



## **Impact of wastewater treatment and reuse on the environment and public health; case study from Jordan**

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Treated wastewater is an important component of the water resource in Jordan, and is used in irrigation to support agriculture sector, and hence spare considerable quantities of fresh water groundwater for domestic use. As Samra wastewater treatment plant, the largest treatment plant in Jordan discharges around 110 MCM per year of secondary treated municipal wastewater to Zarqa River, and eventually to Jordan Valley. A few years after its construction, the efficiency of As Samra started to decrease due different reasons, primarily overloading, and therefore gradual environmental deterioration. In 2008, As Samra was reconstructed and upgraded to basically enlarge its capacity and enhance effluent quality. Overall, this intervention results in evident improved ecosystem services that needed quantification, the focus of this thesis. This thesis investigates and evaluates the impact of treated wastewater reuse on the environment and on public health in the most vulnerable area within Amman-Zarqa Basin, specifically from As Samra treatment plant to Jerash Bridge. Historical data is collected, field survey is performed, chemical and biological analyses are performed at eleven selected locations, and all data is managed using suitable tools to address the impact. The findings of this thesis demonstrate high improvement in biological and microbial parameters along the flow path yet the salinity is increased downstream. It is found that this increase is due to brackish water intrusion, apparently from the sandstone aquifer. Analysis of BOD and COD carried out as part of this study showed effective system recovery with COD reduction from 130 mg/l at the effluent to less than 50 mg/l in the downstream. Moreover, microbial activities are reduced, mainly due to self-purification in the river. On the other hand, interviews with 27 farmers indicate a considerable reuse of treated wastewater leading to high economic return due to proximity to water and high nutrient load maximizing productivity. Crop analysis is considered to evaluate the impact on public health through contaminants uptake by plants. This analysis showed that the trace elements in the examined crops tend to accumulate in the green matrix through phyto accumulation and hence, protects fruits. Overall, the outcomes of this thesis indicate safety of treated wastewater reuse in irrigation practices except for greens. The only concern however, is the microbial contamination which can be reduced through environmental management and considering survival time of microbes in the environment. SWOT analysis showed high environmental, social and economic potential of the treated wastewater reuse. The main opportunities within the river area are concluded to be food security and groundwater recovery while climate change and illegal reuse are the main threats. Finally, it was resolved that the upgraded wastewater treatment system and reuse within the study area are successful and sustainable management strategy that are environmentally sound and economically feasible.

**Key words:** Wastewater, reuse, environmental impact, As Samra, Zarqa River, public health, groundwater, SWOT analysis