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Review

Decision aid supports for evaluating agricultural water reuse practices in Tunisia: The Cebala perimeter

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ABSTRACT

A more efficient and sustainable use of available water resources, especially in arid and semiarid areas, is a real challenge for many countries. The reutilization of treated wastewater for irrigation purposes is becoming more widespread in many places around the world because of its positive economic, agricultural and environmental impacts. The present study focuses on the case of North Tunisia, where policymakers are reconsidering the improvement of irrigation practices based on using recycled water. Its aim is twofold: firstly, evaluate the opinion of the stakeholders involved in decision-making (policymakers and farmers) through a compromise programming (multi-criteria decision making technique). Secondly, determine whether farmers would be willing to pay more for water if irrigation programs were improved and analyze the factors that influence their decision. The present study peruses a binary logistic regression analysis to address these questions. The main finding is that policymakers and famers agree that the best option is to invest in tertiary wastewater treatment. Indeed, more than 80% of farmers are willing to pay more for higher quality water.

Contents

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1. Introduction

In forthcoming years, changes in policy and water management will have to be made for a more efficient and sustainable use of available water resources, mainly in areas subject to greater water stress (WWAP, 2012). As water abstraction averages 70% for agricultural uses. Improvements in such a sector can have a large impact. Besides, according to FAO estimates, between 2008 and 2050 water consumption for irrigation will increase by 11% mainly in areas already undergoing water shortages (FAO, 2011).

Recycling water is considered as one feasible strategy out of the various available options for a better use of water resources. Effective management and implementation of wastewater reuse practices can lead to major benefits from an economic, agricultural and environmental standpoint (Scheierling et al., 2010). The reutilization of treated waste water (TWW) for irrigation is a more efficient use of water resources, particularly in arid or semi-arid areas as it helps reduce the environmental costs of untreated or partially TWW discharge (Alfarra et al., 2011).

The use of TWW for agriculture is a widespread practice in both developed and developing countries. The Tula Valley where agricultural water reutilization dates back to 1986 (Jiménez, 2005) is currently the largest irrigated area in the world using recycled water. Israel possesses the highest percentage of recycled water resources available for agricultural uses (Friedler, 2001), while in Galicia (Spain), 72% of farmers report using wastewater collection or treatment systems in their processes (Cuesta et al., 2006). Although treated wastewater for agricultural purposes is booming in many countries, it does suffer from rejection and cost issues. For example, Bakopoulou et al. (2010) concluded from a case study in the region of Thessaly (Greece) that farmers were willing to pay for TWW only if conventional water resources were unavailable. According to Abu Madi et al. (2003), in some areas of Jordan and Tunisia significant quantities of treated wastewater are discharged into the sea, probably due to farmers' reluctance to reuse or pay for recycled water.

This paper focuses on the case of Cebala (North Tunisia), where an important project for recycling water for agriculture was started in 1991. At present, policymakers are considering the possibility of improving the water reuse system in Cebala, which implies further investment and charges. This study pursues two related goals. Firstly, assess the opinion of the stakeholders involved in decision-making—policymakers and farmers—about improving the water reuse system. We are studying whether policymakers and farmers views are aligned regarding the reconsideration of the future water reuse program in Cabala. A compromise programming method will be implemented for this phase of the study. Secondly, according to the variables nature, and through a binary logistic regression, determine whether farmers would be willing to pay more for TWW if the program were improved and the main factors affecting their preliminary willingness to pay (PWTP). In order to achieve this second purpose, we are providing policymakers with data gathered from a questionnaire-based survey conducted with 98 farmers. Its results provide information about the adequate strategy to improve the water reuse program and outline farmers' expectations from their contribution to exploiting and maintaining the irrigation system.

This paper is organized as follows: Section 2 provides background information about the location of the study, Cebala. In Section 3 policymakers' and farmers' attitudes towards the TWW reuse improvement are assessed and a multi criteria decision analysis is performed to provide technical support (compromise programming method). Section 4 analyses farmers' preliminary willingness to pay more for unrestricted tertiary wastewater treatment in farming. Finally, Section 5 draws the main conclusions of the study with some recommendations.

2. Background

Tunisia is a typical example of a Mediterranean country undergoing water stress. In order to take up this challenge, water resources need an efficient and rational management. Using recycled water for irrigation is viewed as efficient for both: water resources increase and wastewater treatment WWT thus protecting coastal areas, water resources and water receiving bodies sensitive to water quality (Qadir et al., 2010). Since the early 1980s, Tunisia has run a nationwide water reuse program to increase the country's exploitable water resources. Irrigated districts, which cover up 408,000 ha, spread throughout the country, particularly in the north by the Medjerda river (120,000 ha), the coastal Sahel and southern oasis (45,000 ha). Northern areas in the north of Tunisia are granted access to irrigation with conventional water from the Madjerda river while others receive only treated wastewater TWW. Most municipal wastewater undergoes secondary biological treatment (mostly activated sludge), together with tertiary treatment. Tunisian regulations allow secondary treated effluents on all crop types except vegetables, whether eaten raw or cooked.

We focus on TWW management, particularly on the Cebala perimeter, the main recycled water irrigated site surrounding the capital city, Tunis. It covers an area of 3200 ha and was planned for wastewater irrigation for fodder and cereal crop, yet market gardening is prohibited (see Fig. 1).

This area is supplied by the treated effluents of four wastewater treatment stations that are responsible for almost 75% of the total urban, domestic and industrial discharges originating from Tunis (the capital of Tunisia). Only a small percentage of the water is pumped to irrigate the Cebala area, the rest being directly dumped into the sea (Belhouchette et al., 2012). The Cebala irrigation scheme began operating in the early 1990s. The project exceeded $17 million implied road infrastructure, underground irrigation, ground and open drainage and an inter-seasonal storage basin. The governmental agency managing water and farmers' needs is the Agricultural Advisory Cell, an institution fulfilling the tasks of selling water, maintaining the irrigation system and offering farmers technical and sanitary advice. A post evaluation of farming activity in this perimeter has focused on the underutilization of treated wastewater. According to the estimates of Abu Madi (2003) the water reuse index stands at approximately 12.7%, a very low percentage in regard to policymakers' expectations before the implementation of the project. The low rate of cost recovery from TWW sales (less than 15%) is yet another problem. After 23 years of operation, irrigation and drainage systems need to be renewed in accordance with the standards previously laid out in the Master Plan of North Waters (SCET International and CNEA, 1981). It has therefore become evident that an evaluation of this new investment is necessary. Apart from considering tangible issues related to economic and social profitability, other intangible issues more difficult to measure should be evaluated. These are equally addressed in this study. Considering that rational use of water resources is a priority objective in Tunisia, an important question regarding the future of the perimeter should be raised. Is it advisable to keep this system or to move to other conventional water resources? Keeping the existing system implies the evaluation of quality improvement possibilities. For that purpose, interested stakeholders' and policymakers' perspectives relating to the possibility of maintaining or improving the treated wastewater reuse for agriculture are evaluated and a multi-criteria decision analysis is performed in order to provide technical support for the decision-making process.