

NESTED SCALES AND INSTITUTIONAL FRAGMENTATION. THE CASE OF WATER GOVERNANCE IN THE CRAU PLAIN

ÉCHELLES IMBRIQUÉES ET FRAGMENTATION INSTITUTIONNELLE. LE CAS DE LA GOUVERNANCE DE L'EAU DANS LA PLAINE DE LA CRAU

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ABSTRACT

The Crau region in southern France is a unique hydrosystem where groundwater and surface water are tightly interconnected through agricultural practices. The aquifer, which supplies drinking water to over 300,000 people and supports agricultural and industrial uses, depends on gravity-fed irrigation of hay meadows for nearly 70% of its recharge. Water originates from the Durance River and is conveyed through a network of canals. This creates unusual dynamics: groundwater levels are highest in summer and lowest in winter. Paradoxically, rainy years can lower the water table because reduced irrigation decreases artificial recharge. Although the aquifer is not structurally overexploited, projected declines in Durance flows and more frequent droughts are intensifying debates over water allocation and challenging the legitimacy of gravity irrigation, often perceived as inefficient despite the ecosystem services it provides. Understanding water-sharing governance in Crau requires considering three temporal dimensions: the long-term balance of the aquifer, short-term drought events, and upstream hydrological variability in the Durance basin. Water scarcity thus reflects a structural vulnerability that becomes more visible during crises. The 2022 drought exposed weaknesses in short-term management. Interdepartmental drought regulations seek to harmonize water management across Durance-dependent territories but often overlook local hydrogeological specificities, creating inconsistencies. The crisis also revealed insufficient preparedness despite lessons from the 2007 drought. Conflicts emerged between upstream and downstream users and among irrigators within Crau. Based on interviews with farmers, water managers, state representatives, and agricultural organizations, this article shows that hydrological interdependencies generate a complexity that institutions and local actors struggle to fully grasp. It examines how multiple spatial and temporal dimensions of scarcity interact and questions whether current governance arrangements can effectively manage these interdependencies.

Keywords: agricultural and industrial uses; drinking water; temporal dimensions; gravity irrigation; Water scarcity.

RESUME

La région de la Crau, située au sud de la France, est un système hydrologique unique où les eaux souterraines et les eaux de surface sont étroitement liées par le biais des pratiques agricoles. L'aquifère, qui fournit de l'eau potable à plus de 300 000 personnes et soutient des usages agricoles et industriels, dépend de l'irrigation gravitaire des prairies naturelles pour près de 70% de sa recharge. L'eau prend sa source dans la rivière Durance et est transportée à travers le réseau de canaux. Cela crée une dynamique inhabituelle : les niveaux d'eau souterraine sont plus élevés en été et plus bas en hiver. Paradoxalement, les années pluvieuses peuvent abaisser la nappe phréatique car une irrigation réduite diminue la recharge artificielle. Bien que l'aquifère ne soit pas structurellement surexploité, les baisses prévues des débits de la Durance et les sécheresses plus fréquentes intensifient les débats sur l'allocation de l'eau et remettent en question la légitimité de l'irrigation gravitaire, souvent perçue comme inefficace malgré les services écosystémiques qu'elle fournit. La compréhension de la gouvernance du

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partage de l'eau à la Crau exige la prise en compte trois dimensions temporelles : l'équilibre à long terme de l'aquifère, les épisodes de sécheresse à court terme et la variabilité hydrologique en amont dans le bassin de la Durance. La pénurie d'eau reflète donc une vulnérabilité structurelle qui devient plus visible pendant les crises. La sécheresse de l'année 2022 a démontré des faiblesses de la gestion à court terme. Les réglementations interdépartementales sur la sécheresse recherchent à harmoniser la gestion de l'eau dans les territoires dépendants de la Durance, mais négligent souvent les spécificités hydrogéologiques locales, ce qui donne lieu aux incohérences. La crise a également révélé un manque de préparation malgré les leçons tirées de la sécheresse de l'année 2007. Des conflits sont apparus entre les usagers en amont et en aval, ainsi qu'entre les irrigants au sein de la Crau. Sur la base des entretiens tenus avec des agriculteurs, des gestionnaires de l'eau, des représentants de l'État et des organisations agricoles, cet article montre que les interdépendances hydrologiques donnent lieu à une complexité que les institutions et les acteurs locaux ont du mal à saisir pleinement. Il examine la manière dont les multiples dimensions spatiales et temporelles de la rareté interagissent et s'interroge sur la capacité des dispositifs de gouvernance actuels à gérer efficacement ces interdépendances.

Mots-clés : Usages agricoles et industriels; Eau potable; Dimensions temporelles; Irrigation gravitaire; Pénurie d'eau.

1. INTRODUCTION

Before reaching the Crau aquifer in south-eastern France (

Figure 1), water flows along multiple routes, both physical and institutional, creating numerous interdependencies between the various uses of the Durance basin, from which it originates. First stored at the Serre-Ponçon dam and then conveyed through a series of canals, it is finally transferred out of the basin to this irrigated plain, which was once very arid. The Crau aquifer thus exhibits counter-intuitive, reversed hydrodynamic behaviour, with high water levels in summer and low water levels in winter. These high summer water levels are attributable to the gravity-fed irrigation of hay meadows, which provides the bulk of the groundwater recharge. Paradoxically, therefore, a rainy year can mean low groundwater levels, as reduced irrigation decreases artificial recharge. The system is not currently in structural deficit, but projections of declining flows in the Durance and the recurrence of drought episodes are raising questions once again about water sharing.

The 2022 drought revealed numerous dysfunctions in the management of this resource, highlighting the multiple interdependencies (spatial, temporal and institutional) that underpin the Crau hydrosystem. This article examines the capacity of the current institutional framework to manage these interdependencies across spatial and temporal scales. We draw primarily on research into polycentric governance (Ostrom, 2010 ; Carlisle and Gruby, 2019) and *institutional fit* (Heikkilä *et al.*, 2018).

A polycentric system is characterised by several independent decision-making centres that interact with one another through cooperation, competition and conflict resolution (Carlisle and Gruby, 2019). Ostrom (2010) considers that these systems are more effective than centralised approaches ; Carlisle and Gruby (2019) identify three advantages: greater adaptability, better institutional alignment and redundancy that mitigates risks. However, Heikkilä *et al.*, (2018) point out that this concept remains “*nebulous*” and is capable of encompassing a wide variety of approaches. Pahl-Wostl and Knieper (2014) show that decentralisation without coordination leads to fragmented governance, resulting in poor outcomes. The concept of ‘institutional fit’ refers to the alignment between institutional rules and the biophysical characteristics of the system being regulated (Heikkilä *et al.*, 2018 ; Carlisle and Gruby, 2019).

Our study is based on 38 semi-structured interviews (with WUA chairpersons, government departments, agricultural representatives, farmers and water management stakeholders), numerous informal discussions with local residents during field visits in 2024–2025, participation in various meetings in the region, and an analysis of a large body of grey literature. The verbatim transcripts, originally in French, have been translated in English word for word. After explaining the nested scales that structure the Crau hydrosystem (section 2), we analyse how the 2022 drought highlighted the interdependencies and

inconsistencies of this system (section 3), before drawing theoretical and operational lessons in terms of governance (section 4).

2. NESTED SCALES

The Crau hydrosystem is characterized by complex interdependencies between resources located at distinct spatial and temporal scales, which cannot be fully captured by the hydrological boundaries of the catchment alone. The concept of the *problemshed*, developed as an extension of the *watershed* (Mollinga *et al.*, 2007) is particularly insightful here, as it allows us to incorporate the spatial, temporal and social dimensions of water management, going beyond a purely hydro(geo)logical framework. The configuration of this water system is illustrated through two approaches: the water's path and its physical characteristics on the one hand, and the various stakeholders on the other.

2.1 The Waterway: Nested but distinct spatio-temporal dimensions

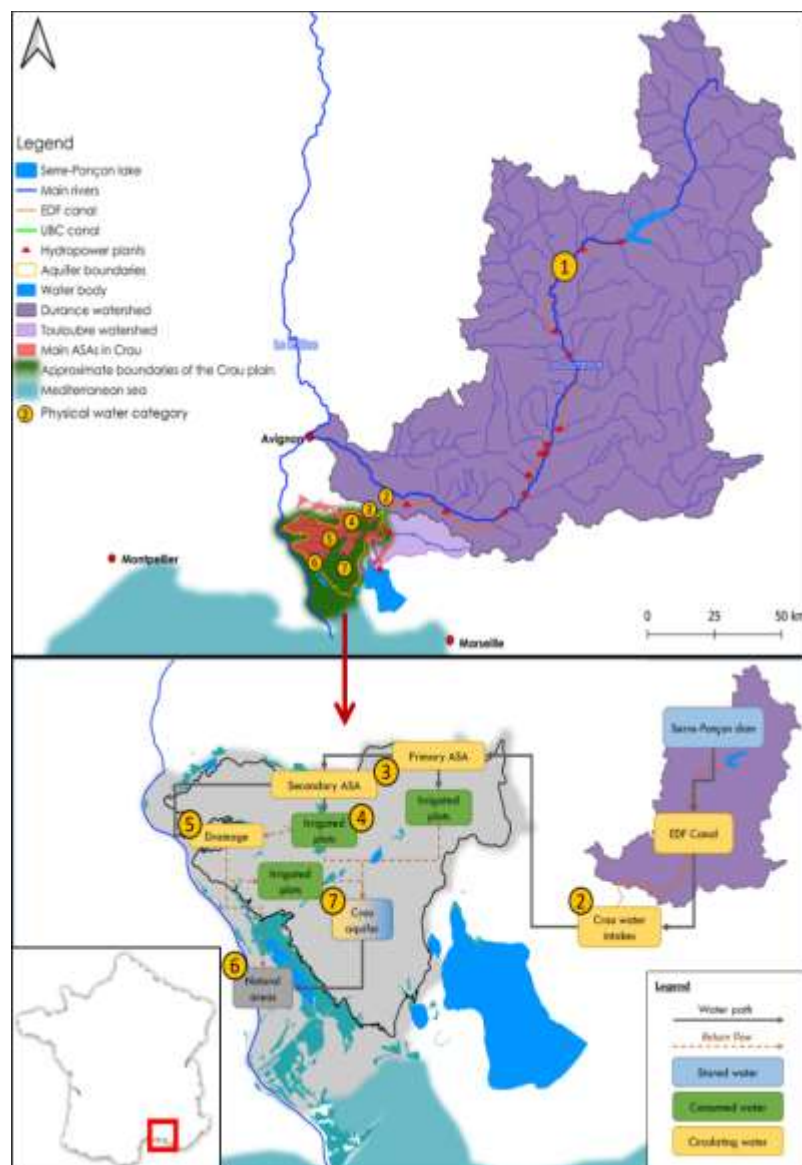


Figure 1 : Map showing all identified physical water categories in the Crau watershed (Authors, 2025).

The pathway of water flowing into the Crau aquifer is analysed here by dividing it into seven successive physical categories, each associated with its own stakeholders, rights and management approaches (

Figure 1). The water stored and conveyed upstream (Serre-Ponçon dam, EDF canal) forms the starting point of the system, under the quasi-monopolistic management of EDF, national electricity production company (1). The water diverted by the major Crau intakes corresponds to water abstracted from the EDF canal (2); the historic rights associated with these intakes, which are in some cases dated back to the 15th century, have been converted into contractual allocations, but are still regarded as heritage rights by the irrigators.

The channelled waters of Crau flow through the internal network managed by the ASAs (3), collective irrigation landowner associations, which determine the water rotation schedule, access priorities and distribution arrangements. Irrigation water is applied to the plots by flooding, thereby exercising the individual abstraction right (4).

Drainage water refers to the excess water that flows off irrigated plots (5). Resurgent water refers to groundwater that re-emerges at the surface, feeding various wetlands (6). Finally, groundwater is extracted via boreholes to supply drinking water, industry and agriculture (7). L'analyse de ce chemin de l'eau met en évidence une chaîne d'interdépendances où chaque catégorie influence les suivantes. La modification d'un paramètre à une échelle se répercute sur l'ensemble du système. Par exemple, les contraintes de rejet sédimentaire dans l'étang de Berre ont conduit à l'installation de bassins de décantation à Mallemort, réduisant la charge en limons de l'eau d'irrigation. Ces limons jouent un double rôle en Crau : colmatage des parois des canaux en terre et formation de sol fertile, leur diminution accroît donc les pertes par infiltration.

The central paradox of the Crau hydrosystem lies in flood irrigation: although viewed by some neighbouring territories as 'wasteful' it is, in fact, the main mechanism for aquifer recharge. Around two-thirds of the annual recharge of the aquifer comes from the infiltration of water from gravity irrigation of hay meadows, making specific irrigation practices at the plot level an issue that extends beyond the individual level to affect the entire Crau region and its multiple uses of groundwater. Any change in the allocation of water from the Durance to the Crau will therefore have a significant impact on the groundwater level (Trolard *et al.*, 2020 ; Baillieux, 2020).

2.2 A wide range of stakeholders at different levels

The institutional configuration at the scale of the Durance basin is dominated by EDF, which holds a quasi-monopolistic position in the abstraction, management and transformation of the materiality of water. The Executive Commission of the Durance (CED), created in 1907, plays an arbitration role between the canals of Basse-Durance (including those serving the Crau) during low-flow periods. At the scale of the Crau, the ASAs of Crau display strong heterogeneity: some irrigate fewer than 100 hectares with around ten members, while the largest have a perimeter of thousands of hectares. Canal management rests on an architecture at the crossroads between participatory democracy and "hydraulic technocracy" (Auvet, 2019).

As for the aquifer, SYMCRAU, the Crau aquifer management syndicate, carries out several essential missions in the areas of knowledge, outreach and coordination, without holding its own regulatory competencies or executive authority. Its role as the lead structure of the SAGE, a local water management plan, reinforces its place in the local institutional landscape, but does not confer upon it any regulatory or executive prerogatives. An OUGC has been established over the Crau aquifer, a structure responsible for managing and allocating the volumes of water earmarked for agricultural use in a given area.

Relations between the Crau and upstream actors are characterised by an asymmetry of power relations and a growing contestation of the legitimacy of Crau abstractions. It emanates from Alpine actors claiming priority over water generated by their territory, from EDF controlling information on available

volumes, from users in neighbouring territories who consider themselves more virtuous, and from the Canal de Marseille holding a regulatory priority of use. The configuration of the Craven hydrosystem thus generates interdependencies between actors situated at different positions along the water's path, a tension manifesting at every scale: between the Alpine upstream and the Provençal downstream, between neighbouring ASAs sharing the same water intakes, and between surface irrigators and aquifer abstractors.

3. 2022: HOW INTERDEPENDENCIES MANIFESTED THEMSELVES

3.1 *Chronology of an unprecedented crisis*

The winter of 2021-2022, marked by a persistent anticyclone, a month of January among the driest since 1960 and historically low snowpack on the Durance, generated as early as the first half of the year an unprecedented crisis on the Durance-Verdon system since the commissioning of the major infrastructure works of the last century. The CED was forced to take unprecedented measures: progressive restrictions from 13 June 2022, early mobilisation of the Serre-Ponçon agricultural reserve from 17 June, drawdown reaching 40 m³/s in August to compensate for a natural flow that had fallen to 30 m³/s... Until the anticipated exhaustion of the reserve (used at 80%) led to the cutting off of the Crau canals, effective from 1 to 19 September. This abrupt interruption of gravity irrigation, more than a month ahead of the usual winter shutdown, constitutes an unprecedented event whose immediate effect translated into a fall in piezometric levels of 0.21 m on average, even as the aquifer's quantitative index reached for the first time the "very low" threshold during the summer period.

This *focusing event*, in the sense of Birkland (1998), that is to say an event concentrating public attention and opening a window of opportunity for the politicisation of problems hitherto little visible, made visible the necessity of simultaneously articulating three temporal dimensions in the management of water scarcity in the Crau: the long-term structural balance of the aquifer, conjunctural droughts, and the hydrological variability of the Durance basin upstream.

The history of water management on the Durance illustrates the role of crises as drivers of institutional evolution: the creation of the CED in 1907 in response to violent disputes between users; the 2007 crisis, which led to the development of the 2013 crisis management protocol; the 2022 crisis, which initiated the formalisation of protocols at the ASA scale and the drafting of the first inter-departmental framework order for the Durance-Verdon. As an agricultural representative underlines: "crises make things evolve, as long as there is no crisis, minds remain set on old, even very old, ways of operating"

3.2 *The vulnerabilities and inconsistencies revealed by the crisis*

The irrigation canals, designed and dimensioned to operate at full capacity, proved ill-suited to the imposed flow reductions: some reaches no longer received enough water to reach the level of the intakes. Operating under reduced flow thus generated inequalities in water delivery. Furthermore, earthen canals experienced increased infiltration losses: one ASA president estimated these losses at "around 10% per kilometer", while another testified to "20% water loss over 100 meters of canal". A person from the state services summarises the cumulative consequences: "in general, there is the combination of a reduction in the allocation and a lengthening of the irrigation turns. So you have not only less water in allocation, but on top of that, you will get it later. It is something of a double penalty". On the plots, some farmers chose to sacrifice part of their meadows, with significant consequences: yield loss, invasion of "weeds" such as foxtail millet, downgrading of cuts under the Foin de Crau label. The size of the calans (levelled plots) also constitutes an issue revealed by the crisis: the recent trend towards their enlargement, in a logic of rationalising working time, turns into a vulnerability during restriction periods. Indeed, water distributed at reduced flow no longer necessarily reaches the far end of large plots.

The tools governing conjunctural management (

Figure 2) proved incomplete. While protocols existed at higher scales – CED had, for example, a crisis management protocol approved in 2013 defining restriction thresholds – this was not the case at the ASA scale. A person from the state services expresses their surprise: "the CED had a crisis management protocol approved in 2013, with thresholds. [...] On the other hand, no ASA had a protocol to say that if the CED decides on minus 20%, here is how we organise ourselves". Despite this unpreparedness, smaller structures were generally able to adjust more quickly: in many ASAs, informal management based on agreement between neighbours replaced the formal irrigation turn schedule. This capacity illustrates what Cleaver (2002) defines as "institutional bricolage": the capacity of actors to improvise and recombine rules in the face of unforeseen contingencies. However, in larger structures, the heterogeneity of situations and anonymity (linked to the large number of members, which reduces mutual knowledge between them) made consensus more difficult and facilitated free-rider behaviour.

The inverted hydrodynamic functioning of the Crau aquifer generates another inconsistency: in the absence of precise piezometric indicators for the aquifer, restrictions on boreholes are aligned with those applied to canal abstractions. The justification follows from a logic of territorial solidarity assumed by the state services: *"it is not a question of social peace, it is a question of awareness-raising and making people realise that there are major water issues and that there is a solidarity to be maintained between what happens on recharge and on consumption"*. The state services further argue that significant abstractions during high summer flows would affect the following winter low flows. This argument seems however contestable in light of the hydrogeological characteristics of the aquifer, including its low inertia and the speed of its flows (Baillieux, 2020). Drip irrigation nonetheless benefits from favourable treatment in the orders: it remains authorised at all restriction stages, including during crisis.

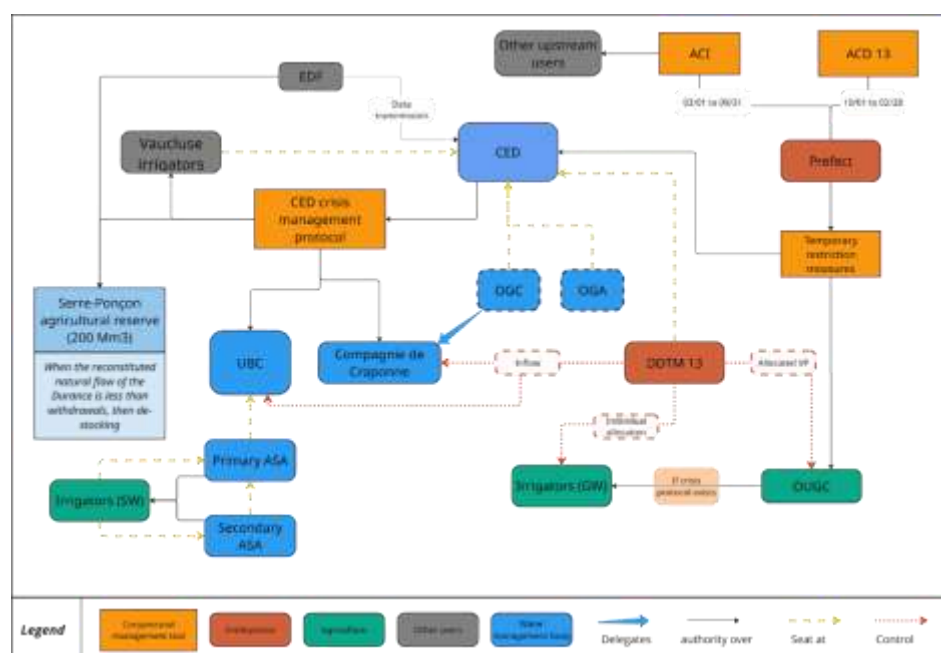


Figure 2 : Stakeholders and tools for conjunctural management and their application to the Crau river system (Authors, 2025).

3.4 The canal cutoff and its divergent framings

The canal cutoff between 1 and 19 September 2022 brought the interdependencies between institutional scales into sharp relief. Scarcity cannot be reduced to a technical phenomenon linked to the physical insufficiency of the resource, but constitutes a social phenomenon, as Fernandez (2017) underlines: *"governing water means, on the one hand, defining a certain nature of water and our relationship to it, and, on the other hand, producing a certain framing of the problem"*. Garcier (2010) underlines that any shortage is liable to be put to political use. By redistributing the social and economic legitimacy of uses,

it opens the way to allocation modifications that would otherwise be impossible: which is what the 2022 crisis illustrated.

What many ASA presidents seemed unaware of is that the closure of the canals had in reality been decided by their own representatives within the CED, in order to maintain full canal flow for as long as possible: *"it was not a unanimous position. But it was the position taken by the Crau representatives at the CED"* (state services). This gap between the decision and its reception at the level of irrigators testifies to a significant communication deficit.

Two readings then confront one another regarding responsibility for the crisis. The first attributes it to a failure of EDF management, directing solutions towards a regulation of turbinage and greater informational transparency. An ASA president summarises this idea, shared by most of his peers: "the 2022/2023 crisis is mostly attributable to an electricity crisis, which means that EDF needed to turbine heavily in winter and the forecast snowfall did not materialise". The second attributes it to the structural vulnerabilities of the irrigation system and calls for a transformation of practices. These two readings engage competing power relations and divergent interests, whose resolution would require explicitly acknowledging the political dimension of the scarcity problem. Media coverage in 2022 moreover contributed to producing a narrative in which Foin de Crau producers were held responsible. Faced with this stigmatisation, agricultural actors mobilise a counter-narrative grounded in the multifunctionality of gravity irrigation and its contribution to aquifer recharge.

4. DISCUSSION

4.1 Institutional fragmentation rather than polycentric governance

The Crau hydrosystem displays the structural attributes of a polycentric system, with numerous institutions and organisations at different scales. The coexistence of these arrangements nonetheless generates considerable complexity. Our interviews show that this multi-scale architecture, whose articulations remain difficult to grasp for most actors, feeds a sense of dispossession and distrust towards management institutions.

This distinction between functional polycentrism and simple institutional fragmentation is crucial. The decentralisation of management bodies without coordination does not constitute the formation of polycentric governance, but fragmented governance, which generally produces poor performance in the management of water resources (Pahl-Wostl and Knieper, 2014). The conjunctural management of water on the Crau hydrosystem thus pertains more to institutional fragmentation than to functional polycentric governance. Multiple decision-making centres exist and operate at different scales, but the coordination mechanisms between them remain insufficient, rules are not always adjusted to the realities of the system, and learning processes remain limited.

Eakin and Shearing (2025), studying the "Day Zero" crisis in Cape Town, show that polycentric arrangements can emerge during scarcity but come to an end with the drought, thereby underlining the necessity of institutionally anchoring the lessons learned from crises. This is precisely the challenge for the Crau hydrosystem, where the central paradox – that is to say the tension between restricting irrigation to conserve the resource in the Durance and maintaining that same irrigation to ensure aquifer recharge – runs through all the arrangements without finding a satisfactory and lasting resolution therein. Three findings emerge.

First, coordination mechanisms remain insufficient: according to Pahl-Wostl and Knieper (2014), a fragmented regime is distinguished from polycentrism precisely by this absence. Second, rules are not adjusted to biophysical realities. This is the institutional fit deficit, of which the mirroring of groundwater restrictions onto those of surface water, and the legal fragility of the CED with respect to the management of the agricultural reserve, constitutes an illustration. One interviewee explains "managing the agricultural reserve is not the CED's mission. In 1907, there is no agricultural reserve". The CED was indeed created by a law 50 years before the construction of the Serre-Ponçon dam. Third, learning processes remain limited: despite the 2007 crisis and the 2013 CED protocol, the territory was

unprepared in 2022. "Memory is short. Memory is very short" (state services). However, the CED played an essential role in 2022, and the Inter-Departmental Framework Order (order framing conjunctural management over the Durance-Verdon territory) of 2023 constitutes a notable development. Shortages can occur simultaneously or not on the Crau plain and on the Durance basin, adding a spatial dimension to the temporal complexity. Thus, what governance of water scarcity to adopt when the effects of decisions manifest themselves at different scales, in a non-concurrent manner? These institutional inconsistencies refer back to another reality: the fact that the balance of the Crau system is almost entirely anthropogenic. The Crau environments, far from being an immutable natural state, are the product of a social and technical construction. As a person from the state services summarised: "it is an anthropogenic balance; when we modify it for X, Y, Z reasons, clearly, today, we are playing a bit at sorcerer's apprentices, we do not really know how the system reacts".

One can then legitimately ask what the relevant ecological reference would be: an ecosystem without irrigation that perhaps never existed in this form, or a hybrid balance, shaped by agricultural practices, that one now seeks to protect? The question of what constitutes the "natural" to be preserved is therefore not only ecological, it is eminently political and revealing of the implicit choices upon which the environmental management of the territory rests. Scarcity is not the origin of the tensions, but renders them visible. It carries a narrative that legitimises certain interventions and delegitimises others.

4.2 Gravity irrigation facing the efficiency paradigm

Two irrigation models coexist in the PACA Region. The region has largely modernised its systems by adopting localised irrigation, but traditional gravity irrigation is maintained in certain systems such as in the Crau. This maintenance is justified by the ecosystem services it provides, but gravity irrigation is perceived as highly "inefficient" and "wasteful" by the proponents of "modern" irrigation, who thus call its legitimacy into question.

In his study of irrigation modernisation in two Spanish basins (Guadalquivir et Júcar), Schütze (2025) illustrates how the absence of coordination between water and agricultural administrations can lead to effects contrary to those envisaged. Despite massive investments in localised irrigation technologies, the non-reduction of water rights after modernisation led to a rebound effect where consumption increased rather than decreased. In the case of the Crau, an efficiency-based approach does not take into account the positive externalities provided by gravity irrigation: a regulatory framework designed to reduce abstractions can thus paradoxically weaken the groundwater resource upon which the entire territory depends. This phenomenon is directly perceptible in the discourse of actors. A person from the state services underlines the disconnection between the logic of the abstraction point and systemic logic: "for my colleagues at the state services, at the water agency or elsewhere, when I talk to them about it, gravity irrigation means canals that take far too much water in summer".

Facing these accusations of waste, Crau actors have developed a counter-narrative grounded in the "multi-use" of water. Gravity irrigation is presented therein as simultaneously productive (Crau hay), ecological (aquifer recharge, maintenance of wetlands) and patrimonial (landscapes, local biodiversity), thereby transcending the classic opposition between agricultural use and resource preservation.

The introduction of the Inter-Departmental Framework Order (ACI) Durance-Verdon in 2023 constitutes an important institutional development. It recognises that drought management in part of the Bouches-du-Rhône cannot be apprehended in isolation, but must be articulated with the management of upstream reserves. From a management still centred on administrative territories in 2022, one moves to a more systemic approach recognising hydrological interactions at the catchment scale. However, the coexistence of the ACI, the Departmental Framework Order, the CED protocol, and the local arrangements specific to each ASA creates a multi-tiered architecture whose comprehension is far from straightforward, not only for users but also for managers themselves. The question of the articulation between irrigation restrictions and the maintenance of recharge thus constitutes the central element of drought management in the Crau, which successive orders attempt to address without resolving it entirely.

4.3 Future directions for governance adapted to interdependencies

The fact that a crisis provokes adaptations does not mean that these adaptations durably anchor themselves in practices and rules. The memory of crises fades: the hydrologically favourable years that followed 2022 have attenuated the urgency that was felt. The concept of institutional bricolage (Cleaver, 2002) aptly describes the adaptations observed, but the question of whether these improvisations can lastingly transform themselves remains open.

Several directions can therefore be put forward. Beyond the Crau SAGE, which identifies adaptation of the recharge system, qualitative water protection, and the safeguarding of wetlands as priority issues, the definition of piezometric indicators specific to the aquifer, the recognition of gravity irrigation as an ecosystem service (for example via payments for environmental services (PES)), and the construction of coordination integrating the temporal gaps between surface and groundwater regimes constitute the conditions for more adapted governance. The answer therefore lies not so much in institutional simplification as in the strengthening of coordination mechanisms, the improvement of institutional fit, and the construction of a shared culture of scarcity.

SYMCRAU itself points to a paradox running through the idea of payments for environmental services (PES): on the one hand, the State and the Water Agency have funded a first wave of PES to maintain the gravity irrigation that recharges the aquifer; on the other, these same institutions "*keep hammering away at the canals to make them save water*" (SYMCRAU). This paradox is explained by a difference of scale: at the local level, infiltration is beneficial; at the Durance basin level, every abstraction is perceived as a "loss". As Barbier and Fernandez (2024) underlines : "‘riveraineté’ [neighbourhood] and ‘rivalité’ [rivalry] share [in French] the same etymology. French law constructs hydrosocial communality as a collection of individuals bound in solidarity by a water that connects them despite themselves, while being a source of reciprocal obligations".

Crau hay producers, by maintaining gravity irrigation, provide an ecosystem recharge service benefiting 300,000 inhabitants for drinking water, without this solidarity necessarily translating into recognition or compensation. This imbalance induces an inequitable distribution of benefits between users located downstream, who benefit from groundwater services, and upstream actors, who bear the preservation efforts for the downstream "water rights" (Hérivaux et Maréchal, 2019 ; Le Coent, 2023).

CONCLUSION

The Crau hydrosystem illustrates how the structural conditions of polycentrism can coexist with persistent institutional fragmentation, for lack of sufficient coordination mechanisms. The 2022 drought, by simultaneously revealing the three temporalities of water scarcity and the inadequacies of existing rules, opened a window of opportunity whose translation into lasting learning remains, to this day, uncertain. The recent implementation of the Crau SAGE could however constitute a sufficiently federating framework to durably anchor these learnings and strengthen coordination between scales.

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