031	-0.116	-0.125	1									
Paddy	**0.239**	0.279	-0.146	-0.135	-0.130	1								
Mulberry	**-0.331**	0.681	-0.554	-0.308	-0.138	0.379	1							
Maize	**0.253**	0.062	-0.125	0.172	-0.009	0.065	0.376	1						
Cotton	**0.349**	-0.345	0.288	0.213	-0.084	-0.043	-0.393	-0.198	1					
Coconut	**0.349**	-0.345	0.288	0.213	-0.084	-0.043	-0.393	-0.198	0.100	1.000				
Chilly	**0.057**	0.498	-0.036	0.213	0.086	0.327	0.218	0.041	0.133	0.133	1			
Bengal gram	**-0.378**	0.520	-0.597	0.000	-0.641	0.220	-0.172	0.094	-0.270	-0.270	-0.59067	1		
Banana	**0.037**	0.311	-0.080	-0.194	-0.236	0.539	0.724	0.481	-0.168	-0.168	0.156301	-0.10722	1	
Areca nut	**0.155**	0.302	0.102	-0.068	-0.008	0.152	0.558	0.009	-0.161	-0.161	-0.21042	-0.03571	0.404334	1

Source: Field study

Table 4.51e: Correlation matrix of crop yield vs training of medium farmer

Medium farmer	*Training*	*Tomato*	*Sugarcane*	*Redgram*	*Ragi*	*Paddy*	*Mulberry*	*Maize*	*Cotton*	*Coconut*	*Chilly*	*Bengal gram*	*Banana*	*Areca nut*
Training	**1**													
Tomato	**-0.030**	1												
Sugarcane	**0.390**	-0.031	1											
Redgram	**0.454**	-0.063	-0.101	1										
Ragi	**0.207**	-0.055	-0.060	0.106	1									
Paddy	**0.258**	-0.045	-0.057	0.248	-0.032	1								
Mulberry	**0.113**	0.120	0.035	-0.099	-0.126	-0.009	1							
Maize	**0.203**	0.069	-0.116	-0.057	-0.052	-0.085	0.166	1						
Cotton	**0.356**	0.182	-0.195	0.024	-0.086	0.242	0.105	-0.055	1					
Coconut	**0.146**	0.206	0.065	0.039	0.190	0.202	0.047	-0.124	0.206	1				
Chilly	**0.058**	0.089	-0.025	-0.010	-0.181	0.215	0.196	-0.121	0.145	-0.089	1			
Bengal gram	**0.266**	-0.155	0.365	0.014	0.233	-0.039	0.181	0.167	-0.312	-0.130	-0.198	1		
Banana	**-0.373**	-0.027	-0.245	-0.256	-0.080	-0.091	0.066	-0.135	0.121	0.096	0.270	-0.610	1	
Areca nut	**0.086**	0.037	-0.113	0.050	-0.045	0.053	-0.075	0.011	0.264	-0.096	-0.010	-0.168	0.086	1

Source: Field study

Table 4.51f: Correlation matrix of crop yield vs training of marginal farmer

Marginal farmer	***Training***	*Tomato*	*Sugarcane*	*Redgram*	*Ragi*	*Paddy*	*Mulberry*	*Maize*	*Cotton*	*Coconut*	*Chilly*	*Bengal gram*	*Banana*	*Arecanut*
Training	**1**													
Tomato	**0.335**	1												
Sugarcane	**0.348**	-0.295	1											
Redgram	**0.332**	0.468	0.247	1										
Ragi	**0.286**	-0.342	-0.435	-0.458	1									
Paddy	**0.071**	0.439	-0.259	0.370	-0.292	1								
Mulberry	**0.225**	0.075	-0.091	-0.341	-0.032	0.048	1							
Maize	**0.249**	0.074	0.031	-0.184	-0.165	-0.378	0.564	1						
Cotton	**0.072**	0.553	-0.314	0.556	-0.179	0.595	-0.333	-0.521	1					
Coconut	**0.164**	-0.306	-0.154	-0.306	0.403	-0.372	-0.545	0.295	-0.303	1				
Chilly	**0.242**	-0.167	0.699	0.357	-0.364	-0.143	0.361	0.036	-0.020	-0.598	1			
Bengal gram	**-0.159**	-0.300	-0.073	-0.731	0.400	-0.695	0.553	0.504	-0.571	0.075	-0.037	1		
Banana	**-0.306**	-0.312	0.466	-0.084	-0.289	-0.365	0.004	0.278	-0.212	-0.474	0.371	0.253	1	
Arecanut	**0.475**	0.278	-0.087	0.456	0.118	0.006	0.154	-0.075	0.211	0.147	0.346	-0.224	-0.579	1

Source: Field study

Table 4.51g: Correlation matrix of crop yield vs training of large farmer

Large farmer	*Training*	*Tomato*	*Sugarcane*	*Redgram*	*Ragi*	*Paddy*	*Mulberry*	*Maize*	*Cotton*	*Coconut*	*Chilly*	*Bengal gram*	*Banana*	*Areca nut*
Training	**1**													
Tomato	**0.168**	1												
Sugarcane	**0.073**	0.052	1											
Redgram	**-0.244**	-0.670	0.166	1										
Ragi	**0.183**	0.638	-0.190	-0.986	1									
Paddy	**-0.168**	-0.478	-0.279	0.680	-0.606	1								
Mullbery	**0.004**	-0.626	-0.178	0.920	-0.935	0.659	1							
Maize	**-0.368**	0.559	-0.160	-0.415	0.379	-0.076	-0.123	1						
Cotton	**-0.025**	-0.293	0.204	0.254	-0.226	0.629	0.150	-0.194	1					
Coconut	**0.194**	-0.269	-0.170	-0.368	0.290	-0.745	-0.188	-0.535	-0.399	1				
Chilly	**-0.187**	0.715	-0.023	-0.648	0.624	-0.408	-0.677	0.693	0.075	-0.147	1			
Bengal gram	**-0.054**	0.157	0.071	-0.592	0.680	-0.169	-0.556	-0.049	0.402	-0.006	0.501	1		
Banana	**0.204**	-0.371	-0.464	-0.178	0.235	-0.095	0.056	-0.556	-0.388	0.564	-0.535	0.086	1	
Areca nut	**-0.479**	-0.530	-0.249	0.775	-0.745	0.560	0.485	0.108	-0.187	-0.470	-0.333	-0.402	-0.008	1

Source: Field study

4.4.5 Net water saving

The focus PMKSY-PDMC scheme is to ensure provide end-to-end solutions in the irrigation supply chain, from source to- field application with the vision of “Prathi Jaminige Neeru = Har Khet Ko Pani” and “More crop per drop= Parthi Hanigu Hechina Bele”.

> *Ensuring adequate water supply to the farms is essential. Agriculture therefore needs more efficient irrigation methods. Given its higher efficiency, micro irrigation systems can go a long way in addressing the issues faced by the country and the agricultural sector in the state and Country. Micro irrigation provides*

One of the focus objectives of the current study is to assess the extent of water saving in various ground water zones of the study area.

Table 4.52 highlights the results of the comparative water saving before and after adoption of MI system as well as among beneficiaries and non-beneficiaries. The entire 10 sample districts have been classified in to three zones based on ground water status as safe, semi critical/critical and over exploitation. The field study results showed that due to micro irrigation intervention, almost an equal net water saving was observed in the study area, ranging from 4.1 to 4.4-acre inches. Among different ground water zone, with the installation of MI system showed maximum (39%) water saving in over exploitation zone followed semi critical\critical zone (33.1%) and under safe zone (31%) after installation of MI as compared to before installation of MI system under beneficiaries. On analysing the percentage of water saving among beneficiaries and non-beneficiaries, it is observed that water saving interventions through micro irrigation appears to be productive in over exploitation (18% saving) zone, followed by safe ground water zone (10% saving) while, it is quite marginal in the semi critical zone (only 5% saving). Given the water scarcity scenario in the state, MIS could be a vital option for effectively managing and utilizing existing resources, and sustaining the irrigation systems in a viable manner. Further, realizing the long-term potential of the Water Sustaining Technology (WSTs), both the Government of India as well as Govt. of Karnataka should promote sprinkler and drip irrigation through convergence of various schemes / program like Jala Jeevan Mission, Jalamrutha, NIHM programme and others.

Table 4.52: Ground water zone wise water saving

Ground water zones	Beneficiaries (AMI: After MI installation/ BMI: Before MI installation)				Non beneficiaries (Acre Inch)	Net saving in (Acre Inch) (Beneficiaries vs Non beneficiaries	Change % saving to the beneficiaries vs Non beneficiaries
	BMI (Acre Inch)	AMI (Acre Inch)	Net saving (Acre Inch)	% saving			
Over exploitation	10.8	6.5	4.3	39.8	7.9	1.4	18
Semi critical /critical	12.3	8.2	4.1	33.3	8.6	0.4	5
Safe zone	14.2	9.8	4.4	31.0	10.9	1.1	10

Source: Field study

The estimated after MI installation and before MI installation water savings at the beneficiaries (before and after MI installation) and non-beneficiaries, for agriculture, horticulture and mulberry crops, based on the interview with the farmers is given in Table 4.53.

Agriculture

With agricultural crops, both sprinkler and drip irrigation system are supported under the scheme. Predominantly three major crops Viz. sugarcane, paddy and cotton are supported with drip irrigation system, while rest of the crops are mainly supported with sprinkler irrigation system.

In general beneficiaries, with the installation of MI, it was found that a maximum water saving was observed in paddy (72.0%) followed by sugarcane (62.0%), and least water saving was noticed in maize (10.0%) crop as compared to before installation of MI. Similar trend of observation was noticed among beneficiaries and non-beneficiaries. Maximum percentage of water saving noticed in Paddy (66.8%), followed by sugarcane and minimum of 18.2 percent water saving found with black gram.

The Table 4.54a provides district-wise and crop-wise water saving after installation of MI. It is observed that the range of percent of water saving varies from 10 percent to 73.8 percent which is noticed with maize and paddy in Haveri. Higher percent of water saving in paddy crops is due to efficient use of both drip irrigation by the beneficiaries and also expressed that micro irrigation adoption as the best water saving approach than conventional irrigation practices for closely spaced and water intensive crops.

Horticulture

The Table 4.53 provides horticultural crop wise average water saving before and after MI installation within beneficiaries and also among beneficiaries and non-beneficiaries. Common 10 horticulture crops were classified in to 4 groups Viz. Fruits, plantation crops, spices and vegetables. Drip installation is a common practice under horticulture crops which is well suited and this is mainly due to this nature of crop density and spacing of crops.

The results of the comparative water saving before and after the installation of drip within beneficiaries, as well as among beneficiaries and non-beneficiaries showed positive growth under almost all the crops as compared to the conventional irrigation method. It is important to note that, installation of drip system resulted in a maximum (55.3%) water saving under banana crop followed by 55.1 percent in arecanut and minimum (35.6%) water saving was noticed under mango as compared to before installation of drip system of irrigation. However, among beneficiaries and non-beneficiaries, a maximum (50%) percent of water saving was noticed in beans crop and minimum (16%) water saving found in mango under beneficiaries as compared to the nonbeneficiaries.

The detailed crop wise and district wise percentage in water saving after MI adoption given in Table 4.54b. Survey results describes that average maximum (68.9%) water saving was noticed in Kolar with onion followed by arecanut (62.2%) in Shivamogga and 61.7% with tomato in Tumakuru, and minimum water saving (17%) was noticed in Kalaburgi under onion crops. Performance in term of water saving varies from district to district, even for the same crop due to varied reasons like agro-climatic conditions, planting material, cultivation practices, soil productivity, irrigation system adopted, etc.

Sericulture

Mulberry is a perennial commercial crop, where the leaf biomass is the principal sources of food to silkworms. The temporal (before and after MI), among beneficiaries and non-beneficiaries and spatial (district wise) variation in water saving under mulberry is presented in Table 4.53 and 4.54b. Field study results indicated that the percent of water saving was found to be maximum up to 42.6 percent as compared to conventional practices and only 1.2 percent increment in water saving among MI adopters as compared to non-adopters.

Among various districts, after adoption of MI, the percentage of water saving was noticed to be maximum (50% each) in Mysuru and Shivamogga district followed by Tumakuru and

Uttara kannada district as compared to before installation of MI, while a minimum water saving was seen in Haveri district (21.4%).

Farmer category wise water saving

It could be observed from the table 4.54c that differential water saving has been observed with respect to different crops among various group of farmers under agriculture, horticulture and sericulture due to the adoption of Micro irrigation. Under agriculture crops, a maximum water saving up to 77.9 percent (59.5 to13.5 acre inch) was observed under paddy with small farmers followed by marginal and a minimum of 8.3 percent (1.2 to 1.1 acre inches) water saving was observed in maize with large farmer category. Under horticulture crops maximum 72 percent (25 to 7 acre inches) water saving was observed with arecanut in medium farmers and minimum of 17.0 percent (4.1 to 3.4 acre inches) in onion with small farmers. In mulberry maximum change in productivity of 57.05 percent (15.6 to 6.7 acre inches) with medium farmers 20.91 percent (11 to 8.7 percent) with marginal farmers. From the above analysis the water saving with adoption of micro irrigation was benefitted more with small category farmers in agriculture and medium category farmers in horticulture and mulberry crops as compared other category of farmers. The net water saving among small and medium farmer category farmers could be due to higher rate MI adoption, functioning status and filter used which leads to uniform distribution of water in short span to cover the at a stretch than extended period of irrigation.

In an FGD analysis in Kalburgi and Belagavi districts, sharing of water to needy farmers during water scarcity periods was adopted as a gesture and social concern to neighboring farmers, which was due to the water-saving realized by the MI adopted farmers.

Table 4.53: Crop wise water saving (Before and After MI and beneficiaries and non-beneficiaries)

Crop Category	Crop Name	Beneficiaries				Non-beneficiaries Conventional irrigation (Acre Inch)	Net saving in (Acre Inch) (Beneficiaries vs Non beneficiaries	Change % saving to the Beneficiaries vs Non beneficiaries
		BMI (Acre Inch)	AMI (Acre Inch)	Net saving (Acre Inch)	% Saving			
Agriculture								
Cash crop	Sugarcane	32.1	12.2	19.9	62.0	35.3	23.1	65.4
Cereals	Jowar	0.7	0.5	0.2	28.6	1.1	0.6	54.5
	Maize	1	0.9	0.1	10.0	1.5	0.6	40.0
	Paddy	61.8	17.2	44.6	72.2	51.8	34.6	66.8
Pulses	Bengal gram	1.2	0.9	0.3	25.0	1.5	0.6	40.0
	Black gram	1.2	0.9	0.3	25.0	1.1	0.2	18.2
	Green gram	1.2	0.8	0.4	33.3	1	0.2	20.0
	Redgram	1.3	0.9	0.4	30.8	1.4	0.5	35.7
Fibre	Cotton	4.2	2.5	1.7	40.5	3.5	1.0	28.6
Oil seeds	Groundnut	1.7	0.9	0.8	47.1	2.1	1.2	57.1
	Soyabean	3.2	2.2	1.0	31.3	2.8	0.6	21.4
	Sunflower	1.5	0.9	0.6	40.0	1.8	0.9	50.0
Millet	Ragi	0.9	0.65	0.25	27.8	1.1	0.4	40.9
Horticulture								
Plantation crop	Arecanut	28.3	12.7	15.6	55.1	21.3	8.6	40.4
	Coconut	26	14.9	11.1	42.7	24.5	9.6	39.2
Fruit crops	Banana	28.4	12.7	15.7	55.3	21.4	8.7	40.7
	Grapes	27.3	14.6	12.7	46.5	28.3	13.7	48.4
	Mango	21.6	13.9	7.7	35.6	16.6	2.7	16.3
Spices	Chilly	9.5	4.4	5.1	53.7	7.8	3.4	43.6
	Onion	3.8	2.1	1.7	44.7	3.2	1.1	34.4
	Turmeric	9.5	5.3	4.2	44.2	10.5	5.2	49.5
Vegetable	Tomato	9.5	5.6	3.9	41.1	9.5	3.9	41.1
	Beans	2.6	1.6	1.0	38.5	3.2	1.6	50.0
Sericulture								
Mulberry	Mulberry	14.8	8.5	6.3	42.6	8.9	0.4	1.2

Source: Field study, AMI: After MI installation BMI: Before MI installation MF: Marginal farmer, SF: Small farmer, MeF: Medium famer LF: Large farmer

1 Acre filled with 1 inch of water = 103 mt^3

Table 4.54a: Crop and district wise water saving in agriculture crops (Acre Inch)- Before and After MI installation

Crop Name	**MI status**	**Belagavi**	**Bidar**	**C. R. Nagar**	**Haveri**	**Kalaburgi**	**Kolar**	**Mysuru**	**Shivamogga**	**Tumakuru**	**Uttara Kannada**
Sugarcane*	BMI	36.5	33.2	28.2	----	----	----	32.3	----	----	32.6
	AMI	17.7	14.6	14.6	----	----	----	17.3	----	----	19.8
	% Saving	**51.5**	**56.0**	**48.2**	**----**	**----**	**----**	**46.4**	**----**	**----**	**39.3**
Jowar	BMI	0.8	0.7	----	0.7	0.9	----	----	----	----	----
	AMI	0.3	0.4	-----	0.5	0.6	----	-----	-----	----	-----
	% Saving	**62.5**	**42.9**	-----	**28.6**	**33.3**	----	-----	-----	----	----
Maize	BMI	1.5	----	1.05	1	----	-----	0.9	1.6	-----	1.15
	AMI	1.2	-----	0.8	0.9	-----	----	0.5	0.9	----	0.85
	% Saving	**20.0**		**23.8**	**10.0**			**44.4**	**43.8**		**26.1**
Paddy*	BMI	55.0	----	55.6	66.1	----	-----	69.5	68	-----	55
	AMI	15.6	-----	17.8	17.3	-----	----	19	18	----	19.5
	% Saving	**71.6**		**68.0**	**73.8**			**72.7**	**73.5**		**64.5**
Bengal gram	BMI	1.4	-----	----	1	1.1	-----	----	----	-----	----
	AMI	1.0	-----	-----	0.7	0.9	----	-----	-----	----	-----
	% Saving	**28.6**	-----	-----	**30.0**	**18.2**	-----	-----	-----	-----	-----
Black bean	BMI	-----	1.05	0.9	-----	-----	-----	1.5	----	-----	----
	AMI	-----	0.9	0.7	-----	-----	-----	1.2	-----	----	-----
	% Saving	**-----**	**14.3**	**22.2**	**-----**	**-----**	**-----**	**20.0**			
Green gram	BMI	1.8	1.5	1.2	1.4	1.4	-----	1.1	-----	1.2	-----
	AMI	1.1	0.8	0.5	1.1	0.95	----	0.8	----	0.8	----

Crop Name	**MI status**	**Belagavi**	**Bidar**	**C. R. Nagar**	**Haveri**	**Kalaburgi**	**Kolar**	**Mysuru**	**Shivamogga**	**Tumakuru**	**Uttara Kannada**
	% Saving	**38.9**	**46.7**	**58.3**	**21.4**	**32.1**	**-----**	**27.3**	**-----**	**33.3**	**-----**
Redgram	BMI	----	1.4	----	1.3	1.4	-----	-----	-----	-----	-----
	AMI	-----	0.9	-----	0.8	0.9	----	----	----	----	----
	% Saving	**----**	**35.7**	**----**	**38.5**	**35.7**	**-----**	**-----**	**-----**	**-----**	**-----**
Cotton*	BMI	5.4	4.5	4.1	4.7	5.5	-----	----	----	----	3.2
	AMI	2.3	2.0	2.8	2.5	2.6	----	-----	-----	-----	2.5
	% Saving	**57.4**	**55.6**	**31.7**	**46.8**	**52.7**	**----**	**----**	**----**	**----**	**21.9**
Groundnut	BMI	1.4	----	1.8	1.7	1.8	----	----	----	1.8	----
	AMI	0.6	-----	0.9	0.7	1.1	-----	-----	-----	1.2	-----
	% Saving	**57.1**	**----**	**50.0**	**58.8**	**38.9**	**----**	**----**	**----**	**33.3**	**----**
Soyabean	BMI	4.3	3.5	2.1	----	----	----	3.2	3.1	2.8	----
	AMI	2.3	2.5	1.8	-----	-----	-----	2.1	2.1	2.4	-----
	% Saving	**46.5**	**28.6**	**14.3**	**----**	**----**	**----**	**34.4**	**32.3**	**14.3**	**----**
Sunflower	BMI	1.6	1.4	----	1.5	1.6	----	----	----	----	1.2
	AMI	1	0.6	-----	1.1	0.9	-----	-----	-----	-----	0.85
	% Saving	**37.5**	**57.1**	**----**	**26.7**	**43.8**	**----**	**----**	**----**	**----**	**29.2**
Ragi	BMI	----	----	0.9	----	----	0.5	0.9	0.8	1.3	----
	AMI	-----	-----	0.6	-----	-----	0.3	0.5	0.6	0.8	-----
	% Saving	**----**	**----**	**38.1**	**----**	**----**	**40.0**	**44.4**	**25.0**	**38.5**	**----**

Source: Field study, AMI: After MI installation BMI: Before MI installation, * Crop irrigated under Drip irrigation

Table 4.54b: Crop and district wise water saving-Horticulture and sericulture crops (Acre Inch)- Before and After MI installation

Crop	MI status	Belagavi	Bidar	C. R. Nagar	Haveri	Kalaburgi	Kolar	Mysuru	Shivamogga	Tumakuru	Uttara Kannada
Arecanut	BMI	----	----	----	----	----	----	----	27.8	32.3	25.0
	AMI	-----	-----	-----	-----	-----	-----	-----	10.5	15.5	11.2
	% Saving	**----**	**----**	**----**	**----**	**----**	**----**	**----**	**62.2**	**52.0**	**55.2**
Coconut	BMI	----	----	27.5	25.6	----	----	28.0	28.9	28.0	23.4
	AMI	-----	-----	13.0	18.0	-----	-----	18.0	13.0	15.0	13.0
	% Saving			**52.7**	**29.7**			**35.7**	**55.0**	**46.4**	**44.4**
Banana	BMI	32.2	----	26.5	30.3	33.2	29.4	27.4	27.3	23.1	22.8
	AMI	14.8	-----	11.2	12.3	13.7	13.4	11.4	11.2	15.6	12.2
	% Saving	**54.0**		**57.7**	**59.4**	**58.7**	**54.4**	**58.4**	**59.0**	**32.5**	**46.5**
Grapes	BMI	33.0	----	----	25.0	----	----	----	23.0	----	----
	AMI	20.0	-----	-----	10.5	-----	-----	-----	13.4	-----	-----
	% Saving	**39.4**	**----**	**----**	**58.0**	**----**	**----**		**41.7**	**----**	**----**
Mango	BMI	----	-----	-----	25.6	-----	-----	18.0	----	----	----
	AMI	-----	----	----	14.0	----	----	13.0	-----	----	----
	% Saving		**-----**	**-----**	**45.3**	**-----**	**-----**	**27.8**	**----**	**-----**	**-----**
Chilly	BMI	9.3	----	----	9.5	9.9	10.0	----	-----	----	----
	AMI	4.5	-----	-----	4.6	4.5	4.0	-----	----	-----	-----

Crop	**MI status**	**Belagavi**	**Bidar**	**C. R. Nagar**	**Haveri**	**Kalaburgi**	**Kolar**	**Mysuru**	**Shivamogga**	**Tumakuru**	**Uttara Kannada**
	% Saving	**51.6**	----	----	**51.6**	**54.5**	**60.0**		-----	----	----
Onion	BMI	3.5	----	----	3.8	4.1	4.5	----	----	-----	-----
	AMI	1.4	-----	-----	2.3	3.4	1.4	-----	-----	----	----
	% Saving	**60.0**	----	----	**39.5**	**17.1**	**68.9**			-----	-----
Turmeric	BMI	8.8	9.8	9.5	9	----	9.7	10.5	12.0	----	----
	AMI	4.3	5.5	6.5	5.5	-----	5.7	5.6	6.3	-----	-----
	% Saving	**51.1**	**43.9**	**31.6**	**38.9**		**41.2**	**46.7**	**47.5**	----	----
Tomato	BMI	10.2	----	11.6	7.8	----	9.8	9.4	----	8.1	----
	AMI	5.6	-----	8.9	4.8	-----	4.5	5.6	-----	3.1	-----
	% Saving	**45.1**		**23.3**	**38.5**		**54.1**	**40.4**		**61.7**	
Beans	BMI	2.6	----	3.2	----	5.5	1.2	1.5	1.2	1.5	----
	AMI	1.5	-----	2.5	-----	3.4	0.8	1.2	0.8	0.9	-----
	% Saving	**42.3**		**21.9**		**38.2**	**33.3**	**20.0**	**33.3**	**40.0**	
Mulberry	BMI	18	15.4	15.6	11.2	11.8	17.4	16.0	15.2	14.5	14.5
	AMI	10.5	9.9	8.5	8.8	8	12.7	8.0	7.6	7.8	7.8
	% Saving	**41.7**	**35.7**	**45.5**	**21.4**	**32.2**	**27.0**	**50.0**	**50.0**	**46.2**	**46.2**

Source: Field study, AMI: After MI installation BMI: Before MI installation, * Crop irrigated under Drip irrigation

Table 4.54c: Crop wise water saving status with farmer categories (acre inches)- Before and After MI installation

Crop	**Agriculture**					**Crops**	**Horticulture and Sericulture**				
	MI status	**MF**	**SF**	**MeF**	**LF**		**MI status**	**MF**	**SF**	**MeF**	**LF**
Sugarcane*	BMI	30.4	32.4	35.7	32	**Arecanut**	BMI	27.8	32.3	25	29
	AMI	15.4	12.3	12.5	10.4		AMI	13.2	11.3	7	19.5
	Net saving	15	20.1	23.2	21.6		Net saving	14.6	21	18	9.5
	% Change	**49.3**	**62.0**	**64.9**	**67.5**		**% Change**	**52.5**	**65.0**	**72.0**	**32.7**
Jowar	BMI	0.78	0.9	1.2	0.7	**Coconut**	BMI	23.4	23.4	24.3	35.6
	AMI	0.5	0.6	0.8	0.6		AMI	14	19	13.4	32.3
	Net saving	0.28	-0.3	0.4	0.1		Net saving	9.4	4.4	10.9	3.3
	% Change	**35.9**	**33.3**	**33.3**	**14.2**		**% Change**	**40.1**	**18.8**	**44.8**	**9.2**
Maize	BMI	1	1.05	1.5	1.2	**Banana**	BMI	21.5	30.3	33.2	29.4
	AMI	0.9	0.9	1.3	1.1		AMI	11.2	11.5	13.6	14.5
	Net saving	0.1	0.15	0.2	0.1		Net saving	10.3	18.8	19.6	14.9
	% Change	**10.0**	**14.2**	**13.3**	**8.3**		**% Change**	**47.9**	**62.0**	**59.0**	**50.6**
Paddy*	BMI	66.1	51.4	59.5	70	**Grapes**	BMI	26.4	27.3	29.3	28.3
	AMI	17.5	14.4	13.5	23.5		AMI	19.5	18.6	19.7	18
	Net saving	48.6	37	46	46.5		Net saving	6.9	8.7	9.6	10.3
	% Change	**73.5**	**71.9**	**77.3**	**66.4**		**% Change**	**26.1**	**31.87**	**32.7**	**36.4**
Bengal gram	BMI	1.3	1.1	1.4	1	**Mango**	BMI	26.4	21	18	19
	AMI	0.9	0.8	0.95	0.7		AMI	15.5	13	10	15

Crop	**Agriculture**					**Crops**	**Horticulture and Sericulture**				
	MI status	**MF**	**SF**	**MeF**	**LF**		**MI status**	**MF**	**SF**	**MeF**	**LF**
	Net saving	0.4	0.3	0.45	0.3		Net saving	0.9	8	8	4
	% Change	**30.7**	**27.2**	**32.1**	**30.0**		**% Change**	**41.2**	**38.10**	**44.4**	**21.0**
Black gram	BMI	0.9	1.05	1.2	1.1	**Chilly**	BMI	9.5	9.9	10	9.3
	AMI	0.7	0.9	0.8	0.8		AMI	4.6	5	4	4.5
	Net saving	0.2	0.15	0.4	0.3		Net saving	4.9	4.9	-6	-4.8
	% Change	**22.2**	**14.2**	**33.3**	**27.2**		**% Change**	**51.5**	**49.4**	**60.0**	**51.6**
Redgram	BMI	1.2	1.4	1.1	1.3	**Onion**	BMI	3.8	4.1	4.5	3.5
	AMI	1	0.9	0.7	0.8		AMI	2.3	3.4	1.4	1.4
	Net saving	0.2	0.5	0.4	0.5		Net saving	1.5	0.7	3.1	2.1
	% Change	**16.6**	**35.7**	**36.3**	**38.4**		**% Change**	**39.4**	**17.0**	**68.8**	**60.0**
Green gram	BMI	1.7	1.1	0.9	1.4	**Turmeric**	BMI	8.8	9.8	9.5	9
	AMI	1.5	0.8	0.6	1		AMI	4.3	5.5	5	5.5
	Net saving	0.2	0.3	0.3	0.4		Net saving	4.5	4.3	4.5	3.5
	% Change	**11.7**	**27.2**	**33.3**	**28.5**		**% Change**	**51.1**	**43.8**	**47.3**	**38.8**
Groundnut	BMI	1.5	1.8	1.8	1.7	**Tomato**	BMI	11.2	11.2	9.2	7.8
	AMI	0.9	1	0.9	1.1		AMI	7	7	5	4.8
	Net saving	0.6	0.8	0.9	0.6		Net saving	4.2	4.2	4.2	3
	% Change	**40.0**	**44.4**	**50.0**	**35.2**		**% Change**	**37.5**	**37.5**	**45.6**	**38.4**
Soyabean	BMI	4.3	3.5	2.1	2.1	**Beans**	BMI	1.5	1.2	3.4	5.5

Crop	**Agriculture**					**Crops**	**Horticulture and Sericulture**				
	MI status	**MF**	**SF**	**MeF**	**LF**		**MI status**	**MF**	**SF**	**MeF**	**LF**
	AMI	3.2	2	1.3	1.5		AMI	1.1	0.8	1.5	3.4
	Net saving	1.1	1.5	0.8	0.6		Net saving	0.4	0.4	1.9	2.1
	% Change	**25.5**	**42.8**	**38.1**	**28.5**		**% Change**	**26.6**	**33.3**	**55.8**	**38.1**
Sunflower	BMI	1.6	1.3	1.1	1.4						
	AMI	1	0.8	0.45	1.1	**Mulberry**	BMI	11	15.4	15.6	18
	Net saving	0.6	0.5	0.65	0.3		AMI	8.7	8.9	6.7	10.5
	% Change	**37.5**	**38.4**	**59.0**	**21.4**		Net saving	2.3	6.5	8.9	7.5
Ragi	BMI	0.5	0.9	1.3	0.8		**% Change**	**20.9**	**42.2**	**57.0**	**41.67**
	AMI	0.3	0.5	0.6	0.6						
	Net saving	0.2	0.4	0.7	0.2						
	% Change	**40.0**	**44.4**	**53.8**	**25.0**						
Cotton*	BMI	5.4	4.5	4.1	4.7						
	AMI	2.8	2.2	1.9	2.8						
	Net saving	2.6	2.3	2.2	1.9						
	% Change	**48.1**	**51.1**	**53.6**	**40.4**						

Source: Field study, AMI: After MI installation BMI: Before MI installation, * Crop irrigated under Drip irrigation

4.4.6 Fertilizer saving

The quantity of fertilizer use among different kinds of crops per acre was compared before and after the installation of MI within beneficiaries and among beneficiaries and non-beneficiaries. As a production input, fertilizer application is a critical activity. District-wise fertiliser saving among beneficiaries and non-beneficiaries given in Table 4.55 In the present study, the average reduction/saving of fertilizer usage was 23.3 percent. Maximum saving was noticed in Belagavi (30.5%), followed by Mysuru (29.5%) and least in Uttara Kannada (17.6%). Among beneficiaries and non-beneficiaries an average of 16.3 percent with a range of 13.4 to 22.2 percent saving was observed with Uttara Kannada recording the highest savings (22.2%) followed by Belagavi (19.2%) and Shivamogga for the lowest of (13.4%).

In the present study it is noted that use of fertiliser as a result of micro irrigation can improve fertiliser savings by 23.3 percent on an average.

Table 4.55: Fertiliser saving with beneficiaries and non-beneficiaries with MI installation

District	Beneficiaries (AMI: After MI installation/ BMI: Before MI installation)				Non beneficiaries (qt/acre) AMI	Net saving in (qt/acre) (Beneficiaries vs Non beneficiaries	Change % to the Beneficiaries vs Non beneficiaries
	BMI (qt/acre)	AMI (qt/acre)	Net saving (qt/acre)	% Saving			
Belagavi	13.2	9.1	4.0	30.5	11.4	2.2	19.2
Bidar	6.7	5.2	1.5	21.8	6.5	1.2	18.5
C. R. Nagar	8.7	6.7	1.9	22.2	8.3	1.5	17.8
Haveri	10.8	8.3	2.5	22.8	9.8	1.5	14.8
Kalaburgi	7.7	6.0	1.8	22.7	7.2	1.2	16.2
Kolar	12.0	9.4	2.6	21.3	11.2	1.6	14.7
Mysuru	9.8	6.9	2.9	29.5	8.4	1.4	17.0
Shivamogga	12.5	9.7	2.8	22.0	11.3	1.5	13.4
Tumakuru	12.3	9.6	2.7	21.7	11.5	1.8	15.6
Uttara Kannada	10.5	8.7	1.7	17.6	11.2	2.5	22.2
Total	**10.4**	**8.0**	**2.4**		**9.6**	**1.6**	
Average -%				**23.3**			**16.8**

Source: Field study. AMI: After MI installation/ BMI: Before MI installation

Agriculture

Table 4.56 describes crop category wise fertiliser saving in the study area. The percent fertilizer saving after installation of MI was observed to be maximum for jowar (33.3%), followed by cotton (30.0%) while black gram and ragi recorded minimum (11.1% each) reduction in fertilizer consumption. However, among beneficiaries and non-beneficiaries maximum percent fertilizer saving was noticed in cotton (53 %) cultivation, followed by Bengal gram (44%) and minimum saving of 24 % was recorded for maize.

The Table 4.57a provides district-wise and crop-wise fertilizer saving after installation of MI. Crops under MI cultivation were recorded for savings ranging between 4.5 to 60.0 percent with the lowest begin green gram at Tumakuru and highest being black gram Bidar.

Horticulture

Table 4.56 provides a comparative analysis of fertilizer savings before and after the installation of drip within beneficiaries, as well as among beneficiaries and non-beneficiaries showing a reduction in fertilizer consumption for all the crops recorded under the study. Installation of drip irrigation system resulted in maximum savings of 32.4 percent for beans crop, followed by Banana (31.3%) and least being 15.9 percent for arecanut. Among beneficiaries and non-beneficiaries, a maximum of 63.3 percent of fertilizer saving was recorded under tomato cultivation and a minimum of 21.9 percent for Onion crop with beneficiaries.

The detail crop-wise and district wise percentage in fertiliser -saving after MI adoption is given in table 4.57b. Survey results describe that average maximum (52%) fertilizer saving under tomato cultivation at Belagavi and followed by 50.0 percent in beans at Tumakuru and a minimum of 5 percent for arecanut at Shivamogga in comparison to the conventional practice followed before installation of drip irrigation system.

Sericulture

Table 4.56 provide system a comparative analysis of fertilizer savings before and after the installation of drip within beneficiaries, as well as among beneficiaries and non-beneficiaries. After Installation of the MI system, mulberry cultivation has recorded a fertilizer savings of 11.1 percent and among beneficiaries and non-beneficiaries, the maximum reduction of 33.3 percent in fertilizer, consumption has been recorded after MI installation. Table 4.57b indicates 36.8 percent of the reduction in fertilizer consumption in Tumakuru and minimum of 4.5 percent in Belagavi among the sampled districts

Micro Irrigation as technology has been popularly known for reduced consumption of fertiliser, however, its potential to reduce fertilizer consumption is really a boon to soil health. Supply of excessive fertilizers mostly followed during conventional cultivation practice which leads to pollute the farming land. MI as the technology holds greater scope in checking the excessive supply of chemicals to the soil.

Farmer category wise Fertiliser saving

It could be observed from the Table 4.57c that saving in fertilise consumption has been observed with respect to different crops among various group of farmer under agriculture horticulture and sericulture due to the adoption of Micro irrigation. Under agriculture crops, a maximum (57.1%: 14 to 6 qt/acre) fertiliser saving was observed under medium category farmers with Jowar followed by same category of farmer with Bengal gram crop that is 37.5 percent (5.5 to 5.2 qt/acre) as compared to before adoption of MI, while it was minimum (4.5%: 5.5 to 5.25 qt/acre) with groundnut with large farmers. Under horticulture crops maximum fertiliser saving ranged from 42.8 percent (14 to 8 qt/acre) with banana under medium category farmers followed by same category of farmer with beans crops that is 37% (4 to 2.5 qt/acre) and minimum of 13.3 percent (3 to 2.6 qt/acre) reduction in fertiliser usage with onion under large category of farmers. In mulberry maximum fertiliser (only FYM) saving of 22.2 percent (9 qt/acre to 7 qt/acre) was observed with marginal farmers and minimum of 4.5 percent (11 to 10.5 qt/acre) with large category farmers. From the above analysis the fertiliser saving with adoption of micro irrigation was benefitted more with medium category farmers in agriculture, horticulture and sericulture as compared other category of farmers. The reduction of fartliser dependency by saving under medium category farmers could be due to higher rate MI adoption, functioning status, use of improved verity of seeds and supplementation of irrigation during critical crop growing seasons.

Table 4.56: Crop category wise fertiliser saving in the study area (before and after MI and beneficiaries and nonbeneficiaries)

Crop Category	Crop Name	Beneficiaries				Non beneficiaries (qt/acre)	Net saving (qt/acre) (Beneficiaries vs Non beneficiaries)	% Saving to the Beneficiaries vs Non beneficiaries
		BMI (qt/acre)	AMI (qt/acre)	Net saving (qt/acre	% Saving			
Agriculture								
Cash crop	Sugarcane*	5.5	4.0	1.5	27.3	6.0	2.0	33.3
Cereals	Jowar	15.0	10.0	5.0	33.3	14.0	4.0	28.6
	Maize	15.5	12.5	3.0	19.4	16.6	4.1	24.7
	Paddy	25.0	18.0	7.0	28.0	26.0	8.0	30.8
Pulses	Bengal gram	3.1	2.5	0.6	19.4	4.5	2.0	44.4
	Black gram	4.5	4.0	0.5	11.1	6.0	2.0	33.3
	Green gram	5.5	4.5	1.0	18.2	7.5	3.0	40.0
	Redgram	5.0	4.0	1.0	20.0	7.0	3.0	42.9
Oil seeds	Groundnut	6.0	5.0	1.0	16.7	8.0	3.0	37.5
	Soyabean	7.5	5.5	2.0	26.7	8.2	2.7	32.9
	Sunflower	9.5	7.0	2.5	26.3	11.0	4.0	36.4
Fibber	Cotton	5.0	3.5	1.5	30.0	7.5	4.0	53.3
Millet	Ragi	4.5	4.0	0.5	11.1	6.4	2.4	37.5
Horticulture								
Plantation crop	Arecanut	22.0	18.5	3.5	15.9	24.5	6.0	24.5
	Coconut	24.0	20.0	4.0	16.7	32.2	12.2	37.9

Crop Category	**Crop Name**	**Beneficiaries**				**Non beneficiaries (qt/acre)**	**Net saving (qt/acre) (Beneficiaries vs Non beneficiaries)**	**% Saving to the Beneficiaries vs Non beneficiaries**
		BMI (qt/acre)	**AMI (qt/acre)**	**Net saving (qt/acre**	**% Saving**			
Fruit crops	Banana	16.0	11.0	5.0	31.3	17.5	6.5	37.1
	Grapes	18.0	15.0	3.0	16.7	19.3	4.3	22.3
	Mango	18.0	12.5	5.5	30.6	20.9	8.4	40.2
Spices	Chilly	7.5	5.5	2.0	26.7	8.5	3.0	35.3
	Onion	3.0	2.5	0.5	16.7	3.2	0.7	21.9
	Turmeric	3.0	2.4	0.6	20.0	3.3	0.9	27.3
Vegetable	Tomato	2.5	2.0	0.5	20.0	5.5	3.5	63.6
	Beans	3.7	2.5	1.2	32.4	3.5	1.0	28.6
Sericulture								
Mulberry	Mulberry	9.0	8.0	1.0	11.1	12.0	4.0	33.3

Sources: Field study. AMI: After MI installation/ BMI: Before MI installation) ** Sugarcane: only chemical fertilizers, Rest all crops FYM: +chemical fertiliser

Table 4.57a: Crop wise and district wise fertilizer saving in agriculture (qt/acre)- Before and After MI installation

Crop	**MI status**	**Belagavi**	**Bidar**	**C. R. Nagar**	**Haveri**	**Kalaburgi**	**Kolar**	**Mysuru**	**Shivamogga**	**Tumakuru**	**Uttara Kannada**
Sugarcane*	BMI	7.5	5.1	5.1	----	----	----	4.8	----	----	4.8
	AMI	4.5	4.3	4	-----	----	-----	3.6	-----	-----	3.8
	% Saving	**40.0**	**15.7**	**21.6**				**25.0**			**20.8**
Jowar	BMI	14	12	----	17	18	----	---	----	----	----
	AMI	6	11	-----	13	12	-----	-----	-----	-----	-----
	% Saving	**57.1**	**8.3**		**23.5**	**33.3**					
Maize	BMI	15	----	18	13	----	----	11	15	----	17
	AMI	8.8	----	11.8	8.8	----	----	6.8	9.8	----	12.8
	% Saving	**41.3**	----	**34.4**	**32.3**	----	----	**38.2**	**34.7**	----	**24.7**
Paddy	BMI	27	----	25	22	----	----	29	28	----	21
	AMI	20.7	----	18.7	21.6	----	----	21.9	23.7	----	16.7
	% Saving	**23.3**	----	**25.2**	**1.8**	----	----	**24.5**	**15.4**	----	**20.5**
Bengal gram	BMI	3.4	3	----	4	4	----	0	----	----	----
	AMI	2.7	2.4	----	2.3	2.8	-----	0	-----	-----	-----
	% Saving	**20.6**	**20.0**		**42.5**	**30.0**					
Black gram	BMI	----	4.5	5	----	----	----	4.5	----	----	----
	AMI	----	1.8	2.4	----	----	----	1.2	----	----	----
	% Saving	----	**60.0**	**52.0**	----	----	----	**73.3**	----	----	----
Green gram	BMI	8	5	5	6	5	----	4	----	8	----
	AMI	6	3.25	3.5	4.2	3.7	-----	3.2	-----	7.6	-----

Crop	**MI status**	**Belagavi**	**Bidar**	**C. R. Nagar**	**Haveri**	**Kalaburgi**	**Kolar**	**Mysuru**	**Shivamogga**	**Tumakuru**	**Uttara Kannada**
	% Saving	**25.0**	**35.0**	**30.0**	**30.0**	**26.0**		**20.0**		**4.5**	
Redgram	BMI	----	5	----	7	5	----	----	----	----	----
	AMI	-----	3	-----	5	3	-----	-----	-----	-----	-----
	% Saving		**40.0**		**28.6**	**40.0**					
Cotton	BMI	5.5	4	7	6	4.5	----	----	----	----	7
	AMI	3.5	2.5	5.5	3.2	3.6	-----	-----	-----	-----	3.2
	% Saving	**36.4**	**37.5**	**21.4**	**46.7**	**20.0**					**54.3**
Groundnut	BMI	7	----	6.5	7.2	6	----	----	----	6	----
	AMI	3.9	----	3.9	3.9	2.9	----	----	----	2.9	----
	% Saving	**44.3**	----	**40.0**	**45.8**	**51.7**	----	----	----	**51.7**	----
Soyabean	BMI	7.8	9.3	9.6	----	----	----	5.8	8.2	6.5	----
	AMI	5.0	7	7.0	----	----	----	4	5	4	-----
	% Saving	**35.9**	**24.7**	**27.1**	----	----	----	**31.0**	**39.0**	**38.5**	
Sunflower	BMI	7.9	10	----	15.0	9.0	----	----	----	----	9
	AMI	5.5	6	-----	8.0	6.0	-----	-----	-----	-----	8
	% Saving	**30.4**	**40.0**		**46.7**	**33.3**					**11.1**
Ragi	BMI	----	----	5.0	----	----	7	5	3	4	----
	AMI	-----	-----	3.0	-----	-----	5	4	2.5	3	-----
	% Saving			**40.0**			**28.6**	**20.0**	**16.7**	**25.5**	

Sources: Field study. AMI: After MI installation/ BMI: Before MI installation. ** Sugarcane: Only chemical fertilizers, Rest all crops FYM: +chemical fertilise

Table 4.57b: Crop wise and district wise fertilizer saving Horticulture and Sericulture(qt/acre)- Before and After MI installation

Crop	**MI status**	**Belagavi**	**Bidar**	**C. R. Nagar**	**Haveri**	**Kalaburgi**	**Kolar**	**Mysuru**	**Shivamogga**	**Tumakuru**	**Uttara Kannada**
Arecanut	BMI	----	----	----	----	----	----	----	20.0	26.0	20.0
	AMI	----	----	----	----	----	----	----	19.0	19.0	16.0
	% Saving	----	----	----	----	----	----	----	**5.0**	**26.9**	**20.0**
Coconut	BMI	----	----	27.0	22.0	----	----	28.0	24.0	23.0	23.0
	AMI	----	----	19.0	19.0	----	----	18.5	21.4	19.4	20.0
	% Saving	----	----	**29.6**	**13.6**	----	----	**33.9**	**10.8**	**15.7**	**13.0**
Banana	BMI	14.0	----	14.0	15.0	13.0	17	18.0	14.0	19.0	17.0
	AMI	9.0	----	8.0	9.0	9.0	11	13.0	11.0	13.0	12.0
	% Saving	**35.7**	----	**42.9**	**40.0**	**30.8**	**35.3**	**27.8**	**21.4**	**31.6**	**29.4**
Grapes	BMI	22.0	----	----	19.0	----	----	----	15.0	----	----
	AMI	19.0	----	----	15.0	----	----	-----	10.0	----	----
	% Saving	**13.6**	----	----	**21.1**	----	----		**33.3**	----	----
Mango	BMI	----	----	----	17.0	----	----	19.0	----	----	----
	AMI	----	----	----	12.0	----	----	13.0	----	----	----
	% Saving	----	----	----	**29.4**	----	----	**31.6**	----	----	----
Chilly	BMI	9.5	----	----	6.5	5.8	7.8	----	----	----	----
	AMI	5.5	----	----	5.5	4.5	6.4	----	----	----	----
	% Saving	**42.1**	----	----	**15.4**	**22.4**	**17.9**	----	----	----	----
Onion	BMI	3.0	----	----	3.0	4.0	3.5	----	----	----	----
	AMI	2.5	----	----	2.0	3.2	2.8	----	----	----	----
	% Saving	**16.7**	----	----	**33.3**	**20.0**	**20.0**	----	----	----	----

Crop	**MI status**	**Belagavi**	**Bidar**	**C. R. Nagar**	**Haveri**	**Kalaburgi**	**Kolar**	**Mysuru**	**Shivamogga**	**Tumakuru**	**Uttara Kannada**
Turmeric	BMI	3.5	2.5	4.3	3.5	----	3.0	3.0	3.0	----	----
	AMI	2.3	3.7	2.8	2.3	----	1.8	2.0	2.0	----	----
	% Saving	**34.3**	**48.0**	**34.9**	**34.2**	----	**40.0**	**33.3**	**33.3**	----	----
Tomato	BMI	2.5	----	3.5	3.0	----	3.5	2.6	----	2.0	----
	AMI	1.2	----	2.0	2.5	----	2.2	1.6	-----	1.2	----
	% Saving	**52.0**	----	**42.9**	**16.7**	----	**37.1**	**38.5**		**40.0**	----
Beans	BMI	4.0	----	4.0	----	4.0	4.0	3.5	4.0	4.0	----
	AMI	2.8	----	2.2	-----	2.3	3.3	2.0	3.0	2.0	----
	% Saving	**30.0**	----	**45.0**		**42.5**	**17.5**	**42.9**	**25.0**	**50.0**	----
Mulberry	BMI	11.0	10.6	9.0	8.0	9.5	10.5	12	8.0	9.5	9.0
	AMI	10.5	9.0	7.0	7.0	7.0	8.0	9.0	6.0	6.0	6.0
	% Saving	**4.5**	**15.1**	**22.2**	**12.5**	**26.3**	**23.8**	**25.0**	**25.0**	**36.8**	**33.3**

Sources: Field study. AMI: After MI installation/ BMI: Before MI installation

Table 4.57c: Crop wise fertiliser saving with farmer categories (qt/acre)- Before and After MI installation

Crop	**Agriculture**						**Horticulture and Sericulture**				
	MI status	**MF**	**SF**	**MeF**	**LF**	**Crop**	**MI status**	**MF**	**SF**	**MeF**	**LF**
Sugarcane*	BMI	5.1	4.8	7	5.1	**Arecanut**	BMI	20	20	26	23
	AMI	4	3.6	4.5	4.3		AMI	18	17.5	17	20
	Net saving	**1.1**	**1.2**	**2.5**	**0.8**		**Net saving**	**2**	**2.5**	**9**	**3**
	% Change	**21.5**	**25.0**	**35.7**	**15.6**		**% Change**	**10.0**	**12.5**	**34.6**	**13.0**
Jowar	BMI	12	18	14	17	**Coconut**	BMI	23	24	28	22
	AMI	11	12	6	13		AMI	19.6	20	21	19
	Net saving	**1**	**6**	**8**	**4**		**Net saving**	**3.4**	**4**	**7**	**3**
	% Change	**8.3**	**33.3**	**57.1**	**23.5**		**% Change**	**14.7**	**16.6**	**25.0**	**13.6**
Maize	BMI	15	18	15	13	**Banana**	BMI	14	17	14	17
	AMI	12	14	11	11		AMI	11	11.2	8	12
	Net saving	**3**	**4**	**4**	**2**		**Net saving**	**3**	**5.8**	**6**	**5**
	% Change	**20.0**	**22.2**	**26.6**	**15.3**		**% Change**	**21.4**	**34.1**	**42.8**	**29.4**
Paddy	BMI	27	29	25	22	**Grapes**	BMI	22	14	19	19
	AMI	21	19	16	18.9		AMI	19	12	14	16
	Net saving	**6**	**10**	**9**	**3.1**		**Net saving**	**3**	**2**	**5**	**3**
	% Change	**22.2**	**34.4**	**36.0**	**14.0**		**% Change**	**13.6**	**14.2**	**26.3**	**15.7**
Bengal gram	BMI	3.4	3	4	3	**Mango**	BMI	17	19	17	17
	AMI	2.6	2.4	2.5	2.7		AMI	12	13	11	12

Crop	**Agriculture**						**Horticulture and Sericulture**				
	MI status	**MF**	**SF**	**MeF**	**LF**	**Crop**	**MI status**	**MF**	**SF**	**MeF**	**LF**
	Net saving	**0.8**	**0.6**	**1.5**	**0.3**		**Net saving**	**5**	**6**	**6**	**5**
	% Change	**23.5**	**20.0**	**37.5**	**10.0**		**% Change**	**29.4**	**31.5**	**35.2**	**29.4**
Black gram	BMI	4	3.5	5	6.5	**Chilly**	BMI	8	7.8	9.5	6.5
	AMI	3.5	3	4	5.5		AMI	6	6	5.5	5.5
	Net saving	**0.5**	**0.5**	**1**	**1**		**Net saving**	**2**	**1.8**	**4**	**1**
	% Change	**12.5**	**14.2**	**20.0**	**15.3**		**% Change**	**25.0**	**23.0**	**42.1**	**15.3**
Green gram	BMI	8	5	5.5	5.1	**Onion**	BMI	3.25	3.5	3.5	3
	AMI	6.5	4.5	3.5	4.5		AMI	2.8	2.8	2.7	2.6
	Net saving	**1.5**	**0.5**	**2**	**0.6**		**Net saving**	**0.45**	**0.7**	**0.8**	**0.4**
	% Change	**18.7**	**10.0**	**36.3**	**11.7**		**% Change**	**13.8**	**20.0**	**22.8**	**13.3**
Redgram	BMI	4	5	5.5	7	**Turmeric**	BMI	3	3.5	4.3	3
	AMI	3.2	4.5	3.5	6		AMI	2.5	2.5	3	2.5
	Net saving	**0.8**	**0.5**	**2**	**1**		**Net saving**	**0.5**	**1**	**1.3**	**0.5**
	% Change	**20.0**	**10.0**	**36.3**	**14.2**		**% Change**	**16.6**	**28.5**	**30.2**	**16.6**
Cotton	BMI	5.5	4	7	5	**Tomato**	BMI	2.5	3	3.5	3
	AMI	4.4	3.5	5.5	4		AMI	2	2.2	2.5	2.5
	Net saving	**1.1**	**0.5**	**1.5**	**1**		**Net saving**	**0.5**	**0.8**	**1**	**0.5**
	% Change	**20.0**	**12.5**	**21.4**	**-20.0**		**% Change**	**20.0**	**26.6**	**28.5**	**16.6**
Groundnut	BMI	6.5	6	7.2	5.5	**Beans**	BMI	4	3.5	4	4

Crop	**Agriculture**						**Horticulture and Sericulture**				
	MI status	**MF**	**SF**	**MeF**	**LF**	**Crop**	**MI status**	**MF**	**SF**	**MeF**	**LF**
	AMI	6	5	5.5	5.25		AMI	2.8	2.5	2.5	3.3
	Net saving	**0.5**	**1**	**1.7**	**0.25**		**Net saving**	**1.2**	**1**	**2**	**0.7**
	% Change	**7.6**	**16.6**	**23.6**	**4.5**		**% Change**	**30.0**	**8.5**	**37.5**	**17.5**
Soyabean	BMI	8.5	8.3	7.8	5.8	**Mulberry**	BMI	11	10.6	9	8
	AMI	7.4	7	5	4		AMI	10.5	9	7	7
	Net saving	**1.1**	**1.3**	**2.8**	**1.8**		**Net saving**	**0.5**	**1.6**	**2**	**1**
	% Change	**12.9**	**15.6**	**35.9**	**31.0**		**% Change**	**4.5**	**15.0**	**22.2**	**12.5**
Sunflower	BMI	7.9	9	12	9						
	AMI	5.5	6	8	8						
	Net saving	**2.4**	**3**	**4**	**1**						
	% Change	**30.3**	**33.3**	**33.3**	**11.1**						
Ragi	BMI	5	5.5	4	3						
	AMI	4.4	5	3	2.7						
	Net saving	**0.6**	**0.5**	**1**	**0.3**						
	% Change	**12.0**	**9.0**	**25.0**	**10.0**						

Sources: Field study, AMI: After MI installation/ BMI: Before MI installation. ** Sugarcane: only chemical fertilizers, Rest all crops FYM: +chemical fertiliser

4.4.7 Labour saving (on water management)

The average labour saving before and after installation of MI is about 23 percent whereas, among beneficiaries and non-beneficiaries it is 4.0 percent. Maximum of 25 percent each labour savings was recorded in C. R Nagar, Kolar and Uttara Kannada and least Kalaburgi (21%; 37 to 30) after installation of MI under beneficiaries. Among beneficiaries and non-beneficiaries maximum (7%; 28 to 26) labour saving was noticed in Bidar district followed by Uttara Kannada and least of 2 percent (31 to 30) in Kalaburgi. Remaining sampled districts were found to have achieved saving withing range of 2 to 7 percent. The saving in labour man-days spatially in water management is an input and cost reduction component. Manual labor involvement in regular release of water into furrows/ channels, its distribution to plots and sub-plots in the crop field for several times /turns during the entire cropping season has been drastically reduced with the M I supported irrigation besides, reduction additional labor for weeding. This could be categorized as an agronomic investment saving.

Table 4.58: District wise labour saving by implementation of MI system (Before and After MI and beneficiaries and Non beneficiaries)

District	Beneficiaries				Non-Beneficiaries (No) AMI	Net saving in (No) (Beneficiaries vs Non beneficiaries	% Saving to the Beneficiaries vs Non beneficiaries
	BMI (No)	AMI (No)	Net saving (No)	% Saving			
Belagavi	38	29	9	23	31	2	5
Bidar	34	26	8	24	28	2	7
C. R. Nagar	43	32	11	25	33	1	4
Haveri	41	31	10	24	32	2	6
Kalaburgi	37	30	8	21	30	1	2
Kolar	41	31	0	25	33	2	5
Mysuru	39	30	9	24	31	1	4
Shivamogga	45	35	10	23	36	2	5
Tumakuru	41	31	10	24	32	1	3
Uttara Kannada	46	35	9	25	37	2	6
Total	**41**	**31**	**9**		**32**	**1**	
Average -%				**23**			**4**

Sources: Field study. AMI: After MI installation/ BMI: Before MI installation

Agriculture

Table 4.59 provides district and crop wise labour requirement details of beneficiaries and non-beneficiaries. After installation of the MI system, 26 percent labour reduction in paddy has been recorded followed by Bengal gram and soybean with 25 percent savings each and ragi with a minimum 13 percent of labour reduction. Whereas under beneficiaries and non-beneficiaries maximum labour saving of 38 percent each in tomato and Bengal gram was observed, with minimum 12 percent in green gram

Labour savings following to the implementation of MI practice was observed maximum in Soyabean (38.8 %) cultivation at CR Nagar, followed by Sunflower (38.5 %) in Kalburgi and minimum in green gram (5.6 %) at C. R Nagar (Table 4.60a). Efficient use of water management is key to efficient agricultural practices but involves substantial labour work. MI technology is a planned motorized system of water monitoring system built with due consideration of crop tillage and cultivation mechanism. Hence, had great potential to reduce labour work compare to conventional system of operation.

Horticulture

It may be seen from the following Table 4.59 that a maximum 36.4 percent labour saving was noticed under tomato, followed by arecanut (35%), onion (33 %) and least was in grapes (12 %) with in beneficiaries (before and after). Whereas under beneficiaries and non-beneficiaries maximum labour saving (40 %) was noticed in beans, followed by 38 percent each in tomato and areacnut with a minimum labour savings of 21percent in banana.

District-wise results of the comparative labour saving before and after the installation of drip within beneficiaries given in Table 4.60a. Installation of drip irrigation helped maximum (57.8%) labour saving under tomato in Mysuru district followed 47.2 percent in turmeric in Shivamogga by and minimum (7.5%) labour saving under banana at C. R. Nagar.

Horticultural practices are known to be labour intensive, required regulation of water distribution manually under conventional irrigation system in view of adequate supply without excess flow, which would otherwise affect the yield. Hence, this entailed grater labour work. However, with installation of drip irrigation, direct supply of water to root coverage area without any excess flow as it could be in the case of conventional flood irrigation method is greatly avoided. Furthermore, automized system of water supply with well control water monitoring system have regulated optimum supply of water for cultivation.

Sericulture

In mulberry crop the range of labour saving from 17 percent with the installation of MI (before and after) and the percent labour saving up to 23 percent between beneficiaries and non-beneficiaries was recorded.

Table 4.60b describes district-wise and crop-category-wise labour-saving details in the study area. In Mysore and Tumakuru districts it is notice that a highest labour savings in mulberry cultivation with 23.6 percent and 23.5 each. While in Belagavi district is noticed for a minimum labour savings of 3.6 percent. As in the case of horticulture crops, mulberry also requires regular distribution of water through manually created channels, however with drip irrigation system these mundane works is avoided minimizing the labour requirement.

Farmer category wise labour saving

It could be observed from the Table 4.60c that labour saving has been observed with respect to different crops among various group of farmers under agriculture horticulture and sericulture due to the adoption of Micro irrigation. Under agriculture crops a maximum (57.1%: 14 to 6 qt/acre) labour saving was observed under medium category farmers with Bengal gram followed by same category of farmer with paddy crop that is 34.7 percent (69 to 45 no/acre/year) as compared to before adoption of MI, while it was minimum (6.6%: 30 to 28 No/acre/year) with Jowar with large farmers. Under horticulture crops, maximum labour saving ranged from 47.1 percent (53 to 28 No/acre/year) with tomato under medium category farmers followed by same category of farmer with chilly crops that is 44.2 percent (52 to 29 No./acre/year) and minimum of 7.5 percent (40 to 37 No/acre/year) reduction in labour usage with banana under large category of farmers. In mulberry labour saving of 30.9 percent (55 to 38 No/acre/annual) was observed with marginal farmers and minimum of 5.7 percent (42 to39.6 No./acre/year) with small category farmers.

From the above analysis the labour saving with adoption of micro irrigation was benefitted more with medium category farmers in agriculture, horticulture and sericulture as compared other category of farmers. The reduction of labour dependency especially for water management under medium category farmers could be due to higher rate MI adoption, functioning status.

Table 4.59: Crop category wise labour saving on MI installation (Before and After MI and beneficiaries and Non beneficiaries)

Crop category	Crop Name	Beneficiaries				Non-Beneficiaries (No/acre)	Net saving (No/acre) (beneficiaries vs Non beneficiaries	% Saving (beneficiary's vs Non beneficiaries)
		BMI (No/acre)	AMI (No/acre)	Net saving (No/acre)	% Saving			
Agriculture								
Cash crop	Sugarcane	51	41	10	20	53	12	23
Cereals	Jowar	32	27	5	16	33	6	18
	Maize	33	27	6	18	35	8	23
	Paddy	55	41	14	26	58	17	29
Pulses	Bengal gram	24	18	6	25	29	11	38
	Black gram	22	18	4	18	26	8	31
	Green gram	18	15	3	17	17	2	12
	Redgram	21	16	5	24	20	4	20
Oil seeds	Groundnut	32	25	7	22	37	12	32
	Soyabean	28	21	7	25	29	8	28
	Sunflower	25	19	6	24	25	6	24
Fibre	Cotton	41	32	9	22	48	16	33
Millet	Ragi	31	27	4	13	33	6	18
Horticulture								
Plantation crop	Arecanut	55	36	19	35	58	22	38

	Coconut	48	33	15	31	52	19	37
Fruit crops	Banana	38	33	5	13	42	9	21
	Grapes	33	29	4	12	37	8	22
	Mango	28	24	4	14	32	8	25
Spices	Chilly	55	38	17	31	57	19	33
	Onion	57	38	19	33	55	17	31
	Turmeric	50	35	15	30	55	20	36
Vegetable	Tomato	55	35	20	36	56	21	38
	Beans	47	33	14	30	55	22	40
Sericulture								
Mulberry	Mulberry	48	40	8	17	52	12	23

Sources: Field study. AMI: After MI installation/ BMI: Before MI installation

Table 4.60a: Crop category wise labour saving in Agriculture crops (No)- (Before and After MI Installation)

Crop	**MI status**	**Belagavi**	**Bidar**	**C. R. Nagar**	**Haveri**	**Kalaburgi**	**Kolar**	**Mysuru**	**Shivamogga**	**Tumakuru**	**Uttara Kannada**
Sugarcane	BMI	55.0	51.0	51.0	----	----	----	49.0	------	------	48.0
	AMI	45.0	43.0	41.0	----	----	----	36.0	------	------	38.0
	% Saving	**18.2**	**15.7**	**19.6**	**----**	**----**	**----**	**26.5**	**------**	**------**	**20.8**
Jowar	BMI	36.0	35.0	----	27.0	29.0	----	----	----	----	----
	AMI	30.0	31.0	----	23.0	22.0	----	----	----	----	----
	% Saving	**16.7**	**11.4**	**----**	**14.8**	**24.1**	**----**	**----**	**----**	**----**	**----**
Maize	BMI	35	----	38	33	----	----	34	35	----	27
	AMI	33	----	37	31	----	----	31	33	----	23.6
	% Saving	**5.7**	**----**	**2.6**	**6.1**	**----**	**----**	**8.8**	**5.7**	**----**	**12.6**
Paddy	BMI	69.0	----	55.0	55.0		----	59.0	48.0	----	45.0
	AMI	48.0	-----	43.0	42.0	0	-----	42.0	38.0	-----	32.0
	% Saving	**30.4**		**21.8**	**23.6**			**28.8**	**20.8**		**28.9**
Bengal gram	BMI	22.0	20.0	----	26.0	28.0	----	----	----	----	----
	AMI	17.0	18.0	-----	19.0	18.0	-----	-----	-----	-----	-----
	% Saving	**22.7**	**10.0**		**26.9**	**35.7**					
Black gram	BMI	----	24.0	22.0	----	----	----	21.0	----	----	----
	AMI	-----	16.0	18.0	-----	-----	-----	19.0	-----	-----	-----
	% Saving		**33.3**	**18.2**				**9.5**			
Green gram	BMI	18.0	19.0	18.0	19.0	25.0	----	17.0	----	13	----
	AMI	12.6	17.0	17.0	16.0	16.0	-----	15.0	-----	9.0	-----
	% Saving	**30.0**	**10.5**	**5.6**	**15.8**	**36.0**		**11.8**		**30.8**	

Crop	MI status	Belagavi	Bidar	C. R. Nagar	Haveri	Kalaburgi	Kolar	Mysuru	Shivamogga	Tumakuru	Uttara Kannada
Redgram	BMI	----	21.0	----	18.0	25.0	----	----	----	----	----
	AMI	-----	17.0	-----	15.0	17.5	-----	-----	-----	-----	-----
	% Saving		**19.0**		**16.7**	**30.0**	----	----	----	----	----
Groundnut	BMI	27.8	39	19.6	----	----	----	25	28	25.6	----
	AMI	24	28	13	----	----	----	20	22	18	----
	% Saving	**13.7**	**28.2**	**33.7**	----	----	----	**20.0**	**21.4**	**29.7**	----
Soyabean	BMI	27.8	39.0	19.6	----	----	----	25.0	28.0	25.6	----
	AMI	23.0	27.0	12.0	-----	-----	-----	19.0	21.0	17.0	-----
	% Saving	**17.3**	**30.8**	**38.8**				**24.0**	**25.0**	**33.6**	
Sunflower	BMI	27.0	24.0	----	25.0	26.0	----	----	----	----	22.0
	AMI	22.0	19.0	-----	18.0	16.0	-----	-----	-----	-----	18.0
	% Saving	**18.5**	**20.8**		**28.0**	**38.5**					**18.2**
Cotton	BMI	41.0	42.0	33.2	41.2	45.1	----	----	----	----	42.0
	AMI	35.0	31.0	28.1	32.1	36.8	-----	-----	-----	-----	32.0
	% Saving	**14.6**	**26.2**	**15.4**	**22.1**	**18.4**					**23.8**
Ragi	BMI	----	----	20.0	----	----	37.0	35.0	29.0	33.0	----
	AMI	-----	-----	17.0	-----	-----	33.0	30.0	24.0	29.0	-----
	% Saving			**15.0**			**10.8**	**14.3**	**17.2**	**12.1**	

Sources: Field study. AMI: After MI installation/ BMI: Before MI installation

Table 4.60b: Crop wise and district wise labour saving in horticulture and sericulture (No.). (Before and After MI Installation)

Crop	**MI status**	**Belagavi**	**Bidar**	**C. R. Nagar**	**Haveri**	**Kalaburgi**	**Kolar**	**Mysuru**	**Shivamogga**	**Tumakuru**	**Uttara Kannada**
Arecanut	BMI	----	----	----	----	----	----	----	55	58.0	53.0
	AMI	-----	-----	-----	-----	-----	-----	-----	35	33.0	36.0
	% Saving	**----**	**----**	**----**	**----**	**----**	**----**	**----**	**36.4**	**43.1**	**32.1**
Coconut	BMI	----	----	57.0	52.0	----	----	58.0	48.9	48.0	23.0
	AMI	-----	-----	33.0	40.0	-----	------	40.0	35.0	33.0	18.0
	% Saving			**42.1**	**23.1**			**31.0**	**28.4**	**31.3**	**21.7**
Banana	BMI	42.0	----	40.0	35.0	39.0	37.0	38.0	40.0	39.0	37.0
	AMI	38.0	-----	37.0	28.0	35.0	32.0	32.0	35.0	29.0	29.0
	% Saving	**9.5**		**7.5**	**20.0**	**10.3**	**13.5**	**15.8**	**12.5**	**25.6**	**21.6**
Grapes	BMI	35.0	----	----	33.0	----	----	----	32.0	----	----
	AMI	29.0	----	----	29.0	-----	-----	----	28.0	----	----
	% Saving	**17.1**	**-----**	**-----**	**12.1**	**----**	**----**	**-----**	**12.5**	**-----**	**-----**
Mango	BMI	----	----	----	24.0	-----	-----	31.0	----	----	----
	AMI	-----	-----	-----	20.0	----	----	27.0	----	----	----
	% Saving	**----**	**----**	**----**	**16.7**	**-----**	**-----**	**12.9**	**-----**	**-----**	**-----**
Chilly	BMI	55.0	-----	-----	65.0	48.0	50.0	----	----	----	----
	AMI	34.5	----	----	45.3	36.0	38.0	-----	-----	-----	-----

Crop	**MI status**	**Belagavi**	**Bidar**	**C. R. Nagar**	**Haveri**	**Kalaburgi**	**Kolar**	**Mysuru**	**Shivamogga**	**Tumakuru**	**Uttara Kannada**
	% Saving	**37.3**	-----	-----	**30.3**	**25.0**	**24.0**	----	----	----	----
Onion	BMI	57.0	----	----	55.6	57.4	58.0	----	----	----	----
	AMI	39.0	-----	-----	38.0	39.0	34.0	----	----	----	----
	% Saving	**31.6**	----	----	**31.7**	**32.1**	**41.4**	-----	-----	-----	-----
Turmeric	BMI	53.0	42.0	55.0	48.0	----	50.0	52.0	53.0	----	----
	AMI	38.0	37.0	38.0	39.0	-----	39.0	28.0	28.0	-----	-----
	% Saving	**28.3**	**11.9**	**30.9**	**18.8**	----	**22.0**	**46.2**	**47.2**	----	----
Tomato	BMI	52	----	55	50	----	55	65	----	52	----
	AMI	40.2	----	43.2	37.2	----	40.2	41.2	----	37.2	----
	% Saving	**29.4**	----	**27.3**	**34.4**	----	**36.8**	**57.8**	----	**39.8**	----
Beans	BMI	50.2	----	48.0	----	45.0	42.0	49.0	47.0	45.0	----
	AMI	38.2	-----	36.5	-----	33.0	33.0	29.0	31.2	33.2	-----
	% Saving	**23.9**		**24.0**		**26.7**	**21.4**	**40.8**	**33.6**	**26.2**	
Mulberry	BMI	44.0	42.0	50.3	42.0	42.4	52.0	55.0	48.0	52.3	52.0
	AMI	33.6	39.6	43.7	38.2	38.0	41.0	42.0	38.0	40.0	42.0
	% Saving	**3.6**	**5.7**	**13.1**	**9.0**	**10.4**	**21.2**	**23.6**	**20.8**	**23.5**	**19.2**

Sources: Field study. AMI: After MI installation/ BMI: Before MI installation

Table 4.60c: Crop wise labour saving status with farmer categories (No)- Before and After MI installation

Crop	**Agriculture**					**Crop**	**Horticulture and sericulture**				
	MI status	**MF**	**SF**	**MeF**	**LF**		**MI status**	**MF**	**SF**	**MeF**	**LF**
Sugarcane	BMI	55	51	49	51	**Arecanut**	BMI	58	55	50	58
	AMI	45	43	36	41		AMI	39	38	33	36
	Net saving	**10**	**8**	**13**	**10**		**Net saving**	**19**	**17**	**17**	**22**
	% Saving	**18.1**	**15.6**	**26.5**	**19.6**		**% Saving**	**32.7**	**30.9**	**34.0**	**37.9**
Jowar	BMI	30	25	30	43	**Coconut**	BMI	43	45.6	53	52
	AMI	24	23	23	38		AMI	28	34	32	40
	Net saving	**6**	**2**	**7**	**5**		**Net saving**	**15**	**11.6**	**21**	**12**
	% Saving	**20.0**	**8.0**	**23.3**	**11.6**		**% Saving**	**34.8**	**25.4**	**39.6**	**23.0**
Maize	BMI	30	36	34	33	**Banana**	BMI	42	38	35	40
	AMI	28	29	24	28		AMI	38	32	28	37
	Net saving	**2**	**7**	**10**	**5**		**Net saving**	**4**	**6**	**7**	**3**
	% Saving	**6.6**	**19.4**	**29.4**	**15.1**		**% Saving**	**9.5**	**15.7**	**20.0**	**7.5**
Paddy	BMI	49	48	69	55	**Grapes**	BMI	35	32	31	33
	AMI	39	38	45	42		AMI	29	28	27	29
	Net saving	**10**	**10**	**24**	**13**		**Net saving**	**6**	**4**	**4**	**4**
	% Saving	**20.4**	**20.8**	**34.7**	**23.6**		**% Saving**	**17.1**	**12.5**	**2.9**	**12.1**
Bengal gram	BMI	21	18	23	35	**Mango**	BMI	36	24	23	30
	AMI	15	13	14	30		AMI	33	20	18	28
	Net saving	**6**	**5**	**9**	**5**		**Net saving**	**3**	**4**	**5**	**2**
	% Saving	**28.5**	**27.7**	**39.1**	**14.2**		**% Saving**	**8.3**	**16.6**	**21.7**	**6.6**

Crop	**Agriculture**					**Crop**	**Horticulture and sericulture**				
	MI status	**MF**	**SF**	**MeF**	**LF**		**MI status**	**MF**	**SF**	**MeF**	**LF**
Black gram	BMI	18	20	21	29	**Chilly**	BMI	55	50	52	65
	AMI	14	16	14	26		AMI	39	38	29	45.3
	Net saving	**4**	**4**	**7**	**3**		**Net saving**	**16**	**12**	**23**	**19.7**
	% Saving	**22.2**	**20.0**	**33.3**	**10.3**		**% Saving**	**29.0**	**24.0**	**44.2**	**30.3**
Green gram	BMI	18	19	18	18	**Onion**	BMI	57	58	55	59
	AMI	14.6	17	12.6	17		AMI	41	36	32	42
	Net saving	3.4	2	5.4	1		**Net saving**	**16**	**22**	**23**	**17**
	% Saving	18.8	10.5	30.0	5.5		**% Saving**	**28.0**	**37.9**	**41.8**	**28.8**
Redgram	BMI	27	21	15	22	**Turmeric**	BMI	55	42	53	48
	AMI	19	17	11	17		AMI	38	34	36	35
	Net saving	**8**	**4**	**4**	**5**		**Net saving**	**17**	**8**	**17**	**13**
	% Saving	**29.6**	**19.0**	**26.6**	**22.7**		**% Saving**	**30.9**	**19.0**	**32.0**	**27.0**
Groundnut	BMI	37	27	28	35	**Tomato**	BMI	52	55	53	58
	AMI	30	22	20	27		AMI	35	38	28	40
	Net saving	**7**	**5**	**8**	**8**		**Net saving**	**17**	**17**	**25**	**18**
	% Saving	**18.9**	**18.5**	**28.5**	**22.8**		**% Saving**	**32.6**	**30.9**	**47.1**	**31.0**
Soyabean	BMI	27.8	39	19.6	25	**Beans**	BMI	50.2	48	45	50
	AMI	24	28	13	20		AMI	33.5	34	30	36
	Net saving	**3.8**	**11**	**6.6**	**5**		**Net saving**	**16.7**	**14**	**15**	**14**
	% Saving	**13.6**	**28.2**	**33.6**	**20.0**		**% Saving**	**33.2**	**29.1**	**33.3**	**28.0**
Sunflower	BMI	27	24	22	25	**Mulberry**	BMI	44	42	55	52

Crop	**Agriculture**					**Crop**	**Horticulture and sericulture**				
	MI status	**MF**	**SF**	**MeF**	**LF**		**MI status**	**MF**	**SF**	**MeF**	**LF**
	AMI	22	18	16	21		AMI	37	39.6	38	44
	Net saving	**5**	**6**	**6**	**4**		**Net saving**	**7**	**2.4**	**17**	**8**
	% Saving	**18.5**	**25.0**	**27.2**	**16.0**		**% Saving**	**15.9**	**5.7**	**30.9**	**15.3**
Cotton	BMI	43	43	34	44						
	AMI	33	32	25	36						
	Net saving	**10**	**11**	**9**	**8**						
	% Saving	**23.2**	**25.5**	**26.4**	**18.1**						
Ragi	BMI	29	29	31	35						
	AMI	24	26	25	32						
	Net saving	**5**	**3**	**6**	**3**						
	% Saving	**17.2**	**10.3**	**19.3**	**8.5**						

Sources: Field study. AMI: After MI installation/ BMI: Before MI installation

4.4.8 Energy saving

From Table: 4.61, it could be inferred that there are differential views by the beneficiaries and non-beneficiaries regarding the adequacy of power supply. Beneficiaries who have installed MI have indicated the adequacy of power supply up to 33.6 percent, whereas, with non-beneficiaries it was 57.5 percent. From the data it could be inferred that there is an urgent need to be address to supply of continuous energy. Among different districts, considering Kolar and Belagavi suffering highest power shortage, followed by Kalaburgi and Mysuru beneficiary. Whereas, under non-beneficiaries, Shivamogga facing a maximum shortage of power followed by Belagavi, Bidar, Kalaburgi, Mysuru, and Tumakuru. Thus, there is urgent need to take step towards sufficient power supply for effective utilisation of MI system and on other side it was also found that there is potential scope to promote renewable energy (solar) among beneficiaries and non-beneficiaries, by integrating energy conservation schemes.

Table 4.61: Farmer opinion on power supply (%)

District	Beneficiaries			Non-Beneficiaries		
	Total Beneficiaries (No.)	**Adequate** (%)	**Not adequate** (%)	**Total Beneficiaries (No.)**	**Adequate** (%)	**Not adequate** (%)
Belagavi	376	28.2	71.8	4	50.0	50.0
Bidar	364	40.7	59.3	4	50.0	50.0
C. R. Nagar	370	32.1	67.9	4	75.0	25.0
Haveri	375	31.4	68.6	4	75.0	25.0
Kalaburgi	370	29.3	70.7	4	50.0	50.0
Kolar	362	28.5	71.5	4	75.0	25.0
Mysuru	376	30.2	69.8	4	50.0	50.0
Shivamogga	375	34.4	65.6	4	25.0	75.0
Tumakuru	372	41.9	58.1	4	50.0	50.0
Uttara Kannada	350	40.0	60.0	4	75.0	25.0
Total	**3690**	**-**	**-**	**40**	**-**	**-**
Average -%		**33.6**	**66.4**		**57.5**	**42.5**

Sources: Field study

It may be seen from the following Table 4.62, that there are 10187 borewells found in the study area and majority (48.4%) of the beneficiaries are using pump sets of capacity ranging between 5-10 hp followed by 1-5 hp (41.4 % beneficiaries). Whereas, minimum of 3.4 percent beneficiaries uses 10-15 hp range capacity pump-set for their irrigation purpose. Among various districts, Shivamogga district has maximum (71.4%) beneficiaries installed with 5.5-10 hp pump sets followed by Tumakuru district beneficiaries (57.1%). In Bidar district 84.4 percent of beneficiaries have installed with 1-5 hp pump capacity. The variations in the capacities of installed pump sets as attributed to the depth of water, extent of land irrigated, type of MI system installed and cropping pattern. Most of the farmers reported that pump sets of appropriate capacity have been installed which thoroughly meet the system requirements and they are not facing any problem to irrigate the crops as per their requirements.

Table 4.62: Capacity of pump set used by beneficiaries for MI operations

District	No. of open well/borewells surveyed	Pump set capacity (%)			
		1-5 hp	5.5 -10 hp	10.5 to 15 hp	> 15 hp
Belagavi	599	50.3	45.2	3.0	1.5
Bidar	633	84.8	12.5	0.6	2.1
C. R. Nagar	371	50.9	42.6	4.6	1.9
Haveri	679	63.0	32.4	0.7	3.8
Kalaburgi	379	34.6	54.9	4.0	6.6
Kolar	457	41.4	33.4	2.3	15.5
Mysuru	2235	48.9	48.4	3.1	7.2
Shivamogga	2621	17.0	71.4	7.3	4.3
Tumakuru	1737	36.7	57.1	0.8	5.4
Uttara Kannada	476	55.9	34.2	2.7	7.1
Total	**10187**	**-**	**-**	**-**	**-**
Average -%		**41.4**	**48.4**	**3.4**	**6.9**

Sources: Field study

The figures on consumption of electricity before and after installation of MI system by the beneficiary farmers and also energy consumption pattern by non-beneficiaries have been tabulated in Table 4.63. The data clearly indicate that savings of electricity with the installation of MI was significantly high ranging from 24 to 28 percent with an average saving of 26 percent before and after installation of MI within beneficiaries. Whereas among beneficiaries and non-beneficiary energy consumption range from 7 to 10.2 percent. The maximum percent of saving in energy consumption was observed in Bidar (10.2%) followed by Kalaburgi (9.3%) and minimum energy saving was expressed by Tumakuru beneficiaries which is accounted to only 7.0 percent

Table 4.63: District wise change in energy consumption (Kw/h/acre: hp x 0.75 x hr/day) (Before and After MI and beneficiaries and Non beneficiaries)

Crop type	Beneficiaries (BMI: Before MI installation/ AMI: After MI installation)				Non-Beneficiaries (Kw/h/acre) AMI	Net saving in (Kw/h/acre) (Beneficiaries vs Non bbeneficiaries	% Saving to the Beneficiaries vs Non beneficiaries
	BMI (Kw/h/acre)	AMI (Kw/h/acre)	Net saving (Kw/h/acre)	% Saving			
Belagavi	34.9	26.3	8.7	25.0	28.5	2.2	7.7
Bidar	29.4	21.2	8.2	28.0	23.6	2.4	10.2
C. R. Nagar	36.1	26.4	9.7	27.0	28.7	2.4	8.3
Haveri	35.8	26.7	9.1	25.0	29.2	2.5	8.5
Kalaburgi	30.6	22.6	8.0	26.0	24.9	2.3	9.3
Kolar	36.7	28.0	8.7	24.0	30.3	2.3	7.6
Mysuru	34.4	25.2	9.1	27.0	27.5	2.3	8.3
Shivamogga	52.3	39.2	13.1	25.0	42.7	3.5	8.2
Tumakuru	37.3	28.4	8.9	24.0	30.5	2.1	7.0
Uttara Kannada	53.3	38.7	14.6	27.0	42.0	3.4	8.0
Total	**38.1**	**28.3**	**9.8**		**30.8**	**2.5**	
Average -%				26.0			8.2

Sources: Field study

The results of the comparative energy saving before and after the installation of MI with beneficiaries, as well as among beneficiaries and non-beneficiaries showed positive growth under almost all the crops as compared to the conventional irrigation method.

Agriculture

Crop wise energy saving by beneficiaries before and after installation of MI and also among beneficiaries and non-beneficiaries was presented in Table 4.64. Energy savings following to the implementation of MI practice was observed to be maximum in sugarcane (35.3%) cultivation, followed by groundnut (31.4%) and minimum in black gram (11.1%).

Subsequently, among beneficiaries and non-beneficiaries a maximum energy savings was noticed in soyabean and sugarcane (36.4% each) cultivation and minimum of 17.5 percent in maize cultivation. Sugarcane is known to be water intense crop and excessive water supply through flood irrigation is the common practice amongst non-adopters, energy savings under sugar cane cultivation is mainly due to adoption of drip irrigation system.

Table 4.65a indicates a maximum energy savings of 53.1 percent under soyabean cultivation is Tumakuru and followed by 50 percent under ragi cultivation and lowest of 4.8 percent for paddy cultivation at Shivamogga district. Sprinkler technology enables greater area of distribution optimal supply of water in short duration of pumping time, in contrast to flood irrigation. Thus, MI technology has contributed for greater energy savings in the crop production.

Horticulture

The Table 4.64 provides crop wise average energy saving before and after installation of MI within beneficiaries and also among beneficiaries and non-beneficiaries. The results of the comparative energy saving before and after the installation of drip within beneficiaries, as well as among adopters and non-adopters showed increasing trend under almost all the crops as compared to the conventional irrigation method. It is important to note that, installation of drip resulted maximum (33.3% each) energy saving under arecanut and coconut followed in chilly 28.0 percent and minimum (18.2%) energy saving under onion as compared to conventional method. Similar trend was seen among adopter and non-adopters, with a highest energy savings with coconut (40.3%) followed by arecanut (36.4%) and minimum energy saving found in tomato (24.2%) under beneficiaries as compared to the non-beneficiaries. The maximum saving in energy by adopting drip irrigation, as it allows direct injection of water to the root coverage area reducing irrigation time, hence, decrease in energy consumption.

Detailed crop-wise and district wise percentage in energy saving after MI adoption is given in Table 4.65b. Survey results describes that average maximum (71.7%) energy saving was noticed in Shivamogga under sugarcane cultivation followed by Chilly (58.7%) in Kolar and minimum energy saving (5.9%) was noticed in Belagavi under Grapes cultivation.

Performance in term of energy saving varies from district to district, even for the same crop due to varied reasons like agro-climatic conditions, planting material, cultivation practices, soil productivity, irrigation system adopted, etc. have rendered water usage efficient implementation of MI technology and hence, reduction in energy consumption.

Sericulture

The temporal (before and after MI), among beneficiaries and non-beneficiaries and spatial (district wise) variation in energy saving under mulberry is presented in Table 4.64 and 4.65b. Field study results showed that the percent of energy saving was found up to be 27.3 percent as compared to conventional practices within beneficiaries (before and after MI adoption) and 29.3 percent increment in energy saving among MI adopters as compared to non-adopters.

Among various district, after adoption of MI, the percentage of energy saving was noticed in kolar (44.9%) followed by Uttara kannada (39.5%) with minimum energy savings of 12.8 percent achieved at C. R Nagar district as compared to before installation of MI.

Farmer category wise Energy saving

It could be observed from the Table 4.65c that energy saving has been observed with respect to different crops among various group of farmers under agriculture horticulture and sericulture due to the adoption of Micro irrigation. Under agriculture crops a maximum (49%: 98 to 50 Kw/h/acre) energy saving was observed under medium category farmers with sugarcane crop followed by same category of farmer with Jowar crop that is 42.3 percent (26 to 15 Kw/h/acre) as compared to before adoption of MI, while it was minimum (8.6%: 52 to 47.5 Kw/h/acre) with maize with small farmers. Under horticulture crops, maximum energy saving ranged from 44.7 percent (55.2 to 30.5 Kw/h/acre) with coconut under medium category farmers followed by same category of farmer with coconut 37.2 percent (10.2 to 6.4 Kw/h/acre) and minimum of 12.0 percent (58 to 51 Kw/h/acre) reduction in energy usage with tomato under large category of farmers. In mulberry labour saving of 28.4 percent (15 to 8 Kw/h/acre) was observed with medium farmers and minimum of 18.1 percent (15.4 to 12.6 Kw/h/acre) with small category farmers.

From the above analysis the labour saving with adoption of micro irrigation was benefitted more with medium category farmers in agriculture, horticulture and sericulture as compared other category of farmers. The reduction of labour dependency especially for water management under medium category farmers could be due to higher rate MI adoption, functioning status.

Table 4.64: Crop category wise change in energy consumption (Kw/h/acre: hp x 0.75 x hr/day)- (before and after MI and beneficiaries and Non beneficiaries)

Crop Category		**Beneficiaries**				**Non-Beneficiaries (Kw/h/acre)**	**Net saving in (Kw/h/acre) (Beneficiaries vs Non beneficiaries**	**% Saving to the Beneficiaries vs Non beneficiaries**
Agriculture	**Crop Name**	**BMI (Kw/h/acre)**	**AMI (Kw/h/acre)**	**Net change (Kw/h/acre)**	**% Saving**			
Cash crop	Sugarcane	110.5	71.5	39.0	35.3	112.5	41.0	36.4
Cereals	Jowar	21.0	15.0	6.0	28.6	20.8	5.8	27.9
	Maize	56.0	47.0	9.0	16.1	57.0	10.0	17.5
	Paddy	112.0	90.0	22.0	19.6	115.0	25.0	21.7
Pulses	Bengal gram	21.0	17.0	4.0	19.0	23.0	6.0	26.1
	Black gram	9.0	8.0	1.0	11.1	11.0	3.0	27.3
	Green gram	11.0	9.0	2.0	18.2	13.0	4.0	30.8
	Redgram	8.0	6.0	2.0	25.0	9.4	3.4	36.2
Oil seeds	Groundnut	17.5	12.0	5.5	31.4	16.5	4.5	27.3
	Soyabean	10.0	7.0	3.0	30.0	11.0	4.0	36.4
	Sunflower	12.5	10.5	2.0	16.0	14.5	4.0	27.6
Fibre	Cotton	35.0	28.0	7.0	20.0	35.0	7.0	20.0
Millet	Ragi	11.5	9.0	2.5	21.7	13.0	4.0	30.8
Horticulture								
Plantation crop	Arecanut	12.0	8.0	4.0	33.3	13.4	5.4	40.3

Crop Category		**Beneficiaries**				**Non-Beneficiaries (Kw/h/acre)**	**Net saving in (Kw/h/acre) (Beneficiaries vs Non beneficiaries**	**% Saving to the Beneficiaries vs Non beneficiaries**
Agriculture	**Crop Name**	**BMI (Kw/h/acre)**	**AMI (Kw/h/acre)**	**Net change (Kw/h/acre)**	**% Saving**			
	Coconut	52.5	35.0	17.5	33.3	55.0	20.0	36.4
Fruit crops	Banana	40.0	29.0	11.0	27.5	41.0	12.0	29.3
	Grapes	48.0	36.0	12.0	25.0	51.0	15.0	29.4
	Mango	37.5	28.0	9.5	25.3	41.0	13.0	31.7
Spices	Chilly	25.0	18.0	7.0	28.0	26.0	8.0	30.8
	Onion	11.0	9.0	2.0	18.2	13.0	4.0	30.8
	Turmeric	37.5	27.5	10.0	26.7	38.5	11.0	28.6
Vegetable	Tomato	60.0	47.0	13.0	21.7	62.0	15.0	24.2
	Beans	33.0	26.0	7.0	21.2	36.0	10.0	27.8
Mulberry	Mulberry	16.5	12.0	4.5	27.3	17.0	5.0	29.4

Sources: Field study. AMI: After MI installation/ BMI: Before MI installation

Table 4.65a: District wise and crop category wise change in energy consumption (hp x 0.75 x hr/day)- Agriculture crop

Crop	**MI status**	**Belagavi**	**Bidar**	**C. R. Nagar**	**Haveri**	**Kalaburgi**	**Kolar**	**Mysuru**	**Shivamogga**	**Tumakuru**	**Uttara Kannada**
Sugarcane	BMI	14.8	10.2	10.7	----	----	----	10.2	----	----	12.3
	AMI	7.5	8.9	9.3	-----	-----	-----	9.0	-----	-----	9.8
	% Saving	**49.3**	**13.0**	**13.1**				**11.8**			**20.3**
Jowar	BMI	12.0	11.0	----	7.0	9.0	----	----	----	----	----
	AMI	9.0	6.5	-----	5.0	6.0	-----	-----	-----	-----	-----
	% Saving	**25.0**	**40.9**		**28.6**	**33.3**					
Maize	BMI	15.7	----	11.5	11.3	----	----	9.0	16.2	----	11.5
	AMI	11.2	-----	9.0	9.8	-----	-----	7.5	13.5	-----	8.5
	% Saving	**28.7**		**21.7**	**13.3**			**16.7**	**16.7**		**26.1**
Paddy	BMI	9.0	----	10.0	10.4	----	----	9.7	8.3	----	10.0
	AMI	8.0	-----	7.8	7.8	-----	-----	5.8	8.7	-----	8.0
	% Saving	**11.1**		**22.0**	**25.0**			**40.2**	**4.8**		**20.0**
Bengal gram	BMI	105.0	113.2	----	110.0	123.0	----	----	----	----	----
	AMI	90.4	92.3	----	89.4	89.2	-----	-----	-----	-----	-----
	% Saving	**13.9**	**18.5**		**18.7**	**27.5**					
Black bean	BMI	----	39.2	32.1	----	----	----	32.1	----	----	----
	AMI	------	25.6	28.2	-----	-----	-----	29.3	-----	-----	-----
	% Saving		**34.7**	**12.1**				**8.7**			
Green gram	BMI	18.7	19.8	22.1	21.1	14.0	----	11.0	----	12.2	----
	AMI	12.6	14.2	15.6	11.2	10.3	-----	9.0	-----	8.2	-----

Crop	**MI status**	**Belagavi**	**Bidar**	**C. R. Nagar**	**Haveri**	**Kalaburgi**	**Kolar**	**Mysuru**	**Shivamogga**	**Tumakuru**	**Uttara Kannada**
	% Saving	**32.6**	**28.3**	**29.4**	**46.9**	**26.4**		**18.2**		**32.8**	
Redgram	BMI	----	8.5	----	7.0	9.5	----	----	----	----	----
	AMI	-----	7.0	----	5.6	6.5	-----	-----	-----	-----	-----
	% Saving		**17.6**		**28.2**	**31.6**					
Groundnut	BMI	17.8	----	17.3	17.1	18.1	----	----	----	18.1	----
	AMI	16..0	-----	12.0	9.0	11	-----	-----	-----	11.1	-----
	% Saving	**10.1**		**30.6**	**47.4**	**39.2**				**38.7**	
Soyabean	BMI	27.8	29.5	19.6	----	----	----	22.3	27.3	25.6	----
	AMI	23.0	25.0	12.0	-----	-----	-----	15.7	21.0	12	-----
	% Saving	**17.3**	**15.3**	**38.8**				**29.6**	**23.1**	**53.1**	
Sunflower	BMI	47.5	34.1	----	35.0	36	----	----	----	----	32.0
	AMI	32.7	26.2	-----	23.4	28.5	-----	-----	-----	-----	28.0
	% Saving	**31.2**	**23.2**		**33.1**	**20.8**					**12.5**
Ragi	BMI	----	----	10.5	----	----	10.8	15.0	8.0	13.0	----
	AMI	-----	-----	7.0	-----	-----	7	8.0	4.0	9.0	-----
	% Saving			**33.3**			**35.2**	**46.7**	**50.0**	**30.8**	
Cotton	BMI	34.2	32.4	33.2	41.2	45.1	----	----	----	----	38.2
	AMI	23.5	21.7	28.1	32.1	36.8	-----	-----	-----	-----	25.3
	% Saving	**31.3**	**33.0**	**15.4**	**22.1**	**18.4**					**33.8**

Sources: Field study. AMI: After MI installation/ BMI: Before MI installation

Table 4.65b: District wise and crop category wise change in energy consumption (Kw/h/acre: hp x 0.75 x hr/day)-Horticulture and Mulberry

Crop	MI status	Belagavi	Bidar	C. R. Nagar	Haveri	Kalaburgi	Kolar	Mysuru	Shivamogga	Tumakuru	Uttara Kannada
Arecanut	BMI	-----	-----	-----	-----	-----	-----	-----	12	15.1	11
	AMI	-----	-----	-----	-----	-----	-----	-----	3.4	12.4	7.6
	% Saving	**-----**	**-----**	**-----**	**-----**	**-----**	**-----**	**-----**	**71.7**	**17.0**	**30.9**
Coconut	BMI	-----	-----	61.6	57	21.8	21.8	62.4	53.3	52.4	27.8
	AMI	-----	-----	38.5	42.1	21.8	21.8	43.1	38.3	35	18
	% Saving	**-----**	**-----**	**37.5**	**26.1**	**21.8**	**21.8**	**30.9**	**28.1**	**33.2**	**35.3**
Banana	BMI	49.8	-----	45.8	50	41	40	40.9	41.8	41.2	40.6
	AMI	29.7	-----	28.6	30.8	29.5	27.9	27.6	27.6	30	29.3
	% Saving	**40.0**	**-----**	**37.6**	**38.4**	**28.0**	**30.3**	**32.5**	**34.0**	**27.2**	**27.8**
Grapes	BMI	48.9	-----	-----	47.4	-----	-----	-----	47.6	-----	-----
	AMI	46	-----	-----	44	-----	-----	-----	44.2	-----	-----
	% Saving	**5.9**	**-----**	**-----**	**7.2**	**-----**	**-----**	**-----**	**7.1**	**-----**	**-----**
Mango	BMI	-----	-----	-----	38.8	-----	-----	35.5	-----	-----	-----
	AMI	-----	-----	-----	29	-----	-----	27	-----	-----	-----
	% Saving	**-----**	**-----**	**-----**	**25.3**	**-----**	**-----**	**23.9**	**-----**	**-----**	**-----**
Chilly	BMI	30.3	-----	-----	40.3	23.3	6.3	-----	-----	-----	-----
	AMI	23.15	-----	-----	33.95	13.85	2.6	-----	-----	-----	-----

Crop	**MI status**	**Belagavi**	**Bidar**	**C. R. Nagar**	**Haveri**	**Kalaburgi**	**Kolar**	**Mysuru**	**Shivamogga**	**Tumakuru**	**Uttara Kannada**
	% Saving	**23.6**	**-----**	**-----**	**15.8**	**40.6**	**58.7**	**-----**	**-----**	**-----**	**-----**
Onion	BMI	30.1	-----	-----	33.1	32.1	30.4	-----	-----	-----	-----
	AMI	23.6	-----	-----	30	27	23	-----	-----	-----	-----
	% Saving	**21.6**	**-----**	**-----**	**9.4**	**15.9**	**24.3**	**-----**	**-----**	**-----**	**-----**
Turmeric	BMI	33.3	27.5	28.5	27.5	-----	29.5	27.4	18.5	-----	-----
	AMI	26.6	25.3	26.8	22.6	-----	27.4	21.3	10	-----	-----
	% Saving	**20.1**	**8.0**	**6.0**	**17.8**	**-----**	**7.1**	**22.3**	**45.9**	**-----**	**-----**
Beans	BMI	53.2	-----	58.8	-----	62.6	68.3	54.2	63.2	54.3	-----
	AMI	38.2	-----	45.3	-----	53.2	58.2	32.1	51.2	45.2	**-----**
	% Saving	**28.2**	**-----**	**23.0**	**-----**	**15.0**	**14.8**	**40.8**	**19.0**	**16.8**	**-----**
Tomato	BMI	32.7	-----	-----	22.2	-----	29.7	37.2	21.8	39.6	21.8
	AMI	31	-----	**-----**	17	**-----**	14	35	21.8	22	21.8
	% Saving	**5.2**	**-----**	**-----**	**23.4**	**-----**	**52.9**	**5.9**	**21.8**	**44.4**	**21.8**
Mulberry	BMI	11.5	28.6	21.8	8.9	8.8	18.5	16.4	18.9	15.5	19
	AMI	7.7	17.7	19	6.3	6.1	10.2	10.8	14.9	9.7	11.5
	% Saving	**33.0**	**38.1**	**12.8**	**29.2**	**30.7**	**44.9**	**34.1**	**21.2**	**37.4**	**39.5**

Sources: Field study. AMI: After MI installation/ BMI: Before MI installation

Table 4.65c: Crop wise energy saving status with farmer categories (Kw/h/acre)- Before and After MI installation

Crop	Agriculture					Crop	Horticulture and Sericulture				
	MI status	**MF**	**SM**	**MeF**	**LF**		**MI status**	**MF**	**SM**	**MeF**	**LF**
Sugarcane	BMI	125	102.3	98	102.5	**Arecanut**	BMI	10.2	11.5	10.2	17.4
	AMI	78	64	50	80		AMI	7.6	7.4	6.4	13
	Net saving	**47.0**	**38.3**	**48.0**	**22.5**		**Net saving**	**2.6**	**4.1**	**3.8**	**4.4**
	% Saving	**37.6**	**37.4**	**49.0**	**21.9**		**% Saving**	**25.4**	**35.6**	**37.2**	**25.2**
Jowar	BMI	19	17	26	21	**Coconut**	BMI	55	45.9	55.2	50.6
	AMI	16	14	15	17.5		AMI	40.1	30.3	30.5	40.1
	Net saving	**3.0**	**3**	**11.0**	**3.5**		**Net saving**	**14.9**	**15.6**	**24.7**	**10.5**
	% saving	**15.7**	**17.6**	**42.3**	**16.6**		**% saving**	**27.09**	**33.9**	**44.7**	**20.7**
Maize	BMI	56	52	57	60.7	**Banana**	BMI	38.1	39.3	34.1	48.3
	AMI	44.6	47.5	43.6	51.3		AMI	29.3	28.1	24.2	36.4
	Net saving	**11.4**	**4.5**	**13.4**	**9.4**		**Net saving**	**8.8**	**11.2**	**9.9**	**11.9**
	% Saving	**20.36**	**8.6**	**23.5**	**15.4**		**% saving**	**23.1**	**28.5**	**29.0**	**24.6**
Paddy	BMI	114	125	110.4	98	**Grapes**	BMI	39.2	48.3	52.2	51
	AMI	91	96	84	87		AMI	31.5	35.4	36.7	39.3
	Net saving	**23.0**	**29.0**	**26.4**	**11**		**Net saving**	**7.7**	**12.9**	**15.5**	**11.7**
	% Saving	**20.18**	**23.2**	**23.9**	**11.2**		**% saving**	**19.6**	**26.7**	**29.6**	**22.9**
Bengal gram	**BMI**	15.4	25.4	25.6	18.5	**Mango**	BMI	36.1	39.5	38.9	34.3

Crop	**Agriculture**					**Crop**	**Horticulture and Sericulture**				
	MI status	**MF**	**SM**	**MeF**	**LF**		**MI status**	**MF**	**SM**	**MeF**	**LF**
	AMI	12.4	20.2	19.6	14.4		AMI	28.2	28.6	24.9	29
	Net saving	**3**	**5.2**	**6**	**4.1**		**Net saving**	**7.9**	**10.9**	**14**	**5.3**
	% Saving	**19.4**	**20.4**	**23.4**	**22.1**		**% saving**	**21.8**	**27.5**	**35.9**	**15.4**
Black bean	BMI	9	7.5	10.2	9.2	**Chilly**	BMI	26.7	28.2	21.2	25.2
	AMI	7.5	6.5	8.2	8.2		AMI	19.5	21.2	15.4	19.3
	Net saving	**1.5**	**1**	**2**	**1**		**Net saving**	**7.2**	**7**	**5.8**	**5.9**
	% Saving	**16.6**	**13.3**	**19.6**	**10.8**		**% saving**	**26.9**	**24.8**	**27.3**	**23.4**
Green gram	BMI	9.5	11.8	10.5	11.5	**Onion**	BMI	10.1	9	12.4	13.1
	AMI	8.5	10.4	6.6	9.3		AMI	7.4	6.4	8.7	10.3
	Net saving	**1**	**1.4**	**3.9**	**2.2**		**Net saving**	**2.7**	**2.6**	**3.7**	**2.8**
	% saving	**10.5**	**11.8**	**37.1**	**19.1**		**% saving**	**26.7**	**28.8**	**29.8**	**21.3**
Redgram	BMI	9	7.5	10.2	7	**Turmeric**	BMI	35.3	38.5	42.5	32.5
	AMI	6.8	6.3	7.2	5.7		AMI	28.6	28.8	27.3	25.4
	Net saving	**2.2**	**1.2**	**3**	**1.3**		**Net saving**	**6.7**	**9.7**	**15.2**	**7.1**
	% Saving	**24.4**	**16.0**	**29.4**	**18.5**		**% Saving**	**18.9**	**25.19**	**35.7**	**21.8**
Groundnut	BMI	17.8	18.1	17.3	17.1	**Beans**	BMI	45.2	32.5	25.5	28.4
	AMI	16	11.1	12	9		AMI	38.2	29.4	15	23.3
	Net saving	**1.8**	**7**	**5.3**	**8.1**		**Net saving**	**7**	**3.1**	**10.5**	**5.1**

Crop	**Agriculture**					**Crop**	**Horticulture and Sericulture**				
	MI status	**MF**	**SM**	**MeF**	**LF**		**MI status**	**MF**	**SM**	**MeF**	**LF**
	% Saving	**10.1**	**38.6**	**30.6**	**47.3**		**% Saving**	**15.4**	**9.5**	**41.1**	**17.9**
Soyabean	BMI	7.8	9.5	11.6	12.3	**Tomato**	BMI	52	68.5	62.5	58
	AMI	5.6	6.3	7.5	8.5		AMI	38	52	45	51
	Net saving	**2.2**	**3.2**	**4.1**	**3.8**		**Net saving**	**14**	**16.5**	**17.5**	**7**
	% Saving	**28.2**	**33.6**	**35.3**	**30.8**		**% Saving**	**26.9**	**24.0**	**28.0**	**12.07**
Sunflower	BMI	11.5	9.1	16	14	**Mulberry**	BMI	18.3	15.4	15.8	15.7
	AMI	8.5	7.7	11.5	12.5		AMI	14.6	12.6	11.3	12.2
	Net saving	**3**	**1.4**	**4.5**	**1.5**		**Net saving**	**3.7**	**2.8**	**4.5**	**3.5**
	% Saving	**26.0**	**15.3**	**28.1**	**10.0**		**% Saving**	**20.2**	**18.1**	**28.4**	**22.29**
Ragi	BMI	10.8	15	10.5	9						
	AMI	8.6	11.3	7.5	7						
	Net saving	**2.2**	**3.7**	**3**	**2**						
	% Saving	**20.3**	**24.6**	**28.5**	**22.2**						
Cotton	BMI	33.2	32.4	34.2	41.2						
	AMI	28.1	25.7	25.5	32.1						
	Net saving	**5.1**	**6.7**	**8.7**	**9.1**						
	% Saving	**15.3**	**20.6**	**25.4**	**22.0**						

Sources: Field study. AMI: After MI installation/ BMI: Before MI installation

4.4.9 Employment generation

Changes in the man days or labour utilisation before and after MI intervention at pre harvest and post-harvest stages were studied. District-wise impact of MI on employment generation is given in Table 4.66 and 4.67. During pre-harvest stage on an average increased man day was 10.8 percent being maximum in Kalaburgi (16.9% each), followed by Tumakuru (14.8 %) and least was in Chamarajanagar (5.5%). Likewise, with respect to post-harvest activities the average precent increased of man days was 26.3% in the study area, maximum (36.1%) being in Haveri and followed by Tumakaur and Belagavi (31.3% and 31.1% respectively) and least in Mysuru (15.4%). The variation in the man days between districts could be due to change in cropping pattern especially in Haveri where maximum adopted crop diversification noticed among beneficiaries (changes in sanctioned crop Vs current crop) through shifting towards commercial crop like chilly, fibre and oil seeds which are characterized by close spacing with moderately short duration which requires maximum labour requirement both during pre- and post-harvesting phases. While perennial crop with wide spacing also demands higher man days especially in land preparation and processing which is observed in the district like Uttara Kannada and Tumakuru, where plantations crops are predominant. This reflects the employment generation due to MI adoption, which could be referred as an economic derivative, is generally noticed with the early and extended number of harvests, its primary processing at field level (sorting, grading, bulking, packing etc.,) than with lower production in the traditional flood/surface irrigation.

Table 4.66: Impact of MI installation on farm employment generation (Man days/acre/year)-Pre harvest

District	Pre harvesting (BMI)					Pre harvesting (AMI)					Change in man days (%)
	Land preparation	Sowing	Watering	Weed and fertilizer	Total	Land preparation	Sowing	Watering	Weed and fertilizer	Total	
Belagavi	19	12	18	18	67	24	22	14	13	73	9.0
Bidar	14	9	14	14	51	18	17	11	10	56	9.8
C. R. Nagar	20	13	20	20	73	25	23	15	14	77	5.5
Haveri	15	9	14	14	52	19	17	11	10	58	11.5
Kalaburgi	18	12	18	18	65	25	23	14	14	76	16.9
Kolar	16	10	15	15	56	20	19	12	11	62	10.7
Mysuru	17	11	17	17	62	22	20	13	12	67	8.1
Shivamogga	22	14	21	21	78	29	26	17	16	87	11.5
Tumakuru	15	10	15	15	54	20	19	12	11	62	14.8
Uttara Kannada	22	14	21	21	79	29	26	17	16	88	11.4
Average					**64**					**71**	**10.8**

Sources: Field study

Table 4.67: Impact of MI installation on farm employment generation (Man days/acre/year)-Post harvest

District	Post harvesting (BMI)			Post harvesting (AMI)			Change in man days (%)
	Harvesting	Processing	Total	Harvesting	Processing	Total	
Belagavi	32	16	45	41	21	59	31.1
Bidar	24	12	34	31	15	44	29.4
C. R. Nagar	39	20	56	46	23	66	17.9
Haveri	21	11	30	29	14	41	36.7
Kalaburgi	32	16	45	38	19	54	20.0
Kolar	29	15	42	36	18	52	23.8
Mysuru	27	14	39	32	16	45	15.4
Shivamogga	25	13	36	29	15	42	16.7
Tumakuru	22	11	32	29	15	42	31.3
Uttara Kannada	20	10	28	25	13	36	28.6
Average			**38**			**48**	26.3

Sources: Field study

4.4.10 Increase in farm income

Adoption of MI is quite prominently noticed in increasing of farm income (gross income) in present assessment study and detail district-wise on farm and off-farm income change before and after adoption of MI within beneficiaries and farm income change between beneficiaries and non-beneficiaries given in Table 4.68.

In all the surveyed districts it is reported that by adoption of MI showed increase in gross income/acre, ranging from 17.8 (Rs 61847/acre to Rs 72833/acre) to 42.8 percent (Rs 83245/acre to Rs 118942/acre) with an average increase of 30 percent under beneficiaries as compared to before adoption of MI. The maximum gross increase in farm income has been reported in Belagavi, followed by Bidar and minimum increase in gross income/acre by 17.8% in Mysuru. Similar trend of increasing in farm level income per acre was found among beneficiaries as compared to non-beneficiaries. The enhancement of gross income among beneficiaries as compared to non-beneficiaries ranged from 10.9 to 46.6% with an average increase of 26.1%. The maximum increase in gross income has been reported in Bidar 46.6% (Rs 84000/acre to Rs 118942/acre) followed by Belagavi (Rs 49600/acre to Rs

72692/acre). Likewise, off farm gross income ranged from Rs 11198 to Rs 30942 and maximum off farm income found Haveri and minimum in Bidar.

A generalized observation as reflected in the FGD in several districts like Kolar, Chamarajanagar, and Bidar that due to the installation MI system the significant stabilization and crop yield enhancement was observed with vegetables, flower crops, and mulberry. An evidential impact in the case study analysis, of an additional benefit of 20 percent yield enhancement leading to an increased profit up to Rs. 1.00 Lakh with lesser usage of 20 percent fertilizers and 50 percent of water in turmeric with farmers in Shivamogga. A similar trend with sugarcane, pigeon pea, and mulberry in Belagavi, and Kolar districts, respectively. Besides, MI system installation has supported the farmers as an investment saving technology and proved to be a shining irrigation practice for crop productivity enhancement. In a predominant rainfed district like Tumakuru, the sprinkler system enhanced the ragi crop yield by 32% with a saving of water and fertilizers (60%), labor (20%). Multiple crop yield enhancement with increased income (Rs.48,000) was noticed with mulberry in a case study analysis in the Haveri district.

Table 4.68: Average gross income of Beneficiaries & Non-Beneficiaries in the study area (Rs/acre)

District	Beneficiaries (Rs)				Non-Beneficiaries (Rs)		% Increase income (Beneficiaries vs non-Beneficiaries
	On farm (before MI)	On farm (after MI)	% Increase income	Off farm	On farm	Of farm	
Belagavi	83245	118942	42.9	20363	84000	25386	41.6
Bidar	52145	72692	39.4	11198	49600	18120	46.6
C. R. Nagar	64253	79802	24.2	26298	66200	10000	20.5
Haveri	58231	77999	33.9	30942	56740	14000	37.5
Kalaburgi	53268	70278	31.9	12993	50460	12600	39.3
Kolar	55285	76285	38.0	20804	60460	19000	26.2
Mysuru	61847	72833	17.8	30197	65333	32000	11.5
Shivamogga	71548	87023	21.6	12067	78500	19200	10.9
Tumakuru	53754	71020	32.1	26055	57333	12000	23.9
Uttara Kannada	62185	78476	26.2	23630	70000	34000	12.1
Average	**61576**	**80535**		**21454**	**63862**	**19630**	
% Change			**30.8**				**26.1**

Sources: Field study

Table 4.69 depicts the corelation matrix of training impact on net income of various farmer category. The study revealed participation in training on MI technology really helps in enhancing the net household income among small, medium and marginal farmers however not much directly influenced on net income of large farmer.

Table 4.69: Correlation matrix of net training vs farmer net income

Correlation matrix for training vs net income	*Training*	*Net income small farmer*	*Training*	*net income medium farmer*	*Training*	*Net income Marginal farmer*	*Training*	*Net income large farmer*
Training	1.000							
Net income small farmer	**0.447**	1.000						
Training	0.190	0.187	1.000					
net income medium farmer	0.293	0.427	**0.577**	1.000				
Training	0.055	0.122	0.060	-0.236	1.000			
Net income marginal farmer	0.108	0.586	-0.113	0.120	**0.383**	1.000		
Training	-0.083	0.443	-0.192	-0.068	-0.192	0.068	1.000	
Net income large farmer	-0.005	0.187	0.331	0.052	-0.487	0.295	**-0.066**	1.000

Sources: Field study

Adoption of MI is quite prominently noticed in increasing of farm income of various famers category. The detail district-wise income change before and after adoption of MI among different farmer category is given in Table 4.69.

In all the surveyed districts it is reported that by adoption of MI showed average increase in gross income/acre, ranging from 6.1% to 39.7 percent (Rs 71245 to RS 115838/ acre) under different category of beneficiaries as compared to before adoption of MI. The average maximum gross increase in farm income has been reported among medium famers (Rs 82945 to 115838/acre) followed by small (Rs 50708 to Rs 6641/ acre) and marginal farmers however least was noticed in large farming (Rs 67146 to Rs 71245/acre) communities as compared to before MI adoption. This increase in form income among medium farmers may be due to increase in farm production by reducing input cost and material.

Table 4.70: Average gross income of farmer category of beneficiaries group the study area (Rs/acre) on farm activities

District Name	Marginal			Small			Medium			Large		
	Before MI	**After MI**	**% Increase income**	**Before MI**	**After MI**	**% Increase income**	**Before MI**	**After MI**	**% Increase income**	**Before MI**	**After MI**	**% Increase income**
Belagavi	75878	90822	19.7	79698	101962	27.9	120081	151529	26.2	61143	65887	7.8
C. R. Nagar	37147	46783	25.9	41762	61021	46.1	69451	107371	54.6	60221	66845	11.0
Haveri	45772	56849	24.2	51459	69521	35.1	85577	118011	37.9	74204	74649	0.6
Kalaburgi	41482	55545	33.9	46636	60109	28.9	77556	116335	50.0	67250	72091	7.2
Kolar	37947	49103	29.4	42661	61645	44.	70946	104291	47.0	61518	64901	5.5
Mysuru	39384	54349	38.0	44276	61212	38.2	73633	102732	39.	63847	70487	10.4
Shivamogga	44058	51901	17.8	49532	57506	16.1	82372	107578	30.6	71426	75783	6.1
Tumakuru	50969	51520	1.1	57301	62428	8.9	95293	128741	35.1	82629	84943	2.8
Uttara Kannada	38293	50585	32.1	43050	62294	44.7	71594	105959	48.0	62079	65618	5.7
Average	**45659**	**56384**		**50708**	**66411**		**82945**	**115838**		**67146**	**71245**	
% Change			**23.5**			**31.0**			**39.7**			**6.1**

Sources: Field study

4.4.11 Social and Environmental benefits of MI system installation

Micro irrigation scheme implementation has resulted in inclusive development of beneficiary contributing for their infrastructure, livestock, household assets and education enhancement, sequentially. From the field study it was noticed the infrastructure improvement (47%) was observed to be a most significant social impact followed by livestock (20%), household assets (19%) and education (14%) support as general phenomena by adoption of MI. Similar trend was noticed with the MI system system (Table 4.71).

Among various district beneficiaries in Haveri, Shivamogga and Tumakuru have registered higher percent of social benefits than other districts in terms of infrastructure and minimum was noticed in Kalaburgi (2.0%) under drip beneficiaries. Among sprinkler beneficiaries, Haveri, Shivamogga and Belagavi beneficiary obtained higher support to develop infrastructure and minimum in Bidar and Kalaburgi.

However, livestock support was obtained a maximum in Bidar and Kalaburgi by adopting drip system and Bidar and Shivamogga by sprinkler. Kalaburgi and Uttara Kannada beneficiaries were expressed positive response towards gaining household assets benefit by adopting drip and Kalaburgi and Belagavi with sprinkler. Similarly, the family members like children getting into the academics through MI support in education front to the extent of 14 % each and maximum was noticed with 33 percent in Uttara Kannada, 52 percent in Kolar by installations of drip and sprinkler. An improvised status of the MI beneficiaries w.r.t family scale improvement in the order of infrastructure, education, household assets, and livestock is a remarkable change.

Table 4.71: Comprehensive other benefits with MI

District	Total Responses (No.)	MI (%)				Total Responses (No.)	Drip (%)				Total Responses (No.)	Sprinkler (%)			
		HH Assets	Lives-tock	Infrast-ructure	Edu-cation		HH Assets	Lives-tock	Infrast-ructure	Edu-cation		HH Assets	Lives-tock	Infrast-ructure	Edu-cation
Belagavi	502	15.0	15.0	67.0	3.0	332	10.0	18.0	71.0	1.0	170	24.0	9.0	60.0	7.0
Bidar	504	11.0	44.0	15.0	30.0	244	18.0	42.0	18.0	21.0	260	5.0	47.0	13.0	35.0
C. R. Nagar	457	21.0	24.0	44.0	11.0	307	24.0	25.0	42.0	8.0	150	15.0	20.0	49.0	16.0
Haveri	387	7.0	10.0	75.0	8.0	112	11.0	16.0	63.0	11.0	275	6.0	7.0	80.0	7.0
Kalaburgi	405	66.0	19.0	10.0	5.0	127	65.0	25.0	2.0	8.0	278	68.0	15.0	13.0	4.0
Kolar	426	9.0	19.0	36.0	35.0	246	11.0	21.0	45.0	24.0	180	6.0	18.0	24.0	52.0
Mysuru	447	15.0	24.0	55.0	6.0	130	13.0	25.0	55.0	8.0	317	16.0	24.0	54.0	6.0
Shivamogga	396	12.0	9.0	71.0	8.0	116	26.0	4.0	55.0	15.0	280	5.0	11.0	79.0	5.0
Tumakuru	411	7.0	20.0	66.0	7.0	200	5.0	13.0	73.0	9.0	211	9.0	27.0	59.0	5.0
Uttara Kannada	539	30.0	8.0	40.0	22.0	278	41.0	5.0	21.0	33.0	261	18.0	11.0	59.0	12.0
Total	**4474**	**-**	**-**	**-**	**-**	**2092**	**-**	**-**	**-**	**-**	**2382**	**-**	**-**	**-**	**-**
Average -%		**19.0**	**20.0**	**47.0**	**14.0**		**21.0**	**20.0**	**45.0**	**14.0**		**18.0**	**19.0**	**50.0**	**14.0**

Sources: Field study

4.4.11.1 Labour migration

Adoption of MI irrigation has delivered several other social benefits of which the labour migration is one of the determinant factors. Table 4.72 is tabulated with beneficiaries' views on the extent of labour engagement with MI technologies. In the present study is observed that MI has reduced labour migration to the extent of 69.4 percent with the adoption of drip irrigation and 67.9 percent with sprinkler irrigation. Among various districts, a maximum reduction in labour migration was observed in Shivamogga (98.4%) district followed by Uttara Kannada (90.3%). However, no change has been noticed in Kalaburgi district.

Table 4.72: Reduced labour migration with adaption of MI system

District	Sample size (No.)	MI (%)		Sample size (No.)	Drip (%)		Sample size (No.)	Sprinkler (%)	
		Reduced	No change		Reduced	No change		Reduced	No change
Belagavi	376	83.5	16.5	262	81.7	18.3	114	87.7	12.3
Bidar	364	0.5	99.5	170	1.2	98.8	194	0.0	100.0
C. R. Nagar	370	78.9	21.1	235	83.8	16.2	135	70.4	29.6
Haveri	375	73.6	26.4	111	57.7	42.3	264	80.3	19.7
Kalaburgi	370	0.0	100.0	110	0.0	100.0	260	0.0	100.0
Kolar	362	85.6	14.4	211	77.7	22.3	151	96.7	3.3
Mysuru	376	87.8	12.2	104	87.5	12.5	272	87.9	12.1
Shivamogga	375	98.4	1.6	104	99.0	1.0	271	98.2	1.8
Tumakuru	372	86.6	13.4	179	85.5	14.5	193	87.6	12.4
Uttara Kannada	350	90.3	9.7	162	96.3	3.7	188	85.1	14.9
Total	**3690**			**1648**			**2042**		
Average -%		**68.6**	**31.4**		**69.4**	**30.6**		**67.9**	**32.1**

Sources: Field study

4.4.11.2 Labour drudgery (water management)

Agricultural water management tend to possess several heavy and hard activities causing stress and strain to human labour, which is very predominant with irrigation practice. A transition from traditional flood irrigation towards MI irrigation resulted in the reduction of labour drudgery especially in water management which sustained human energy for productive activities. In the present analysis, it was found that the average reduction of labour drudgery of 57.9 percent by adopting MI. With respect individual component, drip adoption reduced labour drudgery by 64.5 and 52.5 percent by sprinkler adoption (Table 4.73). Among the districts maximum reduction in labour drudgery was noticed in Chamarajanagar, Kalburgi and Belagavi districts, owing to the dependence of higher population on agricultural labour. The shifting, shuffling and insertion of sprinkler jets calls for additional drudgery, hence which is not so in-case of drip system.

Table 4.73: Reduction in labour drudgery (water management) due to MI installation (Avg labour reduction)

District	Sample size (No.)	MI (%)	Sample size (No.)	Drip (%)	Sample size (No.)	Sprinkler (%)	Average reduction (%)
Belagavi	376	61.3	262	65.1	114	52.5	61.3
Bidar	364	56.9	170	65.7	194	49.1	56.8
C. R. Nagar	370	62.7	235	65.1	135	58.5	62.7
Haveri	375	53.6	111	64.9	264	48.8	53.6
Kalaburgi	370	61.5	110	67.4	260	59.0	61.5
Kolar	362	57.8	211	64.6	151	48.4	57.9
Mysuru	376	54.2	104	60.0	272	52.0	54.2
Shivamogga	375	57.5	104	66.2	271	54.2	57.5
Tumakuru	372	56.3	179	60.8	193	52.1	56.3
Uttara Kannada	350	57.8	162	65.9	188	50.8	57.8
Total	**3690**		**1648**		**2042**		
Average -%		**57.9**		**64.59**		**52.58**	**57.94**

Sources: Field study

4.4.11.3 Water scarcity and irrigation issues.

The major intention of MI system installation is to overcome the constratins in irrigation such as water supplementation during scarcity situation, distribution and water saving. It is heartening to note that the 75.4 percent beneficiaries have expressed installation of MI system as a practice to overcome water scarcity (Table 4.74). However, still 24.6 percent of beneficiaries substituting water through purchasing or shared by neighbour. Among various districts, Mysuru and C. R Nagar beneficiaries expressed that installation of MI helped maximum (94.3% each) to overcome water scarcity during critical period and minimum was in Bidar (45.9%).

Table 4.74: Water supplementation during scarcity situation with MI adoption.

District	**Sample size (No.)**	**Beneficiary response (%)**	
		Yes	No
Belagavi	376	79.0	21.0
Bidar	364	45.9	54.1
C. R. Nagar	370	94.3	5.7
Haveri	375	63.2	36.8
Kalaburgi	370	64.6	35.4
Kolar	362	84.5	15.5
Mysuru	376	94.4	5.6
Shivamogga	375	62.9	37.1
Uttara Kannada	350	78.3	21.7
Tumakuru	372	83.6	16.4
Total	**3690**	**78.6**	**21.4**
Average -%		**75.4**	**24.6**

Sources: Field study

Table 4.75 describes district wise occurrence of water scarcity during summer season. Among total MI beneficiaries,77.6 percent of drip irrigation practitioners and 79.3 percent of sprinkler irrigation practitioners have expressed they are facing scarcity of water supply from the available source during summer. A maximum water scarcity was observed in Kalaburgi and C. R Nagar in drip irrigation and sprinkler beneficiaries and minimum in Bidar (47.9% and 43.5%). Thus, it can be understood that MI has been a boon for those beneficiaries who are already facing heat of water scarcity to take up agricultural activities, while for those with adequate source, it is a mechanism to limit unnecessary exploitation.

Table 4.75: Water scarcity status with available sources

District	Sample size (No.)	MI (%)		Sample size (No.)	Drip (%)		Sample size (No.)	Sprinkler (%)	
		Yes	No		Yes	No		Yes	No
Belagavi	376	79.0	21.0	262	75.6	24.4	114	86.8	13.2
Bidar	364	45.9	54.1	170	43.5	56.5	194	47.9	52.1
C. R. Nagar	370	94.3	5.7	235	91.5	8.5	135	99.3	0.7
Haveri	375	63.2	36.8	111	73.0	27.0	264	59.1	40.9
Kalaburgi	370	99.2	0.8	110	97.3	2.7	260	100.0	0.0
Kolar	362	84.5	15.5	211	77.7	22.3	151	94.0	6.0
Mysuru	376	94.4	5.6	104	83.7	16.3	272	98.5	1.5
Shivamogga	375	62.9	37.1	104	51.0	49.0	271	67.5	32.5
Tumakuru	372	83.6	16.4	179	88.3	11.7	193	79.3	20.7
Uttara Kannada	350	78.3	21.7	162	87.7	12.3	188	70.2	29.8
Total	**3690**	**-**	**-**	**1648**	**-**	**-**	**2042**	**-**	**-**
Average -%		**78.6**	**21.4**		**77.6**	**22.4**		**79.3**	**20.7**

Sources: Field study

4.4.11.4 Soil quality

Soil quality is a comprehensive attribute wherein the earthworms are recognised as farmer friend from the perspective of soil pulverisation and improving the soil texture. Its population directly relates to improved soil porosity and aeration, microbial activity, and water retentivity, hence, its assessment is also factored-in as soil quality promoting activity. In this study it is noted that the 72.1 percent farmers have experienced the incremental population of earth worms with MI, owing to the softening of the soil due to a well-maintained moisture level in the soil, around the growing basin of the plant. Farmer beneficiaries experiencing the enhanced earthworm population was observed in Shivamogga and C. R Nagar districts followed by Haveri and Uttara kannada district (Table 4.76).

Adoption of MI irrigation technology is claimed to benefit the soil properties as well. The respondents were asked about secular changes in soil quality by increasing earth worm over the years on their farms since the increase in moisture due to adoption of drip technology. Table 4.76 presents the compiled results of benefits of MI installation towards increasing earth worm. Average 72.2 percent of the overall sample district perceive an improvement in the soil quality by adoption of MI irrigation. Among districts beneficiaries of Shivamogga district expressed maximum (97.1%) improvement in soil earth population followed by from Chamarajanagar beneficiaries (92.2%) and minimum with Bidar beneficiaries (only 2.5%). Similar opinion was found with nonbeneficiaries. This particular trend of optimum moisture favouring increased earthworm population and also positive contribution towards the direct injecting moisture to root system and improved soil environment, which promotes growth and productivity of crop, and availability of other inputs.

Table 4.76: Soil Earthworm improvement status with drip and sprinkler system

District	**Sample size (No.)**	**MI (%)**		**Sample size (No.)**	**Drip (%)**		**Sample size (No.)**	**Sprinkler (%)**	
		Yes	**No Change**		**Yes**	**No Change**		**Yes**	**No Change**
Belagavi	376	76.6	23.4	262	74.0	26.0	114	82.5	17.5
Bidar	364	2.5	97.5	170	5.3	94.7	194	0.0	100.0
C. R. Nagar	370	92.2	7.8	235	93.6	6.4	135	89.6	10.4
Haveri	375	90.9	9.1	111	92.8	7.2	264	90.2	9.8
Kalaburgi	370	37.8	62.2	110	39.1	60.9	260	37.3	62.7
Kolar	362	80.4	19.6	211	73.0	27.0	151	90.7	9.3
Mysuru	376	79.0	21.0	104	69.2	30.8	272	82.7	17.3
Shivamogga	375	97.1	2.9	104	100.0	0.0	271	95.9	4.1
Tumakuru	372	79.6	20.4	179	79.3	20.7	193	79.8	20.2
Uttara Kannada	350	84.0	16.0	162	92.0	8.0	188	77.1	22.9
Total	**3690**	**-**	**-**	**1648**	**-**	**-**	**2042**	**-**	**-**
Average -%		**72.1**	**27.9**		**72.2**	**27.8**		**72.0**	**28.0**

Sources: Field study

Quality of soil and soil health are determined by the nature of soil stability without any exposure of subsoil (Table 4.77). It is observed that moderate and uniform water supply through MI system support the growth of the root and the shoot of the plant. As experienced by 77.5 percent of beneficiaries have expressed no soil cracking through the adoption MI system and which is quite an encouraging note. Maximum (99.2%) beneficiaries belong to Kolar district expressed that soil cracking was not observed due to adoption MI system. However, beneficiaries from Haveri district expressed still facing soil crack problem. Among various system, adoption of drip system showed maximum (97.8%) reduction in soil cracking experience. However, farmers owned sprinkler system expressed soil cracking reduced on an average of 61 percent. This is mainly due to unexpected occurrence of splash flood by bursting of pipes which is mainly due to non-adoption of filter and clogging effect in the nozzles.

Table 4.77: District-wise beneficiaries' opinion on soil cracking attributes

District	**Sample size (No.)**	**MI (%)**			**Sample size (No.)**	**Drip (%)**			**Sample size (No.)**	**Sprinkler (%)**		
		Yes	**No**	**No change**		**Yes**	**No**	**No change**		**Yes**	**No**	**No change**
Belagavi	376	22.1	74.5	3.5	262	1.1	98.5	0.4	114	70.2	19.3	10.5
Bidar	364	0.0	45.9	54.1	170	0.0	98.2	1.8	194	0.0	0.0	100.0
C. R. Nagar	370	5.1	88.4	6.5	235	2.1	97.4	0.4	135	10.4	72.6	17.0
Haveri	375	32.3	67.7	0.0	111	0.0	100.0	0.0	264	45.8	54.2	0.0
Kalaburgi	370	0.0	54.6	45.4	110	0.0	96.4	3.6	260	0.0	36.9	63.1
Kolar	362	0.3	99.2	0.6	211	0.0	100.0	0.0	151	0.7	98.0	1.3
Mysuru	376	5.6	82.2	12.2	104	1.9	91.3	6.7	272	7.0	78.7	14.3
Shivamogga	375	8.5	90.9	0.5	104	0.0	100.0	0.0	271	11.8	87.5	0.7
Tumakuru	372	9.4	87.1	3.5	179	5.6	94.4	0.0	193	13.0	80.3	6.7
Uttara Kannada	350	13.1	84.6	2.3	162	0.0	100.0	0.0	188	24.5	71.3	4.3
Total	**3690**	**-**	**-**	**-**	**1648**	**-**	**-**	**-**	**2042**	**-**	**-**	**-**
Average -%		**9.7**	**77.5**	**12.8**		**1.2**	**97.8**	**1.0**		**16.6**	**61.1**	**22.4**

Sources: Field study

4.5 Trainings and Capacity Building

Participation

The training and capacity building is an integral component of the PMKSY-PDMC initiatives. In the present study, it was assessed as the level of beneficiary participation, stakeholder engagement, frequency, seasonality, topic covered, usefulness in building the knowledge and skill, in MI system management. The field investigation results revealed only 12.6% beneficiaries have attended training and rest of the majority (87.4%) of beneficiaries across all districts have not undergone any training under PMKSY-PDMC. Thus, there is an urgent attention need for this type of interventions to strengthen the knowledge and skill in MI system management among various community. Among the various district beneficiaries of Kalaburgi, Mysuru and Shivamogga were the top three districts where the beneficiaries had attended training programs. The percentage share of participation is 26, 22 and 15, in Kalaburgi, Mysuru, and Shivamogga district respectively (Table 4.78).

Table 4.78: Beneficiaries participation in MI training

District	Sample size (No.)	Beneficiary response (%)	
		Yes	No
Belagavi	376	12.0	88.0
Bidar	364	14.0	86.0
C. R. Nagar	370	4.0	96.0
Haveri	375	4.0	96.0
Kalaburgi	370	26.0	74.0
Kolar	362	11.0	89.0
Mysuru	376	22.0	78.0
Shivamogga	375	15.0	85.0
Tumakuru	372	5.0	95.0
Uttara Kannada	350	13.0	87.0
Total	**3690**	**-**	**-**
Average -%		**12.6**	**87.4**

Sources: Field study

Institutional involvement

Scheduled contents of the training are to be shared, taught and interacted for effective understanding by the beneficiaries. The detail district wise level of institution engagement, mode of training, duration and frequency of training program and seasonality of training were given in Table 4.79. The survey results reveal that there are five institutions were actively involved in conducting training programme and the total of 465 beneficiaries were attended the training programs from the 10 districts. During survey, beneficiaries have expressed that, among various institution/agency, MI agencies have taken maximum (41%) initiative in conducting training program, which is a dominant approach followed by the governmental department to an extent 25 percent. RSK and SAU\KVKs are found only marginal participation in organising training programme (17 and 12 percent respectively). Whereas, involvement of NGOs/CBOs in conducting training programme is very low, only 5 percent share. In terms of active involvement of top three institutions across different districts, MI agencies were most active in Belagavi, Bidar and Mysuru; Government Departments were most active in the districts of Uttar Kannada, Tumakuru and Haveri and RSK are most active in Kalaburgi, Kolar and Shivamogga.

Method, Duration, Frequency and Seasonality of training

Among participated beneficiaries, 71% beneficiaries expressed that dominant mode of training was through demonstrations and the balance 29 percent expressed that training was through class rooms. Similar trend of beneficiary expression was seen across most of the districts except in Haveri, where 87 percent beneficiary mentioned that training was through classroom and 13 percent was through demonstration. A 60:40 ratio of classroom and demonstration was also seen in the districts of C R Nagar and Tumakuru, respectively. This indicates, theoretical conceptual exposure followed by actual, “seeing is believing” type of field exposure and demonstrations will have a positive impact on the adoption of the MI as water saving socio-technical program.

Generally, one time training extended by the department is quite realistic but followed training program are also quite essentially required to redefine and refine the system for a more productive outcome. In terms of duration of program, maximum (79%) beneficiaries expressed they attended one-day training program and the rest 29 per cent beneficiaries attended training programs that ranged from 1 to 3 days. Similar trend was seen for most districts except in the case of Tumakuru wherein 50 per cent of the beneficiaries attended one day training program and the balance 50 per cent attended 1 to 3 days training program. A 60 to 40 ratio was seen in Haveri and 67 to 33 ratio was seen the district of CR Nagar.

In terms of training frequency, again the majority of beneficiaries expressed one time and 15 percent beneficiaries attended the training programs that were staggered with a frequency of 2 to 3 times. A similar trend was seen across all districts.

The feedback was obtained with regard to the timing of the training program, 69 percent reported that the training program was scheduled at an inconvenient time and around 31 percent beneficiaries expressed the scheduled timing was convenient. This feedback provides organisers for future plan of timing that is convenient to the beneficiaries so as to enhance the participation. Districts that were most affected with inconvenient scheduling of training program was Kolar with 88 per cent, followed by Kalaburgi with 83 per cent and the districts of C.R Nagar (80%) and Haveri (80%) respectively.

Table 4.79: Institutional engagement in training programme

District	Sample size (No.)	Institution engaged in training (%)					Mode of training (%)		Duration of training program (%)			Frequency of training (%)			Timeliness / Seasonality of training (%)	
		SAUs/ KVKs	Govt. Dept	MI Agencies	RSK	NGOs/C BOs	Class room	Demon-station	1 day	1-3 days	4-10 days	1- time	2-3 time	3-5 time	Conve -nient	Inconve -nient
Belagavi	45	4.0	33.0	62.0	0.0	0.0	27.0	73.0	84.0	16.0	0.0	78.0	22.0	0.0	44.0	56.0
Bidar	50	8.0	24.0	60.0	8.0	0.0	30.0	70.0	74.0	26.0	0.0	76.0	24.0	0.0	70.0	30.0
C. R. Nagar	15	27.0	33.0	27.0	0.0	13.0	40.0	60.0	67.0	33.0	0.0	87.0	13.0	0.0	20.0	80.0
Haveri	15	13.0	40.0	47.0	0.0	0.0	87.0	13.0	60.0	40.0	0.0	73.0	27.0	0.0	20.0	80.0
Kalaburgi	96	20.0	13.0	8.0	49.0	10.0	20.0	80.0	89.0	11.0	0.0	91.0	9.0	0.0	17.0	83.0
Kolar	40	18.0	25.0	18.0	25.0	15.0	23.0	78.0	80.0	20.0	0.0	85.0	15.0	0.0	13.0	88.0
Mysuru	84	10.0	14.0	60.0	8.0	8.0	21.0	79.0	83.0	17.0	0.0	92.0	8.0	0.0	24.0	76.0
Shivamogga	55	9.0	22.0	51.0	18.0	0.0	36.0	64.0	73.0	27.0	0.0	84.0	16.0	0.0	33.0	67.0
Tumakuru	20	15.0	50.0	35.0	0.0	0.0	40.0	60.0	50.0	50.0	0.0	75.0	25.0	0.0	50.0	50.0
Uttara Kannada	45	4.0	51.0	44.0	0.0	0.0	33.0	67.0	80.0	20.0	0.0	89.0	11.0	0.0	27.0	73.0
Total	**465**															
Average -%		**12.0**	**25.0**	**41.0**	**17.0**	**5.0**	**29.0**	**71.0**	**79.0**	**21.0**	**0.0**	**85.0**	**15.0**	**0.0**	**31.0**	**69.0**

Sources: Field study

Subject covered and satisfaction with training material

Table 4.80 describes the district wise beneficiary response towards subject covered during training program, material benefitted and level of satisfaction on given material. The survey also captured feedback on the various topics that were covered in the training program. A majority of beneficiaries across all locations (72 per cent) reported that the training program covered the subjects on irrigation. District-wise coverage of these subjects was highest in Mysuru and Kolar (85%) and the least coverage (20%) of the irrigation subject was in the district of C R Nagar.

With respect to training material provided during training period, 50 per cent of the beneficiaries expressed that they have received training materials in the form of brochure and 50% received leaflets provided during training which they could refer during post training period. However, none of the beneficiaries received any training manual. This is very essential for long term management of the system. Among the various district, beneficiaries belong to Bidar (70 %), CR Nagar (67%) and Belagavi (64%) were expressed they got leaflets whereas in Kolar (25%) beneficiaries obtained lowest leaflets. In terms of brochure, beneficiaries belong to Kolar (75%), Kalaburgi (70%) and Haveri (60.0%) got highest and minimum brochure obtained by Bidar farmers (30%).

In terms of satisfied with the given training materials, 55 per cent reported average, 36 per cent reported them to be good, and 9 per cent reported that it was poor. Here again these findings of the survey can provide inputs for future training interventions in terms of provision of training materials are to be simple, visually appealing and in regional language.

Table 4.80: District wise beneficiary response on various training attributes

District	Sample size (No.)	Subject coverage (%)									Training material (%)			Satisfaction with training material (%)		
		Technology & Operation	Maint-enance	Irrig-ation	New Cropping pattern	Water regulation	BIS-quality issues	Warranty issues	Crop- water relationship	Efficient usage of MI	Leaf lets	Brochure	Manual	Good	Aver age	Poor
Belagavi	45	51.0	44.0	40.0	27.0	22.0	27.0	62.0	51.0	22.0	64.0	36.0	0.0	22.0	44.0	33.0
Bidar	50	68.0	80.0	66.0	46.0	40.0	28.0	54.0	56.0	40.0	70.0	30.0	0.0	34.0	56.0	10.0
C. R. Nagar	15	80.0	60.0	20.0	13.0	13.0	67.0	13.0	13.0	13.0	67.0	33.0	0.0	27.0	60.0	13.0
Haveri	15	60.0	47.0	60.0	40.0	60.0	60.0	53.0	53.0	60.0	40.0	60.0	0.0	33.0	67.0	0.0
Kalaburgi	96	77.0	76.0	85.0	0.8	63.0	16.0	64.0	26.0	63.0	30.0	70.0	0.0	39.0	49.0	13.0
Kolar	40	80.0	78.0	80.0	73.0	75.0	33.0	70.0	65.0	75.0	25.0	75.0	0.0	25.0	55.0	20.0
Mysuru	84	71.0	76.0	85.0	71.0	85.0	27.0	60.0	42.0	85.0	58.0	42.0	0.0	43.0	56.0	1.0
Shivamogga	55	51.0	40.0	78.0	62.0	49.0	16.0	58.0	73.0	49.0	60.0	40.0	0.0	40.0	60.0	0.0
Tumakuru	20	30.0	60.0	40.0	20.0	30.0	20.0	10.0	65.0	30.0	60.0	40.0	0.0	25.0	75.0	0.0
Uttara Kannada	45	51.0	22.0	76.0	27.0	51.0	36.0	73.0	60.0	51.0	40.0	60.0	0.0	49.0	51.0	0.0
Total	**465**	**-**	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Average -%		**65.0**	**62.0**	**72.0**	**55.0**	**55.0**	**27.0**	**58.0**	**49.0**	**55.0**	**50.0**	**50.0**	**0.0**	**36.0**	**55.0**	**9.0**

Sources: Field study

The district wise opinion of the beneficiaries in terms of usefulness, skill enhancement and willingness to participation in training was given in Table 4.81. Around 62 percent of the beneficiaries who attended the training program reported that the programs were useful and 38 percent felt that the programs could be further improved. Similar trends were seen across most of the districts. The district of C R Nagar registered the highest (80%) positive response to be good and district of Uttar Kannada recorded the highest (51%) response in terms of needing improvement.

In terms of gaining knowledge and skill enhancement, 33 percent of respondents rated the training program was very good, 47 percent rated it is good and 20 percent rated it is medium/average. In Haveri district beneficiaries had expressed highest satisfaction (very good) in terms of graining knowledge and skill at 87 percent and lower satisfaction (average/medium) was reported for the district of C R Nagar (67%). In terms of interest to attend future training program 82 per cent of the beneficiaries reported that they would attend the training program in the future. The top three districts reporting the same views were noticed in Mysuru (92%), Bidar (90%) and Uttar Kannada with 89 percent. During FGD in Mysuru and Uttar Kannada districts the farmers reported the necessity of technical narration of the impact of the MI system than mere exposure to field demonstration.

Table 4.81: Beneficiaries response on usefulness of training

District	Sample size (No.)	Usefulness of training (%)		Improvement in knowledge /skill (%)			Willingness to attend training (%)
		Good	Need to improve	Medium	Good	Very good	
Belagavi	45	56.0	44.0	27.0	51.0	22.0	78.0
Bidar	50	66.0	34.0	24.0	58.0	18.0	90.0
C. R. Nagar	15	80.0	20.0	67.0	7.0	27.0	80.0
Haveri	15	73.0	27.0	13.0	0.0	87.0	67.0
Kalaburgi	96	70.0	30.0	10.0	83.0	6.0	81.0
Kolar	40	70.0	30.0	3.0	78.0	20.0	85.0
Mysuru	84	54.0	46.0	14.0	8.0	77.0	92.0
Shivamogga	55	64.0	36.0	18.0	42.0	40.0	62.0
Tumakuru	20	45.0	50.0	60.0	20.0	20.0	75.0
Uttara Kannada	45	49.0	51.0	27.0	49.0	24.0	89.0
Total	**465**						
Average -%		**62.0**	**38.0**	**20.0**	**47.0**	**33.0**	**82.0**

Sources: Field study

Table 4.82: Achieving SDG 6 targets under EMKSY/PDMC scheme (2015-16 to 2018-19)

S N	Key components	Quantified/Validated Outcome	Impact Realised	SDG Goal Addressed
	Practicing M I system as an agricultural production practice	• 534354 No. Of farmers have adopted the practice in the State	Adoption of water saving technology as a package of practice	6.3
	Crop diversification and cropping pattern	• 10.63 lakh ha agriculture and sericulture • 5.87 lakh ha Horticultural crops • 61.5% crop diversification	Best alternate practice to overcome the climate change, and drought	6.3 & 2.4
	Successful adoption of Micro-Irrigation (drip and sprinkler system) in farmers field	• 16.51 lakh Ha M I adoption in the State	Improved water use efficiency	6.4.
	Reduction in exploitation of ground water resource	• Overall, 40.5% water Saving (range 10% to 72%)	Ground water restoration	6.4
	Integration and convergence of other governmental programs with M I	• 31% scheme convergence (Ganga Kalyan, Krishi Bhagya Yojane, NFSM)	Community Participation	6.6 b
	Controlled Water use in agricultural production	• **Water saving** • Maximum in paddy (72%), Sugarcane (62.0%), Banana (55.3%) • Least saving in maize (10.0%)	Restoration of natural resources and water ecosystem	6.6 & 12.2
	Crop yield/ production change	• 33% increase production	increase in agriculture productivity	2.3
	Change in income status	• Rs 80535 on farm/household • Rs 21454 off farm/household	Poverty reduction and Income enhancement	2.3
	Irrigation aided low-cost input management	• 21.9% Savings in Fertilizers • 22.9%. Savings in Labour	LEISA & Doubling the Agricultural productivity & Income	2.3
	Adoption of drought management practices	• 24.0% area change from flood irrigation to MI • 76.0% area change from rain fed to MI irrigation	Resilient agricultural practice	2.4 &15.4
	Management of power for low pressure water distribution M I system	• 24.2% Energy Saving	Energy Affordability and saving	7.1
	Restoring the ground water and open water sources through M I installation	• Gained water saving • 39.8% critical zone • 33.3%: semi critical zone • 31.0%: safe zone	Reduction in exploitation of water resource	12.2

Sources: Field study

4.6 Glimpses of Focus Group Discussion

Table 4.83: Highlights of focus group discussion

Date	Location of FG Discussion	Taluk	District – ACZ
21 Oct. 2020	Adahalli	Athani	Belagavi – NDZ
25 Jun 2020	Morkandi	Basavakalyan	Bidar – NETZ
20 Apr 2020	Karadaggi	Shiggaon	Haveri – NTZ
15 Apr .2020	Tengli	Chitapur	Kalaburgi -NETZ
20 Oct 2020	Hulidevanhalli	Malur	Kolar – EDZ
13 May .2020	Maddur	Yelandur	Chamarajnagar – SDZ
21 May 2020	B Matagere	H D Kote	Mysuru – SDZ
8 Jun. 2020	Mydholalu	Bhadravathi	Shivamogga – STZ
12 Aug.2020	Mudapali	Mundgod	Uttara Kannada -HZ
7 Jul. 2020	Hunsaghatta	Tiptur	Tumkur - CDZ

Sources: Field study

MI a uniform water distribution technology has become an agricultural practice through the MI system to support crop production and area expansion dimensions in both flat and uniform terrains like in northern Karnataka and with undulating terrains in coastal Southern Karnataka districts also. Irrespective of soil types and texture, the MI practices are found to be an adaptive one in all parts of the state- [Hunsaghatta, Tumakuru and Mudapali, Uttara Kannada]

Cereal crops like paddy, maize, groundnut, soybean, pluses, and closely spaced vegetables have been the most choicest crops for sprinkler adaption, while perennial crops including widely spaced row crops like various fruits, plantation crops spices and row crops like vegetables and flower crops are with the drip system, which is being very well acclimatized as a most viable irrigation practice by the farming communities across the land holding size. [Morkandi, Bidar and Hulidevanhalli, Kolar]

A common voice of adoption of MI system enabling the farmers in stabilising their crops and yield was observed in most of the districts of study. Simultaneously, the financial improvements are received as MI scheme compensated the initial investment. Owing to soil physiography in district like Chamarajanagar has been observed to be a marginal exception: [Maddur, Chamarajanagar and Hulidevanhalli, Kolar]

Prevalent of seasonal drought in districts like Tumakuru and Kolar during 2018-2019, and with unsettled rainfall pattern decreasing up to 30-40% of the total rainfall in North Karnataka region, the MI system sustained as a boon for crop production. [Morkandi Bidar and Hulidevanhalli, Kolar]

Borewell has been the major source of irrigation across the state and the number of bore-wells would vary with land size. Cultivators with up to 2-3 acres would own one bore-well while in land holding of 10-12 acres up to six bore-wells. [karadaggi, Haveri and B Matagere Mysuru]

Affluence of revenue Out come with MI practice has been well relished by the farmers and it tempted them dug borewells up to a maximum depth 800-1400 above at Kolar/Tumakuru and minimum record of 600-1200 ft at Shivamogga/ Uttar Kannada: [Mydholalu, Shivamogga and Hunsaghatta, Tumakuru]

In general, during summer season and in dry regions crops face shortage of water and farmers would like to avoid cultivation of crops which yield on lesser water. In case scarcity of water, farmers would request and trade the water from the neighboring land holder in return of sharing some produce, out of gratitude. [Tengli, Kalaburgi and Adahalli, Belagavi]

It has been a conscious suggestion by famers for joint inspection by field implementing officials of Revenue, Irrigation and Electricity Departments towards confirming the water source, water Output, power supply before launching the program for efficient utilization of Government subsidy. [Morkandi, Bidar]

Irregular time of power-supply has forced farmers to accommodate unconventional irrigation timings and this has also led to the use of condenser for power extraction as an illegally compromised plan. [Maddur, Chamarajanagar and Hunsaghatta, Tumakuru]

Farmers reported to have not provided with any organized training apart from providing one onsite demo at few places of study area. Lack of training has been the major bottle neck. [Matagere, Mysuru and Mudapali, UttaraKannada]

Table: 4.84: Abstract of salient features of FGDs

District	Land use pattern, topography, soil type and Crop intensity/diversity	Production and productivity	Water use efficiency	Energy:	Social Aspects: employment and social assets	Technological aspects	MI system and support services:	Environmental Aspects	Capacity building and Participation	Bottlenecks that limit use	Gender participation and adaptation rate
Belagavi	70% of the land is irrigated; Region comprises both flat and sloped surfaces; Black soil in major, muddy and red soil are also recorded; Major crop includes grape (drip), Sorghum, sugarcane.	Lack of stable sources of water among some farmers; Farmers apart from agriculture have their own business or go for labour work	Farmers experienced irrigation drought and alternate dependence on bore-wells coupled with MI enabled cultivation of summer season crops. Water reading practices were also initiated which leads to drilling of additional bore-wells. MI increased crop production ranging from 20-30 both in field and fruits crops and have realised labour savings and energy savings also.	Utilization of electrical pumps to supply water to MI system. Government program of regularization of power connection enabled higher adoption of MI.	MI efficiency minimized the farm and family labour thus, labour migration was observed for gaining additional family income from neighbouring villages	MI installation issues with respect to timely supply, substandard quality of materials and advance payment to agency are observed to be deviation hampering the scheme implementation.	Clear absence of follow and support and guidance from officials and agencies was observed to be common expression.	Implications of environmentally related issues are out of bounds from the majority of the beneficiaries.	A marginal guidance was initiated by the Government Department in its training program with marginal participation of beneficiaries.	General Impression included the extension of the provisions with timely release of subsidies.	Beneficiary group experienced the non-availment of the benefits to small and marginal farmers which is not being substantiated to the beneficiaries by the implementing agencies.

District	Land use pattern, topography, soil type and Crop intensity/diversity	Production and productivity	Water use efficiency	Energy:	Social Aspects: employment and social assets	Technological aspects	MI system and support services:	Environmental Aspects	Capacity building and Participation	Bottlenecks that limit use	Gender participation and adaptation rate
Bidar	Red sandy loom soil enabled 2 seasonal crops with inter-cropping of cereals and pulses	Installation of Sprinkler system. has increased yield of sugarcane by 20-30 % and similarly in pulses and wheat.	Declined Rainfall by 40% induced farmers to MI and adoption of high-income crops like vegetables and flowers, besides generating an awareness of crop planning to suit water availability.	Quality power supply for effective irrigation through bore-well was a group conscious opinion.	A field reflection of mechanised farming, reduced labour requirement and labour charges, with increased production by 20-30% was noted.	. Although farmers invest on selection of quality material but practices of drip system management are yet an issue.	Public service department was substituted by private sector unit for input management and maintenance guidance	flood irrigation causing top soil erosion was avoided with MI and thus retention of soil fertility has been experienced	Exposure visits to demo blocks have although triggered farmers interest but the need for training was observed further expansion....	Technological support for fertigation practices	Marginal participation farm women was noticed

District	Land use pattern, topography, soil type and Crop intensity/diversity	Production and productivity	Water use efficiency	Energy:	Social Aspects: employment and social assets	Technological aspects	MI system and support services:	Environmental Aspects	Capacity building and Participation	Bottlenecks that limit use	Gender participation and adaptation rate
Chamarajanagar	flat surface; clay sandy soil	Installation of MI system have resulted in enhanced yield in horticulture cultivation	Rainfall has been normal less; Adoption of MI in the region with Bore-wells as major source of water for irrigation have enhanced crop growth; Have to identify water source	power extraction as relatively higher power cuts;	Agriculture and agriculture labour is main occupation, people haven't improved as compared to other regions; soil is not so great and water source; soil gets quickly dried after rain		Follow-up from department is needed		Farmers were provided with demonstration and orientation program	MI is good but should reach all;	Female labours take part in sowing and harvesting;

District	**Land use pattern, topography, soil type and Crop intensity/diversity**	**Production and productivity**	**Water use efficiency**	**Energy:**	**Social Aspects: employment and social assets**	**Technological aspects**	**MI system and support services:**	**Environmental Aspects**	**Capacity building and Participation**	**Bottlenecks that limit use**	**Gender participation and adaptation rate**
Haveri	Fruits, cereals and pulses are cultivated in undulating terrain with sandy mixed grey soil,	Pest and wildlife (wild-bore/peacock) invasion and damage of MI system has been major concern for significant production	Power supply support for best utilization of water for MI and extension of provision to utilize water from Farm ponds reflects to interest of beneficiaries to adopt MI.	Regular fixed timely power supply can encourage farmer to build a routine for better production	Primary Occupation is agriculture fallowed by labour work. Migration is observed to nearby cites for non-agricultural work	with a concern and quality product installation provision to choose the agencies was urged from the farmers to realize improved MI scheme benefits.	Sprinkler adoption found to be usefully linked with the power availability during night times and need for correcting the clogging drippers was expressed by the farmers	MI changes leading to reduced soil erosion and top soil and leading to improved crop yields.	Lack of technical training or guidance to majority in respect to MI maintenance.	Department should not freeze on agencies, rather should select on few numbers of agencies and allow farmers to choose any, to buy the product, even if cost is exceeding the subsidy amount. If farmers are given good quality MI installations, most of them will enjoy the benefit.	There is greater participation of women on frontline work.

District	Land use pattern, topography, soil type and Crop intensity/diversity	Production and productivity	Water use efficiency	Energy:	Social Aspects: employment and social assets	Technological aspects	MI system and support services:	Environmental Aspects	Capacity building and Participation	Bottlenecks that limit use	Gender participation and adaptation rate
Kalaburgi		Need for improved technological inputs on water management, cropping plan, inputs management and energy support was observed. ..	Water trading practice in return of 30% of yield and shifting from traditional practices to MI exhibited the interest MI expansion plan	Inadequate access to power supply hampered the MI initiative for crop production.	Improvement in family social status and lifestyle and reduced labour invest by 25-30% leading to project farming as livelihood occupation and family labour support secondary income generation activity...	Farmers interest in MI installation and its management led to realize improved yield and fertilizer use efficiency.	Equipment quality leading to malfunction of sprinkler system was noticed. Post installation management support is observed as an issue.	Observation of reduction in soil erosion up to 20% with MI system was an encouraging note.	Effective function of RSK for guidance and zeal for extension of MI for sericulture activities and participation in training program was observed as it was triggered by the regional MI dealer personnel.		Enhanced women labour participation in harvesting the enhanced quantum of production was expressed by the beneficiaries.

District	Land use pattern, topography, soil type and Crop intensity/diversity	Production and productivity	Water use efficiency	Energy:	Social Aspects: employment and social assets	Technological aspects	MI system and support services:	Environmental Aspects	Capacity building and Participation	Bottlenecks that limit use	Gender participation and adaptation rate
Kolar	flat surface; red sandy soil	Vegetables - Tomato, beans, cauliflower, Knolkhol	Rainfall had reduced 2 years back; has recently improved. Farm pond (25-30%) borewell 50%;		Agriculture and agriculture labour is main occupation; Horticulture farmers have improved very well;		Very well used; 10% fertigation; most of them apply directly	MI enhances earthworms as well;			

District	Land use pattern, topography, soil type and Crop intensity/diversity	Production and productivity	Water use efficiency	Energy:	Social Aspects: employment and social assets	Technological aspects	MI system and support services:	Environmental Aspects	Capacity building and Participation	Bottlenecks that limit use	Gender participation and adaptation rate
Mysore	Dark brown clay soil, undulation topographic with open spaces	Banana, sweet potato, corn, groundnut are cultivated	Rainfall has been normal; Waterlogging was problem; MI system checks on flood; helps enhance water absorption; there is been good rainfall; Borewell is preferred for irrigation, surface water is allowed harvest groundwater; borewell never drains. Minimum of `1 and maximum of 4 borewell have been recorded.	Power has been issue; power-cuts has been concern; farmers extract farmer	Agriculture is primary and major source of income; decrease in labour requirement; as such no migration of labour	There has been considerable increase in the yield following to implementation of MI system; Farmer cultivate cardamom and Banana using MI system; Chemical fertilizer is used to the requirement as they tend to block the flow.	Follow-up from department is needed		Farmers were provided with demonstration and orientation program	Lack of information /awareness on MI system; no financial assistance; applications is beyond beneficiaries	Female labours take part in sowing and harvesting; they may be beneficiaries but don't take lead.

District	Land use pattern, topography, soil type and Crop intensity/diversity	Production and productivity	Water use efficiency	Energy:	Social Aspects: employment and social assets	Technological aspects	MI system and support services:	Environmental Aspects	Capacity building and Participation	Bottlenecks that limit use	Gender participation and adaptation rate
Shivamogga	Undulating surface area; Black soil	Paddy and Arecanut; Inter crop - arecanut-betel leaves-black pepper	Receives good rainfall, consists of canal, borewell and open well irrigation. Surface water is harvested by construction check dam adjacent to surface water flow; open well are 10-30 feet deep; arecanut mulching for moisture conservation; acacia A. auriculiformis mulching; up to 3-acre land holder will have 1 borewell and cultivators with 12-15 acre of land will have 5-6 borewell.		Agriculture has been primary and major source of income; MI system requires less labour; Though there is sufficient water, farmers shifted to Arecanut over paddy as Arecanut is requires less labour and commercially profitable comparatively	No power issues observed as such;	Agency people extend support post installation but nothing from department;	MI enhances verms as well;	No Training; Agency people extend support post installation but nothing from department;		Female labours take part in sowing and harvesting; they may be beneficiaries but don’t take lead.

District	Land use pattern, topography, soil type and Crop intensity/diversity	Production and productivity	Water use efficiency	Energy:	Social Aspects: employment and social assets	Technological aspects	MI system and support services:	Environmental Aspects	Capacity building and Participation	Bottlenecks that limit use	Gender participation and adaptation rate
Tumakuru	flat surface, sandy soil, black soil	Arecanut ; Banana	Rainfall has been normal; people shifted from Paddy to Arecanut due water issues	Irregular timing and power cuts has been concern	Agriculture and agriculture labour is main occupation; Tiptur farmers have improved	Very well used;	As such no support from department or agency; would consult know farmer and field assistance	Canal irrigation caused soil erosion; soil gets hard during canal irrigation if not water is poured regular opined by farmers; MI doesn't make soil hard	Farmers were provided with demonstration and orientation program	Farmers will go through agency as they get back to farmers once subsidy is to release	Female labours take part in sowing and harvesting; they may be beneficiaries but don't take lead.
Uttara kannada	Undulating surface area; Black soil	Paddy, sugarcane, corn,	Receives good rainfall; Open, borewell (40%), canal used to fill farm pond (30%)	3hrs 3phase; timing will variation shift; condenser; to	Agriculture and agriculture labour is main occupation		Follow-up from department is needed	MI enhances worms as well;	Farmers were provided with demonstration and orientation program		Female labours take part in sowing and harvesting;

Sources: Field study

FINDINGS OF THE EVALUATION STUDY

5.1 Process and Implementation of Micro Irrigation

The sequential process from the initiation of application till complete implementation with strategic linkages with critical analysis of the present pattern of various procedures and processes with the key institutions and actors are addressed with exclusive thoughtfulness are highlited as under.

1. Funds are allocated in the proportion of 50: 40 between centre and state for MI scheme under PMKSY-PDMC program. However, state extended his share through convergent of other scheme and provide up to 90% subsidy for 0.1- 2 ha
2. The selection of beneficiaries is done on the principle of "first come first serve" basis, categorized based social groups norms, scheme guidelines and on ground water exploitation status (Over exploitation-I, Critical/Semi critical-II and Safe zone-III).
3. Administrative and implementation processes observed in the study includes; approval and assessment of the crop water requirement and design, Preparation and review of cost estimate, issue work order. verification of quality components followed by training, a certificate towards successful installation/commissioning of system is obtained from the beneficiary
4. District Irrigation Plan (DIP) the irrigation details are observed to be very preliminary, being side-lined due to the necessity of structured guidelines.
5. DMIC's existence has to be improvised with review-able components like integration, relocation of potential zones, priority assessment, corrections, budget support, various partners' performance, guiding for transparency, and social and technical audits.
6. The convergence of credit support and efforts to of related governmental schemes for a complementary support to the MI scheme necessitates greater attention.
7. Prevalence of a weak bond between dealer, field assistant and farmer during and after the installation of MI.
8. The inadequacies and deviation of the PMKSY-PDMC GOI guidelines during the execution of MI especially with respect to planning (DIP & DAP), implementation (scheme convergence, post installation service, training) and technologies (designing, solar pump, quality inspection) to be addressed at various levels for effective promotion of the scheme.

5.2 Performance of PDMC-PMKSY Scheme

5.2.1 Physical performance of MI scheme

Micro irrigation area coverage between the years 2016- 17 to 2017-18 was remarkable both at national and state level, as this coverage represents 24 percent and 69 percent respectively increase. While marginally increase (only 10.0%) at national level however, it was reduced about 0.5 percent in Karnataka between 2017- 18 to 2018-19.

Micro irrigation system majorly classified in to two types namely drip and sprinkler in Karnataka. Out of this, drip irrigation area has covered 32.7 percent while sprinkler area covered 67.3percent. Both drip and sprinkler irrigation area coverage between the years 2016- 17 to 2017-18 was remarkable, as this coverage represents 44 and 82percent increase respectively, however marginally increase (only 14.2%) in drip and reduced about 6.4 percent in sprinkler between 2017- 18 to 2018-19.

The average maximum area, coverage under MI in Kalaburgi increased from 8217.7 ha to 23733.2 ha by 2018-19 which represents 65 percent increment as compared to 2016-17. A moderate growth was noticed in the Shivamogga, Ballari, Bidar, Chitradurga and Yadgir districts, with minimum area coverage in Dakshina Kannada District 358.4 ha to 476.0 ha by 3 years.

5.2.2 Financial performance of MI scheme

Public investment and area covered with micro irrigation has shown a consistent increase was observed with 19.3 percent increased between 2016-17 to 2018-19 at national level and 60 percent in state level.

An amount of Rs. 206724.8 Lakhs has been spent recording an average expenditure of 91.2 percent over the three-year (2016 to 19) period. The average annual growth of allocation of grants was 77.6 percent during 2017-18 and 14.2 percent during 2018-19, while the expenditure grew by 38.6 and 18.4 percent. The average utilization against the release of fund during three consecutive year (2016 to 2019) is about 96.4 percent. However, the utilisation against the allocation showed a consistent increase from 91.2 percent

5.2.3 District wise potential area and projected financial estimation for MI

Cumulatively a maximum 16336.2 ha. drip irrigated area coverage is noticed in Belagavi district followed by Vijayapura; (13863.92 ha), Kolar; (13303.1 ha), Davanagere; (12262.79 ha) and Tumakuru; (10905.94 ha). The lowest area coverage is observed in Kodagu; 200.44 ha, Dakshin Kannada; 458.91 ha and Udupi 644.67 ha. The conversion of area in to drip irrigation is mainly due to extensive cultivation of water intensive crop like sugarcane, Paddy, banana, vegetables mulberry, arecanut, cotton, Chilly, turmeric and ginger.

Among the different districts, the maximum area under sprinkler irrigation is seen in Kalaburgi (39263 ha), Mysuru (29850.69 ha), Belagavi (28479.45 ha) and Shivamogga (22954.26 ha) districts. While lowest area coverage was observed in Bengaluru urban (833.29 ha), Bengaluru rural (1267.9 ha) and Dakshin kannada (994.49 ha). The Maximum are coverage in sprinkler is mainly due to extensive cultivation of closely spaced agriculture crops like cereals, pulses, oil seeds.

At present the state possess net irrigated area is about 29.9 lakh ha with a cumulative total of area covered under MI (Sprinkler and Drip) between 2016-17 to 2018-19 is 6.70 lakh ha in the state with still 23.23 lakh area is under potential to expand micro irrigation system in the state. District wise distribution potential area for promoting MI irrigation is presented in Fig 4.10 The estimated potential area ranges from 1031.4 ha to 325001.7 ha in the state. The maximum potential area of MI system is in Belagavi (16.9%) Vijayapura (13.9%) and Bagalkot (12.0%). The estimated financial outlay for MI treatment for all the district of the state (as per current average cost Rs 20370/) works out Rs. 4733.5 cr for period of next five years.

5.3 Performance of MI Scheme (Micro analysis)

5.3.1 Beneficiary covered under sample survey

The overall coverage of beneficiaries under drip and sprinkler irrigation is 44.7 percent and 55.3 percent respectively. Maximum drip irrigation beneficiaries are noticed in Belagavi district (69.7%) followed by Chamarajanagar (63.5%) and Kolar (58.3%) and minimum numbers was in Shivamogga and Mysuru (27.7 % each). Likewise, under sprinkler irrigation maximum beneficiaries up to 72.3 percent was noticed equally in Mysuru and Shivamogga followed by Kalaburgi and Haveri (70.3% each) and a minimum of 30.3 percent in Belagavi district.

5.3.2 Area covered under sample survey to the achievements of MI system

The extent of area coverage under Drip and Sprinkler irrigation in the study districts are widely varied between the districts. Among the 10 districts the lowest to highest area coverage under MI is in the following order: Uttara Kannada, C. R. Nagar, Belagavi, Haveri, Shivamogga, Kolar, Tumakuru, Mysuru, Bidar and Kalaburgi. The MI sample area coverage in the state is about 1.0 percent, in which drip is 1.4 percent and 0.8 percent under sprinkler.

5.3.3 Demographic profile

Social groups

- In the overall sample, more than 50 percent of the beneficiaries were from the general category, 29.6 percent of the beneficiary from OBC category while 7.5 percent and 6.3 percent of the beneficiaries represented SC and ST categories. Similar trend was also noticed with non-beneficiaries which is 47.5 percent are general, 30 percent OBC, 17.5 percent SC and 5 percent ST respectively.

Gender pattern

- A scenario of dominance of male farmer beneficiaries (84.9%) compared to female beneficiaries which account to only 15.1 percent among MI beneficiaries, and similar trend (male 70% and female 30%) of dominance of ownership of land was noticed with non-beneficiary. On gender analysis it is observed that the male category of beneficiaries was maximum in Belagavi, followed by Haveri and Tumakuru and minimum of 75.5 percent male in Bidar.

Family size

- The average family size ranges from 2.8 to 3.3 family among beneficiaries and in non-beneficiaries it was 2.1 to 4.1. This phenomenon is almost a prevalent scenario in Karnataka as the average farming family size is about 4.6. Overall educational profile indicates nearly two thirds of the beneficiaries are exposed to education while one third is not educated among MI beneficiary. Education status among beneificies was found to be at an average of 76.3 percent. Highest (88.3%) portion of educated beneficiaries was found in Haveri followed by Tumakuru (82.6%) and Chamarajanagar (82.4%). However, exposed to education among non-beneficiary was only 63 percent.

Occupational profile

- The predominance of agriculture-based occupation (88.5%) found to be the lead adopters and of MI systems compare to other occupations and off farm occupation was only 11.5 Similarly, non-beneficiary also engaged primally with on farm (agriculture 87.8%) and 12.2 percent off farm activities

Livestock

- Among the distribution of animals, the proportion of milch animals are dominant over draught and small ruminants both among beneficiaries and non-beneficiaries. The average household livestock owned at beneficiary area is 25.3 drought, 71.0 milch and 3.6 small ruminants and non-beneficiaries 37.5 draught, 57.5 milch and 5 small ruminants.

Operational size of land holdings

- Among the four categories in the present study, it is noted that medium farmer category accounted for 67.8 percent, whereas 23.2 percent farmers are reported to be small, 6.5 percent are marginal and 2.4 percent under large farmer category.
- In the beneficiary category the extent of the average area covered was maximum with medium farmers (75.8%) followed by small farmers (12.7%), large farmers (9.4%) and marginal farmers (2.3%).

5.3.4 Awareness of MI system (Status)

- On an average 85.5 percent farmers aware about PMKSY PDMC-program among beneficiaries and 75.5 percent among non-beneficiaries.
- Awareness on PMKSY-PDMC among gender found lot of variation. The percentage of awareness varies from 85 percent to 15 percent among male and female. Further information access and knowledge about PMKSY-PDMC was noticed highest in medium size (66.7%) followed by small (24.3%) and marginal (6.5%) farming community and least was observed among large farmers (2.4%).
- Among social groups, general/other category beneficiaries have better knowledge and well aware about the scheme which account 57.2 percent followed by OBC category and least was noticed among with SC and ST community which accounts only 6 and 7 percent respectively.
- There is mixed trend among the beneficiary farmers regarding the major sources of information about the scheme

- Gram Panchayats, Fellow farmers, and newspaper are major sources of information about programme about 22.9 percent, 18.9percent, and 18.5percent. Govt officials are played major role in disseminating information on adoption of MI and increasing in income (16.0%). However, it is interesting to note that the suppliers/representatives of the manufacturers are the major sources of information awareness to the beneficiaries about subsidy/incentives (17.7% farmer benefitted). NGOs and financial institutions played important role in disseminating information about MI scheme and local governing office (Gram panchayat) play important role in disseminating information about overall advantage of scheme and its convergence with ongoing activity

5.3.5 Reasons for non-adoption of MI by non-beneficiaries

- Among various reasons for non-adoption of MI system is primarily due to lack of clarification of subsidy issues (12%) followed by lack of technical guidance and labour scarcity (9.7%) followed by inadequate power supply (8.7%) and quality material issues (8. %) and the cumbersome procedure of in MI sanction (6.3%)
- General willingness to adopt MI system was average 65 percent among the all the districts which is a clear indication of the merits of the technology and program which makes a dent in the adoption and extension of Micro irrigation system among non-beneficiaries in general

5.3.6 Progress of installation of MI system

- The percentage of drip irrigation installation gradually improved from 26.5 percent, 33 percent and 40 percent between 2016-17 to 2018-19. Similarly, year wise increment was 20 percent and 18.3 percent respectively between the years. In sprinkler irrigation the installation progress was 33 percent, 26 percent and 41 percent respectively with decline of 28 percent between 2016-17 to 2017-18 and escalated to 36 percent between 2018-19.
- Among Drip irrigation it is found that maximum installation was noticed in Belagavi (69.7 %) followed by Chamarajanagar (63.5%) and lowest was equally common in Mysuru and Shivamogga. (27.7%). With regard to Sprinkler irrigation maximum installation was observed commonly in Mysuru and Shivamogga (72.3%) each and lowest was in Belagavi 30.3 percent. The area surveyed in the study district was an extent of 6515.06 acres in which drip irrigation are covered is about 2792.3 acres (42.9%) and 3723.04 acres under Sprinkler irrigation (57.1%).

- The study substantiated the choice of crops suiting to micro irrigation system in specific agro climatic zones. The assessment study covered around 40 crops with the classification of 12 major crop categories. It is noted that cash crops (Sugarcane) in Belagavi, cereals (Paddy) in Uttara kannada and Shivamogga, fibre crops (Cotton) in Haveri, flower crops in Belagavi, fruit crops in Chamarajanagar and Tumakuru, millets in Kolar and Mysuru, mulberry in Kolar, oil seeds in Haveri, Plantation (Coconut and arecanut) crops in Shivamogga and Tumakuru, Pulses in Kalaburgi, Spices in Mysuru and Chamarajanagar, vegetables in Kolar and Tumakuru. The facts reveal that the technology leading to area coverage is also enabling the shifting towards horticulture crops and less for the field crops
- It is noteworthy observation that under the study that the participation of the farmer beneficiary was higher up to 71.7 percent across all district is being maximum in Shivamogga, Kolar and Tumakuru and least in Belagavi and Uttara Kannada. Similar trend of participation was also observed with respect to drip and sprinkler irrigation.

5.3.7 Investment and subsidy

- Awareness on the transparency issues in the beneficiaries it is noted that 45.8 percent of the beneficiaries are fully aware of the transaction in transparent manner. Contrastingly a maximum 49.9 percent of the beneficiaries were unaware and not clear about the transparency in the transaction and procedures which is alarming from the point of meeting the objectives of the scheme. Owing to cumbersome procedure starting from registration, application, inspection, installation and subsidy claims, only 54 percent have suggested to focus on the improvement in the implementation system.
- The average investment for drip installation cost is Rs.31161/-. and sprinkler irrigation cost Rs. 17421/- and the enhanced investment for drip irrigation is found to be 78.8 percent compared to sprinkler irrigation. In field observation it is noted that the MI investment is maximum (Rs 40832/acre) of drip irrigation in kolar and Rs 23298/acre for sprinkler at Belagavi. Whereas, in mulberry crop is higher than other crops agriculture and horticultural crops on average of Rs 82920/acre.
- Maximum subsidy availed by medium size farmer 47.5 percent followed by large (23.6%) farmers and minimum was observed among marginal farmers by 9.6 percent which is in line with the principles of scheme guideline.

Processing the subsidy claims

- Maximum (55%) beneficiaries have availed their subsidy between a time period of 6-12 months which a delayed duration total deviating the specified norms and thus it is demotivating factor.
- DBT system found to be functional with only 31.2 percent beneficiaries while 69.3 percent beneficiaries availed their subsidies through other non-considerate modes of disbursements including 59 percent of the subsidy disbursement channelized through MI agency.
- Convergence of PMKSY-PDMC with MGNREGA, NHM, Krishi Bhagya, Ganaga Kalyan, NFSM, and ISOPHOM, found very marginal (only 31%) to a financial gain of about Rs. 35,000 each Maximum scheme convergence of the scheme noticed with NFSM programme in Kalaburgi district (91.1%), Bidar (82.6%) and Kolar (77.6%), the other scheme enabled included NMH Ganga Kalyan and Krishi Bhagya scheme intermediately while ISOPHOM scheme as recoded less convergence under drip irrigation. Similar observation was made among sprinkler implementation but maximum convergence of NSFM was in Haveri, Kalaburgi and Uttara kannada sprinkler

5.3.8 Technical process of MI system

Functioning status of MI system

- Systems supported under the scheme are functional enough to the extent 86.3 percent both under drip and sprinkler. Maximum functioning of the MI installation is observed in Shivamogga and Uttara kannada (97.1%) followed by Tumakuru and Kalaburgi.
- The Non-functionality of the MI units is due to a maximum of 38.4 percent beneficiaries have sold the units to others and followed by the damaging of the units to the extent of 38.1 percent also reflects the farmers attitude towards the maintenance, followed by chocking of the system to the extent of 23.2 percent.
- This study reveals gradual increase in variance showed by R2 from 50, 59%, 96% and 59% meaning that the coefficients of the independent variables (training) is positive and significant influenced among medium farmers in improving functioning status than other category of farmers.
- The study indicated that MI as techno-economic tool invariably demands a most calculative application to match the suitability of the design (90.8%), Installation of

materials qualifying BIS specifications as satisfactory (84.9%), 63.7 percent found to have installed valves., 52.2 percent beneficiaries installed the ventury and 51.9 percent of the beneficiaries have installed pressure gauge and 60.1 percent of the farmers using emitters and 64.5 percent have installed the filter system.

- Awareness on the perspectives of availing material and system functioning warranty is quite low (43.2%) which need to be again initiated through orientation, training and frequent field inspection of agents and departmental authorities.
- In the present study it is observed that Maximum proportion of farmers have expressed the lifespan of 3-5 years (36.3%) followed by2-3 Years (32.8%). Among various district It is noted that the beneficiaries in Uttara Kannada (71.1%). have experienced have longer lifespan of the system compared to other district

5.3.9 Post installations services

- Failure to extent post installation services by MI agencies up to an extent of 78.7 percent is quite alarming and warranting on the part of the public sector to insist for a conditional host installation service support system. The role mode expert of 21.3 percent of the MI companies in providing the post installation services must be noted and streamed for a continuous adoptive mechanism in the operationalization of the scheme. Among the district under study Uttara kannada District suffered heavily without the maintenance support to an extent of 96.9 percent followed by Belagavi (88.3%).
- Most of the beneficiaries to the extent of 56.percent under sprinkler and 37 percent under drip irrigation have obtained the post installation services between 3-5 month followed by 41 percent within two months and 13.5 percent beneficiaries after six months
- It is noted that farmers have been experienced the Post installation services with in time span of 2-4 Months (45%) compared to 41 percent within two months. 13 percent after six months. In drip irrigation maximum beneficiaries have ailed the post installation services within 2 months whereas sprinkler irrigation maximum beneficiaries have availed the services within 3-5 months
- Departmental scheme coordination: The necessity of interdepartmental coordination and program convergence was brought out in an FGD in Bidar and case study analysis in Kalburgi districts.

5.3.10 Soil test

- A popular program like soil health testing has enabled a maximum number of farmers to test their soils to supplement benefit of micro-irrigation to the extent of 62.3 percent, while 37.7percent requires guidance to reap better Out come out of MI investment. Maximum numbers of beneficiaries undertaken the soil testing were represented from Chamarajanagar, Shivamogga, Mysuru, and Belagavi, owing to better awareness, motivation from implantation partners and ease of facilities.
- Among non-beneficiaries, various district farmers have shown a similar trend of soil tested report, which was adapted average 60percent. Farmers of Kolar district have undergone 100 percent of utilisation of soil test facility, followed by Bidar, Chamarajanagar, Mysuru, and Tumakuru equally with 75percent. Belagavi, Kalaburgi, Shivamogga, Uttara Kannada with 50percent each, and farmers belonging to Haveri district yet to undergo soil test.
- The adoption of Soil test recommendation (majorly soil amendment) by the beneficiaries and non-beneficiaries resulted quite marginal to the extent of 47.6percent are expressed fully adapted, around 41.1 percent beneficiary are partial adoption and 11.3 percent beneficiaries have not followed among beneficiaries. Among non-beneficiaries around 37.5 percent farmers have fully adapted soil testing recommendations and 54.2 percent farmers partially

5.3.11 Details of irrigation sources

- Borewell was the predominantly used as source of water by beneficiaries as well as non-beneficiaries in all the districts which accounts 94 and 97.5 percent followed by open well. Among various district under MI beneficiaries, C.R. Nagar, Mysuru and Shivamogga district beneficiary farmers completely relied on borewell water. Use of open well water source for irrigation was limited to only 5 percent and that to majority of them are belongs to Bidar district. Use of combination of borewell and farm pond is very common practices in Kolar, Tumakuru and Haveri district¸ among non-beneficiaries, only Belagavi and Bidar farmers used open well for irrigation whereas remaining districts were dependent on borewell as sole source.
- With respect to water depth, open well ranges from 10 to 100 ft and maximum open wells found in Bidar and Belagavi district which depth ranges between 25 to 50 ft. with respect borewells, more than 500 to 750 ft depth were most common with 48%

beneficiaries followed by 250 to 500 ft depth with 34 percent of beneficiaries. Similar trend was also observed with non-beneficiaries.

- Among various district, maximum (604.8 ft) deep borewells are observed in the Kolar district beneficiaries land, followed Shivamogga (547.7ft) and minimum depth of borewell (361 ft) noticed in Mysuru. Average water yield of borewell is 2.1 inch under beneficiary land and 2.0 inch in nonbeneficiaries. Study results show that on an average grass irrigated area per borewell is 9.5 acre in MI beneficiaries and 9.5 5.96 acre under nonbeneficiaries.

5.3.12 Dynamics of micro irrigation adoption rate

- Among farming community medium size farmers have adopted the MI system to the maximum up to 47.2 percent followed by small farmer 24.4 percent, marginal farmer 19.1 and large farmer 9.2 percent.
- The study revealed that training significantly influenced on their knowledge and interest towards technology which leads to increase in adoption of MI system among medium and small farmer as compared to other farming community.
- Greater interest in the MI adoptability to the extent of 42.5 percent, 26.8 percent, 16.5 percent and 14.2 percent respectively with General, OBC, ST and SC category.
- SC/ ST category benefits: As evidenced in the case study analysis, the adoption of MI system is supported as a ray of hope to a socially vulnerable farmer in the Haveri district with the cotton crop.
- It is noted that in the proportion of MI adoption with respect to gender, the ratio between the genders is almost 1/3rd. Male gender representation is recorded at 72.6 percent, and female gender representation is only 27.4 percent, with respect to their total area contribution to the MI system.
- One of the main reasons for adoption of MI system by beneficiaries is quite acceptable that MI is water saving technology and found on an average 14.6%.
- One of the prime reasons for adoption of MI system by beneficiaries is quite acceptable that MI is water saving technology and found on an average 14.6%.
- The other reflections gathered in-terms of delay in system installation (43.7 %), differences in quality material supply of MI components (43.1%), cumbersome procedures (42.4%), difficulty during inter-cultivation (41.5%), quality issues of MI

Components (34.8%), lack of guidance in utilizing and managing the system for effective use (34.1%), difficulty in maintaining proper pressure (31.3%), clogging of emitters and laterals (25.7%)

5.4 Impact Evaluation

Land use change

- Maximum increase in irrigated area through the adoption of MI was highest in Kolar (99%) followed by Mysuru (98%) and Kalaburgi compared to other district. The percentage MI area enhancement was least in Uttara kannada 13 percent. The irrigated area with in the 3690 sample beneficiaries of the 10 districts before adoption of MI was found to be 1594.49 acre which has increased to 6515.34 acre after adoption of MI system. Hence it could be inferred that the total percentage increase in irrigated area with the sample beneficiaries after adoption of MI system was noted to be 76.0 percent.
- Among districts, conversion MI from rainfed area was noticed in maximum (99%) in Kolar followed by Kalaburgi and Mysuru (98%) and moderate range of enhanced MI area was observed in Belagavi (63%) and Shivamogga (51%) and least in Uttara kannada (13%) as these areas are generally rainfall predominant districts. Likewise, the conversion of MI from flood irrigation practices in the survey district changed up to 24% of on an average, where in maximum conversion was observed in Uttara kannada (87%), moderate in Shivamogga (49%) and least was in Kolar (2%).
- Under drip irrigation, 77.7 percent rainfed area got converted in to drip irrigation, maximum in Haveri, Kalaburgi (100 % and 99.5%), moderate range in Shivamogga 70.8% and Kolar districts (100% and 95.5%) and least was in Uttara kannada (31.7%).
- 73.9% rainfed area is converted in the sprinkler irrigation, being maximum in Mysuru (99%), Kalaburgi (97.3%) and least was in Tumakuru (2%). With respect to conversion of flood irrigation to Sprinkler irrigation, maximum (98.0%) in Tumakuru and minimum in Mysuru (0.9%).
- With respect to crop diversification, it is found that the tendency of retention of the crop as per the approval was found to be of average up to the extend 61.5 percent and the changes in the crop were observed in 38.5 percent beneficiaries land.
- With respect to introduction of new crop it was seen that maximum new crop adoption up to 4.3 percent farmers in Belagavi farmers have introduced new crops with an expansion of up to 4.5 percent area followed by Kolar, Kalaburgi and Tumakuru district.

Introduction of new Crop

Crop type	Tube rose name of the crop
Fruits	Grapes, Jackfruit, Watermelon,
Vegetable	Beans, Cabbage, Cluster bean, Knolkhol, Ridge gourd
Flowers	Jasmin, Marigold, Rose flower, Tube rose
Spices	Ginger

- The average increase in cropping intensity by number of farmers was 34.0 percent. Being maximum (38%) was noticed under medium farmers followed by small farmer (28.1%) and minimum was with large farmers (22.7%). It is also found that the tendency of kharif farmers growing famers was found to be average of 36.1% (1063 to 1514) being maximum (42.9 %) among medium farmer and lowest of 23.1 (39 to 48 farmers). Our study reveals that the MI technology increased the net sown area by irrigating crop under season and there by helps in achieving higher cropping intensity.

Production enhancement

- Among various crops cotton, have recorded a greater positive impact with MI as seen in the percentage changes in production to the extent of improvement by 44.8 percent followed by sugarcane 44.4 percent and least 16.8 percentage change in production is noticed under Ragi in beneficiaries (before and after). Whereas in non-beneficiary the percentage change in production found highest in Banana followed by ground nut and least was observed in Ragi. The net and realistic change in yield between MI adopters and non-adopters is found maximum in Sugarcane followed by mulberry and beans. However, no change was observed underground nut soyabean, onion and green gram.
- Among beneficiary and non-beneficiary, beneficiaries were recorded for highest productivity in ground nut crops, to an extent of 78.6 percent in compare non-beneficiary, which is followed by green gram (64.3%) and least (5.9%) increase in productivity found with sunflower. With respect to district wise production enhancement Bidar district got highest productivity (72.4%) under sugarcane followed by C. R Nagar with same crop (sugarcane) which is about 63.6 percent productivity enhancement are seen as compared to before installation of micro irrigation
- With Installation of MI, percent of productivity horticulture crops viz turmeric crops was raised to 52.0 percent. In Kalburgi with maximum average productivity of the turmeric has increased by 69.0 percent followed by Banana 64.7% percent. While, in Shivamogga minimum (11.9%) increase in productivity was noticed under grapes.

- Mulberry found highest up to 40.0 percent as compared to conventional practices and 43.8 percent increment in productivity among MI adopters as compared to non-adopters. Maximum biomass of (59.1%) in Mysuru district followed by Uttara kannada district and C. R Nagar with minimum begin recorded with Haveri 24.6%
- Supply of optimum resources at beneficial level with MI technology, ensuring uniform distribution neither causing any defect nor overload supply on crop, has resulted greater productivity. This has also resulted in farmer expressing interest towards cultivation of cash crops and hence, increased income.
- Among farming category, adoption of micro irrigation was benefitted more with medium category farmers in agriculture and horticulture crops. While, marginal category farmers benefitted with sericulture crop as compared other category of farmers. In agriculture crop, a maximum (66.7%: 7.5 to 12.5 qt/acre) productivity was observed in medium category farmers with black gram followed by same category of farmer with ground nut crop that is 57.0 (8.6 to 13.5 qt/acre) percent as compared to before adoption of MI, under horticulture crops horticulture crops maximum crop productivity ranged from 66.2 percent (23.1 qt/acre to 38.4 qt/acre) with turmeric in medium category farmers and in mulberry maximum change in productivity of 50.0 percent (114 qt/acre to 171 qt/acre) was observed with marginal farmers.
- The average increase in cropping intensity by number of farmers was 34.0 percent. Being maximum (38%) was noticed under medium farmers followed by small farmer (28.1%) and minimum was with Large farmers (22.7%). It is also found that the tendency of kharif farmers growing was found to be average of 36.1% (1538 to 2093) being maximum (42.9 %: (1063 to 1514)) among medium farmer and lowest of 23.1 (39 to 48 farmers).
- The study revealed participation in training on MI technology really helps in enhancing the crop yield except Bengalgram and mulberry crop among small farmer, Tomato and Banana crop among medium farmer, Bengal gram and Banana among marginal farmers and Red gram, Paddy, Maize, Cotton, Chilly, Bengal gram, Areca nut among large farmer. not much directly influenced on productivity. The micro irrigation found more effective in enhancing the productivity among marginal, small and medium farmers than the large farmers
- A generalized observation as reflected in the FGD in several districts like Kolar, Chamarajanagar, and Bidar that due to the installation MI system the significant

stabilization and crop yield enhancement was observed with vegetables, flower crops, and mulberry. An evidential impact in the case study analysis, of an additional benefit of 20 percent yield enhancement leading to an increased profit up to Rs. 1.00 Lakh with lesser usage of 20 percent fertilizers and 50 percent of water in turmeric with farmers in Shivamogga. A similar trend with sugarcane, pigeon pea, and mulberry in Belagavi, and Kolar districts, respectively. Besides, MI system installation has supported the farmers as an investment saving technology and proved to be a shining irrigation practice for crop productivity enhancement. In a predominant rainfed district like Tumakuru, the sprinkler system enhanced the ragi crop yield by 32% with a saving of water and fertilizers (60%), labor (20%). Multiple crop yield enhancement with increased income (Rs.48,000) was noticed with mulberry in a case study analysis in the Haveri district.

Net water saving

- Net water saving was observed in the study ranging from 4.1 to 4.4-acre inches. Among different ground water zone, the net change in water saving was maximum (39%) in over exploitation zone followed by in semi critical/critical (33.1%) and safe zone (31%). However, water saving was observed with non-beneficiaries is from safe to over exploitation.
- In general beneficiaries, with the installation of MI, it was found that a maximum water saving was observed in paddy (72.0%) followed by sugarcane (62.0%), and least water saving was noticed in maize (10.0%) crop as compared to before installation of MI. Similar trend of observation was noticed among beneficiaries and non-beneficiaries. Maximum percentage of water saving noticed in Paddy (66.8%), followed by sugarcane and minimum of 18.2 percent water saving found with black gram. District-wise and crop-wise water saving is observed that the range of percent of water saving varies from 10 percent to 73.8 percent which is noticed with maize and paddy in Haveri.
- For horticulture, among beneficiaries and nonbeneficiaries, a maximum (50%) percent of water saving was noticed in beans crop and minimum (16%) water saving found in Mango under beneficiaries as compared to the nonbeneficiaries. Maximum (68%) water saving was noticed in Kolar with onion crop followed by arecanut (62.2%) in Shivamogga and minimum water saving (17%) was noticed in Kalaburgi.
- In mulberry maximum up to 42.6 percent savings as compared with conventional practices is recorded and among MI adopters as compared to non-adopters, only 4.9

percent increment in water saving. Spatially, mulberry recorded maximum (50% each) in Mysuru and Shivamogga district followed by Tumakuru and Uttara kannada district.

- Differential water saving has been observed with respect to different crops among various group of farmers under agriculture, horticulture and sericulture due to the adoption of Micro irrigation. In agriculture crops, a maximum water saving up to 77.9 percent (59.5 to13.5 acre inch) was observed under paddy with small farmers and minimum of 8.3 percent (1.2 to 1.1 acre inches) water saving was observed in maize with large farmer category. With respect to horticulture crops maximum 72 percent (25 to 7 acre inches) water saving was observed with arecanut in medium farmers and minimum of 17.0 percent (4.1 to 3.4 acre inches) in onion with small farmers. In mulberry maximum change in productivity of 57.05 percent (15.6 to 6.7 acre inches) with medium farmers 20.91 percent (11 to 8.7 percent) with marginal farmers
- Reduction in water consumption allows farmer with a scope for expansion of agricultural activities, both in terms of increasing the farming area and taking up farming in all seasons with diverse crops. This would enable continued cultivation practice with lesser burden on resources while ensuring sustained food security, income and financial stability
- Water Sharing: In an FGD analysis in Kalburgi and Belagavi districts, sharing of water to needy farmers during water scarcity periods was adopted as a gesture and social concern to neighboring farmers, which was due to the water-saving realized by the MI adopted farmers.

Fertiliser saving

- The average change of fertiliser usage was 23.3 percent, maximum being in Belagavi with 30.5 percent followed by Mysuru 29.5 percent and least in Uttara Kannada 17.6 percent. The percent change analysis of the parameter is indicated an average percentage change of 16.8 percent with a range between 13.4 percent to 22.2 percent of fertiliser use among beneficiary and non-beneficiary
- The percent fertilizer saving after installation of MI was observed maximum for jowar (33.3%) crop and 32.4 percent for beans crop while black gram and ragi recorded minimum (11.1% each). Among beneficiaries and non-beneficiaries maximum percent fertilizer saving was noticed in cotton (53 percent) and followed by Bengal gram (44%) and minimum saving of 24 percent was recorded for maize.

- Installation of drip irrigation system resulted in maximum savings of 32.4 percent for beans crop, followed by Banana (31.3%) and least being 15.9 percent for arecanut.
- Among beneficiaries and nonbeneficiaries, a maximum of 63.3 percent of fertilizer saving was recorded under tomato cultivation and a minimum of 21.9 percent for the onion crop with beneficiaries.
- Similarly, maximum (52%) fertilizer saving under tomato cultivation at Belagavi and followed by 50.0 percent in beans at Tumakuru and a minimum of 5 percent for Arecanut at Shivamogga. Mulberry cultivation has recorded savings of 11.1 percent and among beneficiaries and non-beneficiaries, the maximum reduction of 33.3 percent in fertilizer, consumption. Regionally, among sampled districts, 36.8 percent of the reduction in fertilizer consumption was recorded at Tumakuru and minimum of 4.5 percent at Belagavi.
- With respect to different crops among various group of farmers a maximum (57.1%: 14 to 6 qt/acre) fertiliser saving was observed under medium category farmers with Jowar as compared to before adoption of MI, while it was minimum (4.5%: 5.5 to 5.25 qt/acre) with groundnut with large farmers. Among horticulture crops maximum fertiliser saving 42.8 percent (14 to 8 qt/acre) with banana under medium category farmers and minimum of 13.3 percent (3 to 2.6 qt/acre) reduction in fertiliser usage with onion under large category of farmers. In mulberry maximum fertiliser (only FYM) saving of 22.2 percent (9 qt/acre to 7 qt/acre) was observed with marginal farmers and minimum of 4.5 percent (11 to 10.5 qt/acre) with large category farmers
- Reduction in fertilizer can help in reduction of soil contamination and environment pollution further facilitating organic farming and hence sustaining natural fertility.
- Reduction in fertilizer would mean reduction in input cost and savings on beneficiary pocket.

Labour saving

- The percent labour saving with the installation of MI among various crops recorded a net overall saving of 23 percent before and after installation of MI whereas, between beneficiaries and non-beneficiaries it is 4.0 percent. Labour savings on account of irrigation, weeding, fertilizer application and field other operations are evidently noticed in the evaluation study. Use of human labour decreased significantly and ranged from 21 percent to 17 percent with the beneficiary after installation of MI as compared before.

Among beneficiaries and non-beneficiaries change in labour saving ranged from 4 percent to 40 percent.

- Maximum 36 percent labour saving was noticed under tomato crops and least 12 percent was in grapes with in beneficiaries (before and after). Whereas, under non-beneficiary it was noticed under beans (40%) and minimum labour saving was found in green gram -12 percent. The actual change in labour saving was observed with Banana 9%), followed by Grapes 8 and Red Gram 4% with no change in Bengal gram and Black gram.
- After installation of the MI system, 26 percent reduction in paddy has been recorded followed by Bengal gram and soybean with 25 percent savings each and ragi with a minimum 13 percent of labour reduction. Beneficiaries and non-beneficiaries maximum labour saving of 38 percent each in tomato Bengal gram and was observed with minimum 12 percent in green gram.
- Labour savings following to the implementation of MI practice was observed maximum in Soyabean (38.8 %) cultivation at CR Nagar, followed by Sunflower (38.5 %) in Kalburgi and minimum in green gram (5.6 %) at C. R Nagar
- maximum 36.4 percent labour saving was noticed under tomato crops followed by arecanut (35 percent) and onion (33 percent) and least was in grapes (12 percent) with in beneficiaries (before and after). Whereas under beneficiaries and non-beneficiaries maximum labour saving (40 percent) was noticed in beans, followed by 38 percent each in tomato and areacnut. The minimum labour of 21percent in Banana.
- Installation of drip irrigation helped maximum (57.8%) labour saving under tomato in Mysuru district followed 47.2 percent in turmeric in Shivamogga by and minimum (7.5 %) labour saving under banana at C. R. Nagar.
- In mulberry crop the range of labour saving from 17% with the installation of MI (before and after) and the percent labour saving up to 23% between beneficiaries and non-beneficiaries was recorded. Mysore, notice that a highest labour savings in mulberry cultivation with 23.6 percent followed by Tumakuru and Kolar. While in Belagavi district is noticed for a minimum labour savings of 3.6 percent.
- With respect to farmers category, under agriculture crops, a maximum (57.1%: 14 to 6 qt/acre) labour saving was observed under medium category farmers with Bengal gram while it was minimum (6.6%: 30 to 28 No/acre/year) with Jowar with large farmers.

Under horticulture crops maximum 47.1 percent (53 to 28 No/acre/year) labour saving was with tomato under medium category farmers followed by same category of farmer with chilly crops that is 44.2 percent (52 to 29 No./acre/year) and minimum of 7.5 percent (40 to 37 No/acre/year) reduction in labour usage with banana under large category of farmers. In mulberry, labour saving of 30.9 percent (55 to 38 No/acre/annual) was observed with marginal farmers and minimum of 5.7 percent (42 to39.6 No./acre/year) with small category farmers.

- Decrease in labour decreases lability on the farmer not just in terms of minimizing the workforce but also with decreased monitoring stress. This can lead to reduction in input cost, encouraging farmer to invest on something financially forthcoming.

Energy saving

- Beneficiaries who have installed MI have indicated the adequacy of power supply up to 33.6 percent, whereas with non-beneficiaries it was 57.5 percent.
- Among 10187 borewells assessed it observed that a maximum of 48.4 percent beneficiaries has installed 5.5 to 10 hp followed by 1-5 hp and higher capacity over 15 hp were hardly very less 6.9 percent of beneficiaries. Among Various district 71.4 percent of beneficiaries belongs to Shivamogga district installed with 5.5-10 hp pump sets followed by Tumakuru District 57.1 percent. In Bidar district 84.4 percent of beneficiaries have installed with 1-5 hp pump capacity.
- The energy savings with the installation of MI was significantly high ranging from 24 percent to 28 percent with an average saving of 26 percent before and after installation of MI within beneficiaries. Whereas among beneficiaries and non-beneficiary energy consumption range of 7.0 percent to 10.2 percent. The maximum percent of saving in energy consumption was observed in Bidar 10.2 percent followed by Kalaburgi (9.3%) and minimum energy saving was expressed by Tumakuru farmers which is accounted only -7.0 percent.
- The crop wise percent change in (before and after MI installation) energy consumption was observed maximum in sugarcane (35.3%) and least change was observed in black gram (11.1%) among beneficiaries. Among beneficiaries and non-beneficiary maximum energy savings was noticed in soyabean and sugarcane (36.4% each) cultivation and minimum of 17.5 percent in maize cultivation. With respect crop wise and district wise energy saving, maximum energy savings of 53.1 percent under soyabean cultivation is

Tumakuru and followed by 50 percent under ragi cultivation and lowest of 4.8 percent for paddy cultivation at Shivamogga district.

- For horticulture, installation of drip resulted maximum (33.3% each) energy saving under arecanut and coconut followed by 28.0 percent in chilly and minimum (18.2%) energy savings. Similar trend was seen among adopter and non-adopters, highest energy savings with coconut (40.3%) followed by arecanut (36.4%) and minimum (24.2%) energy saving found in Tomato under beneficiaries as compared to the non-beneficiaries.
- Survey results describes that average maximum (71.7%) energy saving was noticed in Shivamogga under sugarcane cultivation followed by Chilly (58.7%) in Kolar and minimum energy saving (5.9%) was noticed in Belagavi under Grapes cultivation.
- Energy savings for mulberry was found up to be 27.3 percent as compared to conventional practices. Within beneficiaries (before and after MI adoption) and 29.3 percent increment in energy saving among MI adopters as compared to non-adopters. Highest was recorded at kolar (44.9%) followed by Uttara kannada (39.5%) with minimum energy savings of 12.8 percent achieved at C. R Nagar district as compared to before installation of MI.
- Among various farmer category, under agriculture crops, a maximum (49%: 98 to 50 Kw/h/acre) energy saving was observed under medium category farmers with sugarcane crop as compared to before adoption of MI, while it was minimum (8.6%: 52 to 47.5 Kw/h/acre) with maize with small farmers. Under horticulture crop, maximum energy saving ranged from 44.7 percent (55.2 to 30.5 Kw/h/acre) with coconut under medium category and minimum of 12.0 percent (58 to 51 Kw/h/acre) reduction in energy usage with tomato under large category of farmers. In mulberry labour saving of 28.4 percent (15 to 8 Kw/h/acre) was observed with medium farmers and minimum of 18.1 percent (15.4 to 12.6 Kw/h/acre) with small category farmers
- Energy reduction undoubtly has direct benefit on maintenance cost of electrical equipment viz. motor pumps and auxiliaries given reduction in its use, further minimized load on supply can avail supplier with option of increasing the duration of supply or on other side farmers can exploit scope of enhancing the larger area for cultivation. Energy, given its share sourced from thermal powers plants factors reduction in emission contributing for mitigation of climate change and hence favouring sustainable development collectively

Employment generation

- Changes in the man days or labour utilisation before and after MI intervention at pre harvest and post-harvest stages were studied. study results revels that during pre-harvest stage on an average increased man day was 10.8 percent being maximum in Kalaburgi (16.9%), followed by Tumakuru (14.8 %) and least was in Chamarajanagar (5.5%). Likewise, with respect to post-harvest activities the average precent increased of man days was 26.3% in the study area, maximum (36.1%) being in Haveri and followed by Tumakaur and Belagavi (31.3% and 31.1% respectively) and least in Mysuru (15.4%).

Increase in farmers income

- In all the surveyed districts reported that by adoption of MI showed increased in gross income/acre which ranging from 17.8 (Rs 61847/acre to Rs 72833/acre) to 42.8 percent (Rs 83245/acre to Rs 118942/acre) with an average increase of 30 percent under beneficiaries as compared to before adoption of MI. The maximum gross increase in farm income has been reported in Belagavi followed by Bidar and minimum increase in gross income/acre by 17.8% in Mysuru. Similar trend of increasing in farm level income per acre found among beneficiaries as compared to nonbeneficiaries. The enhancement of gross income among beneficiaries as compared to non-beneficiaries ranges 10.9% to 46.6% with an average increase of 26.1%. The maximum increase in gross income has been reported in Bidar 46.6% (Rs 84000/acre to Rs 118942/acre) followed by Belagavi (Rs 49600/acre to Rs 72692/acre). Likewise, off farm gross income ranged from Rs 11198 to Rs 30942 and maximum off farm income found Haveri and Minimum in Bidar.
- Adoption of MI is quite prominently noticed in increasing of farm income of various famers category. By adoption of MI showed average increase in gross income/acre, ranging from 6.1% to 39.7 percent (Rs 71245 to RS 115838/ acre) as compared to before adoption of MI. The average maximum gross increase in farm income has been reported among medium famers (Rs 82945 to 115838/acre) followed by small (Rs 50708 to Rs 6641/ acre) and marginal farmers however least was noticed in large farming (Rs 67146 to Rs 71245/acre).
- The participation in training on MI technology really helps in enhancing the net household income among small, medium and marginal farmers however not much directly influenced on net income of large farmer.

Social and Environmental benefits of MI system installation

- Infrastructure improvement (47%) was observed to be a most significant social impact followed by livestock (20%), household articles (19%) and education support as general phenomena by adaptation of MI. with respect to different type of system. Beneficiaries have expressed an overall maximum social gain over 45 percent in drip irrigation and to 50 percent in Sprinkler irrigation in-terms of their social security, especially infrastructure, education, livestock and household articles.

Labour migration

- MI has reduced labour migration to the extent of 69.4 percent, in drip irrigation and 67.9 percent in sprinkler irrigation, respectively, is a noteworthy Outcome of the scheme. Maximum reduction in labour migration was observed in Shivamogga (99 percent) and Uttara kannada (96.3%) followed by Mysuru and Tumakuru with the installation of drip system. With respect to sprinkler irrigation Shivamogga (98.2 percent) and Kolar (96.7%) followed by Mysuru, Tumakuru and Belagavi.

Labour drudgery

- The average reduced labour drudgery with MI was 57.9 percent with respect to drip adoption it was 64.5 percent and 52.5 percent by sprinkler adoption, respectively. Maximum reduction in labour drudgery was noticed in Kalburgi and Belagavi districts, owing to the dependence of higher population on agricultural labour.

Water scarcity and irrigation

- It is heartening to note the beneficiaries have expressed installation of MI system as a practice to overcome water scarcity in the crop production activities to maximum extent of 75.4 percent. Among various district Mysuru and C. R Nagar farmers expressed maximum (94.3% each) installation of MI helped in supplementation water during scarcity period and minimum was with Bidar (45.9%).

Soil quality

- In this study it is noted that the 72.1 percent farmers have experienced the incremental population of earth worms with MI owing to the softening of the soil due to a well-maintained level of moisture in the soil and around the growing basin of the plant. Response of 100 percent and 95.9 percent improvement was noticed in Shivamogga by drip and sprinkler irrigation.

- It is observed that moderate and uniform water supply through MI system supported the growth of the root and the shoot of the plant as experienced by 77.5 percent of beneficiaries where no soil cracking was observed which is quite an encouraging note. Among various system, adoption of drip system showed maximum (97.8%) reduction in soil cracking experience. However, farmers owned sprinkler system expressed soil cracking reduced only 61percent.

5.5 Trainings and Capacity Building

- The survey highlighted that a majority around 87.4 percent of beneficiaries across all districts not had training program, thus highlighting the need for interventions to strengthen the training and capacity building component of the program.
- As business traders the MI agencies have taken maximum initiative to the extent of 41 percent which is a dominant approach. Followed by the involvement of governmental staff to an extent 25 percent, RSK with 17 per cent share, SAUs/KVKs with 12 percent share and NGOs/CBOs with 5 percent share ought to have been doubled in the conduct of training program.
- The dominant mode of training was through demonstrations (71 %) and the balance 29 per cent was through class rooms. A blended mode of class-room and field demonstrations found to be the useful training approaches.
- In terms of duration of program, the one-day training program was most popular with 79 percent of beneficiaries and the rest 29 percent attended training programs that ranged 1-3 days. With regards to frequency of training only one time training, maximum farmers expressed it was organised only one time. With regard to the timing of the training program, 69 percent reported that the training program was scheduled at an inconvenient time and around 31 percent found the timing to be convenient.
- The survey also captured feedback on the various topics that were covered in the training program. A majority of beneficiaries across all locations (72%) reported that the training program covered the principal topic on irrigation. In terms satisfied they were with these training materials, 36 percent reported them to be good, 55 percent reported it to be satisfactory and 9 percent reported that they were poor. The training organizers have shared the technical literature with illustrations with the form of leaflets and brochures (50% each)
- Around 62 percent of the beneficiaries who attended the training program reported that the programs were useful and 38 percent felt that the programs could be further improved. Similar trends were seen across most of the districts. The district of Chamarajanagar reported the highest positive response where 80 percent reported it to

be good and district of Uttar Kannada reported the highest response in terms of needing improvement (51%).

- In terms of gaining knowledge and skill enhancement, 33 per cent of respondents rated the training program to be very good, 47 per cent rated it to be good and 20 per cent rated it as medium/average.
- Since the program is a more technically oriented one, any improvement in the wisdom and skill matters the sustainable Out come from the program and investment. More than 82 percent of the farmer beneficiaries have expressed willingness to attend the training program.
- Farmers Training: During FGD in Mysuru and Uttar Kannada districts the farmers reported the necessity of technical narration of the impact of the MI system than mere exposure to field demonstration.

5.6 Focus Group Discussion and Case Studies

Focus group discussion

- MI a uniform water distribution technology has supported crop production and area expansion dimensions in both flat and uniform terrains. Irrespective of soil types and texture, the MI practices are found to be an adaptive one in all parts study area [Hunsaghatta, Tumakuru and Mudapali, Uttara Kannada]
- A common voice of adoption of MI system enabling the farmers in stabilising their crops and yield was observed in most of the districts of study. Simultaneously, the financial improvements are received as MI scheme compensated the initial investment Maddur, Chamarajanagar and Hulidevanhalli, Kolar]
- Prevalent of seasonal drought in districts like Tumakuru and Kolar during 2018-2019, and with unsettled rainfall pattern decreasing up to 30-40% of the total rainfall in North Karnataka region, the MI system sustained as a boon for crop production. [Morkandi Bidar and Hulidevanhalli, Kolar]
- Borewell has been the major source of irrigation across the state and the number of bore-wells would vary with land size. Cultivators with up to 2-3 acres would own one bore-well while in land holding of 10-12 acres up to six bore-wells. [karadaggi, Haveri and B Matagere Mysuru]
- In general, during summer season and in dry regions crops face shortage of water and farmers would like to avoid cultivation of crops which yield on lesser water. In case

scarcity of water, farmers would request and trade the water from the neighbouring land holder in return of sharing some produce, out of gratitude. [Tengli, Kalaburgi and Adahalli, Belagavi]

- It has been a conscious suggestion by famers for joint inspection by field implementing officials of Revenue, Irrigation and Electricity Departments towards confirming the water source, water output, power supply before launching the program for efficient utilisation of Government subsidy. [Morkandi, Bidar]
- irregular time of power-supply has forced farmers to accommodate unconventional irrigation timings and this has also led to the use of condenser for power extraction as an illegally compromised plan. [Maddur, Chamarajanagar and Hunsaghatta, Tumkur]
- Farmers reported to have not provided with any organised training apart from providing one onsite demo at few places of study area. Lack of training has been the major bottle neck. [Matagere, Mysuru and Mudapali, UttaraKannada].

Case studies

- The case studies revealed that the presence of fragmented or consolidated land holdings could also influence the adoption of drip irrigation through the benefits that can accrue from the same. Farmers with consolidated landholdings realised it is easier for them to relay pipes and cover the whole farm with lesser drip equipment.
- On the whole it is found that the case studies showed a wide variation in adoption level and benefits. Also, some complications in terms of lack of awareness, accessibility favouritism lack of post installation services delay in subsidy release Etc was observed. The subsidy process was also found to vary and different perception prevailed about the clarity and ease of availing subsidy amongst the farmers.
- Another interesting observation is that in certain district, some farmers have responded that they were able to sell or share water with other farmers in need of irrigation water due to the adoption of drip irrigation.

RECOMMENDATIONS

6.1 Short term

1. To trace the entire process from application to installation with clarity among the implementing stakeholders and transparency of transactions till subsidy transfer, applications like geo-tagging and referencing for real-time monitoring, IT enabled initiatives are to intensified.
2. A proper regulatory mechanism such as proper field verification of ownership, water sufficiency, electricity connection to avoid duplication of scheme benefits.
3. A streamlined means and plans to be formulated through the development of appropriate guidelines for year-round adoption (12 months) and utilization of MI to suit all the cropping season including peak demand months and timings for efficiencies and effective operating process.
4. Post-installation services of micro-irrigation system and training to the adopter farmers must be critically monitored to ensure maximum benefit from MIS and to instil confidence among farmers through regional training cum services centres.
5. Innovative low-cost systems having a longer lifespan, with a calendar of irrigation to be developed as a practicing tool.
6. Direct Benefit Transfer (DBT) model to be rationalized (instead of Direct Beneficiary Transfer) to enhance efficiency and transparency.
7. Mandating the MI system for heavy water-consuming crops like sugarcane, Banana, and vegetables with special subsidy incentives. Groundwater recharging through aquifer mapping, aquifer recharging and rainwater harvesting needs to be pursued vigorously in most parts of the country
8. Developing regulatory measures to enforce the unapproved firms/dealers to avoid sub-standard components.
9. It is understood from the field study that the officials who are involved in promoting micro-irrigation technology under the GoI Scheme have inadequate knowledge about the technical and related details of MI. Therefore, the state government extension staffs need to undergo ‘Refresher Courses and exposure visits’ to have basics of micro-irrigation thereby enabling their role in the implementation of the scheme.
10. MI system manufacturers should be involved intensively in promoting micro-irrigation through demonstrations at farmers’ fields and strategic locations and provide

advisories on agronomic packages so as to encourage the adoption of micro-irrigation at a large scale.

11. Suitably designing the subsidy schemes in itself can shape adoption with Innovative technologies originating from end-users to transform the context of micro-irrigation.
12. A conditional relaxation of the land ceiling to 10 ha in a faced and seniority method for availing subsidy can be taken as measure to expand coverage under micro irrigation
13. There is need to widen the ratio of drip to sprinkler as drip is the more efficient system. Presently, the system is designed for one crop. But it is encouraging to see that many farmers use the system for the subsequent crops during the same year. Many times, the due differential crop geometry the system may not be as effective as it should be for the subsequent crop. Hence it is suggested that the design may be made for a sustainable cropping sequence instead of only one crop. This will improve the cost benefit ratio, earlier investment recovery, and maximum system utilization
14. In order to encourage adoption of micro irrigation and its promotion among the poor and marginal farmers, a special scheme could be introduced that links the bank loan facility for digging wells with electricity connection for pump sets.
15. Analytically based and proposed institutional and governance frame work model for greater and holistic efficiency for Karnataka state has been designed for implementation of micro irrigation scheme for ensuring efficient fund flow, autonomy, organisation structure at field level, improvised administration and processing at supervisory level, transparency and quality of post installation services.
16. Intensive technical orientation on technical feasibility of design quality and cost of equipment and skills of maintenance are to be provided as mandatory beneficiary requirement

6.2 Medium term

1. The system suppliers should make acid available to the growers as part of their after-sales service obligation. Therefore, studies need to be carried out to device efficient eco-friendly de-clogging measures so that farmers do not suffer from such problems.
2. Dovetailing other schemes for adoption of solar energy along with MI to enhance the socio-economic benefits.

3. Promotional plans and Investments of the surface irrigation to be revisited to promote micro irrigation technologies in a faced way to enhance wider adoption of micro irrigation technology.
4. The inclusion of insurance to be mandated that it can be a useful tool to absorb some adoption risks for the farmers to some extent.
5. Institutionalisation of Third-party concurrent monitoring and evaluation (Outsources)
6. The implementing agencies should be more vigilant regarding warranty and after-sales service of the system provided by the suppliers. It is proposed that 10 percent of the subsidy may be released after one year subject to satisfactory performance of the system as certified by the beneficiary. Maintenance manual in vernacular language should be made available to the beneficiaries at the time of installation of the system.
7. There is a need to establish a Central Testing Facility (CTF) to deal comprehensively with the design, development, and testing of all types of equipment, devices, machines used in micro irrigation systems using state-of art technology. The Government to consider conducting regular and random technical audits (2-3 %) of the system within the first and second year of the installation to keep check on the supply good quality of the systemg.
8. A streamlined effort to bridge the gap that farmers lacked knowledge about how the process unfolded at higher levels, i.e., at the levels of the block, district administration, and above.
9. Using the low-cost micro irrigation technology as tool to reduce vulnerability there is need for radical shift a political will on the part of government to deal BIS certificated high quality system and technologies
10. Efforts may be made to reduce gap between system adoption and production enhancement through appropriate technology training and fertigation besides reducing the unit cost by adopting agronomical practices like paired crop row system. To achieve the optimum benefit out of the investments made by both the government and the farmers, well planned intensive as well as extensive technological trainings are recommended for different stakeholder
11. Micro irrigation currently suffers from many shortcomings such as costly after sales service. The government should promote private innovative business entrepreneurship model to take up the challenge of evolving the solutions for these challenges rather than control the business so tightly.

6.3 Long term

1. Formulation of a revised State Irrigation Act (Aquifer and recharge status) for achieving water use efficiency and to address SDG 6 objective.
2. There is a need to formulate and opt or implement State Water Policy in consonance with irrigation schemes and the National Water Policy. Systematic policy focus and administrative initiatives such as revision of the State Irrigation policy are imperative for achieving water use efficiency in the irrigation sector. Policies focusing on an integrated approach involving all stakeholders are necessary for the wider adoption of micro irrigation technologies
3. Need for the establishment of a dedicated institutional setup team (Exclusive man power at state, district and Taluk level) for effective planning, implementation, monitoring and achieving the impact in a coordinated manner for synergy and to overcome the coordination and integration issues in line with the being successfully prove models to accelerate the subsidy process.
4. Awarding an industry infrastructure status to micro-irrigation sector for larger benefits of the multiple stakeholders.
5. On the principle of Public Private Partnership mode water harvesting and utilisation plan on a comprehensive and block bases need to be developed with farming communities.
6. Integrated watershed development, CSR, and Krishi Bhagya with Per Drop More Crop and income programs (Skill India mission; MI Technical training), are critical in transforming rained agriculture and also in facilitating adoption of diversified livelihood options among smallholder, marginal holders and rural youth.

CASE STUDIES

Report

1.1.1 HIGHLIGHTS OF CASE STUDY

CASE **STUDY 1**

AGRICULTURE TRANSITION WITH WATER SAVING

Village: Malagali
Taluk: Savadali
District: Belgaum;
MI System: Sprinkler Irrigation
Crop: Maize

Farmer Mahadevappa owns an agricultural land of 2.2 acres and practices maize farming through flood irrigation system with support of a bore-well. He has a family of 10 members and makes an earning of Rs. 80, 000 per annum from agricultural and allied activities towards taking care of them.

Being a farmer who visits agriculture concerned government departments and agencies, got introduced to MI systems, associated financial support and farming benefits. Being worried of huge water consumption due to current flood irrigation practice,

Mr. Mahadevappa decided to set up a portable sprinkler irrigation system at his farmland. With subsidy of upto 90% from GoK, portable sprinkler of Rs. 22,000 was installed with Bureau of Indian Standards quality material installed in his farm. Mr. Mahadevappa cultivated maize with lesser inputs of fertilizer, manpower to yield an additional produce of **15 quintal of maize** in comparison to conventional flood irrigation practice benefiting him more than **Rs. 25,000 and plus**.

Apart from cultivating the maize, Mr. Mahadevappa has also started cultivation of cash crops viz sugarcane and cotton with MI technique. This is a very promising sign for the MI system with farmers, just not for production and profits yields associated with it and also for its potential to save on both natural and chemical resources inputs.

4

CASE **STUDY 2**

NOVEL IRRIGATION SYSTEM IN PADDY

Village: Shanvalli
Taluk: Mundagoda
District: Uttarakannada
MI Technique: Drip Irrigation system
Crop: Paddy

Mr. Bhat belongs to Bharmin community living in Shanavalli Mundagoda Taluk of Uttara Kannada District with family size 9 people. He owns irrigated and rain-fed farming land of 3.25 acres land and makes an earning of Rs. 1,20,000 per annum out of agriculture and allied activities.

He owns a borewell which was dug 750 feet deep in the year 2001 and yielding 2-2.5 inches of water flow throughout the year. Borewell also costs an annual maintenance of Rs.50,000/-. Having heard about MI system and subsidies available, from neighbourhood farmers, panchayat office, through electronic media and in view of achieving the greater yield minimizing the expenses on bore-well maintenance and chemical fertilizer consumption, further Mr. Bhat got in-line drip irrigation system installed and commissioned through an agency to the total available farm land for cultivation of Paddy.

As expected, Mr. Bhat with help of Drip Irrigation in 3.25 acres of land cultivated 50 quintal of paddy with decrease in fertilizer and pesticide inputs and further savings of upto 40% in water consumption, labour and equipment requirement, while achieving an incremental profit of upto 25% in compare to conventional mode of flood irrigation.

50	**40%**	**25%**
Quantal Produce	**Water Savings**	**Incremental profit**

CASE **STUDY 3**

RAY OF HOPE TO SOCIALLY VULNERABLE FARMER

Village: Madapura
Taluk: Savanur
District: Haveri;
MI Technique: Sprinkler Irrigation system
Crop: Cotton

A Scheduled Tribe family of 4 living in a Madapura village of savanur Taluk in Haveri district is led by a farmer Mr. Pakirappa Thalavar. He used to cultivate groundnut, maize, cucumber and cluster beans in his agricultural land of 3.21 acres with a borewell yielding 2-2.5 inches of water flow and made an annual income of Rs. 1.2 lakhs.

Mr. Pakirappa came to know about MI system of cultivation practice during his regular interaction with neighborhood farmers and further extracted information on government supported provisions, benefits, consulting government officials and referring to government announcements on the same.

With the help of the government subsidy of upto 85%, Mr. Pakirappa set up an Portable sprinkler at 2.47 acres of land primarily to cultivate cotton investing lesser resources viz. fertilizers, pesticides and labor and saving upto **15% of the total expenses** with an incremental profit of **Rs.10,000** and plus.

15% lesser investment

₹10,000 additional profit

CASE **STUDY 4**

INPUT INVESTMENT SAVING TECHNOLOGY

Village: Angadi
Taluk: Sirsi
District: Sirsi
MI Technique: Drip Irrigation system
Crop: Arecanut

Mr. Puttaswamy is a farmer, who is solely dependent on agricultural and allied activities for making his living. He lives in a village Angadi situated in sirsi taluk, with a family of 4, making an earning of Rs. 1,80,000 per annum.

Mr. Puttaswamy owns 3.2 acres of land and cultivates arecanut. He has got a borewell drilled and it pumps an average of 2 inches water throughout the year. After he got to learn about the MI system from his neighborhood farmers, MI agencies and Banks, he installed an on-line drip irrigation system at his farm to continue with the cultivation of Arecanut.

The new irrigation system helped Mr. Puttaswamy reduce his investment on agri-consumables, primarily the saving around **70% on water consumption, 25% on fertilizer and 40% of labour** requirement and **witnessed 3 quintal increase** in the yield benefiting him an additional **perks of Rs. 15,000/- per annum**.

Mr. Puttaswamy believes that further knowledge on efficient use of the MI system can help other farmers and himself yield better gain in farming while saving on resources inputs.

₹15,000
additional income

70%
lesser water

25%
lesser fertilizer

40%
lesser labour

3
qunital additional yield

CASE STUDY 5

INTELLIGENCE IRRIGATION MATTERS THE SUCCESS

Village: Jokina katti
Taluk: Savanur
District: Haveri
MI Technique: Drip Irrigation system
Crop: Mango

Mr. Haithana Gowda is a farmer with a family of 5 members. He practices farming and self-employed business to meet his monetary requirements. With agriculture and related activities he earns around Rs. 75,000 per annum.

Mr. Gowda, owns 3 acres and practices both rain-fed and flood irrigation. During non-rainy seasons he uses bore-well which yield 1.5 inches of low to cultivate his regular crop - cotton.

With help of government subsidy scheme he installed on-line Drip Irrigation system in 0.8 acre of land and started cultivating intercrop viz. Mango and Coconut. Thus, he is now **cultivating 3 crops in land**.

With a partial shift to the MI system for mango and coconut, **he has reduced 50%** fertilizers consumption and work-force requirement and added **20% incremental monetary** benefits per annum. Mr. Gowda also has plans to extend MI technique in land to take advantage of its merits.

3
multiple crop cultivation

50%
lesser fertilizer

20%
incremental profit

CASE **STUDY 6**

MICRO-IRRIGATION IS SHINING IRRIGATION PRACTICE FOR CROP PRODUCTIVITY IMPROVEMENT

Village: Hoshalli
Taluk: Bhadravathi
District: Shimoga
MI Technique: Drip Irrigation system
Crop: Turmeric

Mr. Shekarappa, a middle aged man with preliminary education, lives in Hosahalli of Bhadravathi taluk with 2 more members in the family. He makes an earning of Rs. 1,45,000 per annum from agriculture and related activities.

In total he owns 7 acres of land of which 2 acres is rain-fed and 5 acres are flood- irrigated. He was dependent on rains for cultivation of turmeric. Following the consultation with neighborhood farmers, government officials and MI system suppliers, he installed an in-line drip irrigation system at his farm for cultivation of turmeric.

Drip Irrigation system helped him in reducing the consumption of fertilizer and pesticides by **20%, water by 50% and enhanced yield upto 20% making profit of more than 1 lakh per annum**.

20%
lesser fertilizer and pesticide

50%
lesser water

20%
greater yield

₹1,00,000
additional profit

CASE **STUDY 7**

MI OPPORTUNITIZESES CROP TRANSITION

Village: Kadabi
Taluk: Savadathi
District: Belgavi
MI system: Drip Irrigation
Crop: Sugarcane

Mr. Santosh raiyappa is a graduate from backward community living in kadabi village with his 5 other family members. His practices flood irrigation farming in 5 acres with support of a bore-well yielding an average flow of 2 inches towards making an earning of Rs. 3 lakh plus.

Having studied graduation, Mr Santosh accessed various sources to gain knowledge on MI system alongside interacting with farmers and consulting agriculture department and panchayat officials. With the help of government financial support, he installed on-line drip irrigation setup for his 5 acre of land to cultivate sugarcane.

During the practice of Drip Irrigation Mr. Santosh reduced **50% of chemical fertilizer consumption, 25% of manure and saved on 50% of water for cultivation of sugarcane and further made an incremental profit of 25% in comparison to income gained during the previous harvest.**

Consequently, Mr. Santosh has plans to cultivate maize and mulberry with help of drip irrigation.

50%
lesser
fertilizer

25%
lesser
manure

50%
lesser
water

25%
incremental
profit

CASE **STUDY 8**

GENDER EMPOWERMENT WITH MI

Village: Modahalli
Taluk: Kollegala
District: Chamarajanagar
MI system: Drip Irrigation
Crop: Beans

A secondary school passed women farmer, Ms. Jayamma is leading a family of 5 members in Modahalli village with earning of Rs. 1.2 lacs, made from farming and labor work.

She owns 4 acres of land with a borewell yielding 3 inches of water throughout the year to cultivate beans.

With of help of neighborhood farmers, reading through the departmental handouts and in consultation with government officials she learnt of about MI system and realted provisions from government. At the outset she got both on-line and in-line drip irrigation system installed in her 0.6 acres of the total land.

Having shifted from flood irrigation to drip irrigation Ms. Jayamma made greater reduction in inputs, saving **60% of water, followed by 40% reduction in chemical fertilizer and 20% lesser labor** while doubling the production and monetary benefits. The outcomes have encouraged Ms. Jayamma to extend drip irrigation to total land area for the cultivation of beans.

60% lesser water

40% lesser chemical

20% lesser labor

CASE STUDY 9

WELL PREPARED MI LED TO A GOOD END

Village: Tangali
Taluk: Chittapura
Disrtict: Kalburgi
MI system: Drip Irrigation
Crop: Banana

Shri Shankara practices farming with knowledge inherited by his ancestor and neighborhood community to take cares of the family of 5 members in Tangali village of Chittapura taluk.

He owns agricultural land of 6 acres in which he used to cultivate wheat, bengal gram and chickpea employing flood irrigation with the support of a borewell which yields 2 inches of water flow throughout the year.

MI system was brought to his knowledge by neighborhood farmers and subsequently, he could access information on same in print and electronic media. Further, he also consulted government officials for details and got a bore-well drilled before having MI installed at his 2 acres of land.

He started with horticulture crop viz. Banana, for the first time following to the installation on-line drip irrigation. He took up banana farming in big way with 2000 saplings and ensured adequate fertilization, disinfection, employing enough labour to produce a yield of 20 tons. Thus, in a 2 acre of land which was limited to monetary benefits of few thousands has now leaded him to make profit in lakhs.

Further he has started cultivating pigeon pea towards making similar benefit of installed MI system.

20 tons yield

Monetory profits in lakhs

CASE **STUDY 10**

REAPING MULTIPLE BENEFITS WITH MI

Village: Nandihalli
Taluk: Savanuru
Disrtict: Haveri
MI system: Drip Irrigation
Crop: Mulberry

Shri Hiremath is a backward community farmer cum self-employed business man living with family of 6 members in Nandihalli village in Savanur taluk of Haveri.

He used to cultivate maize in his land of 3 acres with support of bore-well yielding 2 inches of water towards making earning of Rs. 24,000 per harvest.

In consultation with neighbourhood farmers and government officials, he learnt about MI systems of irrigation practices and financial support lend by under PMKSY- PDMC and then, decided to have on-line drip irrigation system installed at earlier flood irrigated 0.8 acres of land.

Following to installation of MI system, he shifted to cultivation of mulberry plantation for the first time and made needed initial investment on fertilizers, disinfectant, infrastructure and labour to realize a stabilize income extending in the future. Shri Hiremath reported around **Rs. 48,000/- income generated out of selling around 95 kg. cocoon produce,** that was fed with mulberry leaves cultivated through drip irrigation practices in comparison to monetary benefits out of previous cultivation and now he also has plans to extend drip irrigation practice to one more new **crop -cotton in 1 acre of his land**.

₹48,000
increased income

2
Multiple crop production

CASE STUDY 11

MI PROMOTED CROP DIVERSIFICATION

Village: Bugathahalli
Taluk: Mysore
Disrtict: Mysore
MI system: Drip Irrigation
Crop: Coconut

Mr.Mallesh is an illiterate farmer with no formal education. He lives in Bugathahalli in Mysore with a family of 9 members and works in his farm land of 1.25 acres to make a living. He used to practice flood irrigation with the support of bore-well yielding 2 inches, for the cultivation of sugarcane and ragi.

He learnt about MI system, related farming techniques and possible profits from his neighborhood farmers and consulted government officials to understand funding provisions made by the government in regard.

Having witnessed benefits availed by his neighborhood farmers, he applied for MI system subsidy and got it installed at his 1.25 acres of land for cultivation of coconut. He used to cultivate ragi earlier through flood irrigation method, now with drip irrigation and modest investment he planted coconut saplings.

During cultivation, he could reduce water requirement by **around 60% and labour requirement by 70% in comparison previous cultivation**. After years of nurturing the saplings with lower investment Mr. Mallesh have started earning **2 times the income made** out of ragi cultivation.

Low investment and low maintenance has tempted Mr. Mallesh to lookout for cultivation of cash crops i.e. sugarcane with installed MI system and he aspires to do so in the near future.

60% lesser water	**70%** lesser labour	**2** times the income

CASE **STUDY 12**

MI ADVANCEMENT ENHANCED FINANCIAL GAINS

Village: Mallahalli
Taluk: Mysore
District: Mysore
MI system: Sprinkler Irrigation
Crop: Ragi

A scheduled tribe family of 5 members are dependent on agriculture and labour work for their survival, is led Mr. Manchappa, who lives in Mallahalli of Mysore. He owns an acre of land and has installed a bore-well which can yield 2 inches of water throughout the year for cultivation of horse-gram.

Mr. Manchappa, after knowing about MI system from neighborhood farmers he further explored about its cultivation practices, monetary benefits and funding options with government officials. and installed rain-gun sprinkler to cultivate ragi.

With all knowledge and confidence gained, he ventured with little excess investment on fertilizer and disinfectant to produce a crop with **40% greater yield and more than 25% incremental** earning to his annual income **of 2 lakhs**. It is important to note that Mr. Manchappa cultivated ragi which is staple food of the region and thus it would also reduce monetary burden on his family livelihood.

40% greater yield

Enhance household Income upto **₹2 lakhs**

CASE STUDY 13

MI SURGES INPUTS SAVINGS AND ENHANCES ECONOMIC OUTPUT

Village: Biddargadikaval
Taluk: Tiptur
Disrtict: Tumkur
MI system: Sprinkler Irrigation
Crop: Ragi

Rangappa is a scheduled caste farmer lives in Biddargadikaval of Tiptur Taluk with his family of 7 members. He has secondary education and is completely dependent on agriculture for his earning.

He has been cultivating green gram and ragi in his 2.4 acres of land, through flood irrigation with support of a bore well which yields an average of 2 inches of water to make a modest income of lakh and plus per annum.

He happened to know about MI system through print and electronic media further, he enquired with MI agency workers to learn about investment, methods and benefits that can be availed. He also consulted banks to know about loan/subsidy provisions. Having learnt about the MI system, he decided to install Mini Sprinkler Irrigation system in his entire land area to continue the cultivation ragi.

With flood- irrigation practice, Rangapppa used to harvest upto 20 qunital of ragi. Following to installation of Sprinkler system, he has reduced chemical fertilizer and water requirement by **50-60%**. Further could manage the work **with 20% lesser labour** to yield **22 quintal of ragi towards making a 32% of incremental income** in compare to previous season.

Upto 60% lesser fertilizer

Upto 60% lesser water

20% lesser labour

32% incremental profit

CASE **STUDY 14**

MANAGEMENT CONCERN TOWARDS MI EXPANSION

Village: Araluguppe
Taluk: Tiptur
Disrtict: Tumkur
MI system: Drip Irrigation
Crop: Coconut

Mr. Narashimamurthy, a backward community farmer lives in Aralugupee village of Tiptur taluk along with a family of 3 members practicing agriculture, animal husbandry and agricultural labour work, for livelihood.

He owns 3 acres of land of which 1.16 acres was rain-fed and 1.84 acres flood irrigated. He used to cultivate green gram and ragi to yield 3 and 10 quintal of produce respectively. He was making an income of Rs. 1.25 lakhs out of his agriculture and related activities.

Mr. Narashimamurthy has received higher secondary education and updates himself with new methods and systems of agriculture practice by watching and reading, electronic and print media. Realizing familiarity of MI system among the farmers, he consulted his neighborhood farmers to understand yield generation, associated benefits and concerns.

Having gained clarity on MI systems, he confidently adopted it, by installing on-line Drip Irrigation System at his 1.17 acres of land for cultivating coconut saplings. He further made all necessary investment on supplying reduced fertilizer, disinfectants and labor to in anticipation of a stable harvest of coconuts. Just in few years after plantation he was been able to witness marginal increase in the yield towards making an incremental profit every year with decrease in the resources investment. He has made huge savings of **up-to 60%** of water every year since installation of Drip Irrigation system. This stable yield and profit has motivated Mr. Narashimamurthy to extend the implementation of Drip Irrigation further to new crops in other part of the land. But wild rodents and birds viz. squirrels and peacocks also trying take share from the benefits of MI systems breaking line to fulfill their water thirst. Mr. Narashimamurthy would be very happy for a solution in the regard so as to continue MI system.

60%
of lesser water

Multiple crop cultivation

CASE STUDY 15

ROBUST INSTALLATION MECHANISM AUGMENTS CROP YIELD

Village: Dinnehalli
Taluk: Malur
Disrtict: Kolar
MI system: Drip Irrigation
Crop: Tomato

Mr. AK kempaiah is an illiterate scheduled caste farmer living in Dinnelhalli of Malur taluk with family of 16 members practicing agriculture for his livelihood.

He owns 3.2 acres of rain-fed land and cultivates ragi and sells milk from his milching cows to make an annual income of around Rs. 1.5 lakhs.

Being an active farmer he has been in regular interaction with his neighborhood farmers, would check on newspaper and other sources for agriculture related information. After learning about MI system, cultivation practice and associated benefits, Mr. AK Kempaiah got a bore-well installed which yield him just a bare minimum flow of 1 inches during the summer season and further he applied for in-line drip irrigation system and had it installed at his 2.2 acres of land to cultivate tomato replacing ragi. During the cultivation of tomato he witnessed greater reduction in water requirement to an extent of **60% and 40-50% reduction in chemical fertilizer, disinfectant and doubled monetary benefit of 100%**, out of new crop support by new irrigation system. Thus it clearly demonstrates that MI system facilitates lesser resource inputs to yield an increased produce for a consistent incremental income.

60% lesser water

2 times household income

40%-50% lesser fertilizer

CASE **STUDY 16**

COORDINATION OF DEPARTMENTAL PARTNERS PROMOTES - PROGRAM SUCCESS

Village: Gundagurlae
Taluk: Chittapura
Disrtict: Kalburgi
MI system: Sprinkler Irrigation
Crop: Pigeon Pea

Family of five is led by an illiterate farmer Mr. Prakash living in Gundagurlae village of Chittapura Taluk. He practices agriculture and agricultural labor for livelihood.

Mr. Prakash owns 5 acres of rain-fed land and cultivated pigeon pea and maize along with selling milk from milching cow to make an earning an annual income of Rs. 80,000. He is well informed agriculturalist who own agriculture equipment for his own agriculture related work and also rents out to make an additional income of Rs. 1.25 lakhs.

He used to cultivate maize to produce a yield of around 20 quintal towards making an income of Rs. 45,000 per crop. However he gained interest in MI system following its familiarity among neighborhood farmers and regular info feed on the same from government officials through handouts and other print medium. He visited neighborhood farmers land to under the MI system of cultivation practice, learnt about financial provisions by the government and further got bore-well installed while applying request at agriculture department for installation MI system. Mr. Prakash got portable sprinkler installed at his farm to be supported by bore-well water supply of 2 inches and started cultivation of Togari.

During cultivation, Mr. Prakash reported considerable reduction of **upto 40-50% fertilizer** and disinfectant inputs and marginal savings on labour expenses apart from saving more **than 30% of water requirement.**

Mr. Prakash almost doubled his income by cultivation of Togari adopting Sprinkler Irrigation system alongside making a substantial savings on inputs.

40%-50%
lesser
fertilizer

30%
lesser
water

CASE **STUDY 17**

RATIONALIZED SYSTEM APPROACH – ENHANCED THE PRODUCE OUTPUT

Village: Antharagange
Taluk: Bhadravathi
Disrtict: Shimoga
MI system: Sprinkler Irrigation
Crop: Pigeon Pea

Farmer Raju practices agriculture at his 1 acre of farm land to earn a livelihood for a family of 5 people living in Antharagange of Bhadravathi Taluk. He is also draws income from his milching cows to support the family.

Mr. Raju has a bore-well which yield 2 inches of water throughout the year to support cultivation of black eyed beans. He has been practicing flood irrigation to yield a produce of 4 quintal Arecanut from one acre of his land.

He witnessed his neighborhood farmers practicing Micro Irrigation system of cultivation and consequently consulted agencies, NGOs in this regard to acquire further more inputs on MI system cultivation methods, government provisions, benefits among others.

In view of reducing the recurring maintenance cost on bore-well due to regular extraction of water, Mr. Raju decided to adopt Sprinkler Irrigation method of farming for Pigeon pea cultivation. Mr. Raju initiated cultivation by providing slightly i.e. **20% reduced inputs of fertilizer and disinfectant** as per his regular farming practice only to realize that it was still an additional quantity and can further reduce the same in the coming season. However, he could observe savings of upto **60% of water consumption**. Mr. Raju cultivated incremental produce of **50% of yield** towards making an **additional income of 50%**.

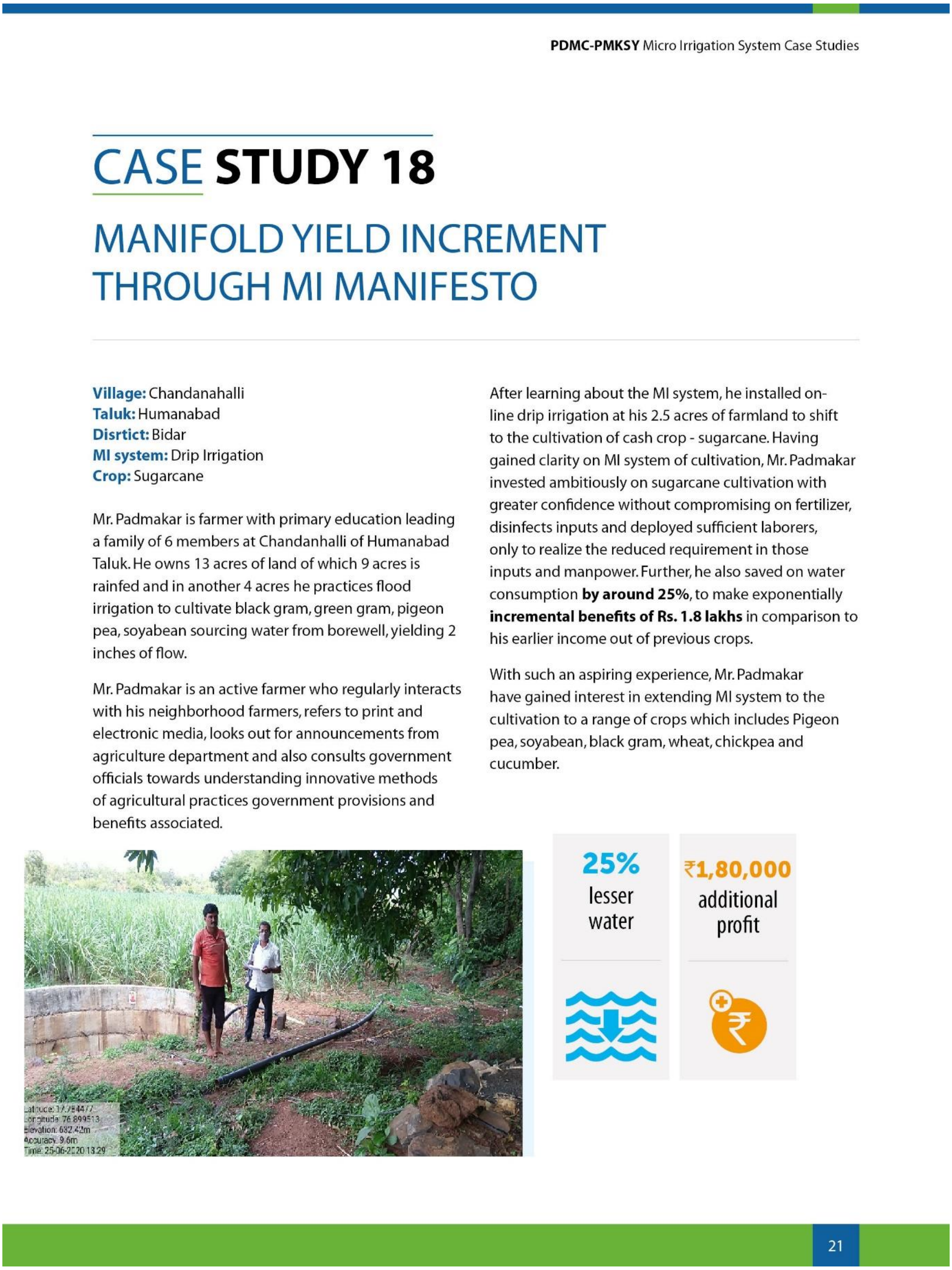
Having explored MI method of cultivation to understand savings he can achieve in-terms of reducing inputs and enhanced benefits, Mr. Raju aspires to make consistent benefits in the future.

20%
lesser
fertilizer

60%
lesser
water

50%
enhance
yield

50%
additional
profit



CASE **STUDY 18**

MANIFOLD YIELD INCREMENT THROUGH MI MANIFESTO

Village: Chandanahalli
Taluk: Humanabad
Disrtict: Bidar
MI system: Drip Irrigation
Crop: Sugarcane

Mr. Padmakar is farmer with primary education leading a family of 6 members at Chandanhalli of Humanabad Taluk. He owns 13 acres of land of which 9 acres is rainfed and in another 4 acres he practices flood irrigation to cultivate black gram, green gram, pigeon pea, soyabean sourcing water from borewell, yielding 2 inches of flow.

Mr. Padmakar is an active farmer who regularly interacts with his neighborhood farmers, refers to print and electronic media, looks out for announcements from agriculture department and also consults government officials towards understanding innovative methods of agricultural practices government provisions and benefits associated.

After learning about the MI system, he installed on-line drip irrigation at his 2.5 acres of farmland to shift to the cultivation of cash crop - sugarcane. Having gained clarity on MI system of cultivation, Mr. Padmakar invested ambitiously on sugarcane cultivation with greater confidence without compromising on fertilizer, disinfects inputs and deployed sufficient laborers, only to realize the reduced requirement in those inputs and manpower. Further, he also saved on water consumption **by around 25%**, to make exponentially **incremental benefits of Rs. 1.8 lakhs** in comparison to his earlier income out of previous crops.

With such an aspiring experience, Mr. Padmakar have gained interest in extending MI system to the cultivation to a range of crops which includes Pigeon pea, soyabean, black gram, wheat, chickpea and cucumber.

25%
lesser water

₹1,80,000
additional profit

CASE **STUDY 19**

MI FOR MAXIMIZING RESOURCE EFFICIENCY

Village: Hunnur
Taluk: Yelandur
Disrtict: Chamarajanagar
MI system: Drip Irrigation
Crop: Banana

Mr. Srinivas is a scheduled caste farmer with primary education living in Hunnur of Yelandur taluk along with a family of 4 members. Mr. Srinivas practiced flood irrigation to cultivate paddy with the help of a borewell yielding minimum of 1.5 inches of water flow during summer season.

Mr. Srinivas is a very active person, who regularly interacts with farmers, visits agencies and look-out of agriculture related info from varied other sources. He was inducted on MI system, its method of cultivation and benefits by his fellow farmers. Further in consultation with agencies he gained inputs on the implementation cost and available financial provisions. The information on benefits that MI system can result in and also about the government schemes (PMKSY-PDMC) made available in this relation, encouraged Mr. Srinivas to apply for the subsidy and obtain Drip Irrigation system installed at his farm for cultivation of banana replacing paddy.

He reported his concerns on recurring maintenance cost on borewell due to flood irrigation and labour intense work during cultivation of Paddy.

Following to installation of both on-line and in-line drip irrigation, during the cultivation of Banana he realized reduction in chemical fertilizer and disinfectant inputs and fetched greater saving on water to an **extent of 70-80%** with an incremental yield of fast consuming and demanding crop of Banana. Mr. Srinivas has been **able achieve 2.5 time incremental income per season** apart from reduction in inputs by following Drip Irrigation method.

Upto 80% lesser water

Greater than **2.5** times income

CASE **STUDY 20**

MI FOR MAXIMIZING RESOURCE EFFICIENCY

Village: Chachadi
Taluk: Chachadi
Disrtict: Belgavi
MI system: Drip Irrigation
Crop: Groundnut

An illiterate, scheduled caste famer Mr. Somappa, is living with family of 4 in Chachadi of Belgavi district. He is totally involved in agriculture and related work to make living for his family. He owns 2.2 acres of land in which he used to cultivate maize and groundnut with the support of an open well pumping an average of 2 inches of water to make an earning of Rs. 1 lakh per annum.

Government officials informed Mr. Somappa about MI systems, yield benefits and PMKSY-PDMC scheme provisions. As informed by the government officials, Mr.Somappa got portable sprinkler installed at his 2.2 acres of land to start cultivation groundnut at the outset.

During the cultivation under MI systems, Mr. Somappa saved on inputs with 30% reduction chemical fertilizers, 25% reduction in insecticide and pesticide, 50% reduction in water consumption towards yielding same produce as in previous season. Having realized the potential to save on the inputs, Mr. Somappa, have further extended the MI system of cultivation to maize and have realized 50% greater savings on overall inputs in comparison to previous cultivation. He reported to include pigeon cultivation in the coming season through MI system.

30% lesser fertilizer

25% lesser insectide and pesticide

50% lesser water

GLIMPS OF PMKSY-PDMC STUDY

Plate: 1 Stakeholder interaction during field visit

Plate: 2 Stakeholder interaction during field visit

Plate: 3 Training organised for enumerator to collect household survey data

Plate: 4 Water sources and MI systems with filtration unit

Plate: 5 Adoption of Sprinkler irrigation for major agriculture crops by beneficiaries

Plate: 6 Adoption of Sprinkler irrigation for major agriculture crops by beneficiaries

Plate: 7 Adoption of Drip irrigation for major horticulture crops by beneficiaries

Plate: 8 Adoption of Drip irrigation for major horticulture crops by beneficiaries

Plate: 9 Adoption of Drip irrigation for major horticulture crops by beneficiaries

Plate: 10 Adoption of Drip irrigation for Sericulture crops by beneficiaries

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Annexure-1: Farmer Beneficiary Interview Questionnaire

IMPACT EVALUATION STUDY OF PER DROP MORE CROP (PDMC) COMPONENT OF PMKSY

(2016-17 to 2018-19)

KARNATAKA

Farmer Beneficiary Interview Questionnaire (Treatment)

TERI, 2020

Part-A

Identification No.(code): ……………………. Date of interview: ______________________

Name of Village:____________________ Name of Taluk: ________________________

Name of GP: _______________________ District: ______________________________

Survey No:………………………………. Mobile No:……………………………….

Latitude:…………………………….Longitude…………………………..Altitude:……………..

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1. **Name of the respondent** : ____

2. **Gender of respondent** (✓)

i. Male	ii. Female

3. **Age of respondent** (✓)

i. 18-30	ii. 31-45	iii. 46-60	iv. Above 60

4. **Education of respondent** (✓)

i. Illiterate	ii. Primary	ii. SSLC	iv. PUC	v. Graduate and above	vi. Others

5. **Social Group** (✓)

i. SC	ii. ST	iii. OBC	iv. General/Others
TOR -2			

6. **Family size (Number)** (✓)

Gender	Early childhood (0-6 years)	Childhood (6-12 years)	Early Adult (13-18 years)	Adulthood (19-40 years)	Late adulthood (40-60 years)	Old age (Above 60 years)
Male						
Female						

7. **Main Occupation** (✓)

i. Agriculture	ii. Agri labour	iii. Business	iv. Employed	v. Any other,

8. **Secondary Occupation** (✓)

vi. Agriculture	vii. Agri labour	viii. Business	ix. Employed	x. Any other,

9. Land holding details (Acres)

Type of land	**Owned**		**Lease d-in**	**Leased-out**	**Total Operational land**	**Area under micro irrigation out of the total operational**	**Reasons for keeping Land as fallow**
	Cultivated	**Fallow**					
Rainfed							
Irrigated							
Area under micro							
Fallow land							
Total							

10. Cropping pattern

Season	Crops	Area (acres)	Irrigation					Quantity of Fertilizer used (Qt)	Quantity of Insecticide used (Kg/lt)	Quantity of Weedicide used (Kg/lt)	Total Predilution cost / total expenditure (Rs)	Total Production (Qt)Production (Qt)	net Income (Rs)
			Water sources: sprinkler/drip/ flood	No. of Borewells /open wells used for irrigation	Number of hours taken to irrigate the entire land once (hr)	No of days water given	Number of irrigations for the whole crop						
Irrigated													
1.Kharif													
2.Rabi													
3.Summer													
Rainfed													
1.Kharif				NA	NA	NA	NA	NA					
				NA	NA	NA	NA	NA					
				NA	NA	NA	NA	NA					
2.Rabi				NA	NA	NA	NA	NA					
				NA	NA	NA	NA	NA					
				NA	NA	NA	NA	NA					
3.Summer				NA	NA	NA	NA	NA					
				NA	NA	NA	NA	NA					
				NA	NA	NA	NA	NA					
				NA	NA	NA	NA	NA					
Annuals/ Perennials													
Mulberry													

11. Irrigation sources

Water sources information	**Open well**				**Bore**								**Farm pond-**	**Farm pond-**	**Canal**
	1	**2**	**3**	**4**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**			
Year of Drilling /digging/ construction															NA
No. of working wells/bore wells (√)															
Year of failure															
Year of deepening if any															
Current total depth (feet)															
Pump HP															
Pump Stage (Number)															
Average water Yield of functioning of borewells (GPH/inch)															
Kharif															
Rabi															
Summer															
Total Cost (well: Drilling, casing electrical expenses) (Rs)															
Annual repair and maintenance cost (Rs)															

12. Livestock Information

Sl.. No	**Particulars**	**No.**	**Year of Purchase**	**Cost (Rs)**	**Milk yield from milch animals lt/day**	**Income from sale of milk / hire charges received from draught animals / income from poultry/sheep meet (Rs)**
1.	Drought animals (Ox)				NA	
2	Milch animals					
	Desi-Cow					
	Buffaloes					
	Cross-bred cow					
3.	Calves and Heifers (Below 1 year)				NA	
4.	Sheep and goat					
5.	Poultry				NA	

13. Farm Machinery, Implements and buildings

Sl.No.	**Name of Machinery**	**No.**	**Year of purchase**	**Value in (Rs.)**	**Annual income from hiring-out machinery (Rs.)**
1.	Tractor (…….hp)				
2.	Power tiller (……hp)				
3.	Tractor accessories				
4.	Sprayer:				
5.	Implements • Bullock cart • Hand sprayer • Country plough Other small implements				

14. Other details

Sl No	Particulars	Opinion
1	Have you availed soil testing facilities?	Yes ; No:
2	Have you followed recommended doses of fertilizers? (√)	Fully; Partially; Not followed.
3	Member of organisations/groups Yes/No. If Yes, Name of the organisation: No. of Family Members:	
4	Annual Income (Rs) 1. Agricultural allied activities: 2. Non agriculture activities	

Micro Irrigation system details

1. Are you aware of PMKSY?
   Yes ………………No. ……………………

2. Information Source of MI System? (√)

Sl No	Particulars	Aware ness	Subsidy provision	New method of cultivation	High income	Over all advantage
1	Another farmer					
2	Radio/ TV					
3	Newspaper/ pamphlet					
4	Govt officials					
5	Drip agencies / MI agency					
6	NGO					
7	Banks/financial institutions					
8	GPs					
9	Any other s					

3. Which component you are benefitted under PDMC Scheme? (only 2016 to 2019)

MI system	Type of	Select (✓)	Year of Installation	Area irrigated (Project Benefitted only)	Sanctioned for crop (Name of the crop)	Additional Crops growing (List)	What was earlier this land (Rain or irrig)
Drip	On-line						
	In-line						
	Both inline & online						
Sprinkler	Portable						
	Micro						
	Mini						
	Semi-permanent						
	Rain gun						

4. Functioning status:

Mi System	Functioning (✓)	Non-functioning (✓)	If non-functioning when year it is stopped (Year)	If non-Functional give reason: (✓)
Drip irrigation				Damaged Theft No water (Dried up water sources) in the wells Sold-out Blocked/ chocked up Any other reason
Sprinkler				

5. Who got the MIS Installed in your land? (√)

Department	Through MI company/agency	Self

6. Name of the MI company material used: ---------------------

7. Reasons for buying particular MI company material? (√)

Own decision	Advice from Local Govt. officials	Advice from Local MI agency	Advice from Other farmers	Cost Factors	Quality and services

8. Reasons for Adoption of MI system: (√)

Code	**Reasons**	(√)	**Code**	**Reasons**	(√)
1	Due to Subsidy support		8	Due to failure of borewell	
2	Decline in water availability		9	Proper utilization of Land	
3	Labour Scarcity		10	Time Saving in Irrigation	
4	High cost Fertilizer		11	For Early Planting	
5	Off- Season production		12	To cover Additional area	
6	Production enhancement /Yield		13	For Early Fruiting	
7	Advice from Dept. Officials		14	Other specify; -	

9. Investment and Subsidy details (Rs):

MI system	**Crop**	**Area (Acre)**	**Total cost(Rs)**	**Amount of Subsidy (Rs)**	**Number of Months taken for subsidy**	**Life of the equipment expiry based on farmers opinion**
Drip						
Sprinkler						
Solar						

10. Mode of Subsidy disbursement: (√)

Cheque form Dept	MI agency	Bank	Credit to your bank account	Not known

11. Have you got benefits of any Govt scheme convergence: (Yes/No)

MGNREGA	Krishi Honda-	Ganga kalyan	NHM	NFSM	ISOPHOM	Total amount of benefits or saved

12. Assessment of System Design

Sl No	Particulars	Yes-1, No-2, don't know
1	Is this design layout is as per your project proposal?	
2	Whether the MI systems were found to be functional in the field	
3.	Whether various system components supplied are as per the BIS specifications	
4	Have you adapted any valve system for total distribution of water?	
5	Have you installed any ventury?	
6	Whether any Pressure Gauge is installed	
7	Is there, Emitters used in Drip:	
8.	If yes Type of Emitters Used:	Micro tubes Pressure compensated emitters (PCE) Ordinary emitter
9	Is there any Filters used in drip?	
10.	If yes Type of Filters Used:	Hydro Cyclone -1: Screen-2: Sand-3: Disc-4 Other Type-5
11	Does the installed MI system meet crops water requirement	
12	Has the design suits to other crops during subsequent seasons	
13	Have you taken the Benefit of Warranty provisions	

13. Have you received post installation services from MI Agency? (√)

Yes	No

14. If yes number of times: (√)

Within 2 months	Within 3-6 months	After 6 months	Not provided so far

15. Difficulties faced by the farmer in adapting and maintenance of MI Scheme (Compulsory for all questions):

Sl. No	**Particulars**	**Yes, No**
1.	Delay in subsidy claims	
2.	Cumbersome procedures	
3.	Differences in Quality material supply of MI components	
4.	Delay in system installation	
5.	Inadequate power supply	
6.	Lack of guidance in utilizing and managing the system for effective use	
7.	Clogging of emitters and laterals	
8.	Difficulty in maintaining proper pressure	
9.	Quality issues of MI components	
10.	Difficulty during inter-cultivation	
11.	Other specify:	

16. Have you participated during preparation of irrigation plan for your land?

Yes	No

17. If Yes, have you expressed any specific need / suggestions during irrigation plan?

Yes	No	Not known/cant remember

18. If yes, list the need / suggestion expressed
    - _________
    - _________

19. Have you participated during work implementation?

Yes	No

20. If yes, have you contributed anything in this project, please mention details?
    - Money_________Rs
    - Labour (No):________
    - Material
    - None_____

Part-B

1. Input and output details of reference crop grown (before and after and with and without situation) in the farmers land

a. Name of Reference Crop: **2. Area (acres):** **3. Variety:** Hybrid/Local **Season:** Kharif/Rabi/Summer **(Before MI)**

a. Name of Reference Crop: **2. Area (acres):** **3. Variety:** Hybrid/Local **Season:** Kharif/Rabi/Summer **(After MI)**

Details of activity		**Before MI**				**After MI (Sprinkler/drip)**			
		Unit	**Quantity**	**Value (Rs.)**	**Remarks**	**Unit**	**Quantity**	**Value (Rs.)**	**Remarks**
a. Seed/seedling		NA				**Unit**			
b. Planting material		No.				NA			
c. Fertilizers	1. N	Qt				No.			
	2. P	Qt				Qt			
	3. K	Qt				Qt			
	4. Complex	Qt				Qt			
	5. Micro Nutrient	Kg				Qt			
		Kg				Kg			
	6. Biofertilizer/ organic fertilizer	Kg				Kg			
	7. Liquid Fertilizers	Lt				Kg			
	7. FYM	Qt				Lt			
	8. Others	Qt				Qt			
d. Plant protection chemicals	i. Pesticides	Lt				Qt			
	1.	Lt				Lt			
	2.	Lt				Lt			
	3.	Lt				Lt			
	ii. Insecticides	Lt				Lt			
	1.	Lt				Lt			
	2.	Lt				Lt			
	iii. Weedicides/Herbicides	Lt				Lt			
	1.	Lt				Lt			
	2.	Lt				Lt			
	3. Any other	Lt				Lt			
e. Family labour	1. Male	No.				No.			
	2. Female	No.				No.			
f. Hired Labour	1. Male	No.				No.			
	2. Female	No.				No.			
g. Value of bullock	1. Own	No.				No.			
	2. Hired	No.							

h. Value of Machinery	1. Own	No.				No.			
	2. Hired	No.				No.			
i. Maintenance cost other than (Irrigation equipment)		Rs				Rs			
j. Irrigation*									
1. No Borewells used		No.				No.			
2. Well yield in GPH		Inch				Inch			
3. Number of hours taken to irrigate the entire land once (hr)		No. of hours				No. of hours			
4. Number of irrigations for the whole crop		No.							
5. No of days water given		No.				No.			
6. Any water supplementation form Drip/ Sprinkler through Tankers / pipe (No of tankers Per month from neighbouring water sources)		No.				No.			
k. Energy Sources (Diesel/electrify/solar)		NA				NA			
L. No. of Hours electricity supply/day		No. of hours				No. of hours			
M. Post-harvest	1. Harvesting and collection	RS				RS			
	2. Grading	RS				RS			
	3. Storage	RS				RS			
	4. Transportation	RS				RS			
	5. Commission	RS				RS			
	6. Market fee	RS				RS			
	7. Packaging/material	RS				RS			
	8. Any Other	RS				RS			
N. Any other cost		RS				RS			
O. Total cost of production		Rs				Rs			
P. Output produced									
1. Yield (Qt)		Qt				Qt			
2. Quantity sold (Qt)		Qt				Qt			
3. Net Income (Rs)		Rs				Rs			
4. Net Income from By product if any		Rs				Rs			
5. Sold where on farm/agent, Nearby town, APMC		NA				NA			
6.									

Part-C

Training

1. Have you attended any training program (✓)

Yes	No

2. If Yes, then Training given by (✓)

SAUs/ KVKs-	Department	MI Agencies	RSKs	NGos/CBOs	Other Specify

3. If yes, how many times you were given training since you adopted the scheme (✓)

Not attended	One time	2-3 times	3-5 times	Above five times

4. Year of training programme attended

Year	Places	Duration	Distance from your places

5. Duration of training programme (✓)

1 day	1-3 days	4-10 days	10-20 days	20-30 days	Above 30 days

6. Was the duration of training adequate (✓)

Yes	No

7. Timeliness / Seasonality of training (✓)

Convenient	Inconvenient

8. Training Was it given in a group or at individual level (✓)

Group	Individual

9. Was it is residential training (✓)

Yes	No

10. What was the mode of training? (✓)

Class room	Practical	Demonstration	Field visit/ exposer visit	All of these

11. Training particulars

S. No.	Contents		Covered (√)	Usefulness of training (√)
2.	Topic covered in the training	i. Technology & Operation of the system		
		ii. Maintenance of the system		
		iii. Irrigation Package of practices of the crops		
		iv. Opportunities for Introduction of new crops		
		v. Water regulation during crop growth		
		Vi. BIS quality verification issues		
		vii. Warranty issues		
		viii. Crop wise water requirements		
		Efficient usage of MI system round the Year		

12. What kind of training material was given to you (manuals, leaflets, books etc (✓)

Book/	Leaf lets/	Brochure	Manual	No materials

13. Is training material provided in Local language (✓)

Yes	No

14. Satisfaction with reference material provided during program (✓)

Average	Good	Poor	Not given

15. Satisfaction with Field visit(✓)

Average	Good	Poor

16. Have they taken your feedback in writing after training? (✓)

Yes	No	Can’t remembers

17. Did you find the training useful? (✓)

Yes	No

18. Understanding & usefulness of training (✓)

Average	Good	need improvement

19. Is there any Improvement in your knowledge /skill after training programme (✓)

Poor	Medium	Good	Very good

20. Acceptance of the scheme (✓)

Poor	Average	Good	Very good	Excellent

21. Would you wish to attend advance training again, if given a chance (✓)

Yes	No

22. Advantage of training programme (list them):
    a. ______
    b. _______
    c. _______
    d. ______

23. Any suggestion for improvement in training programme? (list them)
    a. _________
    b. ____________
    c. _____________
    d. _________________

Social benefits:

a. Assets generation: Household-1, Livestock-2, Infrstructure-3, Education support-4

b. Extent of Reduced water scarcity: ______(%)

c. Reduced labor migrations (Own): Yes or No

d. Extent of Reduction in labor drudgery: ________%

e. Improvement in general health: Highly Improved-1, Moderate change-2, No change

Environmental Benefits:

- Improvement in Soil Health: Increase in earth worm population (Yes/No)
- Soil surface cracking Yes/No

Water availability benefits due to MI adaption:

1. For new/additional area coverage (Acre)_____
2. Conservation practices: Yes-1, No-2
3. Irrigation during critical period: Yes-1, No-2
4. Drinking purpose: Yes-2, NO change -2
5. Livestock development: Yes-1, No change-2
6. Conservation sharing or selling to other farmers: Yes-1, No-2

Changes in Employment Generation (Man days/ season):

Activity Phase		**Before MI**			**After MI**		
		Agri sectors	**Horti sector**	**Mulberry**	**Agri sectors**	**Horti sector**	**Mulberry**
Pre-harvest practices	Family						
	Heired						
Harvesting	Family						
	Heired						
Post-harvest handling	Family						
	Heired						

FIELD OBSERVATION

1. About MI system (Observation by field enumerators)

- Overall design: Full coverage- 1, Partial coverage- 2, Excess distribution-3
- Whether Farmers are using flood irrigation along with MI system: Yes-1, No
- Whether choice of drip/ sprinkler MI system match with the crop requirement: Yes-1, No-2
- Capability of farmer to maintain MI system: Very good -1, Moderate-2, Poor-3

2. General views of farmer (collect farmer opinion)

- Are you interested to expand the Sprinkler/ Drip in your land? Yes-1, No-2
- If yes: How Many acres______
- What support do you expect: Subsidy-1, Loan-2, Technical-3
- How many farmers replicated by seeing your structures: No of farmers______
- Would you like to recommend this scheme to others: Yes-1, No-2

3. Suggestion for the better implementation of MI Scheme (collect farmer opinion):

- Subsidy portion To Increase by: 10%: 20%, 30%
- Relaxation of Ceiling on Area limits: Extend by ------: Retain_____-
- Improvement in quality supply of MI materials
- Periodic technical support and follow up by MI agencies
- Guidance for year-round use of MI system
- Supply of quality and regular power
- Clarity on subsidy portion and transparency in procedures
- Providing a specific Irrigation schedule guide or Package of practice

IMPACT EVALUATION STUDY OF PER DROP MORE CROP (PDMC) COMPONENT OF PMKSY

(2016-17 to 2018-19)

KARNATAKA

Farmer
Interview Questionnaire
(Control)

TERI, 2020

Part-A

Identification No.(code): …………………… Date of interview: ____________________

Name of Village:____________________ Name of Taluk: ______________________

Name of GP: ____________________ District: __________________________

Survey No:……………………………… Mobile No:………..………………………

Latitude:…………………………….Longitude…………………………..Altitude:…………..

1. **Name of the respondent** : ____

2. **Gender of respondent** (✓)

iii. Male	iv. Female

3. **Age of respondent** (✓)

v. 18-30	vi. 31-45	ii. 46-60	iii. Above 60

4. **Education of respondent** (✓)

ii. Illiterate	ii. Primary	ix. SSLC	x. PUC	i. Graduate and above	ii. Others

5. **Social group** (✓)

. SC	vi. ST	ii. OBC	iii. General/Others

6. **Family size (Number)**

Gender	Early childhood (0-6 years)	Childhood (6-12 years)	Early Adult (13-18 years)	Adulthood (19-40 years)	Late adulthood (40-60 years)	Old age (Above 60 years)
Male						
Female						

7. **Main Occupation** (✓)

xi. Agriculture	xii. Agri labour	xiii. Business	xiv. Employed	xv. Any other,

8. **Secondary Occupation** (✓)

vi. Agriculture	xvii. Agri labour	xviii. Business	xix. Employed	xx. Any other,

9. **Land holding details (Acres)**

Type of land	**Owned**		**Lease d-in/**	**Lease d-out**	**Total**	**Reasons for keeping Land as fallow**
	Cultivated	**Fallow**				
Rainfed						
Irrigated						
Garden /Plantations						
Drip irrigation (Total: own and project benefit)						
Sprinkler (Total: own investment and project benefit)						
Total						

10. Cropping pattern

Season	Crops	Area (acres)	Irrigation	Quantity of Fertilizer used (Qt)	Quantity of Insecticide used (Kg/lt)	Quantity of Weedicide used (Kg/lt)	Total Predilution cost / total expenditure (Rs)	Total Production (Qt)Production (Qt)	net Income (Rs)
			Water sources: sprinkler/drip/flood						
Irrigated									
1.Kharif									
2.Rabi									
3.Summer									
Rainfed									
1.Kharif			NA						
			NA						
			NA						
2.Rabi			NA						
			NA						
			NA						
3.Summer			NA						
			NA						
			NA						
Annuals/ Perennials									
Mulberry									

11. Irrigation sources

Water sources information **Type of water sources**	**Open well**				**Bore well**								**Farm pond-1**	**Farm pond-2**	**Canal /stream-1**
	1	**2**	**3**	**4**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**			
Year of Drilling /digging/ construction															NA
No. of working wells/bore wells (√)															
Year of failure															
Year of deepening if any															
Current total depth (feet)															
Pump HP															
Pump Stage (Number)															
Average water Yield of functioning of borewells (GPH/inch)															
Kharif															
Rabi															
Summer															
Total Cost (well: Drilling, casing electrical expenses) (Rs)															
Annual repair and maintenance cost (Rs)															

12. Livestock Information

Sl..No	Particulars	No.	Year of Purchase	Cost (Rs)	Milk yield from milch animals lt/day	Income from sale of milk / hire charges received from draught animals / income from poultry/sheep meet (Rs)
1.	Draught animals (Ox)				NA	
2	Milch animals					
	Desi-Cow					
	Buffaloes					
	Cross-bred cow					
3.	Calves and Heifers (Below 1 year)				NA	
4.	Sheep and goat					
5.	Poultry				Na	

13. Farm Machinery, Implements and buildings

Sl.No.	Name of Machinery	No.	Year of purchase	Value in (Rs.)	Annual income from hiring-out machinery (Rs.)
1.	Tractor (…….hp)				
2.	Power tiller (……hp)				
3.	Tractor accessories				
4.	Sprayer:				
5.	Implements Bullock cart Hand sprayer Country plough Other small implements				

14. Other details

Sl No	Particulars	Opinion
1	Have you availed soil testing facilities?	Yes ; No:
2	Have you followed recommended doses of fertilizers? (√)	Fully; Partially; Not followed.
3	Member of organisations/groups Yes/No. If Yes, Name of the organisation: No. of Family Members:	
4	Annual Income (Rs) 1. Agricultural allied activities: 2. Non agriculture activities	

15. Are you aware of PMKSY-PDMC? (✓)

Yes	No

16. If Yes Information Source of Drip/Sprinkler System? (√)

Sl No	Particulars	Awareness	Subsidy provision	New method of cultivation	High income	Over all advantage
1	Another farmer					
2	Radio/ TV					
3	Newspaper/ pamphlet					
4	Govt officials					
5	Drip agencies / MI agency					
6	NGO					
7	Banks/financial institutions					
8	GPs					
9	Any other s					

17. Reasons for Non-adoption of MI system: (√)

Sl. No	Particulars	Yes-1, No-2
12.	Delay in subsidy claims	
13.	Decline in water availability	
14.	Due to failure of borewell	
15.	Cumbersome procedures	
16.	Delay in system installation	
17.	Inadequate power supply	
18.	Lack of guidance in utilizing and managing the system for effective use	
19.	Clogging of emitters and laterals	
20.	Difficulty in maintaining proper pressure	
21.	Quality issues of MI components	
22.	Labour Scarcity	
23.	High cost Fertilizer	
24.	Difficulty during inter-cultivation	
25.	Other specify:	

18. Have you got any benefits of Govt scheme on water conservation practices (other than MI)

Yes	No

If yes, Which Schemes and What component?

Name of the Scheme	Name of the component	Area benefitted/ quantity	Total amount of benefits or saved	Remarks
MGNREGA				
Krishi Honda-				
Ganga kalyan				
NHM				
NFSM				
ISOPHOM				

Part-B

2. Input and output details of reference crop grown (before and after and with and without situation) in the farmers land

b. Name of Reference Crop: **2. Area (acres):** **3. Variety:** Hybrid/Local **Season:** Kharif/Rabi/Summer **(Before irrigation)**

b. Name of Reference Crop: **2. Area (acres):** **3. Variety:** Hybrid/Local **Season:** Kharif/Rabi/Summer **(After irrigation)**

Details of activity		**Before irrigation**				**After irrigation**			
		Unit	**Quantity**	**Value (Rs.)**	**Remarks**	**Unit**	**Quantity**	**Value (Rs.)**	**Remarks**
a. Seed/seedling		NA				**Unit**			
b. Planting material		No.				NA			
c. Fertilizers	1. N	Qt				No.			
	2. P	Qt				Qt			
	3. K	Qt				Qt			
	4. Complex	Qt				Qt			
	5. Micro Nutrient	Kg				Qt			
		Kg				Kg			
	6. Biofertilizer/ organic fertilizer	Kg				Kg			
	7. Liquid Fertilizers	Lt				Kg			
	7. FYM	Qt				Lt			
	8. Others	Qt				Qt			
d. Plant protection chemicals	i. Pesticides	Lt				Qt			
	1.	Lt				Lt			
	2.	Lt				Lt			
	3.	Lt				Lt			
	ii. Insecticides	Lt				Lt			
	1.	Lt				Lt			
	2.	Lt				Lt			
	iii. Weedicides/Herbicides	Lt				Lt			
	1.	Lt				Lt			
	2.	Lt				Lt			
	3. Any other	Lt				Lt			
e. Family labour	1. Male	No.				No.			
	2. Female	No.				No.			
f. Hired Labour	1. Male	No.				No.			
	2. Female	No.				No.			
g. Value of bullock	1. Own	No.				No.			

	2. Hired	No.							
h. Value of Machinery	1. Own	No.				No.			
	2. Hired	No.				No.			
l. Maintenance cost other than (Irrigation equipment)		Rs				Rs			
m. Irrigation*									
7. No Borewells used		No.				No.			
8. Well yield in GPH		Inch				Inch			
9. Number of hours taken to irrigate the entire land once (hr)		No. of hours				No. of hours			
10. Number of irrigations for the whole crop		No.							
11. No of days water given		No.				No.			
12. Any water supplementation form Drip/ Sprinkler through Tankers / pipe (No of tankers Per month from neighbouring water sources)		No.				No.			
n. Energy Sources (Diesel/electrify/solar)		NA				NA			
Q. No. of Hours electricity supply/day		No. of hours				No. of hours			
R. Post-harvest	1. Harvesting and collection	RS				RS			
	2. Grading	RS				RS			
	3. Storage	RS				RS			
	4. Transportation	RS				RS			
	5. Commission	RS				RS			
	6. Market fee	RS				RS			
	7. Packaging/material	RS				RS			
	8. Any Other	RS				RS			
S. Any other cost		RS				RS			
T. Total cost of production		Rs				Rs			
U. Output produced									
7. Yield (Qt)		Qt				Qt			
8. Quantity sold (Qt)		Qt				Qt			
9. Net Income (Rs)		Rs				Rs			
10. Net Income from By product if any		Rs				Rs			
11. Sold where on farm/agent, Nearby town, APMC		NA				NA			

Part-C

Training

1. Have you attended any training program (✓)

Yes	No

2. If Yes, then Training given by (✓)

SAUs/ KVKs-	Department	MI Agencies	RSKs	NGos/CBOs	Other Specify

3. Which subject (✓)

Agriculture	Soil and Water conservation

4. If yes, how many times you were given training since you adopted the scheme (✓)

Not attended	One time	2-3 times	3-5 times	Above five times

5. Year of training programme attended

Year	Places	Duration	Distance from your places

6. Duration of training programme (✓)

1 day	1-3 days	4-10 days	10-20 days	20-30 days	Above 30 days

7. Was the duration of training adequate (✓)

Yes	No

8. Timeliness / Seasonality of training (✓)

Convenient	Inconvenient

9. Training Was it given in a group or at individual level (✓)

Group	Individual

10. Was it is residential training (✓)

Yes	No

11. What was the mode of training? (✓)

Class room	Practical	Demonstration	Field visit/ exposer visit	All of these

12. Training particulars

S. No.	Contents		Covered	Usefulness of training
2.	Topic covered in the training			

13. What kind of training material was given to you (manuals, leaflets, books etc (✓)

Book/	Leaf lets/	Brochure	Manual	No materials

14. Is training material provided in Local language (√)

Yes	No

15. Satisfaction with reference material provided during program (✓)

Average	Good	Poor	Not given

16. Satisfaction with Field visit(✓)

Average	Good	Poor

17. Have they taken your feedback in writing after training? (✓)

Yes	No	Can't remembers

18. Did you find the training useful? (✓)

Yes	No

19. Understanding & usefulness of training (✓)

Average	Good	need improvement

20. Is there any Improvement in your knowledge /skill after training programme (✓)

Poor	Medium	Good	Very good

21. Acceptance of the scheme (✓)

Poor	Average	Good	Very good	Excellent

22. Advantage of training programme (list them):
    e. _______
    f. ________
    g. ________

23. Any suggestion for improvement in training programme? (list them)
    e. __________
    f. ______________
    g. _______________

24. Would you wish to attend advance training of MI system, if given a chance (✓)

Yes	No

Annexure-2: Focus group Discussion

IMPACT EVALUATION STUDY OF PER DROP MORE CROP (PDMC) COMPONENT OF PMKSY

(2016-17 to 2018-19)

KARNATAKA

Focus Group Discussion (FGD)

The check list of FGDs is as follows

Agriculture:

1. What is major Soil type and topography in your village?
2. Generally, what kind of crops are cultivated in your village? - What is cropping pattern, diversity and cropping intensity followed by farmers in your village? - What is average per acre production of most common crops cultivated in your village?
3. Is there any shift to less-water intensive / dry crops (Name the crops) during water scarcity season?
4. What are major issues affecting crop production and productivity?
5. To what extent/degree do these issues have impact on crop productivity and how you are going managing at present?
6. What are major pest and disease occur to agriculture crop in your village and how you are managing these issues at present?
7. Is heir any change is noticed soil health and soil moisture improvement after adaption of micro irrigation system

Water:

8. What are the general irrigation practices or types in your village?
9. Do you think Decrease in rainfall and number of rainy days if yes how much?
10. What are the available sources of irrigation water? Is the irrigation water availability throughout the year and sufficient for your farms need? - How you manage, in case of shortage of irrigation water?
11. Do you share well water among yourself? if yes during which season and what is the charge you quote if any
12. Is Densely spaced wells in your village if yes on an average how many Number per house hold and what is average depth
13. Do you undergo any practice or Deeping your borewell once it dry? If yes on ana average how much
14. Was there any significant increase in yield of well after deepening
15. Is the quality of well water suitable for cultivating all crops?
16. Was there any significant increase in yield of well after adaptation of Micro irrigation in you land
17. Is there any change in purchase of water from other farmers after adapting micro irrigation system?
18. Do you practice Crop irrigated by interfering well if yes how many borewells and how many farmers?

Energy:

1. Problems faced with respect to electricity
2. Problems faced with respect to pump/motor repairs
3. How frequent power cuts/ load shedding occur in your village
4. Any Cost of obtaining electricity connection for irrigation

MI system and support services:

1. Have you got any support regarding to micro irrigation system installation from Govt, NGO and MI agency? If yes list them (Technical, selection of MI system, agronomic practices, water and subsidy). What are the major challenges in using the Micro irrigation system in your land or this area?
2. Whom do you enquire regarding irrigation information like frequency to irrigate, how much to irrigate, depth of irrigation for different crops in different soils types during different stages of crop
3. What are major benefits and issues related drip and sprinkler irrigation
4. What is the major advantage and disadvantage of use fertigation? And how your going to manage is any technical issues come across?

Capacity building and Participation:

1. Have you got any training on micro irrigation system (installation, operation, maintenance, agronomic practices, water allocation etc) from anybody?
2. If yes who given training list them (Duration, Place, type; class room or practical or both, topic covered, relevance, martial benefitted and level of adaption by different farmers, Satisfaction)
3. What are major advantage and learning from training and capacity building (list them):
4. Would like to give any suggestion for improvement in training programme? (list them)

General

1. What are livelihood opportunities (agri. farm and non-farm) available to households in your village? - What is proportion of local and migratory workers in crop management/post-harvest management practices and their labour opportunities on small and medium farms?
2. Other problems in land and water resources
3. What is your participation, contribution and understanding about implementation of micro irrigation system in your land?
4. What is involvement / roles of male and female in agricultural farming? - Are the females involved in post-harvest crop management practices for onion/rice/date/chilly etc.? - What kind of activities and rate of involvement?
5. Are you people interested to expand the Sprinkler/ Drip in your land? If yes on an average how much and what support need additionally
6. How many farmers replicated by seeing your structures: No of farmers______
7. Suggestion for the better implementation of MI Scheme (collect farmer opinion):

Annexure-3: Stakeholder Interview Questionnaire

IMPACT EVALUATION STUDY OF PER DROP MORE CROP (PDMC) COMPONENT OF PMKSY

(2016-17 to 2018-19)

KARNATAKA

Stakeholder Interview Questionnaires

1. INTERVIEW SCHEDULE FOR NODAL DEPARTMENT (State Level)

Sl. No.	Questions & Requirement	Response	Remarks
1.	Has the State level Micro Irrigation Committee (SMIC) been formed?	Yes, No	
2.	How many meetings of SMIC were conducted in an year?	4, 3,2,1	
3.	Whether the District-wise Action Plan/DIP is prepared and Reviewed	Yes or No	
4.	Whether steps have been taken to ensure that eligible farmer gets loan from bank?	Yes or No	
5.	Whether the State level Technical Support Group formed? Yes/No	Yes or No	
6.	Whether monitoring system is put in place? What are they?	Yes or No	
7.	Are there any community based micro irrigation system operating in the proposed evaluation district during 2016-17 to 2018-19?	Yes or No	
8.	If yes provide salient impact of the programme and recommendations if any		
9.	Whether Utilisation certificates are forwarded regularly?	Yes or No	
10.	Whether state level workshops, seminars have been organized for officials/farmers/NGO's/MI Agencies?	Yes or No	
11.	Whether Manufacturers/suppliers are registered/approved at the State SMIC?	Yes or No	
12.	Are companies evaluated every year before renewal of their registration?	Yes or No	
13.	Is there a charter that details the role of companies/departments/beneficiaries under the scheme?	Yes or No	
14.	Is there a provision for taking action against erring suppliers/dealers? If so what action can be taken	Yes or No	
15.	What are the publicity measures taken in the state to popularize the scheme? List them.: Radio, TV, Wal posters/paintings, SMS, mass campaigns, Interactions		
16.	How is unit cost for the purpose of subsidy determined? GOI indicative costs: Revised every Year: Use the quoted minimum price:		
17.	Whether the District-wise potential area under Micro Irrigation is calculated?	Yes or No	
18.	Whether the GOI grants under the scheme adequate compared to action plans/sought funds? If No, give the deviations for last 3 years (in %)	Yes or No	
19.	Whether the water requirement of different crops based on the different agro-climatic zones made available to farmers? Yes/No	Yes or No	
20.	Whether the step wise process in disbursement of subsidy along with the time lines notified? Yes/No If so how many days?	Yes or No	
21.	Are there the pending applications? Year wise (Numbers). 2016-17: 2017-18: 2018-19:		
22.	Any decisions on re-procurement plans and status	Yes or No	
23.	Any Policy decisions on IT applications	Yes or No	
24.	Functioning of KAMIC (Karnataka Anthaganaga Micro irrigation corporation)	Yes or No	
25.	Opinion about the Functioning of the agency:		
26.	Any plans to promote MI Agencies	Yes or No	
27.	Any decisions on R&D / PFDC promotion	Yes or No	
28.	Reviews on State share Allocation	Yes or No	
29.	Initiation to conduct of BLS & Feasibility Studies	Yes or No	
30.	Entrustment on Monitoring and Evaluation	Yes or No	
31.	Web site Hosting plans	Yes or No	
32.	Decisions on promoting institutional Credit Support	Yes or No	
33.	Opinion on the services role of MI companies after installation (List out)		
34.	Provide opinion on the performance of empanelled MI companies		

Annexure-4: Stakeholder Interview Questionnaire

IMPACT EVALUATION STUDY OF PER DROP MORE CROP (PDMC) COMPONENT OF PMKSY

(2016-17 to 2018-19)

KARNATAKA

Stakeholder Interview Questionnaires

1. Schedule for gathering information at the Districts

Name of the District:____________

<table>
<tr><th>Sl. No</th><th>Questions & Requirements</th><th>Response</th><th>Remarks</th></tr>
<tr><td>1.</td><td>Annual Average Rainfall</td><td></td><td></td></tr>
<tr><td>2.</td><td colspan="2">Area of Major crops covered under Drip/sprinkler (Acre)
<table>
<tr><th rowspan="2">Crops</th><th colspan="2">2016-17</th><th colspan="2">2017-18</th><th colspan="2">2018-19</th></tr>
<tr><th>Drip</th><th>Sprinkler</th><th>Drip</th><th>Sprinkler</th><th>Drip</th><th>Sprinkler</th></tr>
<tr><td>Agril-crops</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Cereals</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Pulses</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Oil seeds</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Horticultural crops</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Fruits</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Vegetables</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Flowers</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Others</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Mulberry:</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
</table></td><td></td></tr>
<tr><td>3.</td><td>Whether potential area has been estimated?</td><td>Yes or No</td><td></td></tr>
<tr><td>4.</td><td>Whether Annual Action plan / DIP plans have been prepared?</td><td>Yes or No</td><td></td></tr>
<tr><td>5.</td><td>Has the District Micro Irrigation Committee (DMIC) formed?</td><td>Yes or No</td><td></td></tr>
<tr><td>6.</td><td>How Many meetings have been done by DMIC in last one year</td><td>4, 3,2,1</td><td></td></tr>
<tr><td>7.</td><td colspan="2">Select 5 major activities of DMIC
1. Area assessment on micro irrigation potential
2. Review of MIS to follow guidance
3. Effort for coordination among stake holders
4. Review and transparency issues
5. Safe grading, SCP and TSP beneficiaries
6. Reporting for action on setbacks to state nodal office
7. Publicity and Promotional efforts for Micro irrigation in the district
8. Motivating committee members for effective implementation
9. Efforts for social auditing
10. Any new initiative for Micro irrigation promotion
11. Efforts for credit support from banks.
12. Efforts to converge another related scheme</td><td></td></tr>
<tr><td>8.</td><td>Whether case studies on Micro Irrigation has been done on any crops in the taluk? If yes, the Numbers documented</td><td>Yes or No</td><td></td></tr>
<tr><td>9.</td><td>Is there any community based micro irrigation system implemented between 2016-17 to 2018-19</td><td>Yes or No</td><td></td></tr>
<tr><td>10.</td><td>If yes provide salient impact of the programme and recommendations if any</td><td>Yes or No</td><td></td></tr>
<tr><td>11.</td><td>Whether measures undertaken to ensure the eligible farmer could get loan?</td><td>Yes or No</td><td></td></tr>
<tr><td>12.</td><td>Whether trainings & extension programs conducted by the Dept?</td><td>Yes or No</td><td></td></tr>
</table>

<table>
<tr><th>Sl. No</th><th>Questions & Requirements</th><th>Response</th><th>Remarks</th></tr>
<tr><td>13.</td><td colspan="2">What are the mechanisms to popularize the scheme?
Pamphlets; 2. Newspapers; 3. Local TV channels; 4 others</td><td></td></tr>
<tr><td>14.</td><td>Whether the Utilisation certificates (UC) are forwarded regularly?</td><td>Yes or No</td><td></td></tr>
<tr><td>15.</td><td>Is there any delay in submission of the UC? If so why?</td><td>Yes or No</td><td></td></tr>
<tr><td>16.</td><td>Whether dealers in the district are notified?</td><td>Yes or No</td><td></td></tr>
<tr><td>17.</td><td>Whether the details of the approved dealers/suppliers made available to the eligible farmer? if yes How? Any brochure/pamphlet by dealers?</td><td>Yes or No</td><td></td></tr>
<tr><td>18.</td><td>Whether the releases from GOI are in time? If yes how many times a year releases are made?</td><td>Yes or No</td><td></td></tr>
<tr><td>19.</td><td>Whether the releases from GOK are in time? If yes how many times a year releases are made?</td><td>Yes or No</td><td></td></tr>
<tr><td>20.</td><td>How many applications are received in last 3 years?</td><td>Yes or No</td><td></td></tr>
<tr><td>21.</td><td colspan="2">Year wise beneficiary and area coverage
<table>
<tr><th rowspan="2">Category</th><th colspan="2">2016-17</th><th colspan="2">2017-18</th><th colspan="2">2018-19</th></tr>
<tr><th>No</th><th>Acre</th><th>No</th><th>Acre</th><th>No</th><th>Acre</th></tr>
<tr><td>General</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>OBC</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>SC</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>ST</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Total</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
</table></td><td></td></tr>
<tr><td>22.</td><td colspan="2">Give the number of pending applications year wise
2016-17: 2017-18: 2018-19:</td><td></td></tr>
<tr><td>23.</td><td colspan="2">Convergence efforts with other govt. schemes (list the name of the scheme)</td><td></td></tr>
<tr><td>24.</td><td colspan="2">R & D initiations and fund allocation (% to total allocation)</td><td></td></tr>
<tr><td>25.</td><td colspan="2">Opinion about re-procurement/repetition during first 10 years. if yes suggest total subsidy share from govt.</td><td></td></tr>
<tr><td>26.</td><td colspan="2">List out Needs for IT application
1.
2.</td><td></td></tr>
<tr><td>27.</td><td colspan="2">List out the Impact of DMIC
1.
2.</td><td></td></tr>
<tr><td>28.</td><td colspan="2">Provide opinion on the performance of empanelled MI companies</td><td></td></tr>
</table>

a. Year wise scheme implementation in the district

<table>
<tr><th rowspan="3">Year</th><th colspan="4">Drip</th><th colspan="4">Sprinkler</th></tr>
<tr><th colspan="2">Physical</th><th colspan="2">Financial</th><th colspan="2">Physical</th><th colspan="2">Financial</th></tr>
<tr><th>Target</th><th>Achievement</th><th>Target</th><th>Achievement</th><th>Target</th><th>Achievement</th><th>Target</th><th>Achievement</th></tr>
<tr><td>**2016-17**</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>**2017-18**</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>**2018-19**</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>**Total**</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
</table>

Annexure-5: Stakeholder Interview Questionnaire

IMPACT EVALUATION STUDY OF PER DROP MORE CROP (PDMC) COMPONENT OF PMKSY

(2016-17 to 2018-19)

KARNATAKA

Stakeholder Interview Questionnaires

1. Schedule for gathering information at Taluk

Name of the Taluk: ____________

<table>
<tr><th>Sl No</th><th>Questions & Requirements</th><th>Response</th><th>Remarks</th></tr>
<tr><td></td><td>Annual Average Rainfall</td><td></td><td></td></tr>
<tr><td></td><td>Total no. of Farm Families</td><td></td><td></td></tr>
<tr><td></td><td>Potential area identified for MI (acrea)</td><td></td><td></td></tr>
<tr><td></td><td colspan="2">Area of Major crops covered under Drip/sprinkler (Acre)
<table>
<tr><th rowspan="2">Crops</th><th colspan="2">2016-17</th><th colspan="2">2017-18</th><th colspan="2">2018-19</th></tr>
<tr><th>Drip</th><th>Sprinkler</th><th>Drip</th><th>Sprinkler</th><th>Drip</th><th>Sprinkler</th></tr>
<tr><td>**Agril-crops**</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>**Cereals**</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>**Pulses**</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>**Oil seeds**</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>**Horticultural crops**</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>**Fruits**</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>**Vegetables**</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>**Flowers**</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>**Others**</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>**Mulberry:**</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
</table>
</td><td></td></tr>
<tr><td></td><td>Whether case studies on Micro Irrigation has been done on any crops in the taluk? If yes, the Numbers documented</td><td>Yes / No</td><td></td></tr>
<tr><td></td><td>Whether measures undertaken to ensure the eligible farmer could get loan?</td><td>Yes / No</td><td></td></tr>
<tr><td></td><td>Whether the lead banks are identified for the purpose?</td><td>Yes / No</td><td></td></tr>
<tr><td></td><td>Whether trainings and extension programmes conducted by the department?</td><td>Yes / No</td><td></td></tr>
<tr><td></td><td>What are the mechanisms to popularize the scheme?
Pamphlets; 2. Newspapers; 3. Local TV channels; 4 others</td><td></td><td></td></tr>
<tr><td></td><td>Whether the Utilization certificates (UC) are forwarded regularly?</td><td>Yes / No</td><td></td></tr>
<tr><td></td><td>Whether dealers in the taluk are notified.?</td><td>Yes / No</td><td></td></tr>
<tr><td></td><td>Whether the details of the approved dealers/suppliers made available to the eligible farmer? if yes? Any brochure/pamphlet by dealers?</td><td>Yes / No</td><td></td></tr>
<tr><td></td><td>How many applications are received in last 3 years?</td><td>Yes or No</td><td></td></tr>
<tr><td></td><td colspan="2">Give the number of pending applications year wise
2016-17:__________2017-18:_________2018-19:_________</td><td></td></tr>
<tr><td></td><td>Whether information on crop wise water requirement and type of system adaption is made available to farmers?</td><td>Yes / No</td><td></td></tr>
<tr><td></td><td>Whether procedures to verify the eligibility of farmer put in place?</td><td>Yes / No</td><td></td></tr>
<tr><td></td><td colspan="2">What is the adoption level of Micro Irrigation in the taluk?
< 10%, 10-20%, 20-40%, > 50%</td><td></td></tr>
<tr><td></td><td>How do you rate the scheme performance in the taluk?
Very good-1 Good-2 Poor-3</td><td></td><td></td></tr>
</table>

<table>
<tr><th>Sl No</th><th>Questions & Requirements</th><th>Response</th><th>Remarks</th></tr>
<tr><td></td><td>List 5 critical issues related to implementation of scheme
1.
2.

5.</td><td></td><td></td></tr>
<tr><td></td><td>List 5 key suggestions to improve the scheme
1.
2.

5.</td><td></td><td></td></tr>
<tr><td></td><td>Whether the beneficiary selection is transparent as per norms</td><td>Yes / No</td><td></td></tr>
<tr><td></td><td colspan="2">Adherence to time line in subsidy distribution
Timely-1, Delay-2 If Delay Give reasons:</td><td></td></tr>
<tr><td></td><td colspan="2">Technical Expertise of the departmental staff
Sufficient-1, Moderate-2, Low-3</td><td></td></tr>
<tr><td></td><td colspan="2">Extent of coordination with MI agencies & Subjects experts
Good-1, Average-2, Low-3</td><td></td></tr>
<tr><td></td><td>Whether DBT system is followed and its usefulness
If yes: Good-1, Average-2, Low-3</td><td>Yes /No</td><td></td></tr>
<tr><td></td><td colspan="2">Year wise beneficiary and area coverage
<table>
<tr><td rowspan="2">Category</td><td colspan="2">2016-17</td><td colspan="2">2017-18</td><td colspan="2">2018-19</td></tr>
<tr><td>No</td><td>Acre</td><td>No</td><td>Acre</td><td>No</td><td>Acre</td></tr>
<tr><td>General</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>OBC</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>SC</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>ST</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Total</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
</table></td><td></td></tr>
<tr><td></td><td>Any crop specific irrigation schedules are developed and provided to farmers</td><td>Yes / No</td><td></td></tr>
<tr><td></td><td>Any advice/ package/ plan for utilizing MI system during lean seasons</td><td>Yes / No</td><td></td></tr>
</table>

a. Year wise scheme implementation in the Taluk

Year	**Drip**				**Sprinkler**			
	Physical		**Financial**		**Physical**		**Financial**	
	Target	**Achievement**	**Target**	**Achievement**	**Target**	**Achievement**	**Target**	**Achievement**
2016-17								
2017-18								
2018-19								
Total								

b. Year Wise demonstrations laid out/conducted

Years	**2016-2017**	**2017-18**	**2018-19**
Number of Demonstration			

THE IMPACT OF PER DROP MORE CROP COMPONENT OF PMKSY ON COVERAGE OF AREA UNDER MICRO IRRIGATION (MI), INCENTIVISATION OF SUITABLE CROP PATTERN, CROP PRODUCTIVITY, COST SAVINGS AND WATER USE EFFICIENCY (2016-17 TO 2018-19) FOR ACHIEVING TARGETS UNDER SDG-6

Karnataka Evaluation Authority
#542, 5th Floor, 2nd Gate
Dr. B.R Ambedkar Veedhi
M.S. Building Bengaluru – 560 001

Website: kmea.karnataka.gov.in
Contact No: 080 2203 2561
Email Id: keagok@karnataka.gov.in