

# Enhancing Irrigation Sustainability: The Role of Treated Wastewater and Regulatory Compliance in Saudi Arabia

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## Abstract

The rapid expansion of agricultural areas, coupled with climate change and industrialization, has significantly increased global water demand (. Agriculture is the largest consumer of water worldwide, accounting for 70% of total consumption, with freshwater sources—such as surface water, rainfall, and groundwater—being the primary supply for irrigation. In Saudi Arabia, agriculture accounts for approximately 84% of total water consumption. However, overexploitation of freshwater resources, especially groundwater, has led to depletion and increased salinity, which threatens water quality and availability. This poses significant challenges to sustaining food security and meeting the growing demand for water in arid regions, such as Saudi Arabia. To address these challenges, there is a critical need to explore alternative, sustainable, and renewable water sources for irrigation.

One such alternative is treated wastewater (TWW), which has emerged as a promising resource for agricultural irrigation. TWW is rich in essential nutrients required for plant growth and soil fertility, including micronutrients like boron, iron, copper, molybdenum, manganese, and zinc, as well as macronutrients such as calcium, sulphur, nitrogen, phosphorus, potassium, and magnesium. These nutrients improve soil health and reduce the need for commercial fertilizers. As a result, the reuse of treated wastewater not only offers a reliable water supply for agriculture but also contributes to sustainable agricultural practices by promoting nutrient recycling and reducing environmental degradation.

Despite its advantages, the long-term use of TWW in irrigation raises concerns over chemical and microbial pollution, which could negatively impact both natural ecosystems and agricultural systems . Prolonged use of treated sewage effluent (TSE) in irrigation may lead to the accumulation of undesirable substances, such as heavy metals and sodium, in the root zone of crops, potentially affecting soil quality and crop yield. Therefore, the safe and effective reuse of TWW requires strict regulatory frameworks and monitoring to mitigate these risks. Ensuring compliance with these regulations is essential to maintain the sustainability of irrigation systems and prevent negative impacts on human health and the environment.

This conference paper highlights the efforts of the Saudi Irrigation Organization (SIO) which is responsible for managing and developing the irrigation and drainage sector all over the country in ensuring that TWW quality meets regulatory standards. The SIO has implemented various practices to enhance the quality of TSE for safe reuse in agriculture. Key indicators such as the Water Quality Index (WQI) and Water Pollution Index (WPI) have been used to assess and compare the quality of TWW produced by sewage treatment plants (STPs) in the region. These indices provide a comprehensive evaluation of water quality by considering physical, chemical, and microbial parameters, ensuring that treated wastewater is safe for agricultural use.

**Keywords:** Treated Wastewater (TWW), Saudi Irrigation Organization (SIO), Sustainable Irrigation, Water Quality Standards, Regulatory Compliance, Agricultural Water Management, Sewage Treatment Plants (STPs), Water Recycling, Nutrient-Rich Irrigation, Environmental Protection