

GIS-Based Model to Investigate the Potential of Treated Wastewater for Irrigation

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Abstract

Nowadays, water shortages and water pollution represent two of the worldwide main challenges. In particular, the agriculture sector is the major water user, and it is expected to become more negatively influenced by water scarcity due climate change. Indeed, the reduction in freshwater availability, due to agricultural irrigation, in the context of climate change and population growth, is one of the main threats to the EU water environment. The use of reclaimed water as non-conventional alternative source of water supply (i.e., treated wastewater) could represent a sustainable and cost-efficient valid solution to face up to water scarcity-related issues. However, treated wastewater contains nutrients needed for crop growth, high percentage of this is currently discharged without being reused, implying that most of this resource is wasted without being exploited. Therefore, with the aim of overcome water scarcity issues, the assessment of potential treated wastewater in terms of quantification and localization is urgently needed. Although this topic was worldwide investigated by researchers to define the exact amount of treated wastewater, nowadays there is still a lack of data on the real quantities that are discharged from wastewater treatment plants (WWTPs). Not only the quantification but above all the spatial distribution of this WWTPs is needed since those are key factors for implementing the reuse of treated wastewater in agricultural irrigation. In this respect, Geographical Information Systems (GISs), are worldwide known as a useful tool to analyze the geographical distance and therefore could be adopted to developed tailored GIS-based model. In this regard, the aim of this research was to develop a methodology by using GIS to assess the potential of treated wastewater reuse in agricultural irrigation. The developed methodology was applied to a territorial area selected as study area in Northern Italy. GIS software was adopted for carrying out all the spatial analyses, integrating data provided by the Romagna Reclamation Consortium within the time interval 2017-2019 and thematic maps acquired by the network services provided by National Geoportal. Different criteria were taken into account to evaluate the treated wastewater capability to satisfy crop water needs by considering both the irrigated areas and potential irrigable areas, respectively. The

achieved results confirmed the possibility of extending the water distribution network creating new irrigated areas (potential irrigable areas). In addition, in the selected case study, crop water needs could be largely satisfied by treated wastewater, confirming that it is a valuable and alternative water resource that can help to increase food production and thereby meet the growing food demand. Furthermore, since treated wastewater reuse is still not a widespread practice in Italy, and as it was demonstrated, could represent a valid alternative and constant water resource quantity over time, future research should focus on the quantification of the fertilizers saved depending on the water characteristics. The developed GIS-based model could be applied to other study areas with the aim of increasing the treated wastewater reuse practices.

Keywords: treated wastewater, water reuse, agricultural irrigation, GIS

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