

Article

## Analysis of Stakeholders' Attitudes towards Water Markets in Southern Spain

Giacomo Giannoccaro <sup>1,2,\*</sup>, Verónica Pedraza <sup>1</sup> and Julio Berbel <sup>1</sup>

<sup>1</sup> Department of Agricultural Economics, Sociology and Policy, University of Cordoba, Campus de Rabanales, Cordoba 14014, Spain; E-Mails: veronica\_pj@hotmail.com (V.P.); es1bevej@uco.es (J.B.)

<sup>2</sup> Department of SAFE, University of Foggia, Via Napoli 25, Foggia 71122, Italy; E-Mail: giacomo.giannoccaro@unifg.it

\* Author to whom correspondence should be addressed; E-Mail: es2gigig@uco.es; Tel: +34-957-218-462. Fax: +34-957-218-539.

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**Abstract:** This research examines stakeholders' perceptions of and preferences for water markets in agriculture, focusing on the likely barriers that might refrain them from participating in such markets. The research was carried out on the Guadalquivir River Basin and involved semi-quantitative methods, combining a structured survey and focus group discussions. A very simple questionnaire was administered to each irrigation stakeholder (*i.e.*, managers, water right holders and non-holders). The main result is that stakeholders will only keep selling water seasonally as the rights remain linked to the land. Nonetheless, some relevant differences among stakeholders were found. Managers seem to be more interested in selling water than farmers. Another important discrepancy was found between water rights holders and non-holders. Access to a water rights system, types of existing infrastructure, and legal and administrative aspects are also important factors influencing the acceptability of water trading in the study area. These results might be helpful to policymakers who are currently evaluating the potential for water markets in Europe and have little observable market data to work with.

**Keywords:** water markets; irrigation; stakeholders' attitudes; Guadalquivir River Basin

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## 1. Introduction and Objective

Trading of water rights is increasingly considered as an instrument to support water management under scarcity, drought and water uncertainty. Water supply and demand might be regulated by market systems, which in turn might offer more flexibility and economic advantages. A win-win outcome is usually expected by implementing water markets although externalities should also be considered. Ward [1] reviews economic concepts and tools for water management and sees a market for water rights as a cheaper approach to water management than administrative non-market demand management instruments. He furthermore sees water markets as a useful instrument to meet new water demands.

In Chile, Australia and the United States, water markets have already been operating for several years [2], while in other countries, such as South Africa, a start has been made, but the process of reform has not yet been completed [3]. In the last decade, Alberta (Canada) has also established water markets [4], however, water market activity there remains limited [5,6]. In Europe, water markets exist exclusively in Spain. They remain undeveloped in the rest of Europe due to existing institutional constraints [7].

In the context of water market research, mathematical models have been widely used—mainly due to the absence of real markets—to assess economic impacts, water re-allocation, or environmental consequences of market mechanisms. For instance, efficiency gains from reallocations via water markets were assessed by Jaeger [8] for the Upper Klamath Basin in Oregon, and by Rosegrant *et al.* [9] for the Maipo River Basin, while Hadjigeorgalis [10] and Zegarra [11] did the same in Chile, and Carey *et al.* [12], Carey and Zilberman [13] and Murphy *et al.* [14] in California. Qureshi *et al.* [15] included administrative and financial barriers in their mathematical model for the Murray-Darling basin in Australia, while Pujol [16] based on the farmers' preferences, added limits to profit-maximizing behaviour in implementing a model in different irrigated areas of Spain and Italy. Martínez and Goetz [17] provide another example of a mathematical model used to simulate water market mechanisms in agriculture in Spain, while the issue has also been studied there using Multi Criteria Analysis [18,19].

In spite of the abundant number of papers dealing with water markets, empirical evidence from Chile and from Australia has shown that water markets do not reveal the same extent of benefits that theoretical and simulation works seem to anticipate. According to the experience accumulated in Chile during the 15 years of market operation exchange activity appears rather different across regions, due to: (i) geographic characteristics and type of existing infrastructure; (ii) legal and administrative aspects; (iii) cultural factors and psychological attitudes of local communities; and (iv) prices and water value [20]. Likewise, in Australia the achievement of market expectations depends in part on stakeholders' perceptions and attitudes towards water trading in general and also specifically on their perceptions of the structure and conduct of the market [21].

The Spanish Water Law was reformed in 2005 to allow holders of water rights to trade them on a temporary as well as a permanent basis. However, up until now trading has been very rare. Market mechanisms have exclusively worked under drought conditions and of limited volume.

Spain mainly uses a catchment approach for water management, with the River Basin Authority (RBA) or *Confederación Hidrográfica* being the main management institution at the basin scale. Some decisions relating to reservoir management for irrigation, such as service cost recovery, infrastructural maintenance as well as water trading, are delegated to decentralized organizations of users, so-called

water user associations (WUA) or *Comunidades de regantes*. WUAs basically consist of a board and an assembly of members (*i.e.*, water right holders).

This paper aims to examine stakeholders' perceptions of, preferences for and attitudes towards water markets in agriculture, testing the hypothesis that the existence of market barriers explains the limited exercise of water trading in the study area. As market participation is voluntary and is expected to improve water allocation, the goal is to determine the impediments that farmers and other stakeholders face. Research is carried out on the Guadalquivir River Basin, the largest irrigated area in Spain. Considering the dominance of agriculture in total water use (80% of all the water), the research focuses only on agricultural water markets, and includes the key actors involved in water-related decision making according to the Spanish legal and institutional framework.

The recent experience with water trading in the Guadalquivir has shown some discrepancies between management proposals made by technical managers and final decisions taken by the assembly of WUAs. Technical managers are professionals in charge of defining, funding and implementing water management actions. The recent financial crisis is placing a significant burden on the economic viability of several WUAs and water selling might relax the financial constraint. We will test if there are different attitudes towards and perceptions of water trading between technical managers of the WUAs and farmers.

In the Guadalquivir Basin, new water rights have not been issued since 2005. In fact, the basin is already at the closure stage, defined as the stage when available resources are fully or over committed [22], that is the total volume of licenses exceeds the sustainable yield of the basin. As a consequence the market mechanism is the only available instrument to obtain rights for new users. Therefore, this study also included non-holders of water rights. This group of farmers may be willing (or not) to participate in water trade in order to gain access to irrigation water. The hypothesis tested here is that the non-holders may refrain from water trade in order to put pressure on the RBA to release new water rights.

This research used semi-quantitative methods, combining a structured survey and focus group discussions. A very simple questionnaire was administered to each stakeholder (*i.e.*, managers, water right holders and non-holders) in order to obtain structured information about the local perceptions, attitudes and preferences. The survey included twelve five-point Likert-scaled value statements. Statistical analysis was used to study the survey data in order to determine the existence of differences between the different actor groups and to test the abovementioned hypotheses. In addition, three focus group discussions with local farmers, including holders and non-holders of water rights, were organized.

The remainder of the paper is set up as follows: Section 2 contains a case study description; Section 3 provides a short international review of barriers to water markets; data and methods are discussed in Section 4; and results are reported in Section 5. Finally, Section 6 provides a discussion of the results together with some concluding remarks.

## 2. Study Area: Developments towards Water Trading

The research focused on the Guadalquivir River Basin, which covers 51,900 km<sup>2</sup> and is located in southern Spain. The average yearly rainfall is approximately 590 mm, with a potential evapotranspiration close to 790 mm. Overall available resources in the basin amounts to 3362 million m<sup>3</sup>/year while net demand rose in 2008 to 3578 million m<sup>3</sup>/year, of which more than 80% came from agriculture [23].

Berbel *et al.* [24] analyse the proposed Basin Management Plan and the associated Programme of Measures to meet requirements established by the European Water Framework Directive (WFD) (2000/60), and Berbel *et al.* [22] describe the evolution of the Guadalquivir Basin towards administrative and hydrological closure. In both papers, the authors claim that some reductions have to be made in the total amount of water allocated to uses for the achievement of the WFD goals.

Irrigated areas in the Guadalquivir Basin reached 838,232 ha in 2008 [23], with olive oil being the main irrigated crop located on the upper side of the Guadalquivir Valley; extensive and semi-extensive crops such as maize, cotton and sugar beet were mainly farmed in the middle and lower reaches of the valley; citrus and orchard fruits were generally concentrated in the Seville and Cordoba provinces. Finally, a small area was dedicated to rice near the river estuary, the so-called “Marismas”.

With the approval of the Water Act 1985 [25], water became a good under the sphere of the public domain. In the Spanish legal system, water is attached to land. Landowners received water rights (*i.e.*, access to water as a “license of use” for 75 years) based on the proportion of their acreage to the total acreage served by a particular irrigation infrastructure. In addition, water allocation (*i.e.*, annual water volume per ha) was defined according to a crop-specific irrigation coefficient. Practically, water rights define who has access to water while the actual yearly allocation depends on the availability of resources and the rules of distribution as set out in the Drought Management Plan. In the literature there are different terminologies for the same concept. Indeed, for the long-term access to water, examples such as water right, license or water entitlement are provided; on the other hand, for the short-term right to use water, allocation is the Australian term or assignment in the Alberta (Canada).

The passage of the Water Law in 2001 [26] enabled water allocation trading while trading of water rights was still not possible. Recently, the Royal Decree 15/2005 [27] has broken the water-land link and landowners are granted the right to trade their water rights (in part or whole) on a temporary or permanent basis. However, trading of water rights is subject to a number of restrictions. Agricultural rights holders can only transfer rights to those who already hold a water right and cannot be used to assist the establishment of new water users. This framework is similar to the one in Alberta under its Water Act (1999) [6].

From 2006 to 2007, about 45 million m<sup>3</sup> were transferred from the Guadalquivir Basin to the Mediterranean Basin by means of water markets. As a whole, around 2% of the demand for irrigation water of the Guadalquivir Basin was traded. Table 1 presents more details about the water traded in that period. It should be noted that only a single buyer “*Aguas del Almanzora*” was operative while there were a few sellers. In 2007, there were four sellers and only seasonal transactions were made. A price of 0.18 €/m<sup>3</sup> was agreed upon, while the costs of transfer was paid for by the Regional Government.

**Table 1.** Water market in southern Spain (2006–2007), source: Own elaboration.

Type	Seller	Buyer	Volume (Million m <sup>3</sup> )
Permanent	Aguas del Almanzora Ltd.	Aguas del Almanzora Ltd.	8.48
Temporary	Bembezar MD	Aguas del Almanzora Ltd.	35.32
	Bembezar MI		
	GenilCabra		
	Guadalmellato		
Total			43.80

This trading pattern points to a market characterized by a unique buyer on the demand side and more sellers on the supply side. In this context, water markets in southern Spain appear limited compared to other areas of the world (*i.e.*, California, Australia, Chile), especially with regard to “market depth”, the number of transfers and market participants.

### 3. Barriers to Water Markets in Agriculture: A Short Literature Review

From an institutional perspective, the operational rules, constraints on entry and exit to the market, the number of buyers and sellers, the homogeneity of the product and market knowledge, are important determinants of a market’s performance.

Early cases in the USA, Chile and Australia report spatial limitation in the ability to trade water between different user groups. This limitation refers to physical constraints [28] and supply reliability and flexibility of the delivery systems, and these are considered primary barriers to water markets. The potential for market activity is directly associated with the size of the trading area [29]. For example, interconnected dams create a high level of supply reliability and flexibility and provide a greater variety of user groups [29,30]; a system of flexible gates to control irrigators’ access to water makes adjustments quick and cheap [31].

The issues of culture and tradition as impediments to trade have been identified in the USA, Chile and Australia. Bauer [20] mentioned cultural and psychological attitudes as impediments to more active markets in Chile despite potential significant financial gains for poorer inefficient irrigators. Bjornlund [31] described Australian farmers’ reticence to enter already established water markets. Although the participation rate from 1996 to 2001 was steadily increasing, the study clearly confirms that many were reluctant participants while half never had participated in any kind of water trading.

A distinction should also be made between allocation trading and water rights markets. According to previous studies, farmers’ acceptance of water markets is higher in the case of allocation trading, while they are less willing to permanently transfer water rights. Wheeler *et al.* [32] in Australia found that irrigators who traded water allocations were significantly different from those who traded water rights. While policy makers were generally willing to let go of the bond between land and water, the main perceived reason for farmers not to trade was that they saw their own water right as an integral part of their farm [33]. Institutionally breaking the nexus between land and water will only lead to trade if farmers start seeing water rights as a tradable asset.

Impediments to water markets can also originate in the rules that are set for the market. It is quite common to limit or prohibit trade out of the irrigation sector, and transfers between different basins are sometimes restricted. For example, in the early stage of water markets functioning, within the Goulburn-Murray Irrigation District (Australia) no more than two percent of the total area entitlement at the beginning of the year could be traded out during the year [31]. It was subsequently increased to 4%, with a view to removing the limit entirely by 2014 [32]. In Alberta, for district irrigators, allocation trading can occur only among agricultural rights holders within the same irrigation district [6]. In Spain, inter-basin transfers are allowed but subject to Ministerial approval, equally for allocation and water right markets.

In addition, poorly defined water rights are an important barrier. In Europe, where water markets are still a promising phenomenon, water rights can be unilaterally redefined or revoked by the issuing

authority. Water trade can be opposed by third parties, restricted to certain buyers, or redirected to the state [7]. Under such uncertainty, farmers can be reluctant to trade, and this uncertain institutional environment may also lead to strategic behaviour (e.g., if as mentioned above farmers refrain from buying rights in the hope of attaining new rights for free).

Administrative issues are also mentioned in the literature as a barrier to water markets [33,34]. These relate to the uncertainty of the outcome of the process [35] and the time it takes. The perception of the process, the quality and accessibility of market information and the lack of marketing proficiency are also considered to be important elements that may delay water trading. Most of these issues emerge in the early stages of market development characterized by unfamiliarity and slow market activity. Indeed, Cook and Rabotyagov [36] in the Yakima River Basin (Washington), and Wheeler *et al.* [32] in the Goulburn-Murray Irrigation District (Australia) found that previous participants to water markets would be more disposed to trade water in the future. To this regards, the adoption of water markets in Australia shows that over time farmers overcome their fear of markets, seizing the benefits that a more flexible water management system can provide. By 2003–2006 around 63% of farms had participated in an allocation water sale and 40% in a purchase [37]. Wheeler *et al.* [30] and Bjornlund [29] emphasize that allocation trading in Australia is reaching the maturity stage of water market adoption. However, they claim that the huge increase of market activity has been driven by the prolonged drought conditions and financial realities.

Finally, Zuo *et al.* [38] argue that water trading may be used as a risk management tool by farmers. They found that participation to trade could be affected by on farm specific variables, such as farm cash income, farm size, farm capital, the type of water entitlements and allocations, debt, a farmer's age and education. Similarly, Bjornlund *et al.* [39] found differences in markets acceptance among the three main Alberta irrigation areas according to crop pattern and on-farm water use efficiency.

#### **4. Data Collection and Method of Analysis**

Quantitative and qualitative analysis was carried out based on data collected respectively by means of a survey and focus group discussions. Two different types of irrigation stakeholders in the Guadalquivir River Basin were surveyed namely managers of WUAs and farmers. Technical managers are professionals in charge of defining, funding and implementing water management actions. Among the farmers, interviews were carried out on water rights holders and non-holders. In the case of managers and rights holders, respondents were from different WUAs. To study the variation of the perception of water markets across the river basin, the sampling procedure included several features such as location, farm size, crop pattern, as well as irrigation water availability. A minimum threshold of three respondents for each class according to the variables characteristics was applied. For instance, in the case of farm size, three different classes were established, namely smaller than 5 ha, between 5 and 20 ha, and larger than 20 ha. Initially, the sample attempted to embrace all possible different attitudes towards water markets. Despite the survey's small size, all important groups were included.

Interviews were conducted from 1 December 2011 to 20 February 2012 with 47 participants. A simple structured questionnaire including twelve five-point Likert-scaled statements was administered. Respondents were asked to rank these statements according to their personal point of view. The Likert

scale ranged from one, representing strong disagreement with the statement, to five for strong agreement. The list of questions is presented in Section of results (Table 2).

A similar questionnaire was first used by Bjornlund [31] for the permanent market in Australia, and was adapted to the Spanish market framework, which is very similar. Additionally, the structure of the questionnaire was adapted taking into account the available international literature on market barriers.

The questionnaire was sent by mail to 60 managers of WUAs. Of these, 25 were fully completed (in total 28 were received back). The response rate in a mailed questionnaire is usually very low, and our case (46%) can be considered in line with other research [40]. Managers were asked to reply to the questionnaire according to their point of view as technicians. WUAs included in the sample covered 94,754 ha, of which 90% is irrigated. The average annual water allocation in the sample is 6769m<sup>3</sup>/ha with water cost ranging from 57 to 166 €/ha.

Three focus group discussions with farmers were carried out in the provinces of Cordoba, Jaen and Seville. The discussions included the following groups: (a) farmers who currently do not hold any water rights; (b) farmers who currently rely on poor water rights, namely with little water allocation and low supply security; and (c) farmers relying on water rights with satisfactory allocations (over 6000 m<sup>3</sup>/ha) and who have already sold water in the allocation trading of the 2007 season. The main irrigated as well as rain fed crop systems as geographically distributed across the Guadalquivir Basin were covered. In total, 19 farmers participated in the focus groups.

The first discussion with 11 farmers took place in Puente Genil (Central Valley, Cordoba, Argentina). They were seen as potential buyers given that their farms currently held water rights. Their average farm size was 48 ha, and rainfed olive trees were the main crop. The average farmers' age was 52 years.

Secondly, a focus group discussion among olive growers in Cambil (Upper Valley, Jaen, Spain) took place. Only three people attended this focus group. The average farm size was 16 ha. The annual water allocation was less than 1000 m<sup>3</sup>/ha, for which a water tariff of 0.08 €/m<sup>3</sup> was paid. Although they held water rights, they could also be seen as potential buyers as they were exposed to huge uncertainty about water supply both in terms of annual supply security and availability. The average participants' age was 60.

In the third meeting, which was held in Lora del Río (Middle-lower Valley, Seville, Spain), there were five attendants with an average age of 65 years. This focus group consisted of rights holders who were potential sellers and included some of the farmers mentioned above who had sold part of their annual water allocation to *Aguas del Almanzora*. They had both larger farms (average of 336 ha) as well as a bigger water allocation of 6000 m<sup>3</sup>/ha per year. The main irrigated crops were citrus, cotton and maize.

After answering the same questionnaire as mentioned above, an open discussion on water market issues took place among the participants. The focus groups were unstructured and aimed to understand the issues from the farmers' individual viewpoints. Participants started with a speech about their personal opinion on water markets. During the discussion, topics such as administrative issues, required investments, interest in permanent water right trading and allocation trading, willingness to sell and to buy, problems in current water management and a water market system were discussed. Perceptions of involved institutions in existing water markets were also discussed. The same topics were covered in each focus group discussion.

A quantitative analysis of the responses to the structured questionnaire was carried out, to which—where relevant—qualitative information from the focus group results was added to provide context.

The five-point Likert-scaled responses were analyzed through a series of *t*-tests, used in statistics for population samples that follow a Student's *t* distribution. This type of distribution occurs when the population is expected to follow a normal distribution, but the sample size is small, as in our case. Firstly, managers and farmers were combined into one sample to obtain a larger number of observations. The analysis was carried out in order to statistically show the degree of agreement or disagreement with each statement (in contrast to neutrality, which has a value of three in the five-point Likert scale). If the mean is significant and higher than three, respondents are in agreement with the statement; significant lower values indicate that respondents disagree.

Secondly, the Mann-Whitney *U* (MW) test was used to test for differences between the different groups in the sample (managers vs. farmers; and holders vs. non-holders of water rights). It is a non-parametric statistical test to assess whether two samples of independent observations have different values from each other. The MW test assumes that the variable is at least ordinal and that its distribution is similar in both groups. The test is used to prove whether the sub-samples come from populations with the same mean. When significant, the test tells us that the sub-samples have different means.

Finally, the two-sample Kolmogorov-Smirnov test was also used to validate the assumption of similar distributions in the different groups. The two-sample test is one of the most useful and general non-parametric methods for comparing two samples, as it is sensitive to differences in both location and shape of the empirical cumulative distribution functions of two samples. The two-sample test checks whether the data sub-samples come from the same distribution of ranking.

## 5. Results

In this section, results of the survey are reported first, followed by the main findings from the three focus groups. Overall responses to the survey statements are shown in Table 2.

Results show that the majority of stakeholders agree with the statement that water markets are a good idea. The next five statements in Table 2 (Number 2 to 6) are related to motivations that may explain the agreement with or opposition to a water market. Stakeholders are mainly in disagreement with Statement (2) “*water which is sold is water that is not going to be used*”. Stakeholders’ general agreement with Statement (3) “*Water markets ... facilitate farmers to exit through a permanent sale*” reveals that permanent trade is seen as a tool for farmers to abandon irrigation. Likewise, the respondents give a similar positive response to Statement (4) “*I agree with allocation sales as long as the water rights remain linked to the land*”. Statement (5) “*Permanent water right trade is necessary to allow long term planning*”, is more evenly distributed with more disagreement than agreement. Finally, Statement (6) “*Water trade is NOT a good idea because water cannot be a commercial good and trade should not be allowed*”, receives a large majority of disagreement. However, a large share of respondents also gives a neutral answer.

The next group of statements from Number 7 to 10 deals with the intention of selling and buying water allocation or water right in the coming years. On the whole, the majority of respondents are interested in participating in the water trade in the near future, except for the case of selling permanent water rights.

**Table 2.** Stakeholders' perceptions of and attitudes towards water markets <sup>a</sup>.

Topic	No.	Statements	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
General	1	Water markets are a good idea	9%	14%	20%	39%	18%
	2	Water markets are NOT a good idea because they increase water use, as water which is sold is water that is not going to be used anyway, reducing the resource available	23%	41%	27%	5%	5%
	3	Water markets are good because they allow farmers who want to abandon irrigation to facilitate exit through a permanent sale	9%	18%	18%	36%	18%
Motivations	4	I agree with allocation sales as long as the water rights remain linked to the land	9%	7%	12%	53%	19%
	5	Permanent water right trading is necessary to allow long term planning	12%	29%	26%	19%	14%
	6	Water trade is NOT a good idea because water cannot be a commercial good and trade should not be allowed	17%	31%	31%	7%	14%
	7	In the future I would be interested in buying seasonal water allocation	14%	21%	19%	42%	5%
Stated Intentions	8	In the future I would be interested in buying permanent water rights	12%	23%	23%	33%	9%
	9	In the future I would be interested in selling seasonal water allocation	9%	21%	19%	42%	9%
	10	In the future I would be interested in selling permanent water rights	21%	31%	19%	21%	7%
Strategic Behaviours	11	I would not sell because in the future it is likely that the Government will reduce my allocation	5%	23%	23%	31%	18%
	12	I would not buy because I believe that I will get it free in the future	23%	41%	28%	5%	3%

Notes: No. of respondents:  $N = 44$ ; (a): The same questions were asked to holders and non-holders, and managers. For all non-holders, questions 7 to 11 were asked differently, considering the hypothesis of having a water right and the possibility of buying it. Managers were asked if they would buy/sell water of other/their WUA in the future.

The last two statements are related to stakeholders' perceptions of policy uncertainty and possible strategic behaviour. The agreement of half of the respondents to Statement (11) "*I would not sell because in the future it is likely that the Government will reduce my allocation*" shows that there is a worry about this eventuality. On the other hand, Statement (12) "*I would not buy because I believe that I will get it free in the future*" is perceived as unrealistic by a large majority.

Table 3 shows the response to statements from number 2 to 12 after separating three groups of respondents according to their response to Statement (1) "*Water markets are a good idea*": (i) agree, (ii) neutral, and (iii) disagree. For this table, the five-point-Likert scale is re-ordered to only three categories of response.

The first sub-group, namely those agreeing with markets covers 25 respondents, including 12 farmers and 13 managers. The average age is 48 years. The second sub-group is indifferent towards

the water market idea. They include nine respondents of which two are farmers and seven managers. This is the youngest cluster with 32 years being the average age. Finally, 10 respondents disagree with water markets; five farmers and five managers. Their average age is 59 years.

**Table 3.** Differentiated stakeholder responses according to their perception of a water market as a good idea (No. of respondents:  $N = 44$ ).

Statements	Agree with markets ( $N = 25$ )			Neutral towards markets ( $N = 9$ )			Disagree with markets ( $N = 10$ )		
	Disagree	Neutral	Agree	Disagree	Neutral	Agree	Disagree	Neutral	Agree
2	80%	20%	0%	44%	22%	33%	40%	50%	10%
3	16%	8%	76%	11%	44%	44%	70%	20%	10%
4	8%	8%	84%	75%	25%	0%	50%	10%	40%
5	25%	33%	42%	50%	38%	13%	70%	0%	30%
6	71%	21%	8%	25%	50%	25%	10%	40%	50%
7	25%	17%	58%	38%	25%	50%	60%	20%	20%
8	21%	21%	58%	44%	44%	11%	60%	10%	30%
9	21%	13%	67%	22%	22%	56%	60%	30%	10%
10	50%	17%	33%	38%	25%	38%	70%	20%	10%
11	26%	17%	52%	43%	43%	14%	20%	20%	60%
12	61%	26%	9%	57%	43%	0%	70%	20%	10%

Those stakeholders who favourably look upon the idea of a water market (first sub-group) generally have a lower share in the “Neutral” column. Higher percentages of disagreement prevail for Statements (2), (6), (10) and (12), whereas the majority of respondents fall into the column of agreement for the other statements. More than 80% of respondents are in agreement with allocation trading under the condition of water rights being attached to land. More than half (52%) of this sub-group worries about a possible revision of water rights. Finally, many in this sub-group declare a willingness to buy (58%) or sell (67%) seasonal water allocation in the future. At the same time, 58% of respondents would purchase a permanent water right, while only 33% would sell it.

The second sub-group shows the biggest difference to the other groups on Statement (4) “*I agree with allocation sales as the water rights remain linked to the land*”. Indeed, no one agrees to seasonal allocation sales keeping the rights linked to the land.

Respondents in the last sub-group are generally in disagreement with the majority of statements, demonstrating opposition towards all statements concerning water markets. Their behaviour seems to be coherent as a large percentage of them is not interested in selling or purchasing water in the future. This sub-group also accounts for most of the agreement found with Statement (6) “*Water trade is NOT a good idea because water cannot be a commercial good and trade should not be allowed*”.

We now address the statistical comparison of the different stakeholder groups in the survey (managers vs. farmers; holders vs. non-holders). Results of the statistical analysis are reported in Tables 4 and 5.

Findings in Table 4 show that the  $t$ -test is significant in four out of twelve cases, indicating that the responses were significantly different from three, the neutral answer. The first one, concerning the water market reveals that this is generally seen as a good idea across all stakeholders. In line with this, respondents are in general disagreement with Statement (2), which relates to the fact that water

markets might activate sleeping (unused) rights. Receiving the highest agreement of all statements, respondents again approve of allocation sales under the constraint that water rights remain linked to the land. The fourth and final significant result is for Statement (12) showing that respondents do not expect to receive water rights free of charge.

**Table 4.** Statistical analysis of stakeholder responses, comparing managers and farmers.

Statements	Mean of overall stakeholders	Mean of managers	Mean of farmers	Mann-Whitney U test	Kolmogorov-Smirnov two-sample test
1	3.43 *	3.48	3.37	236.00	0.39
2	2.27 **	2.08	2.53	172.50	1.01
3	3.36	3.32	3.42	223.50	0.80
4	3.65 **	3.91	3.32	168.50	0.59
5	2.95	2.83	3.10	187.50	0.52
6	2.71	2.30	3.21	136.50 *	0.91
7	3.02	3.00	3.05	217.50	0.36
8	3.04	2.87	3.26	180.00	0.93
9	3.21	3.54	2.79	146.00 *	0.83
10	2.62	2.91	2.26	155.50	0.63
11	3.33	3.50	3.16	162.50	0.45
12	2.23 **	2.40	2.05	148.00	0.58

Notes: No. of respondents: N = 44; \* = significant at 0.05; \*\* = significant at 0.01.

**Table 5.** Statistical analysis of responses, comparing holders and non-holders of water rights.

Statements	Holders	Non-holders	Mann-Whitney U test	Kolmogorov-Smirnov two-sample test
1	3.00	3.63	36.50	0.80
2	2.25	2.72	23.00	1.10
3	3.25	3.55	44.00	0.54
4	2.87	3.63	33.00	0.95
5	2.50	3.55	23.00	1.10
6	3.50	3.00	38.00	0.88
7	2.75	3.27	34.50	0.80
8	2.25	4.00	12.50 **	1.22
9	2.37	3.09	28.50	0.75
10	1.50	2.81	16.00 *	1.37 *
11	3.00	3.27	43.50	0.54
12	1.75	2.27	32.50	0.51

Notes: No. of respondents: N = 19; \* = significant at 0.05; \*\* = significant at 0.01.

Turning to the Mann-Whitney *U* tests, we find significant values for Statements (6) and (9). Although the mean of the overall sample is not significantly different from neutral for these statements, the significance of the *U* test tells us that there are significant differences between the sub-groups of managers and farmers. For Statement (6) “*Water trade is not a good idea because water cannot be a commercial good and trade should not be allowed*” the mean of the managers is below the neutral value while the mean of farmers is slightly higher than three. The reverse is true for Statement (9) “*In the future I would be interested in selling seasonal water allocation*”, where managers’ mean is

higher than three while farmers have a mean slightly below three. The Kolmogorov-Smirnov two-sample test did not result in any significant value.

The findings reported in Table 5 refer to the comparative analysis between water rights holders and non-holders. Comparing the responses of the two farmer groups for Statement (8) “*In the future I would be interested in buying permanent water rights*” and Statement (10) “*In the future I would be interested in selling permanent water rights*”, significant differences are found. Non-holders are significantly more interested in buying permanent rights than current holders. When it comes to permanently selling rights, current holders show a very low value compared to the close to neutral value of non-holders. For the latter statement, the Kolmogorov-Smirnov test was also found to be significant, meaning that the rank distribution between the two sub-groups is different.

As a whole, results point to a general acceptance of agricultural water markets in the Guadalquivir River Basin. The main result is that stakeholders prefer to keep selling water seasonally as the rights remain linked to the land. However, differences are also found in Statement (6) about water as a commercial good. Here, farmers’ responses are different to those from managers.

In spite of the acceptance of water trading, the findings show that the willingness to participate in water trading, either in a seasonal market such as spot water market, or in a water right market, is not significantly different from neutral (Statements from Number 7 to 10). Nonetheless, some relevant differences among stakeholders have been found: managers seem to be more interested to keep selling water seasonally while farmers seem to be neutral. Managers might think for their WUA as technicians looking for the economic viability of the WUA.

Finally, another important finding is that non-holders are keen on the permanent purchase of water rights, while holders are not willing to sell their water rights permanently, which will make a market of permanent transfers difficult.

In the next paragraphs, the main results of the three focus groups are reported. Participants in the three focus groups provided a common vision to the main existing problems in irrigation water management. One of the most stressed problems by participants was a lack of reliable information provided by public institutions. Most farmers in the three focus groups complained about a lack of information about the procedure for obtaining rights. This was mentioned as one of the most important issues related to the buying of a permanent right. In addition, under the current market framework, exchanges are exclusively allowed among current holders of water rights. Trading with new users is not allowed. This aspect was mentioned as an important impediment to permanent trade by the farmers who did not have a water right at the time.

A second problem that was discussed relates to the types of existing infrastructure. Some farms are still not connected to the delivery systems of the basin’s infrastructure. As a consequence, potential buyers are excluded from water markets. This occurs mainly in the upper part of the Guadalquivir Valley (mainly Jaen) where water sources are still unregulated. As another infrastructural barrier, channel capacity is claimed to be the major constraint to inter-basin exchanges for all farmers. This is followed by technical and administrative restrictions to the inter-basin transfer operations. Inter-basin trade agreements are subject to previous approval by the national government.

A third problem mentioned in the discussion is the asymmetry of information between farmers with previous trading experience and those who have not yet participated. Large differences were indeed found between the farmer sub-groups. Irrigators in Lora del Rio, who had already traded water in

2007, demonstrated a fair knowledge of the markets rules, while little awareness was shown by those farmers with no experience. The latter group showed a strong opposition towards water markets and, furthermore claimed that water markets were not allowed in the basin.

## 6. Discussion and Concluding Remarks

This study focused on stakeholders' attitudes towards and preferences for water markets in the Guadalquivir River Basin. Irrigation stakeholders were asked to rate statements concerning water market issues on a five-point Likert scale. We surveyed three different stakeholder groups: managers of water user associations, farmers who currently held water rights and farmers who did not have water rights. Our initial hypothesis was that irrigation stakeholders faced certain barriers that could explain the low number of real trading operations found in the study area. Moreover, we argued that there would be differences in attitudes and preferences for agricultural water trading between the stakeholder groups.

Physical, institutional and informational barriers were indeed mentioned in the focus group discussions. The former relates to both intra-basin and inter-basin infrastructure, while institutional constraints such as legal and administrative procedures might produce fear and uncertainty among stakeholders. A lack of information about the procedure for obtaining entitlements and the allocation procedure carried out by the administration might delay the activation of a water market.

With reference to the hypothesis that managers and farmers would have different preferences for water trading, findings revealed that the managers were more inclined to see water as a commercial, tradable good, and were more positive towards allocation trading while the farmers seemed to be more neutral on both issues. Differences between holders and non-holders focussed on the latter group wanting to buy water rights permanently, while the farmers who held water rights did not want to sell them.

This result points to a sort of inertia for the agricultural water market in southern Spain. On the one hand, managers of water user associations are interested in selling the water resource, though seasonally. On the other hand, farmers' preferences appear to be different, either because they are not in agreement with water selling or, as in the case of non-holders, they prefer to buy water rights permanently. Put in other words, the low market activity seems to be related to the fact that the non-holders can buy rather than the holders want sell.

Our initial hypothesis that farmers would worry that their water right or allocation could be questioned by the RBA in the event of a water sale was not confirmed. The hypothesis that potential buyers would refrain from doing so to put pressure on the RBA to allow new (free) right releases was rejected as well. The statement referring to this actually received the strongest disagreement of all statements.

Most of our findings are consistent with the evidence found in Australia, Chile, the USA and Canada (Alberta), where water markets have been working for a longer time. For example, we found that irrigation stakeholders were only interested in selling water allocation in a seasonal water market while the rights were kept linked to the land. This aspect points to the nexus between land and water. Interviews with irrigators in Northern Victoria suggested that farmers there were also reluctant to sell their water entitlements because they had always viewed water as being connected to the land [21,41]. Moreover, the increasing willingness to participate in water markets for those farmers with previous trading experiences as found by Wheeler *et al.* [32] and Cook and Rabotyagov [36] emerged as a relevant feature in our study as well.

In general, we can conclude that water markets in southern Spain face similarities with the early stage of water markets in Australia, showing a low numbers of trading and reduced volume. Similarly, an increase of trading activity over time is expected as irrigators become familiar with the concept and ease their fear and, as water scarcity and financial issues force their hand.

Given the size of the sample, results should be considered preliminary findings, aimed especially at providing insights for further research. Moreover, a relevant weakness of this research might be related to the fact that non-holders perceived many research questions as hypothetical. However, findings here could be relevant for European policy makers who are currently evaluating the potential for water markets as a tool for dealing with water uncertainty and climate change. Research on water trade has mostly been based on market model simulations, but the differences between observed and estimated trade point to the need to take stakeholders' perceptions and preferences into account, in order to improve the models. Further research should be undertaken by means of a wide survey to a larger number of stakeholders in order to validate the preliminary findings discussed in this paper, and if possible to integrate preferences into decision making models to compare observed with simulated trade.

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### Conflicts of Interest

The authors declare no conflict of interest.

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