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THE ECONOMICS OF DRIP IRRIGATION ADOPTION AS A CLIMATE-SMART ADAPTATION STRATEGY: A REVIEW WITH REFERENCE TO TELANGANA

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ABSTRACT

Water-saving irrigation technologies occupy a central place in India's climate-smart agriculture (CSA) agenda, yet the economic evidence on whether such technologies deliver on their productivity, adaptation, and conservation promises is more contested than the policy discourse often suggests. This paper undertakes a focused review of the economics of drip irrigation adoption, situating it within the CSA triple-win framework and drawing on farm-level, quasi-experimental, and policy-evaluation literature from India. It synthesises evidence on productivity and profitability gains, the socio-economic and behavioural determinants of adoption, and the unresolved debate over whether subsidised drip adoption actually conserves groundwater or merely enables cultivation intensification - the so-called rebound effect. The paper then examines the under explored linkage between micro-irrigation, energy savings, and carbon-market mechanisms, before turning to Telangana, a groundwater-dependent, high-adoption state where free agricultural power and fragmented landholdings complicate the conservation narrative. The review identifies gaps around basin-scale causal evidence, distributional outcomes across farm-size classes, and the feasibility of measurement, reporting and verification (MRV) systems for carbon finance, and concludes with policy directions relevant to Telangana's semi-arid, borewell-dependent agriculture.

Keywords: Drip irrigation, Climate-smart agriculture, Water-use efficiency, Groundwater, Jevons' paradox, PMKSY, Telangana.

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I. INTRODUCTION

Indian agriculture is being reshaped by two simultaneous pressures: an increasingly erratic monsoon and a groundwater economy that has expanded far beyond its recharge capacity. A large share of the country's irrigated area now depends on private borewells rather than canals, and the crops that sustain rural incomes - paddy, cotton, sugarcane - are also among the most water-intensive. Within this setting, climate-smart agriculture (CSA) has emerged as the dominant policy framework for reconciling three otherwise competing objectives: raising farm productivity and incomes, building resilience to climate variability, and where feasible, reducing greenhouse-gas emissions from the sector.

Drip irrigation, and micro-irrigation more broadly, sits at the centre of this framework. It is promoted simultaneously as a productivity-enhancing technology, a climate-adaptation measure that reduces exposure to rainfall variability, and a water- and energy-conserving practice that eases pressure on depleting aquifers. The Government of India's flagship Pradhan Mantri Krishi Sinchayee Yojana (PMKSY), through its "Per Drop More Crop" component, has made micro-irrigation the single largest subsidised technology intervention in Indian water policy, extending coverage from a negligible base to over ten million hectares between 2005-06 and 2020-21 (Department of Agriculture and Farmers Welfare, 2021).

Yet the economics of drip adoption is considerably more contested than the policy narrative of "more crop per drop" suggests. A substantial body of farm-level research documents genuine gains in yield, water productivity, and profitability (Narayanamoorthy, 2004, 2005; Kumar and Palanisami, 2010). At the same time, a newer strand of quasi-experimental and behavioural research raises the question of whether these private efficiency gains translate into aquifer-level conservation at all, given that farmers who save water per unit of land often respond by expanding the area under irrigation or shifting into more water-intensive but higher-value crops (Fishman, Giné and Jacoby, 2023; Singh, Gandhi and Jain, 2024).

This paper undertakes a focused literature review of the economics of drip irrigation adoption, read through the CSA lens, with an eye toward Telangana a semi-arid, groundwater-dependent state where micro-irrigation adoption is comparatively high (Singh, Gandhi and Jain, 2024) and where free agricultural electricity removes the price signal that would otherwise discourage over-extraction.

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OBJECTIVES OF THE STUDY

1. To synthesise the productivity and profitability evidence on drip irrigation in the Indian context;
2. To review the socio-economic and behavioural determinants of adoption and the barriers that persist despite heavy subsidisation;
3. To critically examine the conservation-efficiency debate, including the rebound (Jevons' paradox) effect; and
4. To identify the research and policy gaps most relevant to a groundwater-stressed, subsidy-intensive state such as Telangana.
5.

RESEARCH METHODOLOGY

The present paper is mainly based on the secondary data sources collected from available interdisciplinary, historical literature. Therefore, the and present scientific paper investigates the result of adoption of drip irrigation practices by agricultural lands in Telangana and analyses the benefits it may accord in terms of water conservation and increasing the production.

II. CONCEPTUAL FRAMEWORK: CLIMATE-SMART AGRICULTURE AND THE ECONOMICS OF MICRO-IRRIGATION ADOPTION

The CSA framework, as originally articulated, rests on three pillars: sustainably increasing agricultural productivity and incomes, adapting and building resilience to climate change, and reducing or removing greenhouse-gas emissions where possible (Lipper et al., 2014). Micro-irrigation technologies are frequently cited as a textbook CSA intervention because they appear, at least in principle, to advance all three pillars simultaneously - raising yields and water productivity (the productivity pillar), reducing dependence on erratic rainfall and buffering against dry spells (the adaptation pillar), and lowering the energy used for groundwater pumping, with an associated reduction in emissions (the mitigation pillar).

From the standpoint of agricultural economics, however, the decision to adopt drip irrigation is best understood through the standard technology-adoption framework: a farm household adopts a new technology when its expected discounted net benefit exceeds that of the existing practice, net of the fixed cost of the system, the opportunity cost of capital, and a risk premium that reflects uncertainty over yield response, water availability, and price realisation. Because drip systems carry a high upfront capital cost - commonly cited in the range of Rs 50,000 to Rs 1.5 lakh per hectare depending on crop and spacing - credit access, liquidity constraints, and the

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availability of capital subsidy become first-order determinants of adoption, independent of the technology's underlying profitability (Kumar, 2012).

Adoption theory is complemented by behavioural models such as the Technology Acceptance Model (TAM), which frame the decision in terms of a farmer's perceived usefulness and perceived ease of use of the technology, mediated by attitude and behavioural intention. Applying this framework to beneficiaries of a World Bank-supported irrigation modernisation project in Tamil Nadu, Doss et al. (2024) find that perceived usefulness and ease of use are significant predictors of farmers' intention to adopt drip irrigation, alongside conventional socio-economic covariates such as landholding size and farming experience. This behavioural layer matters for CSA policy design because it implies that subsidy alone is not a sufficient condition for adoption; extension quality, peer demonstration, and after-sales maintenance support materially affect uptake.

A further conceptual distinction, developed more fully in Section V, is the one between water-use efficiency at the field or farm level and water conservation at the level of the aquifer or river basin. Standard adoption models implicitly assume that a technology which reduces water applied per unit of land also reduces total water withdrawn. This assumption does not automatically hold once farmers are allowed to respond on the extensive margin (area expansion) or intensive margin (cropping-pattern change), a point at the heart of the rebound-effect literature discussed below.

III. ECONOMIC AND PRODUCTIVITY EVIDENCE ON DRIP IRRIGATION

The empirical literature on drip irrigation in India is now several decades deep, and its central finding is fairly consistent: relative to conventional flood or furrow irrigation, drip irrigation raises yields, reduces water and energy use per hectare, and improves farm profitability, though the magnitude of these gains varies considerably by crop, region, and soil type. Narayanamoorthy (2004, 2005) documents substantial water savings and yield gains in sugarcane cultivation in Maharashtra and Tamil Nadu, and subsequent work extends this finding to cotton (Narayanamoorthy, 2008). Kumar and Palanisami (2010), studying farming systems in southern India, similarly find that drip adoption improves resource-use efficiency, cropping intensity, and farm profitability relative to non-adopters, while also documenting a shift in cropping pattern toward higher-value, wider-spaced crops for which drip is agronomically better suited.

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Comparable results emerge from crop-specific field trials. In eastern coastal India, drip irrigation combined with plastic mulching was found to raise capsicum yield and seasonal net income substantially relative to conventional surface irrigation, with benefit-cost ratios exceeding 2:1 even without mulching (as reported in field-experiment literature on drip-mulch combinations for vegetable crops in Odisha and West Bengal). At a more aggregated level, a social benefit-cost analysis of drip irrigation across water-scarce and semi-critical groundwater regions found social benefit-cost ratios well above unity - in the range of 4:1 to over 5:1 - even after accounting for the subsidy cost borne by the exchequer, which is consistent with continued public support for the technology on efficiency grounds (Kumar, 2012).

At the same time, this literature has been overwhelmingly efficiency-focused: it asks whether drip irrigation raises output and income per unit of land and water applied, not whether it reduces aggregate withdrawal from a shared and depleting resource. The two questions are not the same, and conflating them - as much of the early promotional literature on drip irrigation implicitly did - is precisely what the more recent quasi-experimental literature reviewed in Section V has sought to correct. It is nonetheless important to establish, as this section has, that the private productivity case for drip irrigation is empirically well supported; the contested terrain lies specifically in the leap from private efficiency to public conservation.

IV. DETERMINANTS AND BARRIERS TO ADOPTION

Given the well-documented private returns to drip irrigation, a persistent puzzle in the literature is why adoption remains well below its technical potential - roughly 17 million hectares against an estimated potential of about 70 million hectares nationally, despite decades of subsidy support (Chand et al., 2020). The determinants literature offer several complementary explanations.

First, socio-economic characteristics of the farm household matter. Kumar (2012) finds that adoption is significantly associated with farming experience, farm size, the proportion of area under wider-spaced crops for which drip is agronomically suited, and participation in non-farm income activities, which relaxes the household's liquidity constraint. Larger and more capital-endowed farmers are systematically more likely to adopt, which has direct equity implications given that PMKSY subsidies are nominally intended to benefit small and marginal farmers.

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Second, water source and access condition adoption in a specific way: farmers dependent on borewells, and particularly those in groundwater-stressed blocks, show stronger adoption incentives than farmers with access to canal water, since the marginal value of water saved is higher where the underlying resource is scarcer. Access to a functioning well or borewell is frequently ranked by farmers as the primary enabling factor for adoption, with subsidy availability typically ranked second - underscoring that the capital subsidy alone does not overcome the more binding constraint of water-source access.

Third, behavioural and informational factors condition the translation of subsidy eligibility into actual uptake. Using a structural equation model on survey data from beneficiaries of an irrigation modernisation project in Tamil Nadu, Doss et al. (2024) show that farmers' perceived usefulness and perceived ease of use of drip technology significantly shape their attitude and behavioural intention to adopt, independent of the subsidy on offer. This is consistent with a broader finding in the adoption literature that extension quality, peer demonstration effects, and confidence in after-sales technical support materially affect whether a subsidised farmer actually installs and continues to use a drip system, as opposed to abandoning it after initial teething problems such as emitter clogging or damage from rodents.

Fourth, structural constraints - fragmented landholdings (the average operational holding in India is close to one hectare), high upfront capital cost relative to farm income even after subsidy, and limited post-installation maintenance capacity - continue to depress adoption, particularly among small and marginal farmers who are, in principle, the intended beneficiaries of the PMKSY subsidy architecture. Taken together, this determinants literature suggests that closing the gap between technical potential and actual adoption requires more than deepening the capital subsidy; it requires addressing water-source access, extension and after-sales service quality, and the specific liquidity constraints facing smallholders.

V. THE CONSERVATION-EFFICIENCY PARADOX: DOES DRIP IRRIGATION SAVE WATER?

The most consequential development in the recent literature is the emergence of credible quasi-experimental evidence questioning the long-standing assumption that drip irrigation, by raising water-use efficiency at the field level, necessarily conserves groundwater at the aquifer level. Two independent studies, using different methods and study regions, converge on a similar conclusion.

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Fishman, Giné and Jacoby (2023) conducted a randomised controlled trial in Andhra Pradesh in which a group of well-owning farmers was offered a subsidy to adopt drip irrigation. The study finds clear productivity and water-saving benefits at the plot level, consistent with the efficiency literature reviewed in Section III. However, it finds no corresponding reduction in groundwater pumping at the farm level, a result the authors attribute to electricity rationing that already constrains pumping hours in this setting, combined with farmers' tendency to expand cultivated area or intensify cropping once water is used more efficiently per unit of land. The paper's central conclusion is that, absent a price or quantity constraint on water and electricity use, subsidising drip irrigation is an effective strategy for expanding irrigated production but not for conserving groundwater or arresting the decline of water tables.

Singh, Gandhi and Jain (2024), using primary survey data from 404 farmers across Maharashtra, Telangana, Uttar Pradesh, and Madhya Pradesh, frame this dynamic explicitly as a Jevons' paradox or rebound effect: farmers adopting micro-irrigation respond through both an extensive mechanism (bringing additional land under cultivation or irrigation) and an intensive mechanism (shifting cropping pattern toward higher-value but often more water-demanding crops). The study finds that more than eighty-five per cent of sampled farmers increased their operated or irrigated area after adopting micro-irrigation, with a meaningful share of the additional area converted from rainfed to irrigated cultivation. While pumping hours - a proxy for volumetric water use - tended to fall for a given crop, certain high-value crops showed an absolute increase in water consumption once the extensive and intensive responses are considered. The authors conclude that micro-irrigation successfully advances the policy's productivity mandate ("per drop more crop") but does so, in the absence of complementary regulation, at the cost of increased risk to the resource base over the longer term.

A third strand of evidence, drawing on a case study from Rajasthan, situates this paradox in its political-economic context: drip irrigation is promoted explicitly as a groundwater-conservation and climate-resilience measure, yet in the absence of any regulatory ceiling on groundwater abstraction, farmers use the technology to intensify production rather than to conserve water, a pattern reinforced by the broader incentive structure surrounding agricultural water and power (Birkenholtz, 2017).

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The policy implication of this literature is important and somewhat counter-intuitive relative to the promotional framing of micro-irrigation schemes: efficiency-improving technology and resource conservation are not automatically the same objective, and achieving the latter typically requires a complementary institutional intervention - metering, water pricing, tradable groundwater rights, or a cap on abstraction - that most Indian states, including Telangana, currently lack. This is precisely the gap between the CSA framework's productivity and adaptation pillars, which micro-irrigation clearly serves, and its water-conservation ambitions, which it may not, in the prevailing institutional context.

VI. LINKAGES WITH ENERGY SAVINGS, CARBON MARKETS, AND CLIMATE FINANCE

A comparatively underexplored dimension of drip irrigation economics concerns its interface with energy use and, through that channel, with emerging carbon markets and climate-finance instruments. Because drip systems typically reduce the number of pumping hours required per unit of land - documented water savings in the range of 40 to 45 per cent per hectare for some crops translate into meaningfully lower electricity or diesel consumption for groundwater lifting - the technology carries a plausible, if underquantified, mitigation co-benefit alongside its productivity and adaptation functions.

India's evolving policy interest in carbon markets, carbon pricing, and payment-for-ecosystem-services mechanisms for agriculture (Khurana et al., 2024) raises the question of whether these energy and emission savings from micro-irrigation could, in principle, be monetised through carbon-credit mechanisms, providing farmers a second income stream alongside the productivity gains documented in Section III. In practice, however, the literature on agricultural carbon markets in India identifies substantial obstacles to this pathway: measurement, reporting, and verification (MRV) systems for diffuse, farm-level interventions such as micro-irrigation are costly relative to the emission reductions involved; land fragmentation complicates aggregation into bankable project sizes; and the limited empirical evidence available on existing carbon-farming projects in India suggests that benefits accrue disproportionately to larger, better-connected farmers, raising the same equity concerns already noted in the drip-adoption literature (Cariappa and Krishna, 2025).

There is also a deeper policy-coherence issue. As with several other climate-smart practices, the mitigation case for micro-irrigation interacts uneasily with existing agricultural support

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structures - particularly free or heavily subsidised agricultural electricity, which removes the price incentive for energy-saving irrigation technologies to translate into either water or emission savings at the aggregate level (Gulati and Juneja, 2022). A coherent carbon-finance pathway for micro-irrigation in India would therefore need to be designed jointly with power-sector and water-pricing reform, rather than treated as a stand-alone instrument layered on top of the existing subsidy architecture.

VII. TELANGANA IN FOCUS: GROUNDWATER-DEPENDENT AGRICULTURE AND THE CASE FOR CONTEXTUALISED ADOPTION ECONOMICS

Telangana offers a particularly instructive setting in which to situate this literature. The state's agriculture is heavily reliant on groundwater extracted through private borewells, cultivates significant areas under water-intensive crops such as paddy and cotton, and - notably for the arguments in Section V - provides free electricity to agricultural connections, removing the price signal that would otherwise discourage pumping intensification following efficiency gains from drip adoption. At the same time, Telangana is administratively significant for micro-irrigation policy: it is one of the states with the highest numbers of PMKSY micro-irrigation beneficiaries nationally, and the multi-state study by Singh, Gandhi and Jain (2024) specifically identifies Telangana, alongside Maharashtra, as exhibiting comparatively high micro-irrigation adoption rates relative to Uttar Pradesh and Madhya Pradesh.

This combination of high adoption, groundwater dependence, and an absent price signal on power makes Telangana a plausible candidate for the extensive- and intensive-margin rebound responses documented at the national level - farmers who adopt drip irrigation under the Telangana State Micro Irrigation Project may be expected, on the basis of the wider evidence, to expand irrigated area or shift toward more remunerative but water-demanding crops rather than to reduce aggregate groundwater withdrawal, particularly in the absence of any metering or abstraction ceiling. Whether this expectation holds specifically for Telangana's cropping systems, aquifer characteristics, and farm-size distribution is, however, an empirical question that the existing literature - built substantially on evidence from Andhra Pradesh, Rajasthan, and pooled four-state samples - has not yet answered with state-specific, basin-scale precision.

Telangana's landholding structure compounds the adoption puzzle discussed in Section IV. With average operational holdings well below the national mean in several districts, the fixed capital cost of drip installation, even after subsidy, remains a binding constraint for a large share of farm households, while the state's expanding non-farm rural economy (see the rural labour and

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livelihoods literature synthesised elsewhere in this conference volume) offers an alternative channel through which liquidity constraints on drip adoption might be relaxed. This intersection of water-resource economics, farm-size structure, and non-farm income diversification is precisely the kind of contextualised, micro-level analysis that a doctoral research agenda on drip irrigation economics in Telangana is well positioned to address, extending the largely state-pooled or single-district evidence base reviewed in this paper toward a more granular, Telangana-specific account of adoption, water outcomes, and farmer welfare.

VIII. RESEARCH GAPS

Despite the depth of the literature reviewed above, several gaps remain, and each has direct relevance for a Telangana-focused research agenda.First, causal, basin- or aquifer-scale evidence on the net water-balance impact of drip adoption remains limited outside the handful of quasi-experimental studies discussed in Section V, and no such study currently exists for Telangana specifically. Second, the distributional consequences of PMKSY subsidy capture across farm-size classes - whether small and marginal farmers, the scheme's nominal target group, actually adopt at rates comparable to medium and large farmers - require more disaggregated, state-specific analysis than the pooled multi-state samples in the existing literature allow. Third, the interaction between drip adoption, cropping-pattern change, and the state's free-power regime has not been formally modelled for Telangana, even though the theoretical mechanism (Fishman, Giné and Jacoby, 2023; Birkenholtz, 2017) is directly applicable to its institutional setting. Fourth, the feasibility of linking micro-irrigation-driven energy savings to carbon-finance instruments - including realistic MRV cost estimates for smallholder-dominated systems - remains almost entirely unexamined in the Indian context, let alone for Telangana. Finally, comparative work situating Telangana's experience against other high-adoption, groundwater-dependent states such as Maharashtra and Gujarat would help identify which outcomes are Telangana-specific and which reflect a more general pattern across India's semi-arid, borewell-irrigated regions.

IX. POLICY IMPLICATIONS AND THE WAY FORWARD

Three broad policy directions follow from this review. First, if groundwater conservation - as distinct from productivity enhancement - is a genuine policy objective, capital subsidies for drip irrigation need to be paired with a complementary demand-side instrument on water or power use; the evidence reviewed in Section V suggests that efficiency subsidies alone, however generous, are unlikely to arrest aquifer decline in a free-power setting such as Telangana's.

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Options documented in the literature include volumetric or slab-based electricity pricing for agricultural pumping, community-level groundwater management institutions, and area- or crop-specific mandates restricting the most water-intensive crops in critically over-exploited blocks. Second, closing the adoption gap for small and marginal farmers requires attention beyond the capital subsidy rate: targeted credit facilities, portable and modular drip kits suited to fragmented holdings, and stronger after-sales maintenance and technician-training ecosystems are likely to matter as much as the subsidy percentage itself, given the behavioural and structural barriers identified in Section IV.

Third, if carbon-finance and climate-mitigation co-benefits from micro-irrigation are to be realised, policy design should explore aggregation models - through Farmer Producer Organisations or cooperatives - that can lower per-farmer MRV transaction costs, while being explicit about the equity risks of carbon-project capture by larger farmers documented in the wider carbon-farming literature. More broadly, aligning power-sector reform, water governance, and micro-irrigation promotion within a single coherent policy architecture, rather than treating them as separate schemes, is likely to be a precondition for micro-irrigation to deliver on the full CSA triple-win promise in groundwater-stressed states such as Telangana.

X. CONCLUSION

Drip irrigation is, on the weight of the evidence, a genuinely productivity-enhancing and climate-adaptive technology for Indian agriculture, and the case for continued public support on efficiency and farm-income grounds is well established in the literature. What the more recent quasi-experimental evidence complicates is the further, often implicit, assumption that these private efficiency gains automatically translate into public groundwater conservation. In groundwater-dependent, free-power settings such as Telangana, the rebound-effect literature suggests this assumption is unlikely to hold without complementary institutional reform. For a doctoral research agenda situated in Telangana's drip-irrigation economy, this review points toward a specific and researchable gap: state- and aquifer-specific causal evidence on the water, income, and distributional outcomes of micro-irrigation adoption, examined jointly with the state's power-subsidy regime - an agenda that would extend the national and multi-state evidence synthesised here into the granular, policy-relevant terrain that Telangana's agrarian economy currently lacks.

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REFERENCES

Bahinipati, C. S., Viswanathan, P. K., & Singh, A. K. (2024). Do institutions, incentives, and information enhance adoption of climate smart agriculture practices? Empirical evidence from India. Environmental Development, 50, Article 100982. https://doi.org/10.1016/j.envdev.2024.100982

Birkenholtz, T. (2017). Assessing India's drip-irrigation boom: Efficiency, climate change and groundwater policy. Water International, 42(6), 663–677. https://doi.org/10.1080/02508060.2017.1351910

Cariappa, A. A., & Krishna, V. V. (2025). Carbon farming in India: Are the existing projects inclusive, additional, and permanent? Climate Policy, 25(5), 756–771. https://doi.org/10.1080/14693062.2024.2416497

Chand, S., Kishore, P., Kumar, S., & Srivastava, S. K. (2020). Potential, adoption and impact of micro irrigation in Indian agriculture (Policy Paper). ICAR–National Institute of Agricultural Economics and Policy Research.

Department of Agriculture and Farmers Welfare. (2021). Performance and impact evaluation of Pradhan Mantri Krishi Sinchayee Yojana—Per Drop More Crop (PMKSY-PDMC), 2020–21. Ministry of Agriculture and Farmers Welfare, Government of India.

Doss, D. A., Asokhan, M., Balasubramaniam, P., & Kumaresan, P. (2024). Perception and adoption of drip irrigation technology among beneficiaries of the Tamil Nadu Irrigated Agriculture Modernization Project: A structural equation modelling approach. Plant Science Today, 11(sp4). https://doi.org/10.14719/pst.5795

Fishman, R., Giné, X., & Jacoby, H. G. (2023). Efficient irrigation and water conservation: Evidence from South India. Journal of Development Economics, 162, Article 103051. https://doi.org/10.1016/j.jdeveco.2023.103051

Gulati, A., & Juneja, R. (2022). Transforming Indian agriculture. In Indian agriculture towards 2030: Pathways for enhancing farmers' income, nutritional security and sustainable food and farm systems (pp. 9–37). Springer Nature Singapore. https://doi.org/10.1007/978-981-19-0763-0_2

Khurana, A., Kajale, D., Cariappa, A. A., & Krishna, V. V. (2024). Shaping India's climate future: A perspective on harnessing carbon credits from agriculture. Outlook on Agriculture, 53(2), 113–130. https://doi.org/10.1177/00307270241240778

Kumar, D. S. (2012). Adoption of drip irrigation system in India: Some experience and evidence. Bangladesh Development Studies, 35(1), 61–78.

Kumar, D. S., & Palanisami, K. (2010). Impact of drip irrigation on farming system: Evidence from southern India. Agricultural Economics Research Review, 23(2), 265–272. https://doi.org/10.22004/ag.econ.97154

Lipper, L., Thornton, P., Campbell, B. M., Baedeker, T., Braimoh, A., Bwalya, M., Caron, P., Cattaneo, A., Garrity, D., Henry, K., Hottle, R., Jackson, L., Jarvis, A., Kossam, F., Mann, W., McCarthy, N., Meybeck, A., Neufeldt, H., Remington, T., . . . Torquebiau, E. F. (2014). Climate-smart agriculture for food security. Nature Climate Change, 4(12), 1068–1072. https://doi.org/10.1038/nclimate2437

Namara, R. E., Upadhyay, B., & Nagar, R. K. (2005). Adoption and impacts of micro-irrigation technologies: Empirical results from selected localities of Maharashtra and Gujarat states of India (Research Report No. 93). International Water Management Institute.

Narayanamoorthy, A. (2004). Drip irrigation in India: Can it solve water scarcity? Water Policy, 6(2), 117–130. https://doi.org/10.2166/wp.2004.0008

Narayanamoorthy, A. (2005). Economics of drip irrigation in sugarcane cultivation: Case study of a farmer from Tamil Nadu. Indian Journal of Agricultural Economics, 60(2), 235–248.

Narayanamoorthy, A. (2008). Drip irrigation and rainfed crop cultivation nexus: The case of cotton crop. Indian Journal of Agricultural Economics, 63(3).

Singh, G., Gandhi, V. P., & Jain, D. (2024). Micro-irrigation adoption and the Jevons' Paradox: A study from four states of India. Agricultural Water Management, 303, Article 109040. https://doi.org/10.1016/j.agwat.2024.109040