

A GROUNDED APPROACH TO THE REUSE OF TREATED WASTEWATER: ENVIRONMENT AND MODERNIZATION

UNE APPROCHE TERRE-A-TERRRE DE LA REUTILISATION DES EAUX USEES TRAITEES: ENVIRONNEMENT ET MODERNISATION

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ABSTRACT

Since April 2026, treated water from the River Tech (South of France), processed at the coastal town's (Argelès-sur-Mer) wastewater treatment plant, has been reused to irrigate 700 hectares of agricultural land. The aim of this communication is to examine the project's local anchoring in order to understand how it contributes to societal transformations in a territory of scarcity. The study demonstrates how the 'environmental' aspect of the "Reuse" is articulating to the modernization of irrigation and agriculture.

Keywords: Reuse of treated wastewater; Environment; Modernization; Coastal town; Societal transformations.

RÉSUMÉ

Depuis avril 2026, les eaux traitées provenant de la rivière Tech (sud de la France), traitées à la station d'épuration de la ville côtière d'Argelès-sur-Mer, sont réutilisées pour irriguer 700 hectares de terres agricoles. L'objectif de cette communication est d'examiner l'ancrage local du projet afin de comprendre comment il contribue aux transformations sociétales dans un territoire en situation de pénurie. L'étude montre comment la dimension « environnementale » de la « réutilisation » s'articule avec la modernisation de l'irrigation et de l'agriculture.

Mots-clés : Réutilisation des eaux usées traitées; Environnement; Modernisation ; Ville côtière; Transformations sociétales.

INTRODUCTION

In France, the reuse of treated wastewater ("Reuse") is attracting more attention following the 'Water Plan'² adopted by the Government in 2023, which strongly encourages the 'massification' of the use of non-conventional water sources, including treated wastewater (TWW). Since, the process of making Reuse a "credible" option against scarcity (Binz et al. 2016), has accelerated with the implementation of action and support programmes, as well as regulatory reforms to encourage local authorities to embark on this path. 'Reuse' is gradually becoming a solution to address the scarcity issues that the country experienced since 2022. This is particularly the case in the south of France, in the Occitanie region, called a 'laboratory for thinking about water uses', and more specifically in the Pyrénées-Orientales department, where a Reuse project was implemented in April 2026 for agricultural uses.

In this paper, "Reuse" is defined as an infrastructure composed of a technical assemblage including treatment processes, distribution systems, and regulatory frameworks. Like any technology, it is accompanied by a set of "promises" that support its deployment (Audétat, Barazzetti et al. 2015). In France, several registers of promise can be identified: environmental sustainability, climate adaptation, resource security, and economic support (Collard 2026). This argumentative framework notably draws on the rhetoric of recycling (treated wastewater is framed as a resource to be valorized within the paradigm of the circular economy) in order to reconcile environmental and economic objectives

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2 <https://www.ecologie.gouv.fr/dossiers/comment-mieux-gerer-ressource-eau/plan-eau-3-enjeux-53-mesures>

(preservation of water resources and support for agriculture) (Monsaingeon 2017; Le Meur 2021). The aim of this paper is to examine this proposition by investigating the territorial embedding of a wastewater reuse project and the ways in which this promise materializes in practice. In this perspective, the approach adopted involves departing from approaches that attempt to identify obstacles and barriers to the deployment of “Reuse” projects. Instead, it adopts a “relational” approach to infrastructure (Leigh Star 2018), considering that infrastructures acquire meaning only through the uses made of them and the actors who engage with them, thereby shedding light on their “entanglement with human societies” (ibid). This implies both “unfreezing” (ibid) the technical characteristics of wastewater reuse infrastructures by examining the socio-political trade-offs they embody, and making intelligible the societal transformations to which they contribute. It also requires adopting a scale of analysis that extends beyond the boundaries defined by the infrastructure (from the treatment site to the point of use) in order to address a broader water territory. This study is based on a case study: the territorial embedding of a wastewater reuse project in the Tech Valley (Pyrénées-Orientales, France). The project consists in diverting treated wastewater from the Tech River, processed by the wastewater treatment plant of the coastal municipality of Argelès-sur-Mer, in order to supply 700 hectares of agricultural land.

RESEARCH METHOD AND CASE STUDY

Qualitative research protocol

A qualitative research design was implemented between June 2024 and April 2026. A total of 36 interviews were conducted with state services (both regulatory authorities and funding bodies), operational project leaders (primarily project managers and engineering consultants), water management stakeholders, future beneficiaries of the treated wastewater reuse scheme (orchard growers and wine producers), as well as farmers and residents of the territory who will not benefit from the project. The empirical material collected through interviews was triangulated with other sources (Olivier de Sardan 2008), particularly grey literature produced within the territory and relating to water issues (PGREs, canal agreements, SDAGE river basin management plans, etc.), as well as documents specifically related to the wastewater reuse project (reports produced by engineering consultancies and PowerPoint presentations). Additional data were gathered from professional social networks (such as LinkedIn) and the local press.

Redirecting treated wastewater from the tech river (Pyrénées-Orientales) in a water-scarce territory

In 2022, the department experienced multiple scarcity episodes and was repeatedly placed under “crisis” status. The Tech River is one of the few rivers in the region not equipped with flow regulation infrastructures, making compliance with minimum ecological flow requirements particularly difficult, especially downstream in the valley (nodal point T5 = 930 l/s).

Moreover, water scarcity has intensified tensions between two major water-consuming economic sectors: agriculture and tourism. The Tech River is diverted at numerous points through around thirty historic gravity-fed irrigation canals. Originally, these canals were used both for crop irrigation and for powering mills and forges. Water demands vary considerably from one canal to another: some withdraw around ten liters per second, while others require several hundred liters per second during peak periods. Additional irrigation withdrawals are carried out through wells and boreholes tapping into Quaternary and Pliocene aquifers. In 2018, agricultural irrigation accounted for approximately 86% of water withdrawals within the basin (PGRE Tech Valley document, 2018). In the middle and lower sections of the river, agriculture reflects broader departmental trends, characterized by a balance between orchard farming and viticulture, a decline in the number of farms, and an increase in cultivated land areas (Agreste, 2020). Downstream of the valley, the municipality of Argelès-sur-Mer is often described as the “European capital of camping.” While its permanent population is around 10,000 inhabitants, it reportedly reaches peaks of up to 150,000 during the holiday season. Drinking water supply needs are met “approximately one-third from the deep Pliocene aquifers, while the remaining two-thirds are drawn directly from watercourses (including the Tech River), associated alluvial aquifers, the fossil bed of the

Tech, or from boreholes and springs located within the crystalline and metamorphic formations of the upper basin” (PGRE document, 2018).

In this context, the wastewater reuse project appears as a response promoted by the French State to reduce pressure on water resources. In 2024, the Pyrénées-Orientales Department became the first in France to implement a Water Resilience Plan, which included the objective of “acting on resource availability” through support for three wastewater reuse projects. By April 2026, the Argelès-sur-Mer wastewater reuse project had become operational. The project is managed by the public water utility of the “Albères–Côte Vermeille” (CCACVI). Following the public procurement procedure, Class A reclaimed water quality was achieved. However, in accordance with the precautionary principle, the project was implemented according to the standards initially planned for Class B quality water. Authorized uses include “the irrigation of raw food crops: orchards; and the irrigation of processed food crops: wine grapes.” The Argelès-sur-Mer wastewater treatment plant has a daily treatment capacity of 12,500 m³/day, with treated effluents currently discharged into the sea.

The prefectural decree specifies an irrigation perimeter of 573 hectares equipped with drip irrigation systems, including 125.6 hectares of vineyards and 447.4 hectares of orchards (**Figure 1**). Estimated annual water demand amounts to 1,970,000 m³/year, while the wastewater reuse project plans to supply 1,240,033 m³/year. The planned irrigation period extends from April to September. A 14-kilometre distribution network connects the wastewater treatment plant outlet to the withdrawal points: one Authorized Users’ Association (ASA) and seven individual farms. The estimated investment cost of the project is €12.4 million, financed up to 80% by the Water Agency and European funds. The selling price of reclaimed wastewater to farmers is set at €0.20/m³, while an additional €0.40/m³ is borne by drinking water consumers. A contractual agreement defines the distribution of responsibilities between the CCACVI water utility and reclaimed water users. The responsibility of the CCACVI extends from the treatment point to the delivery point. The agreement commits the utility to supplying water of adequate quality to agricultural operators. In turn, irrigators commit for a period of 40 years to purchasing the volume of reclaimed wastewater specified at the time of signing the agreement, although these volumes may subsequently be adjusted.

Figure 1. Schematic representation of the four irrigated zones included in the wastewater reuse project (Source: Appendix to the Prefectural Decree).

RESULTS

Emergence of the project: a convergence of multiple factors

The implementation of the wastewater reuse project resulted from a combination of climatic, institutional, and technical factors. Institutionally, drought episodes accelerated political support for the project, which the CCACVI had already begun to outline in 2021. The department was repeatedly placed under crisis status, compelling the State to intervene:

“During the summer of 2023, when we entered the crisis phase, when the prefect at the time, Rodrigue Furcy, signed the first crisis decree, restrictions were imposed on agricultural irrigation and water uses. At that moment, in order to avoid major tensions within the territory, alternative uses had to be found [...] And that is when I began to see wastewater reuse from another perspective [...] : we needed to move forward because the whole situation was about to explode in everyone’s face, so we had to find solutions capable of securing both users and the prefect.” - Senior civil servant in charge of implementing the Water Resilience Plan.

This political support facilitated the implementation of the project, as expressed by the project leader: “*Fortunately, we have support from the Ministry, and I can tell you that it opens many doors.*” This statement refers both to regulatory compliance procedures and to the release of financial support. Drought episodes also accelerated the adhesion of future beneficiaries, who until then had shown limited interest in the project because they had not experienced major water supply difficulties.

Another facilitating factor relates to the pre-existing sociotechnical infrastructure. First, the wastewater treatment plant was already equipped with an adequate tertiary treatment system capable of producing bathing-quality water, for which the required standards are close to those applied to reclaimed wastewater. Second, treated effluents are discharged into the sea, thereby avoiding questions regarding impacts on river flow levels.

Preserving water resources

The wastewater reuse project is justified through the objective of preserving water resources. In practice, this translates into a logic of substitution, whereby conventional water resources are replaced by reclaimed wastewater. Reclaimed wastewater is therefore not conceived as an additional water supply for beneficiaries. This substitution principle constitutes one of the key conditions imposed by the main funding institution:

“Our focus is substitution and resource preservation, which is also the Water Agency’s approach—and they are the project’s main funder.”— Project leader

Water resource preservation addresses two territorial issues. The first concerns the surface waters of the Tech River. One of the principal beneficiaries of reclaimed wastewater is an Authorized Users’ Association (ASA), which represents around 50% of projected consumption volumes. This ASA is a major water abstractor from the Tech River, supplying the Albères gravity-fed canal and initiating the connected pressurized irrigation network. In this case, substitution consists in replacing Tech River water with treated wastewater, thereby preserving river flows to ensure compliance with minimum ecological flow requirements at nodal point T5.

The second preservation issue concerns groundwater resources: both the alluvial aquifers associated with the Tech River (Quaternary aquifers) and the deeper Pliocene aquifers, and the risk of seawater intrusion. Farmers abstract groundwater through boreholes, as do certain coastal municipalities for drinking water supply purposes. In practice, access to reclaimed wastewater is conditional upon beneficiaries agreeing to revise their abstraction permits in order to reduce groundwater withdrawals. At the time of the final interviews conducted in April 2027, the agreement had still not been signed.

The environmental dimension of the project generated broad consensus among interviewed actors, although not necessarily in terms of substitution. Most stakeholders agreed on the principle that wastewater should be reused rather than discharged into the sea and “lost.” Positions regarding substitution itself were more contrasted, sometimes scarcely discussed or openly criticized. One future beneficiary argued that irrigating an area located 14 km from the coastline did not adequately address what he considered the priority issue: the risk of seawater intrusion. Beneficiaries nevertheless agreed on the opportunity to secure access to water and become less vulnerable to water-use restrictions associated with scarcity. For those benefiting from the “creation” component of the project, the objective was to irrigate young vineyards, recover lost yields, and stabilize production. Notably, water quality issues were largely absent from discussions, except regarding the compatibility of reclaimed wastewater use with organic farming standards.

Beneficiaries: ensuring economic viability

In 2021, the CCACVI launched a feasibility study to define the future irrigated perimeter and identify project beneficiaries. The primary challenge was to ensure the project’s economic viability. To achieve this, reclaimed wastewater “customers” needed to have sufficiently large water demands to guarantee the utility’s ability to sell treated water while maintaining an attractive price per cubic metre (€0.20/m³). Furthermore, farms needed to be equipped with drip irrigation systems in order to comply with regulations governing the use of Class B reclaimed wastewater. Vegetable crops and household gardens were excluded, and only former pressurized irrigation canal systems were deemed eligible. According to these criteria and constraints, the decision was made to distribute reclaimed wastewater to the Albères ASA:

“Through the governance study, we realized that we would need larger volumes and larger irrigated areas to achieve economically acceptable prices, so we looked for other potential farmers [...] And we also needed reliability on the demand side because we need someone who will actually buy the water. A small farmer cannot commit to fixed volumes or fixed subscriptions. So we turned toward the Albères Canal ASA, which is an extremely well-organized ASA [...] They are highly organized, they understand the issue very well, and as you probably noticed, they are very proactive.”— Project stakeholders The other beneficiaries are agricultural operators whose plots are located close to the distribution network route and are therefore relatively easy to connect.

Throughout the interviews, reclaimed wastewater beneficiaries were regularly described as “big” farmers. This qualification does not refer to a homogeneous category. Those designated in this way may include agricultural entrepreneurs from within or outside the region, often engaged in multiple activities (photovoltaic businesses, management of agricultural cooperatives, etc.). They embody a form of “agriculture without farmers” (Purseigle and Hervieu 2022), characterized by limited presence in the fields and closer to managerial figures. One orchard grower (86 ha) distinguished himself from the others by emphasizing that he was *“the last one still working the land.”* The distinction between “big” and “small” farmers is also used within the ASA itself. Only one of the “big” farmers is an external entrepreneur who purchased land in order to benefit from climatic conditions favourable to early variety of peach production. The other “big” beneficiaries belong to long-established local families and include orchard producers and historic wine estates.

The techno-economic criteria underlying the selection of beneficiaries in order to ensure project viability are therefore not socially neutral. They favour a specific profile of beneficiaries: operators managing large agricultural enterprises, possessing the financial capacity to pay for water (individually or collectively), and with a significant local social capital (notably through responsibilities within the dominant agricultural union).

A journey towards modernising irrigation

The decision to distribute reclaimed wastewater to ASA members also forms part of a longer trajectory of irrigation modernization initiated during the 1980s through quantitative water management policies centred on water savings and environmental preservation. The trajectory followed by the Albères ASA illustrates this process.

The Albères Canal was constructed in 1313, while the ASA was created in 1864. Today, the association includes around 1,000 members, both urban residents and farmers. In 1988, the ASA decided to convert part of the gravity-fed irrigation perimeter into a pressurized system and subsequently adopted drip irrigation technologies. Water from the Tech River is now diverted through the gravity-fed canal over 6 km to a pumping station, which then distributes pressurized water through the collective irrigation network supplying approximately 324 hectares. Within this ASA: *“we have become around fifteen large farmers who get along reasonably well. Let’s say seven large farmers and a few small ones”* - ASA director. Other members, including urban residents irrigating orchards and gardens, rely on the water flowing openly through the canal’s secondary networks.

In 2022, in a context of scarcity, the ASA board (composed by farmers) decided to reserve Tech River water for the pumping station and to cut off supply to the secondary canal networks. Following the crisis, the board maintained this decision, arguing that the canal’s “original” purpose was agriculture. Within a few months, the consequences of this interruption became visible in the landscape (death of century-old oak trees and poplar hedges) and biodiversity (drying out of lands previously sustained by infiltration from the canal).

This decision did not generate consensus, particularly among those who lost access to water. However, these actors lacked the capacity to influence collective decisions due to the increasing technicization of water debates and modifications to voting rules proportional to cultivated land area. For some actors, the wastewater reuse project represented an opportunity to reconsider water allocation: reclaimed wastewater for agriculture, and Tech River water for other uses, surrounding lands connected to

secondary networks, and the river itself. Yet this alternative was not considered, since the gravity-fed water volumes previously circulating through the canal are now included within the substituted volumes supplied by reclaimed wastewater. Moreover, closing the secondary networks simplified ASA management, especially during restriction periods when disputes and dissatisfaction were frequent and sometimes highly conflictual.

CONCLUSION

This study shows that the wastewater reuse project extends the modernization trajectory of the Tech Valley, based on a resource optimization paradigm whose effectiveness in addressing water-saving objectives remains contested (Molle 2008; Grafton, Williams et al. 2018; Zwarteveen, Smit et al. 2018, Collard and Kuper, 2026). It also demonstrates that analysing project implementation beyond the limits imposed by the infrastructure itself makes it possible to understand how technical innovations contribute to broader societal transformations. In this case, the application of recycling rhetoric to water management reflects a form of ecological modernization associated with the modernization of irrigation practices, and consequently of agriculture itself, given the interdependence between sectors (Barone 2025). This work was funded by the project interreg sudoe i-rewater (2024-2026).

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