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Quantitative sustainability and qualitative concerns in an irrigations system using recycled water to supplement limited groundwater supply

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Sustainability of irrigation in a country facing water scarcity depends upon adoption of best management practices to deliver 'more crop per drop' together with use of recycled waste-water from urban sewage systems. Saudi Arabia is a country facing extreme water scarcity and in this paper we report on research conducted at an extensive irrigation system where a concerted effort over several years has been devoted to achieving a high level of water productivity. Al-Ahsa oasis is located about 60 km inland from the Persian Gulf and has been inhabited since prehistoric times, due to the abundance of water in an otherwise arid region. It is one of the largest oases in the world with 12,000 hectares of irrigated land and more than 2 million palm trees. Historically the oasis was watered by over 60 artesian springs, but water is now pumped from the aquifer. To supplement this groundwater source, treated waste-water reuse has been practiced since 1992 and now comprises 30% of total supply. In addition, a comparable amount of agricultural drainage water is collected and recycled, so that the 'first-use' water represents only 40% of total irrigation supply. While this re-use system permits sustained irrigation with greatly reduced groundwater abstraction, there is a potential down-side in that fertilizers and contaminants applied with irrigation water move through the soil and return to the irrigation supply enhancing the risk for human and animal health. We investigated this problem using E coli and helminth eggs as indicators of human health risk. We sampled each of the three sources which are delivered separately to the head of the main irrigation canal where they are blended. The groundwater was free from E coli and helminths and the treated wastewater source was generally within designated quality standards. The recycled drainage water was delivered untreated into the canal system and was found to be contaminated with both E coli and helminths above acceptable standards. Sampling from the canal system showed that there was a general increase of E coli concentration with distance downstream representing an increasing risk to human health from consumption of sensitive crops. Reasons for this trend were explored with the most likely explanation being the use of contaminated drainage water. Natural processes of soil filtration were not providing adequate decontamination of drainage water.