



# Empirical Analysis of Socio-Economic and Environmental Implications of Micro-Irrigation Adoption in India

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## Abstract

This study presents an empirical, state-wise analysis of micro-irrigation adoption in India between 2015 and 2024, based on official data from the Per Drop More Crop (PDMC) scheme under the Pradhan Mantri Krishi Sinchayee Yojana (PMKSY). The findings reveal significant inter-state variation, with Karnataka, Gujarat, and Tamil Nadu leading in cumulative adoption. ABY states collectively accounted for approximately 65% of the national micro-irrigation area, highlighting the impact of targeted policy interventions. The paper discusses policy implications, identifies gaps, and proposes strategies to improve adoption rates in lagging regions, thereby contributing to sustainable water resource management and agricultural productivity.

**Keywords:** Micro-irrigation, Water efficiency, Sustainable agriculture, India, State-wise analysis

## Introduction

Agriculture in India is heavily dependent on water resources, with irrigation playing a central role in ensuring food security and rural livelihoods. However, water scarcity, erratic monsoons, and the over-exploitation of groundwater have necessitated a shift towards efficient irrigation systems. Micro-irrigation techniques, such as drip and sprinkler systems, have emerged as sustainable solutions to enhance water use efficiency, reduce wastage, and improve crop yields. Despite the proven benefits, adoption rates vary considerably across states due to differences in policy implementation, farmer awareness, and infrastructural support.

## Literature Review

Previous studies (FAO, 2021; ICAR, 2020) have demonstrated that micro-irrigation systems can reduce water usage by 30–50% while increasing crop productivity by 20–40%. Research by Kumar et al. (2019) highlights that targeted subsidies and farmer training programs significantly improve adoption rates. However, literature also indicates persistent challenges such as high initial investment costs, inadequate after-sales service, and low

penetration in rain-fed areas. This study builds on the existing literature by providing an updated, state-wise empirical analysis covering the period 2015–2024.

### Methodology

The study is based on secondary data sourced from the Ministry of Agriculture and Farmers Welfare (MoAFW), Government of India, particularly from the Per Drop More Crop (PDMC) component of the PMKSY scheme. Data covers cumulative micro-irrigation adoption (in hectares) for each state and Union Territory from 2015–16 to 2023–24 (till date). Analytical methods include ranking states by adoption, calculating percentage shares, and comparing Atal Bhujal Yojana (ABY) states with non-ABY states.

### Results and Discussion

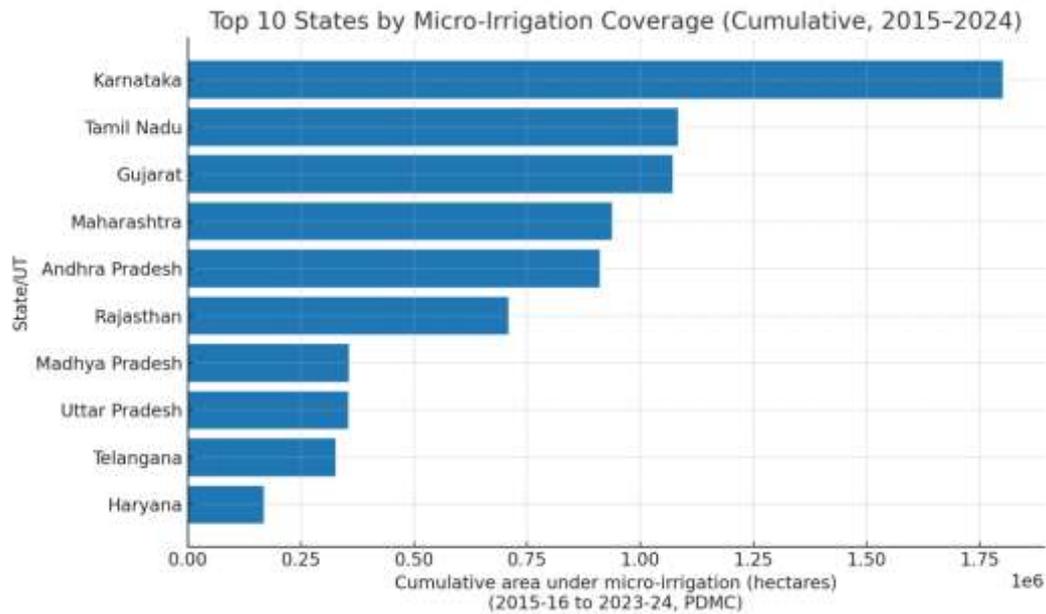
The analysis reveals that Karnataka leads the country with over 1.8 million hectares under micro-irrigation, followed by Gujarat (1.07 million hectares) and Tamil Nadu (1.08 million hectares). These three states alone account for over 40% of the total national coverage. On the other hand, states such as Goa, Ladakh, and Sikkim have recorded minimal adoption. The data also highlights that ABY states collectively contributed nearly 65% of the total micro-irrigation coverage, indicating that targeted policy frameworks have a measurable impact.

**Table 1. State-wise cumulative micro-irrigation adoption (2015–2024)**

STATE/UT	AREA (HA)
Karnataka	1,801,629
Tamil Nadu	1,083,784
Gujarat	1,071,399
Maharashtra	938,089
Andhra Pradesh	910,546
Rajasthan	708,193
Madhya Pradesh	356,091
Uttar Pradesh	354,715
Telangana	326,339
Haryana	168,336
Chhattisgarh	148,146
West Bengal	95,964
Odisha	95,475
Assam	44,356
Jharkhand	34,675
Uttarakhand	32,252
Bihar	28,258
Nagaland	19,180
Manipur	15,894
Punjab	14,502
Sikkim	12,972
Arunachal Pradesh	12,442
Himachal Pradesh	12,235
Mizoram	8,559
Kerala	5,608

Tripura	4,145
Jammu & Kashmir	1,104
Goa	875
Ladakh	3

**Figure 1. Top 10 States by micro-irrigation coverage (2015–2024)**



## Conclusion

The findings underscore the critical role of micro-irrigation in addressing India's water and food security challenges. While leading states demonstrate the potential of targeted policy interventions, lagging states require customized strategies including enhanced subsidies, farmer awareness programs, and integration of irrigation planning with crop diversification. Future research should focus on micro-level farm studies to better understand adoption barriers.

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