

FACING AGRICULTURAL WATER SCARCITY THROUGH WATER REUSE: DRIVING-FACTORS IN SOUTHERN-SPAIN

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Abstract

Many regions at a world level are exploring alternative water resources in response to emerging water scarcity challenges, current and future water shortages, and growing pressures on global water resources. As half of the global water bodies are seriously contaminated, wastewater treatment and reuse promote environmental security by alleviating freshwater resources' pollution and providing water supply for irrigation. Additional advantages of wastewater reuse in agriculture could include: (1) a reliable source of nutrients (nitrogen, phosphorus and potassium), and the provision of organic matter to be used in maintaining soil fertility (fertigation) and productivity; (2) a sustainable water supply source using less energy and costs than other options (e.g., importing water, and desalinated water); (3) a source able to avoid the resulting impacts of new water supply equipment (e.g., dams); and (4) a reduction of pollutants discharged to river systems and the environment. Conversely, a lack of widespread public support and technical implementation are some of the main barriers to be addressed by reclaimed wastewater promoters.

This study extensively reviews the relevant literature from the past two decades guided by the following research question: What are the challenges posed by water reuse in agriculture when addressing water scarcity in semi-arid regions, such as Southern Spain? Furthermore, which driving factors and adopted solutions and strategies should be promoted considering both technical and social narratives? A systematic literature review has been applied based on two scientific databases, Thomson Reuters' Web of Science (WOS) and Elsevier's Scopus. Five driving-factors have been identified when addressing water reuse in agriculture: water uses, water cost, water quality standards, water management, and perception.

- 1) Use: One of the most controversial issues regarding reclaimed water use is the environmental uses or the establishment of minimum stream flows to achieve the so-called good ecological status of water bodies, as stated in the European Water Framework Directive (WFD). Hence, some authors critically determine that compliance with this measure will have the opposite effect than expected because reclaimed water' use for these purposes will reduce the flows for agricultural use, which translates into the maintenance of groundwater extraction and worsens the overexploitation of aquifers.
- 2) Cost: Some studies deepened on the non-market valuation of environmental resources and services, concluding how a large proportion of the surveyed population

(between 70%-80%) was willing to pay an increase in their monthly water bill for the supply of reclaimed water for agricultural and ecological flows. This result could be interpreted as the non-market benefits of reuse reclaimed water is larger than the investment and operational costs of wastewater treatment plants.

- 3) Quality standards: The use of reclaimed water allows health standards to be complied with and thus does not represent a microbial risk or affect plant water status, fruit quality, or crop yield. Furthermore, reclaimed water supplies many crop nutrient requirements, especially for tree crops such as lemon or peach. However, some recent research has focused on emerging pollutants in reclaimed water, including pharmaceutical compounds that are not fully removed after wastewater treatment, which may be eventually released into agricultural systems and can also reach the food chain.
- 4) Management: Although reclaimed water is generated at the municipal level, its management is carried out by each regional government, through regional water sanitation entities such as Entidad de Saneamiento de Aguas (EPSAR) in the Valencian Community, or Entidad de Saneamiento y Depuración de Aguas Residuales de la Region de Murcia (ESAMUR). To cover the costs of operating and maintaining sanitation and treatment facilities, in addition to conveyance and storage infrastructure for irrigators, a new tax, the sanitation fee, was created by these regional entities, which urban users in their water bills pay for the discharge of wastewater into the public sewage system.
- 5) Perception: User's acceptability has been identified as a novel and understudied research topic, which may help implement policy options and water resources management. However, some main barriers or rejection factors for the use of reclaimed water are also identified: water quality (high levels of conductivity or high concentrations of chlorine, sodium, or boron), water price (no clear position among the irrigators, because there is not a very wide knowledge of the cost), and the lack of adequate distribution and regulation infrastructure (including energy costs).

Each of these challenges will require specific solutions from a technical point of view, However, the results highlighted that it would be equally important to propose new approaches to water governance and water management that may deepen on social and behavioural aspects regarding water reuse.

Keywords: water scarcity, cost, management, quality standards, perception