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Reducing water withdrawals: the negotiation and implementation of environmental policy in the Durance River Basin, France

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Abstract

Many parts of Europe are facing an increased risk of water scarcity and a potentially disastrous impact on freshwater ecosystems. In line with the Water Framework Directive and the 2006 Water Act, France developed the Sustainable Withdrawals Reform (SWR) in 2008, which aimed to restore a balance between the available water resources and people's needs across the country by 2017. While the literature has generally focused on the economics of e-flow policy instruments, few studies have analysed the politics of their implementation at the local level or how local interests and strategies influence the process. Inspired by the political sociology of policy instruments, and based on in-depth case studies in two catchments of the Durance River Basin (in southeast France), we argue that in order to achieve e-flows in such catchments, the SWR eventually encouraged new capital-intensive water transfers. Beyond their technical aspects, these infrastructure projects engender new hydro-social configurations by modifying irrigation technology and agricultural practices, as well as the spatial control of water. The impact of these projects on the environment remains uncertain. The discussion focuses on the role of key intermediaries and shows how the framing of negotiations leads certain stakeholders and issues to be excluded from the implementation process.

Keywords: Durance River Basin; e-flows; Policy instruments; Water allocation; Water transfers

Highlights

- In the Durance River Basin, France, e-flow implementation in deficit tributaries encouraged new capital-intensive supply-side solutions (water transfers).
- The micro-politics and translations processes can reshape environmental public policies and outcomes.
- These new water infrastructure projects present large technical and environmental uncertainties that are strategic resources for some actors.

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Introduction

Many parts of Europe are facing an increased risk of water scarcity and a potentially disastrous impact on freshwater ecosystems (EC, 2012; IPBES, 2018, pp. 239–243). By 2015, 47% of Europe's rivers and lakes were still in a 'less than good' state of conservation and water over-abstraction (along with dam development and flow alteration) remained one of the main threats to biodiversity (EC, 2015). Thus, maintaining or establishing environmental flows (e-flows), defined as 'the amount of water required for the aquatic ecosystem to thrive and provide the services we rely on' (EC, 2015, p. 2), is critical to achieving Water Framework Directive[1] (WFD) goals (EC, 2012) as well as international commitments (Aichi Biodiversity Targets; IPBES, 2018, p. 240). In line with the WFD and the 2006 Water Act[2], France adopted the Sustainable Withdrawals Reform (SWR) by issuing two governmental instructions in 2008[3] and 2010[4]. This ambitious reform aimed to restore a balance between the available water resources and people's needs across the country by 2014 (or 2017 where the deficit is over 30%).

The scientific literature largely focuses on e-flow estimation methodologies (Tharme, 2003; Poff *et al.*, 2017) and less so on the policy instruments allowing their implementation (Le Quesne *et al.*, 2010). When it does the focus is generally on the economics of policy options or their comparison (e.g. Grafton & Wheeler, 2018; Marshall, 2020), as if they represented a 'practical toolbox' from which different instruments could be picked up depending on the context (Horne *et al.*, 2017). However, policy tools have been shown to be subject to resistance strategies, different modes of appropriation (Lascoumes & Le Galès, 2007) and processes of translation at multiple scales (Callon, 1984; Lascoumes, 1996; Barone & Bouleau, 2011). Less attention has been paid to the politics of e-flow policy implementation (Fernandez, 2014), despite the fact that politics are often held as the main obstacle to reaching environmental goals (Le Quesne *et al.*, 2010). We, therefore, get inspiration from and contribute to policy implementation studies that are concerned with the 'reality of inter- and intra-organizational micro-politics in the policy–action relationship characterized by multiple negotiations between semi-autonomous agents with often-competing interests and divergent values' (Barrett, 2004). The focus is on how a 'negotiated order' emerges from policy implementation – one that is possibly different from, and even at variance with, stated objectives (Hill & Hupe, 2002).

In the Durance River Basin, in the southeast of France, the implementation of the SWR led to calls for a reduction in, or even the cancelling of, diversions from the lower reaches of some tributaries (thereby restoring river flows in those reaches). Inspired by the political sociology of policy instruments (Lascoumes & Le Galès, 2007), we show how coalitions of users, elected representatives and other stakeholders have successfully negotiated the transformation of reduced withdrawal limits into projects that transfer water from the main stem of the Durance River, thus maintaining access to water (for agricultural and urban uses) while complying with environmental objectives. This negotiation process is analysed through in-depth field studies of two such water-transfer projects: the Thor network extension (Jabron catchment) and the Saint-Tropez canal modernization (Sasse catchment).

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[1] European Parliament and Council Directive 2000/60/EC of 23 October 2000 establishing a framework for community action in the field of water policy.

[2] Law no. 2006-1772 of 30 December 2006 on water and aquatic environments. https://www.legifrance.gouv.fr/affichTexte.do?cidTexte=JORFTEXT000000649171.

[3] Governmental instruction of 30 June 2008 concerning water deficits reduction.

[4] Governmental instruction of 3 August 2010 concerning water deficits reduction.

We first outline our theoretical and methodological framework and the SWR. We then describe the Durance River Basin and analyse the SWR translation processes that occurred in our case-study catchments. The two water transfers analysed represent contrasting circumstances: one has seen local actors' resistance to the SWR lead to the favouring of options allowing them to maintain and extend current water use and practice, while the second saw the reform used to legitimize, depoliticize and finance an old and controversial infrastructure project. We further draw on our case studies to stress the technical and environmental uncertainties inherent in such projects. We finally discuss the critical role of intermediaries and how the framing of the negotiation process led certain stakeholders and issues to be excluded.

Theoretical and methodological frameworks

Political sociology of policy instruments and translation processes

We consider policy instruments here as specific institutions, defined as a 'more or less coordinated set of rules, understood as routines, procedures, conventions, roles, strategies, organizational forms, and technologies […], as well as the belief, paradigms, codes, cultures, and knowledge that surround, support, elaborate and contradict those roles and routines' (March & Olsen, 1989, p. 22). We differentiate between two types of policy instruments (Hood, 2007; Lascoumes & Simard, 2011): on the one hand, regulatory instruments that rely on a 'command and control' style of state intervention, with binding rules to meet strict environmental standards; on the other hand, incentive-based instruments whereby state services try to involve local actors on a voluntary basis, for instance with financial incentives.

Through a political sociology lens, policy instruments constitute socio-technical innovations that rely on translation processes (Callon, 1984) at different scales and across sectors (Lascoumes, 1996). 'Translation' was originally one of the key concepts of the actor–network theory. It referred to the processes that allow (or not) a scientific innovation to modify a given arrangement of social and natural entities (Callon, 1984).

In terms of policy implementation, translation is understood as the reformulation of a policy instrument's conceptual underpinning through its confrontation with various, divergent local interests, appropriation modes, power relations and specific socio-environmental contexts (Lascoumes, 1996; Lascoumes & Le Galès, 2007). It relies on the production of shared interpretative frameworks through two main processes: the reformulation of problems and objectives and the recycling of existing solutions, established practices, and analytical categories (Lascoumes, 1996). The translators, or intermediaries, participate in connecting different networks, sectors, and political arenas, through the remobilization and reframing of existing concepts and projects from one sector/arena to another (Lendvai & Stubbs, 2009). Intermediaries are typically 'located in "hybrid" or "interstitial" spaces: in-between scales, organisations, discursive practices, knowledge systems, and geographies' (Lendvai & Stubbs, 2009).

The translation process leads to new arrangements of social and natural entities (Callon, 1984), which we refer to as hydro-social configurations (Swyngedouw, 2009, 2013). These are defined as 'hydraulic environments that are socio-physical constructions, […] actively and historically produced' that reflect 'how social power is distributed' among stakeholders (Swyngedouw, 2009). Power is understood here 'as a temporal, fluid and interactive process' (Lendvai & Stubbs, 2009), which is materialized and circulates through multiple devices and discourses (Hajer & Versteeg, 2005). In situations of uncertainty (e.g. regarding water flows, water abstraction, environmental impacts, etc.), discourses tend to be performative (Callon, 2007) and to be constructed and mobilized to defend and legitimize particular hydrosocial configurations (Swyngedouw, 2009). Uncertainties may thus represent strategic opportunities for the actors trying to build new arrangements (Latour, 2005). Discourse analysis allowed us to follow the construction of such assemblages during the implementation process.

Methodological framework

This study is based on a review of the literature (administrative and legislative texts, reports, archives, and scientific papers), field observations (field trips and institutional meetings), a survey of farmers' water management practices, and semi-structured interviews.

We collected information on crop types and their respective areas, crop rotations, and irrigation practices (access, quantity, and price) in the Jabron catchment and the Saint-Tropez Canal area. A total of 57 semi-structured interviews were carried out between December 2018 and January 2020 with widely diverse stakeholders: 18 farmers affected by the projects, basin, regional, and local state representatives from the agriculture and environment ministries, officials from the *Agence de l'eau* (water agency) and local basin organizations, fishermen and environmental organizations, Water Users Associations (WUA)[5], researchers, farmers, local civil servants, and elected representatives. Semi-structured interviews were based on sociological methods (Olivier de Sardan, 1995; Beaud & Weber, 2010) and had a duration ranging from 40 min to more than 3 h. They were fully recorded (with a few exceptions) and transcribed in most cases (depending on the interview materials). Interviews focused on five main themes: water resource issues (in particular in the two catchments studied), historical development of quantitative water management policies (origin of policy instruments, possible debates that took place, etc.), current implementation challenges (What works? What does not? Why? Who is participating? How?), water-saving/water-transfer projects (origin, formulation/reformulation regarding e-flow policy instruments, and predicted outcomes) and water-use practices.

We cross-referenced the literature review, field observations, survey and semi-structured interview data to identify actors' discourses, strategies, and practices related to water management policy. Appropriation processes were clarified by insisting, during the interviews, on the existing gaps between policy instruments 'in theory' and their concrete implementation on the ground, analysing who was participating in the translation processes and how (Callon, 1984; Lascoumes, 1996).

Sustainable withdrawal reform in the Rhône–Mediterranean hydrographic district

In the face of increasingly frequent drought events, the French administration developed, in the 2000s, several regulatory tools to address long-term water scarcity. Water is considered a 'common heritage of the nation' according to the 1992 Water Act[6], and six *Agences de l'eau* are in charge of financing and planning water policy within their respective service area (the six main hydrographic districts in France)

[5] Law no. 92-3 of 3 January 1992 on water.

[6] A 'local water commission' (*Commission Locale de l'Eau*), gathering representatives from local authorities, water users and the state, may also be created in order to specify water policy objectives at the catchment level. Such commission is usually run by the river syndicate.

(Colon *et al*., 2018). Basin committees, which gathered representatives from local authorities (municipalities, *départements*, and regions), water users and the state, are in charge of defining the policy of their water agency (Colon *et al*., 2018). At the catchment level, groupings of municipalities (and possibly *département* and region councils), called river syndicates (*syndicat de rivière*), are in charge of water policy implementation (e.g. flood and wastewater infrastructures, and ecological restoration)[7]. The state, through its basin representatives (called *préfets de bassin*) and its decentralized services at the *département* and region levels, is responsible for the regulation and coordination of water management policy and the water policy (Colon *et al*., 2018) (Figure 1).

This legal basis endows the French state with substantial power regarding water management and policy. As part of the application of the WFD and the 2006 Water Act, the Ministry of the Environment published two governmental instructions in 2008 and 2010 that established the SWR. It relies on four main steps and two regulatory policy instruments (Erdlenbruch *et al*., 2013).

First, in each main basin, the *Agence de l'eau* and basin state services publish a list of deficit areas based on the expertise of *département* and regional state services as well as the National Biodiversity Office. When 'on average eight years out of 10, maximum authorized withdrawals (in volumes and flows), irrespective of their use, can be ensured without disrupting the good functioning of aquatic ecosystems', the situation is considered to be in balance (no deficit) (2008 governmental instruction). In practice, almost every basin where drought alerts (that translate into withdrawal restrictions) occurred more than 1 year out of 5 was considered a deficit area.

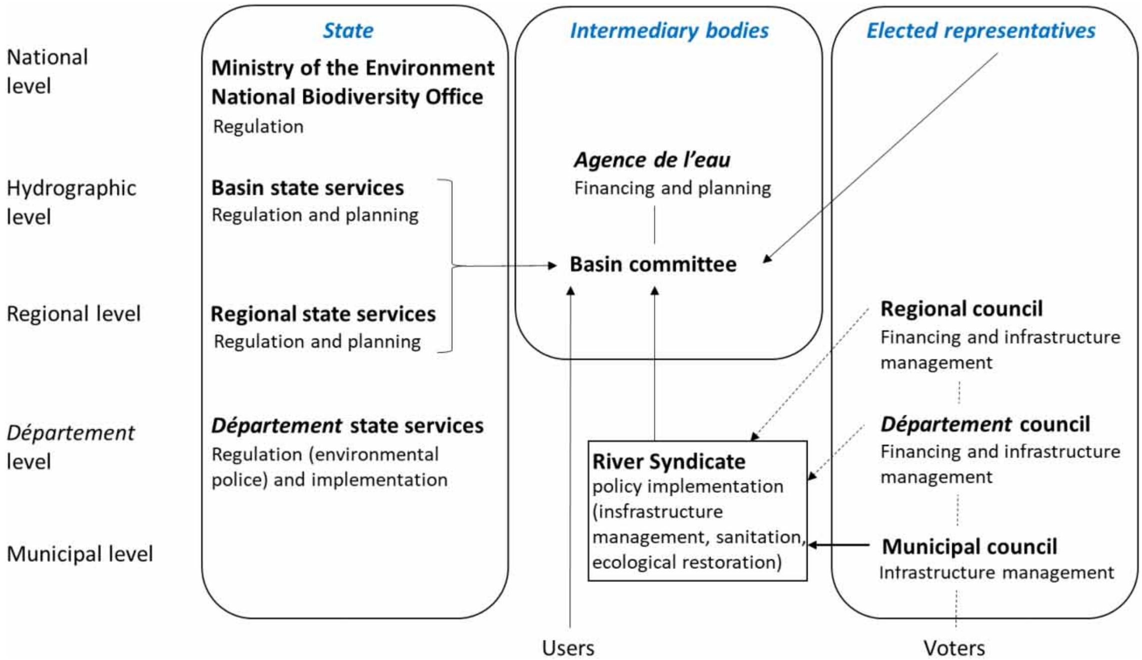

Fig. 1. Water policy actors at different levels in France. *Source:* authors based on Richard *et al*. (2010).

[7] Etude Volume Prélevable (EVP) in French.

Second, the river syndicate (if any) – in coordination with the *Agence de l'eau* and *département*-level state services – has to supervise Sustainable Withdrawal Studies (SWS)[8] to evaluate the environmental needs in each deficit area. These are expressed as (minimum) e-flows at specific points along the river and translated into monthly caps on withdrawals. The basin prefect issues a circular notifying the public of the results. In the Rhône Basin, the methodology of the SWS included hydrological models to estimate catchments' 'natural' (or 'non-influenced') conditions, withdrawal assessments, and the *Estimhab* in-stream habitat model to evaluate environmental needs (Lamouroux & Capra, 2002). The methodology was applied in the 72 deficit areas identified. The majority of the studies were concluded in 2013 and their results were officially endorsed by the basin prefect in 2014.

Third, the basin prefect classifies the deficit river basins as Water Allocation Zones (WAZs)[9], where *any* withdrawal must be declared (rather than only those with a pumping capacity over 400 m^3/h in normal situations). Authorization is required for a withdrawal capacity over 8 m^3/h (rather than 1,000 m^3/h). New withdrawals are not permitted until water needs and resources are balanced, and water fees in WAZs can be increased up to 50% (Erdlenbruch *et al.*, 2013). Furthermore, temporary water-use permits (with a simplified administrative procedure and a validity of 1 year) are discontinued, and multi-annual water licences are required (3–15 years). *Département* state services allocate such licences based on an environmental impact assessment (that includes the SWS results on the estimated volume available in the catchment) and a public inquiry. This revision of water licensing (re-issuing procedure) is the second regulatory instrument (fourth step).

This 'regulatory path' and in particular the WAZs classification aroused protests in various watersheds, mainly from farmers' representatives, because of their critical local implications (imposition of cuts in withdrawals up to 50–60%). As a consequence, the basin state services staggered the classification process over several years, and only 60% of all suggested basins were classified as WAZs in 2018 (Délégation de bassin, 2018).

The Rhône–Mediterranean *Agence de l'eau* developed a second path that involves a Water Management Plan (WMP)[10] – a contractual policy instrument establishing the measures necessary to restore e-flows in the deficit catchments. In particular, it grants subsidies from the *Agence de l'eau* for water-saving interventions (improvements in the efficiency of irrigation or drinking water networks) and substitution projects[11] (construction of water storage or water transfers). River syndicate (if any), *département* state services, and the *Agence de l'eau* design the WMP through a 'collaborative approach' (Secrétariat technique du Sdage, 2019). This incentive-based instrument is considered 'complementary' to the regulatory ones, as the water savings envisioned should then allow the permit re-issuing procedure in accordance with environmental objectives, even if no binding rules are set in the WMP (Figure 2).

The implementation of the SWR, therefore, has a framework that combines regulatory and contractual instruments in the Rhône basin: the WAZs and the re-issuing of water licences on the one hand, and the

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[8] Zone de Répartition des Eaux (ZRE) in French.

[9] Plan de Gestion de la Ressource en Eau (PGRE) in French.

[10] Substitution projects consist of shifting a withdrawal from a deficit to a non-deficit resource (water transfer from a non-deficit catchment, or water storage from a non-deficit period).

[11] The Durance system is arguably one of the most artificialized river systems in the world. It mixes a classic dam cascade with a feeder canal (EDF canal) that parallels the river (whose flow is reduced to a trickle outside rainfall events) and allows successive hydropower plants to maximize the energy produced (as opposed to dissipating much of it through the river bed) (Figure 3).

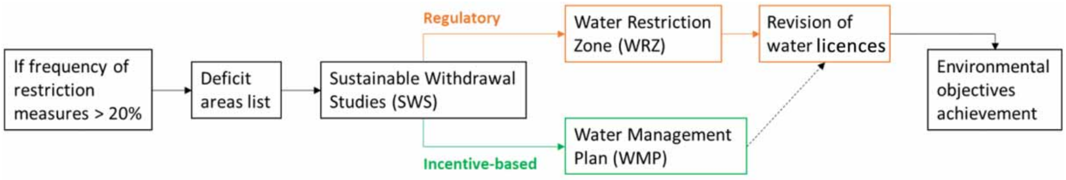

Fig. 2. SWR implementation in the Rhône basin. *Source:* authors based on Secrétariat technique du Sdage (2019).

WMPs on the other hand. After outlining the main characteristics of the Durance Basin and the two catchments studied, we analyse the translation processes of the SWR into new water transfers and the implementation of regulatory and incentive-based instruments.

Features of the Durance River Basin and the Sasse and Jabron tributaries

The Durance Basin: regulated and non-regulated territories

The Durance River drains a total area of about 14,000 km^2. It originates in the Mont Genèvre in the Southern Alps, goes through the Provence region over 310 km, and joins the Rhône River to the south of Avignon. The annual runoff is around 5,500 Mm^3, with low-water periods during summer and winter and high waters during autumn (rainfall) and spring (snowmelt) (Dreal PACA, 2008). The then national electricity company *Electricité de France* (EDF) installed a major infrastructure in the basin from the 1950s to the 1990s. It now runs 22 hydropower plants and 14 dams, almost all connected by a 200 km-long canal[12] (Dreal PACA, 2008; Figure 3). When the EDF canal was built, most existing water withdrawals from the Durance River were transferred to the canal, while new water distribution networks were also constructed. Those areas, called 'regulated territories', enjoy a secure supply from EDF infrastructure, with an annual irrigation reserve of 450 Mm^3 stored in the system's main dams. They include the southeast of the *Provence–Alpes–Côte d'Azur* (PACA) region, which benefits from the distribution networks built after the 1960s by the *Société du Canal de Provence* (SCP) company, and irrigated areas along the middle and lower reach of the Durance River where ancient canal networks are now fed by the EDF canal (Figure 3).

In contrast, with a few exceptions, the tributaries of the Durance did not benefit from such infrastructure. This generated significant differences between the regulated territories that specialized in high-value crops irrigated by pressurized systems (thanks to the secured Durance system) and the tributaries that maintained extensive livestock and collective gravity irrigation systems (with few instances of individual pumping and high-value crops). One crucial impact of not being connected to the regulated Durance system is susceptibility to summer water restrictions, which occur almost 1 year out of 2 in those basins. 'Secure' areas, in contrast, do not face such water restrictions.

The *Agence de l'eau* classified eight tributaries of the Durance River as deficit areas (Figure 3). These are all subject to high flow variations throughout the year. Moreover, the summer low-flow period is expected to become longer and more severe in those tributaries due to climate change, according to the latest estimations (Sauquet *et al.*, 2014). The *département* of *Alpes-de-Haute-Provence* contains six of the eight deficit tributaries and parts of the two others.

[12] Pumping from the river or small water sources.

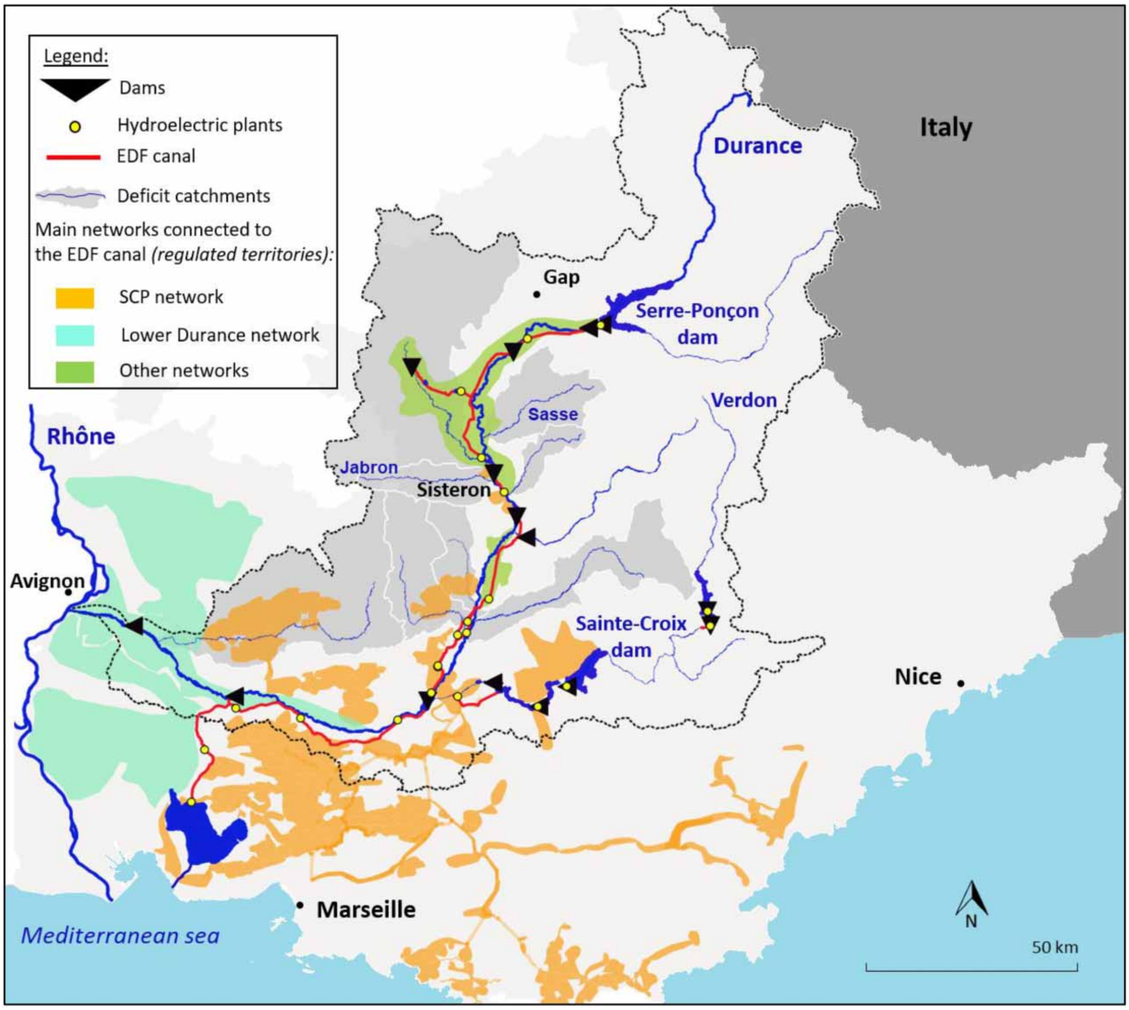

Fig. 3. Regulated territories and deficit catchments in the Durance River Basin (PACA region). *Source:* authors based on BD TOPO, BD Hydra 2015, Dreal PACA data.

The Jabron and Sasse catchments

The Jabron and Sasse rivers are tributaries of the Durance and drain a total area of 200 and 330 km^2, respectively. They constitute 'non-regulated' territories and are classified as deficit areas. Their mean annual flow is about 2 m^3/s for the Jabron and 3 m^3/s for the Sasse, with high variation during the year and, in particular, severe low-flow periods during summer (several reaches may dry up in the Jabron River) (Cereg ingénierie, 2010; Sogreah, 2011). Three main types of agricultural holding can be observed: (1) extensive livestock farming (mainly sheep) with gravity-irrigated grasslands, cereals, and pastures in the highlands; (2) farms specializing in high added-value crops, such as seeds, fruit, and vegetables, with individual pressurized irrigation systems[13]; and (3) various combinations of the above (based on our survey with farmers).

The two catchments represent contrasting cases, with mainly small private irrigation and the SCP company (with its Thor network) in the Jabron watershed, and a collective irrigated system managed by a WUA in the Sasse watershed (Figure 4).

The translation of the SWR into water transfers: resistance, opportunities, and new institutional arrangements

The appeal of new water transfers in the Durance River Basin

Securing water access and adapting to climate change. Before analysing the Jabron and Sasse cases, we present here two arguments that favour water transfers in the Durance River Basin. The first is to secure water supply for non-regulated territories. Water managers commonly underline the unequal allocation of water resources in the Durance Basin:

> '*The water supply infrastructure [in the Durance Basin] was installed more than 50 years ago. But now we have to think about sharing water better – improving the distribution of the resource – even more so in the context of climate change. […] Upstream départements suffer from drought, with small agricultural economies. They argue that this situation isn't sustainable*' (Interview with a state services official, December 2018).

Irrigators in deficit tributaries are now coming under pressure because their withdrawals deplete river flows – below the minimum values established by the SWS – in the lower reaches. Gravity irrigation systems are also criticized for alleged losses. Hence, water transfers from the regulated Durance system appear as an alternative option whereby diversions would be discontinued and river flows enhanced, while irrigators would source secured water from the downstream Durance system through pressurized networks. Farmer representatives also support improvements to irrigation efficiency and water transfers as a means of adapting to climate change and diminishing resources, without which 'irrigation may be doomed in the majority of cases' (Smigiba, 2019, p. 32). According to a river syndicate official, water-transfer projects 'allow the agricultural sector to go on with intensive water use, without taking all the available resources from the environment' (interview with a river syndicate official, December 2018).

Available 'saved water', EDF, and WUAs enrolment. Although there is clear interest in securing access to water and adapting to climate change, sourcing water from the Durance system raises the question as to whether there is enough water for new transfers when most of the river resources are committed to hydropower. Since the 1970s, the *Agence de l'eau* has invested heavily in modernizing irrigation (including the shift from gravity to pressurized systems, piping, and regulation). Initially,

[13] The several dams of the Durance Basin allow water savings storage. Environmental reallocation can take different forms: water transfers for deficit tributaries, water releases from dams for unclogging purposes, or improved sediment transport.

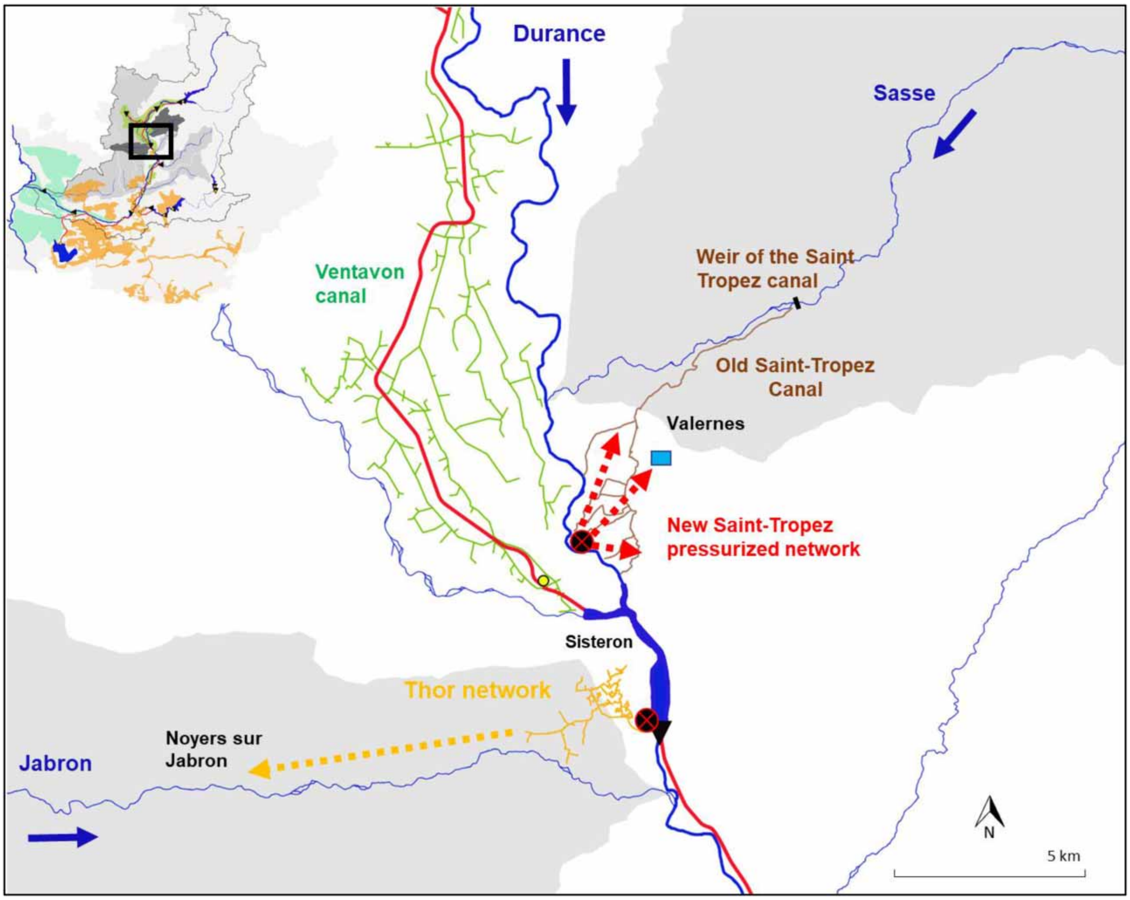

Fig. 4. Thor network extension and Saint-Tropez modernization projects, in the Jabron and Sasse catchments, respectively. *Source:* authors based on BD Hydra 2015, BD TOPO, Dreal PACA data.

the water savings would directly benefit both farmer associations, which could extend their irrigated areas, and hydropower production (Jean, 1975). However, during the 2000s, with the implementation of the WFD and its transposition into national law (the 2006 Water Act), access to subsidies became conditional upon returning the 'saved water' to the environment.

However, when improvements in efficiency are made in irrigation networks connected to the EDF canal (Figure 3), the 'saved water' is passed not to the river but to the EDF canal, thus directly benefiting EDF and its hydropower generation. This defeats the *Agence de l'eau*'s very role in improving aquatic ecosystems. To address this, a 'water savings account' was created in 2016 to account for and (virtually) 'store' (saved) water that should be redirected to the environment rather than to the EDF hydropower cascade (AERMC, 2016).

The transfers actually substitute water withdrawals from the lower reach of the Durance tributaries with new ones from the Durance main stem/EDF canal. Since they aim to restore e-flows in the Durance tributaries and are associated with improvements in irrigation efficiency (pressurized system), they are eligible to use the 'water savings account' reserve[14] (AERMC, 2016), and EDF cannot oppose such projects.

'Environmental water transfers' are also attractive opportunities for water companies and WUAs that want to develop their water networks. First, the 'environmental dimension' of such projects gives access to subsidies of up to 80–90% of the total investment costs (Région PACA, 2014, pp. 247–256). Second, the 'water savings account' provides access to new water volumes from the Durance system, where water rights are almost fully allocated (Dreal PACA, 2008).

Reformulation of the SWR in the Jabron watershed: from contestation to the design of a 'hydro-social fix'

Water infrastructure as a solution to the implementation of the SWR. In the Jabron watershed, the SWS study was carried out in 2011. It pointed to an overall deficit of 350,000 m^3 from June to September, representing about 40% of the basin withdrawals during that period (Sogreah, 2011). This large deficit implied the classification of the watershed as a WAZ (AERMC, 2012). The agricultural sector – local farmers and their representatives at the chamber of agriculture – however, rejected the classification and asked for the support of the *département* state services (Farmers of the Jabron Valley, 2013).

Indeed, the classification would entail a revision (lowering) of water withdrawal limits and prevent farmers from obtaining *ad hoc* temporary permits. The agricultural sector, therefore, tried to avoid the restrictions that come with the WAZ, supporting instead water infrastructure projects through the WMP. As an official from the Chamber of Agriculture put it:

> '*I saw the WMP as an unavoidable step in accessing Agence de l'eau's subsidies. So we put everything we could: ponds, drip irrigation, tensiometers, new water turns* […] *And the SCP irrigation network. So it could be subsidised.* […]. *And the advantage of the 'Thor solution'* [extension of the piped network] *is that it allows irrigated area extensions. There will probably be more new irrigated areas than substituted ones* […]. *People are asking for water*' (Interview with the chamber of agriculture, December 2019).

Farmers also argued that the extension of the SCP irrigation network would make the WAZ classification irrelevant, since it would allow the substitution of most water withdrawals from the Jabron with that sourced from the Durance River, considered a 'non-deficit area' (Figure 4).

Representing the state at the lowest level, the *département* services serve as a key intermediary between basin state services and local actors. They have to implement the SWR while at the same time taking into account interests and limitations in local watersheds 'where people live and work […], where there are also economic activities' (interview with *département* state services, December 2019). Therefore, they supported the Thor network extension project, which appeared as a convenient way to meet the environmental objectives established by the SWS, without disrupting or affecting the agricultural sector at the local level. Initially, *département* state services also claimed that the WAZ classification was unnecessary if the project was to proceed, as a way of promoting the latter.

[14] The 90% subsidization of the project corresponds to a maximum, and the company may 'only' get about 50–60%, for a total amount of 2.6 M€.

Published in 2017, the WMP indeed officially sanctioned the Thor project as the main measure planned to meet environmental objectives in the Jabron catchment (Artelia, 2017). It followed one of the conclusions of the SWS which indicated that 'a sharp decrease in water withdrawals from the Jabron River is only conceivable with the development of large infrastructures' (AERMC, 2012). The implementation of the SWR thus appeared to depend on transfer infrastructure, and the strategy of mobilizing incentive-based rather than regulatory instruments eventually worked. However, the SCP was worried about the project's profitability and asked for guarantees[15].

Enhancing project profitability while abiding by the rules. In 2015, the SCP conducted a feasibility study and identified a potential irrigable area of 260 ha for a network extension of about 12 km. A more detailed design study carried out in 2016 included a survey to estimate the areas for which farmers would be expected to subscribe. The results were below expectations and only reached 159 ha (SCP, 2016). According to our own survey, the main factor that restrained farmers from subscribing to the SCP network was the increase in water charges. Moreover, even if they did subscribe, there was the risk that they would only use the network when there were shortages in the Jabron catchment, since the water prices were higher than when using their own systems. Such shortages do not occur every year and only last a few days or weeks in summer.

The SCP thus explained to the local state administration that it could not invest in the Thor network extension without the assurance that farmers would *only* use their irrigation network so as to ensure a minimum return on investment. For this purpose, 'there is a very important lever. It is the prefectural order [that classifies the basin as a WAZ]' (interview with an SCP agent, December 2019).

While *département*-level services had initially tried to avoid the Jabron catchment being classified as a WAZ, it became necessary to do so in order to get the backing of the SCP: 'to obtain the approval of the SCP […] I announced the [WAZ] classification in public. And the SCP said OK [to the project]' (interview with *département*-level state services, December 2019). The prefectural order that formalized the classification was thus published in October 2019 and specified that the farmers from the lower part of the basin (where the Thor extension is planned) would get a 3-year permit rather than the former temporary ones (Préfet des Alpes-de-Haute-Provence, 2019). This, based on an environmental impact assessment and the SWS results, would allow new restrictions on water diversions in this area to be put in place once the project is completed (expected 2023).

With regard to water access, beyond the 120 l/s currently allocated to the SCP for the existing Thor network, the question of the water rights needed for the extension remained. Access to the 'water saving account', with a total allocation of about 260,000 m^3/year, provided a way out of the deadlock. However, this volume was calculated considering the substitution for a total area of about 80 ha, and it remains unclear whether the 260,000 m^3 would also facilitate an expansion of the irrigated area, which would very likely increase net water consumption.

This case shows how local actors succeeded in ensuring a 'hydro-social fix' (Swyngedouw, 2013) to avoid looming water restrictions. The implementation of the SWR rests on a new water transfer that received the backing of all local actors, as well as their implicit shared interest in not questioning its most ambiguous, if not contradictory, features. While farmers would gain access to secure water over a larger area, with an associated hike in the value of their land, they had to accept stricter rules that

[15] European Agricultural Fund for Rural Development (EAFRD).

ensure a full shift from the Jabron catchment to the new irrigation network, as well as a higher price for water.

Recycling old infrastructure projects in the Sasse catchment: the SWR as a financial opportunity

A 200-year conflict between the farmers of Sisteron and Valernes (1784–1980). To understand the origin of the Saint-Tropez Canal modernization and its replacement with a transfer from the Durance River, we have to go back to 1784, when the canal was built. There was an agreement between the Bishop of Saint-Tropez, who wanted to irrigate the Sisteron land on the left bank of the Durance, and the Lord of Valernes, who allowed the canal to pass through his land on the condition that Valernes farmers could use it free of charge (Seret, 1992). The latter benefitted from 9/19th of the total canal capacity (i.e. 560 l/s), regardless of the water available in the Sasse River. In dry years, downstream Sisteron farmers would lack water while still shouldering the operational and maintenance costs (Seret, 1992). This caused lasting conflict between the farmers of Sisteron and Valernes for the past two centuries (Seret, 1992). The WUA includes Sisteron water users only. The total irrigable area is 469 ha, but only around 370 were actually irrigated, even in years with abundant water (Seret, 1992).

A project to end 'monarchical privileges' (1980–2009). With the urbanization that started at the beginning of the 1980s, water conflicts pitted urban users in growing Sisteron against Valernes farmers. After the severe drought in 1989 and 1990, the WUA commissioned a study to investigate the possibility of 'modernizing' the canal system, converting it from a gravity to a pressurized system.

The study confirmed the water deficit and that all uses could only be met 1 year out of 5 (Seret, 1992). It reviewed three main scenarios: to maintain the gravity-fed canal and complement supply with water abstracted from the EDF canal or the Durance alluvial aquifer; to only modernize the Sisteron area and to maintain a gravity system in Valernes; or to modernize the whole irrigation system. Modernization would include a water transfer from the Durance Aquifer to an intermediary reservoir, whence it would be distributed under pressure to farm hydrants (Seret, 1992).

As the WUA was set to authorize the Sisteron-area modernization plan, its then president refused to sign the project proposal (ASA du canal de Saint-Tropez, 1992). He had irrigated land in both Sisteron and Valernes and was loath to consider any modernization scenario that would jeopardize the Valernes farmers' free access to water (interviews with the Saint-Tropez WUA and *département*-level services).

In 2004, urban water users in Sisteron secured the presidency of the Saint-Tropez WUA and pushed for a fully-fledged modernization project as the only solution to 'abolish the monarchical privileges of the Valernes farmers' (interview, WUA member) and restore water supply to downstream users. For their funding request to the EU[16], they solicited the assistance of the nearby Gap-Ventavon WUA – a far larger association with 4,000 ha and staff qualified to undertake such tasks. The mayor of Sisteron also supported the project (Mairie de Sisteron, 2014), which was publicized in the local press and became an electoral issue. However, it was not possible for an urban water network to benefit from the European Agricultural Fund and, since the Valernes farmers still rejected the idea of a pressurized system, the project faltered until 2010.

[16] The 'loi Grenelle 1' formalized 268 environmental commitments (Law no. 2009-967 of 3 August 2009).

Depoliticizing water conflict: the modernization project as an environmental necessity (2010–present). The SWR reshuffled the cards. In the Sasse catchment, the SWS was conducted in 2010 and revealed an overall deficit of 1.5 Mm^3 during summer (Préfet de la région PACA, 2014). Canal modernization was presented as the main solution to meeting environmental objectives: 'if the modernisation is carried out across the whole scheme, […] there will be no deficit in the administrative sense (adequate supply in four years out of five)' (Cereg ingénierie, 2010, p. 45).

Moreover, ecological continuity restoration became a key objective for the *Agences de l'eau* under the 2006 Water Act and the 'loi Grenelle 1' (2009)[17] (Perrin, 2018). Full modernization would allow the removal of the weir on the Sasse River, restoring continuity for fish and sediment (AERMC, 2013).

Finally, the 2007–2013 EAFRD programme was close to expiring without all its budget having been spent. The canal project's first phase had to be completed by the end of 2015 (ASA du canal de Saint-Tropez, 2014), and because of the legal obligations regarding both minimum flows and ecological continuity, the Valernes farmers eventually had no choice but to accept the project.

The Saint-Tropez WUA was unable to lead the project by itself and decided to merge with the Ventavon WUA in 2013. The latter expanded its reach, and now benefits from water rights on the Durance left bank, and is considering interconnecting the systems to secure water access for both (interview with the Ventavon WUA).

Hence, the water reform managed to legitimize an old modernization plan that had been at the heart of a conflict between urban and agricultural water users. By reformulating a water access problem into an environmental one, it depoliticized the conflict and reshaped the options to favour a fully-fledged, subsidized, modernization plan.

These two case studies added critical steps to the formal policy process (Figure 5). They showed the decisive role of translation processes in the transformation of environmental objectives into new water-transfer projects. In the next section, we look at the technical and environmental uncertainties over water transfers. Finally, we discuss the key role of intermediaries in the appropriation process and the limitations of contractual policy instruments.

Technical and environmental uncertainties over water transfers

Technical issues. Large-scale water infrastructure projects often face 'unexpected' technical challenges. In the case of Saint-Tropez, it turned out there was almost no groundwater available in the Durance although it was to be the source of water for the whole scheme (water rights of 300 l/s). The system, therefore, had to be completed by directly pumping from the Durance River (capacity of about 200 l/s), which involved adding filters to remove silt (especially during heavy rainfall that brings black marl material from upstream basins).

Furthermore, in 2016, after only a few months of use, cracks appeared in the pond that was constructed to serve as buffer water storage, and a prefectural order prohibited the use of the pond's full capacity (5,000 m^3), limiting it to only about 1,000 m^3. Such problems generated greater expense (added pumping costs, studies on pond strengthening/rebuilding) and question whether the project's

[17] Similar situations to those described in this paper have been seen in the Vanson (substitution of an old canal supplying a collective irrigated system) and in the Asse (substitution of individual irrigation systems) catchments but could not be examined here for lack of space.

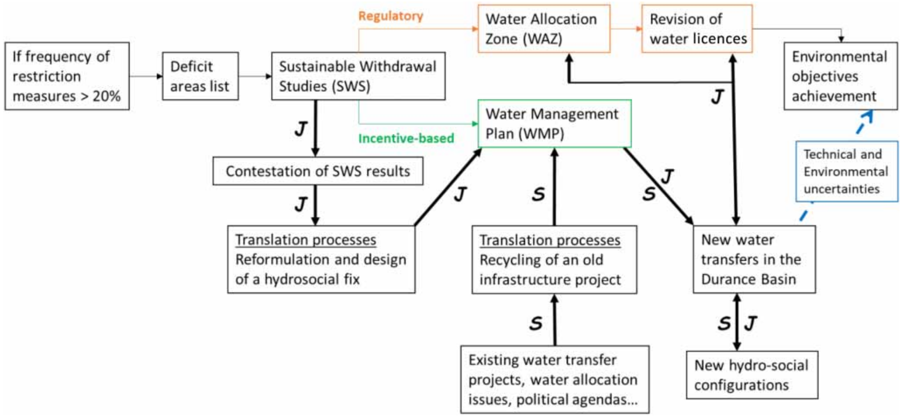

Fig. 5. SWR implementation in the Jabron (J) and Sasse (S) catchments.

final phase (planned for 2020–2021) can be completed. For now Valernes's farmers are still using the old Saint-Tropez canal thanks to a temporary water right.

The Thor extension in the Jabron catchment is under review, but similar complications could arise in terms of pumping capacity, silt, and project profitability.

Environmental uncertainties. 'Deficit watersheds' in the Durance Basin are characterized by a lack of knowledge on river flows, ecological needs, and water withdrawals. There are few or no hydrometric stations in these watersheds and hydrological models are based on a 7-year database (1970–1977) in the Sasse catchment and on three sets of water-level measures in the Jabron catchment (two in 2009 and one in 2010).

Moreover, there is great uncertainty regarding water withdrawals, particularly for gravity irrigation (Conseil scientifique du comité de bassin Rhône-Mediterranée, 2011). Notwithstanding possible undeclared/illegal withdrawals, only pressurized systems are equipped with water meters. Gravity system withdrawals are estimated from gauges at canal inlets and return flows (to downstream rivers or groundwater), although substantial, are virtually unknown. While water substitutions and canal modernization may have a positive impact on the stream flow of deficit tributaries, they will also affect the aquatic ecosystems created by return flows from canals and irrigated land (Masseroni *et al.*, 2017).

The impact of both projects on the Durance Basin's water resources will be at best neutral. Indeed, several studies have shown that improvements in irrigation efficiency could have negative effects on the basin due to increased evapotranspiration (Grafton *et al.*, 2018). In our case, water transfers are often accompanied by an expansion of the irrigable area (Burgeap, 2012; SCP, 2016) that go against the environmental objective of reducing consumption in the basin. Several actors underlined how water transfers shift the problem spatially without resolving it: 'in the Jabron catchment the irrigable area may increase by several tens of hectares. But the Durance River – how will it be in ten years' time? So we secure water uses and we give the impression that we can extend [the irrigated area] again' (interview with state services, December 2019).

Lastly, the increase in water prices due to irrigation modernization and secure water supply encourage farmers to switch from natural grasslands to artificial meadows (alfalfa or a combination of legumes and grasses) or high added-value crops (survey of farmers, 2019). This may have a negative effect on soil organic matter, field biodiversity, agricultural chemical inputs, and also possibly net per-hectare evapotranspiration (i.e. water consumption).

Discussion

Our two case studies show how the implicit threat of stricter measures that the top–down imposition of a WAZ would bring motivated users to organize themselves under the 'shadow of hierarchy' (i.e. the threat that the state could impose binding rules) (Börzel & Risse, 2010). They tried to avert regulatory instruments and adopted incentive-based ones. They criticized the way e-flows were determined but were ill-prepared to contest the scientific legitimacy of the SWS. Rather, the opportunity to comply while receiving subsidies for a substitution project somehow converted the looming stick into a carrot. The two projects analysed in this article are not isolated cases in the Durance Basin, as water transfers represent key measures in five out of the eight WMPs[18].

More generally, this study shows the difficulty of reaching ambitious environmental goals through incentive-based and contractual policy instruments, such as the WMPs. This type of 'coordination instruments' have become common in environmental policy as part of the 'New Public Management', which has advocated for contracts and indicators over command-and-control forms of governance (Lascoumes & Le Galès, 2007). It has been shown how environmental issues could be reformulated 'as a matter of inefficiency', limiting the impact of new regulation and eventually providing financial benefits to the economic sectors involved (see Hajer (1995) regarding air pollution). This study shows how the SWR was reframed in the Durance Basin to promote capital-intensive supply-side solutions such as water transfers. Such processes constitute a resistance to policy instruments that leads to their 'smart use', circumventing or reducing their intended effects (Le Bourhis & Lascoumes, 2013).

Yet, in order to become a reality the projects we have examined required the construction of new arrangements and the mobilization of discourses that legitimize them (Swyngedouw, 2009). This became possible thanks to the involvement of key intermediaries, ambiguities within the discourse in situations of uncertainty, and the repositioning/exclusion of various actors.

The role of mediators must first be underlined. The *département*-level state services, connecting the basin and regional state services on the one hand, and the locals on the other hand were the primary actors in the translation process. Besides being located 'in-between scales and organisations', they are also connected to different 'knowledge systems' (Lendvai & Stubbs, 2009), as officials in charge of water management were attached to agricultural state services at the *département* level for a long period, before passing under the authority of the Ministry of the Environment in 2010. That gave them the ability to reframe the SWR in a way that would be compatible with the agricultural sector's interests. By delaying WAZ classifications through negotiations with regional and basin state services, their objective was to develop alternative solutions before imposing a reduction (or termination) of water diversions in the tributaries. The chamber of agriculture was the other mediator in our case studies. They agreed to represent farmers and participate in the policy process, on the condition that they would access subsidies for agricultural modernization.

Second, the projects needed to be eligible for subsidization, meaning they had to be compatible with the *Agence de l'eau* mandate and policy. The key concept was that of 'substitution', wherein withdrawals in

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[18] European Parliament and Council Directive 2000/60/EC of 23 October 2000 establishing a framework for community action in the field of water policy.

deficit watersheds would be replaced by those from a non-deficit-regulated water body (the Durance/EDF canal), improving low flow in the watersheds and restoring 'ecological continuity'. The unpredictable effects of the projects on the overall net (crop) water consumption and the canal water-dependent ecosystems were obscured by their supporters' emphasis on flow improvement in the lower Jabron and Sasse catchments. This 'construction of facts' (Latour, 2005) was made possible because of the high uncertainties characterizing river flows, ecological needs and water withdrawals, and the ability to enrol other key players (Callon, 1984). Indeed, the projects were attractive to various actors: the city of Sisteron ensured water supply to an expanding urban area thanks to the Saint-Tropez modernization, while the nearby Gap-Ventavon WUA seized the opportunity to expand its reach and power by supporting the project. In the Jabron watershed, the *département*-level administration was eager to support agricultural activities, but the Thor extension was unappealing to the SCP company because it was economically flawed and risky, unless users could be compelled into exclusive subscriptions. State services thus intervened by declaring the WAZ and altering withdrawal permits. Potential opposition by EDF, another powerful player, was diffused by the fact that the schemes were by and large neutral to its operations (or affected them only marginally) and because the new withdrawals from the Durance/EDF canal would actually come from the 'water saving account' that computes savings made in other canals. Last, such projects represented an opportunity for the *Agence de l'eau* to claim environmental achievements (restoring low flows and ecological continuity) while finding a way to both make use of the 'saving account' and justify its role as the gatekeeper of subsidies.

Various adjustments and a strategic use of resources by the stakeholders were thus necessary to cement an overall consensus around these transfer projects. Some actors, however, gave up participating in their implementation and were largely excluded from the debate. Environmentalists and fishermen, for example, abandoned the WMPs' steering committees: 'initially we want to return more water to the environment, […] and then the objective is only to get water for everyone till the end of the summer. […] So I stopped going to those WMP meetings' (interview with the *département* fishing federation, November 2019). They also stressed that climate change was not taken into account in the SWS and that introducing large infrastructure could prove a critical mistake (interview with the *département* fishing federation, November 2019). Their marginalization suggests they wield limited power but also that those behind the consensus had no need to broaden support. Likewise, uncertainties regarding hydrologic hypotheses, the change in overall evapotranspiration (consumption), and planned environmental gains were conveniently glossed over.

Conclusions

Broadly, our case studies illustrate the difficulty of implementing demand-management policies and reallocation measures in particular. Shifting water to the environment means reducing human uses and this has long proved to be a politically charged issue (see Molle & Closas (2019) regarding groundwater). Capital-intensive supply-based solutions are always preferred whenever possible (Molle, 2008).

The implementation of the 2006 Water Act, which incorporated the WFD into French legislation, provoked a national debate on the suitability of substitution projects (water storage or water transfers) to address environmental flow issues (Bisch *et al.*, 2018; Conseil scientifique du comité de bassin Rhône-Mediterranée, 2020). This study shows how such projects, beyond environmental goals, appeared largely consensual and compatible with an array of objectives as diverse as development concerns, e-flow enforcement, drought alerts, property values, WUA expansion, historical conflicts (Valernes/Sisteron), hydropower generation, ecological continuity, and an ethos of (irrigation) modernization. Most critically, this new assemblage was made possible by selective discursive emphases and the obfuscating of underlying costs and hydrologic/environmental uncertainties. Our results emphasize the importance of in-depth case studies in order to elucidate the multiple translation and negotiation processes that work to create significant gaps between policy instruments' conceptual underpinnings and their implementation on the ground.

With a comparative approach in various basins, a fruitful area of research would be to integrate long-term institutional analysis into studies of e-flow policy instruments. This would allow a deeper understanding of how path dependencies interact with current environmental planning decisions, leading (or not) to new infrastructures of different types.

Data availability statement

All relevant data are included in the paper or its Supplementary Information.

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