

USE OF TREATED WASTEWATER FOR AGRICULTURE THROUGH MICRO IRRIGATION IN INDIA: A SUSTAINABLE SOLUTION

UTILISATION DES EAUX USÉES TRAITÉES POUR L'AGRICULTURE PAR MICRO-IRRIGATION EN INDE : UNE SOLUTION DURABLE

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Abstract

India is an agrarian country. Even today more than 50 % of the population depends up on agriculture and allied fields. To feed its ever-increasing population, we need to produce more food. Agricultural productivity can be increased by adopting following ways:

1. **By introduction of high yielding hybrid varieties:** During the first green revolution, this alternative was tried and found that use of hybrid varieties even though high yielding, have limitations, since many times new hybrid varieties bring diseases along with them and they are more prone to diseases rather than the original indigenous varieties.
2. **By increasing the additional area under cropping:** This alternative also has limitations. In fact, because of growing urbanization, the area under cropping gets reduced unless we bring additional waste lands under cultivation.
3. **By increasing area under irrigation:** This is the most practical and technically feasible solution. By increasing area under irrigation we can definitely increase the productivity of crops without any limitations/side effects such as diseases etc. However there are exceptional cases where because of over irrigation the soils have become saline/alkaline. These types of problems can be taken care of by judicious use of available water resources by introducing modern irrigation systems such as drip and sprinkler irrigation.
4. On the water side, more than 75 % of the total water in the country is used for agricultural irrigation purposes. Water is a vital input for increasing crop productivity. India's per capita water resources are shrinking day by day. Apart from this there are issues related to droughts, water shortages, water pollution, excessive use of water through flood irrigation, these are the constraints in the food production system.
5. Since we are continuously facing increasing water scarcity problems, innovative approaches to water management are crucial. There are many innovative approaches to manage the available water resources in judicious manner. One such solution is the use of treated wastewater for agricultural purposes, particularly through micro-irrigation. This technique offers a sustainable and efficient way to conserve water resources while boosting agricultural productivity. The need, advantages, key considerations and actionable points with respect to Indian context are discussed in this paper.

Keywords: Treated wastewater, Wastewater reuse, Agricultural water management, Micro-irrigation, Water scarcity, Water conservation, Sustainable irrigation.

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RÉSUMÉ

L'Inde est un pays agraire. Aujourd'hui encore, plus de 50 % de la population dépend de l'agriculture et des secteurs connexes. Pour nourrir une population en constante augmentation, il est nécessaire de produire davantage de denrées alimentaires. La productivité agricole peut être accrue en adoptant les mesures suivantes :

- (i) **Par l'introduction de variétés hybrides à haut rendement** : lors de la première révolution verte, cette alternative a été testée et il s'est avéré que l'utilisation de variétés hybrides, bien qu'à haut rendement, présente des limites, car souvent, les nouvelles variétés hybrides s'accompagnent de maladies et sont plus sensibles aux maladies que les variétés indigènes d'origine.
- (ii) **En augmentant la superficie cultivée** : Cette solution présente également des limites. En effet, en raison de l'urbanisation croissante, la superficie cultivée diminue, à moins de mettre en culture des terres en friche supplémentaires.
- (iii) **En augmentant la superficie irriguée** : Il s'agit de la solution la plus pratique et la plus viable sur le plan technique. En augmentant la superficie irriguée, nous pouvons sans aucun doute accroître la productivité des cultures sans aucune limitation ni effet secondaire, tels que les maladies, etc. Il existe toutefois des cas exceptionnels où, en raison d'une irrigation excessive, les sols sont devenus salins ou alcalins. Ce type de problème peut être résolu par une utilisation judicieuse des ressources en eau disponibles, grâce à la mise en place de systèmes d'irrigation modernes, tels que l'irrigation goutte à goutte et par aspersion.
- (iv) En ce qui concerne l'eau, plus de 75 % de l'eau totale du pays est utilisée à des fins d'irrigation agricole. L'eau est un intrant essentiel pour accroître la productivité des cultures. Les ressources en eau par habitant de l'Inde diminuent de jour en jour. À cela s'ajoutent des problèmes liés aux sécheresses, aux pénuries d'eau, à la pollution de l'eau et à l'utilisation excessive de l'eau par l'irrigation par inondation. Telles sont les contraintes qui pèsent sur le système de production alimentaire.
- (v) Comme nous sommes confrontés à des problèmes croissants de pénurie d'eau, des approches innovantes en matière de gestion de l'eau sont cruciales. Il existe de nombreuses approches novatrices pour gérer les ressources en eau disponibles de manière judicieuse. L'une de ces solutions consiste à utiliser les eaux usées traitées à des fins agricoles, notamment à l'aide de la micro-irrigation. Cette technique offre un moyen durable et efficace de préserver les ressources en eau tout en stimulant la productivité agricole. La nécessité, les avantages, les considérations clés et les mesures concrètes à prendre dans le contexte indien sont abordés dans ce document.

Mots-clés : Eaux usées traitées; Réutilisation des eaux usées; Gestion de l'eau agricole; Micro-irrigation; Pénurie d'eau; Préservation de l'eau; Irrigation durable.

Water resources in India

The annual average surface water available in India is around 1,869 Billion Cubic Metre (BCM). However, because of the topographical, hydrological and other constraints, only about 690 BCM of the available surface water and annual replenishable ground water resources of 432 BCM can be used. Thus, the total utilisable water in the country is assessed as 1,122 BCM. The annual average per capita water availability is estimated at about 1,829 cubic meters (cu.m) in 2001 at the national level.

The annual average per capita availability is likely to get reduced to about 1,342 cu.m by 2025 AD due to the increase in population. At present, irrigation contributes about 84 per cent of the water consumption. With the increase in demand of quantity of water for other uses, the percentage share of water used for irrigation is likely to get reduced to about 73 per cent by 2025.

Considering the number of challenges that have emerged in the development and management of water resources since the adoption of National Water Policy in 1987, so that no water goes waste and the water resources can be cleaned up, the existing National Water Policy needed to be reviewed and updated. The draft updated National Water Policy has been finalised by the Working Group of the National Water Resources Council (NWRC) and the same is to be considered by NWRC for its adoption.

What is Micro-Irrigation?

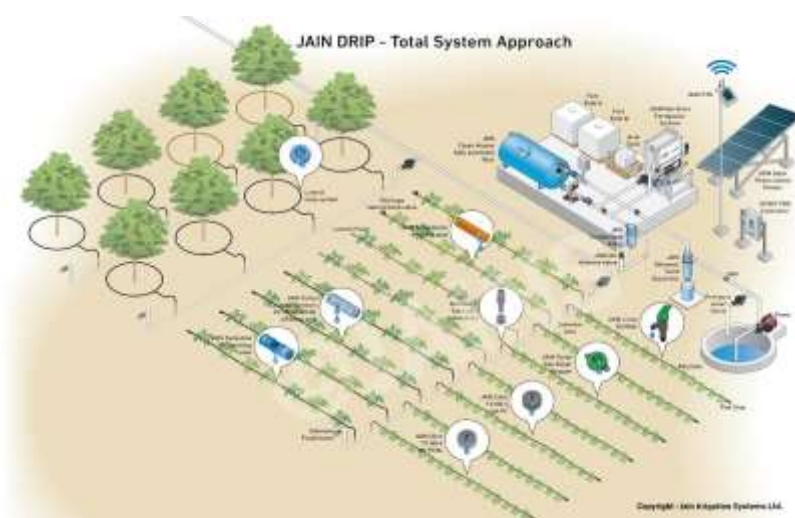
Micro-irrigation, also known as drip, sprinkler or trickle irrigation, is a water delivery system that applies small amounts of water directly to the root zone of plants under low pressure. This method contrasts traditional irrigation techniques of flood irrigation, which often result in huge water losses through conveyance, deep percolation, seepages and evaporation.

In this system water is conveyed through a network of PE/PVC pipes which are enviro friendly products. These losses are minimized with increased crop productivity. Since the water is applied directly near the root zone, there is a considerable amounts of water saving, yield increase, fertilizer saving, power saving and soil health is maintained.

Table 1: Productivity Gains from Micro-Irrigation (MI) MI systems significantly outperform conventional flood irrigation in both yield and resource efficiency.

Crop Type	Yield Increase (%)	Water Savings (%)	Water Use Efficiency Increase (%)
Sugarcane	33%	56%	204%
Tomato	50%	31%	119%
Pomegranate	98%	45%	167%
Banana	52%	45%	176%
Chilies	44%	63%	291%

Source: Compiled from [Micro-Irrigation Advancements \(2024\).1](#)



Benefits of Using Treated Wastewater for Agriculture

- **Water Conservation:** Treated wastewater can significantly reduce reliance on freshwater sources, especially in regions facing water shortages. Treated water can be used for domestic purposes and

also for agriculture . Initially non edible crops such as Cotton, Jute etc can be covered followed by Fodder crops and then edible crops.

- **Nutrient-Rich:** Wastewater often contains essential nutrients for plant growth, such as nitrogen, phosphorus, and potassium. This can reduce the requirements of chemical fertilizers, promoting sustainable agriculture.
- **Improved Soil Health:** Micro-irrigation helps prevent soil erosion and compaction, leading to healthier and more productive soils. Through micro irrigation, we apply less water and hence the water logging etc can be prevented which is very common in case of flood irrigation.
- **Cost-Effective:** Using treated wastewater can reduce the overall costs associated with agricultural production, including fertilizer expenses.

Table 2: Economic Impact of Using Treated Wastewater (TWW)

Utilizing TWW provides a direct financial boost to farmers by reducing input costs and increasing output value.		
Parameter	Impact with TWW Use	Key Benefit
Revenue Potential	~₹966 Billion (Estimated for India)	New revenue stream from water reuse
Fertilizer Savings	₹50 Million reduction (National estimate)	TWW is rich in N, P, and K
Incremental Yield	+13% (Cotton) to +30% (Maize)	Higher nutrient content in TWW
Land Value	+118% to +200% increase	Improved soil health and reliable water
Soil Organic Matter	+35% to +42% increase	Better moisture retention and microbial activity

Key Considerations for Using Treated Wastewater

- **Treatment Quality:** The wastewater must undergo rigorous treatment processes to ensure it meets specific quality standards for agricultural use. This includes removing harmful pathogens and contaminants.
- **Soil Salinity:** The use of treated wastewater can potentially increase soil salinity over time. Proper management practices, such as leaching, are necessary to prevent this issue.
- **Public Perception:** Addressing public concerns about the safety of using treated wastewater for agriculture is essential. Clear communication and education are crucial to foster acceptance and support

Actionable Points

- Establishment of waste water treatment infrastructure across the country. For all major cities the facility of wastewater treatment should be available.
- The standards for use of treated wastewater for agriculture crops should be made available
- There should be separate standards for use of treated waste water for edible and non – edible crops
- Special incentives/separate subsidy norms should be provided for use of treated wastewater for agriculture through micro irrigation systems

- (v) Decentralized Wastewater treatment facilities should be created across the country.
- (vi) In peri- urban areas, it should be made mandatory to use treated waste water through micro irrigation for agriculture.

Green Technology

- (i) Treated Waste Water reduces pollution. The soil pollution and air pollution both are avoided by treating the waste water.
- (ii) Use of Treated Wastewater in agriculture through micro irrigation would increase Crop Productivity, Water Productivity, Energy Productivity, Fertilizer Use Efficiency and ultimately help in solving Food- Water – Energy Nexus.
- (iii) In case of use of treated wastewater for agriculture through micro irrigation, it should be treated as Green Technology, because most of the products used in micro irrigation are inert non- degradable thermo plastics which last for 100 years or so. They are lightweight, easy to handle and recyclable materials.
- (iv) All the benefits/incentives provided to Green Technology Projects should be extended to the projects of use of treated wastewater for agriculture through micro irrigation.

Conclusion

The use of treated wastewater for agriculture through micro-irrigation offers a promising solution to address water scarcity and promote sustainable agricultural practices. By carefully considering the factors involved and implementing appropriate management strategies, this approach can contribute to a more resilient and environmentally friendly food production system.