Good practices of economic and financial instruments

GOVAQUA WP4 Good practice inventory

Deliverable 4.2

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Contents

Summary

This report presents an inventory and assessment of good practices of economic and financial instruments for water governance, developed under Work Package 4 (WP4) in the project *Governance innovations for a transition to sustainable and equitable water use in Europe* (GOVAQUA). The deliverable documents and evaluates a portfolio of six practices that illustrate how economic incentives, market-mediated transactions, private assurance tools, and finance mechanisms can contribute to sustainable and equitable water use, while also highlighting the enabling conditions and limitations that shape their performance in practice.

The WP4 good practices cover a diverse set of instrument types and governance settings. They include: (i) a **drought water bank (the California Drought Emergency Water Bank of 1991, United States)**, (ii) **an environmental water buyback programme (Restoring the Balance in the Murray–Darling Basin, Australia)**, (iii) **a shift from flat-rate to volumetric pricing for irrigated agriculture (Central Emilia Irrigation Water District, Emilia-Romagna, Italy)**, (iv) **impact investment for sustainable water management (DC Water Environmental Impact Bond)**, (v) **water stewardship certifications in export-oriented agricultural supply chains (Huelva/Doñana context, Spain)**, and (vi) **a Payment for Ecosystem Services (PES) scheme for groundwater quality protection (the Vittel case, France)**. The geographical applicability of these practices ranges from catchment- and sub-basin scales to basin-wide and supply-chain governance contexts, with lessons intended for adaptation and replication in Europe rather than direct institutional transplantation.

Data collection and assessment relied on a mixed-methods approach reflecting the nature of each practice. Across the portfolio, the work combined desk-based review of scientific and grey literature with analysis of official documentation and programme reporting. For several cases, the evidence-base also included published quantitative evaluations (notably econometric ex post assessment for volumetric pricing) and, where relevant, structured qualitative material from semi-structured interviews (notably for the stewardship certification case). The practices were assessed using the shared GOVAQUA good-practice criterion: effectiveness, efficiency, inclusivity and reflexivity, and replicability and generalizability, while maintaining a clear separation between claims supported by case evidence and broader interpretative statements derived from the comparative literature.

A central, cross-cutting finding is that economic and financial instruments rarely function as stand-alone solutions. Instead, their performance depends on how they are embedded within wider governance systems—particularly the clarity of rules (rights/permits and allocation arrangements), the credibility of measurement and accounting (volumes, sources and timing), and the presence of capable intermediaries (such as water bank operators, environmental water holders, irrigation districts, certification bodies, or PES intermediaries). In terms of EU policy relevance, the portfolio demonstrates several pathways through which economic instruments can support the objectives of the Water Framework Directive and related EU priorities on quantitative water management, ecological protection, and cost recovery. The report also highlights important limitations and trade-offs.

Overall, the WP4 portfolio supports a clear strategic conclusion for Europe: economic and financial innovations can make material contributions to water resilience and sustainable water use, but only when deployed as part of coherent policy mixes that combine incentives with enforceable rules, credible data systems, and socially legitimate implementation arrangements.

1. Introduction

GOVAQUA´s main objective is to facilitate a transition towards sustainable and equitable water use in Europe. This involves identifying, assessing, and validating innovative governance instruments and approaches. The urgency stems from the need to reconcile water use with environmental needs and align with EU directives and global sustainability goals. This endeavour spans multiple types of governance innovation, including legal and regulatory instruments, participatory and collaborative approaches, economic and financial instruments, and digital tools that can strengthen decision-making, transparency and accountability.

This Deliverable report presents the work carried out under WP4 on economic and financial instruments. WP4 focuses on how pricing, incentives, market-mediated transactions, contractual arrangements and finance mechanisms can influence water use and investment decisions, thereby supporting water-related policy goals. These instruments are increasingly salient in a context of recurrent droughts, tightening environmental constraints, and rising expectations on private-sector accountability for water-related risks and impacts across value chains.

The WP4 good practices documented in this report are organised around six cases that illustrate distinct instrument families and governance contexts. First, the California Drought Emergency Water Bank (1991) provides a crisis-response example of a centrally coordinated mechanism for temporary reallocation under acute scarcity. Second, the Restoring the Balance programme in Australia's Murray–Darling Basin illustrates environmental water recovery via voluntary purchases of water rights and related products. Third, the Central Emilia Irrigation Water District case in Italy documents the behavioural and financial implications of shifting from flat-rate charging to volumetric pricing in irrigated agriculture. Fourth, the report includes a good practice on impact investments for sustainable water management, illustrating how private finance can be directed towards water outcomes under appropriate governance and measurement safeguards. Fifth, the water stewardship certification case from the Huelva/Doñana berry sector in Spain examines private, business-to-business assurance mechanisms that translate water expectations into auditable requirements embedded in supply-chain governance. Sixth, the Vittel case in France illustrates a Payment for Ecosystem Services (PES) arrangement for groundwater quality protection based on long-term contracting, intermediation and practice-based conditionality.

Table 1. Overview table of all the good practice cases.

Name of the good practice	Type of innovative practice	Geographical applicability	Level of water governance
Water Banks: The California Drought Emergency Water Bank of 1991 (EEUU)	Trading schemes	Regional, National, EU, Global	Basin, Catchment
Buyback: Restoring the Balance in the Murray–Darling Basin (Australia)	Trading schemes	Regional, National, EU, Global	Basin, Catchment
Volumetric Rate: The case of the Central Emilia Irrigation Water District (Italy)	Water pricing	Regional, National, EU, Global	Basin, Catchment
Impact Investments for sustainable water management	Financial mechanism	Regional, National, EU, Global	Catchment, National
Water Stewardship Certifications: The case of the berry sector in Doñana (Spain)	Information policies /Voluntary standards	EU, Global	National, Global
Payment for Ecosystem Service: Vittel Case (France)	Subsidies	National, EU, Global	National, Global

The good practices are assessed using the common GOVAQUA evaluation framework—effectiveness, efficiency, inclusivity and reflexivity, and replicability and generalizability—while adapting the application of criteria to the nature of each instrument and its evidence base. Across cases, WP4 draws on peer-reviewed and grey literature, official programme documentation and reporting, and, where relevant, qualitative evidence from interviews. The purpose is not to identify universally applicable "best practices", but to document validated innovations and the conditions under which they are likely to perform well, as well as the trade-offs and limitations that shape their real-world operation.

The WP4 work links to the broader GOVAQUA architecture in several ways (Figure 1). First, the case descriptions and assessments provide structured input to the cross-case comparison and synthesis activities undertaken in WP1. Second, the documented practices provide a portfolio of instrument options, and enabling conditions, for consideration in Living Lab and broader EU water governance contexts, particularly where demand management, environmental objectives, and financing needs must be reconciled. Third, the findings connect directly with other work packages: economic instruments are mediated by legal and regulatory design (linking to the good practices on regulatory instruments), by stakeholder engagement and conflict-resolution capacity (linking to participatory and collaborative approaches), and by monitoring and evaluation infrastructures that determine whether incentives translate into hydrologically and socially meaningful outcomes (linking to governance assessment and digital support tools).

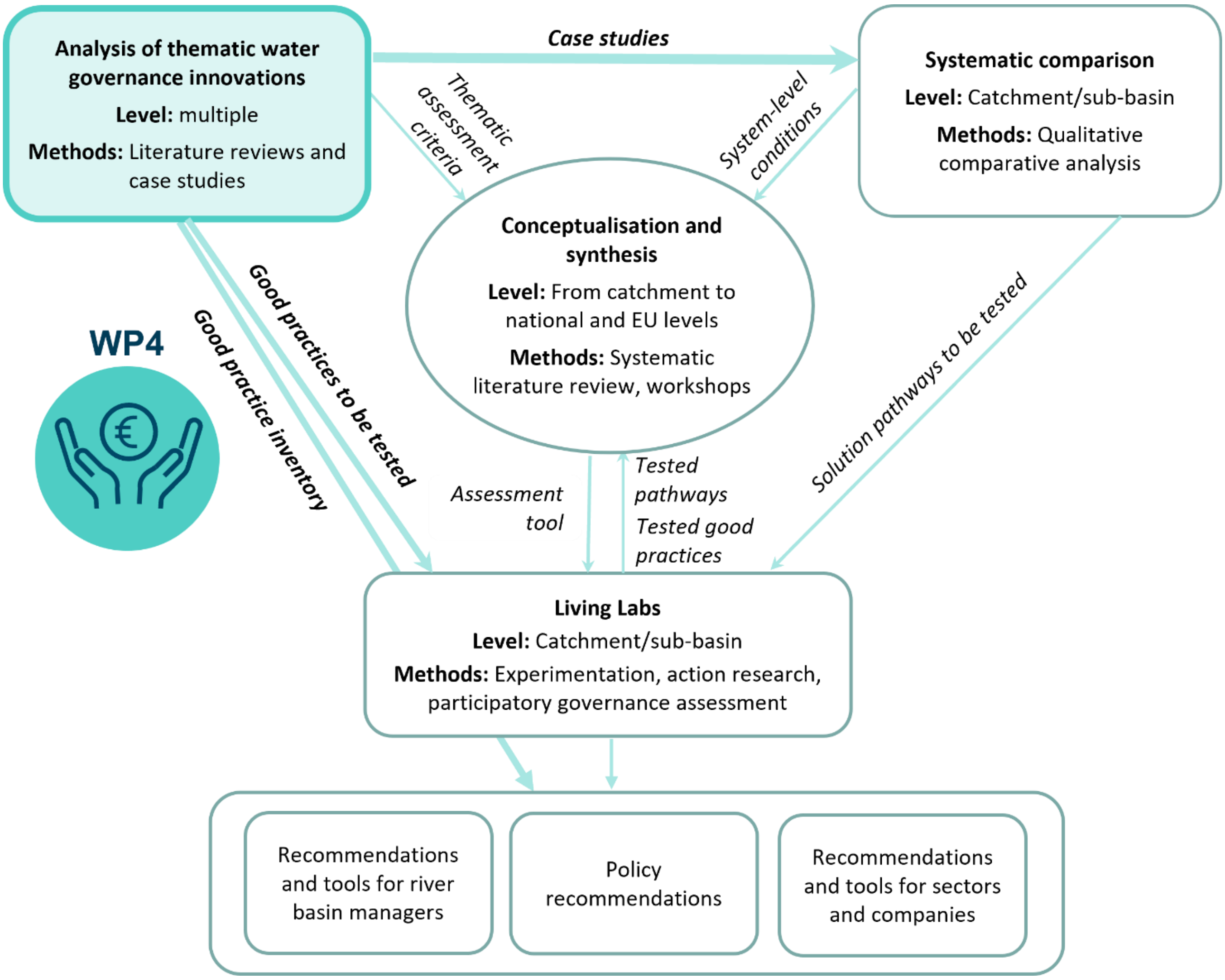

Figure 1. Positioning of WP4 and this report in the overall framework of the GOVAQUA project.

The report proceeds as follows. Chapter 2 presents the general methodology used in WP4, including the definition of good practices, the assessment criteria and the evidence base. Chapter 3 documents and assesses the six WP4 good practices. Chapter 4 synthesises conclusions across the portfolio, reflecting on how economic and financial instruments can contribute, individually and in policy mixes, to delivering towards key EU water-related objectives and the conditions required for their credible upscaling and transferability within Europe.

2. Methodology

2.1 Good practice definition

A good water governance practice in the GOVAQUA project is defined as follows:

A good water governance practice exemplifies an innovative instrument, approach or arrangement that contributes to achieving water-related policy goals and targets in a sustainable and equitable manner. It has been tested in practice, assessed and validated by stakeholders and independent evaluators in a specific context against specific principles and criteria.

Water governance good practices originate from certain contexts and are tied to the water issues of that context. Therefore, they entail certain prerequisites from their implementation environment. Thus, broadly applicable "best practices" for water governance cannot be discerned[1]. However, within good practices implementation different performance levels can be achieved, typically requiring different levels of effort and resources, building on a continuous improvement.

The good practices documented in the GOVAQUA project are all examples of emerging water governance innovations that are not yet broadly applied but hold promise for replicability and up-scaling in the EU context. The difference of this good practice documentation to the "macro-level" water governance assessments, initiated e.g., by the OECD and the self-assessment tool developed in the GOVAQUA project (Özerol et al., 2024), is that the focus of the good practice is at a "micro-level", on an instrument, approach or arrangement, rather than the broader water governance context such as a nation or a basin.

The documented good practices are primarily intended to illustrate and validate existing niche practices and to provide innovative ideas for national and basin level water managers and other decision makers in water governance. The practices are also relevant to other water governance actors, such as NGOs, companies and research institutes that initiate or participate in water governance processes.

2.2 Good practice criteria

General criteria for good water governance practices applied here have been adapted from the 12 OECD water governance principles (OECD 2015).[2] The full list of criteria developed for the purposes of the GOVAQUA project can be found in Annex I. While the criteria aim to be comprehensive, they are not equally relevant for all innovative instruments, approaches and arrangements assessed but can be weighted. For each good practice, additional detailed criteria regarding the type of the innovation, i.e., legal and regulatory, participatory and collaborative, economic and financing or digital solutions, can be applied. Furthermore, we expect that in reality, most good practices do not fulfil all the criteria, or at least not all at the same time. For

[1] Note: OECD *Handbook of What Works Solutions for the Local Implementation of the OECD Principles on Water Governance* (OECD 2024) only makes reference to "evolving water governance practices" that "respond to the challenges underlying each of the 12 (OECD Water Governance) Principles", drawing lesson from "successful" and "challenging" implementation examples. Nevertheless, OECD generally advances identification of "good water governance" practices.

[2] Original principles: effectiveness (clear roles and responsibilities, appropriate scales within basin systems, policy coherence, capacity); efficiency (data and information, financing, regulatory frameworks, innovative governance); and trust and engagement (integrity and transparency, stakeholder engagement, managing trade-offs, monitoring and evaluation) (OECD 2015).

the practices documented by GOVAQUA factors concerning challenges in meeting the criteria are also reported.

In the case of innovative economic and financial instruments the following criteria has been applied:

Effectiveness

1. Address a problem or a need related to sustainable and equitable water use
2. Connect and contribute to water-related policy goals and targets
3. Provide clear economic signals and incentives that are expected to change behaviour (e.g., reduce abstractions, increase efficiency, reduce pollution)
4. Define and follow clear roles and responsibilities for different stakeholders
5. Are linked to appropriate scales within basin or other water governance systems
6. Match or advance the level of technical, financial and institutional capacity in the given water governance system
7. Are coherent with the wider policy mix, avoiding perverse incentives and supporting complementary measures

Efficiency

1. Utilize, share and enhance adequate water-related data and information
2. Are cost-effective relative to alternative measures, taking into account administrative, monitoring, and enforcement costs
3. Help mobilise financing and/or improve financial sustainability
4. Minimise transaction costs for users and administrators (simplicity, clarity, predictable procedures)
5. Support efficient allocation and use of water resources over time (including incentives for innovation and investment)
6. Connect to and advance sound regulatory frameworks

Inclusivity and reflexivity

1. Are built on or advance transparent and accountable processes and outcomes
2. Are built on or advance equal participation and collaboration between stakeholders and water justice, and are gender-sensitive
    a. Recognise the different types of stakeholders and their different needs
    b. Equally distribute the benefits, harms and costs that result from the practice among different stakeholders, and address and resolve trade-offs and potential conflicts between users
    c. Involve different stakeholders and integrate their different types of knowledge into the decision-making process,
3. Include and advance regular monitoring and evaluation mechanisms

The list of assessment criteria follows the GOVAQUA set of good practice criteria, with a few exceptions: gender-sensitiveness has been excluded because the innovations under review consist primarily of economic and financial instruments at national or catchment level, where gender-related issues are difficult to discern. In EU countries, gender equality and non-discrimination are already embedded in constitutional frameworks and in provisions concerning the protection of human rights and fundamental freedoms. These constitutional guarantees ensure that economic and financial instruments must comply with principles of equality and non-discrimination, including gender-related aspects. Equal participation and rights of different actor groups have been otherwise covered.

2.3 Data gathering, analysis and assessment

The WP4 good practice inventory was developed through a structured and iterative process of case identification, evidence collection, and assessment. The overall approach combined desk-based review with targeted qualitative evidence where primary insights were required to document practices operating through private governance arrangements.

Candidate economic and financial instruments were first mapped against the WP4 thematic scope and the overarching GOVAQUA definition of "good water governance practices", with the aim of capturing emerging or under-applied innovations that show promise for replication and upscaling in Europe. Practice selection prioritised: (i) clear relevance to water-related policy goals (e.g., demand management, environmental water recovery, water-quality protection, value-chain accountability, mobilisation of finance); (ii) availability of sufficiently robust evidence (peer-reviewed studies, authoritative programme documentation, or—where appropriate—interview-based validation); and (iii) diversity of governance contexts and instrument families, enabling comparative insights across pricing, market-mediated reallocation, contractual incentives, private assurance, and finance-based approaches. The work was conducted over the project period in parallel with developments in EU policy priorities (including increasing emphasis on water resilience, corporate sustainability reporting and due diligence), which reinforced the relevance of instruments operating at basin and value-chain levels.

Evidence was compiled from three main source types:

1. **Scientific and grey literature.** Peer-reviewed articles and case analyses provided the primary evidence base for most practices, including ex post econometric evaluation for volumetric pricing, and case syntheses for PES and water banking. Grey literature and technical reports were used where they constitute the main record of programme design, implementation and performance (e.g., programme documentation and official reporting for basin-scale recovery mechanisms).

2. **Official documentation and institutional sources.** Where practices are embedded in formal programmes, institutional and policy documents were used to establish the governance context, clarify roles and responsibilities, and identify operational features (e.g., rules, eligibility, accounting conventions, implementation arrangements, and publicly reported outcomes).

3. **Semi-structured interviews (where relevant).** For the water stewardship certification case, semi-structured interviews were conducted to document how certification operates in practice, how requirements are transmitted through supply chains, and how local actors perceive effectiveness, efficiency, inclusivity and reflexivity. Interviewee identities are anonymised and referenced through coded labels (Interviews A, B, C, etc.), with codes corresponding to broad organisational categories (e.g., producers/irrigators, irrigation-community representatives, NGOs, and experts/institutional actors). Interview data were used to complement document-based evidence and to capture implementation dynamics not available in published sources.

Evidence from documents and interviews was synthesised using qualitative content analysis. Information was extracted and coded in line with the shared GOVAQUA good-practice assessment criteria—effectiveness, efficiency, inclusivity and reflexivity, and replicability/generalizability—while maintaining a clear separation between: (i) claims supported directly by case evidence; and (ii) more general interpretative statements derived from the comparative literature. For practices with quantitative evaluation available in the literature, reported effect sizes and identified mechanisms were used as evidence of performance, with careful attribution to the original sources.

Each practice was assessed against the criteria to identify: (i) the problem addressed and the mechanism through which the instrument is expected to work; (ii) enabling conditions and implementation prerequisites; (iii) documented outcomes and limitations; and (iv) implications for transferability to European contexts. Validation was interpreted in a manner consistent with the available evidence base: for practices grounded in programme documentation and peer-reviewed evaluation, validation relies on triangulation across those sources; for the certification case, validation additionally draws on convergence across interview accounts from different actor groups.

Overall, the WP4 methodology is designed to produce practice descriptions and assessments that are sufficiently standardised for cross-case comparison within GOVAQUA, while remaining faithful to the heterogeneous evidence bases and governance contexts of economic and financial instruments.

A milestone report was prepared to document the progress of the case studies, and it was submitted by the end of September 2024 (Milestone 13). The progress of the good practice assessments was presented to the Living Lab representatives and project consortium partners at the GOVAQUA project's General Assembly meeting in Wallingford, UK, in May 2025, and at a project meeting in Microsoft Teams (online) on 1 October 2025. Feedback received at these events was incorporated in this final Deliverable report.

3. Good practices

3.1 Water Banks - The California Drought Emergency Water Bank of 1991 (EEUU)

General description

Water banks are an institutionalised and centralised mechanism that acts as an intermediary in the transfer of water rights between users and users and the environment, facilitating both temporary and permanent transactions. The bank is typically managed by public entities, such as river basin confederations or water agencies, which are responsible for ensuring that transactions comply with legal requirements and environmental criteria (Montilla-López et al., 2016).

The main objective of a water bank is to enable the reallocation of water rights from lower value uses to those of higher economic value, thus optimising water demand management. In this context, the price of water is determined by the intermediary, which contributes to market transparency (Perni et al., 2023). In addition, the system provides information on prices and quantities exchanged, fostering effective contact between buyers and sellers. Consequently, in certain circumstances, Water Banks can be key instruments to address cyclical and structural changes in resource availability, promoting a more efficient and socially desirable allocation of water.

In practice, the term ‘water banks’ can cover a wide variety of institutional designs based on the experience of water banks implemented to date, although the general concept of water banks is adhered to them. Montilla-López et al. (2016) classify water banks respect to the nature of the organization responsible for the implementation (public or private, the type of the rights being exchanged (permanent, spot or temporary and option contract), according to their purpose (reallocation of resources as a production input, environmental purposes, for managing risk related to water availability) and focusing on management strategy (active and passive).

It is important to note that a water bank is a market mechanism through which an administrative agency (public or private) acts as an essential intermediary in the trading of rights, as distinct from the concept of 'water banking', which refers to a resource management strategy based on water storage (see Blomquist and Ostrom (2008) for an analysis of water banking in Orange County, California).

The California Drought Emergency Water Bank of 1991 provides a well-documented example of a state-operated, centralised bank created in response to five consecutive years of severe drought and acute shortfalls in both urban and agricultural water deliveries. The scheme was implemented as a time-bounded emergency programme and operated only during 1991. On 1 February 1991, the Governor issued Executive Order W-3-91 establishing a Drought Action Team, and the Water Bank was established on 15 February 1991 as part of the drought plan; the California Department of Water Resources (DWR) was assigned responsibility for organising and implementing the programme, with dedicated teams formed to negotiate contracts and manage transfer logistics (Lund & Israel, 1992).

In operational terms, the 1991 Water Bank acquired 1,01 km^3 through 348 contracts, drawing on three principal contract types: (i) fallowing arrangements in which irrigators conserved surface water by foregoing irrigation; (ii) groundwater substitution (surface-water replacement) arrangements; and (iii) releases or withdrawals of stored surface water from reservoirs. The relative contribution of sources was approximately 51% from fallowing, 32% from groundwater substitution, and 17% from reservoir storage withdrawals. Water was purchased at a uniform price of 0,086 EUR/m^3 and sold at a fixed rate of 0.121 EUR/m^{3}for delivery to key transfer points, reflecting acquisition, administration and carriage requirements.

By 20 December 1991, allocations from the Bank totalled 0,48 km^3 across twelve purchasers, with the largest purchases concentrated among major urban agencies (Lund & Israel, 1992). Table 1 shows the 1991 Drought water bank allocations.

Table 1. 1991 Drought Water Bank Allocations (DWR, 1992).

1991 Drought Water Bank Allocations		
(in acre-ft as of December 20, 1991)		
Location	**Amount Allocated**	**Percent of Total**
Alameda Co. Flood Control & Water Con. District	500	0,1
Alameda Co. Water District	14.800	3,8
American Canyon Co. Water District	370	0,1
City of San Francisco	50.000	12,8
Contra Costa Water District	6.717	1,7
Crestline-Lake Arrowhead Water Agency	236	0,1
Dudley Ridge Water District	13.805	3,5
Kern County Water Agency	53.997	13,8
Oak Flat Water District	975	0,3
Santa Clara Valley Water District	19.750	5,1
Metropolitan Water District of Southern Ca.	215.000	55,2
Westlands Water District	13.820	3,5
TOTAL	389.970	100,0
Source: DWR, 1992a		

Methodology

This good practice is documented within WP4 (Economic and financial instruments) under the governance innovation theme of trading schemes. The assessment follows a structured literature review and document-based triangulation. The empirical anchor is the California Drought Emergency Water Bank (1991), documented primarily through the detailed ex post case analysis by Lund and Israel (1992) and complemented by programme descriptions in authoritative background materials. The broader evidence base is drawn from international review literature on water banks and water-market governance and from recent analytical contributions on market frictions, efficiency and user preferences relevant to bank design. Evidence was then mapped to the WP4 evaluation criteria: effectiveness (speed and scale of reallocation and prioritisation rules), efficiency (transaction and monitoring requirements and implications for cost-effectiveness), inclusivity and reflexivity (procedural legitimacy, distributional considerations and learning-by-doing adjustments), and replicability (institutional and legal prerequisites for transfer to other contexts).

Initiator

- Bureau of Reclamation of California

Category

- Trading schemes – Water Markets

Water issue

- water quantity
- state of the environment

Geographical applicability

- Global
- EU

Level of water governance

- Catchment

Stakeholders

- Primary sector
    - Industry
    - Primary production
        - Agriculture
        - Forestry
        - Minerals and mining
- Other sectors
    - Public authorities
        - catchment governance agencies
        - municipalities
    - Civil society
        - NGOs
        - local communities
    - Research
        - Research institutes
        - Universities

Effectiveness of the practice

Water banks are intended to **address acute allocation and reliability problems** that arise when scarcity and variability coincide with rigid allocation arrangements, limiting the ability of water users and public authorities to respond rapidly to drought shocks. The California Drought Emergency Water Bank of 1991 provides a salient example of this function in practice: established and operationalised within weeks under statewide drought emergency arrangements, it mobilised substantial volumes within a single season and channelled them towards prioritised demands. Consistent with the figures reported earlier in this report, the Bank acquired 820,665 acre-feet through 348 contracts and, by late December 1991, allocated 389,970 acre-feet to twelve purchasers, with allocations prioritised towards 'critical needs', including municipal shortfalls, the protection of high-value permanent crops, and fish and wildlife requirements (Lund & Israel, 1992). These outcomes illustrate effectiveness in two linked respects: the instrument enabled rapid, administratively coordinated reallocation at scale, and it did so in a manner consistent with stated public-interest priorities during an exceptional drought.

A key mechanism underpinning this effectiveness was **centralised intermediation**. The 1991 Bank standardised contractual arrangements provided a **single credible counterparty,** and coordinated the logistics of transfer, thereby reducing negotiation burdens and increasing the likelihood of completed transactions under tight time constraints. More broadly, international reviews identify this reduction in information and bargaining frictions, together with eligibility screening and administrative verification of feasibility, as a recurring channel through which water banks can enhance the practical effectiveness of reallocation relative to dispersed bilateral trading (Montilla-López et al., 2016). At the same time, the literature cautions that such arrangements should not be interpreted as "pure" markets; effectiveness depends on the **design of legal and administrative safeguards** that align transactions with hydrological realities and public-interest constraints (Carney et al., 2021; Dellapenna, 2001).

The 1991 California experience demonstrates that an emergency water bank can deliver rapid, large-scale reallocation; however, it also illustrates that effectiveness is not automatic and hinges on whether programme rules **generate sufficient participation and maintain legitimacy** under crisis conditions. Retrospective syntheses of water-bank experience highlight that design choices regarding governance, eligibility criteria, and price-setting can materially influence participation rates, perceived fairness, and ultimately the scale of transfers achieved (Carney et al., 2021; Montilla-López et al., 2016). Evidence from irrigator stated-preference research reinforces this point by showing that a non-trivial share of users may opt out altogether when governance arrangements are not aligned with their expectations, and that predictable uniform pricing can be preferred to auction-based mechanisms where acceptability and procedural fairness are salient determinants of willingness to participate (Perni et al., 2023). In addition, recent work suggests that, particularly in contexts with thin or fragmented markets, a bank-type platform can enhance the likelihood of mutually beneficial trades by reducing search frictions and concentrating information, thereby improving price discovery and enabling reallocations to occur at the scale needed to influence basin outcomes (Chen et al., 2024).

Read together, these findings indicate that while the California 1991 Bank provides proof of concept for emergency reallocation, the broader literature clarifies that sustained effectiveness requires a **transaction architecture and governance design** that simultaneously (i) lowers practical barriers to exchange, (ii) secures sufficient participation through credible and acceptable rules, and (iii) aligns transfers with hydrological constraints and public-interest objectives.

Efficiency of the practice

Efficiency in water-banking arrangements is closely tied to whether the instrument can **mobilise water at relatively low total cost**—i.e., not only the purchase price, but also the administrative, monitoring, and enforcement expenditures required to ensure that contracted "water" is hydrologically real and deliverable. In the 1991 California Drought Emergency Water Bank, a central efficiency feature was the creation of a comparatively standardised and administratively streamlined transaction architecture under acute time constraints. The Bank relied on a limited set of contract types, a uniform purchase price, and central coordination of transfer logistics, which reduced the negotiation and contracting burden that would otherwise have fallen on multiple bilateral transactions and approvals (Lund & Israel, 1992).

From a transaction-cost perspective, this design aligns with the general proposition **that centralised intermediation can lower search, bargaining, contracting, and approval costs** by concentrating expertise and standardising procedures, if governance safeguards remain credible (McCann et al., 2005). However, the case also underlines that apparent transaction-cost savings from centralisation must be evaluated against the information and verification requirements embedded in water-bank operation. Where supply is generated through fallowing or groundwater substitution—rather than through straightforward reallocation of clearly metered deliveries—efficiency depends on the availability and quality of data for eligibility screening, contract verification, and compliance monitoring. In 1991, groundwater substitution contracts required metering and local monitoring arrangements to limit adverse impacts and ensure that contracted volumes corresponded to real changes in water use, illustrating how data and monitoring capacity become integral to the instrument's cost structure (Lund & Israel, 1992).

This is consistent with the broader transaction-cost measurement framework, which emphasises that information generation, monitoring, and enforcement costs are not ancillary but central in assessing the cost-effectiveness of environmental policy instruments (McCann et al., 2005). In this respect, water banks can **"utilise and enhance" water-related data by requiring standardised reporting and verification,** but their cost-effectiveness depends on whether these information systems are proportionate to risk and feasible at the relevant scale (Carney et al., 2021; Montilla-López et al., 2016).

Regarding cost-effectiveness relative to alternative measures, the key efficiency claim that can be made on the basis of this evidence base is conditional: water banks are **most likely to be cost-effective where the marginal value of reallocated water is high** (e.g., avoiding critical shortages) and where centralised procurement meaningfully reduces transaction frictions compared with fragmented bilateral trades or purely administrative rationing. International syntheses highlight that the performance of water banks varies strongly with institutional design and with the costs of verification and managing third-party impacts (Carney et al., 2021). In other words, centralisation can lower some costs (search and bargaining) while raising others (monitoring and compliance); the net cost-effectiveness hinges on how these costs balance in the specific hydrological and institutional setting (McCann et al., 2005).

A further efficiency-relevant mechanism is **information concentration and price discovery**. Recent modelling of groundwater-rights markets indicates that bank-type platforms can improve market efficiency by reducing search frictions and concentrating information, increasing the likelihood of mutually beneficial matches and strengthening price discovery relative to decentralised exchange (Chen et al., 2024).

While this evidence comes from a different setting than California 1991, it substantiates an efficiency channel that is relevant: by improving information flows and reducing matching costs, a bank can increase traded volumes per unit of administrative effort and help move water towards uses with higher marginal value during scarcity.

Water banks can support more efficient allocation and use of water resources over time by strengthening the capacity for **reallocation towards higher value uses and** by creating institutional arrangements that make scarcity and reliability risks more salient for users. Over repeated use, this can contribute to learning effects and—where trading is predictable and rules are stable—can reinforce incentives for investment in flexibility (e.g., storage, conveyance access, or on-farm efficiency) to reduce exposure to supply shocks. International reviews and governance analyses emphasise, however, that these dynamic efficiency gains depend on rule stability, credible accounting (including return-flow considerations), and safeguards that prevent private reallocations from generating basin-level inefficiencies through unmanaged externalities.

Inclusivity and reflexivity of the practice

Inclusivity and reflexivity are central to water banks because reallocating water under scarcity has distributional consequences and can generate third-party impacts that extend beyond participating buyers and sellers. The 1991 California Drought Emergency Water Bank illustrates both the potential and the tensions: while it provided an administratively rapid mechanism to **move water towards "critical needs"**, it also attracted criticism from some affected groups regarding the perceived opacity of negotiations and the limited opportunities for broader third-party input under emergency conditions (Lund & Israel, 1992). This highlights a core inclusivity challenge for drought-response banking: even when participation is voluntary, legitimacy depends on whether non-participants and indirectly affected stakeholders—such as local communities, environmental interests, and downstream users—are able to understand the rules, anticipate consequences, and access credible channels for concerns to be heard (Carney et al., 2021; Lund & Israel, 1992).

From an accountability perspective, water banks can **advance transparency through standardised contracting, publicly specified eligibility criteria, and reporting** of procured volumes, prices, and allocation decisions. Such features can make the rationale for reallocations more visible than fragmented bilateral transfers and can support scrutiny of whether the instrument aligns with public-interest priorities. At the same time, the literature cautions that "market" terminology can obscure the extent to which outcomes are shaped by administrative choices; therefore, transparency about governance, decision rules, and safeguards is a prerequisite for both procedural legitimacy and distributive fairness (Carney et al., 2021; Dellapenna, 2001). In the California case, the need to act quickly strengthened the case for central coordination, but it also amplified perceptions of uneven voice and limited deliberation, an instructive trade-off for future drought-bank design (Lund & Israel, 1992).

The California emergency bank is often characterised as a **"learning-by-doing" experience,** where practical lessons from the 1991 operation informed subsequent modifications in the 1992 bank (Lund & Israel, 1992; Montilla-López et al., 2016). More generally, international evidence indicates that reflexive water-bank governance requires (i) **monitoring systems** capable of verifying that contracted "water" corresponds to real hydrological changes (particularly when supply is generated through fallowing or groundwater substitution), and (ii) **iterative refinement of rules** where third-party impacts, environmental risks, or perceived inequities emerge (Montilla-López et al., 2016; Carney et al., 2021). Moreover, recent stated-preference evidence suggests that willingness to participate is sensitive to perceived fairness and predictability of pricing and governance, with a notable share of respondents selecting non-participation under less acceptable designs (Perni et al., 2023). Read alongside the California experience, this implies that reflexivity is not only technical (monitoring and hydrological accounting) but also institutional: maintaining effectiveness over time may require adjusting governance and pricing arrangements to sustain participation while strengthening safeguards for third-party interests.

Replicability and generalizability of the practice

The California Drought Emergency Water Bank (1991) demonstrates that a centrally coordinated water bank can be deployed rapidly to facilitate short-term reallocation under acute scarcity and was successful in mobilising and allocating substantial volumes within a single season towards prioritised 'critical needs' (Lund & Israel, 1992). However, the extent to which such an arrangement can be replicated elsewhere depends on whether **key legal, institutional, hydrological, and social preconditions** are in place. At a minimum, replicability requires a sufficiently **clear and enforceable system of water-use rights** (or transferable allocations) and a **transfer framework** that specifies what can be traded, under which constraints, and with what third-party safeguards. Without this institutional scaffolding, "market" labels can be misleading, because outcomes are determined less by price signals than by administrative feasibility and legal constraints (Dellapenna, 2001).

A second condition concerns **administrative and technical capacity** to run the bank as an intermediary. The California case relied on rapid standardisation of contracts, central coordination of logistics, and the ability to verify and account for different sources of "banked" water (including fallowing, groundwater substitution, and reservoir releases). Replication therefore presupposes: (i) an implementing authority with a clear mandate and operational capacity; (ii) access to adequate water-related data (rights registers, diversion records, conveyance constraints, and—where relevant—groundwater pumping data); and (iii) monitoring and enforcement capabilities proportionate to the risks of non-compliance and adverse impacts. More generally, transaction-cost frameworks emphasise that the feasibility and net performance of environmental policy instruments are shaped by these information, monitoring, and enforcement requirements, which can be substantial in water reallocation contexts (McCann et al., 2005; Montilla-López et al., 2016).

Replicability also depends on the **suitability of the transaction architecture** for the receiving context, particularly where markets are thin or fragmented. Recent modelling suggests that a bank-type platform can improve market performance by reducing search frictions and concentrating information, thereby strengthening price discovery and increasing the likelihood of mutually beneficial trades (Chen et al., 2024). This points to an important generalisability pathway: where decentralised bilateral trading is limited by information and matching problems, an intermediary can expand the set of feasible transfers—provided that legal rules and hydrological accounting allow the intermediary to operate credibly (Montilla-López et al., 2016; Dellapenna, 2000).

A fourth set of conditions relates to **legitimacy, participation, and distributional acceptability**. Water banks can be operationally effective yet contested if procedures are perceived as opaque or if third-party impacts are not adequately recognised (Lund & Israel, 1992; Carney et al., 2021). Evidence from irrigator preference analysis further suggests that participation is sensitive to governance and pricing rules, including preferences for predictability and perceived fairness (e.g., uniform pricing rather than auction-based allocation) and non-trivial propensities for non-participation under less acceptable designs (Perni et al., 2023). These findings imply that, for replication across European basins, attention to procedural transparency, stakeholder communication, and clearly specified safeguards is not ancillary but a necessary condition for achieving sufficient participation and transfer volumes to influence basin outcomes.

Finally, generalisability is constrained by **hydrological and infrastructural realities**. Water banks require conveyance and, where relevant, storage capacity to move water to where it is needed, and they must be embedded within hydrologically defensible accounting rules (including return-flow considerations and third-party protections) to avoid reallocations that are privately beneficial but socially inefficient (Montilla-López et al., 2016; Young, 2014).

In the European Union, where abstraction licensing and basin planning obligations shape transfer feasibility, these prerequisites intersect with broader governance and regulatory frameworks (Martin-Ortega, 2012; Santato et al., 2016). Accordingly, European replication would typically require (i) rights and transfer rules compatible with basin planning objectives, (ii) administrative capacity for data, monitoring and enforcement, (iii) an intermediary design that reduces frictions in thin markets, and (iv) legitimacy-building measures that manage distributional and environmental concerns.

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3.2 Buyback: Restoring the Balance in the Murray–Darling Basin (Australia)

General description

A water buyback is an economic instrument through which a public authority acquires water access entitlements (or equivalent rights) from willing sellers—typically via water markets—in order to reallocate water from consumptive use to environmental purposes. In the Murray–Darling Basin (MDB), buybacks became a central mechanism for environmental water recovery following the establishment of the contemporary Basin governance framework under the Water Act 2007 (Cth), including the statutory creation of the Commonwealth Environmental Water Holder (CEWH) to manage the Australian Government's environmental water holdings (MDBA, 2021).

A water buyback is commonly implemented through structured procurement mechanisms that translate an environmental water-recovery objective into a sequence of market transactions. In practice, this typically requires: (i) a legal architecture that defines water rights in a form that is separable from land and transferable; (ii) a functioning allocation framework that determines how much water a right yields under different hydrological conditions; and (iii) an implementing authority with the mandate and capacity to purchase, hold, account for, and, where relevant, actively manage the acquired portfolio for environmental purposes. Buybacks are most often conducted through competitive tender rounds or other transparent purchasing processes, enabling the buyer to compare offers and prioritise acquisitions that deliver the largest environmental water recovery per unit of expenditure, while maintaining voluntariness and compensation for sellers (Montilla-López et al., 2016). At the same time, the instrument's performance is shaped by market conditions and design choices—such as whether purchases target permanent entitlements, seasonal allocations, or a portfolio of products—and by the extent to which acquisition is integrated with broader rules on diversion limits, compliance, and delivery constraints that ultimately determine whether recovered water can be deployed to achieve intended ecological outcomes (ANAO, 2011).

The policy architecture linking environmental water recovery to Basin-scale objectives was progressively formalised over 2007–2012, including the establishment of regular progress reporting on environmental water recovery in the MDB (updated on a six-monthly basis in the period immediately following the Act). (MDBA, 2009; NWC, 2009)

Within this broader reform programme, the Restoring the Balance in the Murray–Darling Basin (RtB) initiative represents the flagship buyback mechanism as a governance practice that operationalises environmental water recovery through market-based acquisition. RtB was designed to purchase permanent water entitlements from willing sellers, commencing in 2007–2008 and backed by an initial Commonwealth commitment of AU$3.1 billion (with an acquisition objective widely framed as 1,500 hm3 over a ten-year horizon). A performance audit of RtB reports that, by 30 June 2010, the programme had secured 863 hm3 of entitlements for AU$1.37 billion, illustrating the early scale and fiscal materiality of the buyback approach in the Basin's environmental water recovery trajectory (ANAO, 2011).

From the perspective of system-level governance, buyback-acquired entitlements are embedded within the Basin's planning and compliance framework, notably through the Basin Plan 2012 and its implementation via accredited Water Resource Plans (WRPs) prepared by Basin States. The Basin Plan specifies long-term average sustainable diversion limits (SDLs) that took full effect from 1 July 2019 and provides for an SDL adjustment mechanism, thereby establishing the accounting and implementation architecture through which recovered water is recognised and managed at scale (Australian Government, 2020; MDBA, 2025a; MDBA, 2025b)

Notably, the cumulative outcome of the Basin's environmental water-recovery agenda is visible in the growth of Commonwealth environmental water holdings over time. Official CEWH holdings data indicate that Commonwealth entitlements increased from 65 hm3 in 2008/09 to just over 3,000 hm3 by 2024/25 (with holdings tables maintained and updated through 30 September 2025), while the corresponding long-term diversion limit equivalents (LTDLE) increased from 38 hm3 to around 2,100 hm3 over the same period (Australian Government, 2025). Figure 2 provides an overview map of the Murray–Darling Basin.

This expansion reflects the combined contribution of multiple recovery mechanisms, most notably market-based entitlement purchase under programmes such as RtB, alongside other recovery pathways associated with infrastructure and efficiency measures, providing a quantitative backdrop for situating RtB within the Basin's longer-run accumulation of environmental water.

Figure 2. Murray-Darling Basin Map. (Department of Resources. Dept. Of environment and Science)

Methodology

The methodological approach to documenting good buyback practices (Restoring the Balance (RtB) program) combined (i) a structured literature review of peer-reviewed research and (ii) a specific review of official policy, audit, and administration datasets published by Australian institutions. The literature review was used to synthesize how buybacks are theorized and evaluated as an instrument of water recovery for environmental purposes, drawing on studies that analyse buybacks and related market products in the context of the Murray-Darling Basin (MDB) and comparable settings. The main analytical perspectives drew on work on alternative “water market products” and portfolio approaches to acquisition and management, critiques and models of policy mixes that constrain buybacks relative to other recovery instruments, regional or whole-economy model tests of the economic effects of large-scale rights recovery, and broader methodological contributions on cost and trade-off issues in buyback design.

In parallel, the official-document review established the institutional and legal baseline within which RtB operated and provided the evidentiary basis for describing implementation arrangements and outcomes. This included: the legislative architecture underpinning Basin-scale planning and limits (the Water Act 2007 and the Basin Plan 2012); the MDBA’s documentation of early environmental water recovery progress (e.g., the environmental water recovery report as at 30 June 2009 and others); and governance mechanisms relevant to how recovery volumes translate into policy-relevant accounting and compliance trajectories, including materials on SDL adjustment and Basin Plan implementation instruments. To strengthen validity regarding programme operation and procurement practice, the methodology also incorporated external scrutiny from the Australian National Audit Office (ANAO) performance audit of RtB.

For the quantitative backbone of the case narrative, publicly available administrative series were extracted from CEWH/DCCEEW publications on Commonwealth environmental water holdings (including entitlements and Long-Term Diversion Limit Equivalent (LTDLE) reporting where available) and related planning documents that contextualise portfolio management over time. These data were used for descriptive, time-anchored trend reporting (e.g., documenting the evolution of holdings and situating RtB within the broader recovery pathway), with careful attribution: increases in Commonwealth holdings are interpreted as the cumulative result of multiple recovery mechanisms and programmes (including, but not limited to, buybacks), rather than being mechanically assigned to RtB alone.

Initiator

- Australian Government

Category

- Trading schemes

Water issue

- water quantity
- water quality
- ecosystems

Geographical applicability

- Global
- EU

Level of water governance

- Catchment

Stakeholders

- Primary sector
    - Industry
    - Primary production
        - Agriculture
        - Forestry

        - Minerals and mining
- Other sectors
    - Public authorities
        - catchment governance agencies
        - municipalities
    - Civil society
        - NGOs
        - local communities
    - Research
        - Research institutes
        - Universities
    - Industry
        - Consultants

Effectiveness of the practice

The effectiveness of the Restoring the Balance in the Murray–Darling Basin (RtB) programme derives from its capacity to operate at the same scale as the underlying governance challenge: **restoring environmental water in a highly connected, over-allocated basin** where upstream diversions generate downstream ecological externalities. RtB was established as a Commonwealth entitlement-purchase programme under the wider Water for the Future agenda and was intended to contribute directly to Basin-scale environmental water recovery by reallocating existing consumptive entitlements into the Commonwealth environmental portfolio, thereby strengthening the feasibility of meeting environmental flow objectives through a verifiable change in the distribution of water access rights (Australian Government, 2020).

In operational terms, RtB's effectiveness rests on a comparatively direct causal chain: procure permanent water entitlements from willing sellers, transfer them into the environmental holdings managed by the Commonwealth, and use those holdings, subject to prevailing allocation, storage and delivery constraints, to support environmental watering. The programme was implemented largely through **competitive tender rounds**, which is relevant to effectiveness because tender-based procurement allows the buyer to compare offers and prioritise acquisitions within a defined budget while maintaining **voluntariness and compensation.**

Evidence from early implementation indicates that RtB was able to secure substantial entitlement volumes within a short time horizon: the Australian National Audit Office reports that, by 30 June 2010, RtB had purchased entitlements totalling 863 hm3 at a cost of AU$1.37 billion (ANAO, 2011). This scale is substantively important for effectiveness in a basin setting because it demonstrates that market-based acquisition can **accumulate environmental water assets rapidly** relative to regulatory reallocation pathways, **if participation and budget conditions are favourable**.

However, effectiveness also depends on whether acquisition can be **sustained at the pace required to meet policy timeframes**, and the literature highlights that reliance on permanent entitlement purchases alone can encounter participation constraints. Wheeler et al. (2013) note that, although RtB had accumulated 1,204 hm3 of entitlements by 31 January 2012 (with a substantial average annual volume reported as available for the environment), the programme faced a practical risk of slowing progress as participation from irrigators willing to sell permanently diminished. This concern is reinforced by their survey evidence from the southern Basin: close to 60% of respondents indicated they were not interested in selling entitlements to the programme as designed, implying that procurement based primarily on permanent entitlement acquisition could face behavioural and adjustment frictions that limit the attainable recovery rate.

Wheeler et al. (2013) therefore provide a directly relevant effectiveness lesson for RtB: **broadening the acquisition "menu"** beyond permanent entitlements **can expand participation** and improve the alignment between acquired water and environmental watering needs. They assess complementary products including temporary water allocations, leasing of entitlements, and option contracts, and report that around 48% of irrigators would participate in at least one alternative buyback scheme, with a non-trivial share of those unwilling to sell entitlements indicating willingness to participate via alternatives.

This matters for effectiveness not only because it can increase the pool of potential sellers, but also because temporary products **can enhance the capacity to match environmental watering requirements** that are inherently time-sensitive. Their scenario analysis further suggests that, under the conditions examined, a portfolio approach combining entitlement and allocation purchases could deliver substantially more environmental water over a decade than an entitlements-only strategy, strengthening the practical case that acquisition design affects both the volume and usability of recovered water.

Notably, subsequent policy debates over the relative weight placed on entitlement buyback versus subsidised irrigation-efficiency investments reinforce why RtB's effectiveness should be interpreted against the evolving Basin-wide instrument mix. Adamson and Loch (2018) examine settings in which buyback becomes politically constrained, and recovery is shifted towards infrastructure-based 'efficiency' pathways. Their analysis indicates that, under such constraints, achieving higher volumes of environmental water can become more contingent on favourable hydrological conditions (i.e., outcomes are more readily achieved in wet states of nature), thereby weakening the reliability of environmental flow achievement over time. While their results also imply welfare and cost-effectiveness trade-offs associated with constraining buyback, the key effectiveness implication is that the composition of the recovery portfolio influences not only how much water is recovered, but also how robustly environmental objectives can be met across variable climatic conditions.

Efficiency of the practice

Efficiency in the Restoring the Balance (RtB) buyback programme is fundamentally linked to its market-based logic: rather than mandating reductions in use, RtB acquires environmental water by **compensating willing sellers and reallocating entitlements through the existing water-rights system**. This procurement approach can be cost-effective in principle because it **leverages decentralised information about opportunity costs**: irrigators with lower marginal value of water (or higher adjustment capacity) are more likely to offer entitlements at prices the buyer is willing to accept, supporting a least-cost pathway to recovery relative to uniform restrictions. In this sense, RtB is designed to operate as a targeted reallocation mechanism that uses the price system to reveal where environmental water can be acquired with comparatively lower foregone production value (Dixon et al., 2012).

A central efficiency consideration is the relative performance of entitlement buyback compared with alternative recovery pathways, particularly subsidised irrigation-efficiency investments. Adamson and Loch (2018)) show that when buyback is constrained and recovery shifts predominantly towards infrastructure-based efficiency programmes, welfare and cost-effectiveness trade-offs emerge, and higher recovery volumes become increasingly difficult to deliver efficiently (with outcomes also becoming more contingent on wet states of nature). Their analysis therefore supports the interpretation that, under many conditions, constraining buyback can undermine least-cost recovery and impose additional efficiency losses relative to a policy mix in which buyback remains available as a primary recovery channel. Efficiency also depends on **procurement design** and the extent to which a buyback programme can **minimise agency costs and overcompensation.**

It should be noted that RtB's efficiency can be strengthened by **treating buyback not as a single-product instrument but as a procurement strategy capable of using different market products** to meet recovery needs at lower cost and with greater flexibility. Wheeler et al. (2013) assess the efficiency implications of complementing permanent entitlement purchases with alternatives such as temporary allocations, entitlement leasing, and option contracts. Their scenario analysis indicates that, under the conditions examined, a portfolio approach (combining entitlements and allocation purchases) can deliver more environmental water over a given horizon than an entitlements-only strategy, implying potential improvements in the volume delivered per unit expenditure and in the timing fit of acquired water to environmental demand.

Taken together, the evidence base suggests that RtB's efficiency is maximised when (i) buyback is not arbitrarily constrained, (ii) procurement rules reduce overpayment risks and transaction costs, and (iii) acquisition can draw on a wider product set where this improves participation and cost-effectiveness.

Inclusivity and reflexivity of the practice

From an inclusivity perspective, the most robustly evidenced contribution of RtB concerns the **distribution of costs and benefits that arises from voluntary, compensated reallocation** through entitlement purchase. In principle, buyback reallocates water by paying willing sellers at market or tender-determined prices, which can reduce the likelihood of uncompensated losses relative to purely regulatory curtailment. At the same time, the instrument redistributes both water access and associated economic rents: it raises the value of water entitlements through public demand and, by reducing water availability for irrigation, can alter the returns to irrigated land and water-dependent capital. Model-based evidence for the southern Murray–Darling Basin suggests that these distributional effects may include windfall gains for entitlement holders alongside downward pressure on the value of irrigated land in settings where land has limited alternative use, implying that who gains or loses depends on the relative endowment of water and land assets and on local adjustment opportunities (Dixon et al., 2012).

These distributional dynamics matter for inclusivity because they have been central to stakeholder contestation of buybacks in irrigation communities, where concerns have been expressed about adverse local economic impacts and the viability of irrigation-dependent towns. Dixon et al. (2012) directly engage with this narrative, arguing—under their model assumptions—that large-scale buyback does not necessarily imply a "slow death" for basin communities, and that **regional outcomes depend critically on behavioural and spending assumptions**, notably whether buyback proceeds are spent locally or leak to other regions. Their sensitivity analysis illustrates that conclusions about local economic stimulus (e.g., consumption effects) are contingent on these assumptions, reinforcing that distributional outcomes can vary across places and that claims of uniform local impacts are not well-founded without place-specific evidence.

With respect to **transparency and accountability,** RtB's **tender-based procurement model** and the existence of **auditable acquisition volumes** provide a basis for documenting programme performance in a manner that is legible to stakeholders, at least in terms of entitlements purchased and expenditure. Moreover, the literature highlights that perceived legitimacy is shaped not only by reporting totals, but also by whether the programme's design is seen as fair and understandable by irrigators.

A key issue is whether the practice includes mechanisms that enable learning, recalibration and adaptive adjustment as implementation proceeds. The peer-reviewed evidence indicates that buyback programmes face predictable sources of uncertainty and potential inefficiency—such as information asymmetries, strategic behaviour, and the risk of overcompensation—which are unlikely to be fully resolvable ex ante and therefore require monitoring and iterative refinement. Pérez-Blanco and Gutiérrez-Martín (2017) demonstrate, in a European water-scarce context, that compensation rules based solely on foregone income can substantially overstate opportunity costs once farmers' broader utility attributes are considered, implying that programme budgets may purchase less environmental water than intended if procurement and valuation approaches are not updated as better information becomes available. Their results underline the importance of reflexive design features—such as improved price discovery, periodic reassessment of compensation benchmarks, and the use of data-driven valuation approaches—so that buyback procurement remains proportionate and cost-effective over time.

In the MDB setting, Wheeler et al. (2013) similarly frame the case for **adapting acquisition strategy** through a broader product set (allocations, leasing and options), both to widen participation and to improve the temporal fit between acquired water and environmental requirements, illustrating how reflexive adjustment can enhance programme performance when initial design encounters participation limits.

Replicability and generalizability of the practice

Although there are some EU examples of buybacks—both temporary (e.g., emergency purchases to support environmental flows in the Jucar Basin during the 2005–2008 drought) and permanent (e.g., the 2015 acquisition in the Doñana area, Finca Los Mimbrales)—they were not retained for the case analysis because EU experience remains limited and fragmented. These initiatives appear as isolated, highly context-specific interventions, and the available documentation does not provide a sufficiently comparable evidence base to support generalisable conclusions.

The replicability of RtB in other European contexts depends less on the specific Australian institutional configuration and more on whether the **enabling conditions for a market-based entitlement reacquisition programme can be established**. At its core, RtB relies on the existence of legally defined, separable and transferable water access rights and on a governance setting in which a public authority can acquire, hold and deploy those rights for environmental purposes. Without comparable rights architecture, i.e., a regime in which water entitlements are sufficiently well specified, tradable and enforceable, buyback is difficult to implement transparently and at scale, and the scope for cost-effective, voluntary participation is materially reduced (Dixon et al., 2012; Wheeler et al., 2013)

A second condition is **institutional capacity.** Replicating a buyback programme requires an implementing body with the mandate and technical capacity to run procurement rounds, undertake due diligence, manage contracts and payments, and maintain a reliable accounting system for acquired entitlements and the annual water available under variable hydrological conditions. The evidence also suggests that a single-product design (permanent entitlement purchase only) may face participation limits; hence, replicability is improved where legal and administrative arrangements allow the buyer to use a broader set of market products. Wheeler et al. (2013) identify temporary allocations, entitlement leasing and option contracts as complementary acquisition instruments that can broaden the pool of willing participants and improve the timing fit of acquired water to environmental demand, thereby strengthening the feasibility of achieving recovery objectives in practice.

Third, replicability requires **attention to fiscal and information constraints**. Buyback programmes are vulnerable to information asymmetries and strategic behavior, which can lead to overcompensation and reduce the volume recovered per unit budget. Evidence from a European water-scarce basin indicates that compensation benchmarks based on foregone income can substantially overstate opportunity costs once farmers' broader objectives and risk/management attributes are considered, implying that cost-effectiveness depends on robust price discovery, credible valuation methods, and adaptive procurement rules that are updated as better information becomes available (Pérez-Blanco & Gutiérrez-Martín, 2017). This insight is particularly relevant for transferability in Europe because many basins do not have water markets as mature and data rich as the MDB, increasing the importance of administrative datasets and analytical capacity for establishing defensible offer thresholds and limiting agency costs.

Fourth, generalisability is shaped by how the programme **interacts with the wider policy mix.** Modelling evidence from the MDB shows that when buyback is politically constrained and recovery shifts heavily towards subsidised efficiency investments, the recovery of high volumes of environmental water can become more contingent on favorable hydrological conditions and may entail welfare and cost-effectiveness trade-offs (Adamson & Loch, 2018). For European replication, this implies that buyback is most likely to perform well when it is not treated as an isolated measure, but as part of a coherent recovery portfolio—aligned with abstraction regulation, compliance, and delivery constraints—and when it remains available as a flexible channel for least-cost recovery alongside other instruments.

Finally, d**istributional and political acceptability conditions are central to scaling and transfer.** Even when participation is voluntary, buyback can generate uneven local impacts depending on regional adjustment capacity, asset endowments and spending patterns. Dixon et al. (2012) show that regional economic outcomes are sensitive to behavioural assumptions (e.g., whether proceeds are spent locally), underscoring that replicability requires proactive consideration of local impacts, transparent communication, and, where appropriate, accompanying measures to support adjustment in irrigation-dependent communities.

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3.3 Volumetric Rate - the case of the Central Emilia Irrigation Water District (Italy)

General description

Water pricing is commonly understood as the application of a monetary charge to water-related services and uses, namely the assignment of an economic value to activities through which water is abstracted, used, and, under broader conceptions, polluted. In this respect, the European Environment Agency (EEA) glossary defines water pricing as “applying a monetary rate or value at which water can be bought or sold” (European Environment Agency, 2013)., while Arcadis et al. (2012) adopts a wider interpretation by referring to the “monetising” of water abstraction, use, or pollution. International experience points to a range of tariff designs—including fixed charges, two-part tariffs, increasing block tariffs, and volume-differentiated (“jump”) tariffs—through which cost allocation and incentives can be structured, with global examples documented by Dinar et al. (2015).

From a policy perspective, water pricing operationalises how the costs of providing water services are allocated among users through tariffs and charges, including payments for water and sanitation services and for the use of water resources. Besides revenue generation, pricing is expected to improve the efficiency of water use by strengthening the link between consumption and payment, thereby supporting more resource-efficient behaviour (European Environment Agency, 2013).

In the European Union, this rationale is embedded in the Water Framework Directive (Directive 2000/60/EC), where Article 9 requires Member States to take account of the principle of recovery of the costs of water services, including environmental and resource costs (European Union, 2000). This requirement is particularly salient in irrigated agriculture, where, in many Member States, irrigation water prices remain well below levels compatible with financial cost recovery, and even further below those required to account for environmental and resource costs (European Environment Agency, 2013).

Within this regulatory and governance context, a widely discussed reform pathway is the shift from non-volumetric charging arrangements, most notably flat tariffs that are invariant to the amount of water used, towards volumetric pricing, under which payments increase with measured consumption. This transition is intended to address persistent challenges in sustainable water resources management, especially in settings where irrigated agriculture plays a major role in socio-economic welfare and total water consumption (Portoghese et al., 2021).

Historically, flat-rate pricing structures may weaken marginal incentives to conserve water, thereby motivating reforms that introduce volumetric tariffs more closely aligned with actual use and capable of encouraging conservation (Santato et al., 2016). Empirical evidence summarised by the European Environment Agency (2013) indicates that farmers facing flat rates use, on average, 10% to 20% more water than farmers subject to volumetric charging. The same synthesis further suggests that technical measures aimed at modernising irrigation systems, followed by the implementation of volumetric pricing, can deliver substantially higher water-saving potential than simple price increases alone.

At the same time, the evidence-based on water pricing in irrigated agriculture remains mixed, reflecting context-specific and sometimes non-linear demand responses that depend on both institutional and farm-level conditions (Berbel et al., 2018; De Fraiture & Perry, 2002; Molle & Berkoff, 2007; Scheierling et al., 2006). This heterogeneity reinforces the need for rigorous, place-based evaluation when tariff reforms are introduced (Lago et al., 2015; Scheierling et al., 2006).

The Emilia-Romagna case in Northern Italy provides an empirically grounded example of a shift from flat-rate charging to volumetric pricing in irrigated agriculture for a defined group of users. The Central Emilia Water District (CEWD) emerged from the merger of two irrigation districts that initially operated under different tariff regimes—one largely based on a per-hectare flat rate and the other already applying a two-part tariff with a volumetric component. This institutional trajectory created a quasi-experimental setting in which the subsequent harmonisation towards volumetric pricing could be evaluated ex post using observed administrative and delivery data, rather than relying solely on ex ante modelling assumptions, thereby supporting a credible assessment of behavioural change associated with the tariff switch.

In aggregate terms, the policy effect is reported as a general reduction in water demand for both analysed groups, with a more pronounced effect among farmers previously charged under flat tariffs. For the treated group, the reform was associated with annual water-demand reductions of approximately 3.1–5.7 million m³ over 2016–2018 (a cumulative 12.4 million m³), while additional revenues contributing to cost recovery amounted to roughly €0.12–0.20 million per year (a cumulative €0.49 million) (Pronti & Berbel, 2023). Figure 3 below shows the location of the Emilia-Romagna region in Italy.

Figure 3. Map of the Italian region of Emilia-Romagna (Encyclopædia Britannica).

Methodology

The rationale for its selection is twofold. First, EU policy and regulatory discussions continue to emphasise water pricing and tariff design as potentially powerful instruments for aligning use with policy objectives (including cost recovery), yet their application in irrigated agriculture remains uneven and often dominated by area-based charging in many Member States (Arcadis et al., 2012; European Environment Agency, 2013). Second, the broader evidence-base underscores that volumetric charging can strengthen efficiency incentives relative to flat-rate arrangements, while also highlighting that outcomes are context-dependent and therefore benefit from well-identified, place-based empirical evaluation (European Environment Agency, 2013).

Methodologically, the documentation combines a targeted literature review on irrigation water pricing instruments and EU practice with an ex-post data analysis grounded primarily in the quasi-experimental evaluation by Pronti and Berbel (2023).

Pronti and Berbel (2023) build a plot-level panel dataset (2013–2018) from CEWD administrative and delivery records, with annual observations on delivered volumes (m³), irrigated area, crops, irrigation technology, basin/municipality identifiers, and seasonal climate covariates merged at municipal level. The main estimation uses an unbalanced panel (12,604 observations; 3,075 plots) constructed from the CEWD census, retaining plots observed in at least two periods and trimming extreme tails to reduce outlier-driven bias. As a robustness check intended to better isolate tariff effects from technological change, they also estimate models on a balanced panel (675 plots observed for all six years; 4,050 observations) that restricts attention to plots with unchanged irrigation technology over the full period.

The impact evaluation is implemented through a tailored Difference-in-Differences (DiD) design labelled an "inverse DiD". The adaptation is required because the data structure is the converse of the classic DiD timing: the two groups differ in tariff regime before 2016 but share the same regime after 2016.

A methodological strength of the Emilia-Romagna case is that it is evaluated ex post using observed behavioural data, in a literature where many assessments of irrigation water pricing, particularly in Italy, have relied on ex ante scenario analysis based on mathematical programming (MP) models Pronti and Berbel (2023) emphasise that ex post approaches can avoid some of the structural biases inherent to MP-based simulations, which typically depend on strong behavioural and informational assumptions that may diverge from actual farmer decision-making. Furthermore, the empirical basis is unusually large for this research area: the study covers a major agricultural region (Reggio-Emilia and Modena) and builds a plot-level longitudinal dataset that the authors characterise as among the broadest of its kind in the water-pricing policy literature, thereby strengthening statistical power and the credibility of inference.

Initiator

- Central Emilia Irrigation Water District (CEWD, Consorzio di Bonifica dell'Emilia Centrale) in the provinces of Reggio-Emilia and Modena (Italy). The entity was created in 2009 by merging two former irrigation districts (ID) in the area the Consorzio di Bonifica Parmigiana Moglia Secchia (West ID) and Consorzio Bentivoglio-Enza (East ID).

Category

- Water Pricing

Water issue

- water quantity
- water quality

Geographical applicability

- Global
- EU

Level of water governance

- Basin/Catchment
- Sub-basin

Stakeholders

- Primary sector
    - Industry

    - Primary production
        - Agriculture
        - Forestry
        - Minerals and mining
- Other sectors
    - Public authorities
        - catchment governance agencies
        - municipalities
    - Civil society
        - NGOs
        - local communities
    - Research
        - Research institutes
        - Universities
    - Industry
        - Consultants

Effectiveness of the practice

Illustrated by the study of Pronti and Berbel (2023), the shift to volumetric pricing in the Central Emilia Water District (CEWD) **addresses a practical demand-management challenge** in an irrigation-dependent agricultural area that is increasingly exposed to water stress. Operating in a highly productive setting that has faced growing pressure on irrigation supplies and recurrent drought episodes, the reform is intended to curb excess demand and strengthen on-farm water-use efficiency as policy-relevant outcomes.

A key mechanism driving effectiveness is the change in the way irrigation **water is priced at the margin**, and therefore how it features in farmers' production choices. With a flat-rate charge, the cost of water is largely fixed with respect to use, meaning that additional abstraction entails little or no extra payment; consequently, water may not constrain decisions in the same way as other variable inputs. By introducing a volumetric charge, the reform attaches a positive marginal cost to each unit consumed, making water use economically consequential at the point of decision and strengthening incentives to reduce over-application and to adjust water allocation across crops and irrigation practices (Berbel et al., 2018).

Furthermore, CEWD implemented a harmonised two-part tariff from 2016: a fixed fee covering general services plus a volumetric charge with a baseline price of €0.025/m^3 (rising to €0.027/m^3 in 2017). The volumetric component is adjusted through coefficients intended to reflect key cost and scarcity drivers, including basin-level rivalry during the dry season (notably in the Secchia and Enza basins), energy-related operation and maintenance costs, out-of-season services, and crop water intensity (Pronti and Berbel, 2023). This structure is relevant to effectiveness because it does not merely "price water" in the abstract: it seeks to **translate contextual scarcity and service-cost heterogeneity into differentiated marginal incentives.**

Evidence from the ex-post evaluation indicates that the reform was associated with **substantial reductions in irrigation demand** among the group that moved from flat rate to volumetric charging. Pronti and Berbel (2023) report a sizeable post-reform decline for treated plots: descriptively, average water demand falls by around 55% for the treated group, while the comparison group (already facing volumetric charging) remains broadly stable. In model-based terms, the estimated average treatment effect corresponds to water savings of 2,533 m^3/ha, which the authors interpret as roughly a 51% reduction relative to pre-policy water demand per hectare. At the district scale and relative to the pre-policy average, the treated group's annual demand is reported to decline by approximately 3.59 million m³ (2016), 3.12 million m³ (2017), and 5.68 million m³ (2018), alongside additional tariff earnings contributing to cost recovery of about €0.12–0.20 million per year over the same period.

Importantly for effectiveness, these behavioural responses are observed despite water costs being a small share of total production costs in the study area, consistent with the interpretation that the critical change is the move from a zero marginal cost to a positive marginal price rather than a large increase in average expenditure.

Efficiency of the practice

Efficiency in the Emilia-Romagna volumetric-pricing reform is closely linked to the way use-based charging renders water consumption more visible to farmers and, consequently, more salient in day-to-day irrigation decisions. By tying payment to delivered volumes, the **tariff provides regular feedback on the cost implications of irrigation practices,** which can increase users' awareness of consumption and encourage closer scrutiny of irrigation scheduling and application behaviour**.** In CEWD, this linkage between use and payment is operationalised through a comparatively data-rich yet pragmatic information chain: farmers provide plot-level information (e.g., irrigated area, crops, irrigation technology) and request deliveries during the season; CEWD then estimates delivered volumes via hydraulic calculations (flow rates, canal capacity and delivery duration) in an open-channel distribution setting and issues end-of-season reports detailing irrigation activity and the associated charge.

From an efficiency standpoint, this is pertinent because irrigation districts face recurrent operation and maintenance expenditures; accordingly, incremental and more predictable revenue streams **can reduce reliance on ad hoc funding and help stabilise service provision** over time. Moreover, this outcome is aligned with the broader EU policy rationale that pricing instruments should **contribute to recovering (at least) the financial costs** of water services, while also **signalling scarcity and promoting more efficient use** (European Environment Agency, 2013).

Furthermore, CEWD achieves these gains through an administratively workable design in an open-channel delivery context, where billed volumes are derived from hydraulic estimation rather than universal farm-gate metering—an implementation constraint frequently highlighted in EU reviews of agricultural water pricing. In this respect, the CEWD case illustrates how tariff reform can combine demand management with incremental improvements in cost recovery through a feasible approach in a sector where flat-rate charging remains common and volumetric methods are not yet the dominant practice.

Beyond these immediate effects, the reform can be interpreted as **supporting a more efficient allocation and use** of irrigation water over time. By converting water into a priced, variable input, volumetric charging encourages farmers to economise on use where the marginal contribution to returns is lower, while preserving water where it is most valuable. Consistent with this interpretation, the CEWD results show heterogeneous responses across cropping systems: larger reductions are observed for meadows, tomatoes and (in several specifications) maize, whereas "vegetables" are reported as less or not responsive—an effect the authors relate to the high-value and quality-sensitive nature of these crops under water stress, alongside the fact that water costs represent only a minor share of their total production costs. Such patterns suggest that, once a marginal price is introduced, water is progressively prioritised towards activities where reductions would generate larger economic losses.

Over longer horizons, the same pricing signal may also **strengthen incentives for innovation and investment**. Pronti and Berbel explicitly discuss adjustments in irrigation technology and crop patterns as potential adaptation strategies, while noting that such changes typically require technical, capital and knowledge investments and are therefore unlikely to occur instantaneously. Notably, their robustness analysis using a balanced panel constrained to unchanged irrigation systems shows that sizeable water savings still emerge even without contemporaneous technology switching, implying that short-run efficiency gains can arise through improved management while the instrument continues to create incentives for longer-run technical upgrading.

More generally, EU evidence indicates that moving from area-based charging towards pricing structures that reflect use and scarcity can induce a portfolio of adaptive responses, including improved irrigation efficiency through water-saving technologies and, where feasible, modifications in cropping patterns, thereby supporting more efficient resource use over time (European Environment Agency, 2013).

Inclusivity and reflexivity of the practice

From an inclusivity perspective, the most clearly substantiated contribution of the CEWD reform concerns the distributional implications of moving from an area-based flat charge to volumetric billing. Under flat-rate pricing, payments are largely decoupled from delivered volumes, such that lower-use irrigators may implicitly cross-subsidise higher-use irrigators. By contrast, volumetric charging **aligns the incidence of costs more closely with use intensity and renders explicit the trade-offs** between water-intensive practices and higher private bills. In the CEWD assessment, this redistribution is reflected in additional revenues collected from users who transitioned from a flat tariff to volumetric charging alongside a marked contraction in water use, consistent with the interpretation that the reform simultaneously strengthened conservation incentives and rebalanced cost incidence within the district. This accords with wider EU evidence that tariff structure, particularly the shift from flat to volumetric charging, can materially affect both consumption patterns and the distribution of charges across users (European Environment Agency, 2013).

With respect to transparency, the reform can be interpreted as **strengthening procedural clarity** by making both water use and the basis for charging more legible to users. Volumetric pricing requires that delivered volumes be estimated and recorded and that charging rules be applied consistently. In CEWD, this is operationalised through an administrative process in which farmers provide plot-level information (e.g., cropping plans, irrigated area and irrigation technology) and request deliveries during the season, while the district estimates delivered volumes in an open-channel setting and issues end-of-season statements detailing irrigation activity and charges due. By formalising the linkage between use, calculation and billing, the practice **enhances the traceability of payment determination and can increase predictability for users** relative to a flat tariff regime in which marginal use is not priced. More generally, this emphasis on traceable measurement—or defensible estimation—aligns with EU experience, which repeatedly identifies credible measurement and administrative capacity as enabling conditions for transparent and enforceable volumetric pricing in irrigation (Arcadis et al., 2012).

Finally, the practice embeds a **monitoring-and-learning infrastructure** because volumetric charging depends upon routine data collection, internal verification and periodic review. The repeated cycle of delivery requests, volume estimation, billing and end-of-season reporting generates administrative records that can be used to monitor implementation, detect anomalies or unintended patterns of use, and support iterative adjustment of tariff parameters and complementary rules over time. In this respect, reflexivity is enabled by the operational requirements of volumetric charging itself, rather than relying solely on one-off external assessments—an important consideration in gravity-fed/open-channel systems where the credibility of the price signal hinges on the consistency of estimation procedures and systematic record-keeping.

Replicability and generalizability of the practice

Replication of the CEWD volumetric-pricing approach across other parts of Europe is plausible, but it is best characterised as conditional on a set of enabling institutional, technical and governance factors. EU reviews emphasise that volumetric pricing in agriculture has not been adopted uniformly, in part because it presupposes credible quantification of use and sufficient administrative capacity to translate water deliveries into enforceable bills (Arcadis et al., 2012; European Environment Agency, 2013). In this respect, the CEWD case is generalisable primarily to contexts where these prerequisites can be met and where the tariff reform is embedded within a coherent abstraction and allocation regime.

Investment by farmers in water-saving equipment, either within large irrigation schemes or at the individual level, when supported by EU funds (e.g. FEADER), requires the implementation of volumetric water pricing under the conditions established by EU subsidy regulations. In Spain, the experience is that change from previous open channel systems to pressurized and volumetric metering also includes the use of binomial rates (fixed part covering fixed cost and volumetric covering energy and others). The increase of price from previous open systems is 250% and the volumetric part is 30-50% of the total water cost (Berbel et al 2019), therefore serving as a signal to users to optimize the resource allocation. Nevertheless, there is not a public program in Spain similar to the mentioned one in Italy.

A first necessary condition is an **appropriate institutional locus of implementation**, typically an irrigation district, water user association or comparable service provider with a clear mandate to set tariffs, issue bills, collect revenues and manage operations and maintenance. Without such an entity, the continuity of billing, enforcement and adaptive revision could be difficult to sustain. Closely related is the requirement for **credible quantification of use**. While farm-gate metering is often presented as the benchmark, CEWD illustrates that volumetric charging can also be operationalised in open-channel systems through standardised estimation protocols, provided that procedures are consistent and records are systematically maintained; replication therefore requires either metering infrastructure or a defensible estimation-and-verification system.

A second condition concerns **administrative and information capacity**. Volumetric pricing needs reliable data management—linking plot/crop information, delivery requests, estimated volumes and end-of-season statements—so that transaction costs remain manageable and charging is predictable for users. In the absence of such systems, implementation burdens may outweigh efficiency gains. Replication is further strengthened where tariff design reflects local cost structures and scarcity conditions (e.g., energy intensity, seasonal service costs, basin constraints), rather than applying a uniform volumetric charge that may be poorly matched to hydrological and operational realities.

A third condition is **regulatory coherence and integration with the wider governance mix**. Pricing reforms are most robust when they rest on a clear legal basis and are aligned with allocation rules, monitoring and enforcement. This is especially important in regions characterised by conjunctive use, where farmers can substitute between surface water and groundwater: modelling evidence for Emilia-Romagna indicates that tariff reforms can shift pressure onto groundwater if complementary abstraction governance is weak, underscoring the need to couple pricing with effective monitoring and groundwater controls (Portoghese et al., 2021; Arcadis et al., 2012).

Finally, replication requires **attention to distributional effects and acceptability**. Moving from flat-rate to volumetric charging changes who bears costs within the user community and can increase bills for higher-use irrigators. Transparent communication, predictable billing, and—where appropriate—transitional arrangements can therefore be important for managing conflict risks and supporting compliance.

More broadly, EU evidence suggests that volumetric pricing is often most effective when users have the technical capacity to respond, and that combining tariff reform with irrigation modernisation and improved management can unlock greater water-saving potential than price changes alone (European Environment Agency, 2013).

Technical details

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Related websites:

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3.4 Impact Investments for sustainable water management: DC Water Environmental Impact Bond (Washington DC)

General description

An environmental impact bond is a form of pay-for-success (PFS) financing, in which private investors provide upfront capital for usually a publicly led programme or project and financial returns are partially or fully linked to the achievement of predefined and measurable outcomes. Under a PFS model, payments depend on verified performance rather than on inputs, activities, or implementation alone, allowing public authorities to share performance risk with private investors while incentivising effective delivery of desired environmental or social outcomes (Brand et al., 2021).

In practice, environmental impact bonds introduce a structured arrangement (see Figure 4) in which responsibilities for financing, implementation, and performance verification are clearly separated, while financial flows are explicitly linked to achieved outcomes. An intermediary typically coordinates the investment vehicle and contractual relationships, implementation partners deliver the agreed measures, and independent evaluator ensures that outcome payments are triggered only when predefined performance criteria are met. This structure enables outcome-oriented governance by aligning incentives across actors while maintaining public oversight and accountability (Kosciolek et al., 2020).

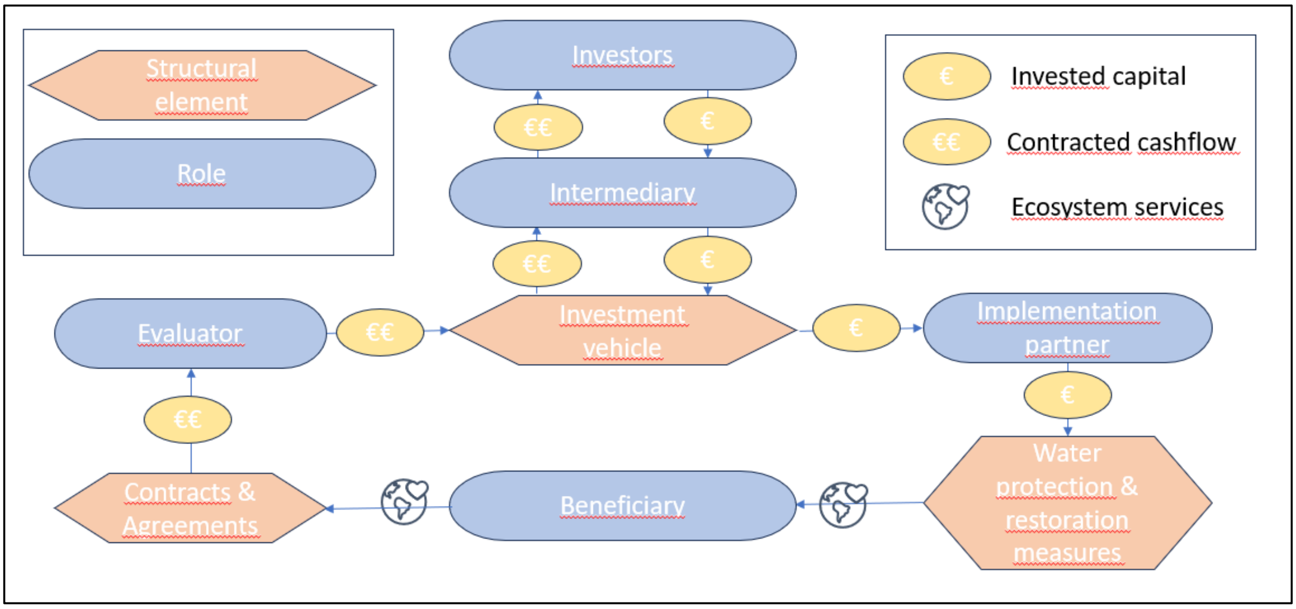

Figure 4. The structure of environmental impact bond (EIB) (Modified from Kosciolek et al., 2020).

The DC Water Environmental Impact Bond (EIB), implemented by the District of Columbia Water and Sewer Authority (DC Water, Washington, D.C.) in Washington, D.C., represents a concrete example of how pay-for-success and impact investment principles can be applied within public water governance. Issued in 2016, the bond was designed to finance green stormwater infrastructure while explicitly linking part of the financial outcome to measured environmental performance, rather than to construction or service delivery alone.

The bond was developed in response to long-standing challenges related to combined sewer overflows and stormwater management in the District of Columbia. Within the framework of an existing regulatory consent decree, DC Water sought to test the effectiveness of green infrastructure as a complement to traditional grey infrastructure solutions. The Environmental Impact Bond provided a mechanism to mobilize private capital for this purpose while sharing the performance risk associated with relatively novel infrastructure approaches.

In the DC Water Environmental Impact Bond, DC Water acts as the beneficiary and outcome payer (see Figure 4), representing the ultimate beneficiaries, namely residents and water users, and defines the targeted outcomes. The intermediary role is performed by Quantified Ventures, which coordinates the pay-for-success transaction and contractual arrangements. The investors are Goldman Sachs and Calvert Foundation, which provide upfront capital through the investment vehicle. The implementation partners are procured by DC Water and deliver the green infrastructure measures. Performance evaluation is carried out using predefined metrics on stormwater runoff reduction.

In this context, impact investment was not used to replace public responsibility for water quality management, but rather as a governance and financing tool to support learning, innovation, and risk allocation within a regulated public utility setting. The case illustrates how outcome-based finance can be integrated into water governance arrangements where objectives, responsibilities, and regulatory constraints are clearly defined (Appel et al., 2017).

Methodology

This good practice description is based on a review of secondary sources, primarily the case analysis published in the Journal AWWA (American Water Works Association) in 2017 (Appel et al., 2017), which documents the design, financing structure, governance context, and intended learning objectives of the DC Water Environmental Impact Bond, complemented by relevant grey literature and practitioner-oriented sources. The description also draws on theoretical and review literature on impact investment and pay-for-success financing, with a focus on applications in water governance and environmental management.

Initiator

- Public sector: District of Columbia Water and Sewer Authority (DC Water, Washington, D.C.) representing the citizens as beneficiaries.

Category

- Financial mechanism (Impact investment)
- Collaborative approach (public-private partnership)

Water issue

- water quality
- ecosystems
- safe access to water supply and sanitation.

Geographical applicability

- Local/catchment: District of Columbia
- National

Level of water governance

- Local/catchment: District of Columbia
- National

Stakeholders

- Primary sector
    - Industry
    - Primary production
        - Agriculture
        - Forestry
        - Minerals and mining
- Other sectors
    - Public authorities
        - catchment governance agencies
        - municipalities
    - Civil society
        - NGOs
        - local communities
    - Research
        - Research institutes: monitoring and verification of impacts
        - Universities: monitoring and verification of impacts
    - Industry
        - Consultants

Effectiveness of the practice

The DC Water Environmental Impact Bond demonstrates **how impact investment can be effective in situations where environmental outcomes can be clearly specified, measured, and evaluated within a defined timeframe**. In this case, the performance metric was stormwater runoff reduction associated with a defined green infrastructure project area. This choice of indicator enabled objective monitoring using established hydrological measurement methods and supported credible outcome-based payments.

Effectiveness in this case should be understood primarily in terms of governance effectiveness and decision support, rather than solely in terms of immediate environmental improvement. The bond was explicitly designed as a pilot, allowing DC Water to assess whether green infrastructure could deliver expected performance levels before committing to broader deployment. **By linking financial consequences to observed performance, the instrument strengthened incentives for careful project design, implementation, and monitoring.**

At the same time, the case highlights the limits of outcome-based finance in water quality management. **The approach is most effective where impacts are relatively localised and attributable.** It is less readily applicable to diffuse pollution problems or ecological processes that respond slowly to intervention. The DC Water case therefore illustrates both the potential and the boundaries of effectiveness for impact investments in water governance.

The literature and experiences from existing EIBs suggest that environmental impact bonds are most effective in linking financial returns to measured environmental performance, thereby increasing accountability for results among implementing actors and investors. Evidence on long-term environmental effectiveness remains limited, reflecting the small number of cases and the mismatch between financial evaluation periods and ecological response times (Brand et al., 2021; Trotta, 2024).

Efficiency of the practice

From an efficiency perspective, the Environmental Impact Bond introduced **a structured form of risk sharing between the public sector and private investors**. Instead of the public utility bearing the full risk that green infrastructure might underperform, part of this risk was transferred to investors through predefined payment mechanisms. This arrangement allowed DC Water to explore innovative solutions without fully internalising the associated uncertainty.

The bond structure also supported more **informed long-term investment decisions**. By generating evidence on performance under real operating conditions, the instrument reduced informational uncertainty and supported more **efficient allocation of future capital**, whether towards green or grey infrastructure. However, the case also illustrates that such efficiency gains come with non-trivial transaction and monitoring costs, reflecting the complexity of designing, contracting, and evaluating **outcome-based instruments**.

In addition, the Environmental Impact Bond demonstrates how outcome-based financing can help **mobilise private capital for water governance** and partially address existing financing gaps. By attracting private investors to fund interventions that would otherwise rely solely on public budgets, the EIB expanded the pool of available resources for water management. While the scale of financing in this case was limited and the public sector remained the ultimate payer, the instrument illustrates the potential of impact bonds to complement traditional public funding sources and to channel private capital toward public water management objectives.

As a result, the DC Water Environmental Impact Bond is best understood as an efficient pilot for targeted water governance with measurable outcomes, rather than as a universally cost-minimising financing mechanism for routine water infrastructure investment. Overall, the literature review by Trotta (2024) indicates that environmental impact bonds tend to be most efficient as targeted, context-specific instruments, particularly where uncertainty, learning value, and risk sharing justify higher transaction and monitoring costs, rather than as cost-minimising tools for routine infrastructure financing.

Inclusivity and reflexivity of the practice

The DC Water Environmental Impact Bond primarily involved institutional actors, including a public water utility, private investors, and technical service providers. While the instrument did not directly engage local communities or individual water users in its financing or governance structure, **it aimed to deliver public environmental benefits** in areas affected by recurring sewer overflows and degraded water quality.

Reflexivity is a central strength of the practice. The bond was explicitly **structured to generate feedback through performance measurement and evaluation, enabling adaptive decision-making**. The inclusion of predefined performance thresholds and corresponding financial consequences ensured that learning was embedded in the governance framework, rather than treated as an external evaluation exercise.

This reflexive design supports adaptive water governance by **allowing public authorities to adjust infrastructure strategies based on observed outcomes.** In this sense, the DC Water case demonstrates how impact investment can enhance institutional learning and accountability, even in the absence of broad stakeholder participation.

Replicability and generalizability of the practice

The DC Water Environmental Impact Bond is selectively replicable in other water governance contexts, particularly where **public utilities operate under clear regulatory mandates and where environmental or other performance outcomes can be monitored with reasonable confidence**. Replication is most feasible in urban stormwater and sewer management contexts, where interventions address relatively well-defined sources of pressure and where performance indicators, such as stormwater runoff reduction or overflow frequency, can be measured at the project or catchment scale and attributed to specific measures.

The potential applicability of impact bond–type instruments has also been explored beyond urban stormwater contexts. For example, the feasibility of using environmental impact bonds for coastal wetland restoration in Louisiana has been assessed highlighting both opportunities for outcome-based financing and significant challenges related to impact attribution, long time horizons, and uncertainty in ecological responses (Herrera et al., 2019). This assessment suggests that while impact bonds may be conceptually transferable to broader ecosystem restoration contexts, their practical feasibility depends strongly on indicator choice, risk allocation, and institutional capacity.

Successful replication requires enabling institutional conditions, including legal capacity for performance-based contracting, access to private capital willing to accept outcome-related risk, and sufficient technical capacity for monitoring and evaluation. In addition, public **authorities must have a clear role** as outcome payers and the ability to integrate outcome-based financing within existing regulatory and investment frameworks. Where these conditions are absent, or where water quality challenges are diffuse, cumulative, or subject to long ecological response times, direct replication of the DC Water model may be difficult.

As a result, environmental impact bonds and similar pay-for-success instruments are not universally applicable across all water management challenges. Their **use is most appropriate where outcomes can be defined in a way that balances scientific credibility, measurability, and contractual feasibility**. In many water governance contexts, particularly those involving agriculture or catchment-scale nutrient management, the complexity of pressures and delayed environmental responses limits the use of final ecological status indicators as contractual performance metrics. In such cases, outcome definitions may instead rely on intermediate, scientifically grounded indicators that are causally linked to longer-term environmental objectives. For example, reductions in soil phosphorus levels, nutrient surpluses, or erosion risk can be measured more reliably and over shorter time horizons than changes in the ecological status of receiving water bodies. While these indicators do not represent final water quality improvements in themselves, they are widely recognised as relevant pressure or response indicators that contribute to improved water status over time.

The use of intermediate outcomes allows outcome-based financing approaches to be adapted to a wider range of water management challenges, provided that the causal links between indicators and long-term objectives are transparent and supported by scientific evidence. When combined with robust monitoring systems and clear communication of assumptions and limitations, such indicators can provide a credible basis for pay-for-success arrangements while respecting the ecological complexity and time lags inherent in water systems. In this sense, the replicability of the DC Water case lies not in its specific performance metrics, but in the broader governance principle of **linking finance to verifiable, outcome-oriented indicators aligned with public water management goals.**

In the European Union context, this governance logic is consistent with the outcome-oriented objectives of the Water Framework Directive (WFD) and the Marine Strategy Framework Directive (MSFD), both of which recognise the role of pressure and response indicators in achieving good ecological and environmental status. While these directives rely primarily on regulatory and publicly funded measures, **impact bond–type instruments could complement existing policies by supporting targeted experimentation, learning, and risk sharing in well-defined contexts, such as urban wastewater and stormwater management.** In the context of the Common Agricultural Policy (CAP), direct replication of the DC Water model is more constrained due to diffuse pollution pressures and longer ecological response times; however, the use of intermediate outcomes is conceptually aligned with result-based agri-environmental schemes. As such, the DC Water case **offers a reference for how outcome-linked financing principles could be adapted within EU water governance**, rather than a model for direct transplantation.

The replicability and scaling of environmental impact bonds is also influenced by the composition of the investor base. In the DC Water case, the bond was placed with large institutional investors capable of engaging with outcome-linked risk and complex contractual arrangements. Broadening participation to include a wider range of actors, such as retail investors or for example food production companies exploring financing water protection measures along their supply chains as studied in the GOVAQUA Living Lab in the Archipelago Sea catchment area in Finland, would require simplified financial structures, clear risk disclosure, and additional safeguards, potentially including guarantees or intermediary vehicles. As a result, **while impact bonds have the potential to mobilise a broader pool of private capital for water governance, their replication at scale would likely depend on strong public-sector involvement and appropriate regulatory frameworks to ensure both investor protection and policy alignment.**

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Related websites

Environmental Impact Bond | DC Water

DC Water Environmental Impact Bond | Quantified Ventures

DC Water's Environmental Impact bond: A First of its Kind

Related resources

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3.5 Water Stewardship Certifications in the berry sector in Doñana (Huelva)

General description

Water stewardship is increasingly used as an umbrella term for approaches through which firms—individually and along supply chains—seek to manage water-related risks and impacts in ways that extend beyond site-level efficiency towards catchment-scale considerations. The Alliance for Water Stewardship (AWS) defines water stewardship as an approach to water governance that emphasises (i) a catchment and ecosystem focus, (ii) equity across economic, environmental and social dimensions, and (iii) collective, stakeholder-inclusive action (AWS, 2019).

This definition has informed subsequent scholarly debates on stewardship in agricultural supply chains, where the concept is commonly analysed through two core practice clusters—water assessment and stakeholder engagement—together with the barriers and enabling conditions that shape implementation (Jia et al., 2019). Within agri-food supply chains, stewardship initiatives have developed partly in response to growing expectations that companies demonstrate transparency and due diligence regarding water use and related externalities, including where impacts occur far from end-consumers and are mediated through complex sourcing arrangements (Jones et al., 2015).

Water stewardship certifications operationalise these stewardship expectations through codified, auditable requirements and third-party assurance—typically delivered as business-to-business schemes rather than consumer-facing labels. In general terms, they translate stewardship principles into verifiable control points and evidence requirements (e.g., documentation of water sources and legal compliance, monitoring and record-keeping of water use, risk assessment, management planning, and, in some schemes, stakeholder engagement beyond the farm boundary). By embedding these requirements into commercial purchasing conditions, certifications function as private governance instruments that can "make water visible" through auditability, traceability and reporting; however, critical scholarship cautions that such standards may also reconfigure responsibilities and power relations along the value chain, with implications for legitimacy, equity and the distribution of compliance burdens—especially where requirements are insufficiently adapted to local hydrological and social contexts or weakly connected to public monitoring and enforcement (Vos & Boelens, 2014).

The relevance of these issues is heightened in the wider Doñana context in Andalucía in Spain, where irrigated production occurs in proximity to a highly sensitive protected area. Doñana is internationally recognised as a World Heritage Site, described as one of the largest surviving wetlands in Europe, and its ecosystems depend on the hydrological integrity of the Guadalquivir basin and associated groundwater bodies (UNESCO, 2025). In such settings, groundwater-dependent wetlands are particularly vulnerable to sustained abstraction and to changes in water-table dynamics. EU-level legal proceedings have explicitly linked deterioration risks in the Doñana protected area to groundwater pressures, while recent scientific assessments document extensive ecological damage associated with groundwater abstraction, reinforcing the need for stewardship claims to be grounded in robust evidence of controlled impacts rather than solely in procedural compliance (European Union, 2021).

The increasing prominence of water stewardship certifications is also shaped by a shifting EU policy landscape that strengthens expectations for companies to manage and evidence sustainability risks and impacts across value chains. In particular, the Corporate Sustainability Reporting Directive (Directive (EU) 2022/2464), operationalised through the European Sustainability Reporting Standards, expands mandatory sustainability disclosures, including in the area of water and marine resources (ESRS E3). In parallel, the Corporate Sustainability Due Diligence Directive (Directive (EU) 2024/1760) reinforces due diligence duties regarding adverse environmental and human-rights impacts in companies' operations and chains of activities, further increasing demand for credible supplier assurance and verifiable controls. In this context, stewardship certifications can serve as one component of the evidentiary infrastructure used by companies to document practices and substantiate water-related claims, although they do not replace public regulation or monitoring.

This is particularly relevant for the berry sector in Huelva and the wider Doñana area (Figure 5), where production is strongly export-oriented and embedded in European retail supply chains. Official sector reporting for the 2022/23 campaign indicates that exports of berries from Huelva totalled 85,579 tonnes with a value of €451.395 million, underscoring both the scale of market exposure and the commercial leverage of downstream buyers. Over the same period, the principal destinations by volume were EU markets, especially Germany (23,434 tonnes) and France (11,530 tonnes), alongside other major European outlets, evidencing the sector's dependence on retail standards and procurement requirements in northern European markets (Gobierno de España, 2023). In such an export-oriented setting, water-related certification has become an increasingly important supply-chain assurance mechanism, through which downstream buyers seek to verify that on-farm water management is consistent with applicable regulation and with increasingly salient sustainability expectations in destination markets.

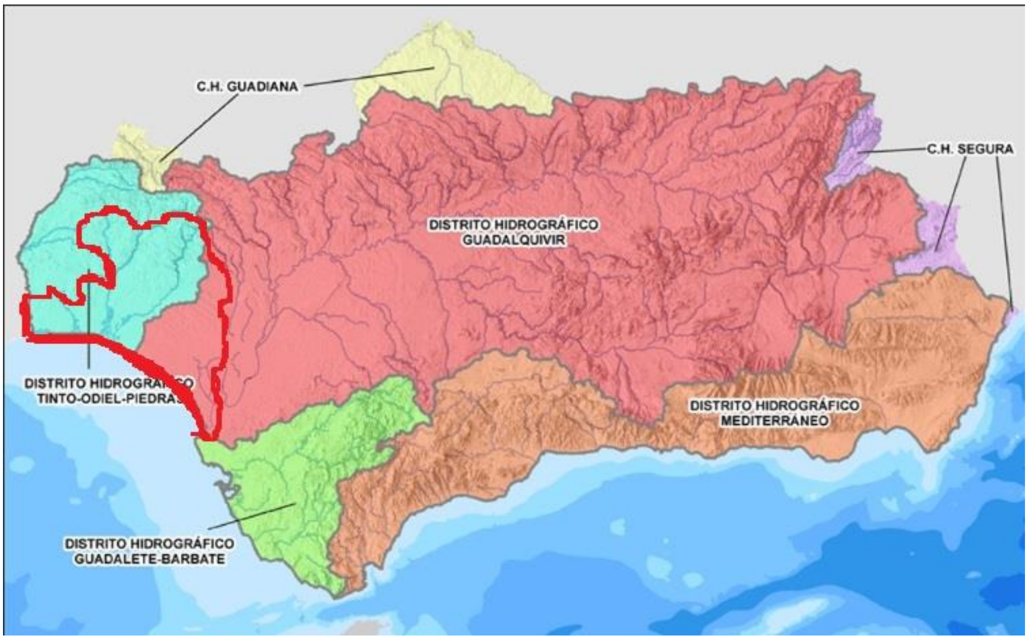

Figure 5. Map of the study area in south-western Spain

The local certification landscape comprises an amalgam of schemes that differ markedly in their governance ambition and in the types of assurance they provide. Interviewees most frequently referred to schemes such as GLOBALG.A.P. SPRING (Globalgap, 2026) and the Alliance for Water Stewardship (AWS) Standard (AWS, 2026), while also noting that multiple other buyer-driven certifications coexist in the market. Some standards operate primarily as farm-assurance modules, prioritising measured use, documentation and compliance evidence, such as requirements for volumetric records, metering systems where feasible, and structured water management planning. Others frame stewardship more explicitly as a catchment-oriented and stakeholder inclusive endeavour, seeking to connect site practices to shared water challenges and local decision-making processes. Taken together, these features provide the conceptual and practical foundation for analysing the Doñana/Huelva water stewardship certification practice as a governance innovation shaped by the interaction of (i) retailer-driven supply-chain requirements, (ii) EU-wide due diligence and reporting incentives, EU-level due diligence and sustainability reporting obligations that primarily apply to downstream buyers and are transmitted upstream through procurement and assurance demands, and (iii) place-specific water challenges that condition what certification can credibly achieve in practice.

Methodology

The case study was documented through a qualitative, evidence-based approach combining semi-structured interviews with targeted document review. Primary data were generated through interviews conducted between October and November 2025, with a cross-section of actor types relevant to water stewardship certification in the study area, including producers/irrigators, an irrigation community representative, an irrigators' association, an environmental NGO, and an academic expert with Doñana-related expertise. Interviewees were coded to preserve anonymity, and the interview guide was used to ensure comparability across conversations while allowing respondents to elaborate on actor-specific experiences, motivations and constraints.

The interviews were analysed using a structured coding framework aligned with the GOVAQUA good-practice criteria—effectiveness, efficiency, inclusivity and reflexivity, and replicability/generalizability—so that interview evidence could be systematically mapped to the assessment dimensions used across work packages. This enabled triangulation of recurring themes and supported explicit differentiation between claims grounded in interview material and broader contextual statements supported by external sources.

Table 2. Overview of interviews in October-November 2025.

Interview code	Represented organisation types
A	Berry producer/farm company; management/technical representative
B	Irrigation community; secretariat/management representative
C	Berry producer/irrigator; farm manager
D	Berry producer/irrigator; technical/operations representative
E	Irrigator/producer; two farm managers
F	Irrigators' association (national); representative
G	Environmental NGO; water programme/Doñana-related representative
H	Academic expert; hydrogeology

In parallel, documentary analysis was undertaken to characterise how stewardship certification is defined and operationalised, and to situate the practice within the evolving EU policy context for sustainability reporting and due diligence. Official sector statistics were additionally consulted to provide quantitative context on the export orientation and market structure of the Huelva berry sector. Taken together, these data sources provide the empirical basis for assessing the practice as a governance innovation and for identifying the conditions under which certification-based stewardship may be credible, efficient and transferable.

Initiator

- Downstream buyers and retail-led supply-chain governance (market access requirements for third-party certification)

Category

- Regulation (voluntary standard)

Water issue

- water quantity
- water quality
- ecosystems
- safe access to water supply and sanitation

Geographical applicability

- Global
- EU

Level of water governance

- Catchment

Stakeholders

- Primary sector
  - Industry
  - Primary production
    - Agriculture
    - Forestry
    - Minerals and mining
- Other sectors
  - Public authorities
    - catchment governance agencies
    - municipalities
  - Civil society
    - NGOs
    - local communities
  - Research
    - Research institutes
    - Universities
  - Industry
    - Consultants

Effectiveness of the practice

Water stewardship certification in the Huelva berry sector can be interpreted as an effectiveness-oriented governance innovation primarily because it **provides a structured and auditable mechanism** through which water-related practices become legible to downstream buyers in export supply chains. Interview evidence indicates that certification is commonly experienced not as a discretionary "improvement tool" but as a practical condition for **maintaining commercial access**, particularly where large buyers and retailers require standardised assurance on production conditions (Interviews A, C, D, G). In this respect, the practice addresses a concrete governance need: it **translates broad and often contested expectations of "responsible water use" into verifiable evidence requirements**, such as documentation of water sources and authorisations, records of irrigation-related practices, and water management planning, consistent with the role of business-to-business certification as a private governance instrument (Vos, 2016; Vos & Boelens, 2014).

A salient dimension of effectiveness in the Doñana setting concerns the extent to which certifications **contribute to locally relevant water policy objectives**, especially legality and risk control in groundwater-dependent zones. Several respondents associated certification with the need to demonstrate that water sources are authorised, and that production is not reliant on irregular abstraction (Interviews A, G). An irrigation community perspective further underscored ongoing efforts to consolidate water use around legally conceded supplies and to communicate “legal water” provenance as a market- and legitimacy-relevant attribute (Interview B). From this perspective, certification can reinforce compliance-oriented behaviours by standardising how evidence is assembled, presented and checked across farms and supply-chain actors (Interviews B, G).

However, interview material also suggests that effectiveness is **uneven across governance scales.** Respondents drew a clear distinction between what certification can support at farm or plot level, improved record-keeping, monitoring routines and managerial attention, and what it can credibly deliver at aquifer/catchment level, such as demonstrable reductions in pressure or measurable recovery of groundwater status (Interviews A, H). This scale challenge resonates with the broader stewardship debate: while stewardship ideals emphasise catchment focus and collective action, in agricultural supply chains implementation often concentrates on water assessment and engagement practices closer to the site boundary, with outcomes constrained by institutional linkages and public enforcement capacity (Jia et al., 2019). In the expert interview, this point was articulated particularly strongly, with concerns that certification may remain weakly connected to basin-level planning and to the hydrogeological realities that ultimately determine the Doñana water problem (Interview H).

At farm level, producer interviews provide more supportive evidence on effectiveness mechanisms. Producers described certification as **encouraging more systematic accounting of water needs** and a more formalised approach to **monitoring variables relevant to irrigation decisions**, thereby **strengthening internal management discipline** (Interviews C, D). At the same time, other interview material qualifies this effect by suggesting that, in a context of already constrained allocations and high technical intensity, certification may formalise and document practices that many producers would undertake in any case, rather than fundamentally transforming water-use behaviour across the board (Interviews A, E, F).

Finally, the credibility of certification as an effective instrument in Doñana is conditioned by **perceived gaps between auditable documentation and actual abstraction practices**, particularly in relation to groundwater monitoring and the risk of circumvention through non-declared sources. The expert interview highlighted the potential disconnect between the formal legal status of parcels and the (harder to verify) origin and volume of water used, noting that closure of one abstraction point does not necessarily imply reduced extraction if alternative sources are used and not systematically reported (Interview H). This observation aligns with critical scholarship warning that certifications can create assurance signals for downstream actors while remaining weakly coupled to the public monitoring and enforcement systems that ultimately determine ecological outcomes and distributive effects (Vos and Boelens, 2014; Vos, 2016).

Taken together, the Doñana/Huelva evidence suggests that the effectiveness of water stewardship certification is strongest as a supply-chain assurance and farm-level management instrument, supporting documentation, procedural discipline and, in some cases, improved irrigation accounting, whereas its contribution to catchment-scale outcomes depends on the degree to which certification requirements are meaningfully aligned with basin governance, credible abstraction verification and the wider enforcement environment (Interviews B, G, H; Jia et al., 2019).

Efficiency of the practice

Water stewardship certification can be considered efficiency-relevant in the Huelva/Doñana setting insofar as it creates a **structured information and assurance architecture** that standardises how water-related evidence is produced, organised and shared along supply chains, and, in some schemes, disclosed more widely through public reporting requirements. In practical terms, certification requirements typically compel farms to formalise record-keeping on water sources, irrigation practices, and water management planning, thereby improving the availability and internal use of water-related data for operational decision-making and external assurance purposes (Interviews A, C, D). This **"data-making" function** is particularly salient in export-oriented value chains, where downstream buyers require comparable, auditable information from heterogeneous suppliers and where certification becomes a routinised compliance channel rather than a bespoke reporting exercise (Interviews A, G; Jia et al., 2019). In that sense, certification may reduce information asymmetries and facilitate monitoring at the supply-chain interface by lowering the effort needed to demonstrate basic controls repeatedly to different commercial counterparties.

At the same time, interview material indicates that the **efficiency profile of certification is strongly conditioned by administrative and verification burdens**. Several respondents highlighted that compliance entails non-trivial costs in documentation, staff time, audits and, depending on the scheme and buyer requirements, potential investment in monitoring and management systems (Interviews A, E, F). From an efficiency perspective, these burdens can be interpreted as transaction costs that are shifted from downstream actors to producers in exchange for continued market access. The extent to which certification is cost-effective therefore depends on whether the marginal assurance and management benefits exceed these compliance and audit costs, and whether requirements avoid duplication across multiple overlapping schemes that some producers may face simultaneously (Interviews A, C). This aligns with the broader policy-evaluation insight that transaction costs and administrative complexity can materially affect the performance of governance instruments and should be treated as part of their efficiency calculus (McCann et al., 2005).

Certification can nonetheless **reduce transaction costs** relative to more fragmented bilateral assurance arrangements by providing standardised protocols, harmonised control points and predictable audit cycles. In interviews, certification was often described as a routinised and recognisable mechanism through which farms can package evidence in a form that is legible to buyers, rather than responding ad hoc to heterogeneous buyer questionnaires or bespoke checks (Interviews A, C, G). Where certification is widely accepted across markets, it can therefore economise on repeated information provision and negotiation. However, this benefit is weakened where buyers require multiple schemes or additional bespoke demands, which can **erode predictability and increase cumulative compliance costs** (Interviews A, F). On balance, efficiency gains are thus most plausible under conditions of (i) acceptance by multiple buyers, (ii) limited duplication, and (iii) requirements that are proportionate to risk and capacity.

With respect to supporting **efficient allocation and use of water resources over time**, certifications can create incentives for continuous improvement in on-farm water management by requiring planning, monitoring, and periodic review. Producer interviews suggest that certification can contribute to greater managerial attention to irrigation scheduling and to the systematic consideration of agronomic and climatic information relevant to water use (Interviews C, D). Over longer horizons, this can support incremental efficiency improvements and, where aligned with investment capacity, may encourage adoption of practices and technologies that reduce waste and improve the productivity of water use. However, both interview material and critical scholarship caution that **farm-level efficiency signals do not automatically translate into basin-level water savings**, particularly in groundwater-dependent systems, unless they are coherently aligned with abstraction governance, caps and credible verification of withdrawals (Interview H;

Vos and Boelens, 2014; Vos, 2016). In that sense, the efficiency contribution of certification is likely to be strongest as a mechanism for improving internal management discipline and supply-chain assurance, while its system-wide efficiency implications depend on the wider institutional context in which “savings” are defined, monitored and governed.

Taken together, the evidence suggests that the efficiency of water stewardship certification in the Doñana/Huelva case rests on a trade-off: certifications can standardise data and reduce some information and negotiation costs for value-chain actors, but they also introduce compliance and auditing costs that may be significant for producers. Efficiency is therefore most credible where certification requirements are harmonised across buyers, focused on risk-relevant evidence, and connected—without duplication—to public monitoring and governance arrangements that ultimately determine whether improved practices translate into meaningful reductions in pressure on shared water resources (Interviews A, F, G, H; Jia et al., 2019; McCann et al., 2005).

Inclusivity and reflexivity of the practice

Inclusivity and reflexivity in water stewardship certification in the Doñana/Huelva context are best understood as an ambivalent set of effects: the instrument can strengthen certain forms of transparency and iterative improvement within certified operations, while also reproducing—at times intensifying—pre-existing asymmetries in value-chain governance and leaving gaps in locally meaningful accountability.

On the one hand, certifications typically **enhance procedural transparency by requiring documented evidence, standardised records and third-party auditing**, which can increase clarity about what is expected from certified producers and how conformity is assessed (Interviews A, C, D). This can support accountability in a narrow, operational sense: non-conformities are recorded, corrective actions are requested, and periodic re-audits institutionalise a cycle of monitoring and follow-up (Interviews C, D). Several producer interviews describe these routines as encouraging more systematic internal organisation of water-related information and management planning, thereby embedding a form of “learning-by-auditing” within farm operations (Interviews C, D). From a reflexivity perspective, these audit cycles are the clearest mechanism through which certification promotes regular review and incremental improvement.

At the same time, interview evidence indicates that transparency is **often oriented primarily towards downstream buyers and auditors** rather than towards catchment-level stakeholders or broader public accountability. In other words, certification can render practices “legible” to commercial counterparties without necessarily making water use and impacts more transparent in locally meaningful terms, particularly in a groundwater-dependent and contested setting (Interviews G, H). This limitation is especially salient in Doñana, where the key governance question is not only whether a farm can produce auditable documentation, but whether abstraction pressures are credibly controlled and aligned with broader sustainability constraints (Interview H). As a result, a recurrent point raised in the interviews is that certification may generate assurance signals that are strong in procedural terms but weaker in demonstrating outcome relevance at aquifer or catchment scale (Interviews A, G, H). A clear implication for improvement is therefore the need for stronger articulation of how certification requirements relate to basin-level objectives, and for greater complementarity with credible monitoring and enforcement arrangements that determine whether “responsible water use” claims are substantively warranted (Interview H).

Inclusivity challenges are even more pronounced. Interview material suggests that certification requirements are frequently transmitted through procurement conditions, which tends to **concentrate the burden of compliance**—documentation, audit preparation, and in some cases investments in monitoring or management systems—**on producers** (Interviews A, E, F). While producers may benefit through market access and reputational protection, the **distribution of costs and responsibilities is not necessarily symmetric across the chain,** and several respondents highlight that producers’ room for manoeuvre is limited where certification is effectively compulsory for selling into certain channels (Interviews A, F). This can operate against the spirit of equitable participation: rather than being co-designed through a balanced governance process, certification can be experienced as a top-down requirement shaped by buyers' risk management and reputational considerations (Interviews A, F). In this respect, the practice may not only fall short of equal participation but may also **reinforce existing power asymmetries in value-chain governance**. A practical improvement point raised by this diagnosis is the need for more meaningful feedback loops whereby supplier experiences—administrative burdens, feasibility constraints, and local water-governance realities—can inform scheme evolution and buyer requirements (Interviews A, F, H).

Notwithstanding these tensions, interviews also indicate that certification can interact with local legitimacy and conflict dynamics in potentially constructive ways. Some respondents associated certification with demonstrating legal water sourcing and distinguishing compliant production from practices perceived as irregular, which can affect reputational dynamics within the sector and shape how different actors position themselves in public debates (Interviews A, B, G). Yet such effects are also distributional: if certification becomes a gatekeeping device, **those with fewer resources to meet documentation and audit requirements may be disadvantaged**, even where their underlying practices are not necessarily worse, while others may be able to comply procedurally without resolving deeper basin-level concerns (Interviews F, H). This again suggests that inclusivity and water justice depend less on the existence of certification per se than on how burdens and benefits are allocated, how verification credibility is ensured, and how the instrument connects to shared water governance challenges in the locality.

Overall, the interview material suggests that stewardship certification contributes to reflexivity most clearly through routine auditing and corrective action cycles at farm level, but that both inclusivity and broader accountability remain constrained by supply-chain power relations and by the limited extent to which certification outputs are integrated into catchment-level deliberation and governance. Strengthening the practice would therefore entail (i) improving the outcome relevance of assurance in groundwater-dependent settings, (ii) reducing duplication and disproportionate administrative burdens, and (iii) creating clearer channels for local stakeholder concerns and producer knowledge to influence how stewardship expectations are defined and assessed (Interviews A, F, G, H).

Replicability and generalizability of the practice

Replicability and generalisability of water stewardship certification in the Doñana/Huelva context are best assessed by distinguishing between (i) scaling the practice within the same value-chain logic (i.e., expanding uptake across producers and buyers) and (ii) transferring it to other European contexts with different water governance conditions. In both cases, certification is comparatively "easy" to diffuse as a private governance instrument because it is implemented through market access requirements and third-party assurance, without requiring the creation of new public authorities. However, the conditions for it to remain credible and to generate outcomes that matter beyond paperwork are more demanding, particularly in water-stressed and institutionally contested settings.

A first enabling condition for scaling up is the presence of strong demand-side pull from downstream buyers and intermediaries, coupled with sufficient **standardisation across procurement requirements**. Interview evidence indicates that diffusion is accelerated where certifications are recognised by multiple buyers and become routinised as an accepted proof of due diligence, whereas proliferation of overlapping schemes and bespoke buyer add-ons increases compliance costs and undermines scalability (Interviews A, F). A practical requirement for further uptake is therefore greater mutual recognition and simplification, either through convergence around a smaller set of accepted schemes or through harmonised equivalence arrangements, so that the marginal cost of compliance does not rise as firms face multiple certifications simultaneously (Interviews A, F). Closely related is the need for implementation support, particularly for smaller farms: scaling up is facilitated when producers have access to technical assistance for record-keeping, water accounting, and audit preparation, and when certification procedures are proportionate and predictable (Interviews A, E).

A second condition concerns **data and verification infrastructure.** Certification depends on the ability to produce credible evidence on water sourcing and use. In groundwater-dependent systems, this is especially challenging because the key sustainability question relates to cumulative abstraction pressure and the provenance of water actually used. Interview material highlights concerns that documentation-based compliance may not fully resolve verification problems where alternative sources exist or where monitoring of withdrawals is incomplete (Interview H). For replication in other parts of Europe, this implies that stewardship certification is most likely to be credible and transferable where baseline water governance provides clear legal entitlements, reliable monitoring of abstraction volumes, and enforceable limits—so that certification can complement, rather than substitute for, public control of withdrawals (Interview H). Without such conditions, the risk is that certification becomes primarily an assurance signal for supply chains without a commensurate improvement in resource outcomes.

Third, transferability depends on the regulatory and reporting environment, but mainly through downstream buyers rather than direct obligations on farmers. EU sustainability reporting and due diligence rules apply to in-scope companies above size/turnover thresholds and are being phased in. For farmers, the practical relevance is typically indirect: large retailers, brands, processors or intermediaries—domestic or international—may require certification to generate standardised, auditable supplier evidence. Such requirements can be transmitted through both long and short supply chains; in fact, shorter chains may transmit them more directly due to fewer contractual interfaces. Replication is therefore most likely where producers supply buyers that are in scope and where **procurement converges on proportionate, non-duplicative assurance demands.**

Finally, generalisability is conditioned by the extent to which certification schemes **incorporate a meaningful catchment dimension and stakeholder engagement pathways**, rather than focusing solely on farm-level procedures, as some certifications already do. While certification can be replicated rapidly as a managerial and assurance instrument, its legitimacy and policy relevance in highly sensitive catchments depend on whether it can be connected to basin objectives and to locally salient accountability mechanisms. Interviews suggest that, in contested settings, certification would be strengthened by clearer articulation of its relationship to catchment governance processes, greater transparency to non-commercial stakeholders, and avenues for incorporating local knowledge and concerns into the way requirements are interpreted and audited (Interviews G, H)[3]. In this sense, the practice is most readily replicable in Europe where it is deployed as part of a broader governance mix: credible monitoring and enforcement, coherent abstraction rules, and supply-chain incentives that reward compliance, combined with mechanisms that ensure that “responsible water use” claims reflect the place-based realities of water sustainability.

Technical details

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Related websites:

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[3] See also GOVAQUA Deliverable D3.2 Good practices of participatory and collaborative approaches, Huelva Collective Action Accelerator (forthcoming).

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3.6 Payment for Ecosystem Service - Vittel Case

General description

Payments for Ecosystem Services (PES) are commonly presented as an economic instrument designed to internalise environmental externalities by creating incentives for land and water managers to adopt practices that sustain or enhance ecosystem services valued by others. In its canonical formulation, PES involves a voluntary transaction in which a well-defined environmental service (or a land-use proxy likely to secure that service) is purchased by at least one buyer from at least one provider, conditional on service provision or compliance with agreed management rules (Wunder, 2005). More recent refinements emphasise that, in practice, PES operates through negotiated, rules-based arrangements linking service users and providers under specified conditionality, rather than through idealised “spot markets” for ecosystem services (Wunder, 2015). At the same time, critical scholarship cautions against treating PES as a policy panacea or assuming “win–win” outcomes a priori: performance depends on political–institutional context, the credibility of rulemaking and enforcement, and the distributional implications of who pays, who receives, and whose priorities ultimately shape scheme design (Muradian et al., 2013).

Within water governance, watershed-oriented PES schemes typically aim to secure services such as improved drinking-water quality, sediment control, or flow regulation by compensating upstream actors for changes in land and input management. Their operational logic is therefore not simply “paying for nature” but translating a hydrologically grounded objective into a contractual bundle of conditional incentives, monitoring, and technical support. In practice, this often requires: (i) a clearly identified service beneficiary with a material exposure to water risks; (ii) a sufficiently well-understood causal chain linking specific practices to the targeted water outcome; and (iii) an implementation architecture capable of contracting, verification, and adaptive management over time—conditions that are repeatedly highlighted as determinants of when PES is likely to deliver conservation results (Muradian et al., 2013; Wunder, 2013).

The Vittel scheme in north-eastern France is widely cited as an instructive, empirically grounded case of PES applied to groundwater protection for bottled mineral water. The scheme emerged in a context where the Vittel aquifer—located roughly 80 metres below the surface and recharged across an area of around 6,000 hectares encompassing 26 farms—faced rising contamination risks associated with agricultural intensification, particularly nitrates and pesticides, creating a direct business risk for Nestlé Waters’ mineral water operations (Perrot-Maître, 2006). In response, Nestlé Waters (Vittel) developed a contractual incentive programme—implemented through an intermediary structure (Agrivair) and informed by applied research and technical expertise from INRA, to induce farm-level practice change aimed at safeguarding groundwater quality (Perrot-Maître, 2006).

Crucially, the Vittel approach operationalised conditionality through long-term, tailored contracts that compensated farmers for adopting (and maintaining) specified changes in production systems and input management, combined with substantial advisory support and facilitation to reduce implementation barriers (Perrot-Maître, 2006). This places the case close to the “textbook” PES logic, clear identification of buyer and providers, strong incentives tied to agreed practices, and an explicit service objective (groundwater quality), while also illustrating a broader point stressed in the literature: PES outcomes are contingent on institutional fit, credible governance, and the ability to sustain commitments over time rather than on payment alone (Perrot-Maître, 2006; Muradian et al., 2013). Figure 6 shows a historic postcard-style illustration of the Vittel thermal spa.

Figure 6. Historic postcard-style illustration of the Vittel thermal spa establishment in the Vosges (France)

Methodology

This good practice was documented through a structured literature review. The Vittel scheme was analysed as the core case study using Perrot-Maître (2006) as the primary empirical source on context, institutional set-up, contracting and incentives. To interpret the case and derive transferable lessons, the review was complemented with key PES scholarship on definitions, conditionality and performance conditions, including both conceptual refinements and critical perspectives on when PES is likely to deliver robust outcomes (e.g., Wunder, 2005; Muradian et al., 2013; Wunder, 2015). Evidence was synthesised using an analytical framework aligned with the GOVAQUA good-practice criteria (effectiveness, efficiency, inclusivity/reflexivity, and replicability), focusing on instrument design, implementation mechanisms and reported results as presented in the literature.

Initiator

- Nestlé Waters
- Institut National de la Recherche Agronomique (INRA)
- Agrivair (later on)

Category

- Subsidies *(although very special type)*

Water issue

- water quality
- ecosystems
- safe access to water supply and sanitation

Geographical applicability

- Global
- EU

Level of water governance

- Catchment

Stakeholders

- Primary sector
    - Industry
    - Primary production
        - Agriculture
        - Forestry
        - Minerals and mining
- Other sectors
    - Public authorities
        - catchment governance agencies
        - municipalities
    - Civil society
        - NGOs
        - local communities
    - Research
        - Research institutes
        - Universities
    - Industry
        - Consultants

Effectiveness of the practice

Effectiveness in the Vittel PES scheme is most clearly evidenced by the way the instrument was **designed to address a concrete, high-stakes water-quality problem under a binding regulatory constraint.** Because Vittel is marketed as "natural mineral water", French legislation requires that quality and composition be maintained without treatment; for the Vittel label this entails very low nitrate concentrations (no more than 4.5 mg/L) and the absence of pesticides, such that deterioration would jeopardise the right to use the label and the associated business model.

This created a strong and direct incentive for the service user (Nestlé Waters/Vittel) to secure groundwater protection through changes in upstream farming practices rather than through end-of-pipe solutions.

The instrument's effectiveness also rests on a **clear alignment between the targeted ecosystem service and the practices required to sustain it**, combined with a credible form of conditionality. Perrot-Maître (2006) reports that the relationship between nitrate risks and intensive maize-based systems was addressed through a multi-year action research and testing process (AGREV), which identified practices needed to keep nitrate concentrations below target levels (including giving up maize cultivation and reducing stocking densities) and to reach “zero pesticides” objectives. However, because attributing nitrate and pesticide levels in the spring to the actions of individual farms was not feasible, conditionality was operationalised through compliance with agreed management rules and investment/adoption commitments, rather than through direct outcome-based payment on measured aquifer concentrations.

This approach is consistent with the broader PES design insight that “conditionality” often needs to be defined around observable proxies or rules when biophysical attribution is impracticable.

A further determinant of effectiveness was the **provision of an incentive package sufficient to change behaviour** while maintaining farm viability, thereby making adoption feasible rather than merely desirable. The scheme combined long-term contracts (18–30 years), income support (reported as around €200/ha/year over five years on average), equipment and building modernisation support (up to €150,000 per farm), free technical assistance with annual farm plans, and operational support such as labour for compost application to address labour bottlenecks and ensure recommended application rates. The compensation logic explicitly recognised that the minimum acceptable offer needed to cover farmers’ opportunity costs of change (including output losses, investment and learning costs), while the upper bound was constrained by the buyer’s willingness to pay given business risk and value considerations—an anchoring that helped translate the water-quality objective into economically credible terms for providers.

Roles, responsibilities and implementation capacity were also defined with unusual clarity for a PES-type arrangement, strengthening credibility and enforceability. An intermediary institution (Agrivair) was created to facilitate transactions, lead negotiations, coordinate design and implementation, and monitor compliance; the intermediary’s leadership and proximity to farmers were presented as critical for continuity between research and implementation and for communicating technical findings. Monitoring and operational responsibilities were differentiated: INRA monitored nitrate rates throughout the year across multiple sites and soil/farming-system types, while Agrivair monitored farming practices and stocking rates, and even directly applied manure according to plot-specific annual plans. The scheme also linked incentives to land tenure through land acquisition in sensitive areas and the use of a dedicated usufruct arrangement (“prêt à usage”) that, at least in principle, could support enforcement by allowing land to be withdrawn in cases of non-compliance.

In outcome terms, Perrot-Maître (2006) characterises the programme as “ultimately successful”, reporting that by 2004 all 26 farms in the area had adopted the new farming system, 1,700 ha of maize had been eliminated, and 92% of the sub-basin was protected. In addition, the programme is reported to have accelerated the retirement of marginal farmers and contributed to a restructuring of farm size, with the number of farms declining (from 37 to 26) while average farm size increased to accommodate extensive production, and with all farmers ultimately signing 30-year contracts—presented as an indicator of durability and continued participation. Collectively, these elements suggest that Vittel’s effectiveness derived not from payment alone, but from the integration of a water-quality objective, long-term conditional contracting, tailored incentives that preserved farm income, and a dedicated intermediary with the capacity to operationalise monitoring and compliance at an appropriate sub-basin scale.

Efficiency of the practice

Efficiency in the Vittel scheme is closely linked to its explicit comparison with alternative compliance pathways for protecting drinking-water quality. Perrot-Maître (2006) presents the programme as an economically rational response to a binding constraint: because treatment would undermine the “natural mineral water” status, the relevant counterfactual was not conventional end-of-pipe remediation but the much higher strategic and reputational costs of losing the Vittel label and/or relocating production. Within that framing, a targeted upstream incentive programme can be interpreted as cost-effective insofar as it

reduces contamination risk at source while avoiding (or greatly reducing reliance on) **downstream treatment and associated compliance risks.**

At the same time, the case illustrates that achieving cost-effectiveness required **substantial up-front transaction and implementation costs**. The scheme relied on an extended period of negotiation, action research and iterative design to identify feasible practice changes and to secure farmer participation, and it involved a large, tailored bundle of compensation and in-kind support rather than a simple per-hectare payment. Perrot-Maître (2006) describes how the intermediary (Agrivair) and dedicated technical support were integral to reducing frictions in contracting, coordinating farm-level changes, and sustaining compliance over time—functions that effectively substitute for the high information, bargaining and enforcement costs that would otherwise arise if a private buyer attempted to contract bilaterally and monitor outcomes directly in a complex hydrogeological setting. In this sense, the scheme's efficiency is partly institutional: it achieved implementability by centralising technical assistance, monitoring routines and contract management in a specialised organisation, thereby lowering per-farm coordination costs relative to a more dispersed arrangement.

A further efficiency-relevant feature is the programme's **emphasis on data and monitoring as a basis for credible conditionality**. Rather than relying on outcome-based payments tied to measured water-quality changes at the spring—which would be difficult to attribute to individual providers—the scheme used a combination of scientific monitoring and practice-based verification, supported by farm plans and ongoing technical oversight. This strengthened the information base for adaptive management and reduced uncertainty about whether agreed measures were being implemented as intended.

This design choice is consistent with broader PES insights that, where biophysical attribution is challenging, efficiency often depends on using observable proxies and robust monitoring architectures that make compliance verifiable at reasonable cost.

In terms of financial sustainability, Vittel is also instructive because it was financed by a clearly identifiable service beneficiary with strong incentives to pay. The buyer's willingness to fund long-term contracts, advisory services and capital support can be interpreted as reflecting the high value of the ecosystem service to the firm's core business, which is a recurring condition for PES schemes to be financially viable beyond pilot scale. However, the case also demonstrates a common trade-off: the very features that make the scheme effective—tailored contracts, intensive facilitation, and sustained technical support—are resource-intensive, which may constrain cost-effectiveness and scalability in contexts where beneficiaries are less concentrated, less solvent, or face weaker incentives to invest.

Finally, the scheme can be interpreted as **supporting more efficient land and input allocation over time by shifting practices** away from high-risk production systems and towards land uses compatible with groundwater protection, while maintaining farm viability through compensation and restructuring support. Perrot-Maître (2006) reports substantial system-wide changes at sub-basin scale (including major land-use adjustments), indicating that the programme operated not as a marginal tweak but as a mechanism for reorienting farming systems towards a water-quality-compatible trajectory.

Overall, the Vittel experience suggests that PES efficiency is not primarily a function of "payment levels", but of the capacity to combine targeted incentives, credible monitoring, and institutional intermediation so that environmental objectives can be met with acceptable administrative and transaction costs relative to the value of the safeguarded service.

Inclusivity and reflexivity of the practice

Inclusivity and reflexivity in the Vittel PES scheme are closely tied to the way the programme was negotiated, how it addressed farmers' livelihood constraints, and how monitoring and learning were embedded over time. Although the scheme was initiated by a private water user seeking to protect a commercially valuable aquifer, Perrot-Maître (2006) emphasises that implementation depended on sustained engagement with local farmers and on redesigning the instrument so that participation was feasible and credible from the providers' perspective. In this sense, inclusivity in Vittel did not take the form of broad, open-ended stakeholder deliberation, but rather of intensive, context-specific bargaining and problem-solving with the actor group whose practices directly affected the targeted ecosystem service.

A key inclusivity feature was the **explicit recognition of heterogeneous constraints across farms** and the corresponding use of **tailored contracts** and support packages. The scheme moved beyond uniform per-hectare compensation by combining multiple instruments—long-term contractual security, income support, investment financing, equipment and building modernisation, and continuous technical advice—intended to offset opportunity costs and reduce barriers to adoption for different farm situations (Perrot-Maître, 2006).

This design choice is consistent with broader PES evidence that participation depends on more than payment levels, including **perceived fairness, risk, and the practical feasibility of compliance**, especially where the required changes imply structural adjustments to production systems (Zanella et al., 2014). By incorporating farm viability concerns into contract design, the scheme sought to reduce the likelihood that compliance would disproportionately disadvantage particular producers. At the same time, distributional implications remain central to assessing inclusivity. Muradian et al. (2013) caution against assuming PES delivers "win–win" outcomes, highlighting that trade-offs and power relations shape who benefits, who bears costs, and how priorities are set.

In Vittel, the buyer's strong bargaining position and the asymmetry in resources relative to farmers could, in principle, raise concerns about equity and procedural balance; however, the case narrative stresses that **participation remained voluntary** and that the intermediary role of Agrivair helped build trust and reduce conflict during negotiations (Perrot-Maître, 2006). Nonetheless, the restructuring dynamics reported in the case, including accelerated retirement of marginal farmers and consolidation of farms, suggest that inclusivity must also be read in relation to longer-run socio-economic adjustments induced or facilitated by the programme (Perrot-Maître, 2006). These changes may be interpreted as either an enabling pathway to sustain water-quality-compatible farming systems or as a distributionally sensitive effect that merits explicit consideration when assessing fairness and social impacts.

Reflexivity is one of the clearer strengths of the Vittel arrangement. Perrot-Maître (2006) describes an **extended action-research phase** that generated an evidence base on the relationship between farming systems and nitrate/pesticide risks and enabled iterative refinement of recommended practices before scaling up contracts. **Monitoring and evaluation** were not limited to a one-off audit but embedded in routine implementation: scientific monitoring of nitrate dynamics was combined with practice-based verification and annual farm planning, facilitating continuous feedback and adjustment. This aligns with PES design guidance that emphasises the importance of credible conditionality and monitoring systems, particularly where direct ecological outcomes are difficult to attribute and where learning-by-doing is necessary to maintain performance over long time horizons (Wunder, 2005; Wunder, 2015).

Overall, the Vittel case suggests that inclusivity and reflexivity in PES are not automatically ensured by the presence of payments. They depend on whether scheme design recognises heterogeneous provider constraints, manages distributional implications transparently, and embeds monitoring and learning mechanisms that allow rules and practices to be adapted as evidence and conditions evolve (Perrot-Maître, 2006; Muradian et al., 2013; Zanella et al., 2014).

Replicability and generalizability of the practice

Replicability and generalisability of the Vittel PES scheme depend less on the formal label "PES" than on whether the enabling conditions that made the arrangement workable can be recreated elsewhere. The Vittel case is often presented as a high-performing example, but the literature cautions that PES effectiveness and efficiency are strongly context-dependent and should not be assumed to deliver "win–

win" outcomes automatically (Muradian et al., 2013). Accordingly, replication should be framed as feasible under a specific set of institutional, economic and biophysical conditions rather than as a broadly transferable template.

A first necessary condition is the presence of an identifiable beneficiary with a sufficiently high willingness to pay and the organisational capacity to sustain long-term commitments. Vittel worked because the ecosystem service (high-quality groundwater) was central to a clearly defined buyer's core business and because the buyer could credibly fund not only annual payments but also substantial up-front investments and long-duration contracts (Perrot-Maître, 2006). This condition is consistent with broader evidence that PES is more likely to be viable where the value of the service to beneficiaries is high, concentrated, and linked to a clear risk exposure (Wunder, 2013). In settings where beneficiaries are diffuse (e.g., multiple downstream users) or where incentives to pay are weak, replicating Vittel-like packages may require a stronger public role (e.g., collective financing mechanisms or regulatory mandates) to overcome free-riding and ensure stable funding.

Second, replicability hinges on the ability to translate water objectives into credible, monitorable conditionality. In water-quality PES, direct outcome attribution is often difficult due to hydrological complexity and time lags. Vittel addressed this by using practice- and rules-based conditionality underpinned by scientific understanding and monitoring, rather than strict payment-on-outcome (Perrot-Maître, 2006). This aligns with PES design guidance that conditionality can be built around observable proxies when outcome-based contracting is infeasible, but it requires robust baselines, monitoring capacity and credible verification (Wunder, 2005; Wunder, 2015). Replication is therefore more plausible where monitoring institutions, data availability and enforcement capacity can support long-term compliance and where the causal chain between practices and the targeted service is sufficiently understood to define defensible rules.

Third, Vittel underlines that scaling up often depends on intermediation and transaction-cost management. The scheme relied on intensive negotiation, tailored contracts, sustained technical assistance and trust-building through a dedicated intermediary, which helped reduce barriers to adoption and ensured implementability at scale (Perrot-Maître, 2006). This points to a general replicability requirement: PES schemes that seek structural change in farming systems are unlikely to scale through "payment alone"; they require institutional arrangements capable of contracting, advisory support, conflict mediation and ongoing monitoring at reasonable transaction cost. Evidence on PES participation similarly highlights that farmers' engagement depends on perceived feasibility, trust, administrative burden and risk management, not solely on payment levels (Zanella et al., 2014). Where such intermediation capacity is absent, replication would likely require investment in local facilitation organisations or partnerships with existing advisory and catchment institutions.

With respect to applying the practice in other parts of Europe, transferability is most credible in settings that share several features with Vittel: (i) a strategically valuable drinking-water source with strict quality requirements; (ii) a relatively well-defined recharge area and a manageable number of land managers whose practices drive the key pressures; and (iii) an institutional environment where long-term contracts, land-related arrangements and compliance monitoring are legally and administratively feasible (Perrot-Maître, 2006; Wunder, 2013). In such contexts—especially where the cost of conventional treatment is high or where treatment is constrained by regulatory or product-identity requirements—Vittel-like upstream incentive schemes may be an attractive alternative. Conversely, generalisability is more limited in diffuse catchments with many small landholders, weak monitoring capacity, or contested property and water rights, where transaction costs can be prohibitive and where distributional and legitimacy concerns may be more difficult to manage (Muradian et al., 2013).

Overall, the Vittel case is replicable in Europe primarily as a model of a transaction-intensive, intermediary-led, long-term contracting approach for protecting high-value water sources, rather than as a low-cost, easily scalable blueprint. Replication is most feasible when a committed buyer (or coordinated set of beneficiaries) can fund and sustain the scheme, when conditionality can be credibly defined and monitored, and when institutional capacity exists to manage negotiations, advisory support and compliance over long time horizons (Perrot-Maître, 2006; Wunder, 2005; Wunder, 2015).

Technical details

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Related resources:

Muradian, R., Arsel, M., Pellegrini, L., Adaman, F., Aguilar, B., Agarwal, B., Corbera, E., Ezzine de Blas, D., Farley, J., Froger, G., Garcia-Frapolli, E., Gómez-Baggethun, E., Gowdy, J., Kosoy, N., Le Coq, J. F., Leroy, P., May, P., Méral, P., Mibielli, P.,…Urama, K. (2013). Payments for ecosystem services and the fatal attraction of win-win solutions. *Conservation Letters*, *6*(4), 274-279. https://doi.org/10.1111/j.1755-263X.2012.00309.x

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4. Conclusions

Across the six good practices presented, a consistent finding is that economic and financial instruments can make water governance objectives operational by translating basin- and value-chain goals into incentives, transactions, and investable propositions—but only when they are embedded in credible legal, measurement, and compliance architectures, and combined with complementary instruments that address hydrological constraints and distributional effects.

At the EU level, this aligns directly with the Water Framework Directive (WFD) logic that water management should pursue ecological objectives while taking account of cost recovery and efficiency-oriented incentives (notably under Article 9). It also aligns with the direction of the EU Water Resilience Strategy (adopted on 4 June 2025), which frames water resilience around stronger demand management and the “water efficiency first” principle, among other measures. In parallel, the increasing relevance of disclosure and due diligence requirements (e.g., CSRD/ESRS and CSDDD) strengthens incentives for traceable evidence on water-related practices in corporate value chains, while sustainable finance frameworks (including the EU Taxonomy objective on water and marine resources) shape the conditions under which private capital can credibly support water outcomes.

Water Banks (California Drought Emergency Water Bank, 1991) illustrate how centralised intermediation can rapidly improve short-term allocative performance under scarcity by reducing search and negotiation frictions and enabling time-sensitive reallocation. In EU terms, the transferable contribution is primarily to drought preparedness and adaptive allocation at basin scale, an increasingly salient priority under the Water Resilience Strategy, while also demonstrating that efficiency gains depend on pre-existing rights clarity, hydrological accounting, and rules that preserve third-party and environmental protections.

Buyback (Restoring the Balance, Murray–Darling Basin) demonstrates a basin-scale pathway for environmental water recovery using voluntary market purchases. Although the institutional setting differs from the EU, the key lesson is that when ecological objectives require water reallocation, buyback mechanisms can be effective—yet their performance is shaped by product design (e.g., widening from permanent entitlements to include allocations and alternative products) and by political constraints that can redirect recovery towards less cost-effective pathways. The EU-relevant implication is that environmental-flow ambition must be matched by governance instruments capable of delivering real water, not only notional savings, and by delivery/enforcement capacity.

Volumetric pricing (Central Emilia Irrigation Water District, Emilia-Romagna) provides strong evidence that tariff reform can function simultaneously as demand management and incremental cost recovery in irrigated agriculture, consistent with WFD Article 9 principles. Its broader implication for EU policy is that pricing can shift behaviour most credibly when it moves users from a quasi-zero marginal cost environment to one where water becomes a priced, decision-relevant input—yet results remain context-dependent and require adequate administrative and measurement capacity.

Impact investments for sustainable water management position water governance objectives within the logic of risk allocation, performance-based finance, and investability, thereby connecting directly with the EU’s broader sustainable finance agenda (including water-related taxonomy objectives). The key finding is that financial innovation can complement public policy goals, but only where outcome measurement, additionality, governance safeguards, and accountability mechanisms are sufficiently robust.

Water stewardship certifications (Doñana/Huelva berries) demonstrate how private governance can “translate” water expectations into auditable requirements and supply-chain purchasing conditions, which becomes increasingly salient under EU reporting and due diligence requirements. However, their contribution to EU water objectives is conditional: certifications can strengthen farm-level practices and documentation, but cannot substitute for basin-level allocation decisions, monitoring, or enforcement—especially in environmentally sensitive contexts where legitimacy and distributional burdens are contested.

PES (Vittel) demonstrates that a well-designed, long-horizon scheme can secure water-quality objectives by aligning incentives with land-use change and by investing heavily in intermediation, trust, and iterative learning. It illustrates a credible pathway to protect water resources in line with WFD objectives, while also reinforcing a key caution from PES scholarship: “win–win” framing is not guaranteed, and success depends on property-rights clarity, strong buyer capacity, credible monitoring, and locally legitimate contract design.

A cross-cutting conclusion is that none of the instruments is sufficient on its own to deliver EU water objectives at scale. Instead, the practices collectively point to a “necessary conditions” bundle:

- Rule clarity and enforceability (rights/permits, diversion limits, compliance checks), without which price signals, trades, or certifications risk becoming symbolic rather than outcome-producing.
- Measurement and accounting capacity (volumes, sources, timing, ecological constraints), which determines whether incentives can be implemented and whether “savings” are hydrologically real.
- Institutional intermediation (bank operator, environmental water holder, irrigation district, certification bodies, PES intermediary), which reduces transaction costs but also becomes a locus of legitimacy and accountability.
- Complementary governance measures (allocation rules, caps, monitoring, sanctions, and participatory and collaborative processes), which shape equity outcomes and prevent problem shifting (e.g., spatial displacement, groundwater substitution, or burden transfer along value chains).

These dependencies imply that economic and financial instruments should be read as components of policy mixes, rather than as standalone solutions—consistent with the Water Resilience Strategy emphasis on integrated, cross-sectoral approaches and efficiency-oriented demand management.

In practical terms, scaling and replication in the EU context is most plausible where these instruments are combined with: (a) enforceable basin plans and abstraction controls; (b) transparent, trusted administrative and data systems; and (c) distribution-sensitive implementation that recognises who bears costs, who benefits, and how trade-offs are managed. This is the core condition under which economic and financial innovations can credibly contribute to WFD objectives and to the EU’s emerging water resilience agenda.

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Annexes

Annex I: GOVAQUA Good practice template for innovative water governance instruments, approaches and arrangements for reaching WFD, EGD and SDG aims

Good practice definition

A good water governance practice in the GOVAQUA project is defined as follows:
A good water governance practice exemplifies an innovative instrument, approach or arrangement that contributes to achieving water-related policy goals and targets in a sustainable and equitable manner. It has been tested in practice, assessed and validated by stakeholders and independent evaluators in a specific context against specific principles and criteria.

Water governance good practices originate from certain contexts and are tied to the water issues of that context. Therefore, they entail certain prerequisites from their implementation environment. Thus, broadly applicable "best practices" for water governance cannot be discern[4]. However, within good practices implementation different performance levels can be achieved, typically requiring different levels of effort and resources, building on a continuous improvement.

The good practices documented with this template are all examples of emerging water governance innovations that are not yet broadly applied but hold promise for replicability and up-scaling in the EU context. The difference of this good practice documentation to water governance assessments, initiated e.g., by the OECD and the self-assessment tool developed in the GOVAQUA project, is that the focus of the good practice is on an instrument, approach or arrangement, rather than the broader water governance context such as a nation or a basin.

Purpose and target audience

The documented good practices are primarily intended to validate existing niche practices and to provide innovative ideas for national and basin level water managers and other decision makers in water governance. The practices are also relevant to other water governance actors, such as NGOs, companies and research institutes that initiate or participate in water governance processes.

Good practice criteria

Water governance instruments, approaches and arrangements advance sustainable and equitable water use when they:

[4] Note: For example, the recent OECD *Handbook of What Works Solutions for the Local Implementation of the OECD Principles on Water Governance* (OECD 2024) only refers to "evolving water governance practices" that "respond to the challenges underlying each of the 12 (OECD Water Governance) Principles", drawing lesson from "successful" and "challenging" implementation examples. Nevertheless, OECD generally advances identification of "good water governance" practices.

1. Are effective, i.e., they
2. Address a problem or a need related to sustainable and equitable water use
3. Connect and contribute to water-related policy goals and targets
4. Define and follow clear roles and responsibilities for different stakeholders
5. Are linked to appropriate scales within basin or other water governance systems
6. Match or advance the level of technical, financial and institutional capacity in the given water governance system

Are efficient, i.e., they

1. Utilize, share and enhance adequate water-related data and information
2. Are cost-effective and/or help mobilizing financing for associated water solutions
3. Connect to and advance sound regulatory frameworks

Are built on or advance inclusivity and are reflexive, i.e., they

1. Are built on or advance transparent and accountable processes and outcomes
2. Are built on or advance equal participation and collaboration between stakeholders and water justice, and are gender-sensitive
    a) Recognise the different types of stakeholders and their different needs
    b) Equally distribute the benefits, harms and costs that result from the practice among different stakeholders, and address and resolve trade-offs and potential conflicts between users
    c) Involve different stakeholders and integrate their different types of knowledge into the decision-making process,
3. Include and advance regular monitoring and evaluation mechanisms
4. Promote social learning, innovative ways to cooperate and science-policy interface

Template

General information

Title
The name of the practice

General description

Initiator

Category

Water issue

Geographical applicability

Level of water governance

Stakeholders

Good practice description/assessment and validation

Methodology for the assessment and validation

Effectiveness of the practice

Reporting by criteria as listed in the previous section, including documented successes and challenges.

Efficiency of the practice

Reporting by criteria as listed in the previous section, including documented successes and challenges.

Inclusivity and reflexivity of the practice

Reporting by criteria as listed in the previous section, including documented successes and challenges.

Replicability and generalizability of the practice

Reflection on the necessary conditions.

Technical details

- Author/contact person
- Publication date
- Related websites
- Related resources

Annex 2: Interview guides

Interview guide for good practice 3.5

BLOCK 1: Effectiveness

1.1 Does obtaining this type of certification contribute to water-related policy objectives and targets that are relevant to your area of operation?

1.2 Does the initiative connect to robust regulatory frameworks and help to advance them?

1.3 Do the certifications define clear roles and responsibilities for the different actors involved?

1.4 Are these certifications well known among the different actors? Are they well accepted by the actors involved?

1.5 Have these certifications been able, in any way, to link actors across the value chain (i.e., buyers and suppliers in the upstream supply/value chain)?

1.6 Have these certifications contributed in any way to enabling certified actors to meet their obligations under regulation and/or voluntary initiatives regarding adverse social and environmental risks or impacts in their value chains?

1.7 Is the long-term sustainability of these certifications ensured (including financing and supportive regulation)?

1.8 If effectiveness has not been optimal, what could be done to improve it?

BLOCK 2: Efficiency

2.1 Do these certifications enable improvements in the collection and appropriate use of water-related data and information?

2.2 Are these certifications cost-effective for certified actors?

2.3 Do they support the implementation of more effective water management measures?

2.4 Can the environmental and social impacts arising from the implementation of these certifications be measured?

2.5 Do they help in any way to mobilise financing for water-related solutions in the area? What conditions are necessary to mobilise private financing from companies?

2.6 If efficiency has not been optimal, what could be done to improve it?

BLOCK 3: Inclusivity and reflexivity

3.1 Does obtaining these certifications promote transparent and accountable processes and outcomes?

3.2 Is there equitable participation and collaboration among the value-chain actors involved?

3.3 Are different types of actors, their varying needs, and power asymmetries recognised?

3.4 Do you think that obtaining these certifications helps to distribute benefits, harms and costs more equitably among different actors, and to address and resolve conflicts and potential trade-offs between users?

3.5 If inclusivity and reflexivity have not been optimal, what could be done to improve them?

BLOCK 4: Main challenges, opportunities and development needs

4.1 What are the main challenges that users face when implementing these certifications?

4.2 What alternative approaches are available in Huelva, and which ones are you aware of?

4.3 What are the key factors for this type of certification to succeed as a water governance practice in Europe?