

Article

Social Resistance to the Hydrological Transition in Southern Spain: Public Support for the Building of New Reservoirs

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Abstract: Spain has the most reservoirs in Europe, and is near the top of the list globally. Despite this, national hydrological planning still continues to rely overwhelmingly on this type of infrastructure. This indicates that the traditional hydraulic paradigm is deeply entrenched in Spain. The present work takes the new, hitherto unexplored perspective of public resistance, and seeks to complement other studies by aiming to understand why a hydrological transition, in line with environmental demands, has not taken place in Spain. In order to do this, we analyze data from a representative survey (years 2004–2013) of the residents of one of Spain's most densely regulated drainage basins, that of the Guadalquivir River. Our results reveal that during a several drought (2005–2008), people's support for the construction of new reservoirs declined sharply, whilst social resistance to changes in the water management strategy was associated with profiles closest to the agricultural sector and characterized by a lack of awareness about water distribution in productive sectors

Keywords: reservoirs; social resistance; hydrological transition; drought; southern Spain; Guadalquivir

1. Introduction

Water policies were, for the most part of the twentieth century, dominated by hydraulic megaprojects, the main objective of which was to satisfy the growing demand for water expressed by different social agents, in order to increase production. At the turn of the millennium—i.e., mainly during the 1990s and 2000s—there was a shift towards new water management strategies, focused on improving the efficiency of water use with a view to protecting the environment.

More specifically, Crow-Miller et al. [1] highlight three milestones that indicate this change of strategy: first, the World Bank, the main funder of major water infrastructure projects in developing countries, halted funding big dams during the latter half of the 1990s; second, the report 'Dams and Development' criticized the social and environmental consequences of large dams [2]; and finally, within Europe, the adoption of the European Union (EU) Water Framework Directive 2000/60/CE (WFD) [3] forced member states to rethink water planning and management strategies, and to assume as their main objectives the remediation of water bodies and the conservation of ecosystems.

The reasons behind the crisis of the traditional paradigm have been analyzed at length by several authors, who all point to wider economic, social and cultural changes [4–6]. The evolution of the 'hydraulic mission' proposed by Allan [7] describes the phases that explain the transition from the so-called "traditional hydraulic paradigm" to the projects considered as "new generation" by the World Bank, which seeks new solutions to water needs.

Currently, the transition between the two paradigms is far from complete; in most countries, water supply-and-demand policies coexist in discourse and practice. Recent studies, compiled by Crow-Miller et al. [1], warn that, while in some parts of the world, environmentally-friendly water management has never been contemplated, the most striking fact is that new hydraulic infrastructures continue to be constructed in countries where hydrological planning claims to be aligned with the principles of efficient water use, and from which, therefore, priority should be given to other types of management measures.

This is the case of Spain, where despite 1225 reservoirs already in existence on its territory, (putting the country at the head of countries ranked by the number of reservoirs per million inhabitants), as many as 45 additional reservoirs were constructed after the adoption of the WFD in legislation in 2003 [8], and there is continuing support for such infrastructure in new hydrological plans [9].

Water policy in Spain is subject to intense debate, owing to, on the one hand, the incorporation of changes to hydrological planning arising from the WFD, and in accordance with environmental sustainability criteria, and on the other, its refusal to abandon the construction of large-scale infrastructure as a solution to the needs of the agricultural sector. It is for this reason that the strongest resistance to the adoption of a new hydraulic paradigm is found in river basins where irrigation is a significant sector, as is the case along the Guadalquivir River in southern Spain [10].

The main aim of this work is to analyze social resistance to the hydrological transition in order to increase our understanding of the reasons why transition has not occurred. Although significant progress has been made in implementing the WFD, basin planning still includes measures to increase the water supply against environmental principles. We are particularly interested in analyzing the continuous support given by the public to the construction of new reservoirs in the Guadalquivir basin.

Although there is considerable literature on the dynamics and triggers of ecological transitions, empirical studies on the barriers, and resistance to such transitions are scarce. Our study rests empirically on the results of a representative survey undertaken in the Guadalquivir River basin, which reflects the evolution of social support for the construction of dams during the period 2004–2013, and which can be related to socio-demographic factors, political attitudes and the drought experienced in the area during this period.

The work is divided into seven sections. The first synthesizes ecological transition theories and their application in the water sector, as well as presenting an up-to-date reflection on their limitations in foreseeing obstruction. In the second section, we present a historical overview, which explains the proliferation of dams in Spain, with Section 3 taking the Guadalquivir River basin as a case study, seen in the context of the 2004–2008 drought. Section 4 describes the methodology, data and statistical techniques used. In Section 5 the empirical results are presented; these results are analyzed and interpreted in Section 6. The last section presents conclusions and future recommendations.

2. Theories of Sustainability Transition and Their Application in Hydrological Transition

Several sectors—including energy, transport, water and food production—face serious challenges in the twenty first century, given water scarcity, environmental decline and climate change. The scientific community proposes innovative technologies, new governance systems and market regulations, and shifts in consumer behavior, among possible solutions to these environmental problems worldwide. So-called theories of sustainability transition have become increasingly popular in helping to explain socioecological change, which has been defined as those ‘long-term, multi-dimensional, and fundamental transformation processes through which established sociotechnical systems shift to more sustainable modes of production and consumption’ ([11], p.956). According to these theories, the main challenge lies in overcoming existing sociotechnical systems where such systems are understood as the combination of interdependent actors and institutional structures within a specific technological domain [12].

However, and despite their impact in the literature, transition theories have not, in general, been able to adequately account for multiple factors that hold back or slow down sustainability transition.

Concerning hydrological transition in Spain, traditional social support for the construction of reservoirs may be said to represent an obstacle, due to the fact that such infrastructure dominates the prevailing sociotechnical system, that is to say, the traditional hydraulic paradigm.

The construction of reservoirs implies satisfaction of demand as a problem to be solved through engineering by increasing basin regulation, the management of which involves a host of state-related institutions (river-basin confederations) and agents with a vested interest in water distribution (in particular, the agricultural sector and hydroelectric industry). In fact, in Spain, the alliance between engineers, legal advisers attached to hydraulic administration and politicians and legislators who support this kind of policy, alongside other interested parties that benefit from these large-scale building works, is known as the ‘triple alliance’ or the ‘iron triangle’. Together, these stakeholders have ensured the continuation of traditional water policies for most of the twentieth century [13].

When considering sustainability transitions, the multilevel perspective (MPL), which focuses on analyzing the social nature of technological change, has become increasingly popular in recent years [12,14,15]. This approach looks at sociotechnical transitions on three analytical levels: sociotechnical regime, sociotechnical niche and sociotechnical landscape. The primary level is that of sociotechnical regime, defined as ‘the coherent complex of scientific knowledge, engineering practices, production process technologies, product characteristics, skills and procedures, established user needs, regulatory requirements, institutions and infrastructures’ [16] (p.338). This regime defines the stability of social and technical relations in a given system, and the consequent resistance to change that is focused on optimizing the existing regime rather than transforming it. The landscape, in contrast, is constituted by sociopolitical factors, macroeconomic dynamics, social patterns, overall global and environmental setting, etc. [14]. Landscape changes take place very slowly (over decades), and according to the MPL, do not determine the evolution of sociotechnical regimes or niches, but they have to be perceived and translated by agents, so that they have impact and exert real influence. Niches are spaces, generally protected from direct market pressures, where individual actors, alternative technologies and local practices express themselves as new ideas, initiatives, or innovative techniques [17].

According to this multilevel approach, sustainability transition takes place when the landscape evolves (global and environmental, as well as political and cultural conditions) and exerts pressure on the regime, within which internal tensions are escalated as a result. This situation may generate opportunities for solutions which emerge from niches, substituting technologies and structures within the regime. For Geels and Schot [14], the way different levels interrelate may stimulate, transform, or delay social or technical changes, and at the same time, changes that take place on a given level may potentially stimulate changes on other levels as well.

This approach has been used to structure and explain factors which contribute to change in the hydrological paradigm, in this case, the shift from a traditional water management strategy based on increasing supply, to other strategies centered on managing demand [18–21]. Water scarcity, and as a result of climate change, exposure to increasingly severe drought, are factors which current research usually assumes to be embedded in the landscape, and which should, as a consequence, favor the transition to new water-management strategies [22–24]. At the sociotechnical niche level, a series of innovations are currently being explored, including wastewater treatment, rainwater collection systems, water markets and new social movements, all of which aim to move the management regime towards more sustainable strategies [19,21]. Resistance to hydrological transition has generally been studied in relation to sociotechnical regime, and on the basis of institutional theories, because it is believed that neither changes in the landscape nor technological innovation can by themselves guarantee change, whilst institutional structure has the ability to affect agent perceptions and disseminate new practices [22–25].

Recently, owing to sustainability transition being slowed down by different factors, and not only with regard to water management, transition theories have come into focus again [26–28]; additional elements, which may help to explain the dynamics and interaction between actors engaged in the transition process, have been included in the analysis. As such, increased emphasis is being put

on the importance of the contexts within which transitions take place [29]: relations of power and political processes [24,30,31]; relations between social actors [32,33]; and the influence of new social movements [34,35] on the multilayered relations between regime, landscape and niche.

For instance, one of the criticisms most frequently leveled at transition theories is that, given the important role assigned to innovation in technological niches (a point already addressed by Geels and Schot [14] (p.400), and also raised by Berkhout et al., [36]), the forces that oppose a given transition within that level are not sufficiently accounted for. From this perspective, it would be necessary to understand the interests and power of actors operating at the microsocial level [26,37]. On the other hand, studies which have analyzed the role of social actors in ecological transitions have mainly focused on relations between producers and institutions, even though it is also necessary to take final consumers into account when investigating fields such as energy, food, or water [38,39]. For this reason, some researchers hold the view that public opinion should be taken into consideration when analyzing transitions, given the lack of information and environmental awareness shown by sectors of the public in certain contexts [27].

This work aims to analyze public support for the construction of new reservoirs within a specific context—the Guadalquivir River basin—over a specified time series (2004–2013). This will allow us to investigate whether public opinion is susceptible to being affected by periods of drought, which, according to the literature [22–24], should encourage society’s willingness to adapt to new, more sustainable strategies. Or, on the contrary, in practice, the population could continue to support the construction of reservoirs during drought, because they understand that it is necessary to have water stored, or because the construction of infrastructure has simply been the response that has historically been given by water managers. Therefore, the present study seeks to complement ongoing efforts to understand the social factors which hold back the hydrological transition at the microlevel, and within which the triggers that facilitate sustainability transitions are generally framed.

Having discussed the criticisms of transition theories, the next sections outline the Spanish historical and legal contexts to help explain the support that the construction of new reservoirs traditionally enjoys, followed by presentation of the case study. In addition, since the literature points to drought as a potential trigger for ecological transition, we also describe the main characteristics of the drought episodes suffered by Spain—especially in Andalusia—during the period under consideration, together with the institutional measures implemented to mitigate their effects.

3. The Context: Why Are There So Many Reservoirs in Spain?

In the Spanish case, the traditional hydraulic paradigm has dictated the priorities of national and regional water policies during the twentieth century: to satisfy the demands of different users, mainly those of irrigation agriculture. In order to accomplish these aims, the regulation of basins by the construction of reservoirs has been a central tenet of water policy. As a result, Spain possesses 1225 reservoirs to date, with a total capacity of 56,075 hm³ [8]. The construction of reservoirs is an attempt to compensate for differences in rainfall across regions and seasons.

As pointed out by Saurí and Del Moral [40], in order to fully understand the development of water policy in Spain, we need to appreciate the pivotal role played by irrigation in the country. The expansion of irrigation was promoted by the Regenerationist (Regeneracionismo) movement at the beginning of the twentieth century, as a way of easing social tensions in rural areas without the need to undertake major agricultural reforms or modify the unequal distribution of land ownership. These ideas were enshrined in the National Plan of Public Works (Plan Nacional de Obras Públicas) in 1902, the objective of which was to extend irrigation to 1.5 million hectares of land by constructing 205 major hydraulic projects (dams and canals), although in the event only 150,000 hectares could be incorporated.

During the opening years of the Second Republic (1931–1936), the Plan of Hydraulic Works (Plan de Obras Hidráulicas) was drafted, which aimed to continue increasing the size of irrigated areas in order to mitigate serious food deficits and placate social unrest in rural areas [41,42].

After the Spanish Civil War (1936–1939), water policy under Francoism (1939–1975) continued to depend extensively on the expansion of irrigation, with a view to sustaining the new authoritarian state. Saurí and Del Moral argue that ‘irrigation was envisaged as the means to create an expanding class of small farmers without jeopardising the interests of large landowners who were among the main supporters of the military revolt of 1936’ [40] (p. 355). As a result, the quantity of water held in reservoirs increased from 4.2 billion m³ in 1939 to almost 8 billion m³ in 1955, thanks to the construction of more than 400 reservoirs [42]. During the Franco regime, reservoirs were a symbol of the State’s power over nature, a display of national technology, and an expression of public effort turned towards agricultural and industrial progress [43]. From a social perspective, the prevailing structure of land ownership thwarted much-needed innovation, otherwise a precondition of paradigm change according to transition theories. This was due to the fact that neither larger landowners (who could rely on a large and cheap workforce), nor smaller ones (who were poorer), had the incentive or the resources to invest in more efficient technologies (crop replacement, adaptation to physical conditions, etc.) [40].

After Spain embraced democracy, conditions were created that allowed the consideration of the environmental functions of water within a new legal framework. However, the 1985 Water Act used expressions such as national ‘water balance system’, and ‘deficit’ and ‘surplus’ river basins, to justify yet again the construction of more reservoirs and water transfers intended to address regional differences in water distribution. As such, the timeworn hydraulic regime within which farmers, basin authorities and engineers presented a united front against change, was still very much in control. The National Hydrological Plan of 1993, which was fully aligned with the philosophy of the 1985 Water Act, also contemplated the construction of 120 reservoirs and the transfer of water from the Ebro River towards south-eastern regions. The mobilization of citizens who opposed the transfer from the Ebro, together with the participation of environmental and expert organizations, succeeded in halting EU financial support for the National Hydrological Plan, and ultimately, in having it repealed in 2004 [21,42,43]. However, the decree that repealed the plan passed in 2001 stated that ‘each and every one of the construction projects included in annexes II and III’, including some 100 major reservoirs, were of ‘public interest’ (Royal Decree-Law 2/2004 of 18 June).

Hydrological planning, derived from the application of the WFD in Spain, also inherits past policies, and continues to support the construction of hydraulic infrastructure in order to increase supply and meet the demand posed by irrigation. During the first phase (2009–2015), a large part of the budget was assigned to hydraulic construction projects [44], with the second phase continuing in the same vein, and the decrease in funds allocated to hydraulic works has been due to general budget cuts, rather than to a change in management criteria [45]. In addition to this, the effects of climate change have not been adequately accounted for in new hydrological plans [46].

4. Case Study: The Guadalquivir River Basin (Southern Spain) and the 2004–2008 Drought

The proliferation of reservoirs during the twentieth century has been particularly prominent in the Guadalquivir basin (southern Spain), an area that is exposed to frequent droughts, and where the agricultural sector plays a particularly important economic role. The GVA of Andalusian agriculture accounts for approximately 4.2% of the total Andalusian GDP—nearly twice as much as the national average, which is estimated at 2.3% [47]. The basin is 57,527 km² in size, and includes 883,083 hectares of irrigated land, which use 87% of the total water consumed in the basin; its 66 major reservoirs have an aggregate capacity of 8283.5 Hm³ [48], (Figure 1).

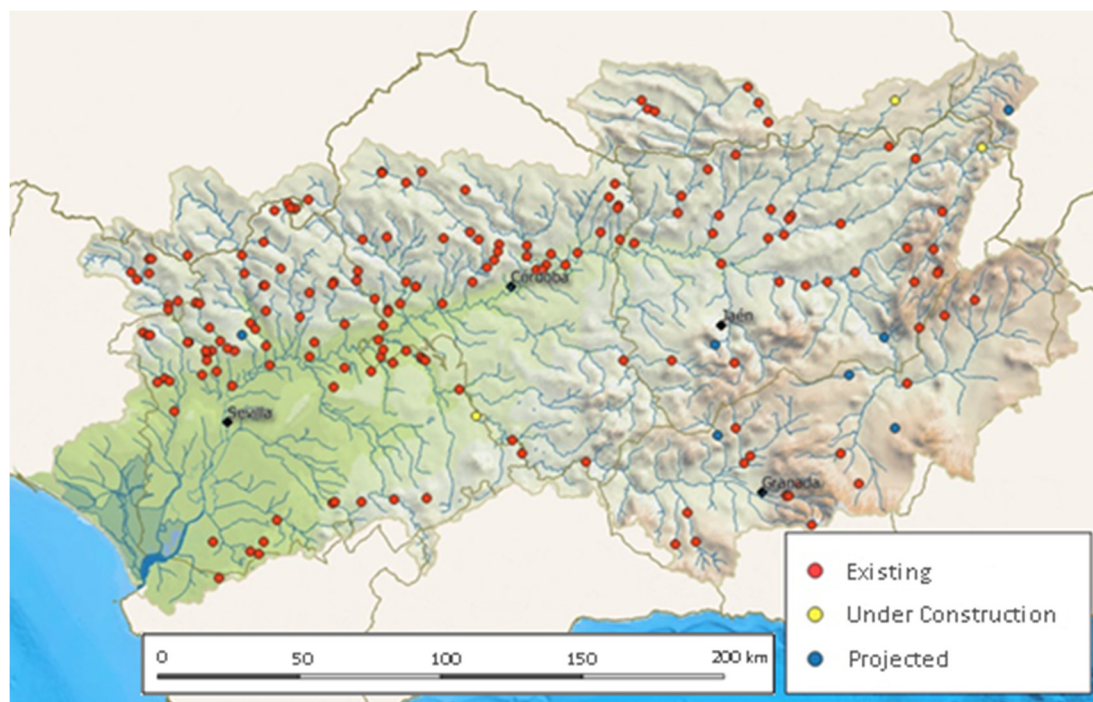


Figure 1. The Guadalquivir river basin and dams located within its territory. Source: Own elaboration. Confederación Hidrográfica del Guadalquivir (<https://www.chguadalquivir.es>).

The WFD introduces the concept of the River Basin District as a territorial domain for water management and planning. As a result of the implementation of the WFD, both phases of the hydrological plan of the Guadalquivir Basin (2009–2015 and 2016–2021) contemplated measures to meet the demand by increasing resources through regulation works—specifically, six new dams—although due to financial shortcomings, the percentage of the estimated investment that has actually been executed failed to reach 11% [9]. Moreover, the *Confederación Hidrológica del Guadalquivir* (Guadalquivir Water Authority) published a technical report which includes a package of 21 alternative measures to those already in existence, all of which aim to increase the regulation capacity of the basin [49].

These measures were implemented within a context of cyclical drought in Andalusia and Spain more generally. The periods 1941–1944, 1979–1982 and 1990–1995 witnessed severe drought episodes. It is known that climate change will increase the frequency and severity of drought [50], especially in southern Spain [51], leading to greater vulnerability to this risk [52,53].

The importance of this factor cannot be overemphasized. In the Guadalquivir basin, the fact that more severe drought will lead to a decrease in available resources, greater scarcity, and accordingly, greater difficulties in meeting demand [54], is used in water planning documents to underline the increasing deficit of resources, and to argue for the greater regulation of capacity.

The latest major drought episode took place in the period 2005–2008, within the study's time frame, and it may be argued, has been a trigger of the beginning of the fall of social support for the construction of reservoirs. Specifically, the beginning of the episode was marked by the mobilization of agricultural associations, which requested mitigating measures to be implemented by the authorities, as well as restrictions to be applied to urban supply. This led to intense debates about drought and its management. This period was characterized by the ongoing hegemony of the agricultural association's discourse, which to a large extent determined the terms of the debate, especially concerning the need for the construction of new infrastructure with which to satisfy the sector's demands. Meanwhile, new actors emerged, such as academic experts and ecological organizations who tried to introduce into the debate the difference between drought and scarcity, but their discourse was still marginal, and could not make its presence felt either in the media or in public opinion more broadly to any significant degree [55,56].

These circumstances led the regional and national authorities to implement urgent measures, such as the enactment, in July 2005, of the *Protocolo de Actuación en Sequías en la Cuenca del Guadalquivir* (Guadalquivir Drought Action Protocol). The need for this protocol resulted from delays in the publication of *Planes Especiales de Actuación en Situación de Alerta y Eventual Sequía* (PES) (Special Plan of Action in Alert and Drought Conditions), which among other things affected the Guadalquivir basin and, according to the *Ley del Plan Hidrológico Nacional* (National Hydrological Plan Act) (2001), should have been published by 2003. Also, the consideration of this drought episode as an exceptional circumstance triggered the *Decreto de Sequía* (Drought Decree), issued by the central government. This decree granted tax exemptions and additional irrigation rights, public loans, *Instituto de Crédito Oficial* (National Credit Institute), the use of inter-basing infrastructure (Negratín-Almanzora transfer) and other urgent infrastructure works for the modernization of irrigation systems, which in Andalusia covered an area of 126.614 ha [57–59].

More recently, in the immediate aftermath of this drought episode, and within the framework of the measures implemented to mitigate its effects, the administration took several steps: the PES de la cuenca del Guadalquivir was finally published in 2007, the *Ley de Aguas de la Comunidad Autónoma de Andalucía* (Andalusia Water Act) was enacted in 2010, and the *Propuesta de Proyecto del Plan del Guadalquivir* (Draft of Guadalquivir Hydrological Plan) completed in 2012. As such, the 2004–2008 drought reactivated public debates about drought, leading the administration to respond at both the national and the regional level. The intense normative, legislative and planning activity which this entailed, however, did not achieve the coordinated management of water resources and the risk of drought [53].

5. Materials and Methods

The empirical data used to carry out this study was taken from the Ecobarómetro, an annual survey on environmental attitudes undertaken in Andalusia between 2001 and 2013 (2012 was not surveyed) among a representative section of the population [60]. The Ecobarómetro was an initiative of the Regional Ministry for the Environment and the Institute for Advanced Social Studies-Spanish National Research Council (IESA-CSIC). Each year between 1200 and 3000 face-to-face interviews were carried out at their homes with people resident in Andalusia over the age of 18. A stratified sampling based on the 2001 Census was applied, with allocation by provinces, and choice of the final unit by random routes and sex and age quotas. We have a very detailed knowledge of the application of the survey, because one of the authors of this paper was part of the technical team that developed the survey.

The original data were statistically processed in accord with the aims of the study. First, although the survey began in 2001, only data from the period 2004–2013 were used, owing to the incorporation, from 2004 onwards, of an indicator of preferences regarding water management. Second, only results for the Guadalquivir river basin (Demarcación Guadalquivir-DG) were taken into consideration, as this was the territorial unit selected for analysis. After merging data pertaining to the period 2004–2013 in order to guarantee the sample's representativeness, a post-stratification was carried out, which took into consideration the distribution of the population by age and gender in each year, using data from the population census. The final samples included 10,171 entries. The level of expected absolute error for the frequency of each variable was $\pm 1.9\%$, with a confidence level of 95%.

The indicator used as a dependent variable, that is to say, the percentage of support for the construction of dams, is based on the answer to the following question: 'Could you indicate which of the following measures, related to water management, you consider to be the most effective for the improvement of water management in Andalusia?' Participants chose one of nine measures related to water: building more reservoirs, improving irrigation, saving water domestically by reducing household consumption, using seawater, transferring water from other regions, reducing water used for irrigation, incrementally increasing the price of water (2004–2013); decreasing construction activities in areas where water is scarce, reducing building in regions affected by scarcity (2004–2008); digging

more wells (2004–2011); re-using wastewater (2009–2013); improving distribution networks, and controlling pollution of rivers and aquifers (2013).

Answers have been grouped under two categories: reservoirs and ‘other measures’. Thus, while the percentage of respondents supporting reservoirs is presented under a single category, the wide range of options available to survey participants should be taken into consideration.

The indicators used as independent variables reflect sociodemographic characteristics, and water management-related attitudes and knowledge, as well as the year during which the survey was carried out.

1. The year in which the survey was carried out is especially relevant: as noted, the decade 2003–2014 included an important period of drought (2004–2008)
2. Age: below 30, 30–44, 45–59, 60 and over.
3. Education: no studies or incomplete compulsory primary education; compulsory primary education; secondary education; university study.
4. Water-scarcity awareness: based on answers to the question: ‘Could you tell me the most important environmental problem that Andalusia currently faces?’ The eight possible answers (soil erosion and desertification; forest fires; beach and marine pollution; river pollution; water scarcity; extinction of flora and fauna; air pollution; landscape fragmentation and habitat loss) were grouped under two categories: ‘water scarcity’ and other problems.
5. Knowledge about water distribution and consumption: based on responses to the statement ‘The largest amount of water is consumed in homes: true or false’. Participants who answered that this statement is false are included in the category ‘knowledgeable’ and the rest in ‘not knowledgeable’.
6. Evaluation of the regional government’s actions related to water management: based on answers to the question ‘How do you evaluate the Andalusian Regional Government’s actions in relation to water management?’ comprising: positive (5–4), average (3), negative (2–1), Don’t know/No answer.

In order to identify the characteristics of the population groups that are in favor of reservoir construction, we have carried out a hierarchical segmentation analysis, using the Chi-squared Automatic Interaction Detection (CHAID) algorithm. This technique is applied to qualitative variables, and using the chi-square test of independence (based on the associated p-value and the Bonferroni correction) in the distinct phases of the segmentation process: grouping of independent variable categories; comparison of effects between different variables; and, finalization of the segmentation process [61]. In the first phase, the variable which best differentiates participants in relation to the given dependent variable is selected, thus creating homogenous groups representing a similar opinion. Those groups form the nucleus of the new divisions, and therefore the variables which discriminate most effectively, will determine the inclusion of the next variables in the process. The end result is presented in a tree diagram, where each ‘node’ shows the variable from which the cluster originates; each branch indicates the category which defines the subgroup and its size; and within each rectangle, the percentage distribution of the dependent variable is noted—in this case reflecting the preference for the construction of reservoirs, or other water management measures, respectively. The SPSS version 26.0 statistical package was used.

In selecting the independent variables, we have taken into account the results of bivariate crossing subjected to the Pearson chi-squared test, according to which there is a statistically significant association between each independent variable and the dependent variable.

6. Results

6.1. Bivariate Analysis

Support for the construction of dams decreased from 52.1% in 2004 to 14.5% in 2013 (Table 1). The percentage did not decrease evenly; the greatest change took place in the first three years of the period, falling 12 percentage points between 2004 (52.1%) and 2005 (40%), followed by an even more abrupt decrease (17 percentage points) in 2006 (22.2%). Between 2007 (19.6%) and 2013 (14.5%), support for this option dropped by a further five percentage points.

Table 1. Bivariate analysis Source: Authors' own after Ecobarómetro de Andalucía (EBA) 2004–2013 (Institute for Advanced Social Studies-Spanish National Research Council (IESA-CSIC)).

Variables	Categories	Construction of Reservoirs		Other Measures		Total	P
		(% row)	N	(%row)	N		
Year	2004	52.1%	556	47.9%	511	1067	0.000
	2005	40.0%	440	60.0%	660	1100	
	2006	22.2%	246	77.8%	864	1110	
	2007	19.6%	221	80.4%	908	1129	
	2008	22.4%	255	77.6%	882	1137	
	2009	16.5%	188	83.5%	954	1142	
	2010	16.8%	193	83.2%	955	1148	
	2011	17.9%	208	82.1%	956	1164	
Age	2013	14.5%	169	85.5%	1003	1172	0.000
	<30 years	18.5%	401	81.5%	1763	2164	
	30–44 years	22.0%	686	78.0%	2426	3112	
	45–59 years	25.9%	604	74.1%	1727	2331	
Education	60+ years	30.7%	786	69.3%	1778	2564	0.000
	No qualifications	29.6%	991	70.4%	2355	3346	
	Compulsory primary education	25.3%	856	74.7%	2528	3384	
	Secondary education	19.6%	377	80.4%	1548	1925	
	University studies	16.8%	249	83.2%	1239	1488	
Question: Chief Andalusian environmental problem	Water scarcity	30.2%	902	69.8%	2085	2987	0.000
	Other problems	21.9%	1575	78.1%	5609	7184	
Question: chief water consumer	Knowledgeable	26.8%	1250	73.2%	3411	4661	0.000
	Not knowledgeable	22.2%	1051	77.8%	3693	4744	
	Don't know	23.0%	176	77.0%	589	765	
Evaluation of water management	Negative	27.0%	523	73.0%	1410	1933	0.001
	Average	22.6%	524	77.4%	1794	2318	
	Positive	23.1%	816	76.9%	2710	3526	
	NS/NC	25.6%	614	74.4%	1781	2395	

¹ The statistical contrasts are based on bilateral tests (level of significance 0.05).

As far as sociodemographic variables are concerned, the results confirm that support for reservoirs increases in parallel with age: 18.5% of young respondents compared with 30.7% of those aged 60 and over. Backing reservoir construction is more frequent amongst people with a lower level of education: 29.6% of respondents who did not complete their compulsory primary education, compared to 16.8% of those with university degrees.

Regarding attitudes to water, construction of new dams is most popular amongst those who consider the region's principal environmental problem to be water scarcity (30.2%, compared to the 21.9% of respondents who prioritize other issues) and those who are aware of the distribution of water consumption amongst different sectors (26.8% as opposed to 22.2% of those who think that most water

goes to domestic consumption). Finally, support for reservoirs is also most pronounced amongst those who are critical of the regional government's water management policies (27%).

6.2. Segmentation Analysis

Hierarchical segmentation analysis, the purpose of which is to identify the profile of those in favor of the construction of more reservoirs in Andalusia, suggests that the variable with the most discriminating weight for support of this type of infrastructure was the year in which the survey was carried out (Figure 2). Thus, the sample was divided into four periods that mark significant differences in the way that Andalusians think about water management, to be interpreted while bearing in mind one of the most recent droughts suffered by the region between 2005 and 2008.

The strongest support (51.9%) for construction of reservoirs was recorded during 2004; out of the nine measures presented by the survey, only reservoirs garnered over 50% of support. Also in 2004, which has been defined as a pre-drought year, age of participants played an important role; support for reservoirs amongst people aged 60 and over reached 65.2% in general, and 70.9% among those who, in addition, had a positive view of regional water management policies (Node 16). Respondents under the age of 30 were on the opposite end of the spectrum—they were the only group among which choice for reservoirs (42%) was not the modal category.

In 2005 a sharp fall in the support for reservoirs (39.6%) was observed; coincidentally, this was the year in which news of drought fully emerged into the sphere of public opinion, and also when the Guadalquivir Basin Drought Action Plan was published [55]. This tendency is especially noticeable amongst those aged 44 or under (32.8%, Node 8), except among those for whom water scarcity was identified as the biggest environmental problem in the region, in which case support for dams reached 39.1% (Node 18), which is only slightly below average. In contrast, people aged 45 and over continued to strongly support this infrastructure, despite the drought (47.8%, Node 9), although the highest percentage was found amongst those who had a negative view of regional water management policies (58.4%, Node 20).

During the time referred to as the 'drought management' period (2006–2008), support for reservoir construction was lower than that registered in previous years (21.4%). During this period, age continues to be a highly discriminating variable: among young people, support dropped to 14.7% (Node 10), while among the group of 30 to 45 year olds, support increased to 19.3% (Node 11), and among those aged 45 and above (Node 12), to 25.6%. It is interesting to note that the slight increase in support for reservoirs in each age group is related to different variables. For instance, amongst those younger than 30, preference for reservoirs was greater among respondents who were familiar with the distribution of water between sectors (21.5%, Node 22); in the group aged 30–45, support increased amongst participants with a lower education level (22.8%, Node 23); and amongst those aged 45 or over, this was the case when respondents disapproved of the regional government's water management policies (29.8% Node 24).

After the end of the drought episode, the remainder of the period (2009–2013) is characterized by low social support for the construction of new dams (15.4%), and by the fact that age ceases to be a significant variable in people's views on water management. During the last period under analysis, resistance to changes in the strategy, expressed by those who continue to be in favor of reservoirs, comes mostly from participants with a low level of education (21.2%, Node 13) and those who are aware of water distribution amongst sectors (25.1%, Node 30). In contrast, only 10.6% of university-educated participants argued that more reservoirs should be built (Node 15), although the percentage increases to 16.7% among those whose main environmental concern is water scarcity (Node 33).

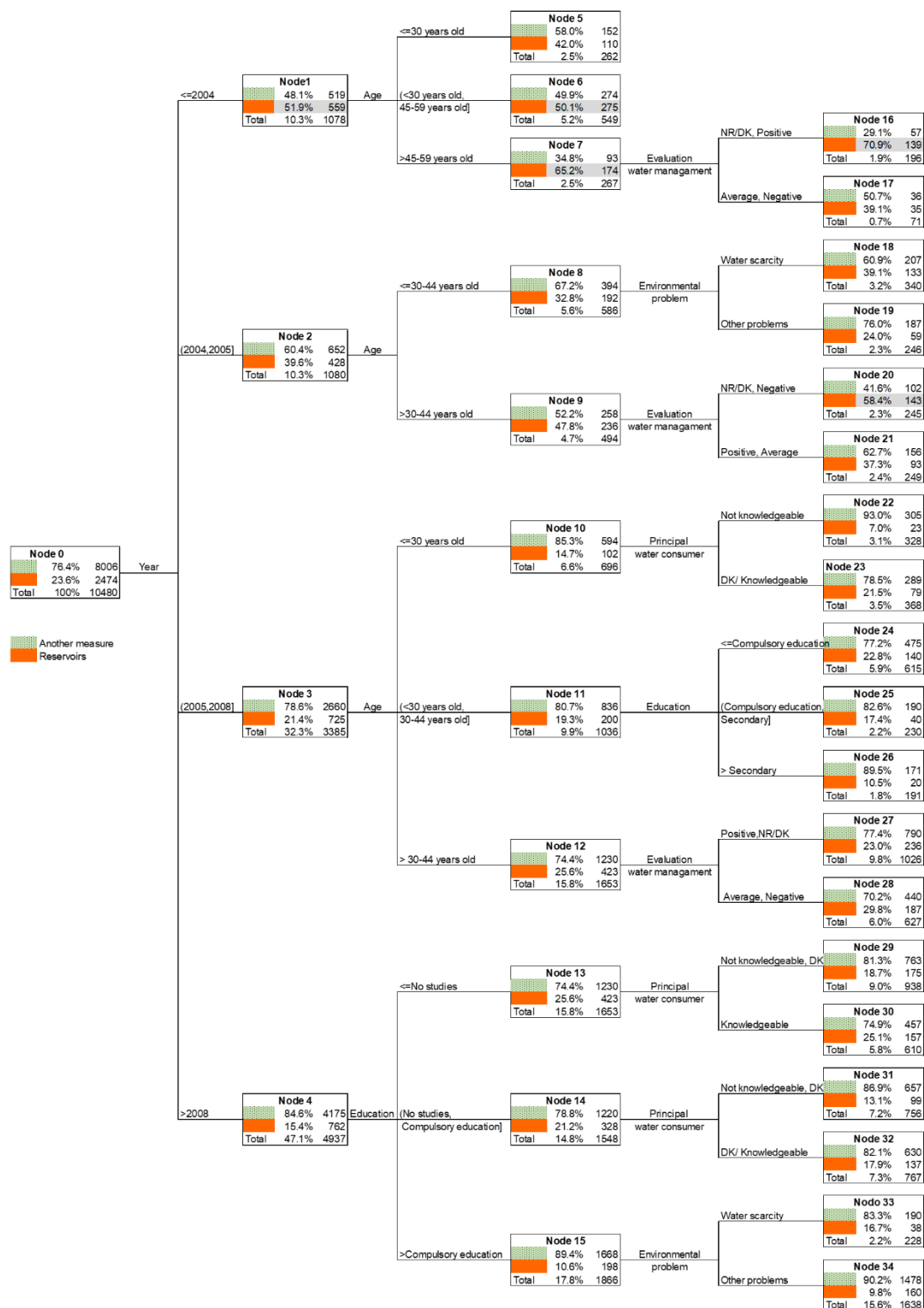


Figure 2. tree diagram which shows the variable from which the cluster originates at each ‘node’, reflecting support for the construction of more reservoirs, or other water management measures. Source: Authors’ own after Ecobarómetro de Andalucía (EBA) 2004–2013 (IESA-CSIC).

7. Discussion

The results of this study contribute to the ongoing scientific debate concerning factors that impede the hydrological transition in Spain, taking a hitherto underexplored perspective: the study presents empirical evidence about the interplay of such factors as landscape (drought) and the sociotechnical regime (water management policies) at the microsocial level; that is to say, about how public opinion regards the construction of new reservoirs. Political support for these infrastructures, which continues to be developed, is one of the main factors in holding back the hydrological transition [1].

Statistical analysis of the results of this study addresses two complementary questions: first, the role played by drought as a trigger of hydrological transition at the microsocial level, insofar as it has been shown that drought has an impact on public preferences for water management; and the second—and the main issue under consideration in this study—the profile of social groups that support the construction of reservoirs, and thus pose resistance to change, in a way that has hitherto received little scholarly attention.

The first prominent feature of the results is the loss of support for reservoir construction during the period under analysis (2004–2013), which may be interpreted as evidence that the public is progressively embracing the necessary steps for the hydrological transition in Spain to be achieved. According to the segment analysis, the effects of the drought suffered by Spain between 2005 and 2008 has had more weight than any other attitudinal, political or sociodemographic factor in making the public more amenable to different water management policies. This result is significant, not only because it confirms what the hydrological transition theories hold about the triggering role of droughts at the microsocial level. In addition, studies on climate change suggest that southern Spain is particularly vulnerable to increasingly severe and recurrent drought, so it is to be expected that the public will continue supporting the adoption of management measures other than reservoirs.

In the same vein, we have shown that social groups critical of the government's water management policies continue to support the construction of reservoirs, even though they are in the minority. The lack of clarity concerning the difference between drought and scarcity, which experts were trying to address, and the intense legislative and institutional activity during this period, undermined the policy's approval ratings among those respondents who are most in favor of building major infrastructure. Therefore, support for continuing to increase available resources by building new reservoirs can be questioned, not only on the grounds that it fails to comply with WFD principles, or to adapt to the effects of climate change, but also in that it fails to adequately supply a population which is increasingly exposed to episodes of drought.

A second group of results corresponds to the aim of this study to identify social resistance to change in water management strategies at the microsocial level. In this regard, the segment analysis suggests that the construction of new reservoirs is especially popular among older respondents, and those whose social profile is nearer the agricultural sector: lower education level, but knowledge about water distribution amongst production sectors.

In order to fully understand the social support which reservoirs still garner amongst older citizens, we must bear in mind the trajectory of hydrological policy in Spain during the last century. Half of the 1200 dams currently in existence in Spain were constructed between 1960 and 2000. Therefore, it is hardly surprising that older generations have internalized the construction of this type of infrastructure as the most efficient way of solving water problems. As such, it is more interesting to identify resistance to change amongst young people.

Those aged 45 or under who, during periods of drought, still favor of the construction of dams have a lower level of education, but are aware that domestic uses do not consume most of water available for consumption. Therefore, knowledge about water allocation among economic sectors is not, in principle, related to academic qualifications, but rather to direct experience of the agricultural sector, which knows that large hydraulic infrastructure is, first and foremost, projected to meet the demands posed by irrigation agriculture. This idea takes a stronger hold during the final period under analysis (2009–2013), when the majority of the population choose other water management

measures, and reservoirs become the least favored option. In this period, resistance to changes in the water management strategy is also found amongst people with a low education level, and who are knowledgeable about the distribution of water consumption in the region. According to a representative survey carried out by IESA-CSIC in 2008, only 29.5% of people were aware that around 80% of the water available for consumption in Andalusia was allocated to agricultural use [62]. As such, resistance to hydrological change in one of the most reservoir-intensive basins in Europe is still led by the agricultural sector, which is the economic sector that benefits the most from the traditional hydrological regime. Even if it now lacks its past social and economic leverage, this sector continues demanding new water management plans to meet its needs.

Segment analysis of the results has allowed us to distinguish a third social group, not identified hitherto, that could pose some resistance to the adoption of a new hydrological strategy, namely, people with a high level of education concerned about water supply at the end of a drought episode.

The distinction between drought and water scarcity is fundamental for hydrological planning. During the recent planning cycles, drought has continued to be regarded as an exceptional circumstance for which equally exceptional measures are designed, taking no account of the fact that droughts are part of the climatic idiosyncrasies of the region. In contrast, scarcity refers to a structural scenario in which there are insufficient water resources to satisfy the demand of all users (including environmental services), a situation that is further accentuated in the context of climate change. When the more educated participants show concern for water scarcity in a period which is not directly affected by drought, this is understood as their being especially aware of the imbalance between demand and supply. However, within this profile, preference for reservoirs is somewhat greater than among those who, although having a similar level of education, also have other environmental priorities. These results clearly suggest that an association between concern about water scarcity and the construction of reservoirs as a possible solution may constitute a social barrier to hydrological transition. It is, however, desirable to confirm these results with additional empirical evidence, which is, to date, not available in southern Spain, and to include the possibility of analyzing more attitudinal and pro-environmental population factors [63].

8. Conclusions

This study aimed to identify the social barriers which contribute to slowing down the pace of hydrological transition in southern Spain, while reflecting the limitations of sustainability transition theories and their ability to foresee resistance to change in sociotechnical systems. In this sense, our results confirm the importance of analysis at the microsocial level, and not only in relation to socioecological niches in which transition triggers are generated. At the microsocial level, resistance to transition may also operate amongst the general public, who may legitimize the prevailing management strategy by supporting a given public policy. In this work, we have analyzed social support for the construction of new reservoirs as an indicator of the acceptance of the traditional hydraulic paradigm, that of increasing water supply.

Following criticisms of transition theories, we have shown that, if the historical, legal and socioeconomic context is taken into consideration, social groups that resist the adoption of a new, more sustainable regime can be identified, which is of interest in the debate surrounding these theories

This study represents an advance relative to previous studies, which, despite offering ways of looking for resistance to socioecological transition at the microlevel, are centered on the general public as final consumers of energy, food or water. In contrast, in this study we analyzed the public not as consumers responsible for their own behavior, but as citizens who express their preferences concerning public measures, and who evaluate their government's performance.

Our results suggest that the construction of hydraulic infrastructure no longer enjoys the strong social support it had in the past. Moreover, people who continue to defend the construction of reservoirs are more critical of regional water policies during periods of drought, which are expected to become more intense as a result of climate change.

The strongest resistance to change in the water management strategy is to be found in the population groups which are closest to the agrarian sector, which, on the other hand, is the greatest beneficiary of reservoir construction. Meanwhile, concerns about water scarcity and a lack of knowledge about actual water distribution amongst the different production sectors, may be constitutive elements of an unforeseen social barrier to hydrological transition.

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