Water distribution management in South-East Spain: a guaranteed system in a context of scarce resources

Joaquín Melgarejo-Moreno, María-Inmaculada López-Ortiz and Patricia Fernández-Aracil

Abstract

Growing global scarcity of water is forcing a change in their management models and the need to implement good governance schemes, understood as the implementation of legal, institutional and economic mechanisms that enable the efficient organisation of the activity developed by all of the agents involved in water management. In this sense, one of the greatest achievements in Spanish hydraulic history is the organisation called *Mancomunidad de los Canales del Taibilla (MCT),* whose existence usually goes unnoticed in one of the most arid regions of Europe: the South-East of Spain. Therefore, this study will analyse the MCT management model, based on the good governance of water, as well as their positive socio-economic impacts on population and areas supplied as a consequence of the quality and continuity of the urban supply, which has been extraordinarily beneficial for resolving health and hygiene and comfort problems. This is all thanks to the continual search for new sources of supply, in addition to efforts to improve leakage control, modernisation of management, educational campaigns implemented and the efficient and sustainable use of resources without financial unbalances.

Keywords

Water governance, water scarcity, alternative water supply sources, distributed systems, South-Eastern Spain, Mancomunidad de los Canales del Taibilla.

1. Introduction

The growing scarcity of water is forcing a change in the way this resource is understood and also in the existing models to manage it (Molina-Giménez and Melgarejo-Moreno, 2015). Currently, the new paradigm conceives water as a basic resource for human life which must be managed as a scarce commodity with increasing value. In fact, thanks largely to tariff policies, water consumption has shown a downward trend in recent years. Domestic users are increasingly moderating their consumption (AEAS-AGA, 2016), which is a socially-assumed necessity, and they pay for a service rather than a product (Melgarejo-Moreno and López-Ortiz, 2016b). Therefore, although the price per cubic metre has increased slightly, the expenditure per family is compensated on the invoice by a gradual decrease in consumption due both to a greater awareness among users and an improvement in the efficiency in the provision of the services.

Specifically, in Spain, the urban water services are managed by the municipalities and each local authority can apply different prices and tariff structures. According to the study of tariffs in Spain (AEAS-AGA, 2016), the average price of water for domestic use in 2015 was €1.77/m³, of which €1.02 corresponded to the supply service and €0.75 to treatment (sewage and waste water purification), without VAT. Therefore, since 2007, when a volume of 301 litres per inhabitant and day was recorded, a constant decrease has been observed in the unitary flows supplied in the secondary phase, with the current figure being 248 litres per habitant and day (AEAS-AGA, 2016). This decreasing trend is the result of a greater efficiency in the services, a higher awareness among the population, supported by the information campaigns promoted by the operators, better domestic equipment, use segmentation invoicing and the widespread use of progressive tariffs.

However, the tariffs paid by users in Spain do not cover the costs of the water services (Krinner, 2014; Borrego-Marín et al., 2016). This means that the investments required in water-related assets and hydraulic services cannot be made. The powerful and complex nature of these infrastructures

confers them a certain degree of inertia, but they must be well maintained and upgraded and intelligently exploited so that they can continue to carry out their functions efficiently.

In order to achieve sustainable development, the efficient management of water on an urban, agricultural and environmental level is fundamental and effective inclusive governance of water use is critical for relieving water use conflicts (Wei et al., 2018). The European Water Policy is based on covering the costs of the services and on each user assuming the costs that correspond to them in order to meet these expenses through rational distribution while heeding “the polluter pays” principle (European Commission, 2000), as well as on the good condition of the water, the aquatic ecosystems and a sustainable use of water (Grindlay et al., 2011).

Despite the average prices above-mentioned, there are significant tariff differences between provinces and autonomous regions for the final user (AEAS-AGA, 2016), which implies a lack of unity in the market. The differences between geographical areas are due to factors of availability, quality, proximity to the water resources, processes, techniques and the costs necessary for treating and purifying water, but also to the incorporation of the different regional charges, the degree to which the service costs are covered (operation, improvement, and renovation of infrastructures) or other factors, many of which are unrelated to the sector.

The water sector in Spain is facing a series of important and urgent challenges: from an environmental point of view, water scarcity and the non-compliance with the European regulations (Melgarejo-Moreno and López-Ortiz, 2016a); from an economic perspective, investment gaps and inadequate tariffs for both recovering the costs incurred in water services and for undertaking the new investments (Molina-Giménez, 2016); and also the deficiencies in the current administrative framework, due to the high number of public authorities with responsibilities in the management of water, in the absence of a sufficiently stable and predictable regulatory framework (Casado, 2004; Molina-Giménez, 2016). The good governance of water (Lautze et al., 2011) plays a fundamental role

in overcoming these challenges. This is understood as the implementation of legal, institutional, and economic mechanisms that enable the efficient organisation of the activity developed by all of the agents involved in water management. This requires a legal and institutional framework which is consistent with the challenges (Melgarejo-Moreno and Molina-Giménez, 2017).

There is no single model to articulate the effective governance of water. In fact, in order to be efficient, the governance systems should adapt to the social, economic, and cultural characteristics of each country. However, there are some principles or basic attributes which are considered as being essential for the effective governance of water (UN and WWAP, 2003). One of these is that the institutions should operate in an open way, using a language that is understandable and accessible so that the population as a whole is able to trust the complex institutions. Furthermore, all policy decisions should be transparent so that everyone may easily follow the steps taken in policy formulation.

In view of the above, this study will analyse the primary distribution phase of the urban water cycle in South-East Spain, fundamentally carried out by the organisation called *Mancomunidad de los Canales del Taibilla* (hereafter, *MCT*), essential for shaping the territorial, social, and economic dynamics of the region which includes mainly the provinces of Alicante and Murcia. After a brief description of the area of study and the entity analysed, the evolution and the composition of water resources are shown and discussed. Finally, a number of socioeconomic impacts complete the analysis of a good water governance example. It is precisely the good governance of water that characterises the MCT and which makes it a practically unique model, as almost since its creation it has been managing the most diverse types of water resources, including surface water, groundwater, transferred water, and desalinated water in order to meet growing demand efficiently and transparently.

2. Area of study

One of the features that defines the climate of the Southeast region of the Iberian Peninsula is its aridity, together with the scarce and irregular rainfall recorded. The effectiveness of this rainfall is considerably diminished by the strong intensity with which it occurs, the high potential evapotranspiration due to the high level of sunshine exposure and the persistence and continuity of periods of drought. The result is an intense water deficit in Southeast region (CHS, 2015).

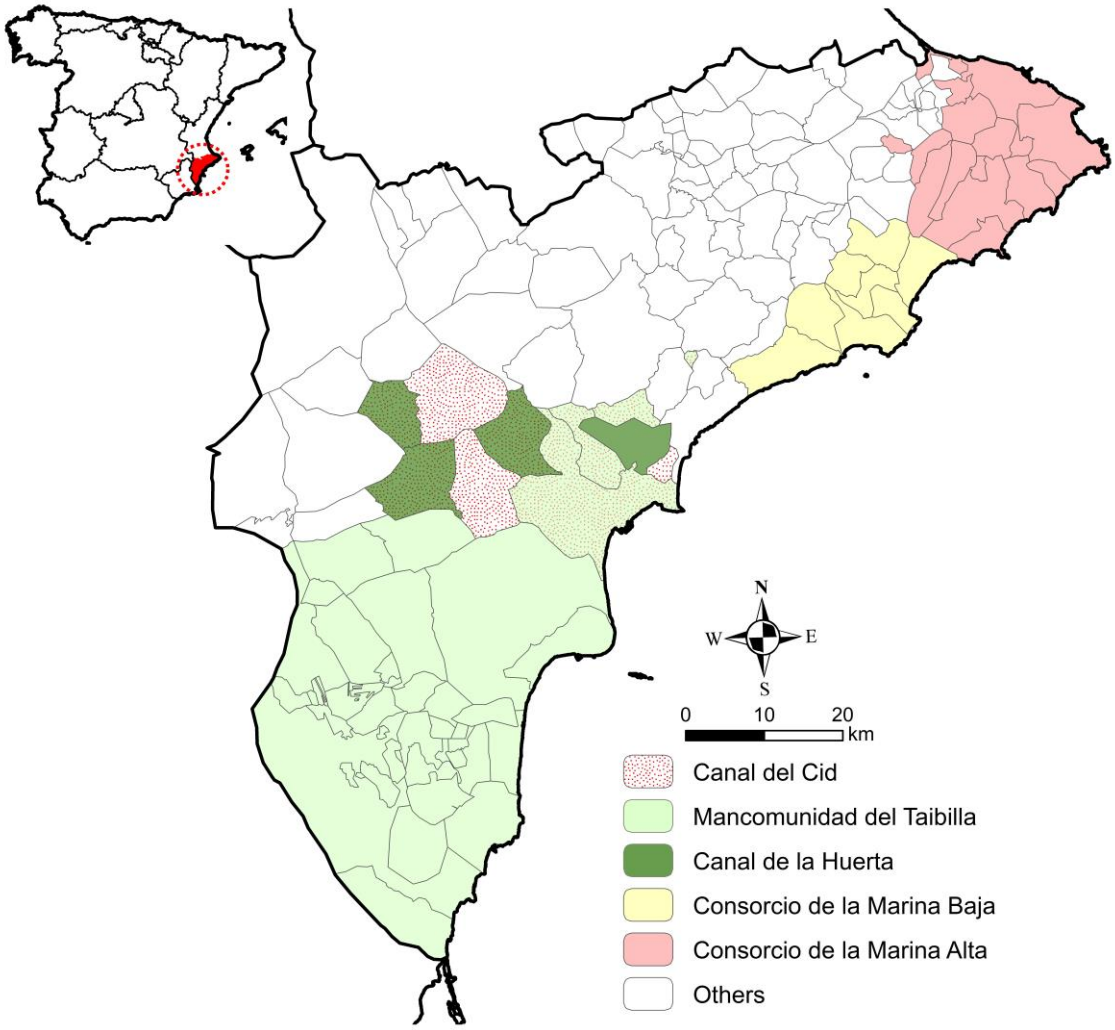
The South-East region of Spain is characterised by endemic water scarcity, and, on many occasions, this area has seen its growth limited by this shortage of water resources. The lack of water, therefore, constitutes a limiting factor for the growth and economic development of the region. This situation has necessitated constant efforts directed at increasing water availability, on the whole, based on the need to obtain resources from outside the territory or on the collection of resources from different systems which, in all cases, requires a fairly complex process of planning, development, and exploitation of hydraulic infrastructures. It is interesting to highlight, in this case study referring to South-East Spain, that the average price paid in the provinces of Alicante and Murcia (AEAS-AGA, 2016) is higher than the average tariffs paid in Spain as a whole. This is mainly due to the combined use of water collected from different supply sources, particularly desalinated water which generates a substantial increase in the average prices of the provision of water for urban supply (Prats and Melgarejo-Moreno, 2006).

There is a variety of water supply systems coexisting in the South-East area of Spain (Figure 1): *Consorcio de Aguas de la Marina Alta, Consorcio de Aguas de la Marina Baja, Sociedad del Canal de la Huerta, Canal del Cid*, etc. However, in this context of insufficient water resources, which are sometimes of a poor quality, the major urban and tourist water supplies to Bajo Segura, Bajo Vinalopó, Campo de Alicante, litoral de Águilas-Mazarrón, Campo de Cartagena and Valle del Guadalentín districts, strategically (and practically exclusively) depend on the water distributed by

120 the MCT (Figure 2), which has acquired an inestimable value for the economic and social

121 development of Murcia and Alicante as it provides very high quality resources for drinking water

122 supplies, the primary phase of which is managed by this organisation (Melgarejo-Moreno, 2015).



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124 Figure 1. Water supply systems coexisting in Alicante province.

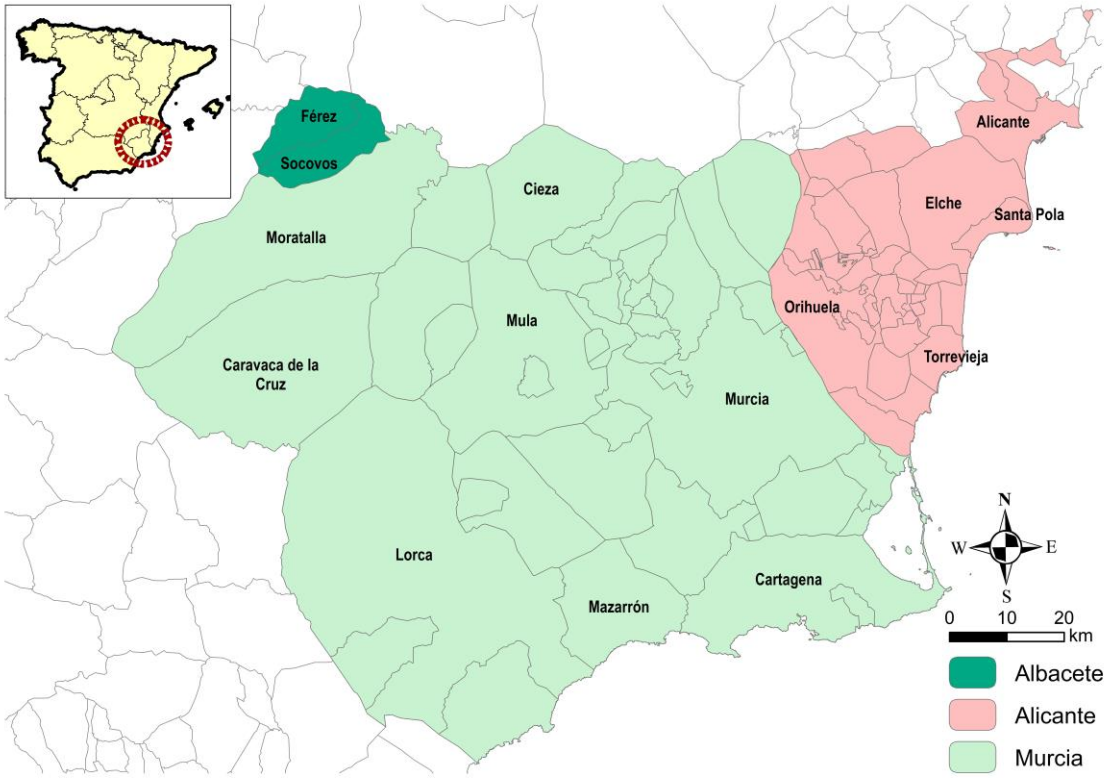


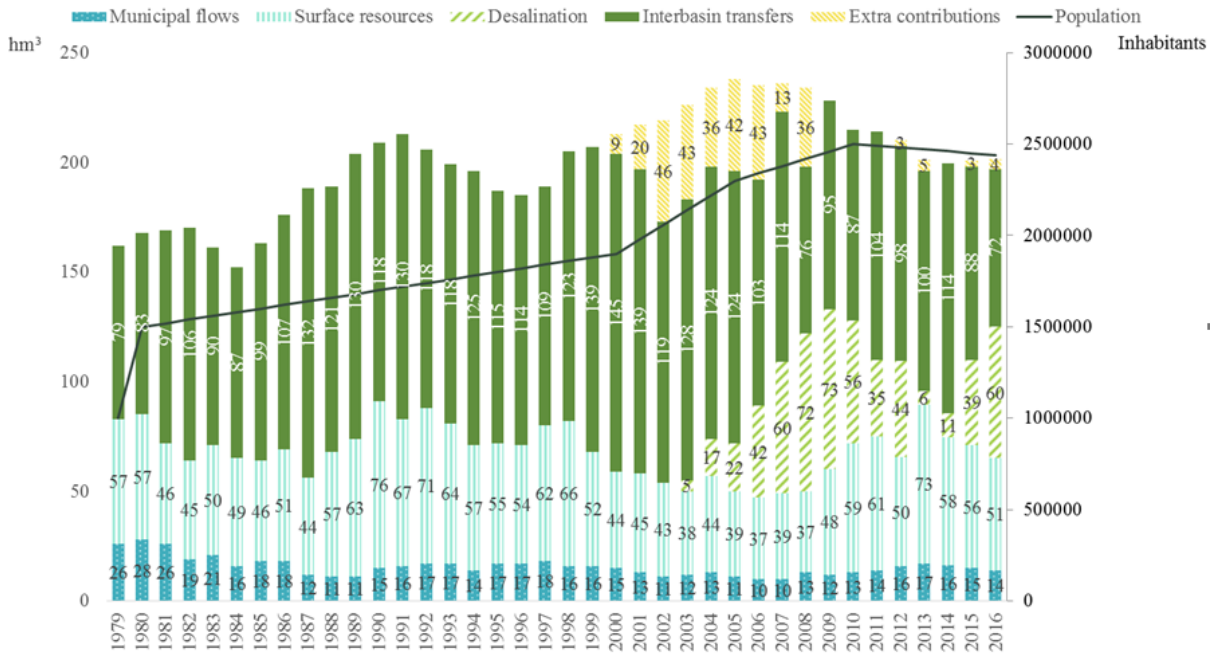
Figure 2. Municipalities and provinces considered in the area of study.

3. The entity of study: Mancomunidad de los Canales del Taibilla (MCT)

MCT is an autonomous organisation attached to the Ministry for the Ecological Transition (Ministry of Environment), with its headquarters in Cartagena. Its purpose is the supply of drinking water to the primary network (collection, purification, or desalination, piping, and storage in water reserve tanks). It was established in 1927 by Spanish Royal Decree-Law and initially supplied drinking water to Cartagena and its naval base, but today it supplies an area of over 11,000 km², including 80 municipalities in the South-East region of the peninsula, mainly concentrated in the provinces of Murcia and Alicante, excluding two municipalities in Albacete (MCT, 2014). It supplies a population of approximately 2,500,000 inhabitants, without taking into account tourists and holidaymakers, who consume on average (1979-2016) 201 hm³ of treated and distributed water each year, of which 110

138 hm³ has been transferred from the Tagus River via the Tagus-Segura Aqueduct (hereafter TSA),

139 representing around 55 % of the total volume supplied (MCT, 2017).



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141 Figure 3. Population supplied and evolution of the distribution of the mix of flows demanded by the

142 MCT in accordance with the most relevant sources of origin (1979-2016), expressed in hm³. Source:

143 own elaboration based on data provided by the MCT (2017).

144

145 In order to meet the increase in the demand for water by these municipalities, since the respective

146 years of arrival of the new flows and the dynamic demographic growth, the MCT has not only

147 conducted a continual search for new sources of supply but must have made admirable efforts to

148 improve the management of the resources, maximising leakage control, technically enhancing its

149 management and promoting a culture of a sustained efficient use of water.

150 The latest available information (MCT, 2017) confirms the trend which began in 2005 of the

151 reduction and stabilisation of the demand for water by the local authorities and associated

152 organisations. In Figure 3, extra contributions are groundwater resources and assignment contracts

taken together, as described in section 4. Overall demand during 2013 was 201 hm^3 compared to 210.1 hm^3 in 2012 and has remained constant until the last recorded data in 2016, as shown in Figure 3; however, part of this current demand, specifically 14 hm^3, has been supplied with own resources of the city councils of Alicante (5.3 hm^3), Murcia (7 hm^3), and Elche (1.7 hm^3).

The increase in the proportion of desalinated water in the combined supply sources in recent years is noteworthy. This is because this increase has occurred in detriment to the water supplied by the TSA, which has a much lower price than desalinated water. The failure to update the spending of the MCT and the tariffs charged by the local authorities at the same pace has caused a tariff gap which could lead to serious economic and financial imbalances. Therefore, it could be said that water management is a governance issue which should contemplate the values of general interest and legal certainty through regulation (Martínez-Lacambra et al., 2010). However, national sovereignty, social values, or political ideology can have a strong impact on attempts to change governance models within the hydraulic sector, as is the case, for example, of land and water rights (Rogers and Hall, 2003).

4. Water resources

With emphasis placed on the aforementioned complementarity of the supply sources, the different origins of the resources available have conditioned fundamental aspects of the historical path of the MCT, as its construction plans, and basic infrastructures have been the direct consequence of them. From the initial flows coming from the Taibilla River to the current transfers from the headwaters of the Tagus River, the available resources have taken different forms, which are described below. According to the data recorded for the year 2016 (MCT, 2017), the percentage distribution of the different water sources is summarised in Figure 4.

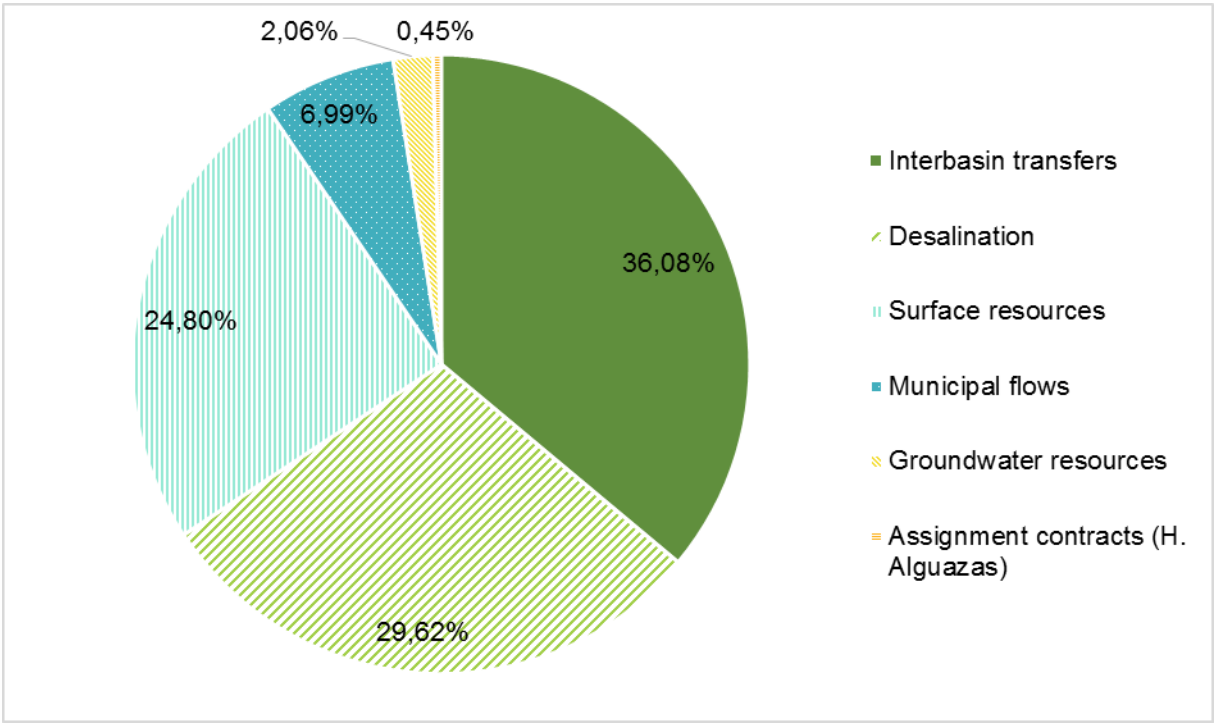


Figure 4. Distribution of flows harnessed by the MCT in 2016 according to their origin. Source: own elaboration based on data provided by the MCT (2017).

4.1. Natural surface resources

The first flows of the MCT came from the surface water of the Taibilla River, a tributary of the Segura River. It was a limited source but of a high quality and initially provided a sufficient volume for the original objective of the MCT: to supply Cartagena and its military base. These resources were complemented with others from the Segura River in the 1960s, before the first water crisis faced by the organisation. Demand exceeded the available supply and it was necessary to expand the range of available resources. This incorporation of resources from the Segura River resolved the MCT's first water resource crisis when real demand exceeded the water available (MCT, 1976).

The contribution of resources from the Segura River to the reservoirs in the headwater basin has reduced considerably in recent years (Jódar-Abellán et al., 2016). If the MCT had continued to take

190 resources from the Segura, a very difficult situation would have arisen that would have been difficult
191 to sustain after 1980. The Tagus-Segura transfer constituted a solution to this problem, providing the
192 MCT with additional resources to complement its own so that it would no longer suffer from drinking
193 water restrictions.

194 The hydrological situation of the Taibilla River allows the future volumes to be estimated at between
195 30 and 50 hm^3 per year, due to current pressures and the possible effects of climate change
196 (Melgarejo-Moreno and Molina-Giménez, 2017).

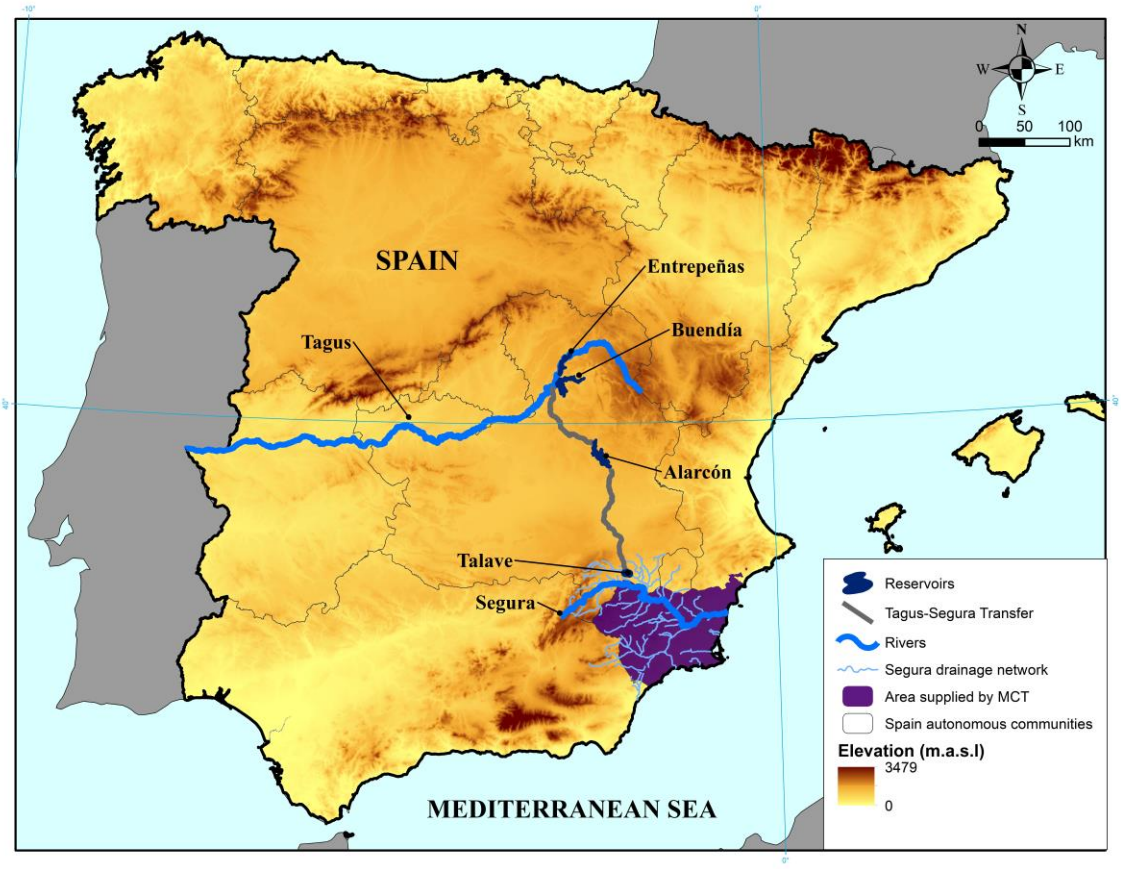
197

198 **4.2.Interbasin transfers**

199 The arrival of the Tagus-Segura transfer waters as from the year 1979 meant that there were
200 sufficient resources to supply the municipalities served by the MCT. Since its integration into the
201 system of water sources distributed by the MCT, the Tagus-Segura transfer has constituted a basic
202 pillar in the functioning of the MCT, enabling the continued expansion of the area supplied. It enables
203 a higher volume of resources with a substantially improved quality and a guarantee of supply, in
204 other words, the system now enjoys water security (Grey and Sadoff, 2007).

205 The TSA constitutes the largest hydraulic infrastructure in Spain, forming part of an ambitious
206 national project of economic and social transformation. In general terms, the structure consists of a
207 286 km-long and 33 m^3/s channel which begins in the Bolarque Reservoir (35 hm^3) in the Tagus River,
208 downstream from the hyper-reservoirs of Entrepeñas (804 hm^3), on the Tagus River, and Buendía
209 (1.638 hm^3), on the Guadiela River. From Bolarque, the water is channelled to the Bujeda Reservoir
210 (884 m in altitude), from where it is conducted towards the hyper-reservoir of Alarcón (Júcar River),
211 and from there to the Talave Reservoir on the Mundo River which is the principal tributary of the
212 Segura River (Figure 5). In order to correct the water deficit on Spain's Eastern Coast, the concept of
213 the transfer was first proposed in the National Hydrological Works Plan of 1933, which laid the

214 foundations of Spain's modern hydrological planning and was continued in the General Plan of
215 Hydraulic Works of 1940 (Melgarejo-Moreno and López-Ortiz, 2009).



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217 Figure 5. Location of areas supplied by MCT and general infrastructure of Tagus-Segura interbasin
218 transfer.

219

220 After the TSA was completed in 1978 and began operating in 1979, it was necessary to regulate the
221 organisational and economic aspects of its exploitation through Law 52/1980, of 16 October 1980,
222 which establishes the calculation of the tariffs, their liquidation and destination (Molina-Giménez,
223 2009). A volume of 600 hm^3/year was calculated for the first phase, distributed between irrigation
224 (400 hm^3/year), urban supply (110 hm^3/year) and losses estimated at 90 hm^3/year, with priority
225 given to the supply of drinking water in the event of drought.

After an extended period of uncertainty and growing unrest that lasted 18 years, Article 23 of the regulations of the Tagus Basin Hydrological of 1998 technically identified the minimum threshold for not transferring when the reserves in the Entrepeñas and Buendía Reservoirs were equal to 240 hm^3. This threshold numerically defines the so-called exceptional hydrological conditions, contributing to the objectification of decision-making. However, after 2008, the future of the Tagus-Segura transfer was questioned through a series of legislative proposals which can be summarised in two possibilities: the possible revocation of the Tagus-Segura transfer or a reduction in the transferable or available flows through an increase in the legal reserves in the Upper Tagus.

After an extended period of stagnation, in March 2013, the Directorate General for Water of the Ministry of Agriculture, Food and the Environment published an announcement declaring the beginning of the public information and consultation period for the "Project proposal for the hydrological plan and report of environmental sustainability of the hydrological planning process corresponding to the Spanish part of the Tagus River Basin". This proposal established the increase of the non-surplus volumes in the Upper Tagus, below which no transfer could be approved, from 240 hm^3 to 400 hm^3 although no reasoned justification was given for this. Similarly, it established the increase in the monthly volumes of the curve through which the transfers to be approved are submitted to the Cabinet, linearly and by an additional 160 hm^3 to those previously established.

In view of the incessant uncertainty surrounding the operating plan of the Tagus-Segura transfer, the use of a governance instrument was chosen to try to resolve the situation through the "Memorandum of Understanding between the Ministry of Agriculture, Food and the Environment, the Region of Murcia and the Region of Valencia regarding the surplus waters of the Tagus-Segura transfer", which was signed on 9 April 2013 in Madrid (Melgarejo-Moreno et al., 2014). Later, in October, the regions of Castilla La Mancha, Madrid, and Extremadura also signed the agreement. Therefore, the territories involved in the Tagus-Segura transfer, in large measure, sealed the continuity of this infrastructure which was so important for Spain as a whole. A notable feature of

the Memorandum is the will to reach agreements regarding the grounds for preserving the Tagus-Segura transfer.

The processing of the Law 21/2013, of 9 December 2013, on Environmental Impact Assessment (hereafter, LEI) constituted a vehicle for adopting part of the observations and recommendations which were developed based on the Memorandum, giving legal certainty to the transfer which it had never previously enjoyed. Furthermore, it was the first time that there had been a consensus between all of the affected Autonomous Regions which contributes to the good governance of the resource. In addition, a mechanism for ensuring security and technical stability was established when the Government of Spain was instructed to update the determining magnitudes in the regulations for exploiting the transfer.

In the LEI, the new exploitation rules of the Tagus-Segura transfer are established in accordance with the levels of joint reserves in Entrepeñas and Buendía at the beginning of each month, with an annual maximum total of 650 hm^3 in each hydrological year (600 for the Segura and 50 for the Guadiana). However, some differences can be observed between the volumes planned to be transferred in comparison with those levels approved in the Environmental Assessment Law and the Royal Decree of 2014 which currently regulates them (Royal Decree 773/2014, which approves diverse regulatory standards for the Tagus-Segura transfer).

Nevertheless, the continuity of the Tagus-Segura transfer, which provides a fundamental part of the flows managed by the MCT, is by no means guaranteed. The infrastructure is periodically subject to the effects of an unproductive political-territorial debate which compromises the good management of the MCT. The conflicts are expected to continue in the future, channelled through mechanisms based on the pact between the different political and territorial institutions.

4.3. Groundwater resources

In situations of water scarcity, when the rest of the available resources are not sufficient to meet the needs of the system, groundwater resources are also important, identified as extra contributions in Figure 3, which regulate and secure water availability in times of drought (Custodio et al., 2016). For instance, annual percent contribution of groundwater resources to MCT water demand is 10% since the year 2000, on average. The groundwater concessions are held by some town councils and are sometimes transferred to the MCT; the resources from one aquifer of the *Confederación Hidrográfica del Segura* (*CHS*, the government of the Segura River Basin), called Syncline of Calasparra (Sinclinal de Calasparra), are particularly important.

4.4. Non-conventional resources

The MCT began to use desalinated water from the Canal desalination plant (Alicante I) in 2003. Since then, this new source of resources has represented a guarantee for supply, although its use is subject to the availability of other sources, as its high production cost directly affects the tariffs charged by MCT to the different distribution operators (Rico-Amorós, 2010). For example, due to the good meteorological and hydrological conditions within the MCT's area of activity and the existence of resources that are cheaper than desalinated water, during 2013, the activity was limited to producing the volume necessary to guarantee the correct maintenance of the facilities (see Figure 3).

In its early stages, there were basically two arguments in favour of desalination which were not fulfilled (March et al., 2014): it was claimed that the costs would be equal to or less than those of other alternative resources, such as the inter-basin transfers, and that its development was justified with the increase in demand due to an expansion of the urbanisation process and the dynamism of the tourism activity.

298 The reality was very different. However, the drought suffered in 2005, together with the paralysis of
299 the Ebro transfer, contemplated in the National Hydrological Plan, led to the approval of the
300 emergency execution of the desalination plant of San Pedro del Pinatar II and the urgent processing
301 of all of the actions managed by the MCT contemplated in the AGUA Programme and the formulation
302 of all of its Environmental Impact Declarations during the year (MCT, 2006).

303 Consequently, the MCT had to increase the tariff that it charged to the municipalities in order to
304 maintain its financial equilibrium after the desalination plants began operating. These agreements,
305 adopted by the organisation's Board of Directors, were opposed by the representatives of the
306 municipalities. This rejection has been customary in recent years. Even though much less water has
307 been generated than the total installed capacity allows, the increased costs derived from the
308 production of these resources have necessitated the adoption of this measure.

309 Currently, in detriment to the resources from inter-basin transfers, desalination is occupying an
310 important role in the percentage distribution of the water sources for the MCT (see Figure 4). In this
311 way, the desalination plants of the area of influence (March, 2014) have provided the following
312 volumes, as shown in Figure 6:

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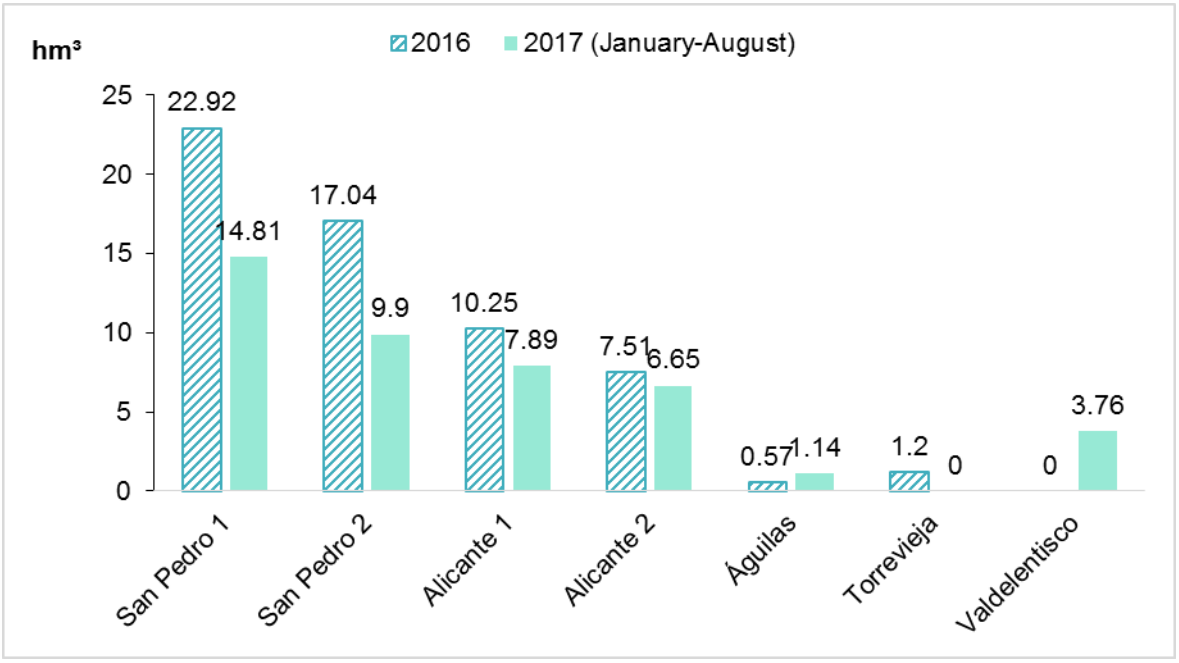


Figure 6. Flows and desalination plants providing non-conventional resources supplied by the MCT. For the year 2017 only figures up to August are available (included). Source: own elaboration based on data provided by the MCT (2017).

As these plants are obliged to produce more resources, due to the reduction in the traditional contributions and, significantly, the Tagus-Segura transfer, successive increases in prices and financial imbalances are likely.

4.5.Assignment contracts

The reform of the Water Law of 1985, through Law 46/1999, which is included in the recast text of 2001 (Articles 67 to 72), gave a legal structure to the water markets. It establishes the possibility of transferring water rights which can be used by other recipients (Vergara-Blanco, 1997). This has been the case in recent years of the MCT. Contracts for the assignation of water rights have been signed with irrigators of Castilla-La Mancha (Tagus River Basin) or of the Segura Basin territory in order to

329 construct a strategic water reserve so as to avoid drastic measures of reducing water volumes to the
330 municipalities and joint entities. For example, in 2006, contracts for assigning water rights (35.5 hm^3)
331 from the Tagus River were signed with the Irrigators Community of the Canal de las Aves (Aranjuez)
332 for an amount of 10.2 million euros. Another contract assigning the water rights from the Segura
333 River was signed with the irrigators of rice-growing areas in Hellín and Moratalla, for a volume of
334 water of 1.2 hm^3.

335 The drought alert in 2006 justified the application of the measures contemplated in the MCT's
336 protocol for drought situations and in their development the following exceptional measures were
337 adopted (MCT, 2007):

338 a. Inter-basin transfer contract; Canal de las Aves (35.5 hm^3).

339 b. Transfer of rights of Hellín and Moratalla municipalities (1.2 hm^3).

340 c. Contribution of the Júcar River (Alarcón Reservoir) to complete the supply of some municipalities:
341 Alicante, Santa Pola, San Vicente del Raspeig, Aspe, and Hondón de las Nieves (7.5 hm^3).

342 d. Contribution of the Syncline of Calasparra, originating from the accumulation of the groundwater
343 extraction campaigns during 2006 (13.1 hm^3) and 2007 (9 hm^3).

344 e. Assignment of management agreement with the CHS, signed on the 26 December 2006, for the
345 extraction of groundwater in the Collado de la Reina Well and five more wells in the municipality
346 called Orihuela (13.8 hm^3).

347 Recently, due to the new drought suffered during the water year 2015, a new agreement had to be
348 signed with the corporation called Heredamiento de Alguazas, whereby 0.9 hm^3 were used as
349 extraordinary additional resources to those provided by the Syncline of Calasparra (MCT, 2017).

350 Acquiring water through this mechanism usually generates a lesser degree of social opposition as the
351 economic compensation can be high. In addition to the bilateral contracts, with which the MCT has

had a positive experience, it would be desirable for the water authority to promote the creation of rights exchanging centres whereby the process of reassigning flows can be conducted in the first person (Melgarejo-Moreno and Molina-Giménez, 2017). They are used as extra contributions in times of need.

4.6. Municipal flows

Practically since the MCT began its operations, several municipalities have complemented the resources of this organisation with their own water and also their groundwaters. However, in quantitative terms, they are not relevant in the system as a whole and these own resources serve as a complement in specific towns. Currently, there are several municipalities that use their own water, principally Murcia (from the Segura River in la Contraparada), Elche, and Alicante (water from the Villena Aquifer).

5. The administrative organisation of the MCT

The Spanish Royal Decree-Law (4 October 1927) mentions, in its first article, the supply of drinking water only to Cartagena, its naval base, Murcia and Orihuela, but notes an expansive vocation by foreseeing the future integration of other municipalities, voluntarily and subjected to budgetary availability. MCT was born as an indefinite duration entity and taking on important administrative functions, empowered to make regulations: the ability to create standards of regulatory standing. Besides, two essential powers are recognised: self-organisation and revenue collection.

MCT is now composed by the following governing bodies, according to the Spanish Royal Decree 2714/1976:

a) The Delegate of the Government, whose responsibilities are: to carry out the agreements, to keep the institutional relationship with the Ministry, to authorise and order expenditure approved. In addition, is the Chairman of the Mangement Board.

b) Management Board and Executive Committee: formed by official representatives of the sectors of the State Administration one representative of each integrated town council or entity supplied. The Executive Committee acts under delegation from the Mangement Board and consists of: representatives of State Administration, the Mayors of Murcia, Alicante, Cartagena and Lorca, and two representatives of the remaining town councils integrated.

c) Director: is the head of technical and administrative services.

Besides, a number of factors characterise and differentiate MCT in comparison with other water distribution management systems, in order to meet good water governance assumptions:

- MCT is a public and independent state agency, in its own right, which operates at a supra-regional scale, and is the only water supply system with this administrative identity in Spain. MCT manages three Spanish autonomous communities, but these regions have no formal role in the administrative control of the organisation.
- MCT relies on a wide variety of origins of water resources.
- The substantial and increasing managed volume of water resources.
- In Spain, there are other big water supply systems such as *Canal de Isabel II*, in the Madrid Region, or Aigües Ter Llobregat, in Catalonia; however, none of these organisations has got the direct and partnering interrelationship between the National Government and Local Entities.
- The continued integration work of local entities.

With regard to financial support, other important issue is the participation of the users (Local Entities) in the costs of construction and operation of the primary phase of water supply, which is clear in its constituent regulation from the beginning: the National Government (through the Ministry of Environment, which is now referred to as Ministry for the Ecological Transition) provides economic assistance, but Local Entities are required to contribute to the operational costs, facilitating the full cost recovery principle for water services.

Concerning sustainable use of resources, MCT makes the ongoing effort to implement new awareness campaigns to manage the water demand in line with the guidance of the prevailing ministry during every period. Moreover, MCT implements new projects and investments every year in order to provide water efficiently (Nieto-Llobet, 2011), improve and modernise the management (Melgarejo-Moreno and Molina-Giménez, 2017), deal with leakages or apply new technologies in achieving energy efficiency, according to its strategic plan (MCT, 2013).

6. Discussion on water resources

MCT has been successful in always finding more complementary water sources for urban use and has never had detractors thanks to its unquestionable benefits: on the one hand, social development and economic growth with an essential resource guaranteed by means of a cost-efficient technical operation and without financial unbalances thanks to a long-term strategic planning; on the other hand, the associated positive environmental externalities as water regeneration, environmental flows in Segura River or the recovery of endemic species in the surrounding areas of desalination plants.

As remarked in Molina-Giménez and Melgarejo-Moreno (2015), only one source of water raised the opposition of certain groups as New Water Culture Foundation: interbasin transfers. Hernández-Mora et al. (2014) argues against water transfers by considering that promote an unbalanced

420 regional development model with the concentration of population and economic development in
421 coastal areas and demographic decline in central rural areas from where water is transferred.
422 Nevertheless, the historical deficit in south-east Spain precedes this issue and should be borne in
423 mind that donor territories participate in the benefits that the water generates in other territories, as
424 well as general interests should be governed by the principle of inter-territorial solidarity (Molina-
425 Giménez and Melgarejo-Moreno, 2015). Moreover, from May 2017 to May 2018, water transfers
426 from Tajo were non-existent due to the compliance with the new exploitation rules (Melgarejo et al.,
427 2014) and tariffs paid by municipalities did not increase due to the strategic long-term financial
428 planning of MCT.

429 Environmental costs are a subject of a separate study, but it is worth mentioning that desalination
430 and water transfers are the only two resources which meet the full cost recovery principle for water
431 services (CHS, 2015).

432

433 **7. Socio-economic impacts**

434 The socio-economic impacts of the MCT on the territory in which it operates extend to all areas of
435 activity and interest due to the importance of the resource. However, it is possible to highlight the
436 effects of the organisation on the quality of life and demographic evolution and its influence on
437 economic sectors such as tourism, industry, or trade.

438 The intervention of the MCT has put an end to the limitations that compromised the quality of life in
439 the municipalities before they became connected: an increase in morbidity and mortality or a
440 decrease in life expectancy. The solution to health and hygiene related problems caused by a lack of
441 water was achieved by guaranteeing a continual and regular supply with the due physicochemical
442 quality, requirements associated with the nature of the water supply system, since the development
443 of a complex legislative and economic framework changed in the application of the concept of a

444 public service (Matés-Barco, 2016). Once these problems were overcome, the next challenge was to
445 introduce comfort in the service.

446 The scarcity of resources and the inadequate quality of those that existed throughout the South-East
447 area of the peninsula meant that the territory between Alicante and Almería traditionally suffered
448 from endemic water-borne diseases, such as typhoid and paratyphoid fevers or other illnesses with
449 frequent outbreaks and profound consequences for the population, such as cholera and malaria
450 (Grindlay et al., 2010). In Murcia, for example, endemic typhoid fevers were common, while in
451 Cartagena or Lorca, the problems were more related to underfunding and supply restrictions
452 (Morales-Gil and Vera-Rebollo, 1989). These diseases can be easily controlled with improved
453 hygiene. Therefore, an adequate drinking water supply is essential which was not available until the
454 arrival of the waters from the Taibilla River (Carrillo, 2002). The hygienic and health conditions
455 improved thanks to the quality of the new waters compared to those used before which had a saline
456 content that was too high for human consumption, traditionally creating a dependence on rainwater
457 collection tanks (Morales-Gil, 2002).

458 Other diseases that propagate when there is a shortage of freshwater and poor sanitation are
459 trachoma or contact dermatitis. The population of Elche (province of Alicante), for example, was
460 affected by an endemic form of trachoma (Melgarejo-Moreno and Molina-Giménez, 2017). It is a
461 disease associated to a lack of hygiene and, most of all, the consumption of brackish water. It was a
462 very common illness until well into the twentieth century throughout the South-East region of Spain
463 where the scarcity of drinking water obliged the population to frequently drink water with a high salt
464 content. Other municipalities of Alicante and Murcia suffered similar problems or others derived
465 from the use of water originating from ditches where the toilet waste of other inhabitants was
466 discharged.

Thanks to the improvement in the sanitary conditions, the population supplied in the area of the MCT of the province of Alicante has grown exponentially, as a result of both the inclusion of new municipalities and the demographic growth of the existing ones. It was also driven by the progress of the different economic sectors which now had the ideal natural resources in order for them to grow, but before had no development possibilities.

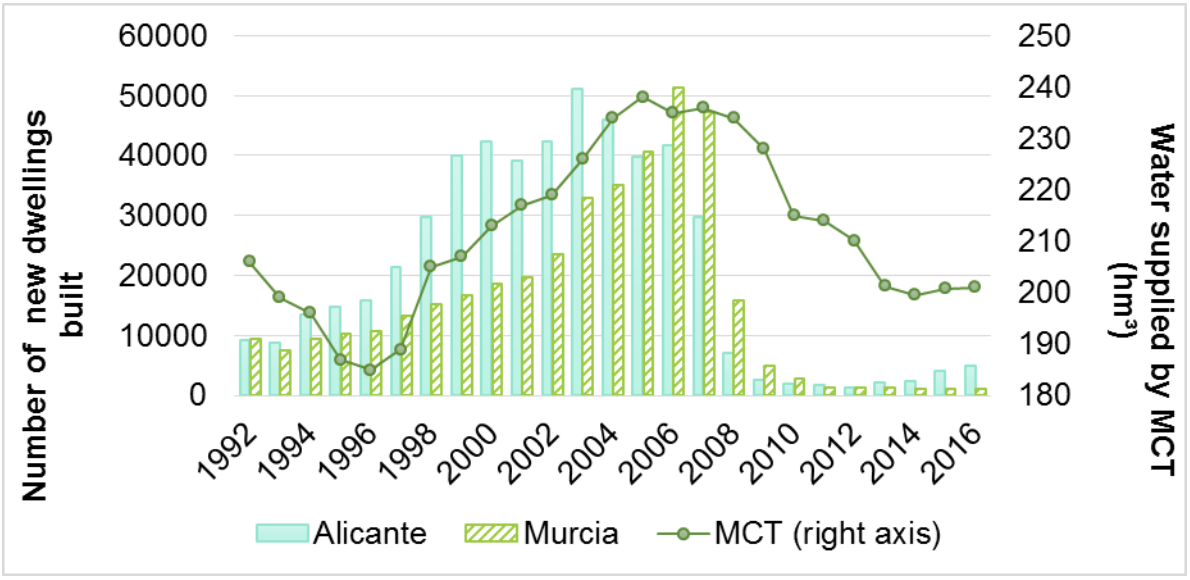
Therefore, with the arrival of water with a guaranteed quality, the conditions of South-East Spain made it a privileged area for the development of tourism activities. Leisure, tourism and second residence activities have acquired great importance in the evolution of water demand in many Spanish regions, including the province of Alicante (Morote et al., 2017).

The availability of water resources in territories where there is natural water scarcity and with intense territorial dynamism justifies the emergence of situations of competition to supply the different uses. In this way, tensions arise due to the use of the scarce resource, which were traditionally resolved with measures to increase supply where possible. If this competition exists between the agricultural activities and the urban-tourist activities and it is not possible to increase the volume of the resources, the guarantee of supplying the demand for water in the urban areas becomes the principal objective (Rico-Amorós et al., 2014).

In tourist territories, the need to plan the current and future uses taking into account a possible reduction in the flows supplied is evident (Gössling et al., 2012) and, therefore, the scarcity of water has conditioned the socio-economic development of the region of the study (Rico-Amorós, 2007; Rico-Amorós and Hernández-Hernández, 2008), as the endogenous resources are structurally insufficient to meet these growing demands. Specifically, the so-called residentialism accounts for considerable amounts of urban units which justify the creation of a broad system of services. In the coastal tourist destinations, properties are being built in the pre-coastal area for the residential market, particularly aimed at capturing foreign citizens (Vera-Rebollo et al., 2009).

Therefore, although the importance of hotel accommodation in the area supplied by the MCT is clear, the truly determining and characterising factor in this area is the accommodation in extra-hotel tourist-residential units. To complement the tourist supply described above, based on the sun and beach product, new tourism models have emerged based on products such as golf (Melián-Navarro et al., 2017). This has given rise to a demand for new and numerous holiday homes in South-East Spain (Ortuño-Padilla et al., 2016) which has increased the urban supply needs, considering that golf courses are watered with regenerated water (Ortuño-Padilla et al., 2015).

Helped by the boom in the tourism activity, the area supplied has experienced major territorial transformations since the 1960s and 1970s (Grindlay et al., 2011; Hernández-Hernández, 2013) due, largely, to the intense urban development process along the Mediterranean coastline during the years prior to the economic recession. The residential expansion of this area has been based on low and medium density land use models which have a relative water consumption that is even higher than that of residential units located in compact towns (Hernández-Hernández and Morote-Seguido, 2016). This real estate activity has a direct relationship with the supply and availability of water, as we can observe in the practically parallel evolution of both processes as shown in Figure 7, as it is not possible to have the former without sufficiently guaranteeing the latter, intensifying the pressure on water resources and their distribution systems (Rico-Amorós, 2007). For this reason, the requests for new supply will be conditioned by the prior guarantee of the long-term sustainability of the exploitation of the resource.



510

511 Figure 7. Evolution of the number of new properties constructed according to the new construction
512 permits registered in the provinces of Alicante and Murcia (left axis) and the flows supplied by the
513 MCT (right axis). Source: Own elaboration based on data from the Ministry of Development (2017)
514 and those provided by the MCT (2017).

515

516 As well as having an important agricultural sector in which irrigation plays a fundamental role, the
517 South-East of the Iberian Peninsula also constitutes a dynamic territory in terms of its industrial
518 activity. These industries require a guaranteed water supply for their day-to-day operations, so the
519 MCT has a decisive role in the maintenance and progression of this highly strategic production fabric.
520 The commercial activity of the area also naturally requires a guaranteed water supply both for the
521 development of the sector itself and due to the carry-over effect produced in the development of
522 other activities directly related to the availability of water resources. In this way, a growing trend in
523 the evolution of the number of companies existing in the provinces of Alicante and Murcia can be
524 observed in line with the parallel increase in the flows of water supplied by the MCT. Similarly, the
525 reduction in the volume of water supplied during recent years has led to the stabilisation in the

number of companies, as shown in Figure 8, although the influence of other socio-economic factors has not been considered, so the correlation is not perfect.

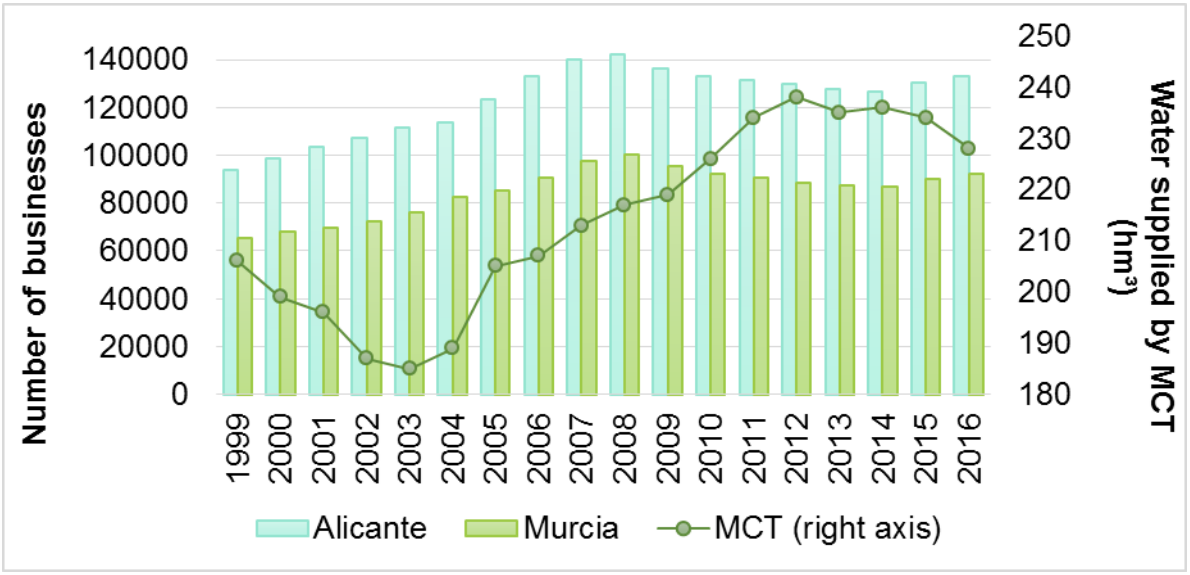


Figure 8. Evolution of the number of companies registered in the provinces of Alicante and Murcia (left axis) and the flows supplied by the MCT (right axis). Source: own elaboration based on data from the INE (2017) and those provided by the MCT (2017).

In short, the availability of water has enabled economic, demographic, tourism, and industrial growth among other aspects, which together have constituted the engine of the territorial and social development in the region.

8. Conclusions

Water governance can be understood as being the set of political, social, administrative, and economic systems that enable a better organisation and management of water, and the most efficient provision of the associated services (Melgarejo-Moreno and Molina-Giménez, 2017). Therefore, the correct management of water resources enables the guarantee of the sanitary

conditions of the population of the region and the success of its economies, the sustainability of its natural resources, public policies, and institutional frameworks accepted by society.

However, there is no single model for water governance as it is necessary to contextualise. Nevertheless, there are some essential basic principles for the good governance of water (Lautze et al., 2011), which are: transparency, the use of comprehensible language, efficiency (economic, political, social, and environmental), the adoption of a holistic approach and the development of the appropriate legal, institutional, economic and technological mechanisms.

Under these precepts, the efficiency of the MCT has enabled it to guarantee the drinking water supply to the South-east of Spain, a region with major demographic and economic growth, overcoming the endemic scarcity of available resources and the drought cycles. This is all thanks to the continual search for new sources of supply, in addition to efforts to improve the management, leakage control, the modernisation of management, the educational campaigns implemented and the efficient and sustainable use of resources. Furthermore, it has guaranteed the quality and continuity of the urban supply, which has been extraordinarily beneficial for resolving health and hygiene and comfort problems; few goods and services provide such a high level of satisfaction as the regularity and quality of the drinking water supply, such as that provided by the MCT.

MCT constitutes a unique management and governance model which structure could be reproduced in other regions with water scarcity problems. It is municipalities, independently of their political colour or their cultural political economy, that are the main claimants to be integrated in the Mancomunidad because, as an immediate consequence of the integration, they enjoy a single price (0.69 euros per cubic metre) and the security of a quality supply, which avoids the constriction of inhabitants' life and economic sectors.

The MCT, therefore, constitutes one of the greatest achievements in Spanish hydraulic history; however, it goes largely unrecognised (Gil-Olcina and Rico-Amorós, 2007). It is thanks to this

566 organisation that the traditional and distressing problem, fraught with hardship and restrictions, of
567 the supply of drinking water has been forgotten. Without it, the development of the extensive area
568 that benefits from its services would have been unimaginable. The fact that its existence goes
569 unnoticed may be a sign of its efficiency; however, if the opposite case were true, it would have been
570 the object of ferocious criticism from the different social agents and local authorities (Morales-Gil,
571 2002).

572

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