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Suggestions to overcome the constraints faced by the farmers using drip irrigation in Tamil Nadu

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Abstract

Drip irrigation, a resource-efficient and sustainable method of water delivery directly to the root zone, has proven to be a valuable agricultural technology, particularly in water-scarce regions such as Tamil Nadu, India. Despite its benefits in enhancing crop yield, conserving water, and improving nutrient management, the adoption of drip irrigation systems remains suboptimal among small and marginal farmers. Several socio-economic, technical, and institutional challenges hinder its widespread implementation. This study investigates the key constraints experienced by farmers in Tamil Nadu under the Tamil Nadu Irrigated Agriculture Modernization Project (TN-IAMP) and offers farmer-driven suggestions to overcome these barriers. A total of 559 respondents across eight major sub-basins—including Aliyar, Lower Vellar, Sathiyar, Sirumalaiyar, and parts of the Cauvery Delta—were surveyed using a structured interview schedule. The results, analyzed through frequency and ranking methods, reveal that the most pressing constraints include high initial investment costs, inadequate access to credit and subsidies, lack of technical knowledge, and limited availability of maintenance services and quality materials. To address these issues, farmers suggested a multifaceted strategy encompassing five key domains: (1) financial support through government-backed low-interest loans and streamlined subsidy access, (2) cost reduction via local manufacturing and price control mechanisms, (3) quality assurance with anti-clogging materials and enforced standards, (4) innovations such as solar-powered systems and durable components, and (5) education and motivation through training, peer learning, and success story dissemination. The study emphasizes the need for a coordinated effort among policymakers, agricultural institutions, financial bodies, and private stakeholders to implement these farmer-driven recommendations. Strengthening institutional frameworks, improving technology access, and building farmer capacity are essential to enhancing drip irrigation adoption, thus contributing to sustainable agricultural practices and water resource management in Tamil Nadu.

Keywords: Drip irrigation, adoption barriers, suggestions, financial support, motivation, cost reduction

Introduction

Drip irrigation has emerged as a promising innovation in modern agriculture, particularly in regions where water scarcity poses a significant threat to productivity and sustainability. The system delivers water directly to the plant's root zone through emitters at low pressure and volume, thereby enhancing water use efficiency and crop yields. Numerous studies have demonstrated that drip irrigation can reduce water usage by 30-70% while increasing productivity by 20-90% compared to conventional surface irrigation methods (Narayanamoorthy, 2004; Sivanappan, 1994) ^[8, 11]. In the context of Indian agriculture, where irrigation accounts for over 80% of total freshwater use, the importance of efficient irrigation systems like drip cannot be overstated.

Tamil Nadu, situated in a semi-arid tropical climate zone, is one of the most water-stressed states in India. With declining groundwater levels, erratic monsoonal rainfall, and over-exploitation of surface water, the adoption of water-saving technologies is a critical imperative. The Government of India and the Government of Tamil Nadu have introduced various programs, such as the Tamil Nadu

Irrigated Agriculture Modernization Project (TN-IAMP), to promote the uptake of micro-irrigation technologies including drip. However, despite policy support and demonstrated agronomic benefits, the rate of adoption remains uneven and limited among small and marginal farmers (Kumar *et al.*, 2011; Kumar *et al.*, 2021) ^[4, 5].

Several empirical studies have sought to understand the barriers to the adoption of drip irrigation. According to Namara *et al.* (2007) ^[6], the high initial investment cost, even after subsidy, remains a major constraint for farmers with limited financial resources. Similarly, farmers often lack adequate technical knowledge and access to skilled personnel for system installation and maintenance, which reduces system longevity and effectiveness (Kumar, Reddy, & Mallikarjun, 2015) ^[3]. These challenges are exacerbated by poorly structured financial incentives and delayed subsidy disbursements under government schemes (Chaurasia, Singh, & Chourasia, 2020) ^[2]. Narayanamoorthy (1997) ^[7] also notes that uneven awareness levels and a lack of localized technical support are further barriers to adoption.

A study conducted in Maharashtra and Karnataka by

Namara *et al.* (2005) ^[6] showed that adoption rates were significantly higher in regions where training, maintenance support, and credit availability were systematically provided. This indicates that a holistic approach, combining financial, institutional, and educational support, is necessary for effective diffusion of drip irrigation systems. Farmers who received both financial subsidies and hands-on training exhibited significantly better system utilization and sustained adoption, confirming the importance of integrated policy design (Chatterjee *et al.*, 2021) ^[1].

In Tamil Nadu, the TN-IAMP project aimed to enhance the sustainability of irrigation practices by promoting precision technologies, but many farmers continued to face structural and procedural constraints. Recent field studies, indicate that while farmers recognize the benefits of drip irrigation—particularly in horticultural crops like banana, sugarcane, and vegetables—multiple operational barriers reduce the technology's practical utility. These include clogging of emitters, absence of filtration units, low-quality components, and lack of post-installation service, confirming the findings of earlier works by Palanisami *et al.* (2011) ^[10].

There is also evidence that region-specific constraints, such as landholding size, crop choice, socio-economic background, and prior exposure to modern irrigation practices, strongly influence the rate of adoption. For example, farmers with larger holdings and better institutional linkages were more likely to adopt and maintain drip systems over time (Narayanamoorthy & Bhattarai, 2006) ^[9]. Furthermore, when extension agencies

and research institutes actively participated in drip system demonstrations and follow-ups, the trust and adoption levels among farmers improved significantly (Kumar & Palanisami, 2010) ^[4].

The present study attempts to systematically document the constraints faced by TN-IAMP beneficiaries in Tamil Nadu and presents their suggestions for improvement. Rather than relying solely on theoretical frameworks, this study grounds itself in the lived experiences and feedback of farmers, making it a valuable contribution to the literature on participatory irrigation development and micro-irrigation policy. The insights derived from this study aim to support future policy design, stakeholder collaboration, and capacity-building strategies, ultimately improving water resource sustainability and farmer resilience in Tamil Nadu.

Materials and Methods

The study was conducted in Aliyar, Lower Vellar, Uppar, Sirumalaiyar, Sathiyar, Cauvery Delta Zone - Nagapattinam, Lower Coleroon - Aduthurai, Vridhachalam sub basins of Tamil Nadu state. These sub basins of Tamil Nadu covering major area under drip irrigation and the districts covered by these sub basins are shown in Fig: 1. From these sub basins all the TN-IAMP beneficiaries were selected for the study with complete sampling procedure. In this the beneficiaries with a total sample size of 559 were selected for the study. The respondents were personally interviewed with interview schedule. The data were tabulated and analyzed by using statistical tools like frequency, percentage and ranking.

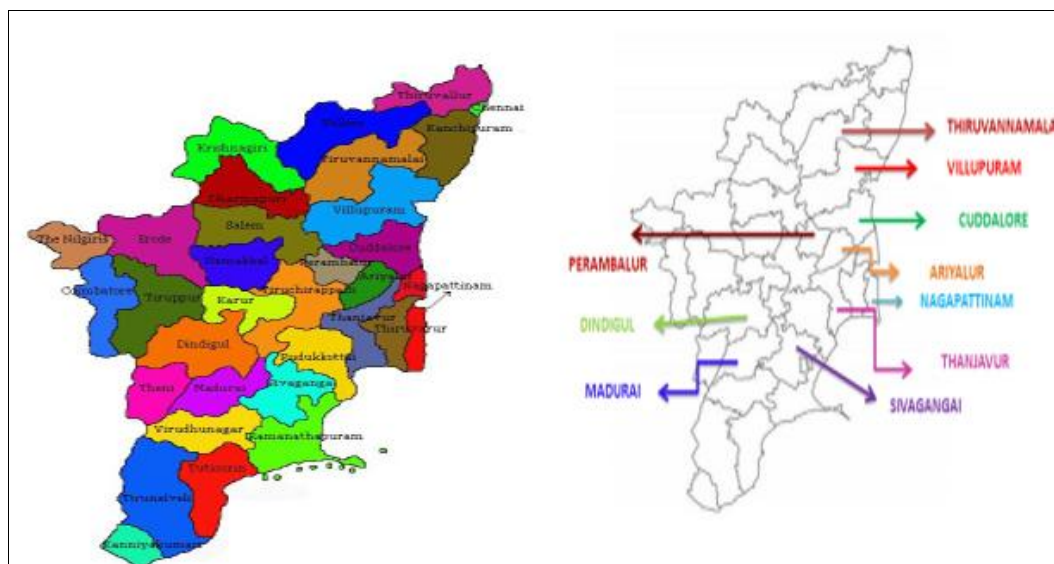


Fig 1: Districts covered under selected sub basins

Results and Discussion

The adoption of drip irrigation systems is crucial for improving water efficiency and agricultural productivity, especially in water-scarce regions. To address the challenges associated with its implementation, a ranked list of suggestions has been developed, focusing on financial support, cost reduction, quality and maintenance, innovation, and farmer education. These recommendations prioritize measures such as government schemes for

subsidized installation costs, the promotion of high-quality materials, and the encouragement of local manufacturing, among others. By implementing these strategies, stakeholders can enhance the affordability, accessibility, and effectiveness of drip irrigation systems for farmers.

The suggestions given by the respondents to overcome the problems faced by them in using drip irrigation are mentioned in the below Table (1).

Table 1: Distribution of respondents according to their suggestions

S. No	Suggestions	Rank
1.	Implement government schemes that offer low-interest loans or grants to subsidize installation costs.	I
2.	Create partnerships with private companies to provide cost-effective solutions.	IV
3.	Encourage local manufacturing of drip irrigation components to reduce costs	III
4.	Establish a price control mechanism for essential parts to make them more affordable for farmers.	V
5.	Collaborate with banks and financial institutions to create targeted credit programs for farmers specifically for irrigation purposes	VI
6.	Simplify application processes for loans	VII
7.	Provide farmers with training on basic maintenance and repairs	VIII
8.	Establish a local network of technicians to assist with repairs when needed	IX
9.	Educate farmers on the importance of pre-filtration systems to reduce clogging	XI
10.	Promote the use of high-quality, anti-clogging materials in drip irrigation systems	II
11.	Enforce quality standards for drip irrigation products	XII
12.	Encourage research and development of more durable materials	XV
13.	Develop comprehensive training programs for farmers on drip irrigation management, maintenance, and best practices, with workshops, online courses, and field demonstrations	X
14.	Promote solar-powered drip irrigation systems to reduce dependence on the grid and ensure consistent operation	XIII
16.	Organize success stories, peer learning sessions to motivate farmers and highlight local success stories and demonstrate tangible benefits.	XIV

Based on the Table (1) the suggestions were categorized in to five criteria,

Financial Support

Implement government schemes offering low-interest loans or grants to subsidize installation costs (Rank I) followed by create partnerships with private companies for cost-effective solutions (Rank IV), collaborate with banks to create targeted credit programs for irrigation (Rank VI) and simplify loan application processes (Rank VII).

Cost Reduction

Encourage local manufacturing of drip irrigation components to lower costs (Rank III) and establish price control mechanisms for essential parts to make them more affordable (Rank V).

Quality and Maintenance

Promote the use of high-quality, anti-clogging materials (Rank II) followed by provide training to farmers on basic maintenance and repairs (Rank VIII), establish a local network of technicians to assist with repairs (Rank IX), educate farmers on the importance of pre-filtration systems to prevent clogging (Rank XI) and enforce quality standards for products (Rank XII).

Innovation and Sustainability

Promote solar-powered drip irrigation systems for consistent operation (Rank XIII) and encourage research into more durable materials (Rank XV).

Education and Motivation

Develop training programs on drip irrigation management, maintenance, and best practices (Rank X) and organize peer learning sessions and success stories to motivate farmers (Rank XIV).

Conclusion

Drip irrigation has emerged as a transformative technology in the realm of water-efficient agriculture, especially in water-stressed regions such as Tamil Nadu. Despite its evident advantages in enhancing crop productivity and

conserving water, the adoption of drip irrigation systems continues to be hindered by multiple socio-economic, technical, and infrastructural barriers faced by farmers. The findings of this study, drawn from diverse sub-basins across Tamil Nadu under the TN-IAMP initiative, reveal the usual constraints they are facing in adopting drip irrigation that are high installation costs, lack of affordable credit facilities, limited technical knowledge, and inadequate support services remain primary impediments.

To address these issues, farmers suggested a multifaceted approach that integrates financial, technical, and educational strategies. Foremost among these is the need for government-backed low-interest loan schemes and grants to mitigate the high initial investment. Concurrently, collaboration with private enterprises and banks could facilitate the development of cost-effective and accessible credit solutions. Reducing costs through the promotion of local manufacturing and the enforcement of price controls on essential components can further make the technology more affordable.

Additionally, maintaining the quality and durability of drip irrigation systems is vital. Training farmers in basic repair techniques, ensuring the availability of local technicians, and introducing high-quality, anti-clogging materials can enhance the longevity and efficiency of the systems. Innovations like solar-powered irrigation and durable components offer promising sustainable solutions. Equally important is capacity-building through structured training programs, peer learning sessions, and the dissemination of success stories that can inspire confidence and foster widespread adoption among farmers.

In essence, a coordinated effort involving policy reforms, financial innovation, technical support, and educational outreach is crucial to overcoming the constraints in drip irrigation adoption. These targeted interventions not only empower farmers but also pave the way for a resilient and sustainable agricultural future in Tamil Nadu.

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