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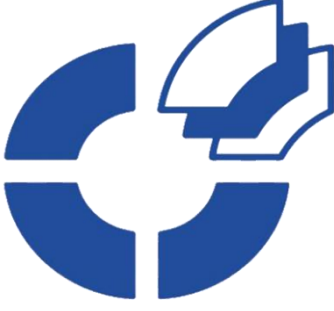
## Socio-economic Impact Assessment of Micro-Irrigation Scheme Implemented by Gujarat Green Revolution Company Ltd. (2025)



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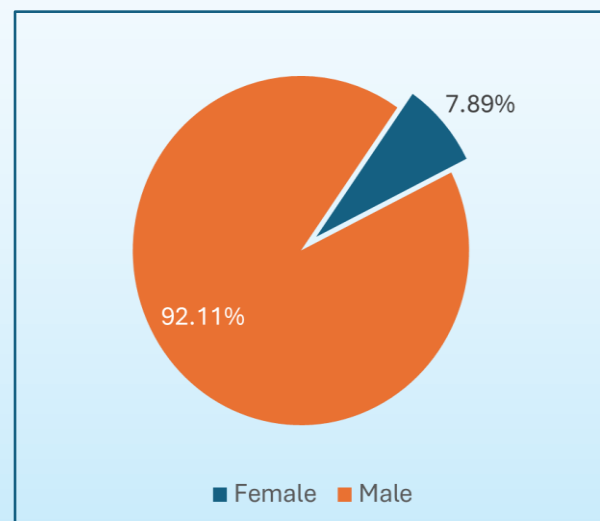
# Executive Summary

This survey provides comprehensive insights into the demographic profile, agricultural practices, and farmers' perceptions regarding Micro Irrigation Systems (MIS) across Gujarat. This study further evaluates the practical, economic, and social impacts of MIS adoption across Gujarat over time.

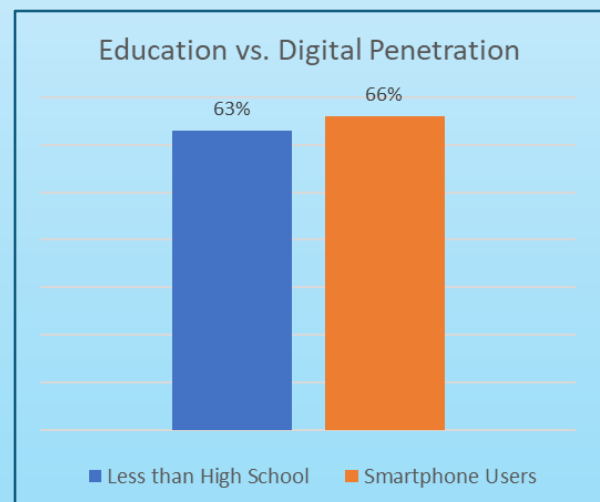
## Section 1: Farmer Profile and Socioeconomic Snapshot

### 1.1 Farmer Profile and Socioeconomic Snapshot

- **Demographics:** Most farmers are male (92.1%), aged 41–60, with a dominant presence in Saurashtra and North Gujarat.
- **Education:** 63% have less than high school education, yet digital penetration is strong (66% use smartphones).
- **Occupation:** Crop farming is predominant (95%), often practiced within joint families (67%), implying collective decision-making.
- **Financial Access:** Despite income levels between ₹1–10 lakh, awareness about the Kisan Card and Soil Health Card is required to be increased.



Attribute	Value
Male Farmers	92.1%
Age Group (41–60)	Majority
Less than High School	63%
Smartphone Penetration	66%
Crop Farming Dominance	95%
Joint Families	67%



## 1.2 Infrastructure and Resources

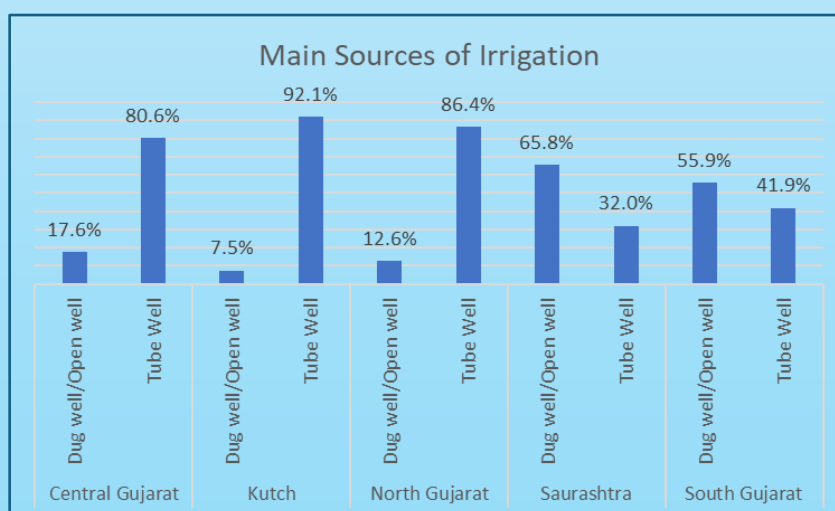
- **Power & Access:** 93% have consistent electricity and road connectivity, although solar adoption is low (5%).
- **Irrigation:** Dependence on tube and open wells dominates, with groundwater levels often exceeding 50 feet.
- **Rainfall & Water Stress:** Most regions received normal rainfall, but 13–18% report local water shortages.

Infrastructure	Percentage / Detail
Electricity Access	93%
Road Connectivity	93%
Solar Adoption	5%
Main Irrigation Sources	Tube wells, open wells
Groundwater Depth	> 50 feet
Rainfall	Normal in most regions
Local Water Shortage	13–18% report shortages

## 3. Costs and Decisions Related to Water Use

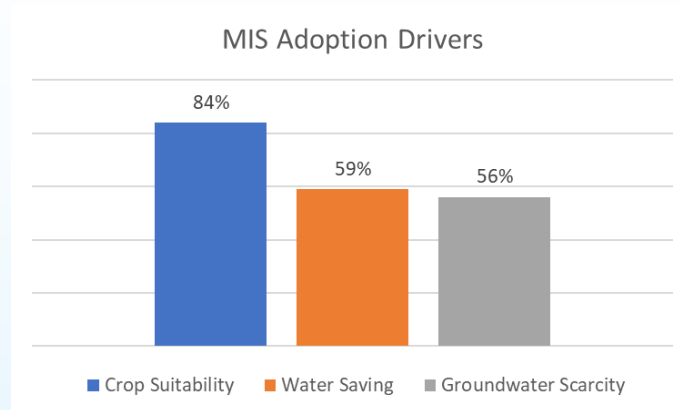
- **Surface Water:** North is diverse, Saurashtra is dependent and costly, Central and South show low usage.
- **Groundwater:** North is costliest, South leans sustainable, Kutch and Central show mixed patterns.

Region	Water Source	Cost/Use Trend
Central Gujarat	Tube wells	Moderate use, low surface reliance
Kutch	Tube wells	High infra, limited surface use
North Gujarat	Tube wells, surface mix	High cost, diversified use
Saurashtra	Dug wells, surface	Costly, surface-dependent
South Gujarat	Dug wells	Low cost, solar-focused



#### 4. MIS Adoption Drivers

- Key motivators include **crop suitability (84%)**, **water savings (59%)**, and **groundwater scarcity (56%)**.

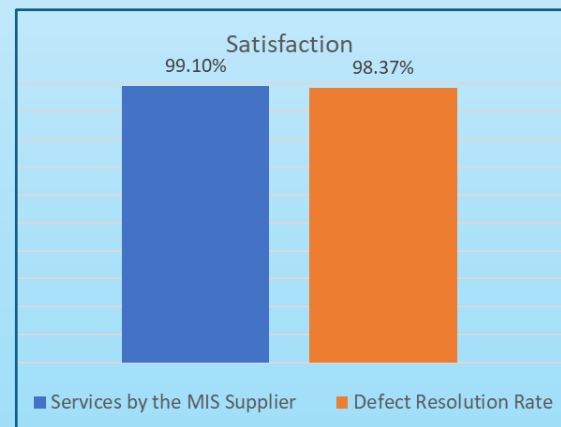


- Decisions are largely peer-driven, with limited NGO influence.

Motivator	Percentage
Crop Suitability	84%
Water Saving	59%
Groundwater Scarcity	56%
Peer Influence	High
NGO Influence	Limited

#### 5. MIS Services and Support

- Satisfaction Levels:** **Over 98%** were satisfied with issue resolution and Services by the MIS Supplier.
- Training & Awareness Gaps:** Over 75% are unaware of local training or testing facilities.
- Post-Installation Support:** 66% required maintenance, and most rely on dealers (78%) for service.



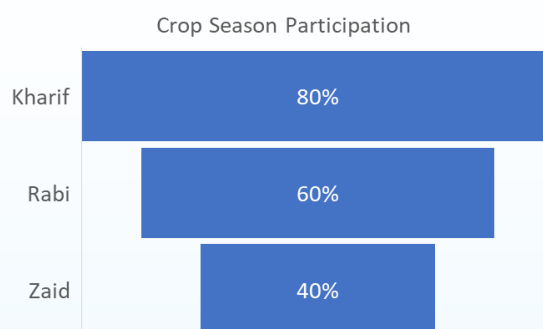
Component	Value
Resolution Satisfaction	>98%
Relied on Dealers for Service	78%

Component	Value
Unaware of Training Facilities	75%+
Required Maintenance	66%

## Section 2: Agricultural Practices & Productivity

### 2.1 Crop Trends and Productivity

- **Kharif:** Dominated by groundnut and cotton (80%).
- **Rabi:** More diverse with wheat, mustard, and potato leading.
- **Zaid:** Least cultivated; 60% of farmers skip this season.



### 2.2 Production Economics

- **Yield Gains:** Particularly strong in Rabi—16.7 tonnes (with MIS) vs. 10.1 (without).
- **Input Costs:** Higher with MIS, but better input targeting increases efficiency.
- **Irrigation Efficiency:** More frequent but shorter irrigations, saving labour and diesel costs.

- **Drip Irrigation Dominates:** >60% adoption statewide; >80% in Saurashtra, Kutch, and South Gujarat.
- **North Gujarat Uniqueness:** Heavy mini-sprinkler use due to local conditions.

### 2.3 Perceived Benefits of MIS

- High scores for **yield increase, water saving, time/labour reduction.**
- Regional differences: North Gujarat showed the highest satisfaction; South and Central Gujarat lower.
- Over **96% of farmers plan to expand** their MIS coverage.

### 2.5 Investment and Financing

- **Declining Farmer Contributions:** From ₹1 lakh in 2008 to ₹30–50K recently due to subsidies.
- **Self-Funded Expansion:** No bank loans recorded for additional systems, limiting further scale for many.

### 2.4 MIS Technology Use and Trends

### 2.6 Land Use and Cropping Patterns

- **Cropping Shift:** Gradual move toward fruit/perennial crops post-MIS.
- **Turnover Increase:** Substantial gains in Kharif and Rabi, especially in Saurashtra and Central Gujarat.

Change Indicator	Trend
Cropping Shift	Toward perennial/fruit
Turnover Gains	High in Kharif & Rabi
Key Regions Benefiting	Saurashtra, Central Guj.

## Section 3: Usage Patterns & Demographics

### 3.1 Utilization and Coverage

- **High Installation (97%) and Usage (87%) Rates.**
- Most non-use is seasonal (off-season); systems are usually stored for reuse.

### 3.2 Impact by Farmer Size

- **Smallholders Benefit Most:** 76% of users are small or marginal farmers.
- **Land Fragmentation Persists:** Most farms <2 ha, especially in Saurashtra and North Gujarat.

### 3.3 Irrigation and Crop Productivity

- **Water Use:** Major savings reported (31.98% on an average), especially in Central Gujarat.
- **Fertilizer Use:** Significant reductions, particularly in Saurashtra and Kutch.
- **Labour Efficiency:** Sharp drops in manual labour for interculture, fertigation, and irrigation.

Factor	Impact/Change
Water Use Savings	32% (On an Average, range 5% - 75%)
Fertilizer Use	Reduced
Labour Efficiency	Improved (interculture, fertigation, irrigation)

## Section 4: Economic, Social & Institutional Impact

### 4.1 Economic and Social Impact

- **Income Gains:** Central and South Gujarat doubled net incomes post-MIS.
- **Lifestyle Improvements:** Over 70% report improved quality of life and food habits.
- **Community Cohesion:** Improved cooperation and lower water-related conflicts.

### 4.2 Farmer Satisfaction and Challenges

- **Satisfaction:** Over 94% happy with MIS; 97% intend continued use.
- **Challenges:** High initial costs, system maintenance (animal damage, dripper clogging), and financial access remain issues.

Metric	Percentage / Note
Satisfaction with MIS	94%+
Continued Usage Intention	97%
Key Challenges	Cost, maintenance, financing

### 4.3 GGRC and Portal Assessment

- **GGRC Services:** 92% satisfied with training/support; 34% face financial barriers.
- **Digital Portal:** Generally user-friendly and transparent, though security and login concerns exist.
- **IEC Effectiveness:** Traditional media and Panchayat workshops/village meetings most effective; emails least.

Area	Observation
GGRC Training/Support	92% satisfaction
Financial Barriers	34% face issues
Portal Usability	Generally user-friendly
Portal Issues	Security, login concerns
IEC Effectiveness	Panchayat, traditional media > email

## Section 5: Policy Analysis & Social Return on Investment

### 5.1 Public Policy Triangle Analysis – Micro Irrigation Scheme

Using Walt & Gilson (1994) Public Policy Triangle framework—**context, content, actors, and process**—to analyze the Micro Irrigation Scheme (MIS) implemented by Gujarat Green Revolution Company Ltd. (GGRC).

- **Context:** Gujarat faces acute water scarcity and high irrigation costs due to deep groundwater reliance. Most farmers are marginal, with limited education and fragmented landholdings, driving the need for efficient irrigation solutions like MIS.
- **Content:** The MIS aims to save water, reduce input costs, increase yields, and enhance food security and livelihoods. It also promotes social cohesion, youth engagement, and environmental awareness.
- **Actors:** Key actors include GGRC (implementer), farmers (users), private dealers and MIS companies (service providers), and local panchayats. Financial institutions and informal support from fellow farmers also play critical roles.
- **Process:** The scheme is promoted via subsidies, media outreach, and workshops. Adoption is high, especially for drip systems. However, challenges persist in maintenance, financial access, spare part availability, and infrastructure issues like land fragmentation and theft.

The analysis highlights the scheme's strong adoption and benefits, but underscores the need for improved support, simplified processes, and targeted interventions for sustained impact.

## 5.2 Social Return on Investment of Micro Irrigation

This Social Return on Investment (SROI) assessment evaluates the economic, social, and environmental impact of Micro Irrigation Systems (MIS) — specifically Drip Irrigation, Mini Sprinklers, and Sprinklers — in Gujarat. The analysis is based on quantitative data (income, water/electricity use, crop yield) and qualitative outcomes (livelihood, social standing, and climate resilience).

### Key Findings:

- **Net Income Increase (per ha/year):**
  - Drip: ₹86,701
  - Mini Sprinkler: ₹65,355
  - Sprinkler: ₹49,056
- **Water Savings:**
  - Drip: 33.66%
  - Mini Sprinkler: 31.48%
  - Sprinkler: 24.75%
  - Combined: 31.98%
- **Crop Yield Improvement:**
  - Drip: 47.11%
  - Mini Sprinkler: 18.73%
  - Sprinkler: 18.61%
  - Combined MIS: 36.22%
- **Social Impact:**
  - 83% reported better quality of life
  - 67% saw reduced social tension over water
  - 66% observed youth retention in farming
  - 60% increased environmental awareness

### SROI Results Over 7 Years:

MIS	Total Benefit	Total Cost	Social Return on Investment	Payback Period (In Years)
Drip Irrigation	501684.5	130000	3.85	1.50
Mini Sprinkler	378168.5	115000	3.28	1.75
Sprinkler	283857.9	25000	11.35	0.51

- **Combined (Weighted SROI): ₹3.92**

### Conclusion:

Micro Irrigation in Gujarat yields a high return, generating ₹3.92 in social value per rupee invested. This is driven by increased incomes, water and energy savings, and socio-environmental benefits. The analysis underscores MIS as a high-impact, cost-effective intervention for sustainable rural development.

## Introduction

The escalating crisis of water scarcity, coupled with the need for sustainable agricultural intensification, has placed micro-irrigation technologies at the forefront of India's agri-policy landscape. Among various state-led interventions, the Micro Irrigation Scheme (MIS) implemented by the Gujarat Green Revolution Company (GGRC) stands as one of the most ambitious and institutionally embedded efforts to address water-use efficiency, crop productivity, and rural livelihoods in a semi-arid context. Given the increasing recognition of irrigation as not merely a technical input but a socio-economic catalyst, this research undertakes a comprehensive and empirical examination of the social return on investment (SROI) and the broader socio-economic impact of MIS implementation across diverse agro-climatic zones in Gujarat.

This study is situated within the broader policy narrative that views water governance and irrigation efficiency as foundational pillars for rural development. The central hypothesis rests on the proposition that the MIS, beyond its technical benefits of reducing water consumption, triggers a cascade of secondary impacts—ranging from input savings, income diversification, and labour reallocation, to shifts in cropping patterns, household well-being, and community-level resilience. By applying a mixed-method approach that combines large-scale survey data, integrated quantitative analysis, and context-sensitive qualitative insights, this research evaluates the extent to which the MIS contributes to measurable socio-economic transformations at the farm and village levels.

The study covers a sample of over 5,000 farmers across five major zones of Gujarat—Saurashtra, North Gujarat, South Gujarat, Central Gujarat, and Kutch—capturing variations in landholding patterns, irrigation sources, cropping intensities, income levels, technology adoption rates, and service delivery ecosystems. Key demographic indicators show a predominance of male farmers aged 41–60, with limited formal education but notable smartphone penetration, indicating a critical interface between traditions and emerging digital competencies. The implementation context is marked by infrastructural enablers such as electricity and road access (reported by over 90% of respondents), contrasted against structural challenges like deep groundwater levels, limited financial inclusion (e.g., <22% Kisan Credit Card penetration), and inconsistent awareness of training and testing infrastructure.

Faced with growing water scarcity, Gujarat's Micro Irrigation Scheme (MIS) by GGRC tackles not just irrigation, but agricultural productivity and rural livelihoods.

This study explores how MIS acts as a socio-economic catalyst, improving income, saving inputs, shifting labour, and boosting resilience — using both data and real-world farmer insights.

### Key impacts of MIS

- Avg. 32% water savings
- Reduced input costs
- Doubled incomes in many areas
- Shifts in labour, cropping, and lifestyle

At the core of the analysis is a disaggregated assessment of MIS-induced impacts, including: (i) changes in land use and cropping diversification; (ii) yield improvements and input cost efficiencies; (iii) seasonal variations in water use and irrigation intensity; and (iv) socio-economic outcomes such as income gains, labour demand shifts, and household lifestyle improvements. For instance, farmers report water savings 31.98% on an average, with substantial reductions in fertilizer and labour costs, particularly for intercultural operations. Income levels doubled in several regions, with a significant movement of farmers into higher income brackets post-MIS adoption.

Moreover, the research highlights spatial asymmetries and system-specific nuances—such as the superior cropping intensity observed under mini-sprinklers (1.89) in North Gujarat versus the extensive but lower-intensity use of drip systems in South Gujarat. It also draws attention to the structural constraints that continue to hinder scaling, including fragmented landholdings, high initial costs despite subsidies, and limited access to post-installation credit for system expansion. Maintenance and service ecosystems are found to be overwhelmingly dependent on

private dealers, with minimal state-led infrastructure support in remote or tribal blocks.

#### System Gaps & Governance

- Mini-sprinklers show higher cropping intensity in the North
- Drip systems widely used in the South but less intensive
- Scaling limited by land fragmentation, high costs, & lack of credit
- 92% satisfied with GGRC, but issues with transparency & portal access persist

From a governance and institutional lens, the role of GGRC emerges as both central and evolving. While 92% of respondents report satisfaction with GGRC's support services, concerns persist regarding subsidy sufficiency, inclusion of GST under subsidy, portal access, and procedural clarity. The study situates these administrative and experiential insights within a broader evaluative framework, assessing the alignment of MIS implementation with equity, efficiency, and sustainability imperatives.

This report aims not only to provide a rigorous empirical evaluation of the socio-economic and agronomic impacts of MIS, but also to contribute to theoretical discourses on technological adoption, water governance, and rural transformation. It seeks to inform future policy design by recommending targeted interventions—such as zone-specific technology mixes, micro-MIS kits for marginal farmers, integrated service ecosystems, and gender-inclusive outreach strategies—that can enhance both the effectiveness and equity of irrigation-led development pathways. The study, therefore, offers a multi-dimensional, data-driven perspective on how a technical intervention, when supported by robust institutions and contextual sensitivity, can act as a transformative lever for agrarian reform in water-stressed regions.

## Objective

The study is guided by five interlinked objectives designed to assess and improve the scheme's performance:

1. **Assess Economic Efficiency:** Measure Social return on investment, productivity improvements, and input cost reductions attributable to MIS.
2. **Evaluate Social Returns:** Understand the broader social impact including quality of life, dietary improvements, and community cohesion.
3. **Map Adoption Drivers and Barriers:** Identify regional, institutional, and behavioural factors influencing MIS adoption and usage patterns.
4. **Analyse Support Ecosystem:** Examine the effectiveness of GGRC's service delivery model, portal usability, financing channels, and dealer networks.
5. **Recommend Scalable Interventions:** Propose actionable policy and programmatic strategies for state and district-level implementation to enhance uptake and sustainability.

### Objectives at a Glance

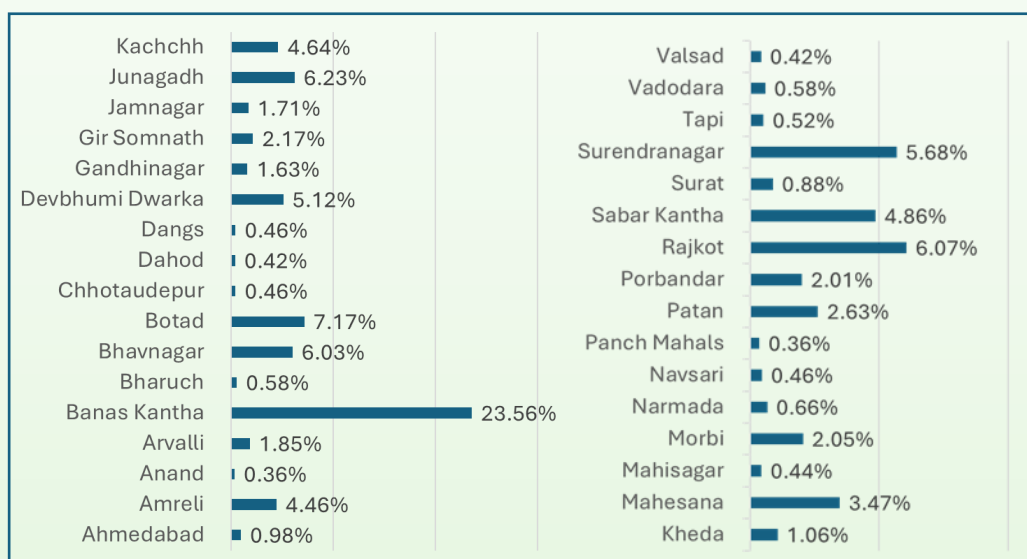
- Measure economic efficiency & SROI of MIS
- Assess social impact on lifestyle & cohesion
- Identify drivers & barriers to MIS adoption
- Evaluate GGRC support & service delivery
- Recommend scalable, actionable interventions

## Research Methodology

A mixed-method approach was adopted for robust, multi-dimensional insights:

- **Sampling & Data Collection:**

- Primary data were collected from 4900 farmers using structured questionnaires.
- These have been divided into districts and zones for the analysis.



- Stratified sampling covered all five agro-climatic zones: North Gujarat (38.84%), South Gujarat (9.02%), Central Gujarat (6.84%), Saurashtra (40.65%), and Kutch (4.65%).

- **Quantitative Analysis:**

- Statistical evaluation of percentages, averages, and comparisons (e.g., yield gains with vs. without MIS, income before vs. after MIS).
- Social Return on Investment has been computed in this report.

- **Qualitative Insights:**

- Interpretation of farmer perceptions, satisfaction levels, and reported challenges.
- Using Public Policy Triangle, the policy has been evaluated and suggestions have been made in the report.

### Research Methodology Snapshot

- **Mixed-method approach:** quantitative + qualitative
- **4,900 farmers** surveyed across 5 agro-climatic zones
- **Statistical analysis** of yield, income, & SROI
- **Farmer perceptions** & challenges captured qualitatively
- **Comparisons** made across time, regions, & farm sizes
- **Public Policy Triangle** used to assess governance

- **Regional Analysis:**
  - Disaggregation of findings by agro-climatic zones within Gujarat (Saurashtra, North Gujarat, Kutch, Central Gujarat, South Gujarat) to identify unique trends and impacts.
- **Temporal Comparisons:**
  - Analysis of changes in income, cropping patterns, and other metrics before and after the adoption of MIS.
- **Segmentation by Farmer Size:**
  - Assessment of the impact of MIS on small, marginal, medium, and large farmers, considering land fragmentation and inclusivity.

The methodology aimed to provide a holistic understanding of the MIS program, its successes, and areas requiring strategic intervention to maximize its benefits across the farming community in Gujarat.

# Analysis, Summary, and Recommendations

## Chapter 1: Farmer Profile and Socioeconomic Snapshot

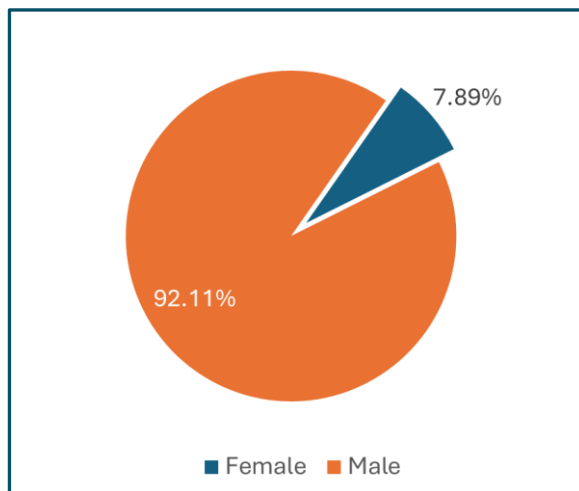
### 1. Overview

Understanding the profile of participating farmers offers crucial insights into the demographic and socio-economic landscape within which the Micro Irrigation Scheme (MIS) operates. This chapter outlines key attributes like gender, age, education, and social background—vital for effective targeting and adaptive implementation of the scheme.

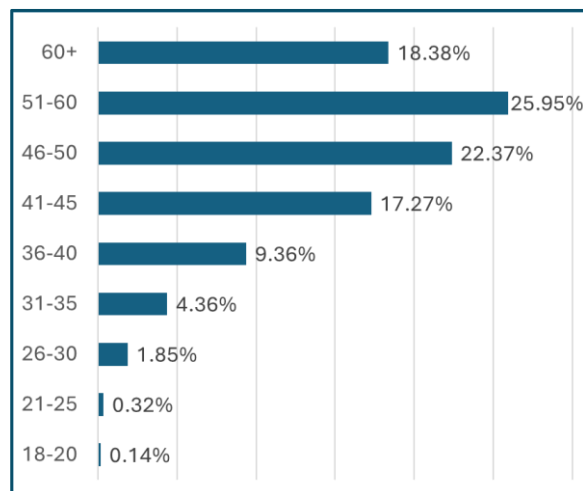
### 2. Gender Distribution

The survey indicates a predominant male representation, with **92.11%** of respondents being male. This aligns with traditional norms where men are primary decision-makers in farming and irrigation investments. Female participation is limited to **7.89%**, revealing a gap in gender inclusion.

**Insight:** There is an opportunity to improve women's inclusion through focused capacity-building and targeted outreach in MIS programs.



*Gender Distribution*



*Age Distribution*

### 3. Age Profile

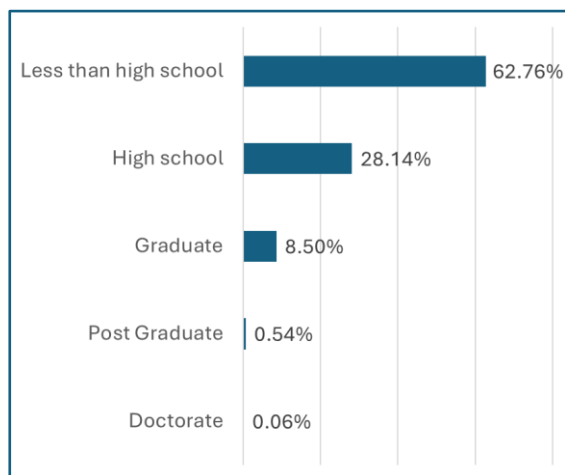
The age distribution shows that **66.7%** of respondents are 46 years or older, with the largest group in the 51–60 range (25.95%). Mid-career farmers (36–45) make up 26.63%, while youth (under 35) constitute just 6.67%.

**Insight:** Engaging younger farmers through digital tools and entrepreneurship models can strengthen future adoption and sustainability of MIS.

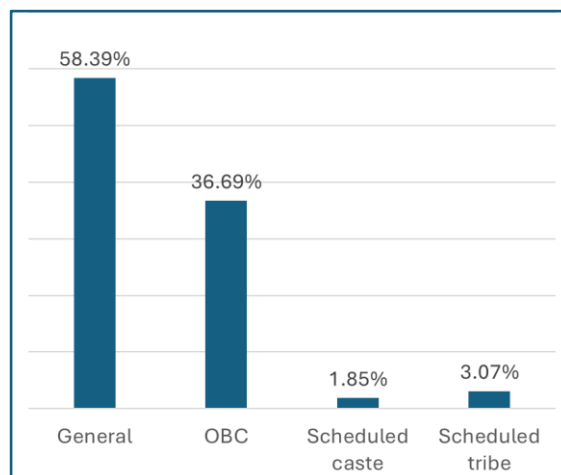
#### 4. Educational Background

About **62.76%** of farmers have education below high school. Only 0.6% hold postgraduate degrees. This suggests the need for simplified, visual, and vernacular materials to communicate the benefits and operation of MIS effectively.

**Key Insight:** MIS-related trainings should avoid technical jargon and focus on experiential learning for broader impact.



*Educational Attainment*



*Social Group Distribution*

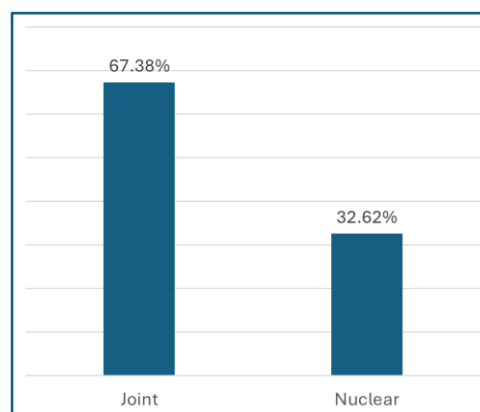
#### 5. Social Group Representation

The social makeup of respondents includes **58.39% General**, **36.69% OBC**, and a combined **4.92% SC/ST**.

**Insight:** Focused inclusion strategies are needed to engage SC/ST farmers, potentially through dedicated schemes or local champions.

#### 6. Family Type and Composition

- Joint families account for **67.38%** of respondents, suggesting a preference for collective decision-making in agriculture.
- Nuclear families represent **32.62%**, requiring individual-oriented outreach.

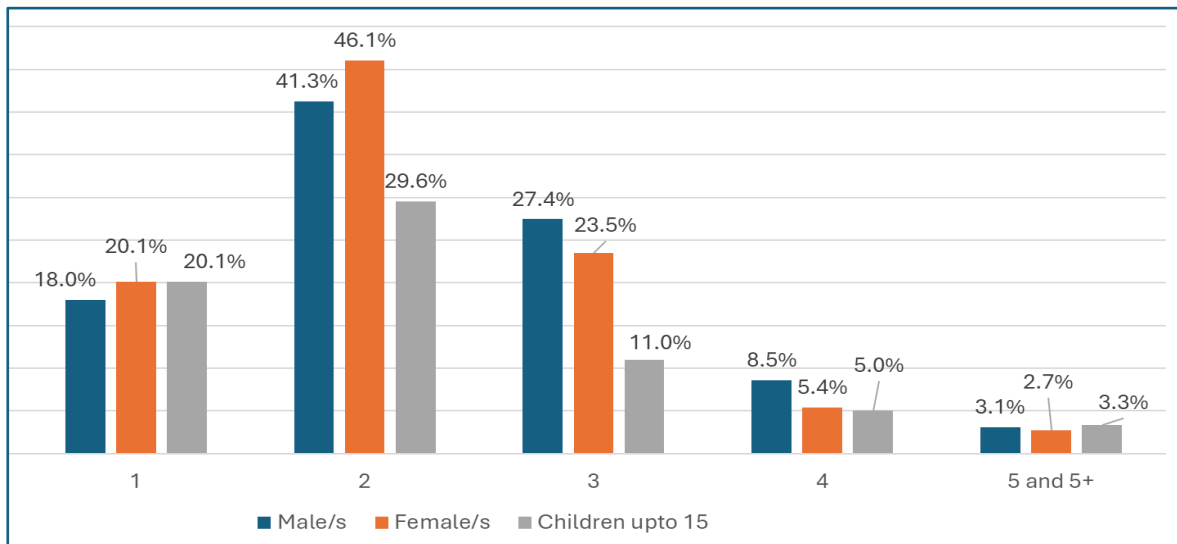


*Family Structure*

## 7. Family Size

- **1–3 adult males** per household: 87.06%
- **1–3 adult females** per household: 89.69%
- Most common: **2 males (41.51%), 2 females (46.29%)**
- **79.92% of households** have 0–2 children, with two children being the most frequent (29.93%).

**Insight:** Predominance of small-to-medium families supports the scalability of MIS, with manageable household sizes aiding adoption and maintenance.

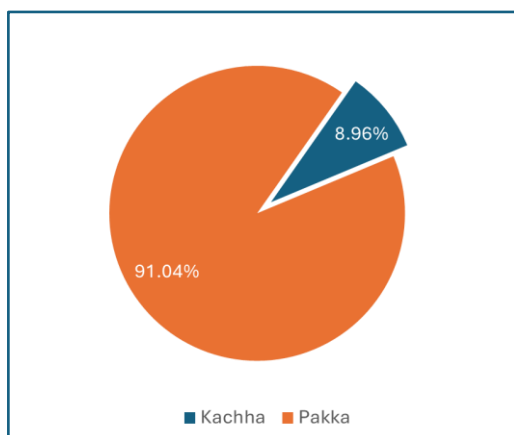


Family Structure – Number of family member/s

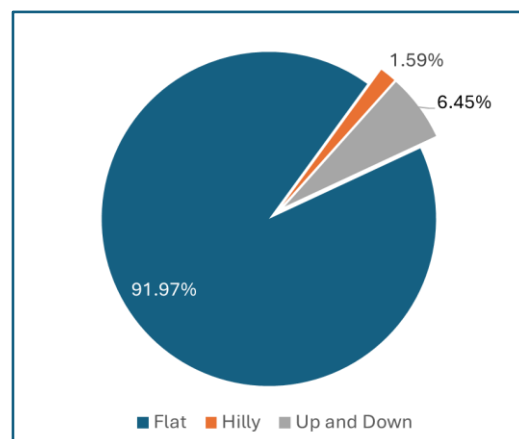
## 8. Road and Terrain Access

- **91.04%** of respondents reported pucca road access
- **91.97%** of the terrain is flat

**Insight:** Excellent physical infrastructure and flat terrain favor wider MIS adoption and service delivery logistics.



Type of access road

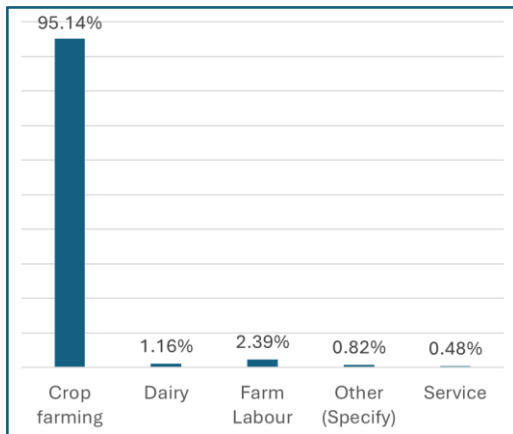


Road and Terrain Access

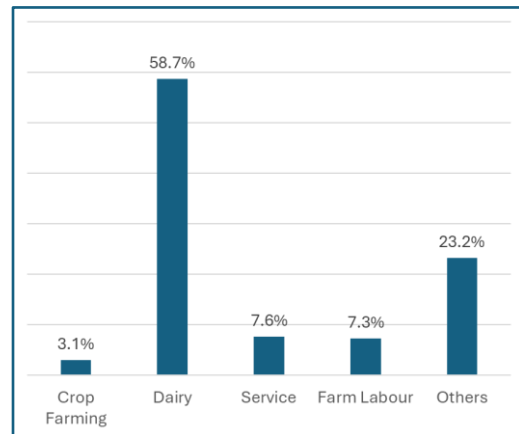
## 9. Primary and Subsidiary Occupation

- **Crop farming:** 95.14% (primary livelihood)
- Non-farming roles like dairy, labour, and service: less than 5%
- About **10%** report a subsidiary occupation

**Insight:** MIS is reaching its intended audience—land-owning cultivators—indicating well-directed targeting.



*Occupational*

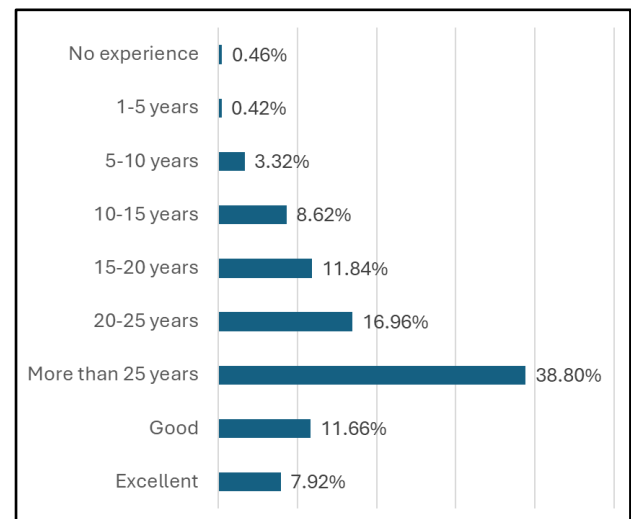


*Distribution*

## 10. Farming Experience and Qualitative Feedback

- **38.8%** have 25+ years' experience
- Another **37.4%** have 10–25 years
- 11.66% and 7.92% report “Good” and “Excellent” performance ratings, respectively

**Insight:** Veteran farmers are a strategic resource—programmes can leverage their trust and insights to guide new adopters.

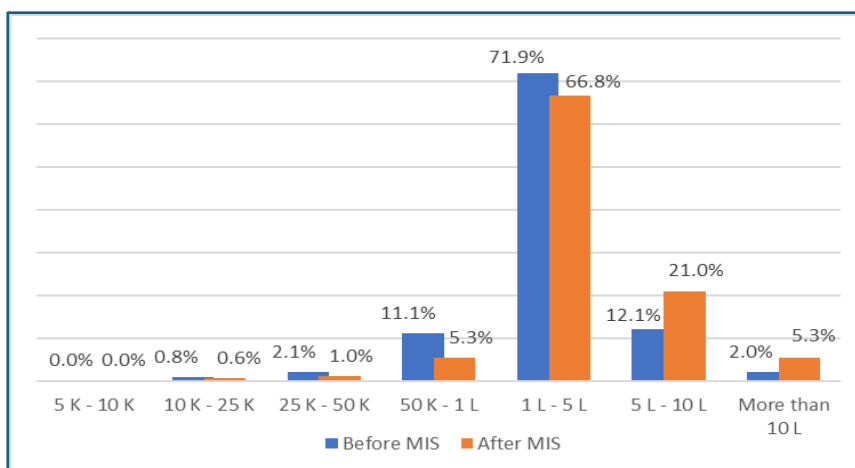


*Farming Experience*

## 11. Income Improvement Post-MIS

Income shifts are noteworthy:

- Farmers earning <₹1 lakh dropped from 14% to 6.9%
- Those earning ₹5–10 lakh increased from 12.12% to 20.97%
- **Above ₹10 lakh** category rose from 1.99% to 5.33%



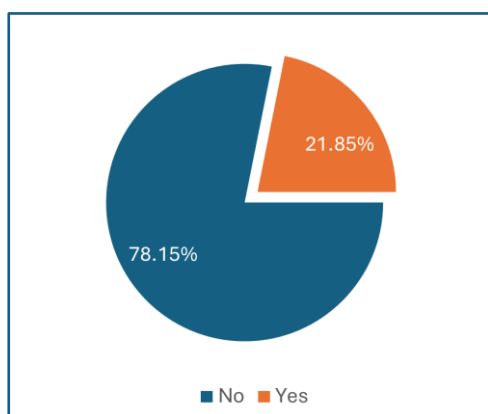
*Income Before vs After MIS*

**Insight:** Clear evidence of income enhancement through MIS adoption makes a strong case for scaling the scheme further.

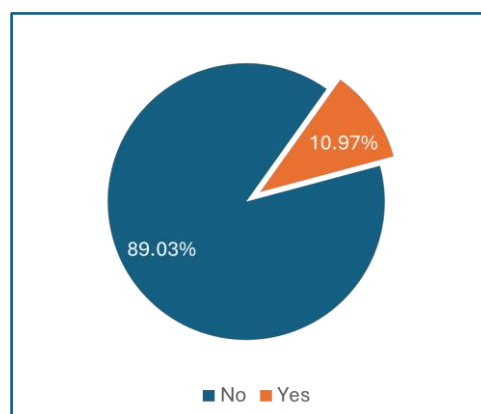
## 12. Financial and Scientific Access

- **Kisan Credit Card (KCC)** holders: only 21.85%
- **Soil Health Card (SHC)** holders: only 10.97%

**Insight:** A large untapped base exists for institutional financial tools and soil management—enhancing this access can boost MIS effectiveness.



*Kisan Credit Card holders*

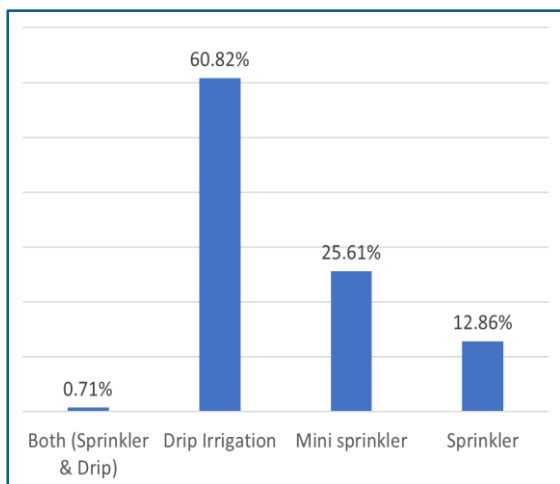


*Soil Card holders*

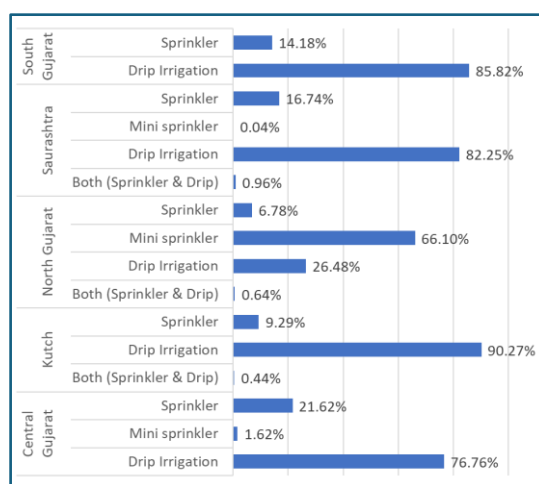
### 13. MIS Technology Adoption Patterns

- **60.82%** use drip systems
- Mini sprinklers: 25.61%
- Sprinklers: 12.86%
- Only **0.71%** use both

**Insight:** Drip irrigation dominates due to its adaptability, but there's scope for system integration and tailored technology use.



System Type Distribution



Zone-Wise Technology Use

### 14. Zone-wise MIS Adoption Trends

- **Saurashtra:** 46.57% of installations, with 82.25% drip
- **North Gujarat:** 66.10% mini sprinklers, regionally unique
- **Kutch & South Gujarat:** High drip use but low overall share
- **Central Gujarat:** Underrepresented despite good adoption rates

**Insight:** Central and South Gujarat offer strategic expansion opportunities. North Gujarat presents a case for region-specific interventions.

### Summary

The profile of farmers under the Micro Irrigation Scheme (MIS) in Gujarat reveals a predominantly male respondent base (92.11%), with strong representation from experienced cultivators—over two-thirds are above 46 years of age, and nearly 39% have over 25 years of farming experience. Education levels are relatively low, with more than 62% of respondents not completing high school, which necessitates the use of simple, vernacular, and visual communication materials for effective engagement. While crop farming is the main occupation for over 95% of the

respondents, their perception of agriculture is split almost equally between it being a business and a livelihood. This dual perspective creates a promising base for both productivity-driven and welfare-driven policy interventions.

The survey also highlights that most households follow a joint family system and have a small-to-medium family size, which supports collective decision-making and resource sharing—factors conducive to MIS adoption. However, youth (below 35) and women remain underrepresented in the adoption base, pointing to the need for more inclusive strategies that reach and engage these groups meaningfully.

Income trends post-MIS adoption are particularly encouraging, with the proportion of farmers earning above ₹5 lakh annually nearly doubling, while those earning less than ₹1 lakh fell by half. These figures underscore the economic viability and transformative potential of MIS. Despite such financial gains, access to key enablers like Kisan Credit Cards (21.85%) and Soil Health Cards (10.97%) remains low, limiting farmers' access to credit and scientific resource management tools that could further enhance outcomes.

Physical infrastructure appears highly favorable to scheme implementation—over 91% of respondents reported pucca road access, and nearly 92% are situated on flat terrain. These conditions support logistics, maintenance, and expansion of irrigation systems. Technologically, drip irrigation is the most widely adopted (60.82%), followed by mini sprinklers (25.61%), with usage patterns showing clear regional variations. Saurashtra leads in total installations, North Gujarat has a strong preference for mini sprinklers, and Central and South Gujarat—while having high internal adoption rates—remain underrepresented in overall reach, suggesting strategic potential for scaling.

## Recommendations

In view of these findings, it is recommended that outreach efforts under MIS be expanded to promote **gender equity and youth engagement**, using targeted communication, training programs, and digital tools. Increasing the **penetration of Kisan Credit Cards and Soil Health Cards** should be prioritized through institutional partnerships and financial literacy initiatives. **Localized, visual, and experience-driven training** formats must be adopted to suit varying education levels among farmers.

Moreover, the scheme should **leverage the presence of highly experienced farmers** by involving them as peer mentors or community champions to guide new adopters. Zone-specific strategies are needed—for instance, strengthening support for mini sprinklers in North Gujarat and expanding MIS infrastructure in Central and South Gujarat. **Innovative models that allow for combined use of drip and sprinkler systems** may be explored for greater efficiency and flexibility. Lastly, policies should actively promote **greater inclusion of Scheduled Castes and Scheduled Tribes** through exclusive schemes, subsidies, or targeted outreach, ensuring equitable access and representation in the benefits of the scheme.

## Chapter 2: Micro Irrigation System (MIS) Investment and Land Use Trends in Gujarat

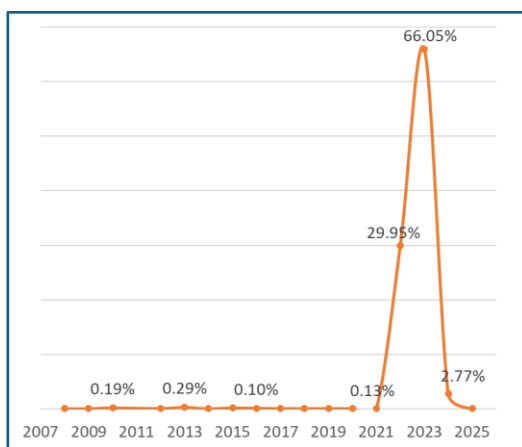
### 1. Overview

This chapter presents a comprehensive view of investment patterns and land use trends under the Micro Irrigation Scheme (MIS) in Gujarat. Drawing from extensive farmer-level data, it captures trends in area coverage, financing patterns, cropping intensity, and regional system preferences. The findings highlight the evolving landscape of MIS across agro-climatic zones and reveal how specific irrigation technologies align with land utilization, water efficiency, and regional cropping practices.

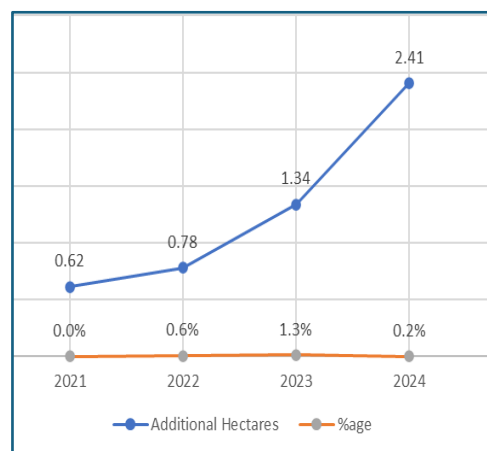
### 2. Investment Trends in Micro Irrigation Systems

#### 2.1 Adoption Coverage and Area per Installation

- The overall adoption of MIS technologies has increased steadily, reflecting the success of awareness, subsidy, and support programs. While drip irrigation remains the most widely adopted system (see Section 3), all technologies have seen consistent uptake across zones.
- A **majority of installations (96%) occurred in 2022 and 2023**, with 29.95% in 2022 and a significant 66.05% in 2023. This clearly suggests a sharp rise in adoption in the last two years, likely influenced by enhanced awareness, implementation efforts by GGRC, and possibly improved subsidies or outreach strategies.



*First Installations (2008 - 2025)*



*Additional Installations*

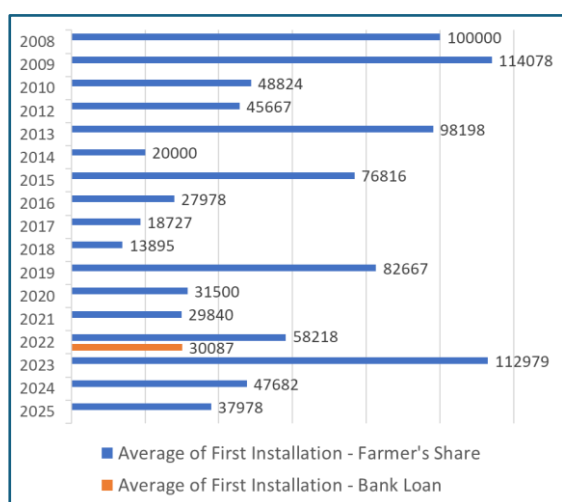
- In terms of **area per installation**, the average has remained **modest and stable**, typically ranging between **1.5 to 2.5 hectares** over the past decade. In recent years (2022–2025),

this figure declined slightly to **1.3–1.4 hectares**. This reduction may reflect **increased targeting of smaller landholders** or more fragmented landholdings, as the scheme seeks to be inclusive across farm sizes.

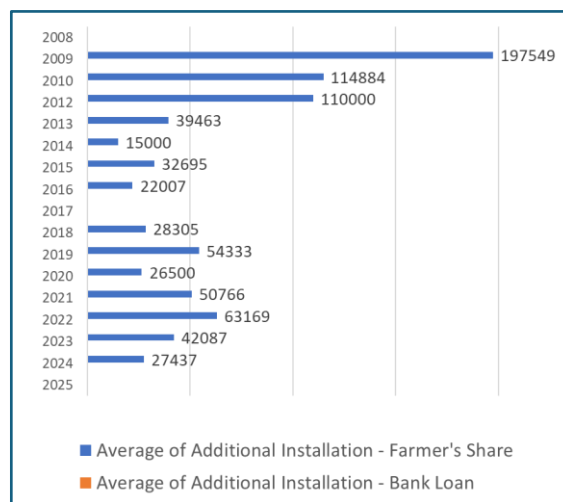
**Insight:** The trend of shrinking installation size supports the idea of **targeted interventions and broader inclusivity**, especially in zones with smallholder dominance.

## 2.2 Farmer Investment in First Installations is Moderating

There is a **clear downward trend in the financial burden** on farmers for their first MIS installation. In earlier years, particularly around **2008**, average farmer contributions were around **₹1,00,000**. In contrast, contributions in recent years (2022–2025) have decreased to an average of **₹30,000–₹50,000**.



*Farmer's & Bank Loan: First Installation*



*Farmer's & Bank Loan: Additional Installation*

This shift indicates **stronger subsidy support, cost optimization, and improved outreach**. These factors together suggest that MIS is becoming **financially accessible to a wider base of farmers**, aligning with policy goals of inclusion and water-use efficiency.

**Insight:** The reduction in first-installation contributions is a **positive marker of affordability and system scale-up**, especially among marginal and small farmers.

## 2.3 Additional Installations are Self-Financed, Not Loan-Supported

While a subset of farmers pursued **additional MIS installations** during 2009–2014 and again in **2022–2024**, **all such expansions were self-financed**. No bank loans or formal credit uptake were recorded for second-phase installations. This pattern suggests that **only financially confident or**

**better-resourced farmers** were able to reinvest in MIS.

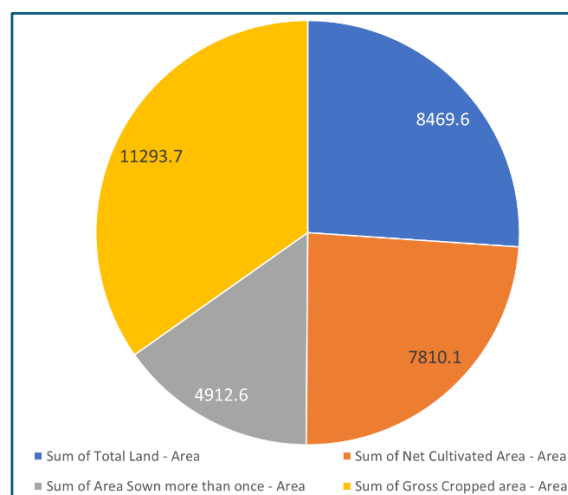
The absence of formal financing points to a critical **gap in credit access and risk-sharing mechanisms** for expansion, which may deter broader reinvestment even among satisfied MIS users.

**Insight:** To ensure **scaling beyond first-time adoption**, it is necessary to create **tailored financial instruments and credit linkage programs** that support additional installations, especially for small and marginal farmers.

#### 4. Overall Land Use Summary

The dataset reflects a total land base of **8,469.6 hectares**, with a **Net Cultivated Area (NCA) of 7,810.1 hectares** and a **Gross Cropped Area (GCA) of 11,293.7 hectares**. This results in a **cropping intensity of 1.45 (or 145%)**, indicating widespread multi-cropping practices across the sample.

Metric	Area (ha)
Total Land	8,469.6
Net Cultivated Area	7,810.1
Area Sown > Once	4,912.6
Gross Cropped Area	11,293.7



*Total vs Net vs Gross Cropped*

**Insight:** The intensity figure reflects high land utilization and supports the case for MIS as a key enabler of sustainable multi-cropping.

#### 5. Land Use by Irrigation System (State Level)

**Drip irrigation** dominates, accounting for **64%** of total land. However, **mini sprinkler systems show the highest cropping intensity at 1.89**, indicating superior support for multiple cropping cycles. In contrast, **sprinklers and dual systems (drip + sprinkler)** occupy smaller shares.

System Type	Total Land	NCA	Area Sown > Once	GCA	Cropping Intensity
Drip	5,426.5	5,021.4	2,354.2	6,798.7	1.35
Mini Sprinkler	1,698.1	1,572.3	1,750.8	2,964.9	1.89
Sprinkler	1,285.7	1,161.7	773.8	1,458.8	1.26
Both Systems	59.3	54.7	33.9	71.3	1.30

*Cropping Intensity by System Type*

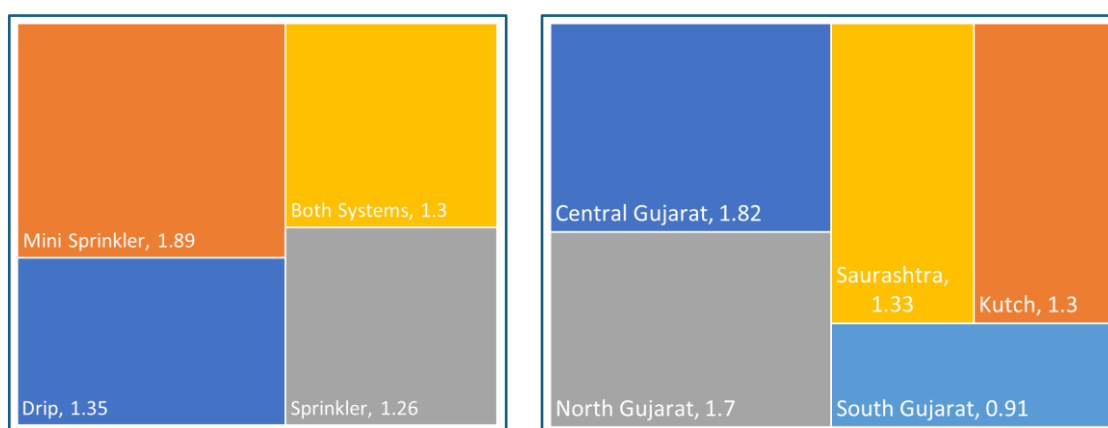
**Insight:** While drip systems lead in area coverage, mini sprinklers are most effective in maximizing land productivity, especially in multi-crop scenarios.

## 6. Land Use by Zone (All Systems Combined)

Zone	Total Land	NCA	Area Sown > Once	GCA	Cropping Intensity
Central Gujarat	683.8	644.8	487.0	1,174.3	1.82
Kutch	565.7	559.4	341.5	726.7	1.30
North Gujarat	2,721.6	2,581.3	2,426.6	4,389.6	1.70
Saurashtra	3,513.2	3,205.5	1,482.8	4,261.4	1.33
South Gujarat	985.2	819.0	174.8	741.6	0.91

*Cropping Intensity by Zone (All Systems Combined)*

**Insight: Central and North Gujarat lead in cropping intensity**, making them high-efficiency zones, while **South Gujarat's low intensity (0.91)** may reflect mono-cropping or perennial crop focus.



*Treemaps of Cropping Intensity by System Type and Zone-wise (all systems)*

## 7. Zone-Wise Analysis by Irrigation System

- **Central Gujarat:** Drip-dominated (81%), with high cropping intensity (1.82). Very little mini sprinkler use.
- **Kutch:** 88% of area under drip. Limited diversification. Cropping intensity ~1.3.
- **North Gujarat:** Most diversified use. Mini sprinklers dominate (1,685.8 ha). Highest re-sown area and intensity (~1.7).
- **Saurashtra:** Drip-dominated (2,679.3 ha), moderate cropping intensity (1.33),

low mini sprinkler usage. **South Gujarat:** Despite high drip adoption, cropping intensity is lowest (0.91), possibly due to sugarcane or perennial crops.

**Insight: Zone-specific tailoring** of MIS interventions can optimize returns. North Gujarat shows high multi-cropping with mini sprinklers; Central Gujarat leverages drip for intensive land use; South Gujarat requires efficiency improvements or cropping model review.

## Summary

The MIS investment and land use profile in Gujarat illustrates a landscape of expanding reach, stabilizing costs, and increasing land productivity. While average area per installation has declined—reaching 0.5 hectares in 2025—this reflects a deliberate inclusion of smaller farms. Farmer contribution levels have dropped significantly, enhancing affordability and uptake. However, **additional installations remain entirely self-financed**, highlighting a structural weakness in credit access. Drip irrigation continues to dominate, particularly in Saurashtra and Central Gujarat, but **mini sprinklers emerge as the most efficient system**, with a cropping intensity of **1.89**.

In regional terms, **Central and North Gujarat** exhibit the most efficient land use, benefiting from diverse system adoption and higher cropping intensities. **South Gujarat**, despite high system adoption, shows underutilization of land (0.91 intensity), likely due to perennial crop preferences or regional constraints. **Zone-wise system alignment** shows how regional ecology, farm size, and crop types influence MIS outcomes—offering valuable cues for program refinement.

## Recommendations

- **Introduce subsidized financing mechanisms** for additional installations to support repeat adoption, particularly for small and marginal farmers.
- **Align irrigation system packages with regional land use profiles**, promoting mini sprinklers in North Gujarat, drip in Central and Saurashtra, and targeted interventions in South Gujarat.
- **Enhance institutional credit access** and simplify loan procedures through partnerships with cooperative banks and agri-credit societies.
- **Promote integrated water and cropping strategies**, particularly in regions with low cropping intensity, to ensure that irrigation investments yield full agronomic and economic benefits.
- **Invest in farmer training** on cropping intensity, system maintenance, and climate-responsive practices to maximize returns on MIS.

## Chapter 3: Irrigation Infrastructure, Water Lifting Costs, and Decision-Making for MIS

### 1. Overview

This chapter examines the complex landscape of water lifting for crop production in Gujarat and identifies key factors influencing the adoption of Micro Irrigation Systems (MIS). It explores both **surface and groundwater cost patterns, energy infrastructure, and regional irrigation behaviours**, offering a grounded understanding of what drives MIS-related decisions at the farm level.

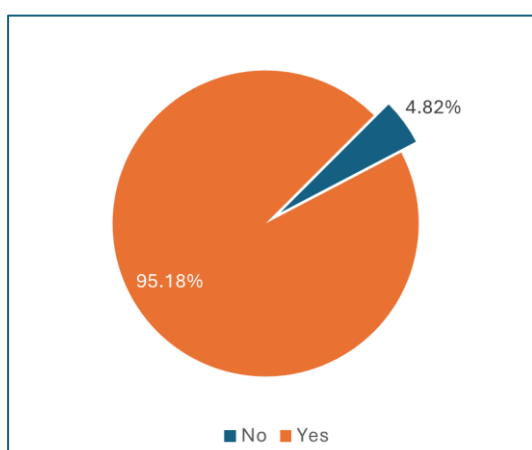
These dynamics are best understood in light of the **physical context** and **irrigation realities** farmers operate within, which are summarized below.

### 2. Infrastructure & Irrigation Sources Context

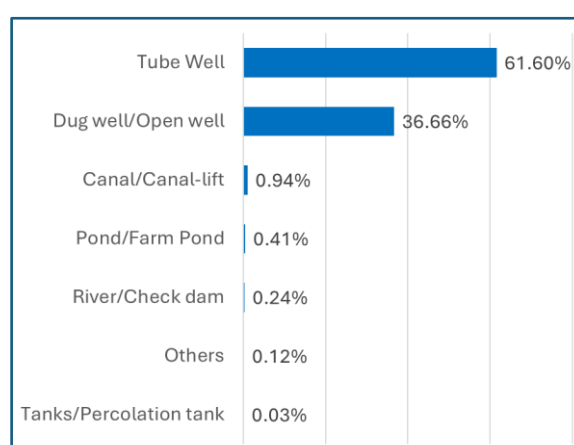
Farmers across Gujarat enjoy **generally favourable infrastructure and terrain. Electricity access is strong, with 95.18% connected to the Gujarat Electricity Board (GEB) and 93.67% receiving 7–8 hours of daily power**, enabling routine irrigation via electric pumps.

Despite this, **solar energy adoption remains limited at only 4.90%**, indicating an underutilized avenue for sustainable irrigation.

**Irrigation sources remain heavily groundwater-dependent, with 61.60% using tube wells and 36.66% using dug/open wells.** Over 74% of wells tap water from depths between 50–750 feet, signaling deep aquifers and significant energy costs for lifting.



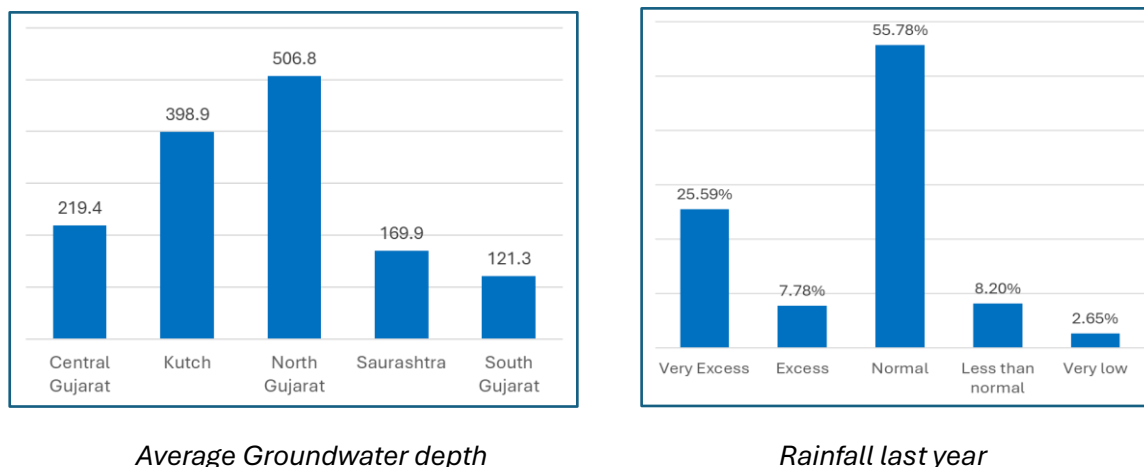
*Electricity availability*



*Irrigation sources*

Rainfall patterns are regionally varied—**55.78% reported normal rainfall**, while **33.37% faced excess/very excess rainfall**, and **13–18% experienced moderate to acute water shortages** on-farm. This suggests that despite good rainfall in parts, **storage, soil absorption, and aquifer conditions** vary enough to create **localized stress**, necessitating efficient irrigation solutions like MIS.

**Insight:** Gujarat’s favorable power access and topography are strong enablers for irrigation, but groundwater depth and rainfall variability highlight the economic and sustainability rationale for adopting water-efficient systems.



## 2. Cost of Water Lifting for Crop Production

### 2.1 Surface Water Usage: Patterns and Cost Implications

Surface water use is significant in North Gujarat and Saurashtra, with limited application in Central and South Gujarat. Cost profiles vary by source—canals, rivers, ponds—and depend on terrain, energy type, and labour.

#### a) North Gujarat: Diverse Sources, Moderate Cost Structure

North Gujarat utilizes **all four surface water sources**—canals, rivers, farm ponds, and “other” categories. **Recurring costs** range between ₹2,000–₹6,250, and **motor infrastructure** costs range from ₹15,000 to ₹23,000.

**Insight:** The diverse use of sources demonstrates **access flexibility**, and moderate infrastructure costs suggest that **surface water remains a viable irrigation input** where available.

#### b) Saurashtra: High Surface Water Dependence, High Costs

Saurashtra reflects **heavy reliance on high-cost surface water**, especially river sources. Diesel costs touch ₹10,000, electric usage costs ₹8,250, and labour adds another ₹6,250. Infrastructure for "Any Other" sources can cost up to ₹55,000.

**Insight:** High cost burdens may reduce profitability, making MIS adoption more appealing for reducing water use and lowering recurring costs.

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### c) Central and South Gujarat: Low Surface Engagement

Surface water use is minimal in Central and South Gujarat. In Central Gujarat, **river-based irrigation costs ₹15,333**, and **farm ponds involve electric (₹2,400)** and labour (₹1,500) use. South Gujarat shows sparse use, with only modest recurring costs.

**Insight:** These regions may rely more on groundwater or receive adequate rainfall. However, where water shortages exist, **cost-efficient groundwater access** and **MIS** can address operational gaps.

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## 2.2 Groundwater Use: Regional Cost Variability

Groundwater remains the dominant irrigation source across all regions. Costs vary based on **depth, pump type, and energy source**—with marked inter-regional differences.

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### a) North Gujarat: Deep Wells, High Electricity Cost

In North Gujarat, groundwater is **accessed from deep tube wells**, driving high expenses. **Motor costs** exceed ₹1 lakh, while **recurring costs** for electricity and water total over ₹46,000 annually.

**Insight:** These recurring burdens reinforce the economic value of MIS, which can help reduce energy and water usage.

---

### b) South Gujarat: Solar Investments for Long-Term Gains

South Gujarat shows progressive investment in **solar-powered water lifting**. While solar system costs average ₹2.8 lakh, recurring costs are low to negligible.

**Insight:** Though still nascent, solar adoption demonstrates a shift toward sustainable irrigation and reduced energy dependency.

---

**c) Kutch and Central Gujarat: Significant infrastructure spending.** Motor cost in Kutch for tube wells was e.g., ₹1.33 lakh, but have incomplete recurring cost details.

**Insight:** This indicates a likely underestimation of operational expenses or variation in water-lifting intensity.

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## Summary

Gujarat's irrigation landscape is defined by **strong power infrastructure, heavy groundwater dependence, and rising water lifting costs**, especially in North Gujarat and Saurashtra. Although regions like Central and South Gujarat show limited use of surface water, groundwater remains energy- and cost-intensive. In North Gujarat, recurring water and electricity expenses top ₹46,000 annually, driven by deep tube wells and electricity usage. Saurashtra too incurs high diesel and capital expenses for river-based irrigation.

Farmers are **increasingly constrained by the costs of lifting water**, and this is a central factor driving **MIS adoption**, which promises to reduce water and energy requirements. However, **solar pump usage remains low** (only 4.9%), despite power access being widespread and reliable. Encouragingly, South Gujarat demonstrates early investment in solar systems for water lifting, which can be replicated elsewhere.

The reliance on self-funding for additional MIS installations remains a structural issue, underlining the need for targeted financing solutions. Rainfall variability and deep water tables further emphasize the importance of efficient irrigation and smart water budgeting.

## Recommendations

- **Expand solar pump adoption** in North and Saurashtra regions through targeted capital subsidies, drawing on South Gujarat's success.
- **Provide differentiated subsidies** or technology packages in high-cost zones (e.g., North Gujarat tube wells, Saurashtra diesel motors) to ease financial burden.
- **Introduce loan products for additional MIS installations**, moving beyond first-time support to scale up water efficiency.
- **Train farmers to assess cost-benefit of water lifting systems**, and offer decision-making tools to compare diesel vs electric vs solar options.
- **Enhance surface water harvesting infrastructure**, especially in Central and South Gujarat, to diversify irrigation sources and reduce groundwater dependence.

## Chapter 4: Factors Influencing Adoption of Micro Irrigation Systems (MIS) and Farm Operational Sizes

### 1. Overview

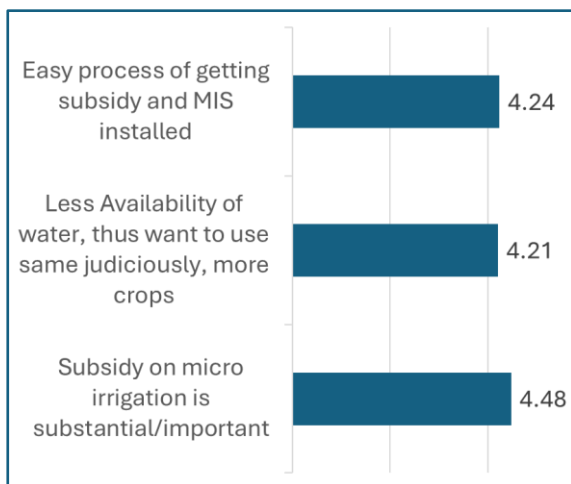
The decision to adopt Micro Irrigation Systems (MIS) is governed by a combination of policy-driven incentives, environmental pressures, and farmer-specific operational conditions. This chapter explores the core **motivators** and **barriers** to MIS adoption using two distinct lenses:

1. Average farmer ratings on enabling and inhibiting factors (scale 1–5)
2. Distribution and scale of landholdings across Gujarat's agro-climatic zones

Together, these insights help identify where the adoption ecosystem is thriving and where it requires further support or simplification.

### 2. Key Factors Determining MIS Adoption

Farmers identified financial incentives, particularly government-provided subsidies, as the most influential factor in their decision to adopt MIS. This was followed by ease of accessing subsidies and installation support, and a growing awareness of water scarcity as a long-term environmental concern.



*Average Rating of Adoption Drivers*

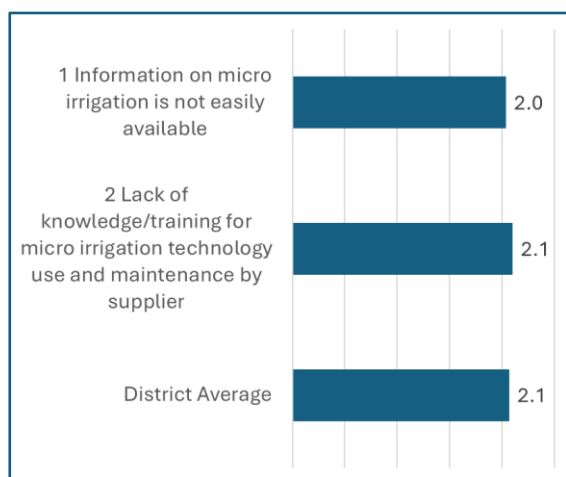
- Subsidy on MIS: 4.48
- Ease of Access to Subsidy and Installation: 4.24
- Water Scarcity Concerns: 4.21

**Insight:** Subsidy-related support is the strongest lever for adoption, but its effectiveness depends on procedural simplicity and farmer perceptions of long-term water availability.

### 3. Challenges Faced in Adopting MIS

Despite positive attitudes, farmers encounter barriers across five major areas—training, financial procedures, cost and maintenance, water and electricity infrastructure, and land-related constraints.

#### 3.1 Awareness and Training



Average Rating of lack or non-availability

Farmer feedback reveals that overall awareness levels are adequate. However, about **10% of farmers reported a lack of structured training from suppliers**, suggesting a localized service gap, particularly in non-clustered areas.

**Insight:** Awareness is widespread, but technical training remains inconsistent across regions, limiting optimal usage and maintenance outcomes.

Please note that the survey questions are phrased in a way that may lead to lower scores on the agreement scale (1 = strongly disagree, 5 = strongly agree)

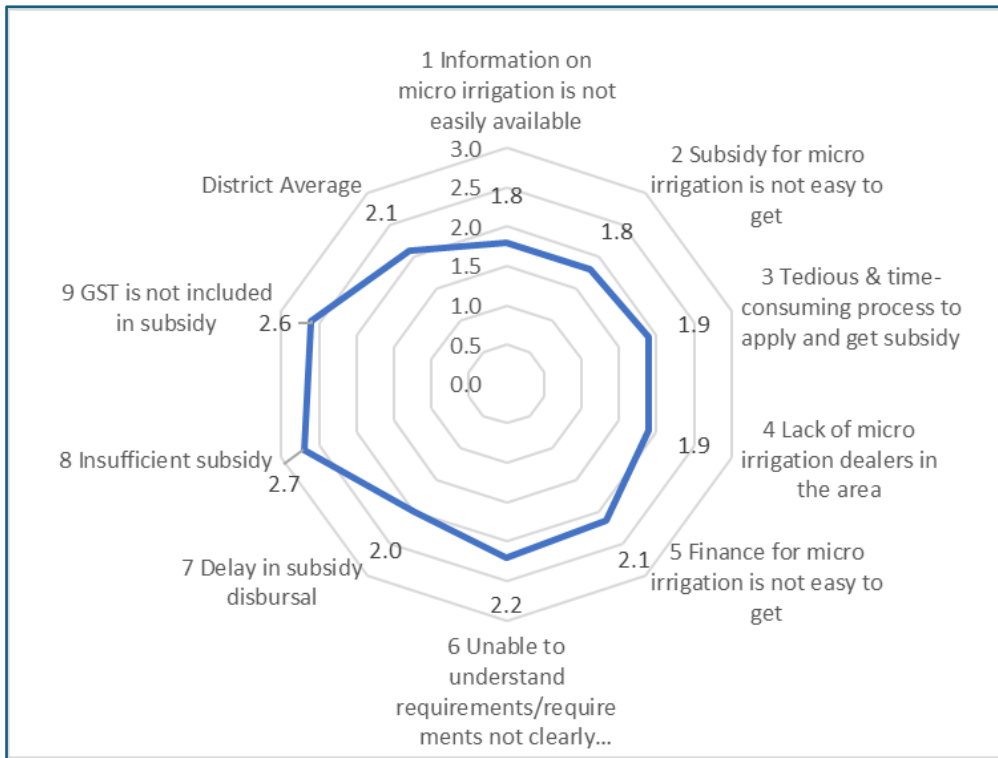
#### 3.2. Subsidy, Finance, and Dealer Access

Subsidy-related dissatisfaction stands out clearly:

- **High concern areas:** insufficient subsidy (2.7), GST not covered (2.6)
- **Moderate issues:** finance difficulty (2.1), subsidy delay (2.0)
- **Lower concern:** info access and application ease (1.8 each)

**Insight:** Farmers are aware of available support, but **lack clarity on disbursement mechanisms and final entitlements**, which dampens motivation despite high perceived value.

Please note that the survey questions are phrased in a way that may lead to lower scores on the agreement scale (1 = strongly disagree, 5 = strongly agree)



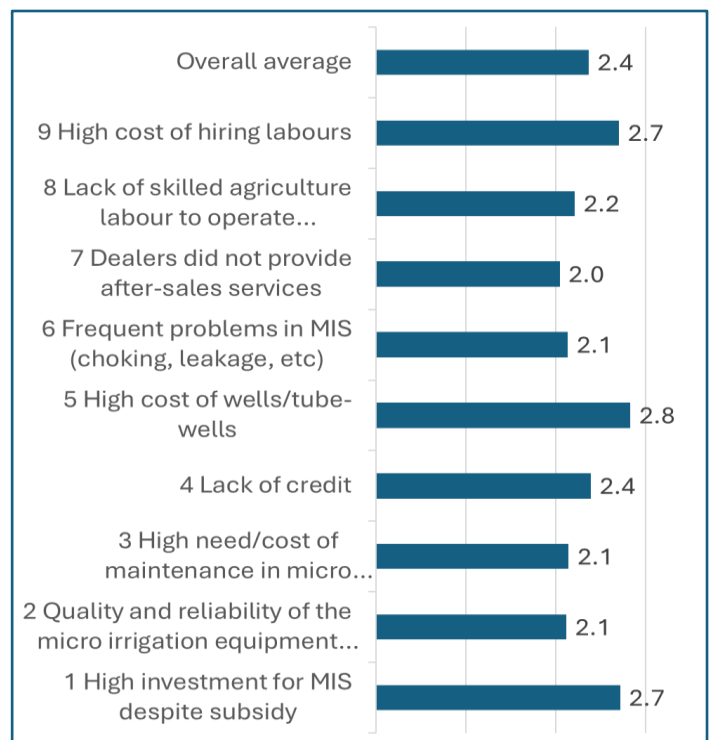
Average Rating of Subsidy, Finance, and Dealer Access

### 3.3 Initial Cost and Maintenance Problems

Farmers showed:

- **High concern** with overall cost (2.7) and labour hiring (2.7)
- **Moderate concern** with technician availability (2.2), credit access (2.4)
- **Low concern** about equipment reliability, dealer support, or system quality (~2.0–2.1)

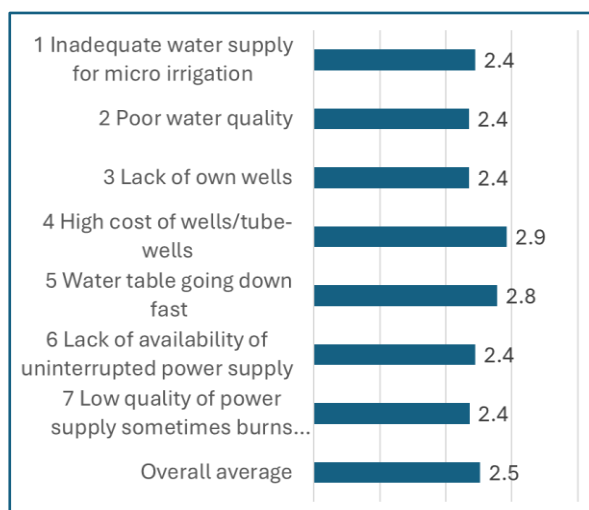
**Insight:** Confidence in system performance is high, but **adoption hesitancy remains driven by financial risk and external labour dependence**, especially among smallholders.



Average Rating of Initial Cost and Maintenance Problems

Please note that the survey questions are phrased in a way that may lead to lower scores on the agreement scale (1 = strongly disagree, 5 = strongly agree)

### 3.4 Water and Electricity Availability and Quality



Farmers reported high concern around:

- **High cost of wells/tube wells** (2.9)
- **Declining water tables** (2.8)
- **Unreliable power, poor water quality, lack of own source** (2.4 each)

**Insight:** Even when subsidies are available, **resource constraints at the farm level**—especially deep-water access and unreliable electricity—remain formidable adoption barriers.

*Average Rating of Water and Electricity Availability and Quality*

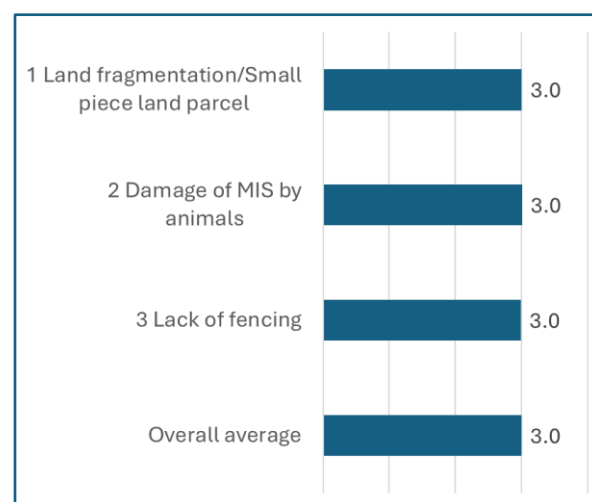
Please note that the survey questions are phrased in a way that may lead to lower scores on the agreement scale (1 = strongly disagree, 5 = strongly agree)

### 3.5 Other Structural and Operational Problems

Issues such as:

- **Land fragmentation**
- **Animal damage**
- **Lack of fencing**

scored around **3.0**, indicating neutral to moderate concern. These problems do not deter adoption but may influence **layout feasibility, maintenance frequency**, and long-term efficiency.



*Other Structural and Operational Problems*

**Insight:** Structural issues add cost and complexity to MIS projects and should be addressed through **context-specific infrastructure solutions**, such as fencing support or cluster installations.

#### 4. Farm Operational Sizes and Distribution

Landholding size is a critical determinant of adoption feasibility. The **majority of farmers (72.3%)** are in the **marginal and small categories**, with limited capital and fragmented plots.

Farmer Category	% of Farmers	Avg. Landholding (ha)
Marginal (<1 ha)	49.0%	0.66
Small (1–2 ha)	23.3%	1.39
Medium (2–5 ha)	18.2%	2.62
Large (5–10 ha)	7.5%	5.39
Very Large (>10 ha)	0.55%	11.0

*% of Farmers by Category vs. Avg. Landholding*

**Insight:** While small and marginal farmers dominate numerically, **larger landholders control more land** and can more easily adopt MIS without financing barriers.

#### 5. Zone-Wise Patterns in Landholding and Adoption Potential

Zone-wise landholding patterns reveal adoption scalability:

Zone	<1 ha (%)	1–2 ha (%)	>10 ha (%)
North Gujarat	16.7	18.4	0.2
Saurashtra	12.3	19.9	0.1
Central Gujarat	9.5	17.2	0.2
South Gujarat	7.8	15.4	0.1
Kutch	11.1	14.7	0.1

*Landholding Size Distribution by Zone*

**Insight:** Regions like North Gujarat and Saurashtra, with a high share of <2 ha farms, require **subsidy-linked micro-MIS packages** and stronger dealer/service support.

#### Summary

The decision to adopt MIS is shaped by:

- **Strong motivational factors** (subsidy, accessibility, water stress)
- **Financial and procedural obstacles** (inadequate subsidy coverage, cost, and labour access)
- **Infrastructure dependencies** (water source depth, electricity reliability)

- **Farm structure constraints** (small and fragmented landholdings)

The average rating-based analysis offers **granular insights** that complement earlier chapters focused on post-installation performance.

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## Recommendations

1. **Digitize and clarify subsidy workflows**, including GST treatment and real-time status updates.
  2. **Develop and promote micro-MIS kits** for <1 ha farmers with modular design and shared usage models.
  3. **Establish regional training/demo hubs**, especially in low-adoption clusters.
  4. **Incentivize private technician certification**, especially in blocks with poor service density.
  5. **Promote cluster fencing and layout planning** in fragmented holdings to reduce operational barriers.
  6. **Combine MIS rollout with groundwater recharge and solar irrigation programs**, especially in high-cost, low-power areas.
-

## Chapter 5: Maintenance, Service Ecosystem, and Utilization of Micro Irrigation Systems (MIS)

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### 1. Overview

As Gujarat continues to scale Micro Irrigation Systems (MIS), the **sustainability and performance of these systems** increasingly depend on **timely maintenance, accessible service support, and informed usage practices**. This chapter explores farmer awareness of training/testing facilities, demand for maintenance support, the reliability of service ecosystems, and actual utilization trends on-ground. The findings reveal **strong adoption and satisfaction**, but also critical gaps in **institutional outreach and decentralized service delivery**, particularly for smallholders in remote regions.

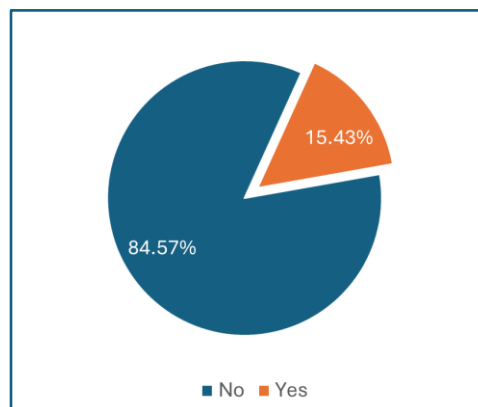
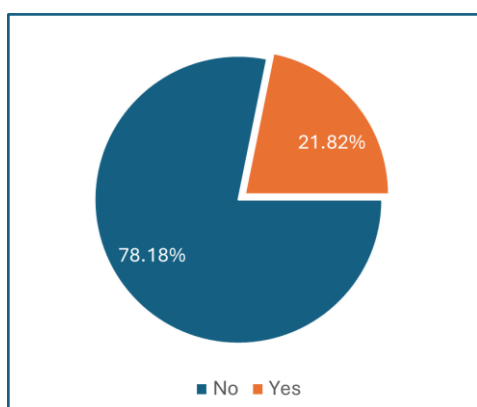
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### 2. MIS Maintenance and Service Delivery

#### 2.1 Limited Awareness of Training and Testing Infrastructure

Despite the existence of established centers like **Deesa and GGRC Devbhumi Dwarka**, farmer awareness of technical services is alarmingly low:

- **78.18%** of farmers are unaware of MIS training centers.
- **84.57%** do not know where to access component testing facilities.



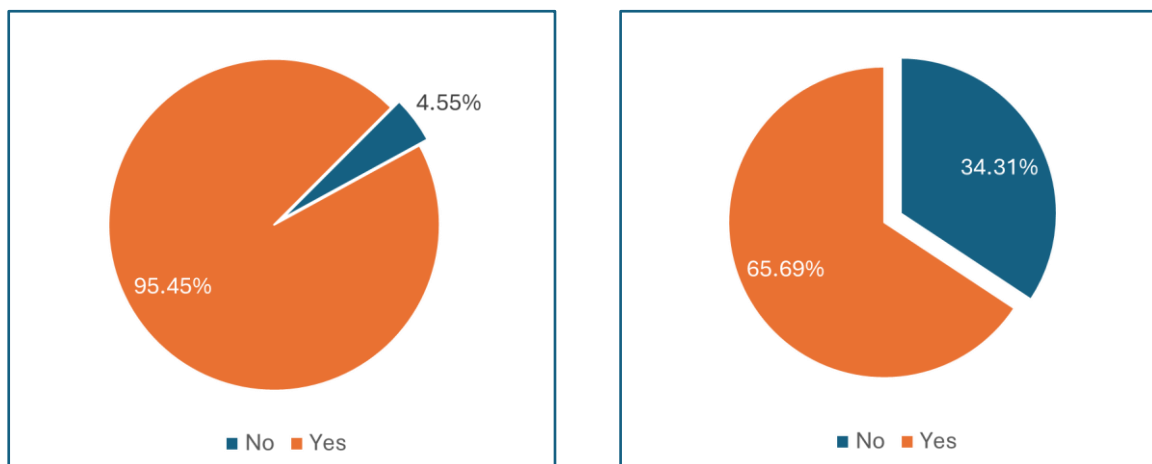
*Awareness of MIS Support Facilities: Training facility and Testing facility*

**Insight:** The gap limits the ability of farmers to properly operate, maintain, and optimize their systems—calling for **localized awareness campaigns in vernacular languages**.

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## 2.2 Maintenance Demand and Information Dissemination

While **95.45% of farmers** received MIS-related information during the **installation or trial phase**, **65.69% required maintenance support** after that point. This suggests a mismatch between one-time orientation and ongoing technical needs.



*Information Received vs Maintenance Needed*

*Depicts the contrast between initial awareness and post-installation support demand.*

**Insight:** Sustained service support must be integrated into the MIS lifecycle—not just frontloaded during installation.

## 2.3 High Service Satisfaction but Private Sector Reliance

Despite limited public infrastructure, service satisfaction is remarkably high:

- **99.10%** of users reported being satisfied with service.
- **98.37%** confirmed their issue was resolved.

Resolution, however, relies heavily on private channels:

Support Source	% of Cases
Dealers	78%
MIS Companies	57%
Distributors	22%
Fellow Farmers	11%
Government Agencies	8%

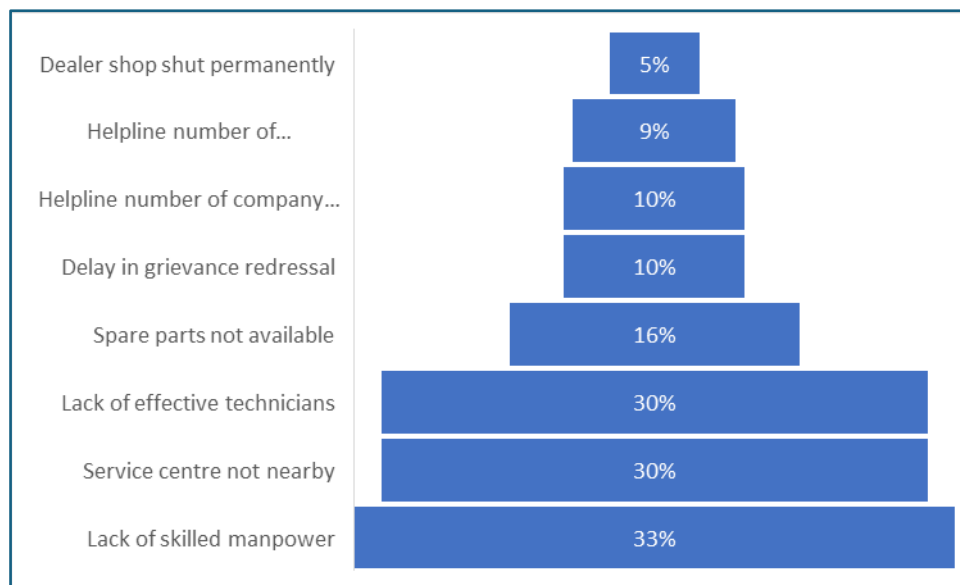
*Sources of Service Resolution*

**Insight:** While efficient, **dealer-based support may not be scalable or equitable**, especially in **low-density or low-income areas**.

## 2.4 Challenges in Unresolved Service Cases

In the minority of unresolved cases, barriers are mostly infrastructural:

- **33%** cite lack of skilled manpower
- **30%** face technician unavailability
- **30%** lack a nearby service center



*Breakdown of Service Barriers in Unresolved Cases*

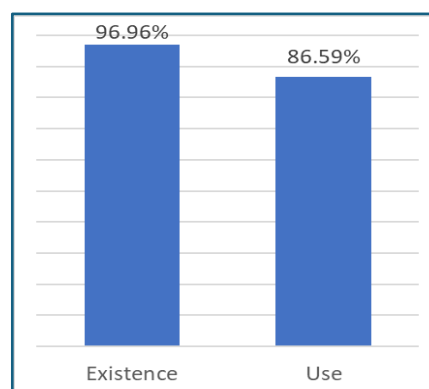
**Insight:** These issues call for **mobile service units, regional part depots, and trained rural technicians** to bridge logistical gaps.

## 3. MIS Utilization in the Field

### 3.1 High Adoption and Active Use

MIS systems have achieved **remarkable field-level penetration**:

- **96.96%** of surveyed farms have an MIS installed
- **86.59%** of those systems are **actively used**



*Installed vs Active MIS Systems*

**Insight:** High utilization indicates both **trust and functional relevance**, validating the outreach and subsidy model.

### 3.2 Seasonal Downtime is the Main Reason for Non-Use

Among the **13.41% of systems not currently in use**, the majority report **seasonal downtime** as the reason—not system failure.

Reason	% of Non-Use
Seasonal Downtime	84.78%
Dry Water Source	14.16%
System Repair	1.07%

*Reasons for MIS Non-Use*

**Insight:** Non-use is **cyclical and agricultural**, not systemic—highlighting **minimal abandonment**.

### 3.3 Strong Preservation and Reuse Intent

Even inactive systems are **rarely discarded**:

- **93.96%** are stored for **future reuse**
- Less than **3%** are scrapped, sold, or transferred

**Insight:** This reflects **continued confidence in MIS technologies**, even among temporarily inactive users.

### Summary

This chapter confirms that **while MIS maintenance ecosystems are largely functioning**, they remain **market-driven**, with strong dependence on private dealers and MIS companies. **Service satisfaction is high**, but the **informal, decentralized support structure** may not be reliable for all regions, especially those with fewer dealers or lower volumes.

Training and testing awareness is **low**, with over **75% of farmers unaware** of available centers. Nonetheless, actual **field utilization is high (86.59%)**, and non-use is primarily due to cropping cycles rather than disrepair or dissatisfaction. Encouragingly, adoption is **most prominent among small and marginal farmers**, validating MIS as a **scalable, pro-poor intervention**.

### Recommendations

1. **Expand training and testing awareness** through field-level campaigns using extension agents, Krishi Vigyan Kendras, and Panchayat networks.
2. **Establish decentralized service infrastructure** such as mobile repair vans, regional part depots, and community-level MIS technicians.
3. **Build public-private partnerships** that reward dealers for timely service while introducing transparent accountability mechanisms.
4. **Document and scale best practices** from high-performing regions to create benchmarks and service quality standards.
5. **Prioritize follow-up support mechanisms**, especially for small and remote farmers, to prevent system neglect and ensure lifecycle optimization.

## Chapter 6: Operational Sustainability and System Management of Micro Irrigation Systems (MIS)

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### 1. Overview

As Micro Irrigation Systems (MIS) move beyond installation to daily use, a shift emerges from dependency on external servicing to **self-managed system upkeep**. This chapter explores the **operational sustainability** of MIS, looking at how farmers manage system performance over time, the frequency and nature of common issues, and how their experiences shape informal repair practices, storage strategies, and digital support preferences.

Crucially, this chapter analyzes a set of field-reported challenges related to **system maintenance, physical damage, and support constraints**, and interprets them in the context of farmer-driven solutions and future policy interventions.

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### 2. Lifecycle Management and System Wear

While post-installation satisfaction with support is high (as covered in Chapter 4), the experience of farmers over time reveals a range of practical challenges. **34.41% of users reported damage from rats or squirrels**, while **31.90% cited damage from animals such as cattle or goats**. **Sun exposure** also affected system parts, with **15.57%** reporting damage due to prolonged sunlight.

Component-specific issues were also observed:

- **Emitting line issues** affected **11.41%** of users, indicating vulnerability in the fine delivery components.
- **Pipes and head units** were reported problematic by **8.47%** and **9.14%** respectively.

Component	% Reporting Damage	Component	% Reporting Damage
Emitting Line	11.41%	Animal Damage	31.90%
Pipe	8.47%	Rodent Damage	34.41%
Head Unit	9.14%	Sunlight Damage	15.57%

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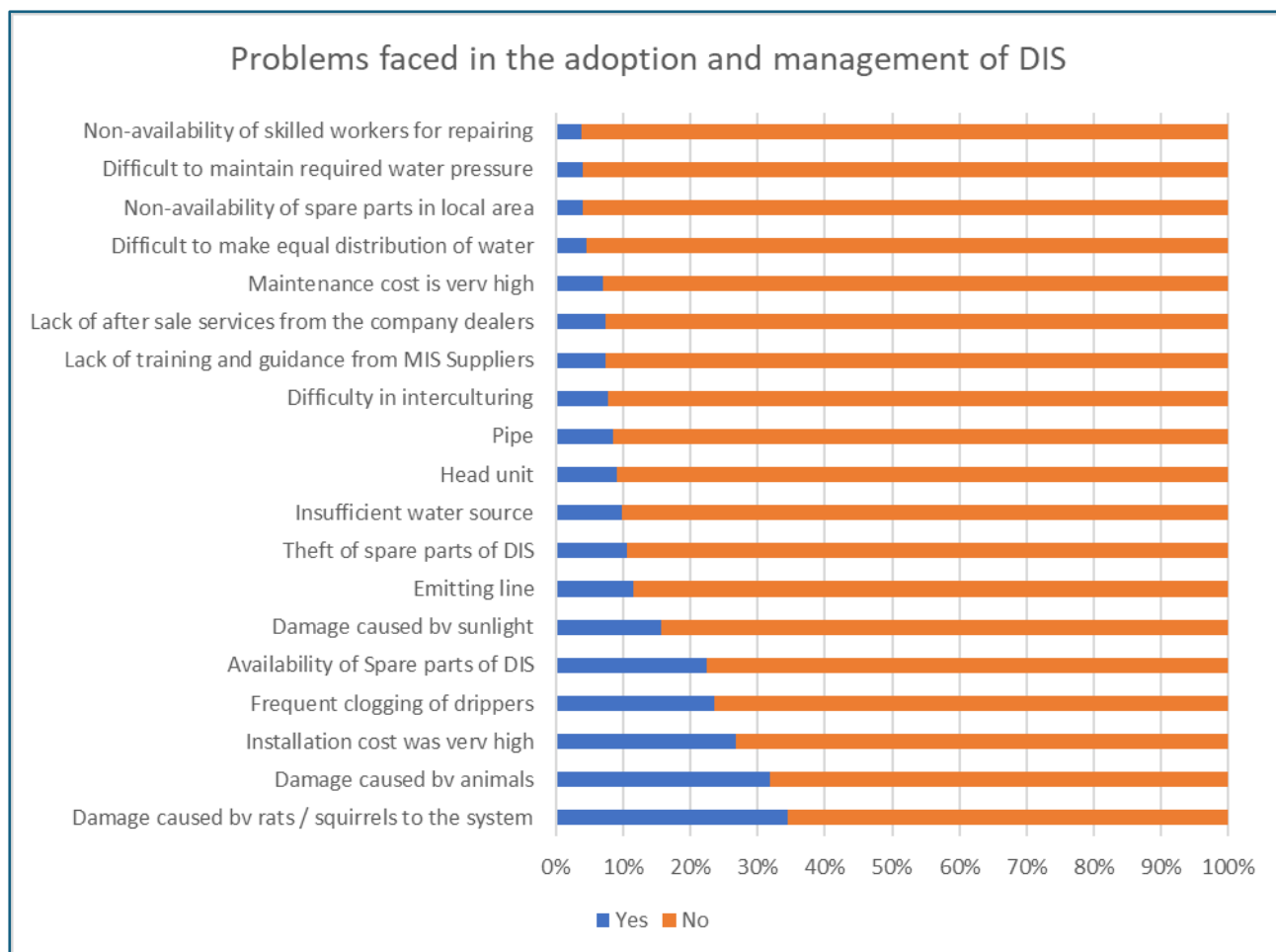
#### *System Components and Physical Damage Reports*

**Insight:** While MIS components are durable under ideal conditions, **field realities—animal interference, exposure, and storage limitations—create long-term system stress**, which farmers must learn to mitigate.

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### 3. Maintenance Barriers and Farmer Workarounds

A deeper look at field-level challenges reveals the most frequently reported issue: **clogging of drippers**, affecting **23.49%** of users. This was followed by **availability of spare parts (22.49%)** and the **high cost of initial installation (26.71%)**—even after subsidies.



*Top 10 Reported Problems in MIS Operation*

Despite these challenges, **maintenance costs are not widely perceived as a burden**—only **7.06%** reported high recurring costs, and fewer than **4%** reported problems with **water pressure regulation** or **unequal distribution**.

Where formal services were unavailable, farmers used **creative fixes** such as:

- **Plugging emitter holes with plastic or rubber seals**
- **Tying makeshift mesh filters from household items**
- **Interchanging emitter heads from unused rows**

These practices highlight a growing **culture of farmer-led repair**, especially among smallholders with limited dealer access.

**Insight:** The top challenges are **manageable but recurrent**, and demand **basic technical literacy**, part access, and preventive guidance to reduce user stress.

#### 4. Preservation and Seasonal Reuse Patterns

Even with system stress and seasonal downtime, farmers show a strong inclination to **preserve and reuse systems**. As earlier data shows, over **93.96%** of systems not in use are stored for future use.

However, challenges such as **animal damage**, **sunlight exposure**, and **rodent interference** often occur **during the storage phase**, when pipes and parts are left exposed in fields or unsecured sheds.

Farmers who reported damage shared adaptations such as:

- Hanging drip lines above ground to avoid rat chewing
- Burying sensitive parts under hay or jute sacks
- Creating wooden “pipe stands” to keep laterals off soil and away from animals

**Insight:** Proper post-use handling and preventive storage measures can **significantly reduce damage** and extend system life, particularly in high-pressure or high-heat areas.

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#### 5. Limitations in External Support

Although satisfaction with service providers was generally high, certain service and support gaps were reported:

- **Non-availability of skilled repair workers:** 3.86%
- **Lack of spare parts in the locality:** 4.06%
- **Lack of training from suppliers:** 7.37%
- **Poor after-sale service:** 7.35%

While these may appear numerically low, they **disproportionately affect farmers in remote blocks or tribal talukas**, where service access is weakest.

In these zones, farmers increasingly turn to:

- **Fellow farmers (11%)** for diagnosis and support
- **WhatsApp video exchanges with dealers** to demonstrate issues
- Community WhatsApp groups to post queries and share solutions

**Insight:** Informal peer networks are **stepping into the service vacuum**, and with proper support, can evolve into **first-line response platforms**.

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## 6. Theft and System Loss

A newer but concerning issue raised was **theft of MIS components**, especially in semi-urban and highway-adjacent farms. **10.53% of respondents reported theft of parts** like emitters, pipes, and joiners, often sold as scrap or reused elsewhere.

**Insight:** While not widespread, this adds a **security risk** to ownership and calls for better guidance on post-use disassembly and secure storage.

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### Summary

This chapter shows that while Gujarat's MIS ecosystem is mature in terms of reach and initial servicing, the **long-term management of systems** is increasingly shifting to the hands of farmers themselves. The data indicates that farmers face **predictable but recurring issues** such as clogging, minor physical damage, and seasonal disassembly—most of which are managed informally through **peer learning, DIY fixes, and community-based knowledge sharing**.

Though some service gaps (especially in parts access and skilled labour) persist, they are not uniformly distributed. Their impact is more acute in **low-access, high-dependency zones**, where MIS plays a critical water-saving role. Despite these stress points, farmer confidence remains strong, with high reuse rates, innovation in care, and willingness to invest in preservation.

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### Recommendations

1. **Design visual micro-guides for common repairs**, such as dripper flushing, emitter cleaning, and pressure maintenance—using pictorial formats in Gujarati for rural literacy contexts.
2. **Recognize and scale informal innovations**, such as drip line caps, filter hacks, and system rotation methods, through district-level “Farmer Innovation Fairs” or local documentation.
3. **Create a preventive maintenance checklist** to be distributed post-installation, focusing on rodent protection, storage hygiene, and sun damage avoidance.
4. **Set up hyper-local spare part depots**, ideally in partnership with agro-input shops, to ensure system uptime with minimal logistics.
5. **Include theft-protection training in MIS orientation**, and promote locking/storing techniques for lateral lines and connectors.
6. **Leverage peer trainers** or “village-level irrigation fellows” who can support first-line repair and system health checks seasonally.

# Chapter 7: Irrigation and Water Use

## 1. Introduction

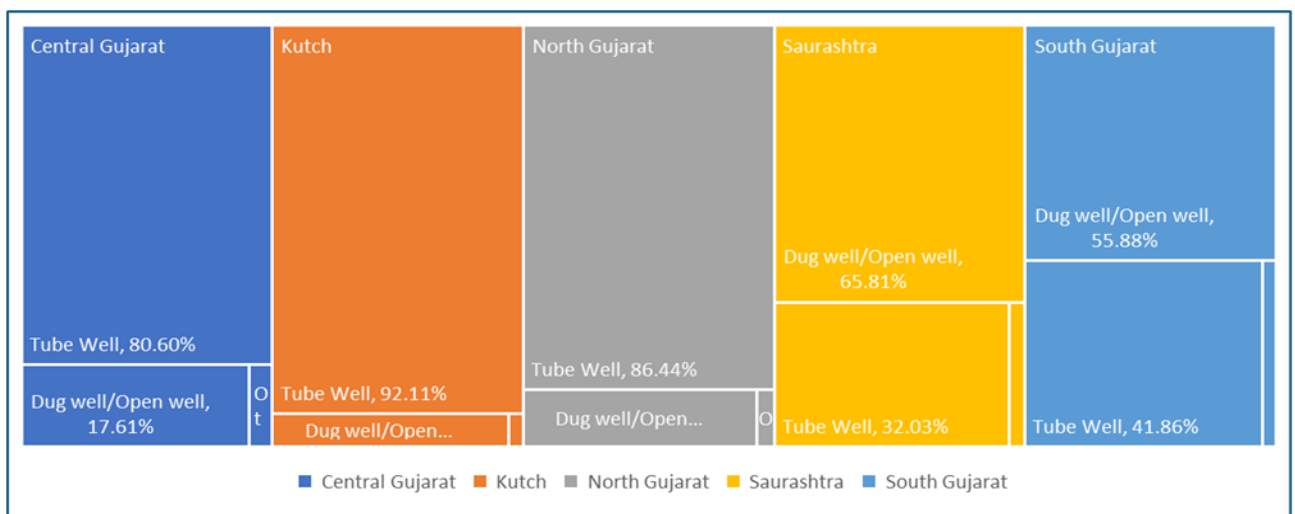
Efficient water use is vital for sustainable agriculture, particularly in Gujarat’s semi-arid zones where groundwater dependence is high. The deployment of Micro Irrigation Systems (MIS) has enabled farmers to apply water more precisely and frequently, improving irrigation productivity while reducing input costs. This chapter explores how MIS has transformed irrigation sources, land-use patterns, water-saving behaviour, and irrigation-related expenses across farm sizes and regions.

## 2. Sources of Irrigation

Farmers’ choice of irrigation sources reflects regional groundwater availability and traditional water use practices.

- **Tubewell irrigation dominates** in deep water table zones:
  - **Kutch:** 92.11% of farmers
  - **North Gujarat:** 86.44%
- **Well irrigation remains prevalent** in regions like:
  - **Saurashtra:** 65.81% of farmers rely on wells
- **Mixed sourcing** is visible in:
  - **South Gujarat:** Approx. 42% use tubewells, 56% wells, and ~2% combine other source (canal, pond, others)

**Insight:** While tubewell dependence is high in most regions, Saurashtra’s well-based irrigation suggests scope for continued traditional sourcing with MIS integration.

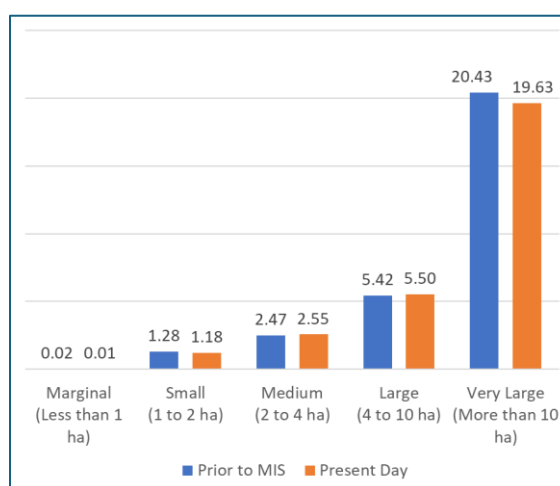
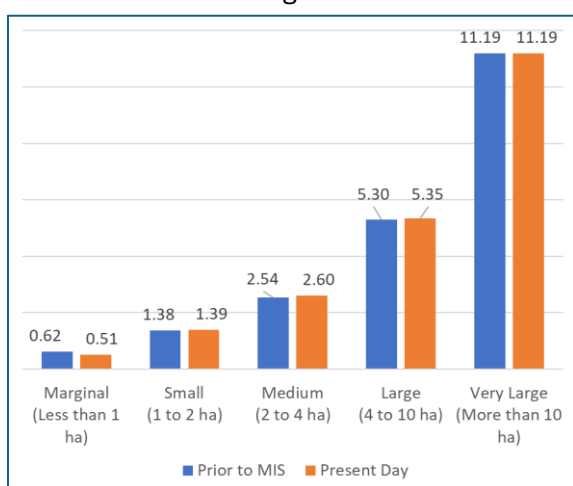


Source of Irrigation by Region (% Farmers)

### 3. Irrigated Area Trends by Farm Size

The extent of irrigated land under MIS varies across farm sizes, often reflecting land-use optimization rather than expansion.

- **Marginal farmers (<1 ha):** Declining landholding and irrigated area, possibly due to targeted use of productive plots.
- **Small & semi-medium farmers (1–4 ha):** Stable landholding, slight increases in irrigated area.
- **Medium farmers (4–10 ha):** Stable irrigated area, slight increase in unirrigated area.
- **Large farmers (>10 ha):** Minor decrease in both total and unirrigated land, with irrigated area stable



*Irrigated vs. Unirrigated Area by Farm Size (Before and After MIS)*

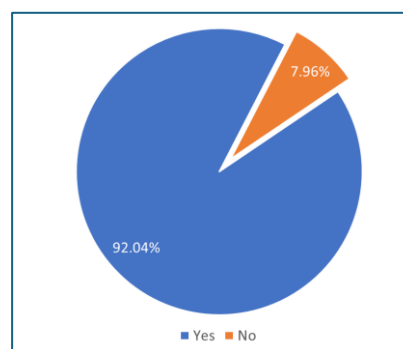
**Insight:** MIS encourages **efficient land selection** for irrigation, particularly among marginal and large farmers, even if it doesn't always expand the irrigated footprint.

### 4. Water Savings and Irrigated Area Expansion

#### 4.1 Perceived Water Savings

Farmers across Gujarat strongly perceive MIS to be water-efficient:

- **92.04%** of respondents confirm MIS helps save water
- Breakdown of estimated water savings:
  - **10–25%:** 30.94%
  - **25–40%:** 27.18%
  - **60–100%:** 17.47%
  - Only **8%** report no savings



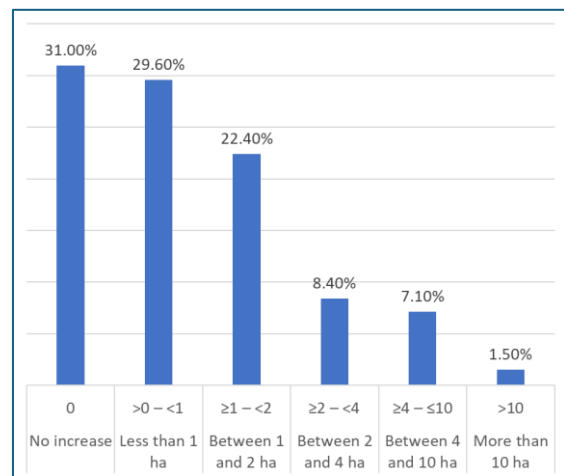
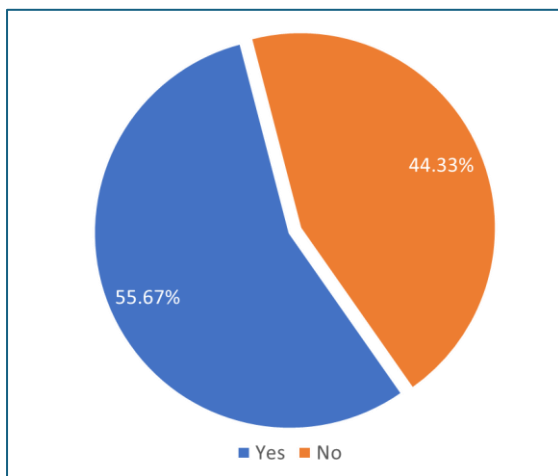
*% Farmers Reporting by Water Saving Range*

**Insight:** The majority of farmers experience 10–40% water savings, with a significant number reporting very high (60–100%) conservation, validating MIS’s effectiveness.

#### 4.2 Potential for Expansion of Irrigated Land

While 55.67% believe MI systems enable irrigation of additional area, not all farmers expand irrigated area post-MIS:

- **31.00%:** No increase in irrigated area
- **29.60%:** <1 ha added
- **22.40%:** Added 1–2 ha
- **17.00%:** Added >2 ha

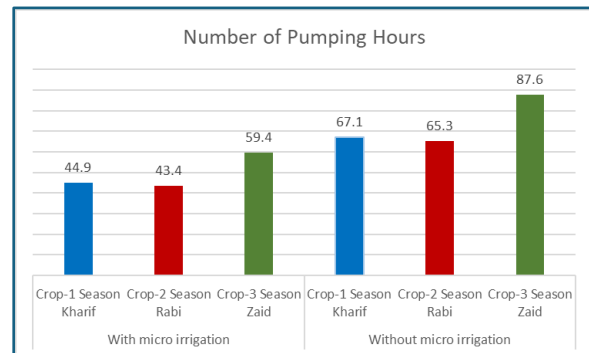
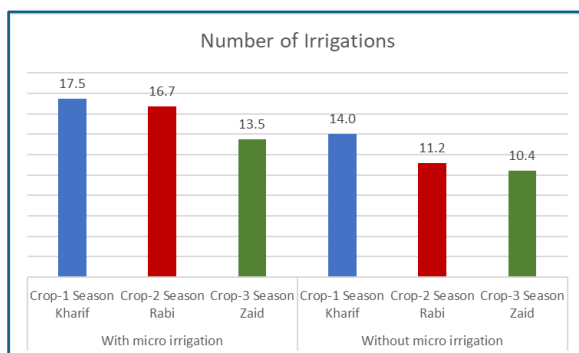


*Irrigated Area Expansion Categories (% of Farmers)*

**Insight:** Water savings do not always translate to land expansion, especially where water availability or field layout limits broader irrigation coverage.

#### 5. Irrigation Frequency and Operational Efficiency

MIS systems enable more precise and frequent irrigation without increasing energy inputs.

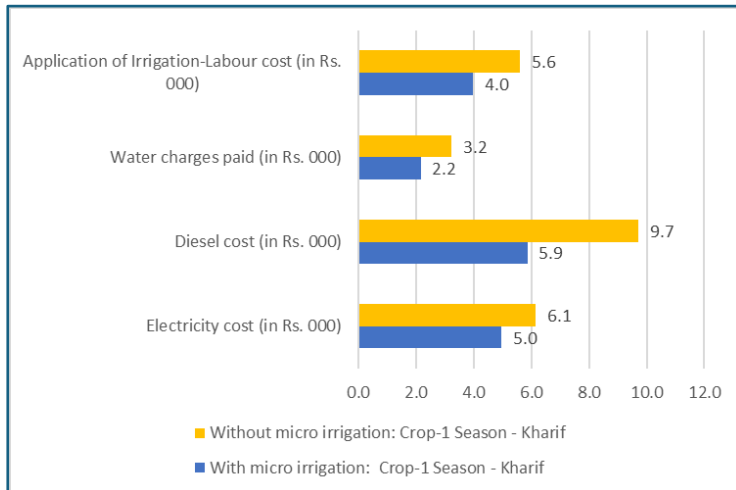


*Irrigation Frequency and Pumping Hours (With vs. Without MIS)*

**Insight:** MIS allows for **increased irrigation intensity**, while reducing operational effort through efficient water delivery.

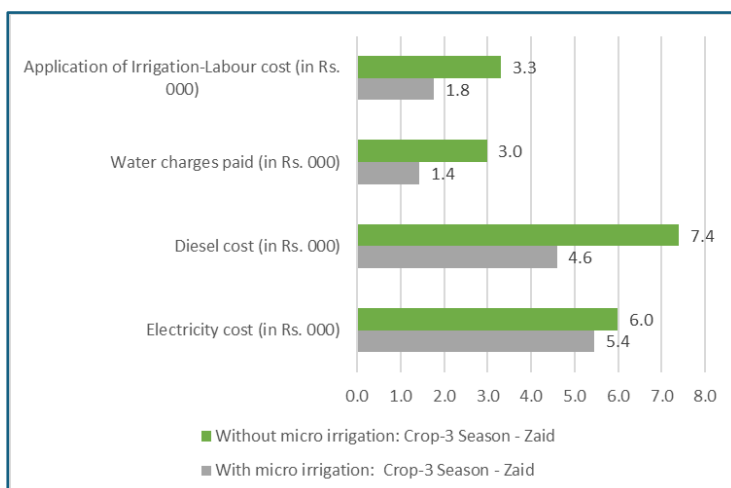
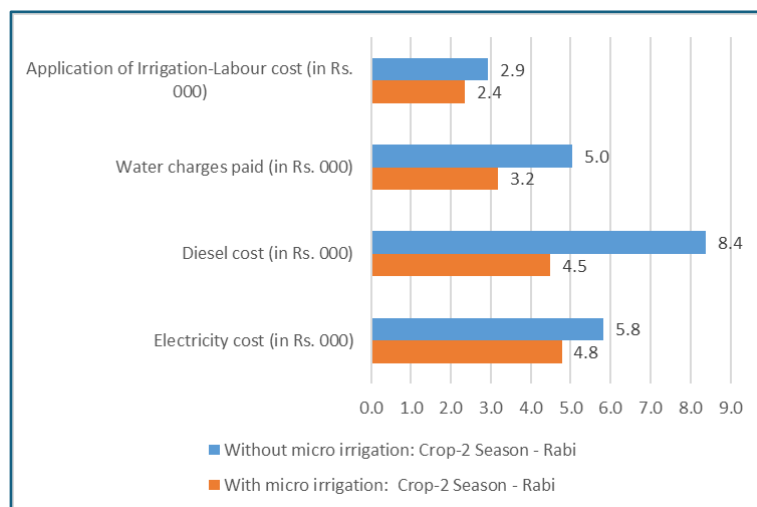
## 6. Irrigation-Related Cost Efficiencies

The cost-saving impact of MIS is substantial across diesel, labour, and water inputs.



*Kharif - Irrigation Costs by Component (With vs. Without MIS)*

*Rabi - Irrigation Costs by Component (With vs. Without MIS)*



*Zaid - Irrigation Costs by Component (With vs. Without MIS)*

**Insight:** MIS helps reduce **labour dependence and input costs**, particularly during high-use seasons like Kharif and Rabi, enhancing economic efficiency.

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## Summary

Chapter 8 underscores how MIS has shifted irrigation practices toward **greater water-use efficiency**, especially in groundwater-dependent regions. While tubewell usage dominates, regions like Saurashtra maintain strong well-based irrigation practices. MIS does not uniformly increase irrigated land but helps farmers **irrigate more effectively and frequently**, reducing pumping hours and associated costs. Water savings are substantial, with nearly 46% of farmers reporting savings above 25%. While not all farmers expand irrigation areas, many **use the saved water to improve timing and coverage**, demonstrating MIS's role in sustainable intensification. Most importantly, significant reductions in diesel, labour, and water charges highlight MIS as not only a conservation tool but a **cost-saving technology** with strong return potential.

## Recommendations

To further strengthen MIS outcomes, especially among marginal and semi-medium farmers, it is important to **align MIS programs with broader water management strategies**. MIS savings should be leveraged not only to increase cropping intensity but also to **encourage collective water governance**, especially in tubewell-dependent regions. Customized training for crop-wise water budgeting, investment in solar-powered pumps, and **micro-cluster approaches** can help farmers better utilize the water-saving benefits of MIS.

- **Promote irrigation scheduling tools** to help farmers adjust timing and quantity based on crop and season.
- **Introduce shared MIS systems** for marginal farmers in dense regions to optimize unit costs.
- **Combine MIS with solar pump initiatives**, particularly in zones with high diesel usage.
- **Encourage collective water savings** through community-level monitoring and recharge programs.
- **Continue training programs** focused on real-time irrigation frequency planning to reduce overuse and labour costs.

## Chapter 8: Seasonal Cropping Patterns and Revenue Impact Post-MIS Adoption

### 1. Overview

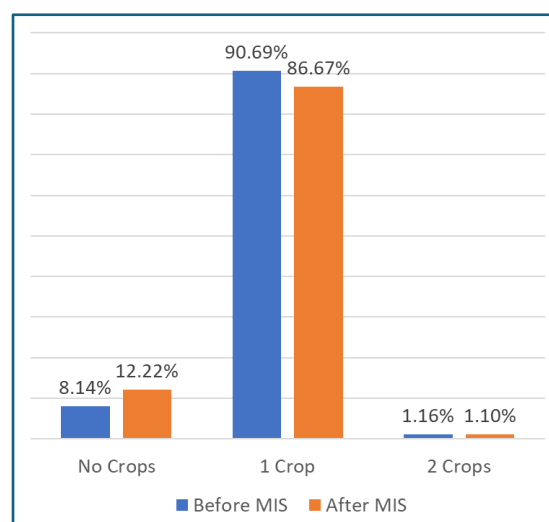
The deployment of Micro Irrigation Systems (MIS) across Gujarat has generated impacts that extend beyond water conservation—most notably in how farmers **plan their seasonal cropping patterns** and allocate land throughout the year. This chapter examines cropping shifts across Kharif, Rabi, Summer, fruit, and perennial cycles, alongside the corresponding impact on **farm-level income and regional turnover**. The integrated findings suggest a **modest but structured movement toward diversification**, resource optimization, and crop-value enhancement—enabled through precise irrigation control.

### 2. Changes in Cropping Patterns: Before and After MIS

#### 2.1 Kharif Season: Slight Decline in Single Cropping and Strategic Fallowing

In the post-MIS period, the share of farmers cultivating single crops in the Kharif season declined from **90.7% to 86.7%**, indicating a gradual diversification strategy. At the same time, fallow land rose from **8.1% to 12.2%**, possibly due to farmers shifting resources to more profitable seasons or reducing dependence on **water-intensive monsoon crops**.

**Insight:** Despite favorable monsoon conditions, the modest shift suggests that farmers are beginning to **de-risk Kharif cultivation** through crop rotation or seasonally balanced planning.



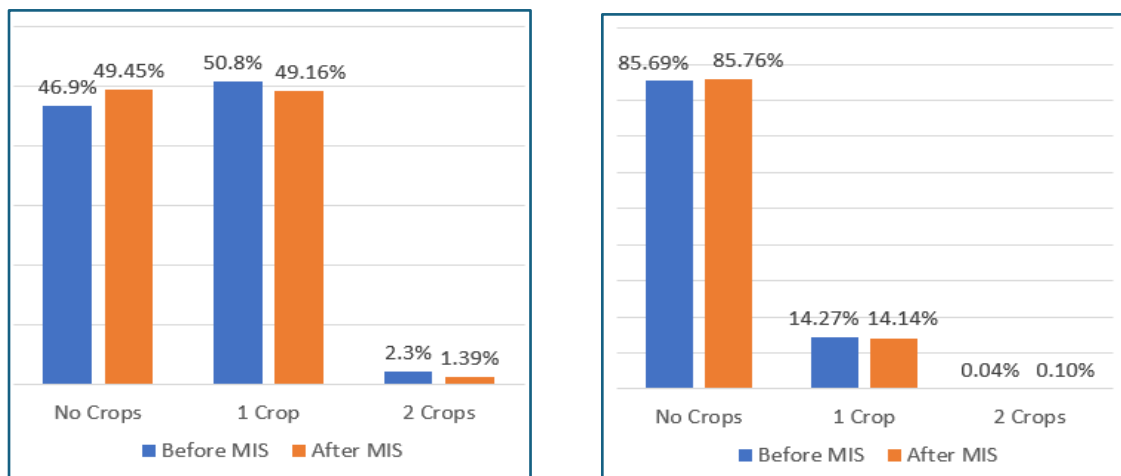
*Shift in Kharif Cropping Patterns  
(Before vs After MIS)*

#### 2.2 Rabi Season: Stable Single Cropping with Subtle Strategic Adjustments

Rabi cropping remained relatively stable post-MIS, with a minor decline in single cropping from **50.8% to 49.2%** and an increase in fallow land from **46.9% to 49.5%**. This trend points to

**conservative resource use** during the irrigation-intensive Rabi period, possibly balancing water availability with income expectations.

**Insight:** The data reflects **deliberate cropping decisions** in the Rabi season, potentially reallocating effort toward high-return crops in other seasons.



*Rabi and Summer Season Cultivation Types (Before vs After MIS)*

### 2.3 Summer Season: Minimal Use, Yet Signs of Emerging Intensification

Summer cultivation remained underutilized across zones, with fallow land almost unchanged at **~85.7%**. However, the rate of double cropping **more than doubled**, albeit from a low base—**0.04% to 0.10%**. This slight rise is an early signal of farmers beginning to explore **Zaid cropping** where MIS ensures water availability.

**Insight:** The trend underscores the **untapped potential** of MIS in making summer cultivation viable in water-scarce landscapes.

### 2.4 Fruit and Perennial Crops: Low Base, Slow Growth

MIS has supported **gradual diversification** into long-duration crops. Fruit cultivation increased from **1.2% to 2.0%**, and perennial crops from **1.3% to 1.9%**, indicating rising confidence in controlled irrigation systems to support year-round yield cycles.

Season	Crop Type	Before MIS (%)	After MIS (%)
Kharif	Single Crop	90.69	86.67
	No Crop/Fallow	8.14	12.22
Rabi	Single Crop	50.80	49.16
	No Crop/Fallow	46.90	49.45
Summer	No Crop/Fallow	85.69	85.76
	Two Crops	0.04	0.10
Perennial	Perennial Crop Growers	1.27	1.90
Fruit	Fruit Crop Growers	1.20	1.98

*Cropping Pattern Shifts Before and After MIS (% of Farmers)*

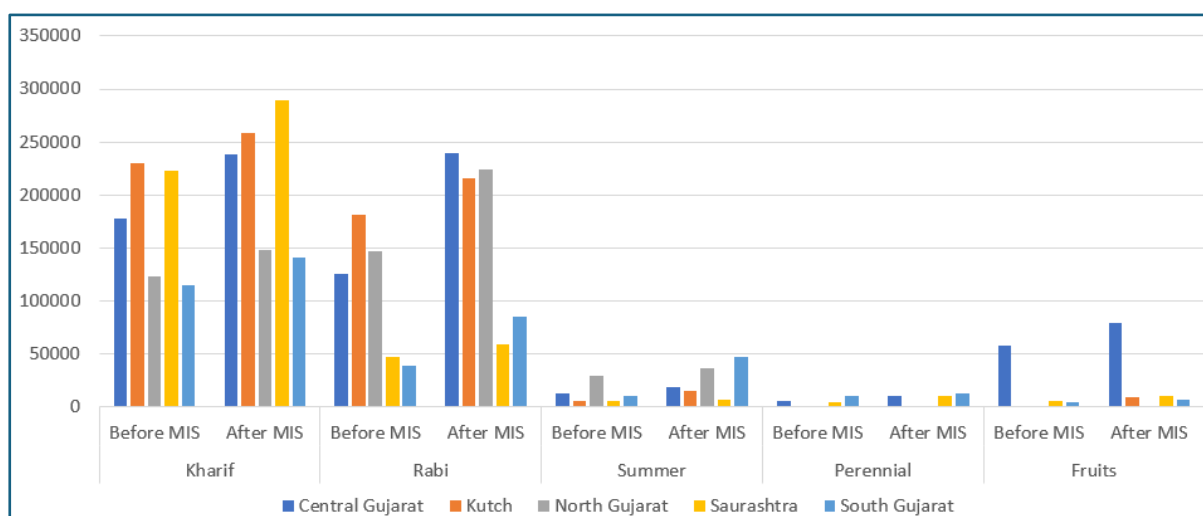
**Insight:** Though numbers remain small, fruit and perennial adoption reflects a **shift in agricultural mindset**—from seasonal cropping to asset-based cultivation.

## 2.5 Summary of Cropping Shifts

- Across all zones, **single cropping remains dominant**, especially during Kharif (e.g., **43.24% in Saurashtra** and **36.63% in North Gujarat**).
- **Rabi and Summer cropping** sees reduced single crop shares (e.g., only **11.1% single cropping** in North Gujarat during Summer), suggesting irrigation constraints or strategic shifts.
- **Fallow land shares are high** in perennial and fruit crop cycles (e.g., **45.59% fallow in Saurashtra** for perennial crops), likely due to long maturity durations and resource planning.
- **Double cropping remains limited** across all regions (rarely exceeding **0.5%**), highlighting the **need for stronger water and market support systems**.

## 3. Zone-wise Cropping Turnover Post-MIS

The economic outcomes of MIS adoption become particularly evident when examining zone-wise turnover changes. Across nearly all zones and seasons, **average household-level turnover has increased**, reflecting better productivity and cropping intensity.

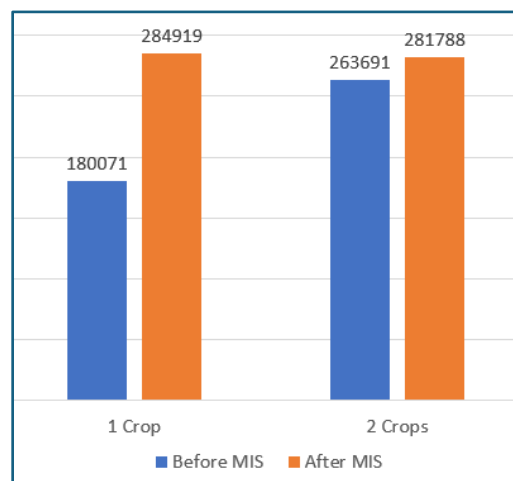
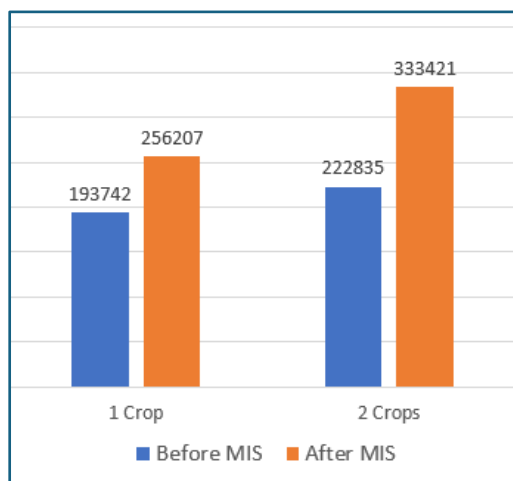


Zone-wise Cropping Turnover - Prior and Post-MIS

### 3.1 Kharif Season: High Growth, Especially for Double Cropping

- Saurashtra led with a Kharif turnover increase from **₹2.23L to ₹2.89L**.
- Farmers practicing **double cropping in Kharif** experienced a **50% increase in income** (from **₹2.23L to ₹3.33L**), compared to **32% for single cropping**.

**Insight:** Income multipliers are greatest for **multi-crop adoption**, even within the Kharif season.



*Kharif and Rabi Income Growth by Crop Intensity (Single vs Two Crops)*

### 3.2 Rabi Season: Strong Gains in Central and South Gujarat

- Central Gujarat saw Rabi income almost **double**, from ₹1.25L to ₹2.39L.
- Single-crop Rabi income grew by **58%**, while two-crop Rabi income rose more modestly (**7%**), likely due to **crop price or input dynamics**.

**Insight:** Even small increases in cropping diversity can translate into **substantial financial gains**, particularly in irrigated zones.

### 3.3 Summer Season: Remarkable Gains, Especially for Two Crops

- South Gujarat recorded a **5x increase** in summer turnover (from ₹10,224 to ₹47,500).
- Two-crop summer farmers almost **doubled their income**, from ₹1.09L to ₹2.19L, showcasing the potential of MIS in water-scarce months.

**Insight:** With MIS, summer cultivation is emerging as a **new productivity frontier** in Gujarat.

### 3.4 Fruit and Perennial Crops: Higher Value, Modest Growth

- Perennial crop income increased by **24%**, from ₹2.48L to ₹3.07L, especially in Central Gujarat.
- Fruit crop income remained largely flat (₹5.86L to ₹5.92L), indicating that **margins are already optimized** or limited by market constraints.

Crop Type	Income Before MIS	Income After MIS	% Growth
Kharif (Single Crop)	₹1.94L	₹2.56L	32%
Kharif (Two Crops)	₹2.23L	₹3.33L	50%
Rabi (Single Crop)	₹1.80L	₹2.85L	58%
Rabi (Two Crops)	₹2.89L	₹3.09L	7%
Summer (Single Crop)	₹1.11L	₹1.45L	31%
Summer (Two Crops)	₹1.09L	₹2.19L	100%
Perennial Crops	₹2.48L	₹3.07L	24%
Fruit Crops	₹5.86L	₹5.92L	~1%

*Crop-wise Income Gains Before and After MIS*

**Insight:** While MIS supports all cropping systems, the **highest returns come from diversified cropping**, especially when **aligned with market opportunities**.

## Summary

The seasonal and zone-wise data clearly establish MIS as a **technology that enhances strategic decision-making** and **revenue resilience**. Key learnings include:

- **Single cropping remains dominant**, but the trend is **slowly shifting** toward diversity and intensification.
- **Perennial and fruit crop adoption** is growing, albeit from a low base, and should be supported through technical and market assistance.
- **Income gains are consistently higher** in multi-crop scenarios across all seasons, especially in Summer.
- Zone-specific outcomes show that **Saurashtra leads in Kharif, Central Gujarat in Rabi, and South Gujarat in Summer cropping**.

## Recommendations

1. **Design crop-specific MIS advisories**, including for double cropping, perennial cultivation, and summer rotations.
2. **Enable forward linkages for fruit and perennial crops**, such as contract farming, storage infrastructure, and market development.
3. **Develop region-wise cropping intensity maps** to target support for underutilized seasons.
4. **Bundle MIS with agronomic support packages** for high-value and intensive crops.
5. **Promote awareness of income gains from double cropping** to incentivize adoption through field demonstrations and case examples.

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## Chapter 9: Impact of MIS on Land Use, Income, Input Savings, and Production

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### 1. Overview

Micro Irrigation Systems (MIS) have not only transformed irrigation efficiency but have also led to measurable changes in land use, cropping strategies, income levels, input usage, and production outcomes. This chapter analyses zone-wise and category-specific shifts in farm operations post-MIS adoption, with a focus on field-level economic and environmental outcomes.

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### 2. Change in Land Use Pattern

The implementation of MIS has enabled farmers to modify their land use strategies, transitioning from traditional field crops to higher-value horticultural crops in several regions.

- **Field crops** increased marginally in **North Gujarat (+2.26%)** and **Kutch (+1.21%)**, but declined sharply in **South Gujarat (-25.90%)** and moderately in **Central Gujarat (-8.43%)**.
- **Fruit cultivation** expanded dramatically in **Kutch** (from 0 ha to 1.37 ha) and **North Gujarat (+2300%)**, indicating diversification.
- **Vegetable crops** saw a major boost in **South Gujarat (+85.71%)** and **North Gujarat (+166.67%)**, enabled by controlled irrigation.
- **Forest and pasture land** in **Saurashtra** declined, implying possible conversion to productive agricultural uses.

Crop Type	Region	Area Before (ha)	Area After (ha)	% Change
Field Crops	North Gujarat	1.33	1.36	+2.26%
	Kutch	2.48	2.51	+1.21%
	South Gujarat	1.93	1.48	-25.90%
	Central Gujarat	1.78	1.63	-8.43%
Fruit Crops	Kutch	0.00	1.37	
Vegetables	South Gujarat	0.56	1.04	+85.71%
	North Gujarat	0.15	0.40	+166.67%
Forest Land	Saurashtra	0.74	0.49	-33.78%
Pasture Land	Saurashtra	0.74	0.64	-13.51%

**Insight:** The pattern indicates a shift toward profitable and water-sensitive crops such as fruits and vegetables in areas where MIS is enabling controlled irrigation.

### 3. Net Annual Income Earned

MIS adoption has resulted in substantial income gains across all zones, with particularly strong growth in Central and South Gujarat.

**Key Highlights:**

- **Central Gujarat:** Income nearly doubled post-MIS (+93.24%).
- **South Gujarat:** Recorded strong income growth (+90.57%).
- **North Gujarat:** Significant increases (+74.78%)
- **Kutch & Saurashtra:** Lowest growth, still notable (+51.40% and 45.31% respectively).

**Table 2: Zone-wise Income Growth Post-MIS**

Region	Net Income Before	Net Income After	%	Notes
Central Gujarat	146,541.6	283,175.8	93.24% ↑	Highest growth
South Gujarat	196,871.8	203,667.3	90.57% ↑	Strong gains
North Gujarat	160,180.4	279,966.5	74.78% ↑	Effective MIS adoption
Kutch	190,789.1	288,866.6	51.40% ↑	Achieved with cost efficiency
Saurashtra	180,631.9	262,459.2	45.31% ↑	Lowest growth, still notable

**Insight:** The post-MIS income surge reinforces the scheme’s economic viability, especially where water use is optimized.

### 4. Savings in Fertilizer Consumption

MIS enables targeted nutrient delivery, reducing fertilizer usage significantly in most regions.

**Key Trends:**

- **Saurashtra and Kutch** show major declines in usage of Fertilizers 1–3.
- **North Gujarat** displays a sharp rise in **Fertilizer 4**, likely due to crop shifts or intensification.

**Table 3: Fertilizer Usage Before and After MIS (kg/ha)**

Fertilizer	Region	Before	After	% Change
Fertilizer 1	Saurashtra	298.9	210.5	-29%
	Central Gujarat	326.6	295.2	-10%
Fertilizer 2	Saurashtra	295.1	190.2	-36%
	Kutch	450.1	296.0	-34%
Fertilizer 3	Kutch	333.3	213.3	-36%
Fertilizer 4	Saurashtra	303.5	102.9	-66%
	North Gujarat	117.2	413.4	+253%

**Insight:** The decline in fertilizer use under MIS reflects higher nutrient efficiency, though crop-specific variations persist.

## 5. Savings in Plant Protection Costs

Reduced chemical use was observed in most zones, due to precise irrigation reducing pest-prone conditions.

### Key Insights:

- Chemicals 1 & 2: Declines in North and Central Gujarat.
- Chemical 4: Strong drop in Kutch (-56%), minor increase in South Gujarat (+7%).
- Increase in Saurashtra (+6%) reflects local pest dynamics.

**Table 4: Plant Protection Use Before and After MIS (ml/ha)**

Chemical	Region	Before	After	% Change
Chemical 1	North Gujarat	1405.8	1089.3	-22%
	Central Gujarat	727.6	673.8	-7%
Chemical 2	Central Gujarat	734.5	560.8	-24%
	North Gujarat	855.5	744.4	-13%
	Saurashtra	1238.0	1313.9	+6%
Chemical 4	Kutch	737.5	328.1	-56%
	South Gujarat	1701.3	1818.0	+7%

**Insight:** Reduction in chemical application costs adds another layer of efficiency in MIS-managed farms.

## 6. Savings in Use of Labour

Labour requirement dropped significantly in key operations:

- Inter-cultivation: -49.2% in North Gujarat
- Fertilizer application: -55.3% in Central Gujarat
- Weed control: -41.4% in Central Gujarat
- Ridge & furrow prep: -58.3% in South Gujarat

However, labour for **irrigation increased (+125%)** in Central Gujarat due to more frequent, smaller-volume irrigation events. In **Kutch**, labour for plant protection increased due to pest pressure.

**Table 5: Labour Changes by Operation**

Operation	Region	Labour Change (%)
Inter-cultivation	North Gujarat	-49.2
Fertilizer application	Central Gujarat	-55.3
Weed control	Central Gujarat	-41.4
Ridge & Furrow Prep	South Gujarat	-58.3
Irrigation Frequency	Central Gujarat	+125
Plant Protection	Kutch	+46.7

**Insight:** While overall labour savings are significant, irrigation and pest control demand targeted support in specific zones.

---

## 7. Increase in Crop Production

MIS has improved yields:

- **91.57%** of farmers observed improved production.
- **85.16%** specifically noted quantitative gains.
- Less than **10–15%** saw no yield increase.

**Insight:** High production impact reinforces the case for MIS as a yield-enhancing technology.

---

## 8. Market of Produce

While MIS improves crop quality, only **59.37%** of farmers reported getting better prices. The remaining **40.63%** faced stagnant returns, suggesting:

- Market access issues
- Crop quality not translating to premium pricing
- Need for stronger farmer-market linkages

**Insight:** MIS must be complemented by value chain strengthening to ensure market-based income advantages.

---

### Summary

MIS adoption has delivered broad-based benefits across Gujarat. Land use has shifted toward high-value horticultural crops, especially in Kutch and North Gujarat. Input efficiency has improved: fertilizer and chemical usage declined, labour savings were widespread, and irrigation became more precise. Net income increased substantially in all zones, especially Central and South Gujarat. While crop yields rose for the majority, limited pricing benefits in some regions highlight the need for better market integration.

### Recommendations

To enhance the already significant impact of MIS, policy focus must now expand from adoption to **post-adoption enablement**—linking irrigation with crop-market alignment, strengthening value chains, and supporting operations in regions with high input use or labour burden. Special attention is needed in zones with rising plant protection costs or limited price realization, to ensure long-term sustainability.

- Promote horticultural cluster development to match MIS-enabled crop diversification with market demand.
  - Provide targeted subsidies or technical advice in zones with high chemical/pest pressure.
  - Link MIS users to marketing federations or FPOs to capture price benefits.
  - Use mobile apps to connect farmers to fertilizer and chemical usage benchmarks.
  - Build awareness on labour-saving mechanization to further reduce manual costs.
  - Monitor regional variations in input usage to refine extension support.
-

## Chapter 10: Crop Production and Revenue

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### 1. Overview

The adoption of Micro Irrigation Systems (MIS) has reshaped not only irrigation efficiency but also core aspects of crop production, farm inputs, and income generation. This chapter explores the season-wise crop patterns, analyzes production outputs and input costs under MIS and non-MIS systems, and examines the resulting effects on revenue, labour use, and cost optimization. Particular attention is given to the Rabi season, where MIS has shown significant gains in productivity and economic return.

---

### 2. Season-Wise Cropping Trends

#### 2.1 Kharif Cropping: Dominated by Groundnut and Cotton

The Kharif season demonstrates a high concentration in two major crops—groundnut and cotton—together accounting for approximately 80% of cultivation. This indicates a dependence on traditional monsoon cropping strategies, with limited diversification.

- **Groundnut:** 41%
- **Cotton:** 39%
- **Other Crops:** Maize, paddy, pulses, and sugarcane have limited presence.

**Insight:** Cropping patterns in Kharif remain conventional; MIS has had limited impact on diversification but supports better input-use efficiency.

---

#### 2.2 Rabi Cropping: Greater Diversity and Higher Production

Rabi season reveals a more varied cropping pattern and better responsiveness to MIS interventions. Farmers grow a range of crops including:

- **Potato (27%)**
- **Mustard (21%)**
- **Wheat (20%)**
- **Castor, gram, spices and vegetables** also contribute meaningfully.

A small share of farmers refrain from Rabi cropping, indicating relatively good water management capacity in this season.

**Insight:** Rabi benefits most from MIS in terms of both yield and economic return due to crop intensity and diversity.

### 2.3 Zaid Cropping: Minimal Participation

The Zaid (summer) season remains underutilized, with **60% of farmers not cultivating** during this period. Among those who do, **pearl millet** is the most common crop (**21%**).

**Insight:** Zaid represents an untapped potential for intensification, where MIS can expand cropping windows through efficient water application.

---

## 3. Production Volumes and Cost Dynamics

### 3.1 Higher Yields Despite Smaller Landholdings

MIS users tend to operate on slightly **smaller landholdings** yet achieve **notably higher production**, especially in Rabi crops.

- **Rabi Production with MIS:** 16.7 tonnes
- **Rabi Production without MIS:** 10.1 tonnes

**Insight:** Efficient water delivery, better nutrient management, and timely irrigation under MIS enable yield maximization per hectare.

### 3.2 Input Costs: Seed and Fertilizer as Major Drivers

While overall cost of production rises with MIS due to intensified inputs, the benefits outweigh the added costs:

- **Seed cost with MIS (Rabi):** ₹24.2K vs. ₹14.0K (non-MIS)
- **Fertilizer cost with MIS (Rabi):** ₹12.9K vs. ₹18.7K (non-MIS) – indicating targeted usage
- **FYM labour cost slightly lower** with MIS (₹2.5K vs. ₹2.7K)

**Insight:** MIS enables precision in fertilizer application, reducing wastage and input cost volatility.

---

## 4. Fertigation and Pest Management

### 4.1 Fertigation Labour

Labour costs for fertigation remain **marginally lower or comparable** under MIS in Kharif and Rabi, but increase during Zaid—possibly due to frequent interventions or complex crop requirements.

### 4.2 Pesticide/Insecticide Use

- **Rabi:** Costs increase under MIS (₹12.0K vs. ₹8.5K), suggesting intensified crop protection.
- **Zaid:** Costs decrease with MIS (₹8.6K vs. ₹13.9K), reflecting better pest control or lower pest loads.
- **Labour for pesticide application** is slightly higher in Rabi under MIS.

**Insight:** Input efficiency varies by season, with MIS supporting targeted applications that align with crop demands.

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## 5. Irrigation and Energy Efficiency

MIS enables **more frequent but shorter irrigation cycles**, optimizing energy and labour usage.

- **Irrigation frequency (Kharif):** 29.2 times (MIS) vs. 20.6 times (non-MIS)
- **Zaid pumping hours:** 29.9 (MIS) vs. 162.6 (non-MIS)
- **Diesel cost (Kharif):** ₹5.9K (MIS) vs. ₹9.7K (non-MIS)

**Insight:** MIS significantly reduces irrigation-related energy and time expenditures, especially during the Zaid season.

---

## 6. Intercultural Operations and Mechanization

### 6.1 Labour Costs

- **Kharif and Zaid intercultural labour costs** are lower under MIS.
- **Machine use costs** remain **largely unchanged**, indicating MIS does not substitute machinery but optimizes human labour.

**Insight:** MIS reduces reliance on manual labour in intercultural operations, improving productivity without increasing mechanization dependence.

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## 7. Harvesting, Marketing, and Miscellaneous Costs

### 7.1 Harvesting Costs

- **Slightly higher under MIS** in both Kharif and Rabi, likely due to increased yield volume.

### 7.2 Marketing Costs

- **No significant difference** between MIS and non-MIS users, implying that improvements in post-harvest logistics remain limited.

### 7.3 Other Costs

- **Notably higher in Zaid** under MIS, possibly tied to maintenance, specific crop handling, or off-season practices.

**Insight:** While MIS increases pre-harvest efficiency, downstream marketing and logistics structures remain unchanged.

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## Summary

Micro Irrigation Systems have significantly impacted crop production and profitability across seasons. Rabi season benefits the most from MIS in terms of yield gains and input optimization. Despite increased upfront input costs, especially for seeds and pesticides, MIS enables higher productivity per hectare, reduces labour demand for intercultural operations, and ensures better irrigation efficiency. However, post-harvest handling and marketing processes remain largely unaffected, suggesting an area for integrated improvement. The limited use of MIS in the Zaid season also presents an opportunity for intensification and revenue diversification.

## Recommendations

To maximize the benefits of MIS in crop production and revenue, efforts must focus on scaling its use in underutilized seasons like Zaid, aligning pest and fertigation practices to regional demands, and building post-harvest systems that complement production gains. Strengthening extension services to guide optimal input usage and expanding market linkages will further enhance the economic impact of MIS adoption.

- **Expand MIS in Zaid Season:**
  - Promote drought-resistant, short-cycle crops for Zaid to utilize MIS efficiency.
  - Provide seasonal crop calendars tailored to MIS capabilities.
- **Enhance Input Advisory Services:**
  - Deliver real-time advisories on pesticide/fertilizer usage through digital platforms.
  - Encourage balanced fertigation to reduce input excesses and environmental load.
- **Integrate Harvest and Marketing Systems:**
  - Develop aggregation and cold-chain models to manage higher yields.
  - Introduce MIS-certified produce labeling to access premium markets.
- **Target Efficiency in Labour and Energy Use:**
  - Incentivize farmers for reduced diesel consumption through green certification schemes.
  - Promote collective irrigation infrastructure for marginal farmers.

# Chapter 12: Information, Communication, and Barriers to MIS Adoption

## 1. Overview

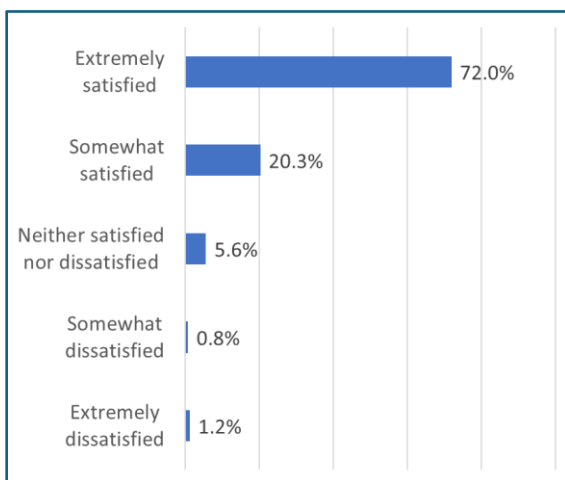
Information, Education, and Communication (IEC) mechanisms form the backbone of successful technology dissemination in agriculture. For the Micro Irrigation System (MIS) initiative in Gujarat, GGRC’s efforts in outreach, training, and digital engagement have played a pivotal role in shaping adoption patterns. While overall satisfaction with services is high, several challenges—particularly related to credit access and financial procedural complexities—continue to limit the full potential of MIS. This chapter evaluates both the strengths of IEC initiatives and areas that require policy and programmatic recalibration.

## 2. Effectiveness of IEC and Farmer Support Mechanisms

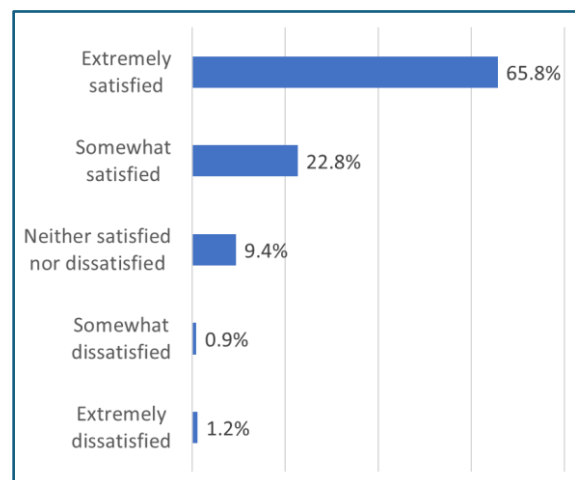
### 2.1 Satisfaction with GGRC Services and Training

GGRC has earned strong approval for its performance in facilitating MIS adoption. The vast majority of farmers report satisfaction with its operational processes and training quality.

- **92.3%** of respondents are satisfied with GGRC’s **overall services**.
- **88.6%** are pleased with **training initiatives**.
- Only **2%** expressed dissatisfaction, while **5–9%** remained neutral, indicating scope for further engagement.



Satisfaction levels with GGRC’s services



Satisfaction levels with GGRC’s Training

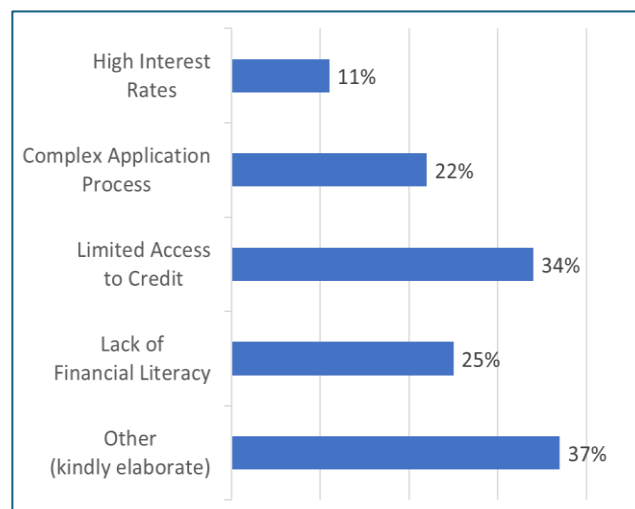
**Insight:** High levels of satisfaction reflect the effectiveness of GGRC’s core IEC model; however, targeted follow-ups may be needed for those remaining indifferent or disengaged.

## 2.2 Challenges in Financial Access and Procedural Complexity

Despite strong satisfaction with service delivery, financial barriers continue to hinder many farmers from either adopting or expanding MIS usage.

- **34% of farmers** struggle with **credit access**.
- **47%** cite difficulties related to **financial literacy** and procedural formalities.

These findings suggest that while the technical communication around MIS is effective, the financial ecosystem accompanying it requires better integration with farmer realities.



*Challenges faced by the farmers*

**Insight:** To complement strong IEC and training performance, GGRC must work with financial institutions to simplify access and communication around subsidies and loans.

## 3. Community-Level Outcomes of IEC Initiatives

### 3.1 Water Conservation and Environmental Awareness

GGRC’s IEC initiatives have created tangible awareness of water conservation and sustainable farming practices.

- **69.55%** of farmers report enhanced **awareness on water conservation**.
- Environmental awareness has increased among **60.52%** of respondents, reflecting growing consciousness of climate-smart agriculture.

**Table 1: Environmental Impact Metrics of GGRC IEC Efforts**

Aspect	% Positive Response	Interpretation
Water conservation awareness	69.55%	Strong environmental impact of IEC
Environmental awareness	60.52%	Broader sustainability orientation developing

**Insight:** IEC programs are driving behavioural change related to resource stewardship—vital for long-term MIS sustainability.

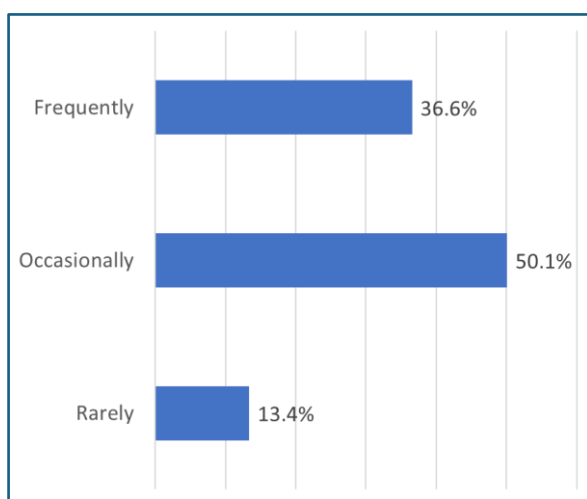
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### 3.2 Social Connectivity and Knowledge Networks

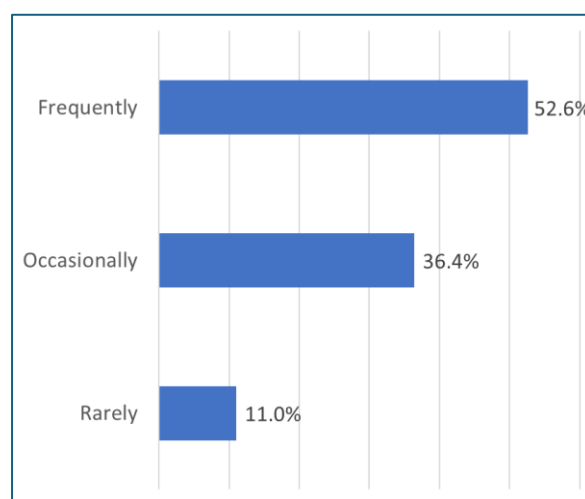
MIS adoption, facilitated through GGRC-led training and outreach, has also improved the social landscape among farmers.

#### Key Social Outcomes:

- **51.43%** feel **more connected with other farmers** post-MIS adoption.
- **52.57%** report **frequent peer collaboration**, such as resource sharing or problem-solving.
- **36.55%** have observed **frequent improvements in community gatherings**, indicating better social cohesion.
- **46.04%** have experienced **positive impacts on community farming**.



*Community gatherings*



*Sharing of Resources and Knowledge*

**Insight:** IEC efforts not only disseminate information but also serve as catalysts for collective action and community engagement in agriculture.

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### 4. GGRC E-Service Portal: Usability and Perception

GGRC's digital platform has gained considerable traction among farmers, particularly for its ease of use and functional design. However, concerns around login security signal the need for technical refinement.

#### Performance Ratings:

- **62.82%** strongly agree that the **portal URL is easy to recall**.
- **58.57%** appreciate the **clear portal structure**.
- **61.24%** affirm that the **information is updated and relevant**.

- **60.98%** confirm **24/7 accessibility**.
- **63.41%** strongly agree on **transactional transparency**.
- **54.90%** trust the **login security**, indicating this as an area for improvement.

**Table 2: Farmer Feedback on GGRC Portal Usability**

Portal Aspect	% Strongly Agree	Comments/Implication
Easy-to-remember address	62.82%	Aids accessibility and usage
Portal structure	58.57%	User-friendly layout appreciated
Content quality and updates	61.24%	Builds trust in information
Range of services offered	60.90%	Reflects platform versatility
Timely and round-the-clock	60.98%	Consistent technical performance
Transparency in transactions	63.41%	Strengthens institutional credibility
Security of login credentials	54.90%	Needs enhancement to assure data

**Insight:** The GGRC portal is functionally sound and informative, but technical and user interface improvements—especially around login security—can increase farmer confidence and engagement.

## 5. Summary

GGRC’s IEC initiatives have significantly enhanced awareness and adoption of MIS across Gujarat. High satisfaction with services and training, combined with increased environmental and social consciousness, points to a robust communication ecosystem. However, persistent difficulties in accessing credit and navigating financial procedures hinder complete adoption. Additionally, while the GGRC portal is largely praised for usability and transparency, concerns around data security remain. Strengthening IEC with a focus on financial education, social network building, and digital access will help overcome current bottlenecks and reinforce farmer empowerment.

## 6. Recommendations

To improve MIS adoption outcomes and build an inclusive ecosystem, future IEC efforts must address the operational and psychological barriers faced by farmers. This includes simplifying financial processes, extending outreach through vernacular and multimedia tools, and strengthening digital and community interfaces for inclusive knowledge dissemination.

### 1. Enhance Financial Literacy and Simplify Credit Access

- Launch farmer-friendly training modules on credit options and subsidy procedures.

- Embed financial support officers in GGRC field teams.
- Collaborate with banks for on-site loan and subsidy processing.

## **2. Expand and Diversify IEC Content and Channels**

- Use digital media (e.g., WhatsApp, video explainers, community radio).
- Introduce region-specific field demonstrations and vernacular IEC materials.
- Engage progressive farmers as peer educators.

## **3. Strengthen Community Networks**

- Support formation of water-user groups or MIS cooperatives.
- Conduct quarterly farmer forums to facilitate collective learning.
- Offer incentives for collaborative initiatives such as joint maintenance.

## **4. Improve GGRC Portal Security and Accessibility**

- Upgrade encryption and two-factor authentication features.
- Simplify user interface with visual cues and voice-assisted navigation.
- Translate key functions into regional languages for ease of use.

## **5. Institutional Feedback Mechanism**

- Institutionalize semi-annual farmer surveys on IEC, support, and service challenges.
- Develop a farmer-facing dashboard to track subsidy application status and training events.
- Establish MIS helpline desks at taluka level for first-hand issue resolution.

## Chapter 13: Socio-Economic Aspects of Micro Irrigation Adoption and GGRC Performance Assessment

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### 1. Overview

Micro Irrigation Systems (MIS), while primarily a water-saving technology, have also yielded significant socio-economic benefits for rural communities. This chapter assesses the broader lifestyle, nutritional, and social impacts of MIS adoption, followed by an evaluation of GGRC's performance in facilitating system adoption, capacity-building, and digital service delivery. Additionally, the chapter incorporates farmer satisfaction levels and their intent to continue or expand MIS usage.

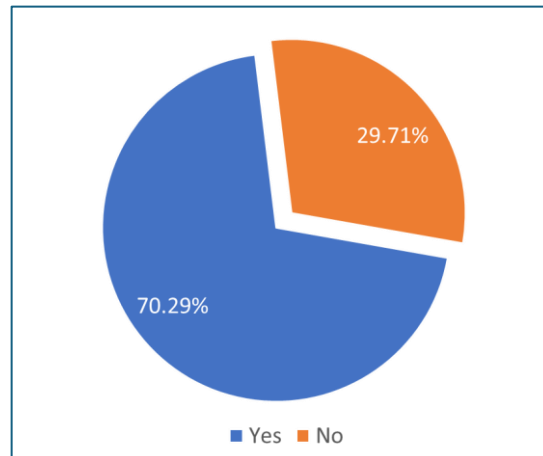
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### 2. Lifestyle and Nutritional Impact

#### 2.1 General Impact on Farmer Lifestyle

The improved irrigation practices introduced by MIS have made a visible difference in farmers' daily lives. Reduced manual workload, better water reliability, and higher yields have led to improved quality of life for the majority.

- **70.29%** of respondents reported a positive change in lifestyle post-MIS adoption.
- **29.71%** reported no significant lifestyle change, reflecting the role of local implementation quality and water access.



*Agreement on lifestyle improvements.*

**Insight:** The majority have benefited, but targeted outreach may be required to reach the remaining one-third.

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#### 2.2 Improvements in Food Habits and Nutrition

Enhanced agricultural output under MIS has contributed to better dietary outcomes. Households reported greater consumption of diverse and nutritious food groups.

- 78.41% reported increased milk consumption.
- 77.01% noted increased vegetable intake.
- 72.16% indicated more fruit consumption.
- 67.68% consumed more cereals and pulses.

Food Category	% Reporting Increase	Nutritional Implication
Cereals & Pulses	67.68%	Enhanced food security
Milk	78.41%	Better livestock and dairy access
Vegetables	77.01%	Improved dietary diversity
Fruits	72.16%	Higher vitamin and fiber intake

**Insight:** The indirect health benefits of MIS are substantial, reinforcing the linkage between irrigation, food productivity, and household nutrition.

### 3. Social Impact of MIS

#### 3.1 Community-Level Benefits

MIS adoption has fostered stronger community dynamics and increased cooperation among farmers. The system has also helped reduce disputes over water and strengthened climate resilience.

Social Aspect	% Agreeing	Implication
Improved livelihood	83.18%	Income and asset enhancement
Farming security	77.57%	Stability in output
Community collaboration	72.97%	Peer engagement and support
Reduced social tensions	67.38%	Fewer conflicts over water
Youth retention in farming	66.80%	Reduced migration, long-term sector stability
Job creation	58.28%	New service and agri-support roles
Climate preparedness	66.37%	Improved risk response
Environmental awareness	60.52%	Promotes sustainability practices

*Spectrum of social gains post-MIS.*

**Insight:** MIS positively transforms the social fabric, particularly where water is a shared resource.

### 4. Farmer Satisfaction and Future Intent

Farmers not only value the current MIS setup but also express strong intent to continue and expand its use. A small proportion still seeks more technical guidance and cost-related clarity.

- 76.80% rate MIS as highly effective; another 16.43% find it somewhat effective.
- 99.16% intend to continue usage.
- 97.27% are willing to recommend MIS to peers.
- 96.04% plan to expand MIS coverage.
- 18.55% still seek more training.
- 21.20% are hesitant to expand further.
- 76.80% are satisfied with installation costs.

**Insight:** Over 93% farmers rate MIS positively, showing the system’s strong operational acceptance.

**Commitment to Continued Use and Recommendation**

Indicator	% of Farmers
Intend to Continue	99.16%
Plan to Expand Coverage	96.04%
Will Recommend to Peers	97.27%

**Additional Support Needs**

Support Area	% of Farmers
Want More Training	18.55%
Hesitant to Expand Further	21.20%
Satisfied with Cost	76.80%

**Insight:** MIS enjoys strong user loyalty, but further technical training and cost transparency could enhance future adoption.

**5. GGRC Performance Assessment**

**5.1 Economic and Training Services**

GGRC has emerged as a well-regarded implementing agency, with high satisfaction rates for training and system support. However, procedural complexity and limited credit access remain barriers.

Parameter	% Agreeing	Notes
Overall satisfaction	92.3%	Strong institutional trust
Satisfaction with training	88.6%	Technical support well-received
Dissatisfied	~2%	Very low negative response
Neutral responses	5–9%	Indicates moderate engagement gaps
Difficulty in credit access	34%	Significant barrier to scaling
Financial literacy challenges	47%	Need for IEC improvement

**Insight:** GGRC is trusted, but streamlining finance processes could make MIS more accessible.

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## 5.2 GGRC's Social and Environmental Role

GGRC's outreach has contributed to increased water awareness, stronger farmer networks, and social cohesion.

Area	% Agreeing	Interpretation
Satisfaction with support	72.04%	Reflects post-installation efficacy
Satisfaction with training	65.76%	Indicates success in capacity-building
Water conservation awareness	69.55%	Signals IEC effectiveness
Farmer-to-farmer collaboration	52.57%	Encourages shared learning
Connectivity with other farmers	51.43%	Enhanced social networks

**Insight:** The agency's social role complements its technical functions, fostering peer support and resilience.

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## 6. GGRC Portal and E-Service Performance

The GGRC portal has proven accessible and reliable, with high user confidence in usability and transparency. However, concerns remain over login security.

Feature	% Strongly Agreeing	Notes
Easy site recall	62.82%	Good entry-level access
Clear navigation structure	58.57%	User-friendly interface
Updated content	61.24%	Reliable information
Service range	60.90%	Comprehensive functionality
24/7 availability	60.98%	High uptime
Timely delivery	62.22%	Responsive back-end systems
Browser compatibility	61.51%	Technical versatility
Transparency in transactions	63.41%	Builds trust
Login security perception	54.90%	Needs improvement

**Insight:** GGRC's digital infrastructure is efficient but must address data security to enhance farmer confidence.

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## Summary

Micro Irrigation Systems have positively transformed rural livelihoods through better water use, productivity, and social cohesion. Farmers report high satisfaction, strong intent to continue, and widespread advocacy for MIS. GGRC has played a pivotal role in enabling these outcomes through effective training, support, and digital services. Yet, areas like financial accessibility, login security, and additional training remain critical to address—especially for scaling and sustaining adoption among marginal communities.

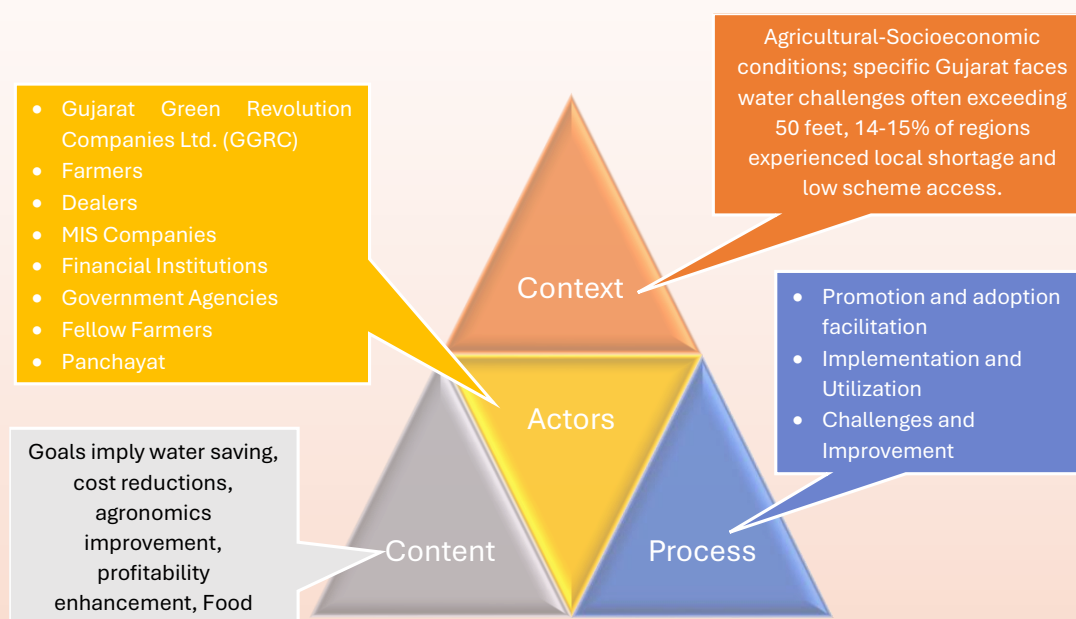
## Recommendations

- **Strengthen Financial Literacy and Credit Access**
  - Introduce guided sessions and rural credit navigators.
  - Simplify subsidy and loan procedures through IEC campaigns.
- **Enhance Technical Support**
  - Expand field-based training modules, particularly in underperforming zones.
  - Create seasonal knowledge refreshers for expanding users.
- **Reinforce Peer Learning and Community Collaboration**
  - Promote farmer collectives and MIS success stories.
  - Conduct regular community water-sharing and problem-solving forums.
- **Improve Digital Services**
  - Boost portal login security and add vernacular user interfaces.
  - Provide WhatsApp or SMS-based MIS service status alerts.
- **Track Farmer Intent and Feedback**
  - Monitor willingness to expand, satisfaction levels, and training needs annually.
  - Develop MIS “readiness scores” to prioritize IEC outreach.

# Public Policy Triangle and Social Return on Investment

## Public Policy Triangle

The Public Policy Triangle, proposed by Walt & Gilson in 1994, is a framework used to analyse public policies and their implementation by examining four key components: content, context, actors, and process. Below is an application of this framework to the Micro Irrigation (MI) Scheme implemented by Gujarat Green Revolution Company Ltd. (GGRC) in Gujarat.



*Public Policy Triangle: Micro Irrigation (MI) Scheme in Gujarat*

**Context:** The context refers to the conditions or environment that necessitated the policymaking on a certain agenda, including political, social, and economic factors that influence policy creation and implementation.

In Gujarat, the Micro Irrigation Scheme (MIS) operates within a specific agricultural and socioeconomic landscape. The state faces significant water challenges, with groundwater levels often exceeding 50 feet and 13–18% of regions reporting local water shortages, even during periods of normal rainfall. Groundwater sources, primarily tube and open wells, dominate irrigation, with deep tube well reliance in North Gujarat leading to high expenses due to energy costs. Farmers are increasingly constrained by the costs of lifting water. Socioeconomically, crop farming is predominant (95%) and often practiced within joint families (67%), implying collective decision-making. A significant portion of farmers (63%) have less than high school education, although digital penetration through smartphones is strong (66%). Despite income levels between ₹1–10 lakh, most farmers lack access to basic schemes like Kisan Cards (78%) and Soil Health Cards (89%). Landholdings are often fragmented, with 72.3% of farmers categorized as

marginal (<1 ha) or small (1–2 ha). These conditions created a need for an efficient irrigation solution like MIS to address water scarcity, reduce operational costs, and enhance agricultural productivity and farmer livelihoods.

**Content:** The content in the policy triangle denotes the nature and scope of the policy created, including its clear objectives and goals.

The content of the GGRC Micro Irrigation Scheme (MIS) focuses on transforming agricultural practices through efficient water management, aiming for both practical and economic benefits. Key objectives include significant water savings, improved irrigation efficiency, and reductions in operational costs such as diesel, labour, and electricity. The policy also seeks to enhance agronomic benefits, leading to higher yields, reduced irrigation time, and better fertilizer and weed management. Economically, MIS is intended to be a cost-effective tool that boosts profitability and input efficiency, ultimately improving farmers' quality of life and food security, including increased consumption of cereals, pulses, milk, vegetables, and fruits. Socially, the scheme aims to strengthen community cohesion, reduce water-related conflicts, encourage youth engagement in agriculture, and foster environmental consciousness.

**Actors:** Actors are mainly the implementers of public policy, responsible for delivering services and benefits, and can also include informal actors who influence the policy.

The primary implementer of the Micro Irrigation Scheme in Gujarat is the Gujarat Green Revolution Company Ltd. (GGRC). Farmers are crucial actors, being the direct beneficiaries and users of the MIS, with their demographics, practices, and perceptions being central to the scheme's impact. Other significant actors involved in the implementation and support ecosystem include:

- **Dealers and MIS Companies:** These private entities are heavily relied upon for post-installation service and maintenance, handling 78% and 57% of service resolutions respectively.
- **Financial Institutions:** Although not explicitly detailed as direct implementers, their role is crucial given the challenges farmers face in accessing credit and financing for MIS adoption.
- **Government Agencies:** These provide support, though direct involvement in service resolution is limited (8%) compared to private dealers.
- **Fellow Farmers:** Play an informal yet significant role by providing diagnosis and support, especially in remote areas where formal services are less accessible.
- **Panchayat Networks and Local Champions:** Important for community-based outreach, workshops, and information dissemination.

**Process:** The process in the policy triangle represents the action plan for policy implementation, explaining the course of action taken by implementation institutions through creating required systems and various schemes and programs.

The implementation process of the MIS in Gujarat involves several key strategies and mechanisms:

### **1. Promotion and Adoption Facilitation:**

- Awareness Campaigns: Information about GGRC MIS is disseminated through various channels, with traditional print media (65%) and Panchayat workshops (58%) being most effective. Electronic media, government advertisements, and internet/mobile campaigns also play significant roles.
- Subsidies: Financial support in the form of subsidies is the strongest motivator for MIS adoption (average rating 4.48), significantly reducing the financial burden on farmers from ₹100,000 in earlier years to ₹30,000–₹50,000 recently.
- Installation Support: Ease of access to subsidies and installation support (average rating 4.24) encourages participation.
- Targeted Inclusivity: The scheme has increasingly targeted smaller landholders, with average area per installation declining to 1.3–1.4 hectares in recent years, reflecting a focus on broader inclusivity, particularly for small and marginal farmers who constitute 76% of users.

### **2. Implementation and Utilization:**

- System Preference: Drip irrigation dominates (60.82% adoption state-wide), while mini-sprinklers are also widely used, especially in North Gujarat (66.10%).
- High Adoption and Usage: A high percentage of surveyed farms (96.96%) have an MIS installed, with 86.59% actively using their systems.
- Seasonal Management: Non-use is mostly seasonal downtime (84.78%), not system failure, and systems are generally stored for future reuse (93.96%).

### **3. Support and Maintenance Ecosystem:**

- Post-Installation Support: While 95.45% of farmers received initial information, 65.69% required maintenance support afterward.
- Private Sector Reliance: Most farmers rely on dealers (78%) and MIS companies (57%) for service, with high satisfaction levels (99.10% satisfied with service).
- Awareness Gaps: There is limited awareness of training and testing facilities; over 75% are unaware of training centers.
- Farmer Workarounds: Farmers engage in informal fixes like plugging emitter holes or creating makeshift filters due to service gaps.
- Digital Portal: The GGRC online portal is utilized for ease of use, quality of information, reliability, and transaction transparency, though login security is a concern.

#### 4. Challenges and Improvement Areas:

- **Financial Barriers:** High initial costs, insufficient subsidy coverage, and difficulties in accessing credit (34%) and financial literacy (47%) remain significant challenges.
- **Maintenance Issues:** Clogging of drippers (23.49%) and availability of spare parts (22.49%) are frequent problems, alongside physical damage from animals (31.90% from cattle/goats, 34.41% from rodents) and sunlight.
- **Infrastructure Constraints:** Declining water tables and unreliable power (despite strong access) act as adoption barriers.
- **Structural Problems:** Land fragmentation and lack of fencing add cost and complexity.
- **Theft:** Theft of MIS components, especially in semi-urban areas, is a concerning issue (10.53% reported).

The overall process aims to scale up the MIS, enhance water efficiency, and improve farmer livelihoods, with a continuous need for targeted interventions, simplified procedures, and strengthened support mechanisms to address persistent challenges.

#### Social Return on Investment of Micro Irrigation

Social Return on Investment (SROI) is a systematic way of incorporating social, environmental, and economic values into decision making processes. It is an impact assessment tool that measures quantitative and qualitative change.

As this scheme is already functional and ongoing so, here we will be using evaluative SROIs separately for Drip Irrigation, Mini Sprinkler and Sprinkler. Only those individual have been taken in the account who have prior and post MIS annual Income to get the accurate results.

#### Net Income Increase after adoption of MIS

MIS	Net Income Increase (Per Hectare)
Drip Irrigation	86701.02
Mini Sprinkler	65355.01
Sprinkler	49056.27

#### Electricity Saving after adoption of MIS

MIS	Electricity Saved (In Rupees per ha)
Drip Irrigation	8854.82
Mini Sprinkler	17431.83
Sprinkler	14886.52
<b>Combined (MIS)</b>	<b>11744.26</b>

#### Water Saving after adoption of MIS

MIS	Water Save (In Percentage)
Drip Irrigation	33.66
Mini Sprinkler	31.48
Sprinkler	24.75
<b>Combined (MIS)</b>	<b>31.98</b>

#### Crop Production Increased after adoption of MIS

MIS	Crop Production Increased (In Percentage)
Drip Irrigation	47.11
Mini Sprinkler	18.73
Sprinkler	18.61
<b>Combined (MIS)</b>	<b>36.22</b>

## Socio-Economic-Environmental Aspects (Qualitative Data)

1. **Improved Livelihood and Social Standing:** 83.18% reported better quality of life, and 77.57% felt more secure in farming, indicating significant economic stability and social upliftment. This highlights the positive impact of micro-irrigation in reducing financial stress and enhancing overall well-being.
2. **Stronger Community Ties:** 72.97% observed better collaboration among farmers, while 67.38% noted reduced social tension over water usage, reflecting enhanced collective resilience. This indicates that micro-irrigation has fostered a sense of shared purpose and mutual support within farming communities.
3. **Youth Retention and Job Creation:** 66.80% believed micro-irrigation encouraged youth to stay in farming, and 58.28% felt it created new job opportunities, highlighting its role in reducing rural outmigration. This suggests that micro-irrigation can help sustain the agricultural workforce by providing more stable employment options.
4. **Environmental Awareness and Climate Resilience:** 66.37% felt better prepared for climate challenges, and 60.52% reported increased environmental awareness, aligning with sustainable farming goals. This reflects the role of micro-irrigation in promoting resource efficiency and climate resilience among farmers.

## Methodology

**Discounted rate of 5% is considered for computation of Present Value for 7 years as the life of MIS is considered to be 7 years by Government of India.**

**Present Value** = Value of impact year 1 / (1+r)<sup>1</sup> + Value of impact year 2 / (1+r)<sup>2</sup> + Value of impact year 3 / (1+r)<sup>3</sup> + Value of impact year 4 / (1+r)<sup>4</sup> + Value of impact year 5 / (1+r)<sup>5</sup> + Value of impact year 6 / (1+r)<sup>6</sup> + Value of impact year 7 / (1+r)<sup>7</sup>

**Net Present Value = Present Value of Benefits – Value of Investment**

Here, Present Value of Benefit include difference Gross Annual Income earned per hectare prior & post adoption of MIS. Value of Investment include all the Gross Annual recurring expenditure prior & post adoption of MIS.

$$\text{SROI Ratio} = \frac{\text{Net Present Value}}{\text{Total value of the Inputs}}$$

## Social Return on Investment for Drip Irrigation, Mini Sprinkler & Sprinkler

MIS	Year1	Year2	Year3	Year4	Year5	Year6	Year7
Drip Irrigation	82572.39	78640.38	74895.6	71329.14	67932.52	64697.64	61616.80
Mini Sprinkler	62242.86	59278.92	56456.12	53767.73	51207.36	48768.92	46446.59
Sprinkler	46720.25	44495.48	42376.65	40358.71	38436.87	36606.54	34863.37

MIS	Total Benefit	Total Cost	Social Return on Investment	Payback Period (In Years)
Drip Irrigation	501684.5	130000	3.85	1.50
Mini Sprinkler	378168.5	115000	3.28	1.75
Sprinkler	283857.9	25000	11.35	0.51

### Interpretation:

This means that for every ₹1 invested in the Drip Irrigation, Mini sprinkler & Sprinkler an estimated ₹3.85, ₹3.28 and ₹11.35 respectively of social value is generated over a 5-year period. Payback period in Years for Drip Irrigation, Mini Sprinkler & Sprinkler is 1.50, 1.75 & 0.51 respectively.

### Social Return on Investment for Micro-Irrigation System

Combined SROI is calculated using weighted average of the Total Benefit and Total cost assigned through the percentage of the respondents from the field survey.

MIS	Percentage of the Respondents (2)	Total Benefits (3)	Weighted Average Benefits (2*3)	Total Cost (4)	Weighted Average Cost (2*4)	Weighted SROI (Weighted Average Benefits/ Weighted Average Costs)
Drip Irrigation	61.25	501684.5	307301.07	130000	79630.01	
Mini Sprinkler	25.80	378168.5	97554.25	115000	29665.98	
Sprinkler	12.95	283857.9	36758.57	25000	3237.41	
<b>Combined (MIS)</b>	<b>100</b>		<b>441613.91</b>		<b>112533.40</b>	<b>3.92</b>

### Interpretation:

This means that for every ₹1 invested in the MIS intervention, an estimated ₹3.92 of social value is generated over a 7-year period.

### Key Observations:

1. The SROI of 3.92:1 indicates very strong social returns from the micro irrigation investments
2. Major drivers of value:
  - Significant income increases
  - Water conservation (critical in Gujarat's water-scarce context)
  - Labour savings and improved productivity
  - Crop diversification enabling higher-value agriculture

3. The calculation is conservative as it doesn't fully quantify:

- Environmental benefits of water conservation
- Social benefits of improved food security
- Potential multi-generational impacts
- Social impacts like youth retention are qualitatively acknowledged but not monetized.

This analysis demonstrates that micro irrigation systems in Gujarat generate substantial social value relative to their costs, making them an impactful investment for rural development and agricultural improvement.

# Learnings from GGRC: Key Antecedents for Successful MIS Implementation

The Gujarat Green Revolution Company (GGRC) provides a compelling example of how a government-backed scheme can be successfully translated from policy to practice. Its achievements in micro-irrigation implementation offer important insights into the **necessary conditions or antecedents for successful execution of development schemes** at scale. These learnings are organized below to reflect a logical sequence, from upstream planning to downstream delivery and impact.

## 1. Clear and Comprehensive Planning

**Success Factor:** The foundation of GGRC's success lay in its robust design and planning structure. Scheme guidelines were clearly defined, target groups (such as small and marginal farmers) were well-identified, and implementation was backed by evidence from baseline assessments and field needs.

**Key Learning:** Detailed needs assessment, region-wise strategy tailoring, and clear eligibility criteria helped ensure relevance and inclusivity from the outset.

**Evidence/Insight:** *"Over 72% of adopters were marginal or small farmers. Income increased in 97% of cases post-MIS adoption."*

## 2. Robust Monitoring and Evaluation (M&E) Framework

**Success Factor:** GGRC established performance-based indicators and conducted regular monitoring at various levels. Feedback loops were built into the system to make mid-course corrections.

**Key Learning:** Data-backed tracking of outcomes, including adoption rates, farmer satisfaction, and water-use efficiency, helped maintain accountability and foster adaptive governance.

**Insight:** *Over 96% of surveyed farmers continue to use MIS, indicating system relevance and responsiveness.*

## 3. Strong Institutional Capacity

**Success Factor:** Dedicated teams at GGRC and its decentralized operational structure played a pivotal role. Clear delegation of responsibilities and coordination with district-level entities enhanced responsiveness.

**Key Learning:** Staff specialization, regular training, and integration with local institutions (e.g., taluka offices, ATMA, and Krishi Vigyan Kendras) significantly improved service delivery.

#### 4. Community Participation and Ownership

**Success Factor:** Though GGRC operates through formal administrative channels, the scheme fostered farmer engagement via demo farms, farmer field schools, local dealer interactions, and feedback mechanisms.

**Key Learning:** Farmers' sense of involvement was boosted through local awareness camps, training modules, and follow-ups, encouraging higher uptake and sustained use.

**Quote:** *“We saw a demo on a neighbour’s farm. That convinced us to apply for MIS.” – Farmer, Saurashtra*

#### 5. Adequate Financial Resources and Timely Disbursals

**Success Factor:** The success of MIS was underpinned by timely subsidy releases and transparent fund flows. GGRC leveraged technology to track disbursements and avoid delays.

**Key Learning:** Strong backend processing and a clear subsidy workflow—despite being complex—ensured confidence among farmers and avoided cash-flow bottlenecks.

**Evidence:** *Farmer contributions for MIS dropped from ₹1 lakh (2008) to ₹30–50K (2025) due to improved subsidy design.*

#### 6. Addressing Implementation Challenges Proactively

**Success Factor:** The scheme addressed challenges like dealer dependency, service gaps, and lack of awareness through structured IEC drives and grievance redress systems.

**Key Learning:** Regular service feedback, satisfaction surveys, and field audits allowed GGRC to respond to systemic challenges and continuously refine its model.

**Insight:** *Only 1% of inactive systems were due to malfunction; 85% due to off-season use.*

#### 7. End-to-End Use of Technology

**Success Factor:** From application submission and farmer onboarding to subsidy tracking and post-installation verification, technology integration across the value chain was a major strength.

**Key Learning:** The GGRC Portal improved transparency, accessibility, and speed of service—especially valuable in remote regions.

**Observation:** *Over 90% of farmers find GGRC’s digital portal user-friendly despite login/security concerns.*

#### 8. Effective Information, Education, and Communication (IEC) Strategies

**Success Factor:** GGRC’s IEC strategy included print, audio-visual content, on-ground workshops, and digital media. This supported both initial adoption and post-installation behaviour change.

**Key Learning:** IEC efforts helped demystify MIS technology, build trust, and reach marginalized or low-literacy groups with contextually relevant content.

**Insight:** *Traditional media and village meetings were rated most effective for awareness; email was least impactful.*

## 9. Public-Private Partnerships (PPP) and Market Linkages

**Success Factor:** GGRC's collaboration with the OEM Network enabled last-mile delivery and innovation.

**Key Learning:** **Leverage PPPs** to enhance service quality, introduce innovation, and build **farmer-market linkages** for sustainability beyond subsidy cycles.

**Statistic:** *78% of farmers relied on dealers for service, with 99% satisfaction in issue resolution.*

## 10. Capacity Building beyond Initial Training

**Success Factor:** GGRC offered repeated training, post-installation guidance, and troubleshooting support.

**Key Learning:** Invest in **ongoing capacity-building modules**—not just at adoption, but for **post-implementation usage and maintenance** to ensure long-term benefits.

**Concern:** *75%+ farmers unaware of testing/training centres, highlighting need for proactive outreach.*

## 11. Local Customization of Technology

**Success Factor:** Technology choices (e.g., type of micro-irrigation systems) were adapted to agro-climatic and crop-specific needs.

**Key Learning:** Allow **flexibility in technology selection** and **customization based on region-specific conditions** to maximize impact.

**Example:** *North Gujarat: 66% mini-sprinkler adoption due to soil/topography; Central Gujarat: 81% drip preference.*

## 12. Risk Mitigation and Contingency Planning

**Success Factor:** Measures to mitigate implementation delays, equipment failure, or farmer drop-out were embedded.

**Key Learning:** Plan for **risks like supply-chain delays, climate variability, or fund misalignment**, and have **backup mechanisms** ready (e.g., emergency support, alternate suppliers).

**Note:** *Farmers used creative DIY (Do it yourself) fixes like mesh filters and rubber plugs when dealers were unavailable.*

### 13. Convergence with Other Government Schemes

**Success Factor:** GGRC facilitated alignment with PMKSY, ATMA, KVKs, and agriculture extension services.

**Key Learning:** Integrate MIS with other agricultural, water, and rural development schemes for synergy, scale, and efficiency.

**Challenge:** *Only 22% of farmers hold a Kisan Credit Card; less than 11% have Soil Health Cards.*

### 14. Behavioural Change Focus

**Success Factor:** GGRC emphasized mind set change regarding efficient water use and modern irrigation.

**Key Learning:** Drive **behavioural transformation** by highlighting benefits in **cost-saving, yield improvement, and long-term gains**, rather than focusing only on subsidies.

**Impact:** *Water use declined by an average of 32%; yield increased by 36.2% across systems.*

### 15. Gender-Sensitive Approaches

**Success Factor:** While not always explicit, inclusion of women farmers and SHGs was encouraged in outreach activities.

**Key Learning:** Design **gender-inclusive outreach strategies**, ensuring that women farmers receive equal access to information, training, and technology.

**Data Gap:** *Only ~8% of respondents were women; targeted gender strategies are needed.*

### 16. Evidence-Based Policy Feedback

**Success Factor:** **Learning** from field implementation was looped back into policy improvements.

**Key Learning:** Create systems for **bottom-up feedback** to inform **continuous policy refinements**, using both **quantitative data and qualitative insights**.

**Model:** *Public Policy Triangle used to inform feedback loops: GGRC as implementer, farmers as key actors, panchayats and dealers as enablers.*

### 17. Sustainability and Exit Strategy

**Success Factor:** Encouraging self-reliance post-subsidy was part of GGRC's long-term vision.

**Key Learning:** Plan an **exit strategy** to phase out dependence on subsidies and foster **financial and operational sustainability** (e.g., link to Farmer Producer Organizations, local credit).

**Observation:** *All second installations were self-financed; yet no formal credit uptake, highlighting opportunity for financing innovations.*

## 18. Climate Resilience Integration

**Success Factor:** MIS inherently promotes water conservation, contributing to resilience.

**Key Learning:** Position MIS as part of a broader **climate adaptation strategy**, linking to **drought resilience, soil health, and sustainable cropping patterns**.

**SROI:** ₹3.92 in social value generated per ₹1 invested in MIS.

*Table: Antecedents of Successful MIS Implementation – Learnings from GGRC*

S.No.	Antecedent	Success Factor	Key Learning
1	Clear and Comprehensive Planning	Evidence-based targeting and well-defined guidelines	Needs assessments and tailored strategies ensure relevance and inclusion
2	Robust M&E Framework	KPIs and real-time monitoring with corrective feedback loops	Continuous tracking enhances accountability and adaptive governance
3	Strong Institutional Capacity	Decentralized teams, defined roles, and coordination with local institutions	Specialization and field integration improve responsiveness
4	Community Participation and Ownership	Demo farms, feedback mechanisms, and training programs	Farmer involvement increases adoption and sustained usage
5	Financial Resources and Timely Disbursements	IT-enabled fund flow and direct subsidy release	Transparent disbursements reduce delays and build trust
6	Challenge Resolution Mechanism	Grievance redress, satisfaction surveys, and audits	Responsive systems address systemic issues and improve service delivery
7	End-to-End Use of Technology	Digital systems from application to verification	Technology improves transparency, efficiency, and accessibility
8	Effective IEC Strategies	Multilingual content, localized campaigns, and farmer-friendly media	Communication drives awareness and behavioural change
9	Public-Private Partnerships	Engaged OEM Network, certified service providers	PPPs enhance quality, innovation, and last-mile connectivity
10	Ongoing Capacity Building	Regular training and troubleshooting support	Capacity-building must continue beyond installation
11	Customization of Technology	Region-specific systems aligned with crops and geography	Local adaptation maximizes usability and impact
12	Risk Mitigation and Contingency Planning	Backup suppliers and emergency SOPs	Advance risk management prevents disruptions

S.No.	Antecedent	Success Factor	Key Learning
13	Convergence with Other Schemes	Integration with PMKSY, ATMA, KVK, etc.	Scheme convergence leads to efficiency, scale, and sustainability
14	Behavioural Change Focus	Shift in mind set about efficient water use	Success requires awareness of long-term gains, not just subsidies
15	Gender-Sensitive Approaches	SHG involvement, female farmer outreach	Gender-inclusive designs ensure wider impact and equity
16	Policy Feedback Loop	Field data and insights used to refine policies	Bottom-up Learning supports continuous improvement
17	Exit and Sustainability Strategy	Linkages to FPOs, markets, and credit	Planning for post-subsidy resilience is crucial
18	Climate Resilience Integration	Water-saving technologies promote drought resilience	Position MIS within larger climate adaptation and sustainability goals

## Conclusion

GGRC's model reveals that technology alone doesn't guarantee success; it's the interplay of policy design, institutional strength, participatory processes, and adaptive management that creates real impact. These 18 antecedents serve as a replicable roadmap for other states and sectors seeking scalable, inclusive, and sustainable development outcome.

## Conclusion

This study set out to assess the socio-economic impact and social return on investment (SROI) of the Micro Irrigation Scheme (MIS) implemented by the Gujarat Green Revolution Company (GGRC). The findings offer compelling evidence that the scheme has delivered transformative results in multiple dimensions—economic, environmental, operational, and institutional. However, it also reveals critical gaps that need to be addressed to sustain, deepen, and equitably distribute these gains.

### 1. Verified Impact across Economic and Agronomic Indicators

The research confirms that MIS adoption leads to substantial gains in productivity, input efficiency, and farm income:

- Water savings of 31.98% on an average were reported by over 92% of respondents, particularly in Central and North Gujarat.
- Fertilizer use declined by up to 66% in Saurashtra (Fertilizer 4), while labour demand for weeding, fertigation, and interculture dropped by 40–58%.
- Net income increased by 73–93% in zones like Central and South Gujarat. For example, average net income in Central Gujarat rose from ₹1.46 lakh to ₹2.83 lakh post-MIS.
- Over 85% of farmers reported yield increases, with Rabi production climbing from 10.1 tonnes (without MIS) to 16.7 tonnes (with MIS).

Moreover, cropping intensity reached a high of 1.89 under mini-sprinklers, and double cropping in summer (Zaid) showed a 100% increase in income, suggesting MIS enables both seasonal expansion and revenue resilience.

### 2. Inclusive Intent, But Uneven Reach

While 76% of users are small and marginal farmers, indicating sound outreach, other dimensions of equity remain under-addressed:

- Female participation in the scheme remains limited to ~8%, and farmers under 35 years of age comprise just 6.7% of the sample—reflecting low generational and gender inclusivity.
- Access to institutional tools like the Kisan Credit Card (21.85%) and Soil Health Card (10.97%) remains poor, limiting credit access and informed input use.
- Zone-wise disparities are evident: North Gujarat shows high cropping intensity with diversified use of mini sprinklers, while South Gujarat exhibits underutilization, with a cropping intensity of just 0.91, possibly due to mono-cropping or lack of operational guidance.

### **3. Service Ecosystem: Functioning, Yet Fragile**

Although 98%+ of farmers are satisfied with installation and support services, these are primarily delivered by dealers (78%) and MIS companies (57%), with only 8% of users citing government agencies as a support channel.

- Over 75% of farmers are unaware of training or testing facilities, pointing to a critical disconnect between scheme roll-out and technical empowerment.
- 33% of unresolved service issues were due to lack of trained personnel, and 30% cited unavailability of technicians—most acute in remote and tribal regions.

This signals a high-performing but private-led and fragile service infrastructure, vulnerable to breakdowns in areas with low commercial density.

### **4. Behavioural and Operational Maturity among Farmers**

Encouragingly, farmers have demonstrated strong ownership of MIS systems:

- 93.96% of systems not in use are preserved for future reuse, and many farmers employ informal repair innovations—such as makeshift emitters or filter hacks—particularly in areas with limited service access.
- Seasonal disuse rather than technical failure is the dominant reason for non-use, suggesting system longevity and user trust.

However, physical damage from animals (34.4%) and sun exposure (15.6%), along with component theft (10.5%), emphasize the need for better post-use protocols, protective infrastructure, and awareness.

### **5. Limitations and Strategic Imperatives**

While the MIS has demonstrated significant returns, its long-term viability and equitable scaling require urgent structural responses:

- Additional installations are 100% self-financed, with zero bank loan uptake, suggesting the need for tailored micro-credit instruments for repeat adopters.
- Subsidy dissatisfaction (rated 2.7/5) and GST non-coverage (2.6/5) reveal procedural opacity, deterring expansion and limiting enthusiasm.
- Low uptake of MIS in tribal, low-income zones and minimal crop diversification in Kharif season (90% still single-cropped) point to an incomplete behavioural transition in some segments.

## 6. Way Forward

To consolidate and expand the gains of MIS, this study recommends the following:

- Develop modular, low-cost MIS kits for marginal and fragmented holdings.
- Establish regional training hubs and decentralized service centers, especially in remote zones.
- Introduce credit-linked packages for second installations, ideally bundled with solar pump financing.
- Promote youth and women participation through targeted IEC campaigns and demonstration projects.
- Expand market linkages and FPO engagement to ensure that better crop quality translates into higher price realization, as only 59.3% currently report improved prices despite yield gains.

### Final Reflection

In conclusion, the MIS program under GGRC illustrates how a state-led, technology-driven initiative can simultaneously achieve efficiency, inclusivity, and impact—when supported by robust institutional design and adaptive field implementation. Yet, this success also comes with a caution: without systemic reforms in financing, service decentralization, and social inclusion, the scheme’s transformational momentum may plateau.

The next phase of MIS must not focus solely on coverage expansion but on deepening user capability, ecological alignment, and livelihood integration. Only then can MIS truly evolve from a subsidy-supported infrastructure into a self-sustaining, farmer-led system of climate-resilient agricultural modernization.





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