

## **Reuse of treated wastewater for irrigation and its environmental impacts**

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The global population is rising steadily and is likely to touch a level of 9.8 billion in 2050 from the existing over 7.6 billion. The quick ascent in the population has expanded the urbanization which results in the production of a huge amount of wastewater. The SDG6 of the United Nations pushes the reuse of treated wastewater to 'ensure the availability of water for all'. The use of treated wastewater for crop irrigation is a feasible option as the agriculture sector is the largest user of freshwater sources and uses over 70% of all water resources. The utilization of wastewater for crop irrigation is a common practice throughout the world. Essentially, the utilization of wastewater for irrigation is viewed as an approach to deal with the disparity between water availability and water requirement. It is particularly practiced in the arid and semiarid areas that are facing the large water scarcities. Wastewater contains basic plant supplements that enhance crop production and simultaneously it reduces the environmental threats by diminishing wastewater released into the water bodies. Wastewater irrigation has associated with some other advantages as well, for example, decreased requirement of chemical fertilizer that results in better and healthy farm produce. Most of the previous studies, however, revealed that long-term utilization of wastewater can cause environmental issues in agro-environments. For instance, it can build nitrogen and phosphorus concentrations alongside other hazardous components in the rootzone over time. It can also change the physical properties of soil, for example, hydraulic conductivity and leaching efficiency which additionally blocks the drainage of harmful salts through the soil. The harmful effects of wastewater utilization are not limited to soil and plants only but it also negatively impacts the human and other creatures. Moreover, wastewater utilizations also negatively affect the climate by releasing greenhouse gases such as carbon dioxide, methane, and nitrous oxide from wastewater-irrigated soils. And thus it could cause great concern for rising global warming potential.

The aforementioned environmental and wellbeing problems of wastewater utilization can be minimized by implementing some better policies, for example, the separation of industrial sewage to contain the most toxic wastewater fractions and by developing a better treatment infrastructure. However, in developing countries, the funding for significant enhancements in wastewater collection and treatment stays constrained. And the small fund allocation for treatment infrastructure and technology has not stayed up with steady increments in the populace and the subsequent increments in wastewater quantity in these nations. In this way, a large part of the wastewater produced is not properly treated, and a major part of this water

is utilized for agricultural production by farmers of the region. The farmers in developing regions use wastewater since it is the main water source accessible consistently, it lessens the requirement for buying fertilizer, and it includes less power consumption as compared to groundwater irrigation. Thus, the provision of a sufficient fund allocation should be done for long-term sustainable utilization of wastewater for irrigation in developing countries. Future studies should also focus on developing a cost-effective and environmentally sound treatment infrastructure.

An inclusive guideline for contaminants in treated wastewater should be implemented, particularly in developing countries. The formulated guidelines should be adaptable to local conditions and integrated with the specific soil and plant characteristics. For example, the intended reuse of treated wastewater under different crop and soil conditions may have dissimilar criteria. For this purpose, an extensive dataset of wastewater irrigation under diverse agro-hydro-climatic and crop conditions is vital for future research.

The community acceptance and understanding of the associated risks of wastewater applications should be enhanced. For instance, farm-workers who utilize treated wastewater should wear shielding kit to avert direct physical contact. Also, the treated wastewater for irrigation should be utilized in rural areas and other non-crowded locations to alleviate direct contact.