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A study on factors affecting for the adoption of drip irrigation

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Abstract
The study, conducted in 2023-24 in Raipur district of Chhattisgarh, evaluated the economic viability of drip irrigation among vegetable growers in selected villages. Farmers were categorized as drip adopters and non-adopters, and primary data were collected from 50 respondents through interviews and analyzed using cost-benefit tools. Results showed that drip irrigation significantly improved water-use efficiency (saving up to 60%), reduced labor costs, and increased crop yields and income, particularly for high-value crops like tomato and brinjal.
Despite these benefits, challenges such as high initial investment, limited technical support, and delays in subsidies hinder wider adoption. The study concludes that drip irrigation is both a water-saving and economically sustainable practice, with strong potential to enhance farm profitability and promote sustainable agriculture in water-stressed regions.

Keywords: Drip irrigation, Per Drop More Crop (PDMC), Water-use efficiency, Benefit-Cost ratio, Farm profitability, Sustainable agriculture

1. Introduction
Chhattisgarh, an agrarian state, is witnessing a growing interest in vegetable cultivation due to its higher income potential compared to cereals. However, traditional irrigation methods remain inefficient, leading to excessive water use, increased labor, and crop damage. Drip irrigation presents a viable solution, offering precise and regulated water and nutrient delivery directly to the root zone, enhancing water-use efficiency, reducing labor, minimizing diseases, and improving productivity.
Despite its advantages such as saving 50-70% water, improving yields by over 50%, and enabling efficient fertigation adoption in Chhattisgarh remains limited due to high initial costs, lack of awareness, and uncertainty about returns. The government has launched initiatives like the Per Drop More Crop (PDMC), under which over 83.46 lakh hectares have been covered nationally with micro-irrigation systems. In 2022-23 alone, vegetables under drip irrigation occupied 49.89 lakh hectares, yielding 68.92 lakh MT. In Raipur district, 23,496 hectares were under vegetable cultivation, producing 3.32 lakh MT.
Given these trends, a localized economic analysis is crucial to assess drip irrigation's cost-effectiveness, water savings, and profitability, thereby guiding both farmers and policymakers. Empirical evidence from such studies can help close the adoption gap, support sustainable agricultural development, and ensure better resource management in water-scarce regions like Chhattisgarh.

2. Methodology
2.1 Selection of Study Area
The study was conducted in the Arang and Dharsiwa blocks of Raipur district, Chhattisgarh, selected purposively due to their significant adoption of drip irrigation. Among the 33 districts of Chhattisgarh, Raipur falls within the Chhattisgarh Plains Zone, which comprises 15 districts. Five villages with a high concentration of drip irrigation adopters were selected: Bhatagaon and Daldal Seoni (Dharsiwa block), and Nisda, Arang, and Paragaon (Arang block).

2.2 Selection of Respondents
A total of 50 vegetable farmers were purposively selected, including 25 adopters of drip irrigation and 25 non-adopters, all with substantial landholdings. The respondents were stratified based on land size into three categories: small (1-2 ha), medium (2-4 ha), and large (>4 ha). Drip adopters included 10 small, 10 medium, and 5 large farmers, while the non-adopters included 16 small, 8 medium, and 1 large farmers. Data were collected through personal interviews using a structured and pre-tested questionnaire.

2.3 Selection of Crops:
Two major vegetable crops tomato and brinjal were selected based on their prevalence and suitability for drip irrigation in the region. These crops are water-sensitive and benefit from efficient irrigation, making them ideal for evaluating the impact of drip systems on productivity and profitability.

2.4. Data Collection Methods
2.4.1 Primary Data
Collected during the 2023-24 agricultural year through personal interviews. Information gathered included landholding size, crop patterns, input costs, drip system expenditures, irrigation costs, labor charges, crop yield, and economic comparisons between drip and conventional methods.

2.4.2 Secondary Data
Obtained from official records of the Village Patwari, Block Office, Land Records, Department of Agriculture, and Horticulture. This data supported and validated field findings and provided contextual insights on irrigation practices, land use, and crop patterns.

2.5 Period of Enquiry
The survey and data collection covered the entire agricultural year 2023-24.

2.6 Analytical Tools: Appropriate statistical and economic tools were employed to analyze the data and meet the study objectives. Comparative economic indicators were computed to assess cost efficiency and profitability.

2.7 Economic Indicators for Comparison:
The following key measures were adopted to assess and compare the economic viability of drip and conventional irrigation:

1. **Cost of Cultivation per Hectare:** Total production cost per hectare including all inputs.
2. **Gross Income per Hectare:** Gross Income = Total Revenue/Total Area
3. **Net Income per Hectare:** Profit calculated as the difference between gross income and total cultivation cost.
4. **Material Cost per Hectare:** Total input cost (seeds, fertilizers, pesticides, etc.) per hectare.
5. **Cost of Production per Quintal:** Total cost divided by total crop output in quintals.
6. **Benefit-Cost Ratio:** The Benefit-Cost Ratio (BCR) is an economic indicator used to evaluate the feasibility and profitability of a project or investment. It compares the total expected benefits of a project to its total expected costs.
   - If **BCR > 1**, the project is considered profitable or economically viable.
   - If **BCR = 1**, the project breaks even.
   - If **BCR < 1**, the project is not economically viable.
7. **Returns:** Total returns from crop cultivation, serving as a measure of financial gain.
8. **Income Analysis:** Comparative income derived from drip vs. conventional irrigation across different landholding sizes and crop types.

3. Results and Discussions
Table 3.1 Drip irrigation adopters, key factors influencing adoption include technical knowledge (84%), perceived yield improvement (92%), water saving (90%), and access to government subsidy (80%). Other important drivers are reduced input use, efficient fertilizer application, fewer pest and disease problems, and better quality produce.

The percentage of non-adopters having these factors is much lower for example, only 24% had technical knowledge and just 16% received subsidies. This gap indicates that lack of awareness, financial constraints, and perception-related barriers are major reasons for non-adoption of drip irrigation.

Table 3.1: Factor Responsible for Adoption for Drip Irrigation

S. No.	Factors	Adopters (n=25)	Non-Adopters (n=25)
1.	Technical Knowledge about drip irrigation	84%	24%
2.	Yield improvement	92%	24%
3.	Less inputs use compared to traditional irrigation	82%	28%
4.	Efficient Fertilizer use	88%	36%
5.	High quality of produce	92%	40%
6.	Reduced problem of disease and pests	76%	24%
7.	Saving of water	90%	-
8.	Subsidy	80%	16%

3.1 Constraints in Implementation of Drip Irrigation programme
The implementation of drip irrigation programs faces several significant constraints that limit their widespread adoption, particularly among small and marginal farmers. High initial investment costs for equipment and installation pose a major barrier, compounded by limited access to technical knowledge and maintenance services. System performance is also affected by inadequate water quality and inconsistent water supply. Furthermore, a lack of awareness, insufficient training, and resistance to moving away from traditional farming practices hinder adoption. Institutional challenges such as limited financial support, weak extension services, and poor infrastructure further complicate the process. Addressing these constraints through effective policy measures and capacity-building initiatives is crucial for the successful adoption and implementation of drip irrigation programs. The key challenges hindering the

installation and effective use of drip irrigation systems are summarized as follows:

1. High initial installation cost discourages many farmers.
2. Limited access to financing options restricts adoption.
3. Lack of awareness about drip irrigation benefits hinders its use.
4. Farmers often lack technical knowledge for system operation.
5. Poor water quality can clog drip emitters.
6. Inconsistent or unreliable water supply reduces system efficiency.
7. Maintenance requirements are often overlooked by users.
8. Limited availability of spare parts in rural areas affects repairs.
9. Lack of skilled labor for installation and maintenance is a barrier.
10. Government subsidy schemes are sometimes poorly implemented.

4. Summary and Conclusion

4.1 Summary

The analysis shows that farmers who adopt drip irrigation are strongly influenced by several key factors. Among these, technical knowledge plays a major role, with 84% of adopters stating that understanding how the system works encourages them to use it. Another important factor is the perceived improvement in crop yield, which motivates 92% of farmers to adopt the technology. Water saving is also a crucial advantage, with 90% of users recognizing that drip irrigation helps them conserve water more efficiently than traditional methods. Access to government subsidies further supports adoption, benefiting nearly 80% of farmers who rely on this financial assistance.

In addition to these major drivers, farmers also consider several other benefits when deciding to adopt drip irrigation. These include reduced input use, such as lower labor and energy requirements. The system also enables more efficient fertilizer application through fertigation, which helps nutrients reach the plants directly. Farmers report fewer pest and disease problems due to reduced moisture on the plant surface, which contributes to healthier crops. Moreover, the technology leads to better quality produce, making it more appealing for market sale. Altogether, these combined advantages create strong motivation for farmers to adopt and continue using drip irrigation systems.

4.2 Conclusion

Farmers in the study area primarily adopt drip irrigation because of its direct and tangible benefits. These advantages include significant cost savings, improved water-use efficiency, and higher crop yields. As a result, farmers are motivated to use the technology based on its intrinsic value rather than relying mainly on government subsidies. This finding highlights the importance of clearly demonstrating the built-in benefits of drip irrigation to encourage even wider adoption. In addition to financial support, awareness programs that showcase its long-term economic and environmental advantages can be highly effective. Training sessions, field demonstrations, and farmer-to-farmer knowledge sharing can further enhance understanding and confidence in the technology. Ultimately, combining strong awareness campaigns with appropriate financial measures can lead to greater and more sustainable adoption rates.

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