

Editorial

# Institutions and Economics of Water Scarcity and Droughts

Julio Berbel <sup>1</sup>, Nazaret M. Montilla-López <sup>1,\*</sup> and Giacomo Giannoccaro <sup>2</sup>

- <sup>1</sup> WEARE–Water, Environmental and Agricultural Resources Economics Research Group, Department of Agricultural Economics, Universidad de Córdoba, Campus Rabanales, Ctra. N-IV km 396, E-14014 Córdoba, Spain; berbel@uco.es
- <sup>2</sup> Department of Agricultural and Environmental Sciences, University of Bari “Aldo Moro”, 70126 Bari, Italy; giacomo.giannoccaro@uniba.it
- \* Correspondence: g02molon@uco.es

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## 1. Introduction

Integrated water resources management seeks an efficient blend of all water resources (e.g., fresh surface water, groundwater, reused water, desalinated water) to meet the demands of the full range of water users (e.g., agriculture, municipalities, industry, and e-flows). Water scarcity and droughts already affect many regions of the world and are expected to increase due to climate change and economic growth.

In this Special Issue, 10 peer-reviewed articles have been published that address the questions regarding the economic effects of water scarcity and droughts, management instruments, such as water pricing, water markets, technologies and user-based reallocation, and the strategies to enhance resiliency, adaptation to scarcity and droughts. There is a need to improve the operation of institutions in charge of the allocation and re-allocation of resources when temporal (drought) or structural over-allocation arises.

Water scarcity, droughts and pollution have increased notably in recent decades. A drought is a temporary climatic effect or natural disaster that can occur anywhere and can be short or prolonged. Water scarcity involves a lack of supply relative to potential or current demand that generates conflict between alternative uses of water, especially regarding the requirements of societies, economic sectors, territories and ecosystems. Traditionally, users in water-scarce regions have adapted to dealing with water shortages; however, droughts can greatly increase problems since they are uncertain events and also affect water-abundant regions, with climate change increasing their frequency and severity [1].

Supply-side mechanisms have traditionally been employed to cope with drought by building infrastructure (wells, dams, channels, inter-basin transfers), and recently by including desalinated, brackish, and reclaimed wastewater into the resource mix. Berbel and Esteban [2] study the influence of drought as a catalyst for water policy reform in three developed economies with a Mediterranean climate (Spain, California and Australia), and find that solutions and institutions are trajectory-dependant and grounded in social institutions. Nevertheless, there is a convergence of the type of instruments employed to manage water scarcity and droughts.

In this Special Issue, the reported case studies recount experiences from USA, China, and the European Union (southern Member States). A variety of proposals aimed at tackling droughts and scarcity have been discussed, ranging from economic tools (pricing and insurance) and the increased use of reclaimed wastewater, to reforming the institutional setting (water markets and priority rights). Most of these papers analyses economic instruments and agriculture, but other economic sectors as well as non-market values are also addressed.

## 2. Papers Contributed

### 2.1. Demand-Side Policy

The use of demand-side policy is represented by Torres-Bagur, et al. [3]. Tourism activities have been steadily increasing in the last decade, thereby adding competition for water sources. Tourism activities show the highest per-capita water use, and conflict between water users for water re-allocation (generally from agriculture to tourism) arises in regions already affected by water scarcity. In order to make tourist accommodation more sustainable, strategies to promote efficient water use therein can be established. The contribution is focused on sustainable water consumption and resource management in the tourist accommodation industry. The authors conduct a survey on guests staying at campsites, hotels, and rural lodgings in the Muga river basin (Spain) and report that the adoption of water-saving practices is largely influenced by the sociodemographic and motivational features of the guests. The most common tourism is that of the sun and beach sector, which unfortunately reports behaviour of a less sustainable nature. The most relevant finding is that three-quarters of the tourists surveyed declared that they would be willing to reduce their water use subject to economic compensation.

### 2.2. Governance of Water Rights

Firstly, a proposal for the implementation of guarantee-differentiated water-right entitlements is proposed as an alternative to the current water rights based on the proportional rule, which fails at guaranteeing the water supply as a relevant attribute in the allocation [4]. The argument is based on the allocative efficiency of current rules implemented during drought periods to reallocate the available water resources during a declared drought. An exhaustive review of alternative allocative instruments is presented with an examination of examples. The case of Australia offers the best real example of guarantee-differentiated priority rights that have been in place since 2000. A proposed framework for Spanish irrigation water is presented which includes differentiated tariffs with a lower charge for ordinary rights and higher charges for priority use.

Irrespective of institutional reforms, the establishment of water allocation rules entails transaction costs. The contribution by Loch et al. [5] deals with transaction costs related to transitions between institutions. Drought management institutions in the Po basin (Italy) are investigated by focusing on transaction costs for transitioning drought management institutions towards informal, participatory, and consensus-based approaches (i.e., a Drought Steering Committee). The contribution has found that costs for establishing, coordinating, and managing drought events through informal arrangement have fallen over time as proof of efficient institutional organisation.

Water markets as a way to allocate scarce water resources have long been recognised among institutional reforms in the United States. The role that water markets have and might play in addressing scarcity in the Southwestern United States, namely in Arizona, Texas and California, is studied in Schwabe et al. [6]. The analysis reports the volume and value of water traded on water markets over the last decade (2009–2018) taking spatial, temporal and sectorial features into consideration. The results show that water-right leasing has increased over time, and has dominated the market share in terms of traded volume and value, with farmers being the primary sellers. While new trading frameworks are emerging, as in the case of groundwater banking and storage water rights in California, the water market remains narrow, the explanation for which may lie in the existing transaction costs, the out-of-region ban, and third-party effects. All these issues are recognised among the challenges facing the water market.

### 2.3. Hydro-Economic Models

Hydro-economic models are a valuable tool for improvement in the understanding of the economic impacts of scarcity and droughts and the evaluation of alternative instruments. An updated review on hydro-economic modelling in the context of climate change is provided in Expósito et al. [7],

whose main conclusion points to the limitation of current models in accounting for uncertainties and risks associated with climate change. Future research should deal with such a limitation.

An example of a complete application of the hydro-economic model is given by the analysis that Borrego-Marín et al. [8] include in the Guadalquivir river basin, where the re-allocative effects of water-pricing policy are analysed. Based upon a simple model, the multi-sectoral impacts of water pricing are assessed at the basin scale. The water–demand curve is drawn for domestic, industrial, recreational, and agricultural uses. According to the results of the model, the irrigation water price needs to be increased three-fold to force savings and re-allocation from agriculture to sectors of a more profitable nature.

The Guadalquivir River basin example shows that water pricing is a limited instrument for water reallocation, thereby confirming the general findings regarding this instrument related to WFD implementation in the EU [9]. Institutional reforms and changes in water rights management are discussed in the subsequent set of three contributions.

#### *2.4. Supply-Side Enhancement*

Analysis of causes for changes in water areas of the Baiyangdian Lake (China) are investigated in Wang, et al. [10]. By combining Landsat images with hydrological and climatic ground data, the extraction of surface water from 1984 to 2018 is studied. The lake area has been affected largely by human activities, and, to a lesser extent, by climate change. The development of artificial water diversion projects for lake replenishment from neighbouring basins seems to have succeeded in reaching a good ecological status. However, such solutions are no longer possible.

The remaining contributions deal with the enhancement of water supply. Firstly, water-supply reliability and its economic impacts are analysed by Sjöstrand, et al. [11]. In this research, the contribution studies the failure in water provision to domestic users and proposes a risk assessment method. The approach is illustrated on the island of Gotland (Sweden), since it is the country's most water-scarce area, where the solution proposed involves an increase in surface water extraction as the most cost-efficient risk-reduction alternative.

Although reclaimed wastewater is envisioned as a reliable water supply, its use remains undeveloped. Barriers and opportunities for reclaimed wastewater use for agriculture in Europe are surveyed in Mesa-Pérez and Berbel [12]. The paper aimed to explore the impact of the recently approved Regulation EU-2020/741 “Minimum requirements for water reuse in agriculture”. The perception given by almost a hundred interviewees regarding key actors across eight European Member States is investigated. Two main groups of countries are found: (a) those concerned about the cost of implementing, distributing, and storing reclaimed water; (b) countries where social and governance issues are the most pressing aspects.

#### *2.5. Innovative Economic Instruments*

Finally, the research by Guerrero-Baena and Gómez-Limón [13] regarding insurance for ensuring irrigation water supply is discussed. A new index-based drought insurance scheme for irrigation, linked to the stock of water available in reservoirs, is proposed. An illustrative example is reported for the Guadalquivir River Basin, located in southern Spain. The main conclusion is that insurance schemes against irrigation shortage may be an available instrument in the future, but further research is required to develop a commercially affordable service.

### **3. Concluding Remarks**

The contributions to this Special Issue highlight the key aspects of institutions that may tackle not only the increasing water scarcity in many regions of the world but also the increasing frequency and impact of droughts in economic and natural systems. Some of the papers analyse critical issues, such as the state and future trends of water markets, the estimation of transaction costs when dealing with drought management, the use of new instruments, such as insurance and water-right entitlements that include water security, water-pricing effects on a whole basin, and intra- and inter-sectorial

re-allocation. Furthermore, the important issue regarding non-conventional water supply and the governance of the new resources also features as the topic of some of the contributions.

To conclude, this issue provides an in-depth revision of the main aspects of institutions and instruments available for the management of droughts and scarcity governance, and has opened a new field of research in certain emerging innovative instruments.

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