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Legal Analysis and Case Study on the Choice between Setting Environmental Flows by Using Reclaimed Water in Non-Permanent Rivers and the Sustainable Management of Groundwater in Southeast Spain

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Abstract: This article studies the interaction between two environmental objectives actively pursued in water governance. On the one hand, the convenience of establishing or raising a minimum circulating flow in surface water bodies so to improve their quantitative and qualitative status. On the other hand, the need to carry out an intelligent management of aquifers avoiding their overexploitation. In the case study, the proposal consisting of increasing the minimum flow rate on a non-permanent river by means of discharging reclaimed water is studied. Such strategy jeopardizes the recovery of a number of overexploited aquifers since reclaimed water is currently being used for farming under the condition to proportionally reduce groundwater withdrawals. The aim is to discuss whether it is reasonable and rational to ensure continuous flows in water courses which do not have that pattern according to their natural dynamics to the detriment of other environmental or socioeconomic goals. In order to help decision makers to make a right choice, a set of criteria based on legal principles is proposed. According to the principles of minimum intervention, rationality and reasonableness, proportionality, and water economy, it is concluded that the use of reclaimed water to set higher environmental flows in discontinuous and ephemeral streams should only have a minor role in water policies, especially whether it may jeopardize other critical environmental goals.

Keywords: ecological flows; groundwater overexploitation; river basin management; water law; water governance

1. Introduction

In the current context of climate change, environmental flows help to preserve the innate resilience of aquatic ecosystems [1]. The allocation of water for environmental purposes is an increasingly active area of river management [2]. However, environmental flows are being implemented in only a small fraction of the world's rivers and in the vast majority of these cases, environmental flow management is focused only on low flows [3].

The specific setting of environmental flow rates is not a univocal decision. More than 200 environmental flow assessment methods have been employed worldwide [2]. There is no (scientifically credible) rule for defining the amount of water that should remain in a river to satisfy environmental flow needs. Decisions about which of the socioeconomic impacts are acceptable, and how much water should remain as environmental flow in a river, involve complex trade-offs among human values and environmental benefits [3].

The most critical component of environmental flows in Mediterranean areas is the minimum flow regime because of the seasonal character of rivers, which experience severe water shortages in summertime. Two main methodologies for the calculation of minimum environmental flow rates at medium-small watersheds can be highlighted: firstly, the Hydrologic methods apply statistical procedures (e.g., percentiles, moving averages) to the historical series of natural flows; secondly, the Basic Flow Method (BFM) offers an alternative approach. The final choice of the thresholds within the ranges proposed is quite subjective and left to open criteria [4]. From a legal perspective, it can be said that such decision is not strictly predetermined by the law, instead, it turns to be a discretionary decision based on the choice of one particular assessment method together with the evaluation of a number of socioeconomical issues.

This difficult choice is even harder in non-permanent rivers with high water demands due to the challenge of managing highly variable flows for competing water uses and adapting policy and water plans to change water availability. The complexity of determining the required flow regimes and the interdependencies between stakeholder outcomes has restricted the implementation of environmental flows [2]. The challenge in semiarid areas for water resource managers and policy makers is to quantify how much water is required to avoid irreversible environmental degradation and the consequent loss of ecosystem services while still satisfying the demands of a growing human population [5].

Meeting environmental flows may not only impose constraints on other water uses, but even enter in competition with other environmental goals. The choice may be certainly challenging when the balance that has to be sought is not between consumptive uses and the environment, but between two environmental goals themselves. In this study, the choice to be made is between ensuring environmental flows or improving groundwater quantitative status.

Groundwater quantity and quality issues constitute a major set of challenges facing the world nowadays. Climate change is expected to reduce renewable groundwater resources in most dry subtropical regions [6]. In particular, groundwater overexploitation is a huge challenge in the Mediterranean arid and semi-arid regions, where many aquifers are particularly at risk due to intrusion of salty marine water [7], or experience diminishing water tables and aquifer depletion. As groundwater resources are becoming overly used and polluted, environmental concerns play a prominent role in groundwater legislation [8].

Many countries are currently strengthening domestic groundwater legislation and ranking it on a par with surface water regimes. These encouraging developments with respect to law, institutions, and administration have to be supported in order to achieve effective and sustainable improvements of groundwater governance and reverse the global trend of groundwater depletion and degradation [8].

The Southeast of Spain is furrowed by innumerable non-permanent river courses which only keep water during short periods of the year. Despite this, they have an undoubted ecological interest. Non-permanent rivers are important links between water stored in soils, aquifers, snowpack, vegetation, and the atmosphere. In arid and semi-arid regions, groundwater recharge is dominated by seepage from temporary river channels. These rivers are also important water vapor sources. In addition to their roles in the water cycle, they provide a wide range of ecosystem services. Floods in temporary rivers have been used for irrigation and also function as flood control systems [9].

The competition over scarce water resources is enormous in these lands. The South East river basin districts (Segura and Júcar river basin districts) present water deficits close to 200 hm^3/year considering their water inputs (1584.5 and 3050.4 hm^3, respectively) together with their total water demands (1722.5 and 3240.8 hm^3, respectively) [10].

Given the limited access to surface water, groundwater abstractions have been multiplied, which has resulted in a serious overexploitation problem. Southeast Spain is considered, in the global context, as one of the regions where the highest rates of intensive groundwater exploitation have been identified [11–13].

A balance between the preservation and enrichment of the environmental status of non-permanent river courses and the need to reduce abstractions in already overexploited aquifers should be found.

Nowadays, river basin plans tend to give priority to the establishment of environmental flows (minimum circulating water flowrate) so to ensure aquatic life and flora. In legal terms, the environmental flow can be defined as the minimum circulating water flowrate a river course must keep in a particular time of the year. It has to be pointed out that setting an ecological flow does not necessarily pursue the recovery of the natural flow that used to circulate before the water body was altered. On the contrary, it is an interventionist response that aims to modify the current status of the body of water in order to guarantee a minimum circulating flow. The definitive flowrate will be quantified according to the objectives the water authorities intend to achieve [14] (p. 142).

Consequently, Spanish river basin management plans have set minimum flows even in river courses that, according to their natural dynamics, would not keep permanent water flows the whole year through, somewhat creating semi-artificial ecosystems. The creation of these type of artificial ecosystems, even of remarkable environmental value, is not something new. These spaces have sometimes reached high levels of legal protection and their preservation is not questioned. In the area of study some good examples can actually be found. In the south of Alicante Province, a water reservoir called "El Hondo" became a nature conservation site and was listed as a RAMSAR site and Natura 2000 site (Decree 187/1988, 12 December 1988). The protected area is in fact an ancient irrigation regulating reservoir built at the beginning of the 20th century [15] (p. 291). Another good example, also near the study area, can be found at the Santa Pola and Torrevieja salt mines, both of which were also designated nature conservation sites (Decree 189/1988, 12 December 1988: Torrevieja; Decree 190/1988 12 December 1988: Santa Pola).

Moreover, in Spain, a large number of permanent river courses ensure their ecological flow rates thanks to the contributions of urban wastewater treatment plants; flows that have previously been taken for human supply are partially poured to the river. In many cases, such resources are the result of a combination of different sources (surface water, groundwater, transfers from other river basins, desalinated water, etc.) [16].

The downside is that setting minimum flow rates sometimes has a negative impact on other environmental strategies, as happens when groundwater overexploitation increases as a consequence of the impossibility of using surface flows reserved to ensure the minimum ecological flow. Not to mention the serious impacts on the socioeconomic context, including adverse effects to hydropower generation industries, agricultural activities, tourist facilities, etc., which are unable to use such flows. Decision making is, therefore, not a simple matter.

In this study we will highlight one case where these conflicts have emerged as a result of new proposals currently under discussion in Spain, in the context of the third period of water planning (2021–2027). In particular, minimum environmental flows are proposed to be either established or increased in most of the sections of a non-permanent river (Vinalopó) located in Alicante Province, by ordering urban wastewater treatment plants to discharge reclaimed water into the riverbed. Such a measure, however, would prevent this type of flow from being granted to a number of irrigation communities, which are committed to reducing their groundwater abstractions in exchange for such flows, thereby reducing overexploitation.

In sum, we shall reflect these conflicts aiming to provide solutions from both legal and water governance perspectives.

2. Legal Principles Concerning Environmental Flows

2.1. The Implicit Requirement of Setting Ecological Flows in the Water Framework Directive (WFD)

The Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000, establishing a framework for community action in the field of water policy (WFD) [17], is the key rule for the environmental protection of water bodies in the European Union. It establishes homogeneous environmental objectives which are applicable in all Member States aiming to harmonize their legal frameworks to achieve good ecological status of water bodies. It was incorporated into Spanish legislation by Law 62/2003, 30 December 2003, which amends the 2001 Spanish Water Act (SWA) [18].

In the aforementioned Directive, the concept of ecological flow does not expressly appear. However, it does require water bodies to attain a good ecological status by 2015, including surface water and groundwater [19]. In order to achieve such result, the maintenance of a minimum flow that ensures the survival of the flora and fauna is necessary. Therefore, it can be affirmed that the setting of ecological flows in river courses is implicitly derived from EU regulations.

In Spain, the establishment of ecological flows is not uniform in current river basin management plans. Different levels of detail and the use of various methodologies can be observed. It is assumed that, in the new period of hydrological planning, some progress should be made in fixing these minimum flows in most water bodies.

The European Commission recently recalled that Spain should continue its efforts to establish ecological flows for all relevant water bodies and should also guarantee their effective implementation as soon as possible. It explicitly recommends Spain to: "ensure that the Ecological Flows established guarantee good ecological status", ordering the government to report deviations "on the basis of technical feasibility or disproportionate costs". According to this statement, the Commission is implicitly accepting derogations based on socioeconomic factors [20].

2.2. The Spanish Legal Framework on the Setting of Ecological Flows

The article 42.1.b.c of 2001 SWA [18] orders water authorities, in accordance with Constitutional Court case law, to set ecological flows by means of the river basin management plan. The article also offers a definition so to clarify the concept: "flows that are required to, at least, maintain the fish life that would naturally inhabit or could inhabit the river, as well as to preserve the riverside vegetation".

The 2007 Spanish Regulation on Hydrological Planning (SRHP) [21] links the WFD "good ecological status" goal to set ecological flows in all water bodies; indeed, article 3.j defines the ecological flow as the "flow that contributes to achieve the good status or good ecological potential in the rivers or in the transitional waters".

These articles certainly draw an ecological flow concept, but they also build it with a set of "indeterminate legal concepts" that require further interpretation. What is the life that would naturally inhabit the river? What does the "good state" or the "ecological potential" of the water body actually mean? Such terminology necessarily leads to an interpretation based on technical criteria which is not always homogeneous and uniform. It can be said that there is not a single possible and legitimate minimum ecological flow rate, but a set of options to identify the lower and upper threshold.

Case law also provides relevant information as an aid to interpret the concept. The Supreme Court judgement num. 2015/459, 2 January 2015, declares that minimum ecological flows must be set both in water bodies showing good ecological status as well as in heavily modified water bodies. The standards of protection and preservation should be more intense for the former. The main purpose is to maintain the biological and functional integrity of water bodies in order to ensure suitable habitat conditions according to the needs of the present ecosystems. To achieve that, the river basin management plan should offer a pattern of flows that should allow, at most, slight changes in the structure and composition of the aquatic ecosystems and associated habitats. The biological integrity of the whole ecosystem should be maintained.

On the other hand, according to SWA [18] and SRHP [21], ecological flows must be set in the context of a public participation process, allowing citizens and stakeholders to actively participate bringing their considerations. Along this procedure, other interests could emerge, including socioeconomic aspects or the will to achieve other environmental objectives that might even be incompatible with the ecological flows proposed thresholds. The decision, in sum, should seek a right balance between the environmental protection and the preservation of the existing water uses.

The setting of a particular minimum ecological flow rate is, therefore, a discretionary decision that each river basin management plan must make according to a proper justification and motives, without making arbitrary decisions. Once approved, the ecological flow becomes mandatory for everyone and water authorities must enforce it. According to case law, single derogations are not allowed unless otherwise stated by the plan (Supreme Court Judgement 3353/2018 of 3 October 2018).

According to article 59.7 of SWA [18], the ecological flow does not equate to water rights. It is considered an environmental restriction instead. This means that the environmental flow is not in competition with the rest of the potential uses and therefore must be ensured first, enjoying the highest priority. Only once it is ensured, the remaining available flows may be allocated for consumptive uses.

2.3. The Establishment of Environmental Flows at the River Basin Management Plans. A Discretionary Decision Based on Technical Studies and Public Participation

The setting of minimum ecological flow rates is just an instrument to reach the good quantitative and qualitative status of water bodies as the WFD requires [17]. The specification of minimum flow rates is therefore the result of a complex analysis that has to be made on the occasion of the drafting of the river basin management plans. The water authority, throughout the decision-making process, should pursue a fair balance between meeting the existing and potential demands and ensuring a minimum environmental flow.

The 2008 Spanish Hydrological Planning Instruction (SHPI) [22], defines two stages for the drafting of the river basin management plans and, consequently, for the setting of the environmental flow rates. Firstly, hydrological and environmental studies must be undertaken. The setting of ecological flows cannot be done without technical justification. Article 59 of the SWA [18] clearly states that the ecological flows will be specified by carrying out: "in-depth studies for each section of river". Such studies are carried out either directly by the water authorities or contracting them out. Secondly, a process of agreement with the regions and other public authorities has to be conducted. This will include a public participation stage called: "Significant Water Management Issues Provisional Scheme" (SWMIPS) [23], where stakeholders and citizens are welcomed to actively participate.

"Desirable" objectives of hydrographic studies are normally determined from an environmental point of view. These studies must identify the needs of the flora and fauna of the river. As flow rates should be determined at each river section, the water course is previously delimitated into units with similar characteristics and ecological needs. The analysis should be sufficiently exhaustive and complete, otherwise the flow rate set by the plan could be overturned by the Courts.

The technical studies are made according to 2008 SHPI technical standards [22]. However, as stated by the Supreme Court ruling of 20 January 2015, the SHPI is just an administrative instruction, a guideline whose content is therefore not mandatory (unlike regulations). That probably explains why each hydrological plan has used a particular methodology to estimate the ecological flow in its context.

Along with the technical analysis, as the Supreme Court has recently reminded (Supreme Court Judgement 309/2019. 11 March 2019), social and economic interests and even policy alternatives must also be weighed throughout the decision-making process. Desirable environmental flows are not always achievable [24] (p. 7).

Technical studies are therefore not enough. Water authorities must also ensure transparency and public participation, aiming to reach a broad-based consensus with the stakeholders whose proposals must, at least, be heard and responded (Constitutional Court judgement 227/1998, 29 November 1998).

The public participation process aims to contribute to the setting of fair ecological flows somehow accepted by citizens and stakeholders, which does not necessarily imply a shared decision: common points should be attempted to be reached, taking into account the plurality of interests whose compatibility must be sought, but the final decision will be unilaterally adopted by the water authorities (Supreme Court judgement 20 January 2015 and Supreme Court judgement 2 January 2015).

Water users have the right to be heard and can contribute with their comments, submissions, requests, and expert's reports in order to help reach a fair decision. Water authorities must give reasons to justify their decisions and must expressly answer all the claims, which should be substantiated by qualitative and quantitative references. In the participatory process, different scenarios must be taken into account, from maximizing the environmental objectives to maximizing the socioeconomic objectives. Within these limits, different ranges and options can be drawn, so that, in principle, there is no single fair solution, but rather a wide margin of discretion.

The establishment of environmental flow rates is undeniably an administrative discretionary decision. It is the result of a decision-making process in which the water authorities will make a choice between different options all of which are perfectly acceptable and lawful; a decision where there is a broad margin of appreciation.

This is clearly evidenced observing the marked differences that can be seen in the river basin management plans approved so far. Some of them have chosen to set higher ecological flows with strong impact on existing uses, while others have limited themselves to setting low or merely indicative minimum flows; in addition, depending on the plan, different enforcing strategies and compliance conditions have been established (conditions to modify current concession rights, guidelines for setting compensations, timelines, derogations in drought situations, etc.). In short, a complete methodological uniformity in the drafting of the different hydrological plans has not yet been reached [25] (p. 327).

2.4. Key Principles Concerning the Setting of Environmental Flows According to Spanish Case Law

Setting a particular ecological flow rate is a wide discretionary power that can be monitored by Courts. The limit of the government´s margin of discretion is the prohibition of arbitrariness. Therefore, water authorities must point out in the planning documents the reasons that support their decision. Courts will be allowed to verify whether the final decision has been made in accordance with current regulations, the general principles of Law, the factual conditions, and whether it is the result of a rational, reasonable, and fair assessment.

To evaluate whether ecological flows set in river basin management plans are arbitrary or not, Spanish case law have drafted a set of principles:

The Spanish Supreme Court has stated that the ecological flows must be set "with the least possible detriment to the existing water rights" (Supreme Court judgements: 2 July 2014; 11 July 2014; 5 December 2014). A recent judgement expressly cites the principle of "proportionality" as a valuable tool of interpretation intending to evaluate the accuracy of environmental flows (Supreme Court judgement 11 March 2019). As a result, in accordance with case law, every possible restriction which may cause substantial damage on existing water rights should be the least possible.

In our opinion, other general principles of the Law, such as "equity", could also be applied. It does not seem equitable to put on some specific users the burden to bear most of the consequences of improving ecological flows; a fair treatment for all water rights' holders should be sought at the river basin district level. On the other hand, the principle of "equal treatment before the Law" should involve the use of a homogeneous methodology for the setting of ecological flows in river basin management plans, which has not been done so far. At least, the planning authority should justify in depth why a particular methodology is used. The implementation of diverging methodologies for calculating ecological flow rates can generate inequalities between the users of the different river basins.

Needless to say, planning must also take into account the principles of "legal certainty" and the "protection of legitimate expectations" in order to strike a balance between environmental protection and water rights. If the establishment of the new or higher ecological flows would eventually set limitations on water rights, their legitimate holders should be properly compensated [14] (p. 154). Moreover, the principles of "rationality" and "reasonableness", which are typical tests for examining discretionary powers, should also be applicable: ecological flow rates should therefore be laid down to the amount which is strictly necessary to reach the objective pursued.

All the aforementioned principles must be taken into account in the river basin management plans' approval proceedings, and the stakeholders are expected to give their feedback by submitting technical, legal, and economic suggestions, claims, and expert reports.

On the other hand, it is also worth considering that the good ecological status of rivers does not exclusively depend on their quantitative status; in fact, many water bodies are in a poor condition as a consequence of polluted flows or deficiencies in wastewater treatment systems. These quality issues should not be faced by means of establishing higher flow rates (so diluting polluted flows). Instead, they should be addressed through a series of comprehensive strategies to reduce the sources of pollution.

It will also be necessary to assess other environmental factors as the qualitative and quantitative groundwater status, since setting or increasing environmental flows in surface waters may sometimes jeopardize the implementation of appropriate and cost-effective remediation strategies for aquifer systems.

Finally, the socioeconomic consequences that may derive from the setting of the minimum environmental flow rate must be fairly evaluated. The legal principle of "water economy", which is established by article 14 of the 2001 SWA [18], involves the consideration of this variable in the setting of ecological flows. The impact of environmental restrictions on the economy and the social context (job losses, rural depopulation, immigration, etc.) should therefore be assessed in the decision-making process, providing water is an extraordinary relevant economic input for many economic activities of great importance to society. The satisfaction of water demands is therefore a legitimate target in water policies.

The Supreme Court has recently recalled the need to take into account the socioeconomic consequences in the decision-making process leading to the approval of the river basin management plans (Supreme Court judgement 11 March 2019). A fair balance between ensuring sufficient ecological flows and the preservation of economic activities based on existing water uses should be therefore sought (Supreme Court judgement 21 January 2015).

3. Groundwater Protection as a Key Strategy in Water Policies and the Law

Groundwater protection policies have been a priority under EU Law from an early stage. Before the 2000 WFD was enacted, a number of Directives were passed so to address specific aspects of groundwater protection: the Directive 80/68/EEC on the protection of groundwater against pollution caused by certain dangerous substances provided a ground-breaking groundwater protection framework; the Council Directive 91/676/EEC of 12 December 1991, concerning the protection of water against pollution caused by nitrates from agricultural sources, addressed this important perspective on groundwater conservation.

In 1996 the European Commission presented a Proposal for a European Parliament and Council Decision on an action program for integrated groundwater protection and management (COM (96) 315 final, 10 July 1996). The 2000 WFD dedicates an important part of its articles to ensuring the protection of the good quality status of groundwater resources [17]. In fact, the Directive declares that groundwater is more vulnerable that surface water and, therefore, reinforced preservation policies should be implemented.

In order to complete such regulatory framework, in 2006 a specific directive on groundwater protection was enacted (Directive 2006/118/EC of the European Parliament and of the Council of 12 December 2006 on the protection of groundwater against pollution and deterioration). Other EU Directives have indirect links to the protection of groundwater bodies (Waste Framework Directive (2006/12/EC); Landfill Directive (99/31/EC); Biocides Directive (98/8/EC); Urban Wastewater Treatment Directive (91/271/EEC), among others). In sum, it can be said that groundwater protection is a milestone in European Union policies.

Groundwater bodies' protection actions are required to ensure good qualitative (chemical state) and quantitative (overexploitation) status. This follows from the definition of "good groundwater status" as provided in section 20 of article 2 WFD. The WFD defines the "quantitative status" of groundwater bodies as: "an expression of the degree to which a body of groundwater is affected by direct and indirect abstractions" [17] (section 26, art. 2.). With regards to the WFD environmental objectives, article 4.1. (b) (ii) orders State Members to "protect, enhance and restore all bodies of groundwater, ensure a balance between abstraction and recharge of groundwater, with the aim of achieving good groundwater status at the latest 15 years after the date of entry into force of this Directive".

From the general provisions of the WFD, it follows:

- Groundwater protection, both in its qualitative and quantitative dimensions, must be a priority in community policies.
- In particular, the Member States must ensure groundwater bodies' good quantitative status by fighting against overexploitation, which must be a priority policy.
- Groundwater must be managed in coordination with surface water resources, since both are in continuous interaction within the water cycle. In fact, groundwater protection against overexploitation is instrumental in terms of achieving good quantitative and qualitative surface water status.

The WFD also makes it clear that the recovery of groundwater good quantitative status must also contain proactive measures to ensure the regeneration of those aquifers that are in a status of overexploitation. Specific and active policies must be clearly oriented for that purpose.

These objectives have been properly inserted in the Spanish legal framework on water resources. The 2001 SWA orders to promote the sustainable use of water by means of protecting all the available resources [18] (art. 92.b SWA, as drafted by Law 62/2003 of December 30) [26] (p. 183). In addition, article 35 of the Spanish Regulation on Hydrological Planning [21] mentions among the key environmental objectives for groundwater management, the need "to protect, improve and regenerate all groundwater bodies ensuring a right balance between abstraction and recharge in order to achieve good groundwater status".

To further develop these objectives, the European Union sanctioned the Directive 2006/118/EC of the European Parliament and of the Council of 12 December 2006 on the protection of groundwater against pollution and deterioration. The Directive outlines that groundwater is the most significant water resource in the European Union, also underlining that it is the main source for drinking water supply. This directive was transposed into Spanish Law by means of the Royal Decree 1514/2009 of 2 October 2009. The concern about the quantitative status of Spanish groundwater bodies is clearly shown in this rule.

From the analysis of the 2006 Directive and the Spanish Law, it follows:

- The protection of groundwater is a priority in both EU Law and Spanish domestic Law. Groundwater is considered as the most vulnerable water resource.
- The recovery of groundwater bodies' good quantitative status requires coordinated actions in the management of surface and groundwater resources. In the absence of good quantitative groundwater status, ensuring ecological flows in surface water bodies becomes really challenging. The aquifer overexploitation detracts flows from surface water bodies due to the natural dynamics of the basins.
- In order to recover the good quantitative status of groundwater bodies it is necessary to carry out a number of proactive measures. A good strategy should be to replace current groundwater withdrawals dedicated to irrigation by reclaimed water as it will be discussed in the next section of this article.

In sum, groundwater protection should be given priority, taking into account the possible long-lasting adverse effects of climate change on these type of water bodies [27].

4. Case Study. A Difficult Choice: Setting Higher Ecological Flows by Means of Pouring Reclaimed Water into the Vinalopó River (Alicante, Spain) vs. Allocating such Resources for Agriculture, thus Reducing Groundwater Abstractions in Overexploited Aquifers

4.1. Groundwater Overexploitation in the Study Area

In accordance with article 171.2 of the Spanish Regulation on Water Resources Management (SRWRM) [28], after amendments by RD 606/2003, the aquifers are regarded as legally overexploited when both the continuity of existing water rights and the good ecological status of the water body are put at risk as a consequence of total annual abstractions higher (or very close to) than the average year-on-year natural recharge rate. There will also be overexploitation when abstractions are carried out in a way that generates significant deterioration in water quality. Finally, the same situation will take place when the abstraction rate is such that, even if there is no current imbalance, the long-term sustainability of the aquifer could be compromised.

Some authors understand that the key condition for considering an aquifer overexploited is not actually found in its renewal rate. The outgoing water flows which are required to ensure the ecological flows in surface water bodies and to protect the associated ecosystems should be evaluated instead [29] (p. 268).

The study area is located inland Alicante Province, near the city of Villena (Spain). In the region, it flows a non-permanent river (called Vinalopó) which, under natural conditions, lacks continuous flows during most of the year. It is a typically Mediterranean non-permanent water body which experiences severe flood events along with long-lasting droughts. The river also disappears in some sections due to infiltration into the aquifer. A good part of its flows come from some municipal wastewater treatment plants (WWTP). These municipalities usually get drinking water from groundwater abstractions.

In Figure 1 the location of the study area can be seen. The exact location of the irrigation area where the Irrigation Communities are currently using reclaimed water from Villena WWTP is also shown.

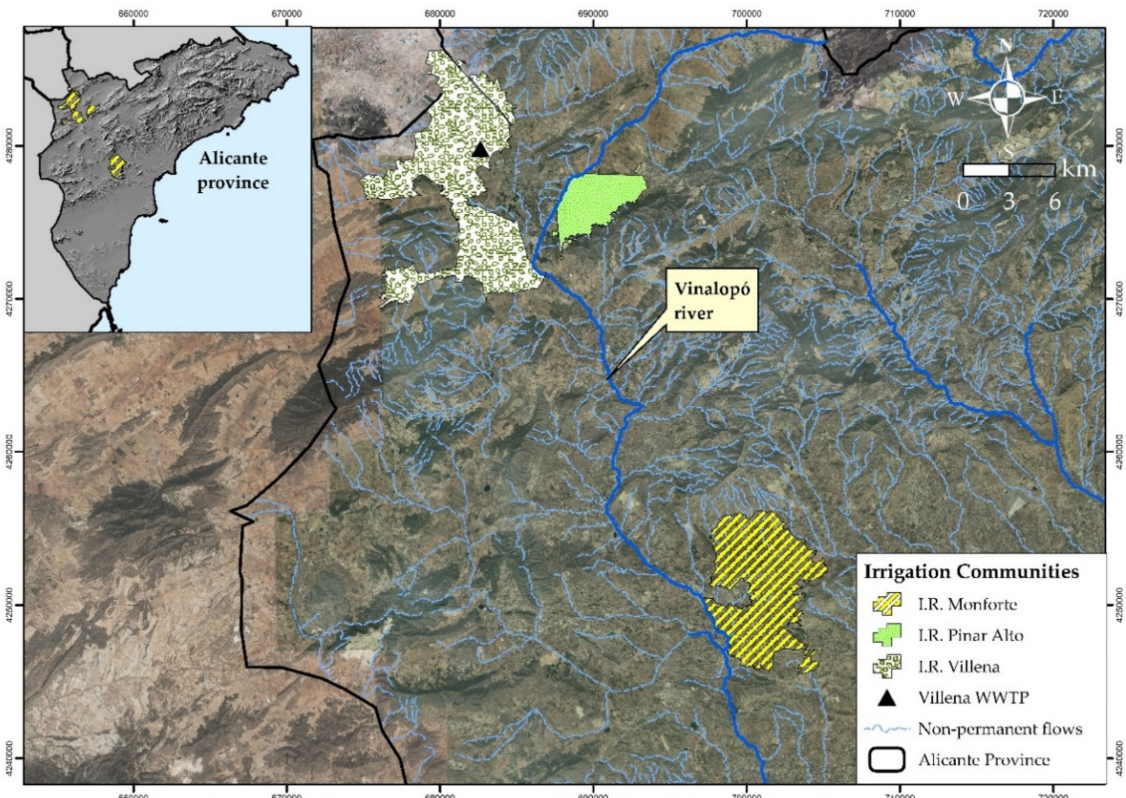

Figure 1. Study area: Monforte del Cid, Pinar Alto and Villena Irrigation Communities. Source: [30].

Most of the aquifers in the study area present a situation of serious and intensive overexploitation [31,32]. In fact, in accordance with the Júcar River Basin Management Plan (Annex 12) [33], the quantitative status of groundwater bodies in the study area is regarded as unsatisfactory (Figure 2).

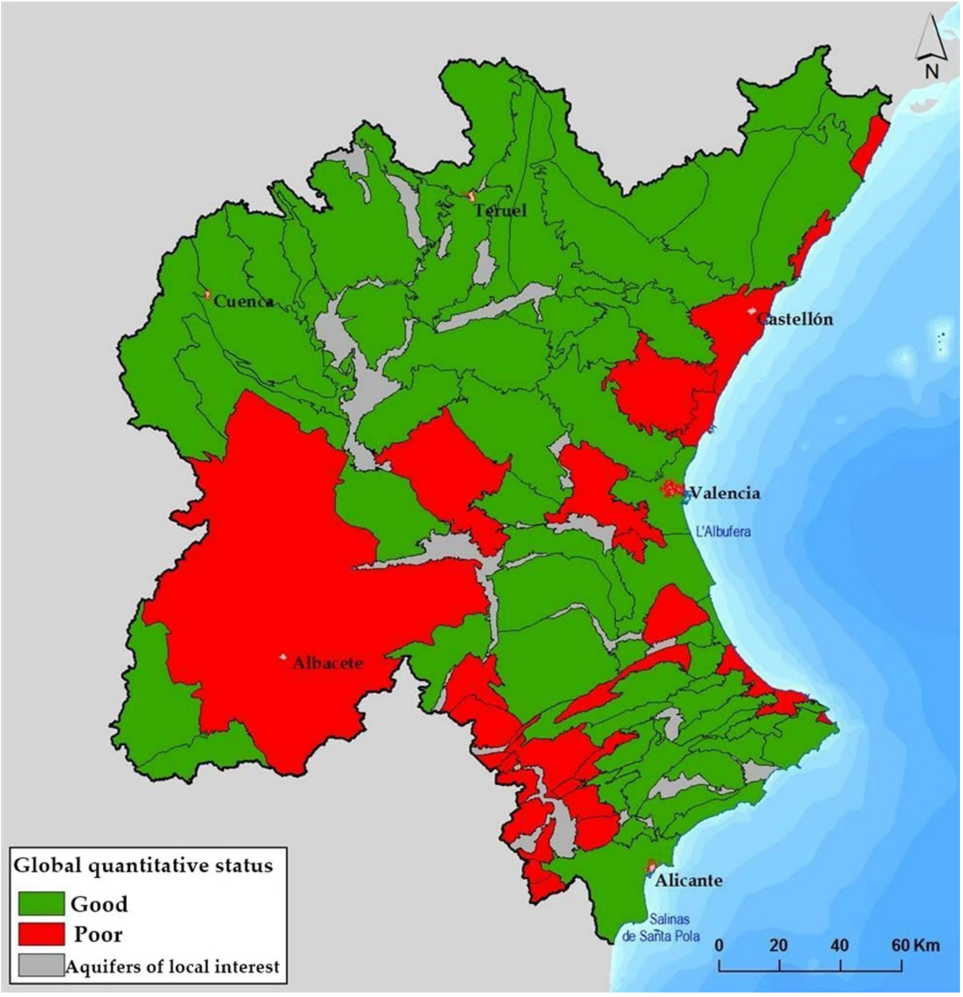

Figure 2. Groundwater bodies' quantitative status in Júcar Demarcation. Source: [33].

The overexploitation of these aquifers has been determined on the basis of the application of three complementary methods (test on water balance; test on the impact on surface water bodies; test on the environmental status of water-dependent ecosystems).

The water balance test allows determining whether the available resources are lower than the average annual rate of abstractions, which results in decreasing piezometric levels. The test offers an accurate picture of the situation of overexploitation. The study area is in a poor quantitative status according to this test (Figure 3).

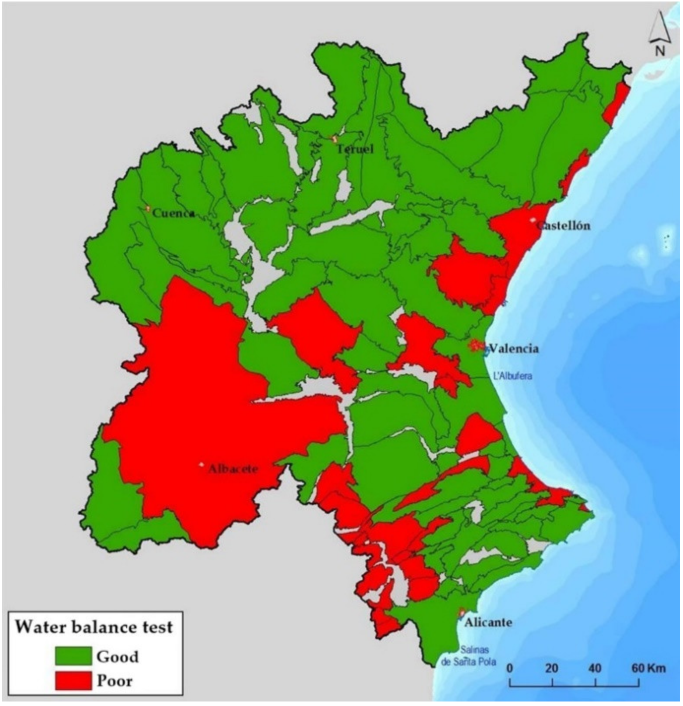

Figure 3. Groundwater in poor quantitative status according to the "water balance test" in Júcar Demarcation. Source: [33].

The test on the impact on surface water bodies aims to determine whether the rivers can achieve their environmental objectives in spite of the anthropogenic alterations on groundwater piezometric levels. In the study area, this test offers a clear image of the limited contribution of the aquifers to the river flow. This also confirms that the aquifers in the area are in poor quantitative status (Figure 4).

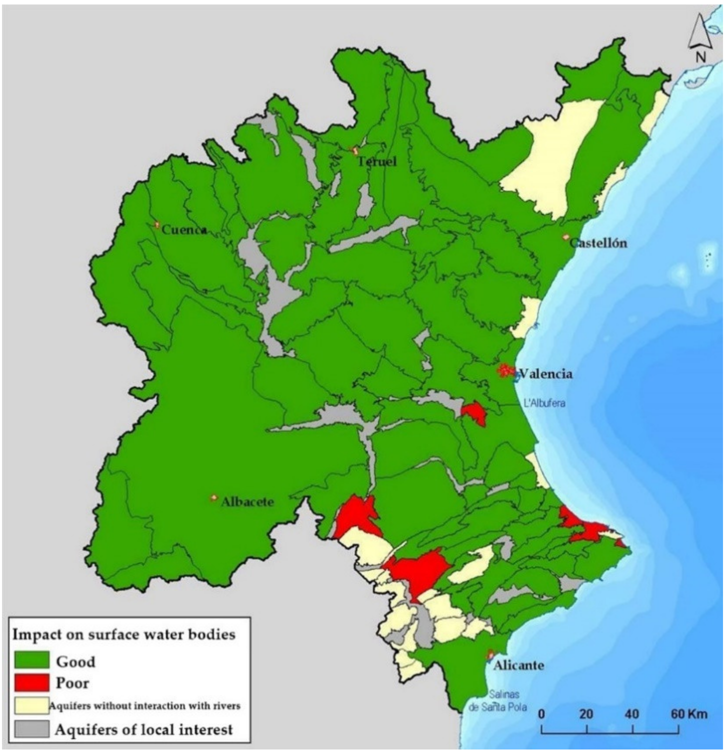

Figure 4. Groundwater in poor quantitative status according to the test on the impact on surface water bodies in Júcar Demarcation. Source: [33].

The test on water-dependent ecosystems also proves that groundwater bodies in the study area are in poor condition, as shown in Figure 5.

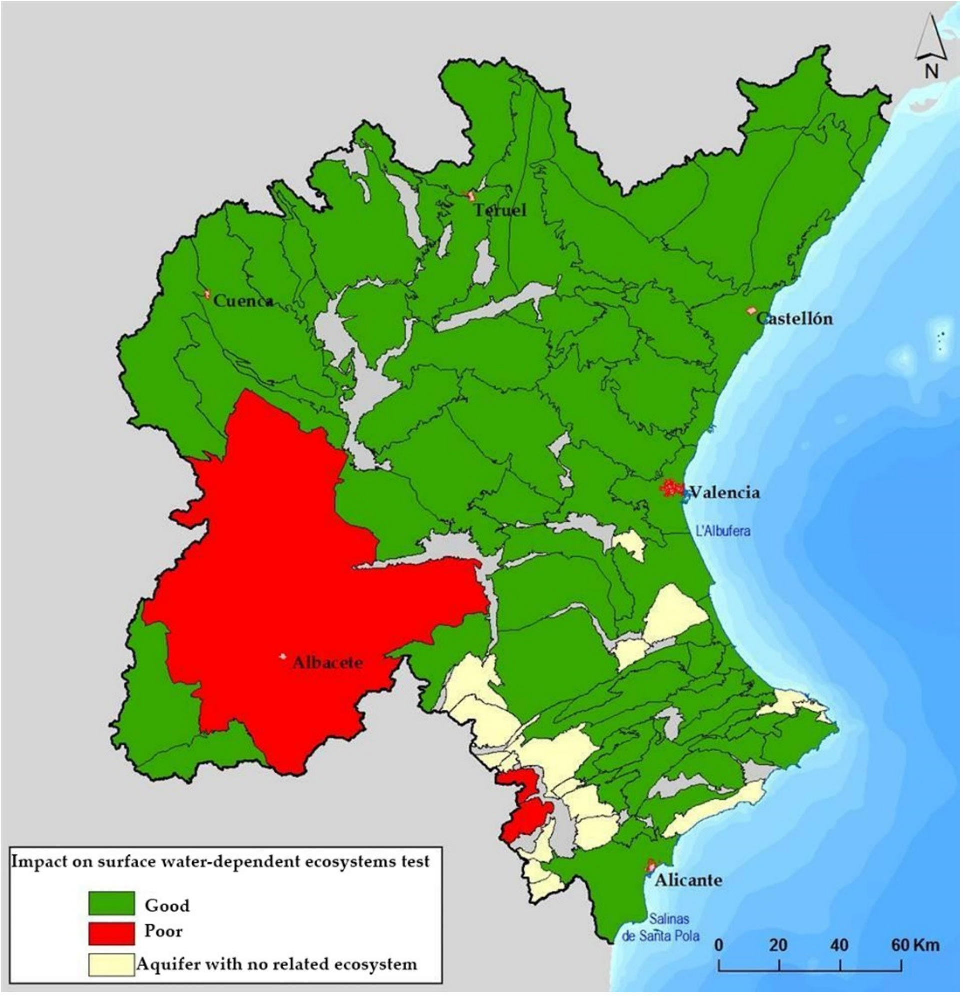

Figure 5. Groundwater in poor quantitative status according to the test on the impact on surface water-dependent ecosystems in Júcar Demarcation. Source: [33].

It can be concluded that, according to the information contained in the maps shown, the situation of the aquifers in the middle section of the Vinalopó River is clearly overexploited.

This conclusion is confirmed taking into account the high abstraction rates that are facing the groundwater bodies located under the irrigation communities' farmland. According to 2008 SHPI [22], a groundwater body or a group of them is in poor condition (under significant pressure) when the Exploitation Index (EI) (the ratio between total abstractions and total available resources) is greater than 0.8 and there is a clear decreasing trend on piezometric levels. Applying this index, virtually all of the groundwater bodies totally or partially located under the studied irrigation area are in poor condition (EI > 0.8) or at least are close to such status [30,34].

Only the groundwater bodies num. 080.190 (Bajo Vinalopó) and num. 080.186 (Sierra del Cid) are in good condition (EI of 0.1 and 0.7, respectively). On the contrary, the groundwater body num. 080.174 (Peñarrubia) presents an EI of 2.0, while num. 080.160 (Villena-Benejama) has an EI of 1.8; Likewise, groundwater body 080.160 (Villena-Benejama) has an EI of 1.8, and num. 080.173 (Sierra del Castellar) presents an EI of 6.4 [30,34].

Considering the analyzed data, it seems clear that the Júcar River Basin Authority (CHJ) should focus on the reduction of groundwater withdrawals in this area. The objective should be to achieve a long-term annual average extraction rate that does not exceed the available resources (EI < 0.8), so that the piezometric level of the aquifers could progressively recover. This would also help improving surface water bodies quantitative status, thus ensuring higher ecological flow rates.

4.2. Use of Reclaimed Water to Replace Groundwater Abstractions in the Study Area. Provisional Authorization and Suspension of the Process for Granting a Concession

Three Irrigation Communities (IC. Villena; IC. Monforte del Cid: IC. Pinal Alto), all of which are members of the Alto Vinalopó General Irrigation Community (AVGIC), have been benefiting from regenerated flows from Villena wastewater treatment plant (WWTP) since at least 1995 thanks to a series of consecutive provisional authorizations. According to data from 2018, Villena WWTP serves a total population of 31,285 inhabitants, and can treat a flow of 7193 m^3/day. The facility lacks tertiary treatment but has secondary treatment through prolonged aeration and aerated lagoon [35].

A first provisional authorization to use 2 hm^3/year of Villena WWTP reclaimed water was granted on 10 May 1995 and later on regularly extended with small variations in the authorized volume. In 2016, 2.4 hm^3 of reclaimed water was used. A minimum ecological flow rate of 0.10 m^3/s was set in the section of Vinalopó River called "Acequia del Rey", downstream the WWTP.

In 2000, aiming to strengthen its legal position, AVGIC requested an annual concession on Villena WWTP reclaimed water estimated at 2 to 2.3 hm^3/year which, surprisingly, is still pending and awaiting a final decision from the Basin Authority [Administrative record num. 3453/2000 (2000RU0014)]. According to AVGIC application, the irrigation communities are committed to reducing their rates of abstraction from overexploited aquifers by at least 50% of the obtained regenerated flows. In other words, groundwater extractions based on pre-existing water rights would be voluntarily reduced by an approximate volume of 1,150,000 m^3/year.

In principle, the Irrigation Communities would renounce said right. However, it should be noted that groundwater resources are not always available, even though they may have been formally granted by means of a water concession. It depends on the real availability. Thus, it is important to figure out whether such reductions are real and effective. In fact, in the case study the reductions would be real, providing a number of reports drafted by the Júcar River Basin Authority have supported this project during the proceeding for granting the concession [30].

After almost 20years of processing time and loads of paperwork before the Júcar River Basin Authority (CHJ), and despite the aforementioned favorable reports, a new and out of time report from the CHJ Hydrological Planning Office dated 16 July 2018 has led to the suspension of the proceeding. A study commissioned to a prestigious research center to determine the advisability of raising the ecological flows of the river at the "Acequia del Rey" section is the reason why the suspension is recommended. As a result, the proceeding will likely be stayed until the new Júcar River Basin Management Plan is approved, which is expected by the end of 2021. The study has not been released to date.

If the increase of the ecological flow rate at Acequia del Rey was finally approved (now it is 0.10 m^3/s), it would be carried out by using all or part of the Villena WWTP regenerated flows, which would make it impossible to allocate such resources for farming.

On the other hand, it is worth pointing out that, according to CHJ Water Rights' Register [36], the drinking water that is consumed by the municipalities in the area of study, whose wastewater is later treated and regenerated at Villena WWTP, does not come from the Vinalopó River itself, but from groundwater resources. As it can be seen in CHJ Water Rights' Registry Office [36], one record confirms that Villena City Council is using groundwater from the aquifer 8.36 Villena-Benejama and from the aquifer 8.33 Almansa, to a maximum annual volume of 3,177,756 m^3 for urban supply, later on treated in Villena WWTP. Therefore, it does not seem reasonable to discharge this treated wastewater into a non-permanent water body to create an artificial ecological flow, instead of allocating it to another use that may contribute to groundwater recovery.

In sum, in the case study there is a clear conflict between two legitimate environmental objectives: the recovery of groundwater bodies and the increase of the ecological flow in one surface water body; a conflict that should be resolved in the current third period of river basin planning.

4.3. The Alternative of Raising the Ecological Flow in the Vinalopó River by Using Reclaimed Water as a Matter Under Discussion in the Third Period of River Basin Planning (2021–2027)

Spanish Water Authorities' latest policies seem to give priority to establishing or eventually increasing the ecological flow rates in most water bodies relegating to the background other legitimate objectives. This policy often conflicts with existing water rights. For instance, it has been recently proposed to raise the Tagus River current minimum ecological flows, which could greatly impair the prospects for future water diversions from this river to the River Segura by means of the Tajo-Segura Transfer [37]. Another good example can be seen in the 2015 Júcar River Basin Management Plan, which orders the River Basin Authority to ensure a minimum flow rate downstream Guadalest Dam in Alicante Province, which would jeopardize water supply in some municipalities in summertime under drought conditions [38].

The new Júcar river basin plan, where the Vinalopó sub-basin is included, is currently at an advanced stage of the approval process. At this point, the water authorities are carrying out the public participation phase, in which the public document: "Significant Water Management Issues Provisional Scheme" (SWMIPS) is under discussion.

In relation to the Vinalopó River, topic num. 2 of the SWMIPS [23] (p. 81), called "hydro-morphological alterations", points out: "The complete fluvial restoration of this water body encompasses a set of actions that must be undertaken in a holistic way and which should include, among others, the following aspects: (…) Improvement of the effluents of WWTPs and the discharge of their effluents to the river, in order to recover circulating flows in the short and medium term. This measure should be applied at least until there is a natural recovery of piezometric levels in the aquifers that allows their connection to the river again".

On the other hand, the SWMIPS seems to favor alternative 1, which recommends either the establishment or increase of ecological flows in all non-permanent rivers, therefore including all the sections of the River Vinalopó. A socioeconomic assessment is not found relevant under such scenario. These types of studies should only be requested in case alternative 2 is chosen, which only takes place when a substantial raise of current ecological flows with relevant impacts to existing water uses may take place. The document clearly states: "as an additional and more ambitious possibility than alternative 1, alternative 2 would include new minimum flows much higher than the current ones, closer to the natural regime. A greater resilience of the rivers would be obtained facing negative impacts such as pollution episodes, the climate change, extraction pressures, etc. This option would have a deep impact on existing uses, mainly on agriculture, therefore requiring a socioeconomic analysis" [23] (pp. 51–52). Finally, alternative 0 would substantially leave things as they are in current 2015 Júcar River basin management plan (0.10 m^3/s at Acequia del Rey) [39].

In sum, it can be affirmed that SWMIPS draws at least two scenarios (alternatives 1 and 2) in which (if the basin plan is approved accordingly) the feasibility of obtaining a concession on reclaimed water from Villena WWTP would almost be impossible.

4.4. The Socioeconomic Relevance of the Activities that the Irrigation Communities Carry out in the Study Area

The Irrigation Communities currently benefiting from Villena WWTP reclaimed water (by means of a provisional authorization) are composed of more than 3000 members (IC. Villena: 1326; IC. Monforte del Cid: 1200; IC. Pinar Alto: 670). With such water resources and their own groundwater rights the communities carry out a relevant farming activity. Orchards and vineyards stand out as their main outputs, together with fruits and cereals.

Considering a total surface of 4466 ha, the following figure shows the number of hectares dedicated to each type of crop in Villena Irrigation Community, as well as the percentage of the total AVGIC activities that each production represents (Figure 6).

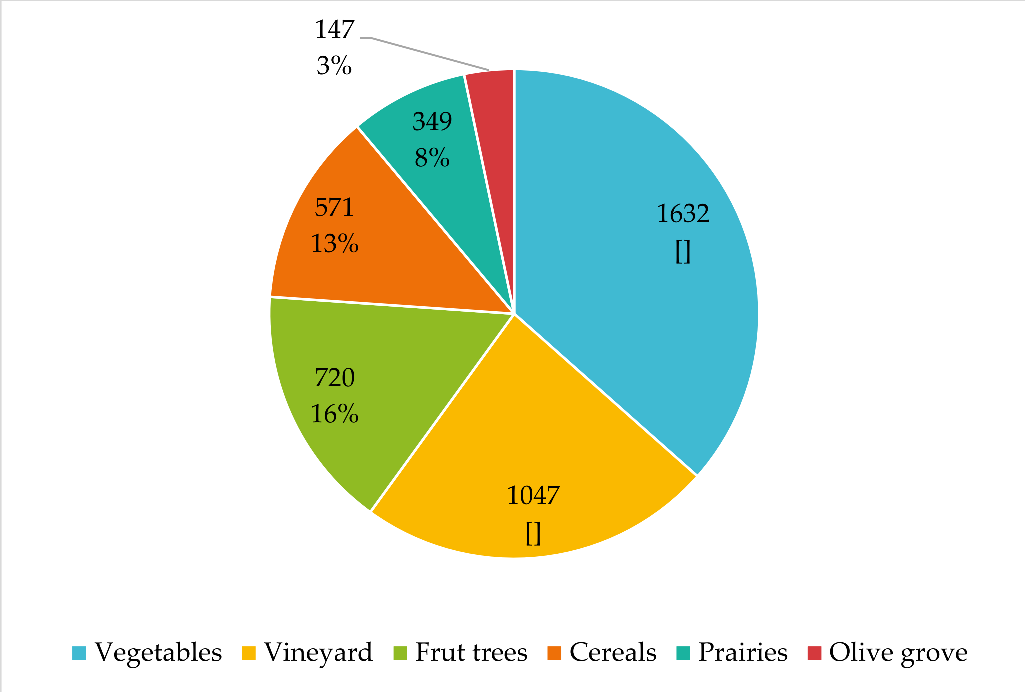

Figure 6. IC. Villena: cultivated area (hectares) and percentage of the total Alto Vinalopó General Irrigation Community (AVGIC) farmland (%) by type of crop. Source: Data reported by IC. Villena. Own elaboration.

Monforte del Cid Irrigation Community has a total cultivated area of 3200 ha, as shown in Figure 7. Likewise, the figure shows the number of hectares dedicated to each type of crop and the percentage of the total AVGIC activities that each production represents. The vineyard is certainly an outstanding activity in this community.

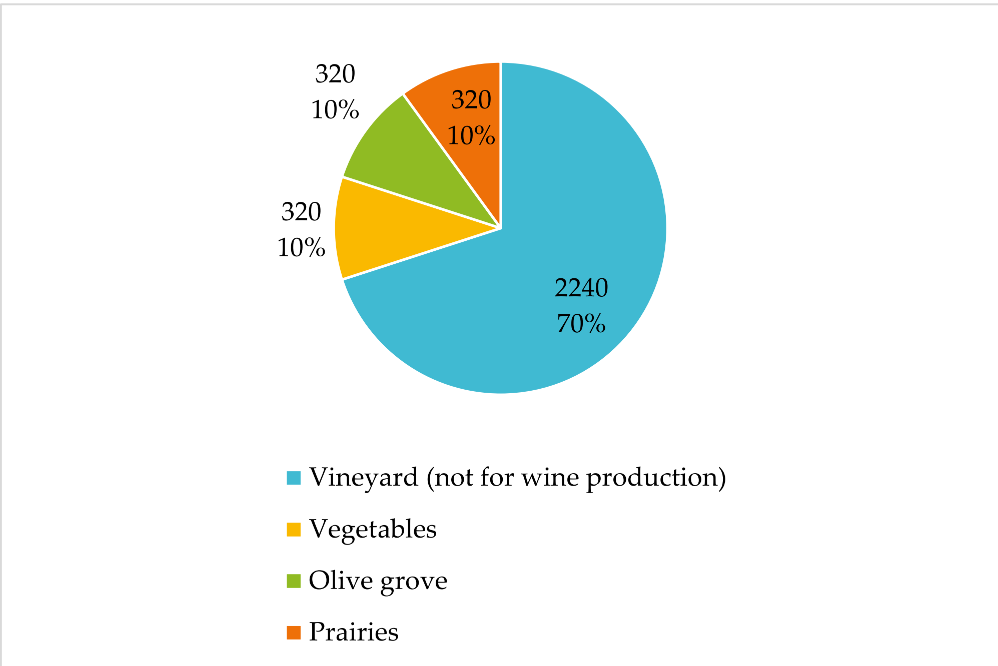

Figure 7. IC. Monforte del Cid: cultivated area (hectares) and percentage of the total AVGIC farmland (%) by type of crop. Source: Data reported by IC. Monforte del Cid. Own elaboration.

The values corresponding to Pinar Alto Irrigation Community are listed in the following figure, accounting for a total farming area of 738 ha (Figure 8).

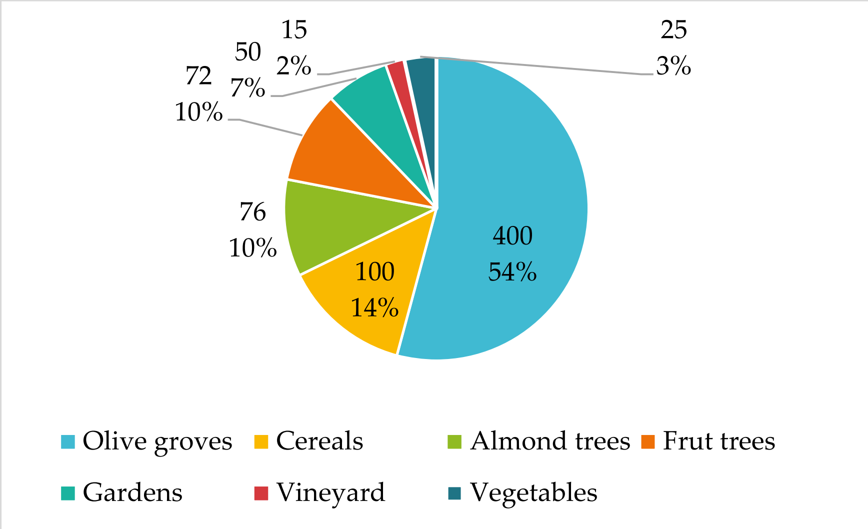

Figure 8. IC. Pinar Alto: cultivated area (hectares) and percentage of the total AVGIC farmland (%) by type of crop. Source: Data reported by IC. Pinar Alto. Own elaboration.

These agricultural activities and their related activities are essential to maintain the rural population in the study area. They also contribute to the creation and maintenance of a significant number of jobs that in many cases employ people at risk of unemployment and social exclusion. There is no alternative employment for these disadvantaged groups in the area and a very substantial part of the economic structure is based on agriculture as well as on the agro-food industry. Some of the productions shown in Table 1, such as fruit trees or vineyards, have led to high value-added export-oriented businesses.

It has to be stressed that meeting water demands is undoubtedly a legitimate goal of hydrological planning, which must be compatible with the environmental protection of water bodies [25].

These agricultural activities are cost-effective, increase carbon sequestration, improve the landscape, and help curb desertification. Reclaimed water from Villena WWTP makes a decisive contribution to the maintenance and economic sustainability of these activities, since it has proven to be an affordable solution to overcome the limited availability of water resources in the area. Table 1 shows the average cost structure identified in the irrigation communities under study.

Table 1. Average crop production annual costs in the Irrigation Communities. Source: Data reported by AVGIC. Own elaboration.

Crops	Costs, Not Including Water (€/ha)	Costs of Water (€/ha)	Costs of Water (€/m³)	Water Consumption (m³/ha)	Total Production Costs (€/ha)	Total €/kg	Cost of Water as a Percentage of Total Production Costs (%)
Carrot	6925.00	1870.00	0.22	8500	8795.00	0.1725	21.26
Leek	11,800.00	1760.00	0.22	8000	13,560.00	0.4843	12.98
Celeries	15,500.00	2200.00	0.22	10,000	17,700.00	0.3933	12.43
Cherry	12,371.43	1178.00	0.22	5500	13,549.43	1.5808	8.69
Olives	1093.75	438.00	0.22	1800	1531.75	0.3631	28.59
Grapes for wine production	2310.86	378.00	0.22	1500	2688.86	0.2011	14.06

Grapes not for wine production	10,400.00	1575.00	0.22	3500	11,975.00	0.3992	13.15

The cost of water includes unforeseen outlays.

This table shows the relevant impact of water costs on the final cost of the products. The unit cost of water is nearly €0.22/m³ including reclaimed water costs and groundwater costs. According to data provided by AVGIC, the cost of €0.22/m³ is what final users (the community members, most of which are farmers) actually pay. It includes all the costs supported both, by AVGIC and the ICs. The €0.11/m³ corresponds to groundwater abstraction cost (paid by the IC), in other words, the average total energy cost (variable + power). Reclaimed water cost (paid by AVGIC) amounts to €0.066/m³ and is broken down as follows (Table 2):

Table 2. Reclaimed water costs. Source: Data reported by AVGIC. Own elaboration.

Cost Element	Costs (€/m³)
Sodium hypochlorite treatment	0.0040
Control analytics	0.0026
Energy (power + variable)	0.0392
Proportional cost attributable to facilities	0.0156
Proportional cost attributable to personal expenses	0.0046
Total	0.066

Reclamation flows are also charged for the amortization costs (storage and distribution infrastructures). The IC may also bear with other additional expenses such as algaecides, etc.

In Spain, reclaimed water production costs range between €0.06 and 0.48/m³, while transport costs range between €0.15 and 0.40/m³, not including the amortization of the infrastructure [40]. In the case study, the irrigation communities are in the lowest range of reclaimed water production costs (0.066).

Breaking down by product categories, it can be seen that the cost of water represents 21.26% of the total production costs for carrots, 12.98% of the total for leeks, 12.4% for celeries, and 8.69% for the cherry tree. This percentage rises significantly for the olive grove, since water represents 28.59% of the total production cost; 14.06% of the total cost for growing grapes destined for wine production is associated to water, while in the case of grapes for direct consumption it is 13.15%.

The cost of using alternative resources, in particular desalinated water from seawater desalination plants would be significantly higher and would cause a significant increase in prices of agricultural products. This could result in total cessation of agricultural activities. Desalinated water price at the closest desalination plant to the irrigation area (Mutxamel Desalination Plant) ranges from €0.38/m³ to 0.69/m³ as shown in Table 3. To this sum we have to add the transporting and delivering costs, since desalinated water should be pumped and transported some 25 km inland and elevated to an average height from 200 to 500 m (I.C. Monforte del Cid and I.C. Villena, respectively).

Table 3. Prices of desalinated water from Mutxamel Desalination Plant (paid by Consorcio de Aguas de la Marina Baja) (CAMB) (1999–2016). Source: [41].

Year	1999	2000	2001	2015	2016
€/m³	0.38	0.38	0.38	0.69	0.69

years 1999, 2000, and 2001 show a subsidized price.

In sum, it can be affirmed that the cost of desalination in Spain remains a major obstacle to reaching its full potential. For agricultural purposes, the greater use of this type of resource has taken place in periods of severe drought, when the Government agreed to subsidize part of the costs [42]. Apart from this exceptional situation in which, according to the Law, state aids are temporarily allowed (thus derogating the application of the WFD full recovery cost principle), the use of desalinated water for farming has been marginal so far.

As observed in the cost structure of crops in the study area (Table 1), water costs have a significant impact on typical farm operating costs. According to the European Environment Agency in 2003, the average use of water was 7000 m^3/ha compared to less than 2000 m^3/ha in western and northern Europe [43] (p. 23). The need for particularly cheap and relatively easily accessible water is therefore of significant importance for the competitiveness and sustainability of the agricultural industry.

5. Examining Decisions on Ecological Flows. Legal Grounds

The setting of minimum environmental flow rates, even in non-permanent river courses, is a legitimate purpose aiming to achieve good ecological status in all water bodies. This strategy, however, could even lead to the creation of artificial ecosystems. The action of man has frequently created wetlands in the past (reservoirs, ponds, etc.). These places have consolidated over time as important natural areas worthy of protection. Ensuring a continuous flow in non-permanent rivers leads, to some extent, to create artificial ecosystems. In principle, there is no legal barrier to it.

Setting an ecological flow rate, which is undoubtedly a remarkable environmental goal, may have, however, a negative impact with respect to another also legitimate environmental objective. The new ecological flows, while improving surface water status, may at once complicate certain actions and policies eventually compromising the environmental restoration of other water bodies, as it has been shown in the case study. An adequate balance should be sought between both environmental objectives.

On the other hand, setting new ecological flows should also be made compatible with the satisfaction of existing water rights and water demands. The decision maker should not underestimate the socioeconomic context linked to the use of water. The maintenance of biodiversity is a desirable objective, but water is also an important trigger of numerous economic activities and jobs. Therefore, this perspective should be addressed in the decision-making process in order to reach a fair choice between all the alternatives and scenarios.

The quantification of the ecological flow rate is a discretionary decision which is made in the context of the proceeding for the elaboration of river basin management plans. It involves the selection of one alternative among several possible ones, all of which are lawful. Various scenarios and alternatives are therefore considered in the decision-making process and one of them must be selected, aiming to reach an adequate balance between existing and potential demands and the protection and enhancement of biodiversity. In order to help reaching the best decision possible, the water authority must order first a thorough study of the hydrological basin. Once the study requested has been carried out, a global assessment has to be done as part of the public participation stage (SWMIPS). At this stage of the procedure, all the variables will be discussed, including those of a social or economic nature.

As any other discretionary decision, the determination of the appropriate ecological flow rate can be challenged before Courts in case it is considered to be against the law. It must be taken into consideration that the river basin management plans are, in formal terms, subordinate legislation (not a product of the Legislative branch; just rules approved by the public administration). Therefore, specific provisions contained in hydrological plans can be monitored by Courts.

A set of guidelines aiming to help examine whether the decisions on the establishment or increase of ecological flows in river basin planning have been correctly done, are next proposed (Table 4).

Table 4. Guidelines for examining decisions on ecological flows. Source: author's own elaboration.

Elements of the decision	Assessment and evaluation
Regulatory elements with only one possible result according to Law	Checking whether the ecological flow rate has been established: – By the competent authority (competence). – In accordance with the rules of procedure (due process). – Having answered all the allegations and suggestions submitted by citizens and stakeholders (transparency and accountability). – Having met all the substantive legal conditions stated in the Law, in subordinated legislation, and even in guidelines and other administrative instructions regarding ecological flows. This test refers to all the legal conditions that has to be enforced exactly as the Law states, with no room for choosing between different options.
Discretionary elements of a technical or scientific nature (more than one option is possible and lawful and there is room for making choices)	– Discussing the technical or scientific fundamentals of the studies that helped to set the environmental flows. – Checking inadequacies, contradictions, lack of due justification, etc., that may be observed in the technical studies supporting the decision.
Common (other than technical) discretionary elements (more than one option is possible and lawful and there is room for making choices)	– Analysis and assessment of the factual elements considered in the decision-making process. – Assessment of the legal conditions (substantive rules) that allow the decision maker a margin of interpretation. It has to be verified whether such legal conditions have been understood in accordance with the common rules of legal interpretation: literal, teleological, systematic, analogical, etc. – Principle of minimum intervention on existing water rights. The solution that has the least impact on existing uses should be chosen. – Principle of rationality and reasonableness. It implies a comprehensive analysis of the decision making a fair balance between the interests of private persons and the general public interest. The decision must be coherent, consistent, effective and efficient. An overall assessment of all the aspects considered in the decision-making process must be made. – Principle of proportionality. The decision must be suitable for achieving the aim pursued and not go beyond what is necessary for that purpose. The imposition of limitations and burdens on existing water uses will only be acceptable insofar as they are strictly necessary and appropriate to achieve the environmental objectives. – Principle of "water economy". It involves evaluating the socioeconomic context. The economic costs of setting the ecological flows should be evaluated. – Principle of legal certainty and principle of legitimate expectations. If water rights are finally limited or canceled as a consequence of the setting of the ecological flow rates, the right holders should be compensated. A transitional period for adaptation to the new circumstances should also be granted. – Principle of equal treatment. All the river basin management plans should be elaborated according to the same methodologies. If a different methodology is used, as it frequently happens, the reason why such method has been selected must be explained in detail.

6. Conclusions

In this case study, the potential raise of minimum flow rates by means of discharging reclaimed water into the Vinalopó River, thus preventing its allocation for agriculture, is analyzed. If this proposal is finally adopted in the next Jucar river basin management plan, groundwater withdrawals will not be reduced by the concerned irrigation communities.

The implementation of the aforementioned general guidelines for examining decisions on ecological flows leads to concluding that the final decision in the study area should take into account that groundwater protection should be a priority. Consequently, reclaimed water from Villena WWTP should be granted to the irrigation communities which are committed to reducing current groundwater abstractions in exchange of such resources, instead of allocating them to increase the ecological flows.

According to the "minimum intervention principle", it would be preferable if the decision implies fewer limitations to pre-existing water rights. Hence, it can be affirmed that, in general terms, continuous ecological flows should not be ensured in non-permanent rivers by means of using reclaimed water. The River Vinalopó is one clear example, providing the river lacks a continuous flow and its biodiversity is adapted to such dynamics. It might be legitimate to create a new ecosystem, but this objective should not enjoy the same priority status as the maintenance of existing ecosystems. The existence of previous water rights whose continuity would be at stake must also be taken into account. The rise of current ecological flow rates would impede the consolidation of a number of uses of reclaimed water currently operative under a provisional authorization dating back to 1995. A provisional authorization that was expected to turn into a definitive concession.

The "principles of rationality and reasonableness" entail weighing up all the present interests according to a global assessment. In the study area, the overexploitation of aquifers is particularly serious and is undoubtedly the priority issue. The aquifers are overexploited according to the three scenarios that are considered by the Júcar River basin management plan: (1) test on water balance, (2) test on the impact on surface water bodies, and (3) test on the impact on surface water-dependent ecosystems. Any action aimed at reducing groundwater withdrawals should be regarded as the more rational and reasonable policy in the area. The use of reclaimed water from Villena WWTP to create a continuous circulating flow would prevent farmers from being granted a concession on such resources. Concession that is expected to be conditioned to the reduction of groundwater extractions. It can be concluded that if reclaimed water is not finally assigned to farmers, the objective of reducing groundwater withdrawals will not be achieved, therefore, such decision cannot be considered rational and reasonable. On the other hand, if using reclaimed water to ensure ecological flows in ephemeral or non-permanent river courses is questionable from a conceptual perspective, it is even more arguable if the origin of said resources is external to the river as it happens in this case. Wastewater treated at Villena WWTP comes from groundwater used by a number of municipalities in the area for drinking water supply. In sum, it does not seem a decision based on a rational and well pondered approach.

The "principle of proportionality" assumes that decisions must be strictly suitable to the set objective, without imposing unnecessary, unfair, and arbitrary limitations; accordingly, it seems proportional that the concession on Villena WWTP's reclaimed water requested by AVGIC should be accompanied by conditions aiming to achieve environmental objectives that compensate the maintenance of current environmental flows. In this sense, it seems appropriate and proportional to impose the reduction of groundwater withdrawals in exchange for obtaining the reclaimed flows, since the main environmental problem in the area is the overexploitation of aquifers.

The "principle of water economy" entails the evaluation of the socioeconomic consequences as well as the examination of the implementation costs. As it has been analyzed, in the study area the farming activity is of paramount importance for both economic growth and social welfare, as well as in terms of employment generation. The use of alternative resources, such as desalinated water, is not feasible due to the high costs of producing and transporting it inland. The economic losses resulting from incorporating these costs to agricultural products would be very high. It would significantly increase their price making them unable to compete in the marketplace. This would probably mean loss of employment and undesirable effects on disadvantaged groups. The use of reclaimed water is therefore a cornerstone of the circular economy in the area.

On the other hand, if the ecological flow rate would be risen to the detriment of pre-existing water rights, an appropriate and fair financial compensation should be provided. This follows from the application of the principles of legal certainty and legitimate expectations.

As a final conclusion, it can be affirmed that the use of reclaimed water to ensure environmental flows in non-permanent river courses should not be considered as a priority but at most as a secondary strategy. Dedicating reclaimed water to the creation of a semi-artificial environmental flow, taking into account the high costs of secondary and tertiary treatments in WWTPs, does not seem reasonable and rational. Such flows should better be assigned to productive uses whose beneficiaries should bear environmental compensations.

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