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"Competing pathways for equitable food systems transformation: Trade-offs and synergies"

Treated wastewater usage for agriculture in water stress areas: a case study in Sialkot, Pakistan

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Abstract

Punjab, the most populous province in Pakistan, relies heavily on agriculture, which produces over 70 % of the country's food crops. However, the region is facing a severe water crisis that threatens the sustainability of its agricultural sector. This crisis has been exacerbated by urbanisation, climate change, and increased competition for water from other sectors, including industry and domestic use. The city of Sialkot, located in central Punjab, is home to around 270 leather tanneries and other industries that are the largest users of water and depend entirely on groundwater sources. Due to climate change and over-exploitation of water resources, farmers face serious challenges in accessing safe water. Effluents from tanneries, industries, and municipalities are discharged directly into freshwater streams, forcing farmers to use wastewater for irrigation, which poses a serious threat to human health and reduces land fertility due to salinisation after a few times. To address this issue, Sialkot's local government has planned to use treated wastewater for irrigation to meet the agricultural sector's water needs. The Water-Energy-Food Nexus approach was used to evaluate the feasibility of collecting and reusing wastewater for irrigation after applying suitable treatments, and GIS-based tools were used to coordinate water supply and demand. Five treatment technologies for domestic wastewater were compared, where the levelized cost of water method was used to determine the best low-cost system and the waste stabilisation ponds (WSP) method was found to be the most suitable for treating captured wastewater. The adoption of this irrigation scheme would result in a noticeable improvement of local water resources, ensure the long-term sustainability of the agricultural sector and improve the livelihoods of millions of farmers who depend on it. It would also reduce water extractions by around 30 % and total energy requirements for groundwater pumping by around 15 %, contributing to a more sustainable and resilient food system in Punjab.

Keywords: Food production, irrigation, low-cost system, sustainability, wastewater use

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