



Application of QMRA to MAR operations for safe agricultural reuse and marine recreational impacts in coastal areas

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The Municipality of Fasano (Puglia, Italy), i.e. owning one of 32 managed aquifer recharge (MAR) sites in operation in the Puglia region, has pioneered the reuse of tertiary-treated municipal effluent for both soil irrigations and the containment of seawater intrusion via groundwater recharge by ditches.

In this work, quantitative microbial risk assessment (QMRA) methodologies have been applied to assess the degree of safety associated with such integrated practices by assessing the risks for public health resulting from the exposure to the reclaimed water. Escherichia coli (E.coli) dose-response model was used in this work since the pathogenic E.coli is reported to potentially occur in reclaimed water obtained from treated municipal effluents. The target count of pathogens ingested during swimming or inoculated by contaminated (uncooked) vegetables and fruits, was determined from the Monte Carlo Markov Chain (MCMC) Bayesian procedure applied to the results obtained from a monitoring campaign carried out in 2019. An optimization routine was applied in order to determine the most probable target pathogen count by minimizing the number of water samplings. The monitoring positions along the coast were defined by means of mathematical modeling, which highlighted the preferential pathways followed by pathogens when released into the fractured aquifer at a recharge operation flow rate of 10-30 L/s.

QMRA results indicated a negligible risk impact (12% probability of 0.4 infections per year) for soil irrigation practices and no impact on the seawater quality as a result of the additional treatment barrier provided by the so-called "soil-aquifer treatment" during the pathogen transport through the fractures of groundwater.