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INN WATER

Promoting social innovation to renew
multi-level and cross sector water governance

D6.8: Replication methodology and implementation progress #V2

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Executive summary

This report presents the results of the replication assessment conducted within the InnWater project. Replication assessment was designed to test whether the methods, tools and governance approaches developed in the pilot sites can be applied, adapted and used in other regional and institutional contexts across Europe. Together with *Deliverable 6.7 Replication methodology implementation and progress #V1*, which describes the methodology and setup of the exercise, this report provides a complete account of the replication work carried out under Task 6.3.

Fourteen replication sites across Europe participated in the assessment, each supported by an external expert. All sites applied the Water Governance Assessment Tool (A structured framework for evaluating how water governance arrangements function in practice for a given geographical unit. It examines institutional, legal, and stakeholder-related factors to identify strengths, gaps, and barriers to effective, transparent, and coordinated water management.) providing a shared diagnostic baseline. In addition, the sites tested specific thematic components of InnWater, including citizen engagement, citizen science, water retention on land, environmental and resource costs, data availability for CGE (Computable General Equilibrium) modelling, the microsimulation model, and the usability of the InnWater Governance Platform. The assessments involved interviews, data analysis, tool testing and local consultations, depending on the theme.

Across all themes, the replication results confirm that InnWater tools and approaches are broadly applicable, provided that they are adapted to local data conditions, governance structures and stakeholder needs. The assessments highlight recurring enabling factors, such as strong local motivation, the presence of committed institutions, and opportunities for cooperation with civil society. At the same time, they reveal common barriers, including fragmented responsibilities, administrative burdens, limited human and financial resources, and the need for clearer guidance and support in tool application. These cross-cutting findings reinforce the conclusions drawn from the pilot sites and demonstrate the value of external testing.

The replication assessment also proved valuable for tool developers. Feedback from external experts supported improvements to usability, visualisation, documentation and methodological clarity, especially for the InnWater governance platform, the Water Governance Assessment Tool and the modelling instruments. The process also highlighted the importance of clear task definition, systematic guidance and early coordination between supervising partners and replication experts.

The thematic summaries in this report provide a concise overview of the main findings. More detailed and extensive replication reports, prepared by the external experts, are available as separate files. Overall, the replication assessment provides evidence for the relevance and transferability of the InnWater solutions, while also identifying practical recommendations for future applications, further development and policy uptake.

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Related deliverables

Given the fact that replication assessment is about testing the suitability, applicability, and usefulness of InnWater methods, tools, and results in areas outside the original project locations, it is related to a relatively high number of deliverables, while some additional deliverables rely on the findings of the replication assessment:

D2.1 Enhanced water governance assessment tool

- D2.3 Assessing Water Governance recommendations for water managers*
- D3.1 Citizen Engagement in Europe in the 21st Century*
- D3.2 InnWater Citizen Engagement Methodology – A practical guidance tool and analysis framework for creating RBWF #V1*
- D4.1 Water Governance diagnostic tool*
- D4.2 Modelling cross-sectoral interactions with water at river basin level*
- D4.3 Methodology for analysing the socioeconomic performance of household water demand management policies*
- D4.4 InnWater Governance platform #V1*
- D4.5 InnWater Governance platform #V2*
- D5.3 Pilot sites implementation progress report*
- D6.3 Communication and Dissemination report and monitoring #1*
- D6.4 Communication and Dissemination report and monitoring #2*
- D6.6 Exploitation road map and update #V2*
- D6.11 Policy Brief – Year 3*

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ACRONYMS

ADBPO	Autorità di Bacino Distrettuale del Fiume Po (Po River Basin Authority)
AI	Artificial Intelligence
ARERA	Autorità di Regolazione per Energia Reti e Ambiente (Italian Regulatory Authority for Energy, Networks and Environment)
CA	Consortium Agreement
CGE	Computable General Equilibrium
DG REGIO	Directorate-General for Regional and Urban Policy (European Commission)
EC	European Commission
ERC	Environmental and Resource Costs
EU-SILC	European Union Survey on Income and Living Conditions
GA	General Assembly
HBS	Household Budget Survey
IBT	Increasing Block Tariff
InnWater	Promoting social INNnovation to renew multi-level and cross-sector WATER governance
NBS	Nature-Based Solutions
NEWTS	National Environmental Water Tariff Survey (Spain)
OECD	Organisation for Economic Co-operation and Development
OiEau	Office International de l'Eau
PES	Payments for Ecosystem Services
PWA	Physical Water Accounts
RA	Replication Assessment
RAAEY	Regulatory Authority for Energy, Waste and Water (Greece)
RBMP	River Basin Management Plan
REKK	Regional Centre for Energy Policy Research (Hungary)
RHOMOLO	Regional Holistic Model (JRC regional economic database)
RS	Replication Site
SAM	Social Accounting Matrix
SERC	State Energy Regulatory Council (Lithuania)
UR	University of La Réunion
URN	University of Rouen Normandy
WFD	Water Framework Directive
WEFE	Water, Energy, Food and Ecosystems
WGA	Water Governance Assessment (Tool)

WP Work Package
WRT Westcountry Rivers Trust

INTRODUCTION

This report presents the results of the replication assessment carried out within the InnWater project. Replication assessment is a core component of the project's ambition to test the transferability and practical applicability of its methods, tools and governance approaches across diverse geographical, institutional and socio-economic contexts. While the project's pilot sites provided the initial ground for developing and demonstrating InnWater innovations, the replication exercise examined how these solutions perform in external settings that were not involved in their development. Through this approach, InnWater was able to gather feedback from multiple European regions and external experts, offering a broader and more realistic understanding of the conditions under which the project's outputs can be used, adapted or scaled.

The design and initial implementation steps of the replication assessment were described in detail in Deliverable 6.7 *Replication methodology and implementation progress #V1*. That report set out the objectives, selection of sites, recruitment of replication experts, and the methodological framework for conducting the assessments. Together, Deliverable 6.7 and the present document provide the full overview of the replication work within InnWater. The earlier report explains the process and setup, while the current report focuses on the execution and findings.

This report summarises the results of the replication assessments carried out across fourteen sites. Each site applied at least one InnWater tool or thematic approach, supported by an independent external expert and supervised by a member of the project team. The topics assessed include water governance, citizen engagement, citizen science, water retention on land, environmental and resource costs, data availability for CGE (Computable General Equilibrium) modelling, and the applicability of the microsimulation model. The replication experts conducted interviews, data collection, tool testing and local consultations, depending on the thematic focus. Their work generated insights into how InnWater solutions perform under differing governance structures, legal frameworks, stakeholder dynamics and data environments.

For the purposes of this report, the individual thematic results are presented in a concise, summarised form. This allows the reader to see the main findings and cross cutting issues without navigating lengthy technical detail. The full thematic replication reports, prepared by each replication expert, are available as separate files. They contain substantially more detail, including interview notes, methodological observations and site specific considerations. These documents complement the current report and can be consulted where deeper understanding or evidence is required.

The structure of this report follows a clear logic. After presenting the overarching summary and methodology, it provides a series of chapters that synthesise the findings for each thematic area. These chapters highlight key lessons, barriers, enabling factors and the degree to which each tool or approach can be transferred to new contexts. The report concludes with a set of overarching conclusions that cut across all themes. These conclusions draw on both the thematic assessments and the reflections shared during the internal meeting of replication assessment supervisors, held toward the end of the process. Together, they provide a consolidated view of the relevance, usability and potential future applications of InnWater outputs. A "replication matrix" summarising the most important features of each replication assessment site and exercise is

included as an annex. Through this structure, the report enables the reader to understand not only what was tested, but also what was learned from applying InnWater innovations under novel conditions.

1 APPROACH AND METHODOLOGY OF THE REPLICATION ASSESSMENT

1.1 Purpose and position within the InnWater Project

The replication assessment represents a key component of Work Package 6 (Impact maximisation) and, in particular, Task 6.3 “Replication assessment throughout Europe.”

Its overarching goal is to test how far the methods, tools and governance solutions developed and demonstrated in the InnWater pilot sites can be transferred, adapted and used under different geographical, institutional, legal and socio-economic conditions.

While the five pilot sites provided proof of concept for InnWater solutions, the replication sites served as testing grounds for broader applicability. The replication assessment therefore did not aim to implement the tools fully but rather to evaluate their suitability, applicability and usefulness elsewhere. The exercise created a structured feedback process linking tool developers, pilot-site teams and external replication experts, thereby ensuring that the lessons from real-world testing could inform the fine-tuning of InnWater products before project closure.

1.2 Overall design and governance of the process

The replication process was coordinated jointly by OiEau and REKK, under the overall supervision of the WP6 lead. Each thematic area was led by the partner responsible for the underlying InnWater tool or method (referred to as “supervisors” later in this report). Fourteen replication sites were established across Europe, eight of which were pre-selected during project preparation and six chosen later through an open call managed by OiEau/INBO and WAREG.

At every replication site, an independent local replication expert was recruited. Each expert worked under the guidance of one InnWater partner (“supervising expert”) who ensured methodological coherence, provided training and oversaw quality control. This one-to-one pairing between InnWater experts and local experts guaranteed focused supervision while allowing cross-learning among thematic groups. One replication expert was also a partner of the RETOUCH NEXUS project, an InnWater’s sister project, fostering exchanges and mutual understanding between projects.

Each replication expert received a fixed contract of €5 000 covering the entire assignment, which included participation in training, data collection, interviews or workshops, and preparation of a final summary report. The replication work was conducted between early 2025 and autumn 2025, following preparatory methodological meetings in 2024.

1.3 Dual-Layered methodological approach

From the outset, the consortium adopted a dual approach combining:

- A transversal assessment using the Water Governance Assessment Tool in all 14 replication sites; and
- Thematic replication assessments of specific InnWater solutions in selected subsets of sites, depending on the relevance of local conditions and data availability.

This structure ensured a consistent governance baseline across all locations while allowing a differentiated evaluation of distinct InnWater innovations. Each replication site tested one solution, and most solutions were tested in at least two sites.

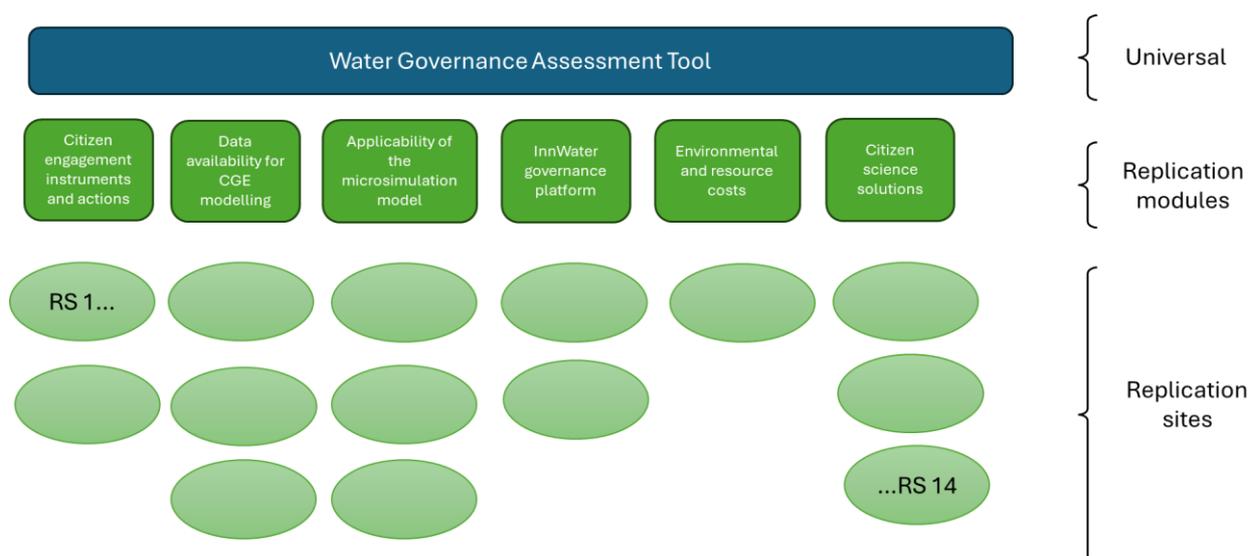


Figure 1: The replication assessment approach

1.4 Phases of the replication process

The replication methodology followed several clearly defined stages:

1. Method development and coordination (spring 2024): The consortium agreed on the replication design through four online coordination meetings and a dedicated workshop at the June 2024 General Assembly. This stage produced the replication matrix, mapping all replication sites, lead partners and associated InnWater solutions.
2. Selection and contracting of replication experts (late 2024 – early 2025): Open calls were launched to identify qualified experts for the remaining six sites. All selected experts fulfilled common criteria regarding experience in water governance, policy, economics or stakeholder engagement, depending on the theme.
3. Training and guidance (February 2025): A joint online training workshop introduced the InnWater project, the replication objectives and the Water Governance Assessment Tool. Each supervising expert subsequently provided a tailored briefing for their replication expert, including data templates, questionnaires and interview guides.

4. Execution of replication assessments (March – October 2025): Experts implemented the agreed activities, including stakeholder interviews, desk reviews, data collection, surveys and/or local workshops. Supervision and feedback were maintained through regular online check-ins.
5. Reporting and synthesis (July – November 2025): Each expert submitted a concise report summarising findings on applicability, barriers, enablers and potential improvements. Supervising experts consolidated some of these into thematic summaries, forming the evidence base for the present deliverable.

1.5 Tools and thematic components

The replication assessment covered all main InnWater innovations emerging from the pilot sites and technical work packages:

- Water Governance Assessment Tool (WP2/WP4.1): applied universally across all replication sites to generate comparable governance diagnostics and feedback on tool usability.
- Microsimulation model (WP4.3): tested in three countries (Greece, Latvia, Spain) focusing on tariff design, data needs and institutional preconditions.
- Citizen engagement instruments and actions (WP3): analysed through interviews in Spanish replication sites addressing water scarcity.
- Citizen science solutions (WP5 – West Country pilot): evaluated in Poland and Croatia to assess feasibility of community-based water-quality monitoring.
- Citizen engagement solutions (WP5 – Middle Tisza pilot): tested in the Bodrogköz region of Hungary and the Usti region of Czechia via interviews with farmers and land users to explore transferability of collective water-retention schemes.
- Environmental and resource-cost methodology (WP5 – Brenta pilot): applied in the Pô River basin to examine the integration of environmental costs into tariffs.
- InnWater Governance Platform (WP4.4): assessed by two external users for usability, data accessibility and potential for integration of new tools.

For each theme, replication protocols specified the evaluation focus (technical, institutional, social, or data-related), the expected outputs (completed questionnaires, interview notes, or workshop summaries) and the key evaluation questions on transferability.

2 WATER GOVERNANCE ASSESSMENT TOOL

2.1 Objectives and rationale

Within the InnWater project, the Water Governance Assessment (WGA) tool was conceived as a practical instrument to help stakeholders identify governance strengths and weaknesses across the water sector. Building upon the OECD Water Governance Principles and enriched with the

InnWater dimensions of sustainability and resilience, the tool was intended to (i) provide replication sites with a rapid, structured diagnosis of their governance performance, and (ii) test the tool's usability, functionality, and adaptability in different governance, legal, and institutional environments.

The replication phase represented the first large-scale validation of the WGA tool beyond pilot sites. Its purpose was twofold: to generate first-hand evidence of the tool's performance in diverse European contexts, and to collect user feedback to refine both content and interface prior to its final integration into the InnWater Governance Platform.

2.2 Implementation process

The WGA replication was conducted as part of the broader Replication Assessment (RA) exercise in fourteen locations across Europe, ranging from river-basin and regional scales to national and municipal systems. The participating sites included Spain, Hungary, Türkiye, Greece, Italy, the Czech Republic, France, Lithuania, Croatia, Slovenia, and Poland.

Each location was assigned an independent replication expert, who received training and methodological supervision from InnWater partners. The validation exercise pursued three complementary goals:

1. Usability validation – testing the accessibility, structure, and intuitiveness of the tool;
2. Content validation – assessing whether the 16 governance principles and related questions captured the essential dimensions of water governance; and
3. Preliminary empirical validation – exploring whether the tool generated meaningful and comparable results across different contexts.

Although all three aspects were examined, the main focus was on usability, viewed as the most direct measure of real-world applicability.

The methodological sequence consisted of four steps:

- Online training workshop introducing the WGA methodology and tool functionalities;
- Information gathering by each expert on local water-governance structures and data sources;
- Execution of the assessment using the digital tool interface;
- Online survey and feedback submission, where experts evaluated usability, content relevance, and perceived usefulness.

The survey combined quantitative and qualitative elements. Closed questions enabled descriptive statistical analysis of user experiences, while open-ended responses were coded and grouped to identify recurring themes and improvement suggestions.

2.3 Profile of participants and application contexts

The replication experts represented a diverse professional mix: approximately 70% from research and consultancy backgrounds and 30% from policymaking and civil society. This diversity reflected the range of potential users of the WGA tool and helped assess its accessibility for both technical experts and policy practitioners.

The levels of application also varied widely. Over half (54%) used the tool at basin or regional level, 23% at national level, and smaller shares at municipal or multi-scale levels. This diversity confirmed the tool's flexibility but also exposed differences in question relevance across governance scales, which became a key area for refinement.

2.4 Main findings

Strengths and added value

Participants widely acknowledged the clarity and analytical power of the tool. The questionnaire's structure guided users logically through governance dimensions such as policy coherence, institutional capacity, financing, and stakeholder engagement. The visualisation outputs - notably the spider-chart representation of governance performance and the integrated AI assistant - were highlighted as especially effective in synthesising complex information and stimulating reflection among stakeholders.

Experts found the tool useful for organising knowledge and supporting dialogue about governance gaps. Its recommendations section was appreciated for translating assessment results into concrete options for improvement, thereby bridging analysis and action.

Limitations and areas for improvement

Several recurring challenges were identified:

- Complexity and time requirements: completing the full assessment demanded significant expertise and preparation; simplified or tiered versions could help broaden usability.
- Rigidity of response options: closed-ended questions sometimes limited nuanced descriptions of complex governance settings.
- Cross-scale consistency: some questions were better suited to basin or national levels, causing misalignment when applied locally.
- Language and interface issues: minor translation inconsistencies and technical bugs occurred in non-English versions, suggesting the need for improved localisation and testing.

2.5 Empirical insights from the governance assessments

The completed governance assessments provided a comparative dataset across Europe. Common strengths emerged in:

- Monitoring and evaluation – rated high in 90% of cases, reflecting the strong compliance culture under EU water policy;
- Institutional capacity and regulatory frameworks – strong in about 70% of cases, indicating mature legal bases and capable water institutions;
- Environmental resilience – particularly notable in Spain, where integrated ecosystem-based management is advanced.

Recurrent governance gaps included:

- Managing trade-offs across users, sectors, and generations – a weakness in roughly half of the sites, revealing persistent tensions between competing water uses and sustainability goals;
- Coordination across scales within basins – another common gap, underscoring enduring challenges in aligning administrative and hydrological boundaries.
- Overall, these findings confirm that while Europe’s institutional frameworks for water governance are generally robust, issues of integration and cross-sectoral coherence remain the key obstacles to adaptive, resilient governance.

2.6 Conclusions

The replication and validation of the InnWater Water Governance Assessment tool successfully demonstrated its usability, analytical depth, and relevance across a wide range of European contexts. The tool proved capable of capturing critical governance dimensions and generating structured, comparable results that support both diagnosis and dialogue.

At the same time, the exercise revealed clear priorities for enhancement: simplifying the workflow for non-expert users, increasing flexibility in question formats, and adapting content to different territorial scales. Addressing these aspects improves accessibility and ensure coherence when the tool is integrated into the InnWater Governance Platform.

3 THEMATIC REPLICATION ASSESSMENT RESULTS

3.1 Citizen engagement instruments and actions

Citizen engagement at the two Spanish replication sites, the Doñana Natural Area and the Júcar River Basin, reveals a shared pattern: although formal participation structures exist and comply with European and national requirements, their practical influence on water governance remains limited. In both contexts, participation is largely consultative, dominated by information-sharing and late-stage public comment periods that seldom shape core decisions. The result is a persistent perception of symbolic rather than meaningful engagement.

In Doñana, the central Participation Council provides broad representation but has little decision-making power, convenes infrequently, and operates with limited follow-up, generating frustration among stakeholders. Hydrological planning and other formal consultations rely heavily on technical language and bureaucratic procedures, which citizens struggle to influence. Local participation initiatives exist but are fragmented and rarely institutionalized, leaving neighbourhood groups, youth, migrants, and small producers underrepresented. This contributes to long-standing distrust in governance, reinforced by tensions between conservation priorities and agricultural interests.

In the Júcar Basin, basin-level participatory bodies bring together many institutional and user representatives, but the scale and complexity of the system mean that large agricultural

associations, government authorities, and technical actors dominate discussions. Marginalized groups in Valencia and its metropolitan area - including women, youth, elderly people, migrants, and homeless communities - remain almost entirely excluded from formal processes. Interviews conducted after the devastating 2024 floods revealed deep barriers to engagement: inaccessible formats, language and digital divides, competing socioeconomic pressures, and an erosion of trust driven by emergency decisions perceived to bypass public consultation. Environmental groups, small-scale farmers, and defenders of L'Horta's cultural and ecological heritage also emphasized that their contributions are rarely integrated into final planning outcomes.

Despite these challenges, both sites demonstrate strong civic energy, community mobilization, and valuable local knowledge. Traditional agricultural systems in the Júcar Basin and long-standing research and NGO involvement in Doñana offer important foundations for co-created solutions. Across both territories, the main needs are consistent: earlier and more transparent engagement; clearer communication and reduced technical barriers; proactive inclusion of underrepresented groups; and stronger, more continuous participatory structures that link basin-scale planning with local realities. Addressing these gaps is essential for moving from symbolic consultation to genuinely influential citizen involvement and for strengthening the resilience and legitimacy of water governance in both regions.

In both Spanish replication sites, the InnWater citizen engagement methodology was used as an analytical and diagnostic framework rather than as an operational tool. It helped structure the analysis of existing participation processes, making visible gaps between formal consultation and effective influence, as well as patterns of exclusion affecting less organised or vulnerable groups. The assessment showed that the InnWater approach is well suited to supporting reflection and learning about participation design, timing and inclusiveness. Its main added value lies in complementing existing engagement processes by identifying where and how they could be strengthened, rather than replacing them.

3.2 Data availability for CGE modelling

The replication assessment on data availability for Computable General Equilibrium (CGE) modelling examined whether the datasets required to build WEFE (Water, Energy, Food and Ecosystems) nexus CGE models are accessible for the two selected replication sites, Seine-Aval and Corsica. CGE models depend fundamentally on Social Accounting Matrices (SAMs), which represent all transactions between economic agents. Because SAMs are normally produced for administrative regions rather than river basins, feasibility depends on the extent to which basin boundaries align with territorial statistical units. The assessment found that, for both replication sites, the river basins correspond closely to NUTS2 administrative regions (the second level of the EU's Nomenclature of Territorial Units for Statistics, representing large regional units used for statistical analysis, regional policy, and cohesion funding allocation) for which regional SAMs already exist in the RHOMOLO (Regional Holistic Model - JRC regional economic database) dataset, enabling their use as a starting point for WEFE nexus modelling.

To capture the four pillars of the WEFE nexus, SAMs require additional disaggregation and data extensions. The assessment confirms that the W, E and F pillars can be represented using available data. Water accounts can be separated from aggregated utilities accounts using information on extraction, supply, pricing, and sectoral use, supported by Physical Water Accounts (PWAs) and basin reports. Energy use can be disaggregated using regional energy

statistics, including electricity and primary fuels. Agriculture is already present as a separate activity in the SAMs, while food processing can be split from manufacturing using sectoral data. These datasets are accessible online or through national and regional institutions, making it feasible to construct the required WEFE nexus extensions.

The ecosystem pillar is the most difficult to operationalize. While environmental reports for both replication basins provide information on water quality, emissions, and ecological status, these are often expressed as point measurements rather than basin wide pollutant loads. For CGE modelling, such data would need to be transformed into suitable aggregated indicators or collected through targeted data requests. The experience from La Réunion shows that, where ecosystem valuation is needed, additional surveys may be required to quantify specific environmental services. Similar efforts may be necessary for Seine-Aval and Corsica to identify priority ecosystem components and generate monetizable or scenario-relevant indicators.

Overall, the assessment concludes that the essential macroeconomic and sectoral data needed to develop WEFE nexus CGE models are available for both replication sites. The alignment with NUTS2 regions greatly facilitates access to SAMs and statistical databases. Water, energy and food data can be integrated through established procedures, while ecosystem data will require more targeted work, though not beyond the scope of typical CGE model development. The feasibility of constructing WEFE nexus CGE models therefore depends not on fundamental data gaps, but on the time and resources required to refine, disaggregate and complement existing datasets. This confirms that replication is viable, provided that appropriate data collection, processing and institutional coordination are planned from the outset.

3.3 Applicability of the microsimulation model

The InnWater microsimulation model is a household-level analytical tool designed to assess the distributional, affordability and behavioural impacts of water tariff structures and demand-management policies. It combines detailed tariff rules with socio-economic household data and water-consumption patterns to simulate how different pricing schemes affect households across income groups and user types. The replication assessment did not aim to fully implement the model in new contexts, but rather to test its applicability, focusing on data availability, compatibility with national and local tariff structures, regulatory frameworks, and the extent of adaptation required for meaningful use in different countries.

The replication assessments carried out in Greece, Gijón (Spain), and Lithuania demonstrate that the InnWater microsimulation model can be transferred to diverse regulatory and socio-economic contexts, although the effort required for localization varies significantly between countries. Across all three cases, the strongest finding is that the tool's modular structure offers sufficient flexibility for tariff heterogeneity, while differences in data availability and regulatory design determine the extent of necessary adaptation.

In Greece, feasibility is rated as high. The current reform of the water sector, led by the Regulatory Authority for Energy, Waste and Water (RAAEY), is creating a unified tariff methodology based on full cost recovery, affordability, and environmental sustainability. The microsimulation model is well aligned with this framework, particularly because Greek tariffs already follow a two-part structure with increasing block tariffs and because social tariffs for vulnerable users are mandated by law. The assessment notes that household-level socio-economic microdata (the European Union Statistics on Income and Living Conditions and the

household budget survey) from ELSTAT, the Hellenic Statistical Authority are readily available, though they are not linked to water consumption data. RAAEY has begun collecting utility billing data, but harmonization across more than 400 providers remains a major challenge. The tool can still be deployed for pilot utilities if tariff structures and billing records are provided directly by suppliers. The main localization needs include incorporating Greek-specific tariff elements, using local demand elasticities from recent econometric studies, and adapting affordability thresholds to Greek policy norms. A phased pilot is recommended, beginning with a small number of committed providers.

The Gijón case provides a contrast: here, water governance is municipal, tariffs are complex, and regulatory diversity across Spain introduces additional layers of variation. Gijón features a highly detailed tariff system combining fixed fees, increasing block tariffs, sewerage charges, and a super-progressive Environmental Tax on Water Use applied by the regional government. The replication assessment finds that the microsimulation tool can accommodate these structures, but significant tariff module customization is required. Spain's fiscal federalism means that policies, tariff design, taxes, and subsidies vary across municipalities, which complicates model replication. The assessment also highlights data constraints: residential water microdata must be constructed through utility cooperation or dedicated surveys, as publicly available datasets rarely include consumption quantities. A major upcoming microdata resource (NEWTS project) will not be available until 2027. Nevertheless, the literature on water demand in northern Spain suggests stable, highly price-inelastic demand, which can be incorporated directly into the model through calibrated elasticities. The demographic structure of Gijón, especially its older population, implies additional attention to communication, nudging, and the interpretation of distributional impacts. The replication expert concludes that the model is applicable but requires careful consideration of tariff complexity, data limitations, and local behavioral characteristics.

The Lithuanian assessment identifies a feasible but more data-intensive pathway for replication. Lithuania has a centralized, highly regulated national pricing system with uniform cost-recovery rules set by the State Energy Regulatory Council (SERC). Unlike Greece and Spain, tariffs do not include increasing block structures; instead, all users pay a uniform volumetric price. This difference requires modifications to the tariff module and the removal of IBT logic in the invoices module. No econometric studies of household water demand exist for Lithuania, meaning that demand elasticities would need to be estimated through new surveys or by constructing an econometric dataset from State Data Agency records and utility consumption data. The assessment notes that household-level socio-economic variables (income, household size, employment) are available nationally, but water consumption microdata must be obtained directly from utilities. The regulatory system embeds a strong affordability rule (water bills must not exceed 4 percent of average family income), making affordability analysis one of the most policy-relevant components of the tool. Implementation is considered feasible, but modifications to model architecture and new data collection efforts could require up to 24 months and substantial investment.

Taken together, the three replication assessments confirm that the microsimulation model's underlying logic and structure are transferable, but the extent of adaptation varies along three main dimensions. First, tariff diversity is the largest source of heterogeneity: Greek and Spanish tariffs rely on increasing block pricing and a variety of charges, while Lithuanian tariffs do not. Second, data availability differs significantly, with Greece benefitting from strong national statistical systems, Spain facing gaps between socio-economic and consumption datasets, and

Lithuania lacking demand elasticity estimates altogether. Third, regulatory context shapes feasibility: Greece’s unified national reform provides favorable conditions; Spain’s fragmented municipal landscape requires highly localized modelling; and Lithuania’s centralized but data-poor system requires new econometric inputs.

Across all sites, the model is applicable and can serve as a valuable tool for evidence-based tariff setting, affordability assessment, and policy scenario design. Successful deployment requires collaboration with utilities and regulators, careful parameterization of demand and tariff structures, and targeted data acquisition strategies. The replication results show that while the microsimulation model is not “plug and play,” its modular architecture supports adaptation across diverse European water governance landscapes.

Table 1: Microsimulation Model’s main characteristics across replication sites

Country	Feasibility Rating	Key Adaptation Required	Main Data Constraint	Policy Relevance / Alignment
Greece	High	Incorporate Greek-specific tariff elements, use local elasticities.	Harmonization of billing data across 400+ providers.	High alignment with national reform (RAAEY) on cost recovery & social tariffs.
Spain (Gijón)	Viable (High effort)	Major tariff module customization due to municipal/regional taxes and complexity.	Residential consumption microdata must be built via utility cooperation.	Accommodation of complex local tariff structures.
Lithuania	Viable (Data intensive)	Modify tariff module (no IBTs), estimate new demand elasticities.	Lack of existing household water demand elasticity studies.	Strong alignment with national 4% affordability rule .

3.4 InnWater governance platform

The replication assessment of the InnWater Governance Platform and its integrated tools provided valuable user-experience feedback that has already informed subsequent improvements. Overall, users found the individual tools increasingly robust, visually clear, and functionally coherent, while the assessment also highlighted areas where refinements were

needed to enhance stability, navigation, and clarity. Since the evaluation, many of these issues have been addressed, but the findings remain important for documenting the evolution of the platform.

For the Water Governance Diagnostic Tool, users appreciated the clearer layout, colour coding, intuitive visualisation through the spider graph, and the multi-language AI assistant that could respond reliably in several languages. They noted that browser-based answer storage and the reset function worked well. At the same time, earlier versions showed occasional issues such as the questionnaire jumping back to previous questions or not saving certain responses during retrieval. Respondents suggested that dividing the long form into several sub-pages, expanding definitions, adding “partially” response options, and including comment boxes would improve usability. These recommendations helped guide the subsequent refinement of interface behaviour and question logic.

The CGE Simulation Model was generally viewed positively, especially because of its interactive graphs, downloadable tables, adjustable indicator sets, and the recently added introductory text. Users commented that axes, units, and variable names could be made clearer, and that rounding numerical values would improve readability. They also encouraged further interactivity through user-defined scenario adjustments or combined scenario analysis. Although users recognised that some of these features go beyond the current design scope, their insights were useful for framing the next stage of tool development.

For the Water Tariff Dashboard, the assessment noted that core functionalities were already in place, including introductory guidance, a working chat function, and the ability to modify model parameters. The system successfully stored previous simulations, which users appreciated. At the time of evaluation, several elements such as the “About” button, some untranslated interface text, and certain simulation outputs were still being finalised. These were identified as routine developmental issues rather than structural limitations.

The evaluation of the InnWater Governance Platform webpage itself identified that, at the time, navigation was sometimes unintuitive and several links or interface components were under development. Users occasionally encountered incomplete pages or external links not directly related to the project. Language switching and account creation also required refinement. Despite these challenges, users found the homepage text clear and informative and appreciated the overall vision of an integrated access point for tools, documents, and resources. The assessment helped prioritise improvements to navigation, link management, multilingual functionality, and the integration of direct tool access.

Taken together, the assessment showed strong progress toward a coherent and user-friendly governance platform, while also providing constructive suggestions that have since contributed to significant improvements. The tools themselves were already perceived as useful and promising, and the platform has been evolving toward a more stable, intuitive environment that better supports users in accessing diagnostics, modelling, and tariff analysis.

3.5 Environmental and resource costs

The replication assessment on the introduction of Environmental and Resource Costs (ERC) examined how the principles of the Water Framework Directive (WFD) could be operationalised within the Po River Basin, working with the Po River Basin Management Authority (ADBPO). The

assessment found that ERC represents an important but still only partially implemented component of cost recovery in Italy. While the national legislation (DM 39/2015) formally adopts the user-/polluter-pays principle and recognises environmental and resource costs as part of full cost recovery, practical application has so far remained limited. In most cases ERC is acknowledged conceptually or through terminology, rather than driving concrete changes in water-service planning and tariff design. The replication exercise therefore focused on exploring how a more systemic and operational use of ERC could be enabled at basin level.

The Po River Basin provides an illustrative setting. It is one of Europe's largest and most economically productive basins, facing significant pressures from agriculture, industry, and urbanisation, alongside water pollution, habitat degradation, and increasing climate-related risks. ADBPO, which coordinates basin-wide planning and protection measures, has expressed interest in integrating ERC more effectively into management and tariff structures, recognising the potential role of Nature-Based Solutions (NbS) in reducing environmental impacts and improving long-term resilience. The recent LIFE Brenta 2030 project has already demonstrated that ERC-compatible investments and Payments for Ecosystem Services (PES) schemes can be made operational when supported by strong stakeholder coalitions and clear criteria for assessing ecological benefits.

The replication assessment identified two main types of barriers. First, a cultural barrier, reflecting limited familiarity with ERC concepts among water managers and the absence of clear guidelines on how ERC should be translated into planning and regulation. Second, a technical barrier, due to insufficient expertise and capacity in economic and environmental accounting needed to quantify ecosystem impacts, opportunity costs, and mitigation needs. Despite these obstacles, the assessment also highlighted a positive institutional context: Italian national regulation is evolving toward more explicit recognition of ERC, and the recent ARERA tariff method (MTI-4) allows utilities to recover the costs of mitigation, compensation, and NbS investments, provided that benefits can be demonstrated. This represents a step toward moving ERC from theoretical acknowledgement to practical implementation.

As part of the replication action, Etifor and ADBPO jointly defined a structured methodology to support basin-level adoption of ERC. The proposed implementation plan includes:

1. a governance assessment using the InnWater Water Governance Assessment Tool;
2. training on water-governance innovations and ERC-related mechanisms;
3. an extended economic analysis quantifying biophysical impacts, mitigation and compensation costs, and the circularity of financial instruments;
4. stakeholder engagement for activating a water-PES scheme; and
5. a feasibility study leading to a draft PES contract.

This multi-step process is intended to build capacity, provide methodological clarity, and create the conditions for operational ERC application in the Po Basin.

Overall, the replication assessment shows that while ERC implementation in Italy is still at an early stage, the Po River Basin has favourable conditions for making tangible progress. By combining governance improvements, targeted capacity-building, and economic analysis aligned with WFD requirements, ADBPO can help mainstream ERC into water-service management and use it as a lever to support NbS and ecosystem-restoration investments. The experience also provides a valuable example for other European basins seeking to close the gap between the

legal requirements of Article 9 and the practical tools needed for full cost recovery and sustainable resource use.

3.6 Citizen science solutions related to water quality testing

The replication assessments conducted in the Warta River Basin (Poland) and the Osijek–Baranja Region (Croatia) provide complementary insights into the potential and limitations of citizen science as a tool to strengthen water-quality monitoring and public engagement. Although the two contexts differ in their existing initiatives and institutional frameworks, both assessments highlight a growing societal interest in participatory water monitoring and identify opportunities for citizen science to fill important spatial and temporal gaps in official water-quality data.

In Poland, citizen science is not formally integrated into national or regional water-monitoring frameworks, which remain dominated by state institutions such as State Water Holding Polish Waters, the Provincial Inspectorates for Environmental Protection, and academic laboratories. Nevertheless, several bottom-up initiatives already operate in the Warta Basin, such as WWF’s “River Guardians” programme and university-based student scientific circles. Stakeholder consultations conducted for the assessment show a strong willingness among volunteers - especially younger people under the age of 29 - to participate in water-quality data collection and to support local environmental protection efforts. Public participants perceive volunteer-generated data as meaningful and useful at the local scale, whereas institutional actors take a more cautious view, emphasising the need for standardised procedures, quality assurance, and stronger coordination. Overall, public receptiveness is high, but institutional uptake remains limited, and voluntary activities are often constrained by inconsistent temporal coverage, limited spatial reach, and the cost of equipment and coordination.

In Croatia, the assessment found no structured citizen-science mechanisms for water-quality monitoring in the Osijek–Baranja region, despite general public interest and previous school-based or NGO-led activities. Official monitoring is undertaken by Croatian Waters and research institutions, but local access to water-quality information is limited. To explore the potential for replication, OSPERA established a pilot Citizen Science Hub and joined the international Drinkable Rivers programme, with training modules and measurement kits already deployed. The Hub has also been selected for support through the DANUBE4all and IMPETUS initiatives, enabling an expansion of citizen-science activities into biodiversity and soil monitoring. Interviews show enthusiasm among schools, NGOs, and local institutions, but also reveal notable barriers: limited resources in the education sector, scepticism among institutional actors regarding data reliability, and the absence of simple, Croatian-language digital tools to support data entry. Sustained engagement will require dedicated funding and careful support for coordination, training, and data validation.

Together, the two assessments show that citizen science can make an important contribution to strengthening water-quality monitoring where institutional networks face spatial or temporal gaps, or where public access to environmental data is limited. In both sites, volunteers express strong interest in participating and see value in being involved in environmental stewardship. Academic actors are generally supportive and can provide methodological guidance. Institutional stakeholders acknowledge the long-term potential of citizen-generated data, although their current concerns-particularly regarding reliability, standardisation, and integration with existing regulatory frameworks-need to be addressed systematically.

The replication assessments point to several enabling conditions for successful implementation: clear protocols and training, robust quality-assurance systems, user-friendly digital tools, and structured coordination led by institutional actors in partnership with community groups. Long-term sustainability will depend on stable funding, continued volunteer engagement, and transparent mechanisms for integrating citizen data with institutional datasets. If these conditions are met, both the Warta Basin and the Osijek–Baranja Region could serve as models for broader citizen-science adoption and for strengthening public involvement in environmental governance across Europe.

3.7 Citizen engagement solutions related to water retention on land

The replication assessments carried out in Bodrozköz (Hungary) and the Ústí Region (Czech Republic) show that water retention on agricultural land is both urgently needed and strongly dependent on farmer motivation, community cooperation, and enabling governance conditions. In both regions, farmers observe clear signs of climate change – especially recurring droughts, declining groundwater levels, and more frequent erosion events – which directly threaten crop yields, livestock management, and long-term economic viability. These experiences are shaping a growing awareness of the need to keep more water in the landscape, yet the willingness and ability to implement retention measures remain deeply conditioned by financial constraints, fragmented property structures, and institutional relationships.

In Bodrozköz, interviews show that farmers have already undertaken several adaptive practices that indirectly or directly improve water retention, such as widespread adoption of no-till farming, reduced fertilizer and pesticide use, staged grazing, and organic manure application. These practices reflect a shift toward lower soil disturbance, better soil structure, and improved infiltration. However, larger-scale retention requires coordinated interventions involving backwaters, canals, and oxbow lakes. Farmers recognise the importance of restoring these features and, in principle, support regulated water replenishment from the Bodrog River. Yet cooperation is challenged by unclear property boundaries, under-maintained canals, and the need for state approval for water release from Slovakia. Farmers possess machinery and local knowledge that could support maintenance, but coordination with water authorities is difficult, and past experiences make some farmers sceptical about collective action. Even so, the assessment indicates an emerging openness to cooperation and interest in forming organisational structures to facilitate dialogue and joint planning.

In the Ústí Region, farmers expressed a strong personal and economic motivation to protect the landscape, driven by family heritage, community reputation, and direct exposure to climate impacts. Water retention measures already implemented include soil-conservation practices, buffer strips, hedgerows, diversification of field structure, and the creation or restoration of small ponds. These measures are often undertaken voluntarily, although costs and administrative burdens remain major barriers. The interviews also indicate that cooperation with municipalities and environmental organisations can play a decisive role in overcoming these barriers. Positive examples include jointly implemented tree planting or pond restoration projects, where farmers contributed land and long-term maintenance while external partners mobilised resources and technical expertise. These cases illustrate how collaborative governance and trusted relationships can make retention measures feasible even under financial constraints.

Across both regions, the link to citizen engagement emerges in two complementary ways. First, farmers themselves can be viewed as central citizen actors whose land-management decisions shape the landscape's water balance. Their willingness to adopt retention measures depends on trust in institutions, clarity of rules, and visible benefits for the broader community. Second, broader community involvement – whether through NGOs, local initiatives, or municipal leadership – can create the social infrastructure needed to support retention. In the Ústí Region, local reputation and community expectations already serve as informal drivers of stewardship. In Bodrogköz, farmers acknowledge the need for better coordination with authorities and neighbours, pointing to the potential role of local collective organisations in mobilising joint action.

Overall, the replication assessments demonstrate that effective water retention requires more than technical measures; it depends on building cooperation among farmers, municipalities, water authorities, and conservation groups. Financial support, advisory services, and simplified administrative procedures are essential to broaden implementation, while trust-building and inclusive engagement strengthen the social foundations for landscape-scale adaptation. The experiences from both regions suggest that when farmers feel respected, supported, and included in decision-making, they are more willing to act collectively – an essential condition for retaining water in the landscape under accelerating climate pressures.

4 OVERARCHING CONCLUSIONS

The replication assessment carried out across fourteen European sites has provided a unique and comprehensive analysis of the InnWater solutions under highly diverse geographical, institutional and socio-economic conditions. Taken together, the results provide evidence for both the value and relevance of the InnWater tools and approaches, and they offer important lessons for how replication activities should be organised, supported and used in future European water-governance projects.

1. *Effective design:* A first overarching conclusion is that the replication design adopted by InnWater worked effectively, despite being implemented under tight timelines and with a wide set of thematic areas. The dual structure - combining a shared governance baseline assessment with thematic testing - proved beneficial. The universal application of the Water Governance Assessment (WGA) tool created a coherent governance diagnostic across all replication sites, while the thematic replications shed light on the technical, institutional and social conditions needed for transferring specific InnWater innovations. The structure succeeded in generating “a very broad brush view” of applicability across Europe. The thematic diversity of the project inevitably limited the depth achievable for each topic, but depth was not the primary objective; instead, the added value lay in obtaining focused, real-world insights from multiple contexts.
2. *The contributions of replication experts were of high quality and provided tangible added value for the project:* A second conclusion concerns the quality and usefulness of replication expert contributions. Across most themes, supervisors reported smooth collaboration, timely delivery and constructive feedback. The fixed fee of €5 000 constrained the scope of work but proved sufficient to motivate highly qualified experts, particularly in Central and Eastern Europe. Several partners noted that the input received helped them refine tool usability, clarify methodological assumptions, and validate the

direction of pilot-site conclusions. For example, the platform developers acted on usability problems identified by replicators, and WP2 showed that WGA results strengthened their validation analysis for D2.3 (Assessing Water Governance: recommendations for water managers). In other cases, such as environmental and resource costs, the replication helped establish that the conceptual approach remained relevant but would require more time for full operationalisation. Even in tasks where the digital tool was not yet available, the replication provided methodological feedback and pointed to user expectations that shaped future iterations.

3. *The replication assessment identified recurring structural factors that shape the transferability of water governance innovations across Europe.* A third, cross-cutting conclusion is that the replication exercise highlighted common enabling and limiting conditions across Europe that influence whether innovative approaches can be transferred. Several themes revealed similar challenges - fragmented responsibilities, lack of coordination bodies, limited local leadership, administrative burdens, data gaps, or insufficient institutional capacity - even though the specific contexts varied widely. These patterns emerged in water retention, citizen science, citizen engagement, tariff modelling and ERC implementation alike. The repetition of these barriers across independent replication exercises suggests that they are not local accidents but structural features of European water governance. Conversely, several enabling factors also appeared across themes: strong local motivation, active civil-society organisations, supportive regulators, and the presence of intermediaries capable of translating complex innovations into practice. Supervisors noted that the replication results often echoed pilot-site findings, reinforcing confidence in InnWater's overall analytical conclusions.
4. *The replication assessment generated important lessons on project design, resource allocation, and the trade-offs between breadth and depth.* Another major conclusion is that the replication work offers important lessons for project design and resource allocation. Supervisors reflected that, given InnWater's broad thematic scope, replication resources had to be spread relatively thinly. This provided wide coverage but limited the potential for deeper engagement in each site. Several partners noted that, in future projects, a trade-off must be made consciously: either prioritise breadth (many sites, limited depth) or depth (fewer sites with more extensive work). The InnWater model - 14 experts covering 7 thematic areas - provided excellent geographical and thematic reach but required significant coordination time from partners. Recruitment was also challenging in some countries because the fee level was modest, making it more attractive in some regions than others. Despite this, the model proved cost-effective compared to typical Horizon Europe replications, where replication partners often receive much larger budgets.
5. *The timing of replication activities within the project lifecycle proved to be a critical factor for their effectiveness.* The assessment also revealed important insights regarding timing within a project lifecycle. Replication cannot begin too early, before tools and pilot-site results are mature, but starting too late risks compressing the assessment phase. Several supervisors noted that summer periods and late project timelines created delays. This points to a need in future projects for careful scheduling, potentially running replication in waves or aligning it more closely with tool development stages.
6. *The replication assessment functioned as an effective mechanism for cross-learning and continuous improvement of InnWater tools.* A further overarching conclusion is that the

replication assessment served not only as a test of tools but also as a mechanism for cross-learning and tool improvement. Many partners emphasised how valuable it was to receive feedback from independent experts not previously involved in InnWater. The assessments identified usability issues, missing functions, and gaps in methodological explanation that might not have been detected internally. The WGA tool, CGE model and tariff dashboard each benefited from this external perspective, leading to concrete adjustments in indicators, instructions, visualisations or user pathways. The process also highlighted the importance of clear guidance materials, well-prepared templates and preliminary meetings to ensure common understanding of tasks.

7. *The replication assessment demonstrated the potential for continued use and uptake of InnWater tools beyond the project duration.* Finally, the replication assessment provided evidence that InnWater tools and approaches have genuine potential for uptake beyond the project, although further development is needed for some themes. In several cases, replicators themselves expressed interest in using the tools again once the project concludes, either because of regulatory changes (e.g., Greek tariff reform), emerging local policy needs (e.g., citizen science in Croatia), or alignment with basin-level strategic planning (e.g., ERC work in the Po Basin). While replication in the strict sense was limited to assessment, the results indicate a genuine window for future deployment and continued cooperation.

In summary, the replication assessment provided evidence that the InnWater solutions are relevant, adaptable and capable of functioning under varied European conditions. It also demonstrated the value of external expert-driven replication as a structured, efficient method for testing innovation in EU water governance. At the same time, the process underscored the need for clear task definition, adequate timeframes, and stronger support materials to maximise the benefits of such exercises. The insights gained from the replication work enrich not only the final deliverables of InnWater but also offer practical guidance for designing replication components in future research and innovation projects.

ANNEXES

Annex 1: The replication assessment matrix

The replication assessment matrix below contains the most critical features for all the replication sites. A results table is placed below the replication matrix with some supporting information.

No. of the replication site	Location of the replication site	Work package / task / pilot site	Partner in charge of coordinating the replication assessment	Content of the replication assessment	Related result (see next table)	Partner hiring and paying the replication expert	Organisation in charge of the procurement
Over-arching	all replication sites	WP2 / WP4.1	ETIFOR	Water governance assessment tool	Results, 2 & 3	see below	
1	Jucar river basin, Spain	WP3	EUT	Citizen engagement instruments and actions	Results 10 & 11	EUT (no. 1)	
2	Doñana national park, Spain	WP3	EUT	Citizen engagement instruments and actions	Results 10 & 11	EUT (no. 2)	
3	Seine (Normandie), France	WP4, Task 4.2	URN	Data availability for CGE modelling	Result 4	URN (no. 1)	
4	Corsica, France	WP4, Task 4.2	URN	Data availability for CGE modelling	Result 4	URN (no. 2)	
5	Greece	WP4, Task 4.3	REKK and UR	Applicability of the microsimulation model	Results 5 & 6	REKK (no. 1)	WAREG



INN WATER

No. of the replication site	Location of the replication site	Work package / task / pilot site	Partner in charge of coordinating the replication assessment	Content of the replication assessment	Related result (see next table)	Partner hiring and paying the replication expert	Organisation in charge of the procurement
6	Northern Spain	WP4, Task 4.3	REKK and UR	Applicability of the microsimulation model	Results 5 & 6	REKK (no. 2)	WAREG
7	Lithuania	WP4, Task 4.3	REKK and UR	Applicability of the microsimulation model	Results 5 & 6	REKK (no. 3)	WAREG
8	Middle Sava basin, Slovenia	WP4, Task 4.4	EUT	InnWater governance platform	Result 12	REKK (no. 4)	
9	Turkiye	WP4, Task 4.4	EUT	InnWater governance platform	Result 12	OiEau (no. 1)	OiEau / INBO
10	Po River basin, Italy	WP5, PS#2 Brenta	ETIFOR	Environmental and resource costs	Result 7	ETIFOR	
11	Osijek-Baranja county, Croatia	WP5, PS#4 West Country	WRT	Citizen science solutions	Result 11	OiEau (no. 2)	OiEau / INBO
12	Warta River Basin, Poland	WP5, PS#4 West Country	WRT	Citizen science solutions	Result 11	REKK (no. 5)	
13	Bodrogköz region, Hungary	WP5, PS#5 Middle Tisza	REKK	Citizen engagement solutions	Result 11	OiEau (no. 3)	OiEau / INBO
14	Usti and Labem region, Czech Republic	WP5, PS#5 Middle Tisza	REKK	Citizen engagement solutions	Result 11	REKK (no. 6)	

InnWater project results:

List of Results (D6.5)	
Result 1	Multi-level and cross sectors governance recommendations – Policy briefs
Result 2	Reference guide for programming – Effective governance practices
Result 3	Water Governance assessment tool
Result 4	WEFE Nexus Macro-economic simulation
Result 5	Water pricing tool
Result 6	Inclusion of environmental costs within water tariff and pricing R6a - examples of Brenta R6b - examples of Coral reef in La Réunion
Result 7	Raising awareness and training support tools
Result 8	Self-sustaining governance Pilot Sites Community
Result 9	Citizen Engagement framework
Result 10	InnWater Governance Platform
Result 11	AI Assistant

Annex 2 : Water Governance Assessment Tool

One of the expert consultations aimed at validating the InnWater Governance Assessment (WGA) tool was **conducted within the framework of the project's replication assessment across Europe**. The objective of this activity was to facilitate the application of InnWater results in new locations by testing the tool in diverse governance contexts. To this end, external experts (i.e., the replicators) were invited to apply the WGA tool to assess water governance systems in fourteen locations throughout Europe, covering scales that ranged from sub-basin and regional levels to national systems. The validation exercise included sites in Spain, Hungary, Türkiye, Greece, Italy, the Czech Republic, France, Lithuania, Croatia, Slovenia, and Poland.

The consultation pursued three complementary validation goals: first, to verify the usability of the tool, ensuring that its structure, interface, and functionalities were intuitive and practical; second, to validate its content, assessing whether the questions and principles effectively captured the essential dimensions of water governance; and third, to conduct a preliminary empirical validation, exploring the tool's ability to generate meaningful and comparable results across different contexts. **While all three aspects were considered, the focus of this exercise leaned primarily toward the first — usability validation** — as the experts' experiences in applying the tool were considered the most direct way to test its real-world applicability and relevance.

The experts who participated in this process came from diverse professional backgrounds, including consultancy, research, civil society, and public administration. This variety sought a multidisciplinary perspective and contributed to evaluating how well the tool could be used by different categories of water governance actors. The overarching aim was to gather practical feedback to refine the WGA tool and strengthen its capacity to guide governance assessments in future applications.

Methodology

The validation process was designed to provide participants with both time and guidance to become familiar with the tool and apply it meaningfully to their own contexts. **The process unfolded in four main steps.** First, all experts took part in an online training session that introduced the WGA methodology, its structure, and key functionalities. After this introduction, participants collected water governance information relevant to their chosen replication site, preparing the background material needed for the assessment. Once this information had been gathered, they conducted the governance assessment using the WGA tool itself. **The exercise concluded with an online survey** through which the experts provided feedback on the tool's usability, content, and overall usefulness.

The **experts were selected through an open call launched by the InnWater replication assessment task**, thought to ensure broad participation across countries and professional backgrounds. However, it did not aim for statistical representativeness. The intention was to capture a diverse range of experiences and expertise, rather than to establish a structured sample.

The online survey included both closed and open-ended questions focused on the dimensions of usability and user experience regarding the tool, its contents and relevance, data availability for conducting assessments, and a section about the impact and usefulness of the tool and its results. Quantitative results, including the distribution of study areas and the professional profiles of participants, were analysed using descriptive statistics. Responses to open-ended questions were

processed through qualitative coding and clustering, allowing key themes and recurring ideas to emerge.

Results

In terms of application level, **the tool was used at multiple governance levels** (Figure). Over half of the experts (54%) applied the tool at the basin or regional level, including protected areas. Another 23% assessed water governance at the national level, while 7% focused on municipal or city-level governance. The remaining 16% used the tool to analyse multiple scales simultaneously or applied it to specific service providers without specifying a geographic level. This diversity of use provided initial insights into the tool’s versatility, although it also raised some challenges related to the consistency of questions across scales.

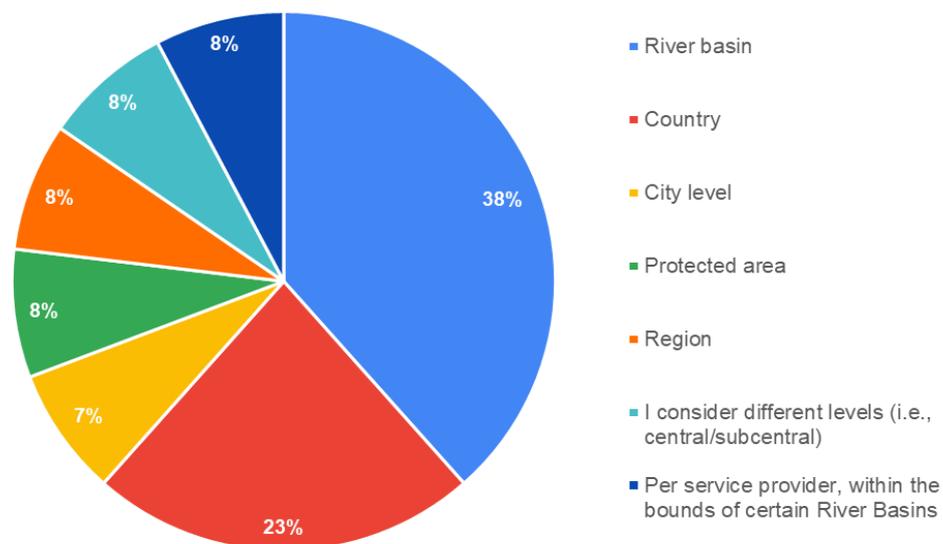


Figure 1: Types of areas assessed using the WGA tool

Regarding the experts role regarding water governance, a large group accounting for 70% conducts research or provides consultancy services, whereas **the remaining 30% is composed of policy or decision makers** and civil society representatives (Figure).

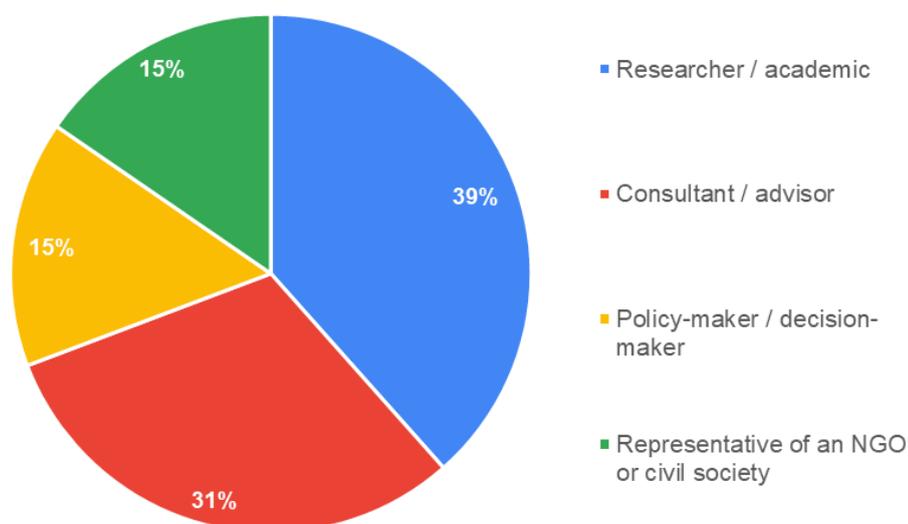


Figure 2: Role of the replicator in water governance

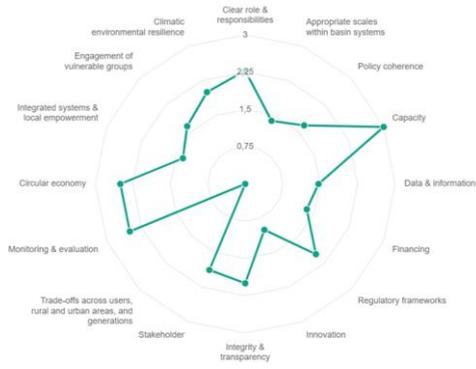


When asked about the aspects they found most useful, the experts frequently mentioned the **output format and visualization** of the tool, with special mention to the results section which “was very impressive with the spider chart and the AI assistant” and effective in summarising governance strengths and weaknesses. Another frequently mentioned aspect was the **structure and user interface** of the questionnaire, with its different sections, which helped them organize the data and knowledge, summarizing complex subjects of water management. Many highlighted the **breadth and depth of the questions**, noting that the tool encouraged reflection from multiple angles and often required evidence-based responses. Finally, they valued **the tool's Practical guidance and usefulness for action**, highlighting its ability to connect assessment results with concrete recommendations and examples of governance improvements.

Despite the generally positive feedback, experts also identified several limitations. A first group of issues related to **technical and usability aspects**, including the time and level of prior knowledge required to complete the assessment. Others pointed to the **rigidity of the question-and-answer format**, explaining that some closed-ended questions did not always allow them to fully represent the complexity of governance situations in their specific contexts. Another frequent observation concerned **conceptual and scope-related difficulties**. Some experts encountered questions that seemed better suited for higher levels of governance, such as regions or basins, when their assessment focused on smaller areas like municipalities. This misalignment between question scope and assessment level reflects a broader challenge inherent to cross-scale governance analysis, where principles such as coordination, participation, and regulatory capacity manifest differently at different scales. Finally, a few participants mentioned **language and contextual adaptation issues**, including translation inconsistencies or technical bugs when using versions of the tool other than English.

Regarding the specific governance assessment carried out by the replication experts, Figure presents the graphical results of 10 governance assessments conducted by the replication experts. These results show the average scores (0–3) for each study area, across the 16 water governance principles of the InnWater framework, summarizing the mains strength points and governance gaps of the assessed systems.

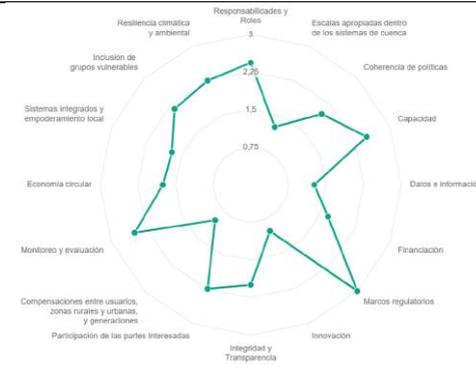




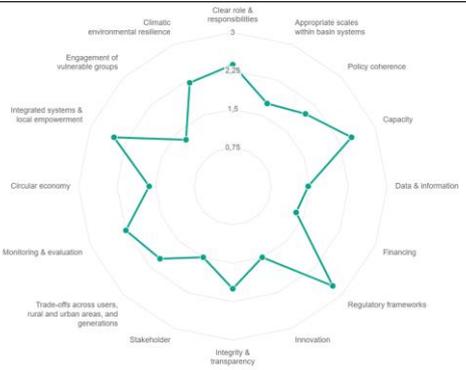
Istanbul Metropolitan Area, Türkiye



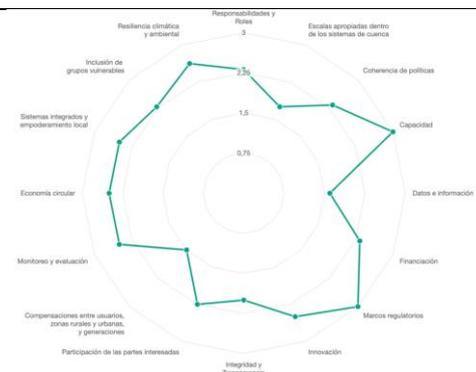
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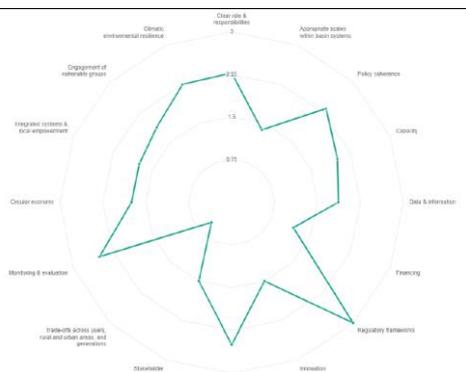
Doñana National Park, Spain



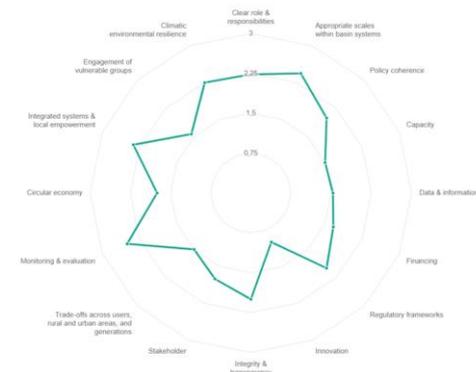
Usti and Labem regions, Czechia



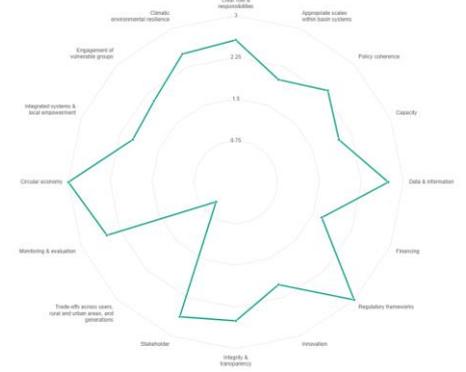
Northern Spain



Lithuania



Osijek-Baranja County, Croatia



Middle Sava basin, Slovenia

Figure 3: Governance assessment results for 10 European study areas



The results of the governance assessments revealed both common strengths and shared challenges across the study areas. **The most consistent strength** identified was in the principle of **monitoring and evaluation**, which was rated highly in nine of the ten assessments analysed (90%). This finding could be due to the strong emphasis placed by European water policy frameworks, such as the EU Water Framework Directive, on compliance and performance monitoring. Similarly, the principles of **institutional capacity**, as well as **regulatory frameworks**, were identified as strong in 70% of the cases each, suggesting that most countries possess well-defined legal bases and capable institutions to manage their water resources. Notably the principle of **environmental resilience** emerged as a strength in all the three Spanish case studies, namely Doñana National Park, the Júcar River Basin, and Northern Spain, where integrated ecosystem-based management practices seem to be well established.

On the other hand, **two recurrent governance gaps were identified**. The first relates to the principle of **trade-offs across users, sectors, and generations**, reported as a major weakness in five of the study areas. This result might suggest enduring challenges in balancing water allocation between competing uses — such as agriculture, urban consumption, and environmental flows — while ensuring intergenerational sustainability. The second common gap concerned **appropriate scales within basins**, also cited in 50% of the cases. This weakness could elicit persistent coordination difficulties between administrative and hydrological boundaries, a challenge that could be present and still unresolved in many European contexts. Together, these findings on both strengths and governance gaps might suggest that while Europe's institutional and regulatory frameworks for water governance are mature, issues of integration, coherence, and cross-sectoral coordination remain central governance challenges.

Conclusion

The validation exercise of the InnWater Governance Assessment (WGA) tool, conducted through its replication across fourteen European study areas, **provided valuable insights into both the robustness and practical applicability of the tool**. Overall, the consultation results suggest that the replication experts appreciated the WGA because of its structured and comprehensive framework for assessing water governance, capable of capturing a wide range of governance dimensions and prompting experts to reflect critically on institutional performance, stakeholder coordination, and policy implementation. Its **clarity, analytical depth, and the visual presentation of results were highly appreciated by the experts**, who found the tool effective for synthesising complex information and supporting dialogue on governance strengths and weaknesses.

At the same time, **the exercise revealed several areas where further refinement could enhance the tool's functionality and flexibility**. Several experts indicated that the effort and expertise required to complete the assessment could be demanding, suggesting the need for simplified user pathways or tiered levels of application depending on the user's familiarity with governance frameworks. The limited flexibility of specific closed-ended questions and the presence of some conceptual overlaps across governance scales also highlighted the importance of adapting the WGA to different territorial levels. Governance challenges and mechanisms often manifest differently at basin, regional, and municipal scales, and future versions of the tool should therefore include more scale-sensitive questions or guidance to ensure coherence in the analysis. Additionally, minor language and contextual adaptation issues underscored the importance of refining translation and interface consistency for broader international use.

The preliminary empirical validation results emerging from the replication exercise suggest that Europe's institutional and regulatory foundations for water governance are generally solid, reflecting the influence of EU frameworks such as the Water Framework Directive. However,



persistent gaps in coordination across administrative levels, as well as in managing trade-offs among users, sectors, and generations, suggest that integration and coherence remain critical challenges for effective water governance. These findings support the idea that the WGA can not only serve as a diagnostic tool but also as a platform for dialogue, learning, and prioritisation of governance improvements.

In conclusion, **this validation backs the idea that the InnWater Governance Assessment tool is both usable and relevant across diverse European contexts**, while also providing clear indications for further methodological enhancement. Future work should focus on enhancing the adaptability of the tool to various governance levels, refining guidance for users, and verifying its consistency through additional comparative applications.

Annex 3: Citizen Engagement instruments and actions – Jucar River Basin

The Jucar River Basin (Spain)

Author : Adria Rubio-Martin

Executive summary

InnWater is a European project funded by the European Commission within the framework of the Horizon Europe Research & Innovation programme. InnWater aims at promoting social innovation to renew multi-level and cross sector water governance, associated with economic and financial mechanisms to support EU Green Deal transition while ensuring water systems sustainability.

The project developed a methodology providing tailored innovative and cross sector governance tools that were tested in 5 Pilot Sites during the first two years of the project (Figure 1). To ensure the suitability, applicability, and usefulness of the InnWater methods, tools, and results in areas outside the original project locations, a replication assessment was planned in 14 locations across Europe. The Jucar River Basin (eastern Spain) was selected as one of the replication sites.

The primary goal of the replication assessment is to assess the usability of the InnWater citizen engagement methods or tools in other locations under different circumstances.

With that in mind, this report aims to document the results of assessing citizen engagement instruments and actions in the Jucar River Basin (Step 1). The assessment examines how existing engagement tools and initiatives are utilized in the river basin, and their effectiveness in fostering citizen participation to improve water resource management under scarcity conditions.

In Step 2 we identify local community groups, particularly local marginalized communities, and will engage them to evaluate their involvement in water governance.

Finally, in Step 3 we propose a series of recommendations and a roadmap to foster inclusive citizen engagement in the case study.



Figure 1. InnWater's methodological guideline to set up a citizen engagement roadmap.

The findings presented in this report highlight a critical truth: the future resilience of the Jucar River Basin and the metropolitan area of Valencia, particularly in the face of escalating climate challenges like droughts and extreme floods, requires a fundamental shift towards more inclusive and equitable water and urban governance. Our engagement with diverse marginalized communities along with the associations in defense of L'Horta's agricultural and ecological heritage, has brought to light profound systemic challenges. These include the persistent underrepresentation of vulnerable and local voices, the inaccessibility of traditional engagement mechanisms, the disregard for local knowledge, and the compounding pressures of socio-economic inequalities. Furthermore, the floods that occurred in Valencia in October 2024 caused a profound erosion of public trust in traditional governance structures, making it challenging to engage communities in general discussions about long-term water management so soon after such a traumatic and impactful experience.

To gain these critical insights, this report employed a qualitative methodology based on the InnWater methodological guidelines, centered on direct engagement with a selection of diverse stakeholders and local community groups. We conducted in-depth interviews via telephone, video calls, and in-person meetings. We also utilized digital communication platforms like WhatsApp to facilitate ongoing dialogue and information exchange. This multi-modal approach allowed us to accommodate the varied circumstances and preferences of the organizations and individuals, ensuring accessibility and fostering trust.

Assessing the InnWater method across such a large and complex river basin presented significant challenges. The sheer scale and intricate local dynamics of water governance meant a direct, uniform application of InnWater's methodologies across the entire basin was impractical. Nevertheless, the replication successfully gathered rich, qualitative data at the local scale of Valencia and its metropolitan area, providing nuanced insights into how existing engagement tools perform. This underscored the vital need for **adaptability and local tailoring** when transferring social innovation methodologies across diverse European contexts.

Ultimately, the findings from this assessment will help refine InnWater's goal of enhancing water governance and pave the way for future research into climate-induced displacement, the integration of traditional and modern water management, and the cost-benefits of inclusive citizen engagement.

1. Introduction

Water governance in water-scarce regions is a complex challenge that requires balancing competing demands, ensuring equitable access, and optimizing resource allocation while considering social, economic, environmental, and cultural dimensions. This task demands participatory frameworks that incorporate the knowledge and needs of multiple stakeholders, adaptive policies to address climatic variability, and robust mechanisms to resolve conflicts over allocation. The need to navigate historical inequities, cultural values tied to water, and, in some cases, transboundary dynamics, makes integrated water resources management (IWRM) a cornerstone of sustainable

governance.

This complexity is amplified by the issue of scale, as governance structures often prioritize basin-wide or regional strategies, which obscure the nuanced needs and knowledge of local communities and marginalized groups. While IWRM provides a framework for coordinating water use across sectors and scales, the granularity required to engage citizens and small, often marginalized, communities are frequently overlooked. This gap limits the ability of governance systems to fully address local realities, where water use is deeply embedded in cultural practices, livelihoods, and social inequities, underscoring the challenge of aligning broad, systemic objectives with fine-scale, citizen-driven perspectives.

The Jucar River Basin in eastern Spain exemplifies these complexities, encapsulating the multifaceted challenges of managing a scarce and highly contested resource. Spanning approximately 22,000 km², the basin supports a diverse range of water uses, including intensive agriculture, urban supply for cities like Valencia, and the maintenance of ecologically significant environments such as the Albufera. Governance in the Jucar River Basin must therefore contend with reconciling these pressures while fostering stakeholder collaboration and ensuring compliance with national and European Union water policies, such as the Water Framework Directive.

While governance at the river basin scale has been extensively studied, with entities such as the Jucar River Basin Authority facilitating stakeholder coordination, the integration of citizen engagement and local-scale perspectives remains underexplored. Small and marginalized groups, such as rural farmers or local communities, often lack representation in decision-making processes, and their local knowledge is sidelined in favor of broader, top-down strategies. This report examines the Jucar River Basin as a case study to explore the challenge of incorporating citizen and marginalized group perspectives into water governance, addressing the scalar disconnect between basin-wide management and local-scale realities.

To perform our analysis, we will replicate the InnWater method summarized in Figure 1. We will start by identifying and analyzing current stakeholder and citizen engagement instruments and actions implemented in the Jucar River Basin. This analysis will encompass both stakeholder and citizen engagement processes, including the types and numbers of groups engaged and the challenges to perform significant citizen engagement activities at the river basin scale.

The next step will be to reduce the scale of analysis, gather insights on local challenges, the extent of citizen engagement, and the perceived efficacy of public participation mechanisms. This will be achieved through direct engagement with organizations for marginalized groups, local environmental associations, and other relevant groups via workshops or interviews. The insights gathered will be crucial for evaluating the effectiveness of current engagement approaches and to collect the group's main perceived challenges and interest regarding water governance. The collected findings will then undergo analysis to determine the relevance, usability, and overall impact of the existing citizen engagement mechanisms. Finally, we will conclude with actionable recommendations and a roadmap aimed at enhancing citizen engagement strategies

within the Jucar River Basin.

2. Case Study Area: the Jucar River Basin (JRB)

We will start the report with the Step 1 of the InnWater methodological guidelines, which consist of the pilot site internal assessment. The Jucar River Basin is a water-scarce Mediterranean basin located in eastern Spain with a surface of 22,261 km². Characterized by a fragile equilibrium between annual renewable water resources (1,713.4 Mm³/year) and demands (1,648.4 Mm³/year). The basin faces significant governance challenges driven by competing sectoral needs, climate variability, and historical over-exploitation. The basin’s hydrological system is highly regulated through three main reservoirs—Alarcón (1,112 Mm³), Contreras (872 Mm³), and Tous (314 Mm³) and is hydraulically linked to the extensive La Mancha Oriental karstic aquifer (7,260 Mm³), one of the largest in Southern Europe (Sanz et al., 2011). These infrastructure elements, combined with intensive agricultural activity (with irrigation accounting for around 80% of the total water demand) in regions like Ribera del Jucar and La Mancha Oriental, underscore the complexity of managing water across diverse ecological, economic, and social landscapes (Figure 2).

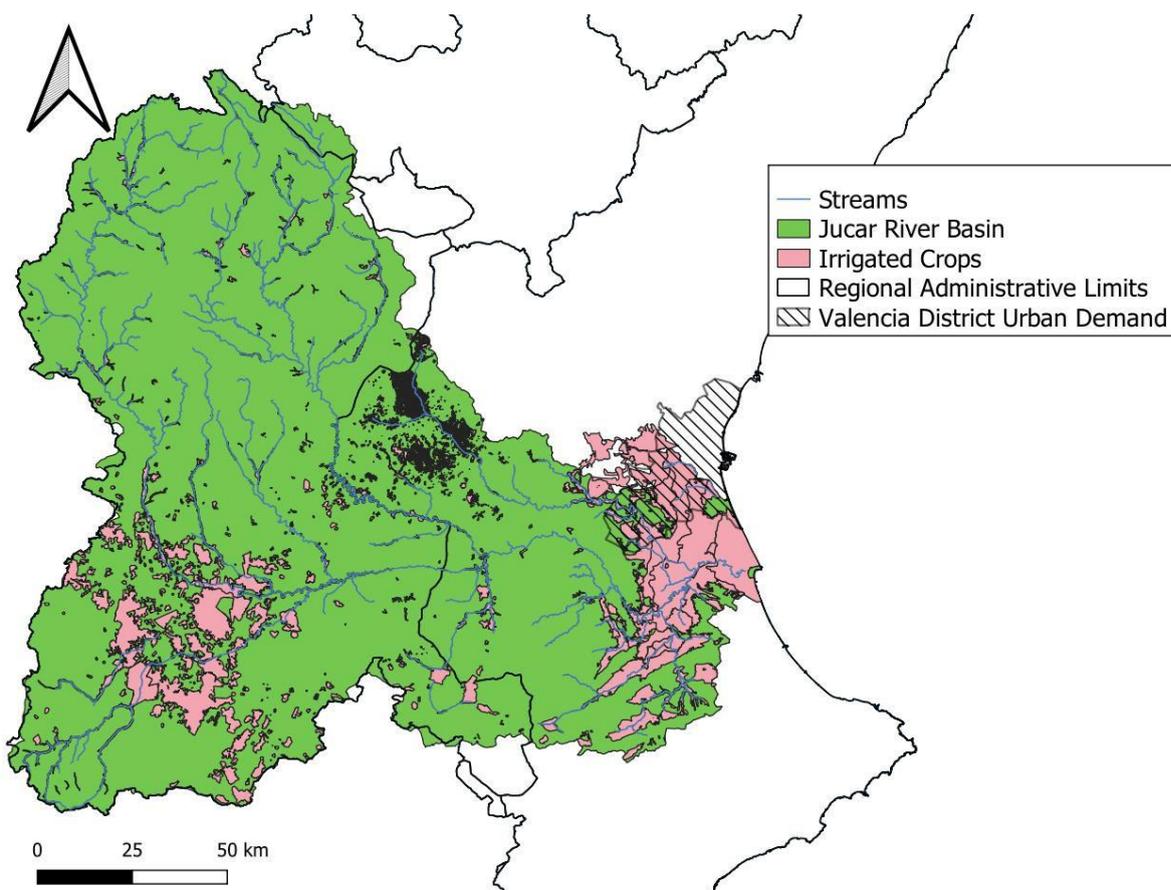


Figure 2. Jucar River Basin system, including main irrigation and urban demands.

In Figure 2, major agricultural demand units are marked, with irrigated crops using surface water along the coast and groundwater in the La Mancha Oriental inland area. Urban demand units such as the one from the district of Valencia take around 2/3 of

their water from the Jucar system, using the Jucar-Turia Canal to transfer water 72 km north from the Tous reservoir. Historical over-extraction of groundwater in La Mancha Oriental, particularly prior to 2000 when pumping rates exceeded 500 Mm³/year, reduced downstream water availability, triggering conflicts between farmers in the middle/upper basin and those in the lower basin, as well as with urban users and environmental stakeholders reliant on surface water flows

Governance in the Jucar River Basin operates within a framework shaped by Spain's national water policies and the European Union's Water Framework Directive (WFD), which emphasize IWRM and stakeholder participation. The Confederacion Hidrografica del Jucar (CHJ), the water authority in the whole region, oversees water allocation, infrastructure management, and drought response, coordinating among agricultural, urban, and environmental stakeholders. However, the basin's governance structure has historically prioritized large-scale agricultural and urban demands, particularly in the coastal area of the Ribera del Jucar, where small-scale horticulture, citrus, rice, and kaki farming dominate (using 675 Mm³/year of surface water and 130 Mm³/year of groundwater). In contrast, the inland La Mancha Oriental region, characterized by larger agricultural holdings and groundwater-dependent cereal, vineyard, and vegetable cultivation, has faced reduced water availability due to excessive pumping rates prior to 2000, which altered the river-aquifer relationship and triggered downstream tensions (Apperl et al., 2015). These regional disparities highlight the scalar challenge: basin-wide policies often fail to address localized needs, particularly those of smallholder farmers and rural communities, whose voices are underrepresented in decision-making processes.

The governance challenges are further compounded by the basin's vulnerability to climate change, which exacerbates water scarcity through reduced precipitation, increased evapotranspiration, and more frequent and intense droughts (Marcos- Garcia et al., 2017). Hydroeconomic analyses indicate significant socioeconomic and environmental risks under current management practices, with drought costs projected to rise unless innovative adaptation measures are implemented (Escriva- Bou et al., 2017). While the CHJ has introduced measures such as water trading and drought contingency plans, these often prioritize economic efficiency over social equity, sidelining marginalized groups such as small-scale farmers in Ribera del Jucar or local communities with traditional water practices. The scalar disconnect, where basin-level strategies overshadow local knowledge and needs, limits the effectiveness of governance in addressing micro-level vulnerabilities, such as access to irrigation for small farms or the cultural significance of water in rural communities.

3. Stakeholder engagement and participatory processes in the JRB

Participatory processes are a well-established mechanism for water governance in the Jucar River Basin. CHJ, the water authority in the region, implemented the processes following the WFD mandate for public participation to ensure transparent and inclusive decision-making, aligning with the principles of IWRM. Participatory mechanisms exist in different shapes (Figure 3).

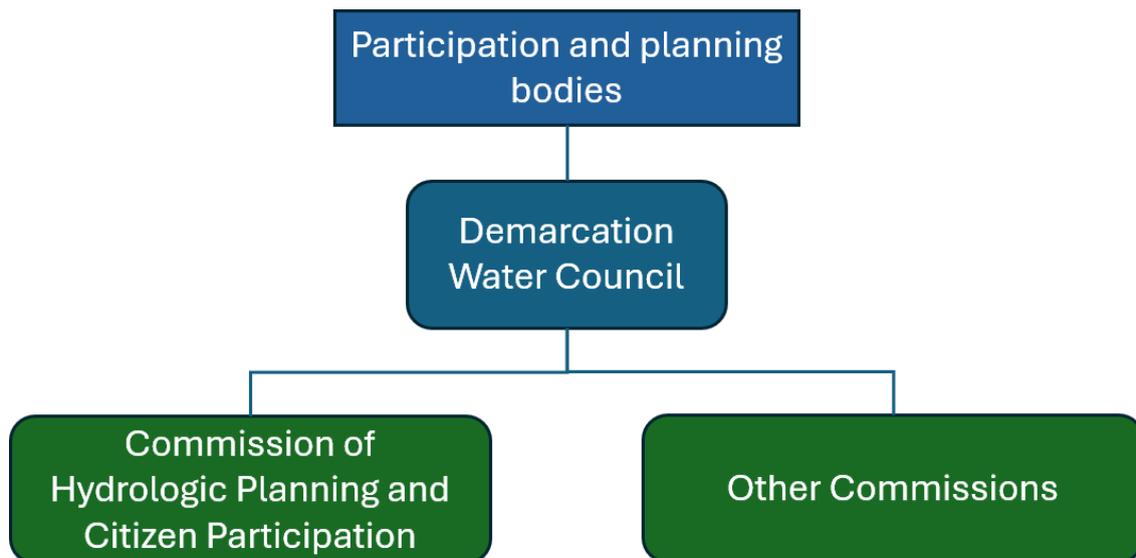


Figure 3. CHJ participation and planning bodies (translated from <https://www.chj.es/es-es/Organismo/organoscolegiados/Paginas/OrganosdeParticipacionyPlanificacion.aspx>)

The Consejo del Agua de la Demarcación (Demarcation Water Council) was established to promote public participation. The Water Council succeeded the River Basin Council (Consejo del Agua de Cuenca), which had a narrower scope, and was granted enhanced responsibilities for public consultation and planning under Royal Decree 255/2013. This transition aimed to strengthen stakeholder involvement in response to the WFD’s mandate for active public participation, particularly in addressing water scarcity and competing demands. The Water Council serves as a key platform for public participation and hydrological planning, with functions designed to ensure informed and inclusive decision-making. Its primary responsibilities include:

- Promoting Public Participation: Facilitating information dissemination, public consultation, and stakeholder engagement in the River Basin Management Plan (RBMP) development process, as mandated by the WFD.
- Approving the RBMP: Submitting the RBMP and its revisions to the Spanish government via the Ministry for Ecological Transition for approval.
- Advisory Role: Providing reports on general interest issues, water protection, resource management, and infrastructure planning, as well as on specific topics assigned by the CHJ’s President or Governing Board.
- Mandatory Reporting: Issuing obligatory reports on the provisional outline of key management issues (per Article 79.6 of Royal Decree 907/2007), draft RBMPs, drought contingency plans, aquifer protection perimeters, and modifications to hydraulic public domain boundaries.
- Drought and Emergency Planning: Advising on special action plans for drought alerts and emergencies, critical in the Júcar Basin given its vulnerability to climate-driven scarcity.

These functions position the Water Council as a central mechanism for coordinating basin-wide governance, but its focus on formal, high-level planning often limits direct engagement with local and marginalized communities, highlighting the scalar disconnect in Jucar's governance.

The Water Council operates in plenary sessions and through specialized commissions, notably the Comisión de Planificación Hidrológica y Participación Ciudadana. It is Chaired by the CHJ President, with the CHJ General Secretary as the secretary. Representatives from multiple ministries, including three from MITECO, two each from Industry, Energy, and Tourism, Development, and Interior, and one each from Health, Social Services, and Equality, Defense, and Economy and Competitiveness. The Water Commissioner, Technical Director, and Head of the Hydrological Planning Office from the CHJ are also part of the Council. One representative each from Alicante, Valencia, and Castellón's peripheral units, Maritime Captaincies, and Port Authorities, plus one from the Valencian Community for autonomous ports. Eleven representatives from the Valencian Community, six from Castilla-La Mancha, two from Aragón, and one each from Catalonia and Murcia, reflecting the basin's transboundary nature. Three representatives from municipalities within the demarcation. Twenty-nine representatives, primarily from irrigation communities, urban suppliers, and industrial users, reflecting the basin's heavy agricultural demand. Six representatives, including two from agricultural associations, two from environmental NGOs, one from business associations, and one from trade unions.

The Commission of Hydrologic Planning and Citizen Participation, a subset of the Water Council, focuses specifically on hydrological planning and citizen participation. Chaired by the CHJ President and with the Head of the Hydrological Planning Office as secretary, it includes three MITECO representatives, one each from Development, Finance, Industry, and Economy ministries, regional representatives (three from Valencian Community, two from Castilla-La Mancha, one each from Aragón, Catalonia, and Murcia), twelve user representatives (covering supply, irrigation, and energy uses), two from local entities, and four from NGOs (one each for environmental, economic, union, and agricultural interests). Representatives are elected for three-year terms, ensuring periodic renewal.

The Commission work with the CHJ to shape the river basin management plans by contributing to consultations, formulating proposals, and defining criteria to ensure coherence, cross-cutting perspectives, and an integrated approach to the participation process. It proposes objectives for the Working Commissions, sets priorities and mechanisms for effective coordination between the participation process and the PRJ's development, and facilitates access to necessary documentation and information flows. The Head of the Commission oversees the coordination and monitoring of the Working Commissions, aligning their efforts with the PRJ's timeline and proposing its Framework for Action and Work Plan. It also acts as a communicator to external social stakeholders, promoting the dissemination of discussions and outcomes. Additionally, it advises the CHJ to enhance the participation process's effectiveness, reviews drafts and working documents, and submits a consolidated document of proposals and conclusions from

the commissions to the CHJ for inclusion in the RBMP.

Public participation in the River Basin Management Plan enables citizens to influence planning and management processes for river basin districts. Different actions are undertaken to promote public participation in the different phases of the planning. The Initial Document, Provisional Overview of Significant Water Management Issues, and the River Basin Management Plan review project are made publicly available for six months each. After each phase, proposals, remarks, and suggestions are collected and analyzed in dedicated reports. Beyond the standard participation process, various actions are taken to encourage active public involvement during the consultation phase, including territorial meetings for each water resources system, and a general presentation session in Valencia. During the public consultation phase of the last RBMP, about 900 topics were collected, with 69% incorporated fully or partially into the plan. Over 20 territorial meetings were held across locations to discuss issues such as water body status and proposed measures, fostering active participation and gathering diverse opinions on district challenges. All improvements and responses to contributions were documented in the Report of Proposals, Remarks, and Suggestions for the RBMP.

The CHJ considers the participation processes described above as an integrative effort that engages diverse stakeholders to enhance the river basin plan's value through active citizen involvement. This engagement is rooted in collaboration and consensus, shaped by the qualitative perspectives of participants. While CHJ admits that operational constraints prevent fully open participation, efforts are being made to find flexible approaches to meet these objectives.

3.1 Main stakeholders involved in the JRB planning process

Reviewing the list of entities participating in the planning phases of the river basin management plan provides an accurate representation of the actors involved in the management of the river basin:

Entity	Classification
Acció Ecologista Agró	Environmental ONG
Acequia Real del Júcar	Agricultural water user
ACUAJUCAR	Public Water Authorities & Infrastructure
Sociedad Estatal Aguas de las Cuencas Mediterráneas S.A (ACUAMED)	Public Water Authorities & Infrastructure
Asociación para el Desarrollo Integral de La Manchuela Conquense (ADIMAN)	Community & Consumer Interests
Asociación Profesional de Regantes del Alto Júcar (APRAJ)	Agricultural water user
Ayuntamiento de Albacete	Urban water demand
Ayuntamiento de Cuenca	Urban water demand

Ayuntamiento de Valencia	Urban water demand
Centro de Estudios y Experimentación de Obras Públicas (CEDEX)	Research & Technical Support
Comisiones Obreras (CCOO)	Economic & Labor Organizations
Comunidad de Regantes de Sueca	Agricultural water user
Comunidad General de Usuarios Canal Júcar-Turia	Agricultural water user
Confederación Empresarial Valenciana (CIERVAL)	Economic & Labor Organizations
Confederación Hidrográfica del Júcar	Public Water Authorities & Infrastructure
Confederación Regional de Empresarios de Castilla La Mancha (CECAM)	Economic & Labor Organizations
Conselleria de Medio Ambiente, Agua, Urbanismo y Vivienda	Government
Consortio de la Ribera	Government
Demarcación Costas de Valencia MIMAM	Public Water Authorities & Infrastructure
Ecologistas en Acción	Environmental ONG
Entidad Pública Aguas de Castilla la Mancha	Public Water Authorities & Infrastructure
EPSAR-Entitat de Sanejament d'Aigües	Public Water Authorities & Infrastructure
Fundación Nueva Cultura del Agua	Environmental ONG
Iberdrola Generación S.A.	Electricity producer
Junta Central de Regantes de La Mancha Oriental	Agricultural water user
Junta de Comunidades de Castilla La Mancha	Government
Ministerio de Medio Ambiente SGPUSA	Government
Organización de Consumidores y Usuarios (OCU)	Community & Consumer Interests
Secretaría General de Agricultura del Ministerio de Agricultura, Pesca y Alimentación	Government
Secretaría General de Sanidad del Ministerio de Sanidad y Consumo	Government
Sociedad Estatal de Infraestructuras Agrarias, SEIASA de la Meseta Sur	Public Water Authorities & Infrastructure
Sociedad Española de Ornitología (SEO / BIRDLIFE)	Environmental ONG
Unidad Sindical de Usuarios del Júcar (USUJ)	Agricultural water user
Unión General de Trabajadores (UGT)	Economic & Labor Organizations
WWF / ADENA	Environmental ONG

Xúquer Viu	Environmental ONG
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Table 1. List of stakeholders participating in the planning phases of the river basin management plan (Source: [CHJ, 2025](#)).

The stakeholder list analysed provides the following count of agents (Table 2)

Classification	Count
Public Water Authorities & Infrastructure	7
Environmental ONG	6
Government	6
Agricultural water user	6
Economic & Labor Organizations	4
Urban water demand	3
Community & Consumer Interests	2
Research & Technical Support	1
Electricity producer	1

Table 2. Classification of stakeholders participating in the planning phases of the river basin management plan.

Numbers show a dominance of public and agricultural entities. Public Water Authorities & Infrastructure (7 entities) and Government (6 entities) represent a significant portion of the stakeholders (13 out of 36). This indicates a strong presence of public sector bodies involved in water governance, policy-making, and infrastructure management. This is typical for river basins, especially in Spain with its well-established Confederaciones Hidrográficas, but their combined weight suggests that formal, institutionalized actors heavily influence water management.

Agricultural Water Users (6 entities) is also a substantial group, given that agricultural water demand accounts for 80% of total use in the basin. Their presence is crucial for implementing water policies on the ground and reflecting the needs of the largest water user sector. In that regard, large agricultural groups like the Unidad Sindical de Usuarios del Júcar (USUJ), with over 40,000 members, and the Junta Central de Regantes de la Mancha Oriental (JCRMO), with approximately 1,400 members, often dominate the engagement and discussions processes around water allocation, land use and drought management strategies.

Environmental NGOs, while numerous (6 entities), often have fewer resources and less institutional power compared to large agricultural unions or government bodies. Their collective presence, however, highlights an active environmental voice advocating for ecological water flows, biodiversity, and sustainable practices. Urban water demand is represented by 3 entities corresponding to major city councils.

The sheer number and diversity of stakeholders, point to a complex multi-level

governance structure involving national, regional, and local government bodies, public companies, user associations, and civil society organizations. This complexity requires robust mechanisms for coordination and conflict resolution.

4. Citizen engagement in the Jucar River Basin

4.1 Stakeholder vs citizen engagement in the Jucar River Basin

Citizen engagement in water management is defined as the active, intentional dialogue between citizens and public decision-makers, often initiated in a top-down process by the government. It aims to increase collaboration to improve public services and policy programs, focusing on the general public and end users. Stakeholder engagement, conversely, encompasses a broader range of actors, including governmental bodies, private sectors, non-profits, and other groups with a direct or indirect interest in water-related issues, capable of influencing outcomes positively or negatively.

The InnWater project explicitly addresses this distinction. Stakeholder engagement includes actors like large agricultural associations, hydroelectric companies and long-term institutional investors, institutionalized through frameworks like the 1992 Dublin Principles and the European Water Framework Directive. Citizen engagement, however, focuses on end users, with examples including town hall meetings, citizen conferences for policy reform, and social protests against water projects. Involving the general public and marginalized groups, particularly end users, in decision-making often involves a top-down approach initiated by the government, aiming for active dialogue. Providing clear, comprehensive information is crucial, especially for underrepresented groups like youth, the poor, women, indigenous people, and remote communities, as highlighted in water governance principles (OECD, 2018).

As showcased in section 3.2, the large number and inherent diversity of stakeholders within the Jucar River Basin, while ostensibly promoting a holistic approach to water governance, paradoxically present significant impediments to effective citizen engagement, particularly for marginalized and small groups. The complexity arising from a multitude of actors, each with distinct interests, technical knowledge, and operational modalities, creates an intricate landscape that is challenging for the average citizen or smaller, less formalized organization to navigate effectively.

This structural complexity is compounded by a pronounced disparity in resources. Dominant entities, such as large agricultural associations and established public authorities, typically possess dedicated personnel, substantial funding, and well-entrenched communication channels. In stark contrast, environmental non-governmental organizations, small-scale agricultural users, urban residents, and other vulnerable segments of the population often lack comparable institutional capacity, financial backing, or access to the technical expertise necessary to engage meaningfully beyond a superficial level. This resource imbalance transforms the invitation to participate from an opportunity into a potential burden, effectively excluding those who cannot afford the time, effort, or specialized knowledge required.

Furthermore, pre-existing power imbalances within the basin's governance framework

exacerbate these challenges, risking the perpetuation of an engagement process characterized by tokenism rather than authentic influence. When historically dominant groups, as evidenced by their numerical strength and institutional entrenchment, largely shape the agenda and discourse, the voices of less powerful actors can be easily sidelined or merely acknowledged without substantive integration into decision-making. This phenomenon can lead to the "elite capture" of participatory mechanisms in the Jucar River Basin, where formal inclusion does not translate into equitable power-sharing or impact. The absence of robust, deliberative mechanisms designed to mediate conflicting interests and foster genuine citizen participation, rather than merely accommodating the most powerful, further entrenches these disparities.

Consequently, the intricate web of stakeholders, coupled with these inherent power asymmetries and resource deficits, can indeed hinder the potential for broad-based citizen engagement. This ultimately undermines the legitimacy and effectiveness of water management outcomes in the Jucar River Basin. A truly inclusive governance model would necessitate targeted interventions, including dedicated capacity-building initiatives, equitable resource allocation for participation, and a fundamental re-evaluation of engagement methodologies to ensure that all voices, particularly those traditionally marginalized, are not only heard but genuinely empowered to shape the basin's water future.

4.2 Local community engagement assessment and identification of local challenges

This section details the efforts following Step 2 of the InnWater methodological guidelines to set up a citizen engagement roadmap. It presents the findings from our initial community engagement assessment, focusing on the lived experiences and unique challenges faced by marginalized groups and local communities within the city of Valencia and the surrounding towns.

The city of Valencia and the metropolitan area extensive metropolitan area and surrounding towns in the Comarca de l'Horta (comprising L'Horta Sud and L'Horta Nord), forms a densely populated region. This area is home to approximately 1.7 million inhabitants (INE, 2024), all of whom primarily rely on the Jucar River Basin for their vital water supply. Specifically, around 75% of the potable water for this entire metropolitan region is sourced from the Jucar River via the Canal Jucar-Turia, underscoring a deep and critical dependence on this river basin's health and management (see Figure 2, Valencia District Urban demand area).

Beyond urban consumption, the waters of the Jucar system are also indispensable for the rich agricultural activities that define much of the surrounding landscape, particularly in the fertile plains of L'Horta Sud and L'Horta Nord. L'Horta de València includes parts of the Albufera Natural Park and is recognized by the Food and Agriculture Organization of the United Nations (FAO) as a Globally Important Agricultural Heritage System (GIAHS) since 2019, celebrated for its historical irrigation systems dating back to the Islamic period and its role in sustaining local food security and biodiversity. This traditional agricultural heartland, famous for its citrus groves, rice fields and diverse orchard products, faces intense competition for water resources, especially amidst

chronic water scarcity exacerbated by climate change.

The vulnerabilities inherent to this area were tragically underscored by the Valencian floods of October 29, 2024. This catastrophic event, which claimed 228 lives and caused extensive damage to urban infrastructure, homes, and agricultural lands, exposed significant weaknesses in existing urban planning, flood resilience strategies, and governance mechanisms. Crucially, these impacts were disproportionately borne by already marginalized communities. Although the interviews conducted for this study were designed to explore broader water management challenges within the basin, the profound impact of the recent floods led many interviewees to focus predominantly on this event, highlighting its pervasive influence on perceptions of governance and resilience.

Our approach aimed to move beyond traditional stakeholder consultations to genuinely amplify the voices of those often excluded from water and urban planning decision-making processes. Through targeted outreach and interviews, we engaged with representatives and members from a selection of associations representing various marginalized and local communities, including:

- Organizations supporting women.
- Associations supporting the youth.
- Associations providing aid and support to the elderly.
- Associations providing aid and support to migrants.
- Associations providing aid and support to homeless people.
- Associations for the support to ethnic minorities.

A comprehensive list of the existing associations registered within the city of Valencia is provided in the Annex¹, though not all listed associations were contacted for this study. The insights gathered from these communities underscore critical gaps in current water and urban planning, revealing how systemic issues may disproportionately affect these communities. We also connected with local environmental associations that, while not falling under the aforementioned categories, share many of their concerns and can add valuable insights on the main challenges for water-related governance issues at the local level.

Following we summarize the outcomes of these interviews for the groups from which we obtained valuable insights: organizations for the support of women, youth, the elderly, migrants, homeless people, and finally local environmental associations.

4.2.1 Outcomes from organizations supporting women

While specific challenges directly tied to gender in daily water access may not always manifest as overtly as in some other global contexts, our engagement with organizations supporting women in Valencia revealed a consistent pattern: a perceived

¹ Note InnWater's authors : we did not provide this long list here, but it can be shared upon demand.

underrepresentation of women in formal water governance bodies and decision-making processes. Representatives from these organizations feel that their voices are largely absent from high-level discussions on water allocation, infrastructure planning, or urban and flood prevention policies.

Beyond the representation and governance challenges, the interviews underscored an often invisible layer of burden and vulnerability that disproportionately impacts women in Valencia, particularly in times of crisis and in their roles within households and communities. As said by a member from a Valencia women's aid association: *"After the floods, many women in our community had to take care of our children and elderly without running water, walking kilometres for clean supplies, and managing the emotional toll of the disaster"*. As primary caregivers, women often bore the additional weight of ensuring family and community well-being. This constant stress, coupled with potential heightened risks in temporary shelters or areas with disrupted public services, created a significant extra toll that may be repeated in future events.

4.2.2 Outcomes from organizations supporting the youth

Engagement with associations supporting the youth in Valencia revealed a generation acutely aware of the multifaceted challenges facing their region's water future. While the catastrophic events of October 2024 certainly amplified their concerns, young people are deeply troubled by the long-term implications of chronic water scarcity in the Jucar River Basin, the increasing frequency of extreme weather events, and the perceived lack of meaningful inclusion in decisions that will profoundly shape their lives.

A significant challenge articulated was the disruption to education and the loss of vital social spaces cause by the October 2024 floods. In particular, school closures and damages to community facilities across affected areas like Paiporta and Catarroja hindered learning and deprived youth of crucial environments for social and emotional development. Crucially, youth involvement in the immediate response to the 2024 floods was certainly a testament to their community spirit and resourcefulness. In the harrowing days following the floods, countless young people stepped up, spontaneously organizing themselves into groups to clean streets choked with mud and debris. They brought food and clean water to older people trapped in their homes, navigated flooded areas to check on vulnerable neighbours, and contributed to the massive clean-up efforts across their towns. However, after the disaster, they feel forgotten: *"We organized street-by-street clean-ups after the DANA, also bringing food and water to those who couldn't leave their homes for days. But when it comes to long-term urban planning and how to prevent the next disaster, no one cares about what young people have to say."*

Following that line, while using a broader lens, a common concern among young interviewees was the lack of genuine engagement opportunities in water and urban planning processes. Young people feel that existing participatory mechanisms are often superficial, outdated, geared towards adults, and fail to translate their ideas into tangible policy changes. Despite their high stake in climate-resilient policies, their innovative perspectives and long-term vision are rarely tapped into by bodies like the

CHJ or local municipalities. A representative from a Valencian youth and environmental organization articulated this frustration clearly: *"We're the ones who'll face worse droughts and floods in the future, but public consultation feels designed for older people, not us. We have ideas, but no one asks, and the language is often too technical."*

Certainly, there is a palpable sense of climate anxiety among the youth. The increasing frequency of droughts and the recent devastating floods heighten their concerns about long-term water security and the overall liability of their future in the region. Despite this deep concern, they often lack accessible platforms or feel their advocacy is dismissed, leading to feelings of powerlessness. As one young activist involved in past local Fridays for Future mobilization shared: *"We've seen heatwaves and drought getting worse every year, and now these devastating floods. It's our future that's on the line, but when we try to speak up, we're often told we don't understand the complexities. We live the complexities every single day, and we want to be part of the solution, not just the generation that inherits the problems."* This sentiment underscores a critical need for meaningful intergenerational dialogue and genuine empowerment of youth in water and urban planning.

4.2.3 Outcomes from organizations supporting elderly

Engagement with associations providing aid to the elderly in Valencia highlighted a demographic especially vulnerable to the impacts of heatwaves but also concerned by chronic water scarcity and sudden events like the floods of October 2024, where over half of the victims were aged 70 or older. While the daily reality of water management might seem stable in non-crisis times, the sudden disruption experienced during the extreme flood event exposed deep fragilities in the system and a concerning lack of consideration for their specific needs in emergency planning.

Beyond the immediate and devastating impacts during the floods, which many recalled vividly during the talks, members of these elderly associations expressed a strong desire to contribute their invaluable insights to plans for improving urban design and water management. They possess a rich repository of lived experience and historical memory, with many intensely recalling the Great Flood of 1957, which inundated Valencia, motivated the diversion of the Turia River south of the city, and left a lasting imprint across generations.

Regarding citizen engagement efforts, they do not feel adequately addressed by the authorities and admit that they struggle to follow most modern digital communication channels and complex bureaucratic procedures. These collective insights reveal that while the elderly may not be actively seeking to participate in technical water management, their lived experiences and profound vulnerabilities demand a proactive and tailored approach to ensure their safety, while the incorporation of their unique knowledge into resilience and alarm planning could prove invaluable for long-term planning.

4.2.4 Outcomes from organizations supporting migrants

Our engagement with associations providing aid and support to migrant communities in

Valencia revealed a group heavily affected by the floods of October 2024, while also concerned about the impact that drought and future floods may have for agricultural and economic activities in the region. Their situation is often compounded by precarious housing, fluctuating legal status, and a systemic lack of formal representation, rendering their contributions to governance largely unseen and their needs frequently unmet in official processes.

Towns in southern Valencia affected heavily by the October floods had a significant proportion of migrant population working in small businesses, or the surrounding industrial and agricultural areas. As a result of this, many migrant workers' livelihoods were heavily impacted by the flood impact. While governmental aid has been deployed since the event, migrants face bureaucratic hurdles in accessing recovery aid, including water infrastructure repairs. An underlying fear of interactions with authorities, even when seeking assistance, often prevents engagement with official bodies.

Adding to these acute challenges, the increasing cost of living and increasing rental prices in Valencia emerged as a significant compounding factor, as expressed by members of this collective. While not a direct water-related issue, the rapid escalation in housing costs places immense financial strain on migrant households, many of whom already face economic precarity. This mounting pressure on their limited budgets means that any additional financial burden, such as higher water tariffs or unforeseen expenses due to water infrastructure disruptions, severely impacts their overall stability and ability to cope with environmental shocks. This was a point frequently raised by aid organizations, as one spokesperson explained, *"Even when they find work, the rents are so high now that it leaves nothing left for emergencies. How are families supposed to afford basic water bills or food when more than half their income goes to rent?"*

Ultimately, the insights from migrant support organizations underscore the urgent need for inclusive policies that address both immediate crisis response and long-term equitable access to resources, ensuring their safety and dignity.

4.2.5 Outcomes from organizations supporting homeless people

Our engagement with organizations providing aid and support to homeless people in Valencia revealed a population facing the most acute and compounded vulnerabilities when it comes to water access, sanitation, and resilience against environmental shocks. With around 800 registered homeless people in the city alone, according to data collected by the municipality (Gallén-Granell et al., 2024), homeless populations are entirely absent from participatory processes.

For individuals experiencing homelessness, the absence of stable shelter and basic infrastructure translates into an existential precarity, making them exceptionally exposed to the impacts of both chronic urban water challenges and extreme weather events, including heatwaves and floods. A fundamental and constant challenge is the limited access to clean water and sanitation. Homeless individuals rely heavily on public fountains, which may be unreliable or damaged, or on the generosity of shelters and businesses. The October 2024 floods severely exacerbated this, rendering many public

water points unusable or inaccessible. This immediate cut-off from basic services escalated an already desperate situation, highlighting a significant oversight in emergency provisions. A volunteer from a homeless aid collective articulated this: *"After the floods, many public fountains around the city were broken, and [they] had nowhere to get clean water for days. The Municipality doesn't have a plan for this situation. It's like they are not part of the city."* Access to contaminated floodwaters and the lack of facilities for basic hygiene significantly increases the risk of waterborne diseases, skin infections, and other serious health complications, according to voluntaries.

Furthermore, the inadequacy of early warning systems and accessible shelter options during the 2024 floods left homeless people dangerously exposed. Many had no means to receive timely alerts, and the available emergency shelters were often not equipped to handle their needs or were simply unknown to them. These collective insights underscore that for the homeless population, water security and urban resilience are not abstract concepts but immediate matters of survival and dignity. Their systemic marginalization in planning processes leaves them at the extreme front line of environmental impact.

4.2.6 Outcomes from organizations of small farmers, environmentalists and for the protection of endangered cultural heritage systems

While the preceding sections focused on directly marginalized communities, our engagement also extended to small-scale organizations that champion the interests of citizens and endangered elements—such as Valencia's natural spaces, its unique L'Horta agricultural system and the traditional acequia network it sustains, critical aquatic ecosystems like L'Albufera, and the intangible cultural heritage intrinsically linked to water use—within the broader Valencian context.

The full list of organizations addressed is available in the Annexes. It includes small agricultural cooperatives from L'Horta de València and a range of environmental, cultural and ecological activist groups. These organizations, though not facing marginalization in the same socio-economic or identity-based manner as other groups, represent a deep-seated connection to the land and its resources, advocating for heritage, livelihoods, and ecological health often threatened by dominant development paradigms.

Our conversations with these organizations revealed a complex interplay of challenges and a shared vision for a more integrated approach to managing Valencia's vital resources. For the small-scale farmers and traditional irrigators, particularly those working within the ancient acequia irrigation systems of L'Horta, the connection to water is ancestral and existential. They articulate profound concerns over chronic water scarcity in the Jucar River Basin, observing its direct impact on their agricultural yields and the viability of their family farms. A pervasive fear among these organizations is that the pressing issue of water scarcity, coupled with the drive for agricultural "efficiency," will increasingly motivate lobbyist and the CHJ to accelerate the modernization of traditional irrigation systems. This trend, which has been steadily advancing over recent decades with the promotion of pressurized systems like drip irrigation, risks

fundamentally eroding the millennia-old heritage of Valencia's acequia network. They worry that while modernization aims for technical efficiency, it often overlooks the broader ecological functions of the traditional system—such as groundwater recharge and maintaining the unique L'Horta landscape—and fundamentally alters the communal governance structures that have sustained it.

Compounding these pressures, the eroding economic margins of farming, coupled with persistent water scarcity and the reluctance of younger generations to continue family agricultural traditions, are leading to a concerning trend of land abandonment within L'Horta. This phenomenon not only threatens the region's food security and iconic landscape but also weakens the very fabric of the traditional water management system, as fewer hands are available to maintain the intricate acequia network.

Environmental and ecological activist groups advocate for the preservation of the Jucar River Basin's ecological integrity, particularly the L'Albufera Natural Park and the L'Horta landscape. These groups criticize the over-reliance on “grey infrastructure” (such as concrete-based flood control measures) and advocate for nature-based solutions that respect natural floodplains and ecosystems. They argue that unsustainable water management and urban encroachment have degraded critical wetlands noting: *“L'Albufera is dying from lack of fresh water, and that impacts everyone, not just the birds”*. Both farmers and environmentalists share a common frustration with the tokenistic nature of citizen engagement in water governance, where their input is solicited but rarely integrated into decision-making processes. This marginalization undermines the incorporation of traditional and ecological knowledge into policy frameworks, hindering the region's adaptive capacity.

On that regard, the Ley de la Huerta de València, enacted in 2018 under the Botànic government (left leaning coalition), aimed to protect over 10,000 hectares of agricultural land, promote sustainable farming, and safeguard cultural heritage through mechanisms such as the Consell de l'Horta and the Plan de Desarrollo Agrario. However, in February 2025, the Generalitat Valenciana, under the leadership of Carlos Mazón and supported by the PP and Vox (right leaning coalition), introduced significant amendments to this law, citing deficiencies exposed by the October 2024 DANA floods.

The administration argues that the original law's bureaucratic requirements, such as mandatory environmental and landscape integration reports, have significantly delayed essential flood-prevention works, including the channeling of key ravines like El Poyo and La Saleta. These delays, they claim, exacerbated the catastrophic impacts of the October 2024 floods. By eliminating the binding nature of these reports and streamlining administrative processes, the government seeks to enable urgent hydraulic interventions to enhance flood resilience. Additionally, the current administration justifies the reform by highlighting the law's failure to regenerate agricultural areas, noting that in six years, only one ineffective recovery project was approved. The modification also aims to address the post-DANA housing crisis by allowing residential and public service developments in degraded huerta zones (grade 3), while still requiring a portion of land to remain agricultural.

The revised law abolishes the Consell de l'Horta, the governing body responsible for

enforcing agricultural protections, and removes the binding nature of landscape impact assessments by relevant governing bodies. Critics among the environmental organizations we contacted, and opposition parties argue that this facilitates urban development on approximately 3,800 hectares of previously protected agricultural land, representing a third of L'Horta's safeguarded territory. The authorization to initiate residential and recreational developments in Huerta grade 3 areas, raises concerns about uncontrolled urbanization and "touristification". The current administration argues that the Consell de l'Horta has proven inoperative and redundant, leading to its dissolution to reduce bureaucratic overlap and presented as a pragmatic response to both environmental and social challenges.

The modification has also paralyzed the development of the L'Horta de València product brand, a long-standing demand of the agricultural sector to enhance the competitiveness of local produce in global markets. A spokesperson contacted emphasized that the brand was critical for guaranteeing product quality and reinforcing the region's agricultural identity, lamenting the loss of investments made toward this initiative. This setback exacerbates the economic vulnerabilities of small-scale farmers already grappling with water scarcity and flood-related losses.

Environmentalists have also called for the restoration of water supply to the wetland areas, highlighting the neglect of traditional irrigation systems like the acequias, which are integral to L'Horta's agricultural heritage. The legislative changes prioritize large-scale hydraulic infrastructure to prevent flooding, such as the reconstruction of the Barranco del Poyo and La Saleta, over the maintenance of these historic systems, further marginalizing traditional practices.

The amendments have sparked significant public backlash and protests demanding a halt to the law's derogation. Demonstrators, organized by some of the organizations interviewed, carried banners with slogans like "Sota l'asfalt L'Horta" ("Under the concrete, L'Horta") or "*Volem l'Horta viva, no terra morta*" (We want a living Horta, not dead land), emphasizing the cultural and ecological value of the region (Figure 4). Legally, the revisions face a constitutional challenge, with the Constitutional Tribunal admitting a recourse filed by opposition parties in June 2025, arguing that the decree exploits the DANA floods to justify urban development without environmental or technical justification. Critics assert that the law violates the principle of non-regression in environmental protection and undermines L'Horta's role as a natural flood buffer.



Figure 4. Demonstration against the repeal of the L’Horta Law, February 2025 (Source: Photograph Valencia Plaza).

The opposition between environmental and cultural groups and the current administration reveals a critical tension between development-driven policies and the preservation of agricultural and ecological heritage. Farmers and environmentalists advocate for a governance model that integrates traditional knowledge and nature-based solutions, emphasizing the role of L’Horta and its acequias in food security, biodiversity, and flood mitigation. However, they claim that the legislative changes prioritize urban and economic interests, potentially compromising the region’s resilience to climate change and its cultural identity. The abolition of the Consell de l’Horta and the relaxation of land protections signal a shift toward a more permissive urbanistic framework, which opposition groups argue disregards the ecological and social value of L’Horta. The protests and legal challenges underscore a broader demand for meaningful citizen engagement in water and land governance.

The 2025 revision of the Ley de la Huerta, while framed as a response to the DANA floods, risks exacerbating the marginalization of farmers and environmentalists by prioritizing large-scale infrastructure and urban expansion over sustainable, community-driven solutions. To achieve resilience, future water and land governance must integrate the traditional knowledge of farmers, the ecological advocacy of activists, and robust stakeholder engagement, ensuring that L’Horta remains a living, productive landscape rather than a relic of the past, while also guaranteeing safe housing and flood protection. The ongoing challenge and public mobilization highlight the urgency of reevaluating these policy changes to safeguard Valencia’s unique agricultural and cultural legacy

Both farmer and environmental organizations share a profound frustration with the current state of citizen engagement in water governance. They often report that their

participation in formal planning processes, while sometimes invited, frequently feels tokenistic. Their input, particularly when advocating for traditional methods or nature-based solutions, is perceived as being heard but rarely genuinely integrated into final decisions. As a volunteer expressed, *"They ask for our opinion, but then they approve projects that destroy more green spaces. Citizen engagement needs to be meaningful, not just a checkbox for a consultation process."* This sentiment underscores a critical gap: despite their intimate knowledge of the local environment and their deep commitment to its long-term health, these stewards of Valencia's land and water feel consistently marginalized from the core decision-making tables. Their combined voices emphasize that the future resilience of the Jucar River Basin and Valencia depends not only on technical solutions but also on respecting and integrating the vital knowledge and interests of those most closely tied to its natural and agricultural heritage.

Additionally, a critical point highlighted by an environmental organization from Valencia is that participation is typically initiated only after a plan or project has been fully drafted, limiting community input to mere suggestions rather than foundational contributions. This late-stage involvement means that core objectives are often misaligned with community needs and desired outcomes from the outset, as they are not defined through collaborative processes. Meetings are also characterized by highly technical language, inaccessible formats, and inconvenient timings or locations, effectively excluding those without specialized knowledge, flexible schedules, or easy transport. This creates a "checkbox" approach to participation, where community input is gathered but rarely feels genuinely integrated into decision-making, leading to widespread frustration and disengagement. Moreover, the administration often fails to adequately identify and proactively engage non-profit organizations that hold legitimate interests over a project, relying instead on a passive, reactive approach to participation.

A severe practical barrier, particularly for non-profit organizations, is the lack of adequate resources for effective engagement. These organizations often rely heavily on volunteer work to perform the detailed analysis and evaluation necessary to respond meaningfully during official public participation periods. However, the time, technical expertise, and financial resources required for such rigorous parallel evaluations are frequently insufficient, making it impossible for them to provide comprehensive and timely feedback.

Finally, a particularly concerning trend highlighted by several organizations was the misuse of "urgency" as an excuse to bypass public participation processes. This has been notably observed in interventions and legislative changes introduced in the wake of the 2024 DANA. The regional government has, in some instances, pushed forward projects and modified regulations without proper public consultation, citing the immediate need for action. This practice undermines democratic principles; while urgency may occasionally necessitate expedited procedures, it must never serve as a blanket justification for the systematic exclusion of citizens, and requires rigorous, independent verification.

4.3 Challenges and recommendations to foster citizen engagement processes in the JRB

The preceding analysis of voices from diverse marginalized groups and environmental organizations in Valencia and its surroundings reveals a critical disconnect between current water and urban planning governance and the lived realities of its citizens. While there is a clear desire for engagement from all segments of the population, systemic barriers consistently impede meaningful participation. This section follows Step 3 of the InnWater's methodological framework. The objective is to synthesize the challenges, propose concrete recommendations and define a roadmap to foster more inclusive, equitable, and effective citizen engagement processes within the Jucar River Basin and the Valencian metropolitan area.

4.3.1 **Key challenges in citizen engagement**

Several overarching challenges emerged from our interviews, highlighting the need for a fundamental re-evaluation of current engagement paradigms:

The most pervasive challenge is the lack of genuinely participatory mechanisms, often leading to a sense of tokenism among community members. Consultations are frequently perceived as superficial, designed more for compliance than for substantive input and initiated too late in the process, typically initiated only after a plan or project has been fully drafted. This lack of involvement during the initial phase means that objectives are often misaligned with community needs and desired outcomes from the outset, as they are not defined through collaborative processes.

Furthermore, meetings are often characterized by highly technical language, inaccessible formats, and inconvenient timings or locations, effectively excluding those without specialized knowledge, flexible schedules, or easy transport. This creates a "checkbox" approach to participation, where community input is gathered but rarely feels genuinely integrated into decision-making, leading to widespread frustration and disengagement. Compounding this is the issue of information gaps and communication failures. Official communications regarding water management, urban development, or critical emergency warnings often fail to reach vulnerable populations effectively. The digital divide disproportionately affects the elderly and low-income households, while language barriers can alienate migrant and ethnic minority communities.

A significant systemic issue is the exclusion and underrepresentation of marginalized voices in formal governance bodies. This absence means that policies are often formulated without considering their unique vulnerabilities, practical needs, or the disproportionate impacts they face during water crises or from urban development. For some, like migrants and the homeless, a deep-seated fear of authority or the lack of formal identification further compounds their inability to engage. Furthermore, there is a consistent disregard for local and traditional knowledge. Technical expertise is frequently prioritized over the lived experience and historical memory held by communities. Even with strong citizen desire to participate, political will and bureaucratic inertia can also hinder effective engagement and implementation of citizen-led ideas. While it is truth that citizens' immediate concerns (post-flood recovery) may clash with the long-term, strategic planning horizons of public administrations, their voices are often disregarded which

causes a sense of frustration and abandonment by the public administration.

Finally, systemic inequalities and compounding socio-economic factors exacerbate all these engagement challenges. Poverty, precarious housing, and the increasing cost of living (particularly for migrants and the homeless) mean that basic survival often takes precedence over civic participation. Economic pressures on small-scale farmers, leading to land abandonment, further weaken the social fabric that sustains traditional water management. Non-profit organizations often face significant challenges in engaging effectively due to limited resources. Relying heavily on volunteers, they lack the time, technical expertise, and funding needed for thorough analysis and evaluation during public participation periods, hindering their ability to provide comprehensive and timely feedback.

4.3.2 Recommendations to foster inclusive citizen engagement

To bridge these gaps and build genuinely resilient and equitable water and urban planning in the Jucar River Basin, the following recommendations are crucial:

Firstly, implement processes of co-development and co-design from the outset of any plan or project. Citizen engagement must begin during the initial stages of objective setting, ensuring that the foundational goals are truly aligned with the needs and aspirations of affected communities. This requires a shift from mere consultation on pre-defined plans to a collaborative environment where stakeholders are empowered to shape the project from its conceptualization. To facilitate this, develop inclusive and accessible participation platforms that extend beyond traditional formal meetings. This entails organizing community workshops and mobile outreach units in local neighbourhoods, offering flexible timings (evenings, weekends), and providing support such as childcare or transport. Information should be provided in multiple languages and accessible formats to ensure broad comprehension. Dedicated, culturally sensitive facilitators should be employed to build trust and encourage participation from all marginalized groups.

Secondly, proactively identify and engage legitimate non-profit local communities and associations. Administrative bodies responsible for developing plans and projects must actively map and engage all relevant non-profit organizations that hold a vested interest in the initiative. This proactive outreach ensures that diverse perspectives are brought to the table early, rather than relying solely on those who can navigate complex official channels. Furthermore, providing adequate resources to non-profit organizations for parallel evaluation could enable them to conduct independent analyses of proposed projects. This support would allow for more robust and informed community responses during official public participation periods, fostering more equitable and substantial dialogue.

Thirdly, mandate comprehensive ex-ante and ex-post evaluation for all projects and plans affecting local communities. Before implementation, a thorough prospective evaluation (ex-ante) should assess potential impacts and alignment with public objectives. Crucially, after implementation, a rigorous retrospective evaluation (ex- post) must be conducted to assess actual outcomes, effectiveness, and unintended consequences. Both

evaluations should actively incorporate citizen feedback and be made publicly accessible.

Fourthly, establish clear criteria and independent verification for "urgency" exceptions.

While extraordinary circumstances may sometimes necessitate expedited procedures, the excuse of "urgency" must not be misused to systematically bypass public participation. Strict guidelines should be put in place, requiring robust, independent justification for any derogation from standard engagement protocols. Bypassing public consultation should always be considered a last resort, reserved for truly exceptional and verified emergencies, with transparency and accountability mechanisms in place for any such decisions.

Furthermore, strengthen communication strategies that leverages not only official digital platforms but also local radio, community-based social networks, and direct outreach through trusted community leaders. Building strong, sustained relationships with community organizations is vital for effective information dissemination and feedback loops, ensuring that projects and plans are received and understood by everyone. Additionally, public administrations must ensure meaningful representation and empowerment within citizens structures. This could involve implementing quotas or establishing dedicated seats for representatives of marginalized groups in key decision-making bodies. Capacity-building programs should be offered to community leaders to equip them with the knowledge and skills to engage effectively in complex policy discussions. Furthermore, creating safe, confidential spaces for engagement can help address the fear of authority that often silences vulnerable voices. Local and traditional knowledge must be valued and systematically integrated. Mechanisms should be established for the formal collection and integration of community insights. Co-creation workshops, where technical experts and community members collaborate and learn from each other, can foster mutual respect and lead to more context-appropriate solutions. Funding research into the efficacy and potential adaptation of traditional practices should also be prioritized. Furthermore, the Jucar Basin and Valencia's metropolitan area involve many municipalities. Coordinating citizen engagement across these administrative boundaries is a complex activity but one required to make sure their voices are heard during the policy making process.

Finally, promote holistic planning that addresses underlying socio-economic inequalities.

Water and urban planning must be integrated with broader social policies concerning housing, employment, and healthcare to address the root causes of vulnerability. This includes prioritizing infrastructure investment in historically neglected neighbourhoods, ensuring equitable distribution of resources and recovery aid, and simplifying bureaucratic processes for accessing support. A shift towards valuing ecosystem services and nature-based solutions, and fostering genuine dialogue between engineers, farmers, and environmentalists, will also be critical for building long-term resilience that benefits all citizens of the Jucar River Basin.

Based on all this, we propose the following Initial Roadmap to enhance citizen in the JRB, concluding Step 3 of the InnWater methodological framework (Figure 5).

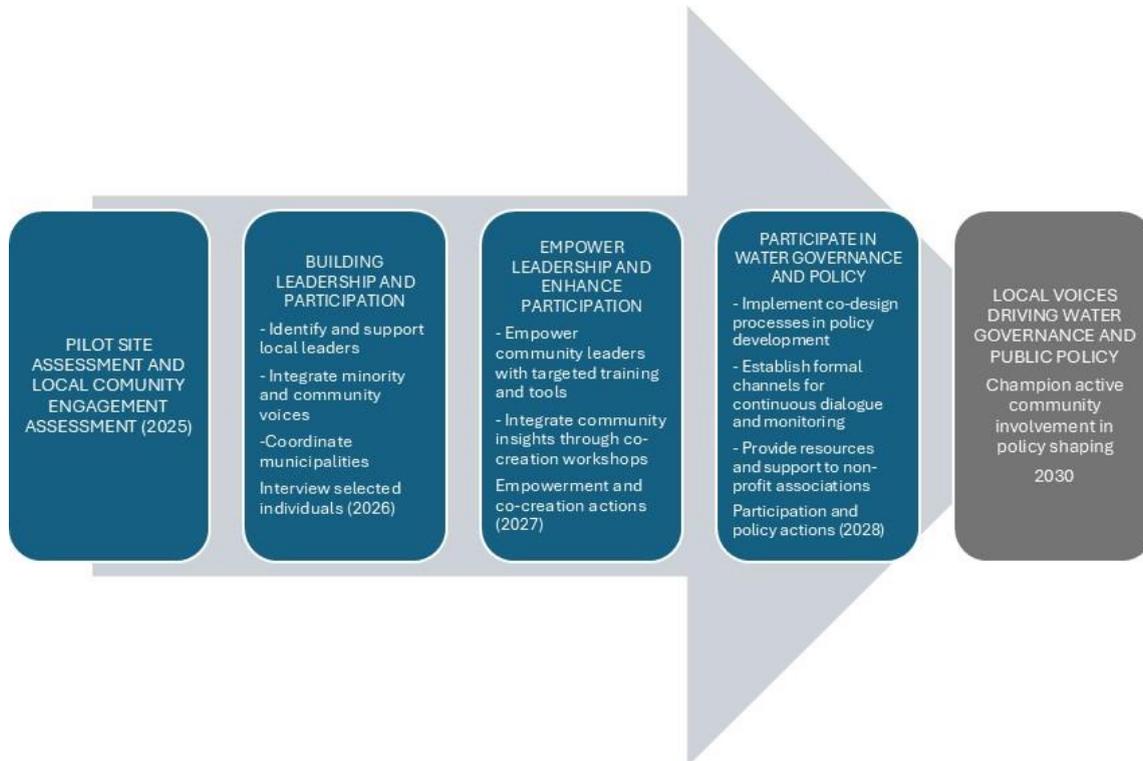


Figure 5. Roadmap for Enhanced Citizen Engagement in the Jucar River Basin Water Governance (2025-2030).

This roadmap outlines the proposal for a phased approach spanning from 2025 to 2030 to build more robust and inclusive participation in water governance and public policy. The roadmap is a preliminary proposal that complements the list of challenges and actions previously listed and based on the insights gathered from our initial, limited engagement with citizens and stakeholders in the region. Its full confirmation and refinement would necessitate broader validation and co-creation with a wider array of community groups.

Conclusions

The findings presented in this report highlight a critical truth: the future resilience of the Jucar River Basin and the metropolitan area of Valencia, particularly in the face of escalating climate challenges like droughts and extreme floods, hinges on a fundamental shift towards more inclusive and equitable water and urban governance. Our engagement with diverse marginalized communities—from women and youth to the elderly, migrants, and homeless individuals—along with the dedicated associations in defense of L'Horta's agricultural and ecological heritage, has brought to light profound systemic challenges. These include the persistent underrepresentation of vulnerable and local voices, the inaccessibility of traditional engagement mechanisms, the disregard for local knowledge, and the compounding pressures of socio-economic inequalities.

The floods of October 2024 caused a profound erosion of public trust in traditional governance structures, making it challenging to engage communities in general discussions about long-term water management so soon after such a traumatic and impactful experience. Furthermore, the swift actions taken to address the crisis and plan new infrastructure to mitigate future events have raised concerns among some

community members about their ability to effectively contribute to public discussions with authorities, especially given the emphasis on urgent responses.

This report, undertaken as part of the InnWater project's replication assessment, aimed to document the usability of its citizen engagement instruments and actions within the distinct circumstances of the Jucar River Basin. The process of assessing these tools in a context as vast and administratively complex as a major river basin presented inherent challenges. The sheer scale, coupled with the deeply entrenched historical, social, and institutional dynamics of water governance in the region, meant that a direct, uniform application of methodologies at the river basin scale was impractical. Nevertheless, this replication effort proved successful on the local scale of Valencia and its metropolitan area. It successfully yielded rich, context-specific qualitative data, offering a nuanced understanding of how existing engagement tools function (or falter) on the ground. This process underscored the critical need for adaptability and local tailoring when transferring social innovation methodologies across diverse European contexts.

Ultimately, the insights gained from this assessment in the Jucar River Basin aim to help achieve the InnWater goal of enhancing and promoting renewed multi-level and cross-sector water governance. This experience also opens several crucial lines of further research: exploring the long-term socio-economic impacts of climate-induced displacement on marginalized communities; investigating the potential for integrating traditional water governance models with modern adaptive management strategies; and conducting quantitative research into the cost-benefits of investing in inclusive engagement processes to demonstrate how early, broad participation can lead to more effective and less costly disaster preparedness and recovery.

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Annex 4: Citizen Engagement instruments and actions - Doñana Natural Area



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Executive Summary

This study constitutes a **Replication Assessment**, which has the aim to apply and evaluate the *Citizen Engagement Assessment* methodology developed within the InnWater project. The methodology combines qualitative and quantitative approaches—including literature review, analysis of legal and institutional frameworks, evaluation of participatory processes, expert interviews, and demographic data—to examine citizen participation in water management.

This report analyzes the current state of citizen engagement in the governance of the Doñana Natural Area, with a specific focus on water management. Doñana, a socio-ecological system of global ecological relevance, is characterized by multiple overlapping interests: conservation, agriculture, tourism, and local livelihoods. Ensuring inclusive, transparent, and effective public participation is therefore essential.

Key findings reveal that although there are formal mechanisms for citizen participation—such as the Doñana Participation Council, public hearings, and EU-funded participatory projects—these are often consultative and lack decision-making power. The Council, while representative, is often criticized for low effectiveness, limited follow-up, and symbolic participation. Hydrological planning is also marked by technical language and limited uptake of citizen inputs.

Local-level participation exists through municipal councils and grassroots platforms, but it remains fragmented and lacks institutional continuity. Several past participatory experiences and EU projects have contributed to awareness and knowledge, yet their influence has been limited.

The report recommends structural reforms to make participation more effective, inclusive, and empowering. Proposed actions include strengthening local participation councils, making the central council's decisions binding, increasing transparency in consultations, using digital tools, improving information access and the implementation of follow-up systems based on indicators.

Overall, the application of the **Citizen Engagement Assessment methodology** demonstrates its value for systematizing analysis and identifying governance gaps. However, its

effectiveness depends on the availability of reliable quantitative data and clearer criteria for evaluating the quality and outcomes of participatory mechanisms.

1. METHODOLOGY AND INTRODUCTION

1.1 INNWATER METHODOLOGY

This report has been prepared using the "Citizen Engagement Assessment" methodology developed within the framework of the InnWater project. This methodology combines a qualitative approach complemented with quantitative data, with the aim of providing a comprehensive view of the state of citizen engagement in the study area. InnWater's proposal implies the application of a replicable and comparable methodology in different case studies. Therefore, this work, called "Replication Assessment", is also intended to serve as an evaluation of this methodology.



Figure 1. Diagram of the InnWater methodology.

In general terms, this methodology offers the following structure [Fig. 2]

- Qualitative analysis of the study site, including:
 - STEP 1: Description of the study site
 - STEP 2: Description of the community
 - STEP 3: Roadmap proposal for citizen engagement
- Quantitative analysis: Clear data will accompany the qualitative analysis.

As stated in the InnWater methodology, the following techniques have been combined to obtain data:

1. Analysis of scientific literature: A review of relevant academic literature on citizen participation, environmental governance and socio-ecological conflicts in Doñana has been carried out. This review, added to extensive previous experience in the study area, has allowed us to contextualise the participatory dynamics in the natural area.

2. Review of institutional documents and websites: Documentary sources issued by the main administrations responsible for the management of Doñana were analysed: the Ministry for Ecological Transition and Demographic Challenge MITECO, the Regional Government of Andalusia, the Guadalquivir Hydrographic Confederation and the Doñana Participation Council. This review has included management plans, regulatory frameworks, official press releases, Council minutes, and informative content available on institutional portals.
3. Consultation of demographic and social statistics: In order to characterise the sociological context of Doñana's area of influence, data from the National Statistics Institute [INE], the Andalusian Institute of Statistics and Cartography
4. IECA and municipal registers were consulted. These data have been used to draw up demographic indicators.

Semi-structured interviews with experts: In-depth interviews were conducted with people with specialised knowledge of citizen participation in Doñana. These interviews, of a qualitative and semi-structured nature, have made it possible to contrast the documentary information, identify critical assessments of the effectiveness of the current mechanisms, and gather proposals for improvement from an informed perspective.

1.2 SITE DESCRIPTION AND CONCEPTUAL FRAME [STEP 1]

Doñana is one of the most emblematic natural spaces in Europe, declared a National Park 1969 and a Natural Park 1989, it also has several international protection figures (Natura 2000 Network, Ramsar, Biosphere Reserve, World Heritage). On the other hand, the region has important economic activities, mainly linked to irrigated agricultural production as well as an important cultural heritage, where religious celebrations related to the water bodies are of great importance.

The search for compatibility between these apparently opposing uses has historically generated tensions in the region, which comprises 13 municipalities and approximately 160,000 inhabitants. For all these reasons, it forms a complex socio-ecological system whose management, in which water plays the most important role, requires participatory planning and the active involvement of local stakeholders, NGOs, scientists, economic sectors, public administrations and citizens in general.

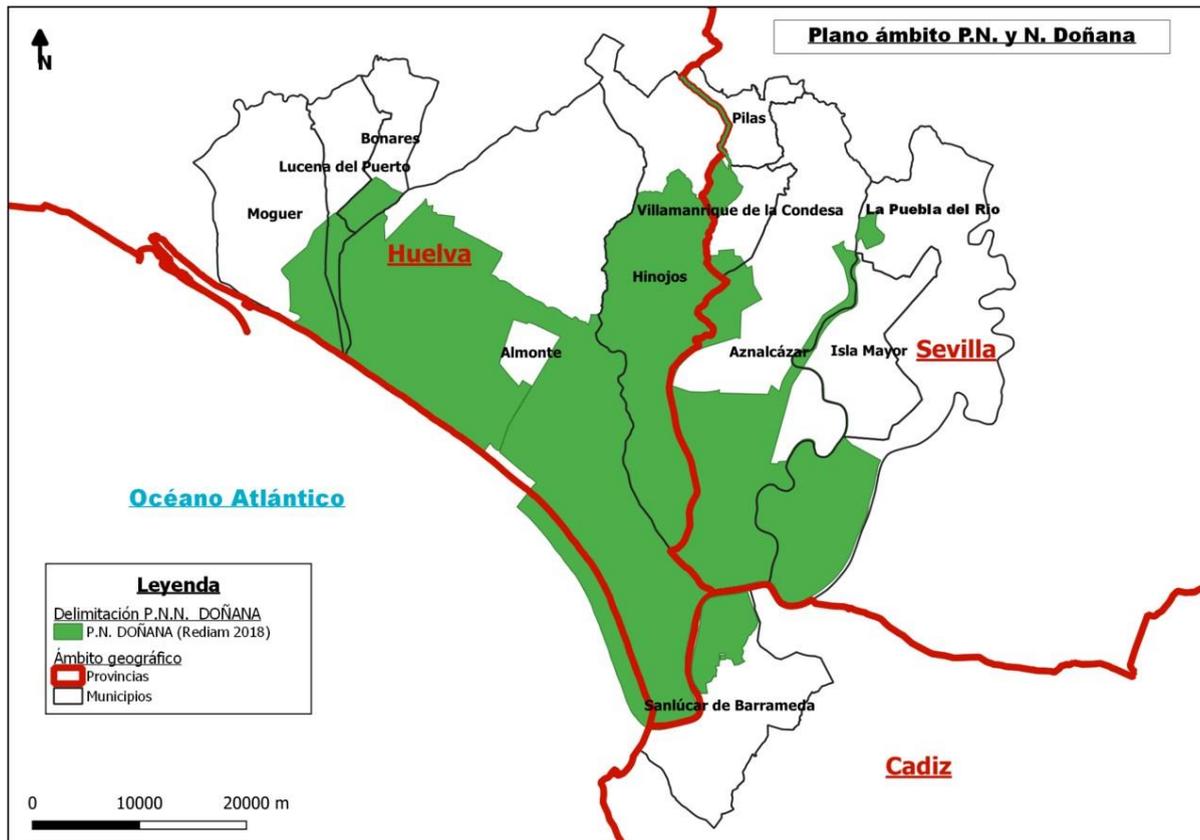


Figure 2. Doñana Natural Area

Citizen participation is understood as the process by which civil society intervenes in public decision-making, either directly or through representative structures. In the context of environmental governance, participation is linked to the capacity of social actors to influence the planning, management and evaluation of public policies that affect their environment.

Different theoretical models exist to classify degrees of participation. One of the most influential is Arnstein's 1969 "ladder of participation", which distinguishes eight levels from manipulation to citizen control, grouped into three main blocks: non-participation, symbolic participation and real participation.

More recent models, such as the one proposed by the International Association for Public Participation IAP2 or the OECD, simplify this classification into three key levels:

1. Information: the administration communicates decisions or data without receiving feedback.
2. Consultation: opinions are collected, but there is no obligation to incorporate them.
3. Active participation: Different models of participation from co-design or citizen empowerment where citizens and institutions jointly design decisions or solutions.

Analysing the state of citizen participation in Doñana implies, therefore, not only identifying the formal channels available, but also critically assessing the real level of influence that these mechanisms allow to the different social actors. This report, therefore, aims to serve as an

analysis of the mechanisms of citizen participation present in the governance of Doñana as a socio-ecological system, paying special attention to water management.

2. CITIZEN PARTICIPATION IN DOÑANA [STEP 2]

2.1 SOCIOLOGICAL ANALYSIS OF DOÑANA

2.1.1 Demographic analysis

Doñana covers a territory that includes 13 municipalities with a total population of approximately 190,000 inhabitants [INE, 2024], of which 160,000 live within the Natural Area. Density varies considerably between localities, with municipalities such as Almonte or Sanlúcar de Barrameda exceeding 20,000 inhabitants, while others such as Hinojos or Villamanrique de la Condesa do not reach 5,000 [Table 1].

The surrounding area shows a progressive ageing of the population (average age > 43 years) and a strong dependence on agricultural employment, especially in the cultivation of red fruits. This context has a direct influence on participation patterns: the most active groups tend to be linked to the agricultural production sector, while youth, rural women and migrants remain under-represented in formal processes.

Municipality	Total Population	Average age
Cádiz		
Sanlúcar de Barrameda	67.269	44,1
Huelva		
Almonte	25.234	41,6
Bonares	6.220	43,5
Hinojos	4.056	44,7
Lucena del Puerto	3.444	39,9

Moguer	22.492	42,8
Rociana del Condado	6.833	44,0
Palos de la Frontera	12.900	39
Sevilla		
Aznalcázar	4.886	45,3
La Puebla del Río	11.871	42,5
Pilas	14.147	41,1
Villamanrique de la Condesa	4.122	46,7
Isla Mayor	5.533	47,9
Total	189.007	43,3

Table 1. Demography of Doñana. INE, 2024

2.1.2 Social actors and their role in participation

Actors	Role/ Description
Administration	
MITECO	Ministry responsible for national environmental policy. It has competences in national parks and water.
Guadalquivir Hydrographic Confederation	River basin organisation that manages water in the Guadalquivir demarcation. Key in hydrological planning.
Doñana National Park	Protected area under joint management, its zoning and conservation are subject to state and regional planning.
Regional Government of Andalusia	Autonomous Administration responsible for the daily management of the Doñana Natural Area, coordinates the Participation Council.
Doñana 21 Foundation	Public Foundation attached to the Andalusian Ministry of the Environment, whose objective is the conservation

	and socio-economic revitalisation of Doñana.
Town and City Councils	Local governments with urban and social competences.
Research	
New Water Culture Foundation	Academic organisation that promotes an ecosystemic and participatory approach to water management. They have developed applied research in Doñana.
Doñana Biological Station [CSIC]	Reference research centre for biodiversity and ecological monitoring. Scientific advisor. Active and influential voice in the Council.
University of Seville	Academic institution with projects focused on Doñana. Provides socio-environmental knowledge.
Pablo de Olavide University	University active in socio-ecological and agricultural research and participatory processes in natural areas.
University of Granada	Contributes with environmental, legal and governance research linked to Doñana.
UAM. Socioecosystems Laboratory	Research group focused on participatory governance and resilience of socio-ecological systems. In 2011 it developed the "Participatory scenarios for Doñana".
IGME	Scientific agency that studies the water systems of Doñana, especially aquifers.
NGOs	
SEO/BirdLife	Environmental NGO specialising in bird and habitat conservation. Very active in denouncing and making proposals about Doñana.
Ecologists in Action	Environmental NGO with a critical and social justice approach. It has been actively involved in legal processes, allegations and social mobilisation around conservation in Doñana.

Save Doñana	Citizens' platform that brings together various social movements in favour of the conservation of biodiversity in Doñana.
WWF	International NGO with a strong historical presence in Doñana, promoting conservation and political pressure.
Agriculture	
ASAJA	Agricultural organisation that defends the interests of the productive sector. Critical of environmental restrictions.
IFAPA	Andalusian institute for agricultural training and research. Provides technical support and training for the primary sector.
Irrigation Communities	Entities that collectively manage the use of agricultural water. They are central actors in the water conflict.
Platform in Defence of County Irrigation (PDRC)	Farmers' group that defends the legalisation of water use. It exerts intense political pressure.
Plataforma de agricultores de la Corona Norte (Northern Crown Farmers' Platform)	Similar to PDRC, with focus on defending access to water and protesting against restrictions.
Culture	
Hermandad Matriz del Rocío	Religious and cultural actor with strong local roots. Symbolic and organisational influence in the area.
Tourism	
Doñana Guides Association	Professional group with an interest in the management of public use and nature tourism. Interested in the conservation of nature in Doñana.
Discovering Doñana	Main ecotourism company offering guided tours. Economic actor in environmental tourism.

Table 2. Map of stakeholders in Doñana.

2.2 INSTRUMENTS FOR CITIZEN PARTICIPATION

2.2.1 **Legal framework**

Citizen participation in the Doñana Natural Area is based on a set of European, national and regional regulations, which recognise the right of citizens to take part in environmental decision-making, although their application has significant limitations.

European legislation

- The Aarhus Convention [1998], ratified by Spain in 2005, is the most important reference framework. It recognises three pillars:
 - 1- Access to environmental information.
 - 2- Public participation in decision-making.
 - 3- Access to justice in environmental matters.

- Directive 2003/35/EC of the European Parliament, reinforces participation in certain plans and programmes related to the environment. This regulation obliges to guarantee "effective and early" participation before final decisions are taken.

State legislation

- Law 27/2006, which regulates the rights of access to information, participation and environmental justice, transposes the Aarhus Convention into Spanish law.
- Law 42/2007 on Natural Heritage and Biodiversity: establishes that the Administrations must encourage social participation in the planning and management of the natural environment, especially in protected areas such as Doñana.
- Water Law [Royal Legislative Decree 1/2001], incorporates mandatory participatory mechanisms in hydrological planning processes, which directly affect Doñana through the Guadalquivir Hydrographic Confederation.
- Law 30/2014, on National Parks: recognises the need to encourage the participation of social and local stakeholders in management.

Regional Regulations

- Law 8/2003 on Wild Flora and Fauna of Andalusia and Decree 23/2007: Establishes mechanisms for public participation in the planning and management processes of protected areas.
- Law 7/2007, on Integrated Management of Environmental Quality
- (Andalusia): Introduces strategic environmental assessment with public participation.
- Law 8/1999, of 27 October 1999, on the Doñana Natural Area: Defines the management and participation bodies.
- Decree 126/2005 and Article 10 of Decree 106/2024 regulate the Doñana Participation Council, a collegiate body of a consultative nature that represents the different actors involved in the conservation and development of the territory.

2.2.2 **Doñana Participation Council**

The Doñana Participation Council is the main participatory body for the management of the Doñana Natural Area. Its existence is regulated by Decree 126/2005, of 10th May, which

establishes its functioning, composition and functions. It is a participatory body attached to the Regional Ministry of the Environment.

Operation

- The Council holds at least one plenary session per year [Fig. 1], although in practice its rhythm has been more irregular. Meetings usually last between 3 and 5 hours.
- There are no standing thematic committees, although they may be set up from time to time to work on specific issues.
- Decisions are taken by consensus or simple majority, although they are often limited to recommendations or non-binding declarations.
- Citizen access to the sessions is limited: although invited guests are sometimes allowed to speak, there is no established mechanism for direct public participation.



Figure 3. Meeting of the Doñana Participation Council [Ecologistas en Acción, 2023].

Composition

The Council brings together representatives of public administrations, environmental NGOs, the agricultural and livestock sector, scientific communities, citizens' associations, the economic fabric and cultural associations [Table 3]. Since 2024, the Council has been chaired by Enrique Mateos, professor of ecology at the University of Seville, who succeeded Miguel Delibes de Castro in this position.

Representative	Nº	Description
Administrations		
Presidency and Vice-Presidency	2	Appointed by the Andalusian Regional Government
General State Administration	10	Appointed by the Central Government

Junta de Andalucía	7	Appointed by the Regional Ministries
Provincial Environment Delegations	3	Representatives from Huelva, Cádiz and Seville
Provincial Councils	3	Representatives of Huelva, Cadiz and Seville
City councils	12	One representative from each municipality that is totally or partially in the END:Almonte, Bonares, Lucena del Puerto, Moguer, Palos de la Frontera, Villamanrique de la Condesa, La Puebla del Río, Aznalcázar, Hinojos, Isla Mayor, Pilas and Sanlúcar de Barrameda.
Public Universities	2	Appointed by the Andalusian Council of Universities.
Conservation		
Director of the Doñana Natural Area	1	Juan Pedro Castellano (2025)
Director of Doñana Biological Station	1	Eloy Revilla (2025)
NGOs	3	WWF, Ecologistas en Acción and SEO/BirdLife
Doñana 21 Foundation	1	-
Economic fabric		
Consumers	1	Appointed by the Andalusian Consumer and User Council.
Business Organisations	2	-
Trade Union Organisations	2	CCOO, UGT, Others
Traditional uses	1	Owners of traditional uses included in the National Park's Master Plan for Use and Management.
Professional Agricultural Organisations	3	ASAJA, UPA, Others
Landowners	2	Includes one landowner with conservationist purposes (Land Stewardship)

Andalusian Hunting Federation	1	-
Culture		
Hermanidad Matriz del Rocío	1	-

Table 3. Composition of the Doñana Participation Council. Prepared by the authors on the basis of Decree 106/2024 and the Minutes of the Participation Council.

Functions:

The Doñana Participation Council has a mainly consultative and representative function, serving as an advisory body in the planning and management of the Natural Area, as well as for channeling social and environmental demands through its constituent groups. The functions of the Council, as defined on the website of the Junta de Andalucía and in the corresponding regulations, are shown in Table 4.

Informative and Consultative Level

- To inform on the plans that affect the planning and management of natural resources, the conservation of flora, fauna and habitats, especially the Sustainable Development Plan and its revisions.
- To report on the Annual Work and Investment Plan, sectoral plans and scientific research programmes.
- To report on actions that may alter the quantity or quality of groundwater and surface water supplied to the area.
- To report on works projects or works not included in the Master Plan or Annual Work Plan.

- To report on the operating regime of the facilities and services of the area.
- To report on collaboration agreements proposed by the management team.
- To report on authorisations for actions not contemplated in the management of resources or the Master Plan.
- To report on the proposed distribution of aid and subsidies in the socio-economic area of the area.
- To encourage, facilitate and channel the participation and initiatives of citizens in the promotion and conservation of the area.
- To propose modifications to the limits of the protection figures that make up the area.
- To gather information on actions and activities carried out in the area related to conservation and public use.

Management Level

- To approve the annual report of activities and results drawn up by the management team, proposing corrective measures.

Representative and Institutional Function

- To promote knowledge and dissemination of the values of the Natural Area.
- To collaborate in the fulfilment of the objectives pursued by the declaration of the Natural Area.
- To ensure compliance with the regulations that affect it and to propose actions or provisions necessary to achieve its objectives.
- To approve its Internal Regulations.
- To agree on the creation of commissions or working groups.

Table 4. Functions of the Doñana Participation Council.

Limitations and proposals for improvement

Despite its broad representation, the Participation Council is mainly informative and consultative in nature, non-binding, but with strong institutional weight. The limitations

of this body in terms of being an effective tool for effective participation include the following:

- Consultative nature without decision-making power: many recommendations are not taken into account by the managing bodies.
- High fragmentation and low operational efficiency: its size makes it difficult to reach agreements and follow up on issues.
- Lack of technical means and permanent resources: it does not have its own staff or technical secretariat.
- Political instrumentalisation: some entities have denounced that the Council is used as an alibi to legitimise decisions already taken.
- Low frequency of meetings and lack of continuity, which reduces its capacity to influence processes in real time.

Different experts and organisations [Bejarano, 2011; WWF, 2010, 2023] have pointed out the need to reform the Council to make it a more operative, plural and useful space for the democratic governance of Doñana. Some proposals for improvement include:

- Creation of permanent working committees.
- Binding role of the decisions taken by the Council.
- Creation of local councils linked to the general Participation Council.

2.2.3 Participation in Hydrological Planning (Guadalquivir Hydrographic Confederation).

Hydrological Planning is the main instrument for the management of water resources affecting Doñana. The management of the water bodies that make up the Doñana Natural Area belongs to the Guadalquivir Hydrographic Confederation CHG, which reports to the Ministry for Ecological Transition. The current hydrological planning process contemplates citizen participation, mainly at the information and consultation levels, as detailed in Table 5. The plan currently in force corresponds to the third planning cycle 2022-2027.

Information level

- The documentation of the plan, including the project, the Strategic Environmental Study, the Outline of Important Issues and the Flood Risk Management Plan, is made available to the public both physically and on the Confederation's website.

- Creation of infographics and explanatory documents to disseminate the content of the Plan.
- Informative webinars.

Consultative level

- The hydrological plan is subject to public consultation for a period of six months, during which time allegations and comments may be submitted.
- Before being submitted to the MITECO, the Hydrological Plan is informed by the Water Council, a consultative body where the administrations, water users, social and environmental organisations of the demarcation are represented. [Royal Decree 1598/2011].

Table 5. Citizen participation in the Hydrological Planning of the CHG.

Limitations and proposals for improvement

Several academic and NGO reports have highlighted important shortcomings in these processes:

- Low traceability and lack of devolution in the incorporation of allegations to the final plan.
- Low representation of environmental and social actors in the Water Council, compared to the weight of large users (irrigation, hydroelectric).
- Occasional participation limited to information and consultation levels, without including instruments for active participation.
- Exclusively bureaucratic consultation procedures and the use of technical language, which hinders the participation of non-specialised groups.

Some proposals for actions that could improve real participation in the Hydrological Planning process include:

- Simplifying and communicating technical documentation in different registers.
- Diversify information channels, for example by holding local explanatory workshops prior to formal consultation periods.
- Include active participation tools in water planning, such as citizen councils, working groups or citizen science programmes.
- Implement monitoring and feedback systems so that contributions are visible in the final plan.

- Give a greater voice to social and environmental entities as opposed to large water users in the Water Council.
- Establish mechanisms for continued participation throughout the water planning cycle, including participatory evaluations of the process itself.

Quantitative analysis

- Inaugural informative webinar with 84 attendees.
- 4 thematic webinars with an average attendance of 25 people.
- 6 face-to-face territorial workshops were held, with an average attendance of 20 people each.

2.2.4 Elaboration of plans and projects: Public hearings, consultations and allegations

In addition to participation in hydrological planning processes, there are also public participation mechanisms associated with the preparation of plans and projects or the approval of regulations affecting the management of the Doñana Natural Area and, therefore, its water resources. For example, in the drafting and approval phases of the Master Plan for Use and Management [PRUG] of the Doñana Natural Area, public disclosure and consultation processes are opened in line with the provisions of environmental regulations (see section 3.1.a).

These tools allow the presentation of allegations by any citizen or entity, through the formal channels set up for each case. Some examples of this type of participation are:

- Public consultation of regulatory projects and subsidies: The MITECO contemplates public hearing periods in regulatory projects, such as those related to subsidies for sustainable territorial development in Doñana. For example, the "Call for grants from the Biodiversity Foundation for environmental improvement in the agricultural and forestry sectors, to contribute to sustainable territorial development in the area of influence of the Doñana natural area" was open to the public between July and August 2024, allowing allegations to be submitted during this period.
- Information and public hearing of plans: During the approval phase of the "Marco de Actuaciones para Doñana" [Framework of Actions for Doñana], a plan with a budget of €356 M a plan with €356 million of environmental investment submitted in November 2023, a period of one month was set aside for comments, until December 2023. These consultations are managed through the publication of documents on official portals and the receipt of comments by email, with formal processes and established deadlines.

Limitations and proposed improvements

In line with what was indicated in the previous section ("Participation in Hydrological Planning"), these tools are embedded in formal procedures and are generally difficult for the general public to access:

- Formal scope but limited in practice: Although there are mechanisms for consultation and reception of allegations, in many processes these contributions are not clearly integrated, and there are no transparent response mechanisms or justification of why they are accepted or rejected, i.e. there is no clear return.
- Low visibility and low citizen mobilisation: These processes tend to have low dissemination, highly technical approaches and short deadlines, which reduces real participation, especially of local groups without technical or informational resources.

Some proposals for improvement include:

- Diversify communication and consultation actions, incorporating tools such as explanatory workshops prior to the consultation, which facilitate access and technical understanding.
- Extend and reinforce the publicity of the processes in order to reach a greater plurality of actors.
- Publish response reports with the list of allegations and the respective decisions on each of them.
- Create participatory spaces for the monitoring and evaluation of the initiatives.

2.2.5 Local Participation

Beyond the formal channels established for participation, participatory actions have been carried out at local level in Doñana, albeit unevenly between the different municipalities and with limited structure and continuity over time. Even so, valuable experiences have been developed that mark the path towards a more active participation, based on the territory and starting from the citizens. Among these experiences, the following stand out:

- Municipal sectoral councils: Some local councils (such as Almonte, Aznalcázar or Bonares) have at certain times promoted sectoral councils or consultation processes for specific issues such as land use planning or the regulation of rural traffic. However, these mechanisms tend to lack continuity and a formalised structure, limiting their effectiveness and advocacy capacity.
- Platforms and local social movements: The emergence of citizen platforms, such as Salvemos Doñana, the Plataforma en Defensa de los Regadíos del Condado or the Plataforma de agricultores de la Corona Norte, has been a significant form of grassroots participation. Between 2020 and 2025 there have been at least 3 major public mobilisations linked to environmental or agricultural demands in Doñana. However, none of these platforms has formal representation in the Council or in technical commissions associated with the planning of the natural area. According to interviews

collected in previous studies [Bejarano, 2011; Torres & Bejarano, 2016], there is a generalised perception of exclusion, especially at the neighbourhood level and among small producers who are not grouped together.

- Permanent Local Councils and City Councils: Organised participation from the municipal level has been a frequent demand in Doñana, both to increase the operability of the Council and to include non-associated citizens in a regulated and continuous way. However, although there are occasional examples of local participation in Doñana, this is still fragmented, dependent on specific initiatives and lacking consolidated structures that guarantee the sustained inclusion of citizens in decision-making. In order to improve environmental governance in Doñana, it is necessary to strengthen and institutionalise participation mechanisms at local level.

2.2.6 Experiences of participatory processes in Doñana

Since the creation of the END, occasional participatory processes have been carried out in connection with the development of action plans and public policies. Although these, although ad hoc and in general not very complete and binding, have been enriching experiences that have contributed to creating a culture of participation in the region, although they can also be associated with a generalised weariness and lack of motivation for participation among the population, as their contributions have not been reflected. Among these experiences, the following stand out:

- Agricultural dialogue process in Condado de Huelva [2014-2018] this was a multi-stakeholder initiative to address agricultural uses and illegal water use, which affect the Doñana environment, mainly with the aim of agreeing measures for the regulation and closure of illegal wells. The main outcome of this process was the drafting of the "Pacto por Doñana" signed in November 2023. During the participatory process, technical roundtables and periodic assemblies were implemented, including sectoral hearings with farmers, authorities and environmental technicians.
- Participation Forum for the elaboration of the II PDS, 2005-2008 One of the most extensive participatory processes carried out in Doñana. Its main objective was the participatory design of the Action Plan within the 2nd Doñana Sustainable Development Plan. In addition, its implementation served as the basis for a series of subsequent actions, such as the "Conference-Colloquium Doñana Ecosocial: In Doñana We All Decide" [2010].
- Process of elaboration of the I Doñana Sustainable Development Plan 1994-2006
- Environmental Forum, January 2001

2.2.7 European projects with a participatory approach

Projects such as [LIFE ADAPTAMED](#), [LIFE INTEMARES](#) or [LENSES PRIMA](#) include participatory mechanisms to co-design adaptation or conservation measures with the agents involved and the population. Although these projects are useful as demonstration pilots for the incorporation of participatory processes in natural resource management, they usually have little institutional continuity as the creation of permanent structures is not guaranteed after the end of the project.

3. RECOMMENDATIONS FOR STRENGTHENING CITIZEN PARTICIPATION (STEP 3)

Based on the analysis developed in the previous chapters, a list of priorities for action, both structural and cultural, has been established to strengthen citizen participation in Doñana. In addition, a proposed roadmap has been drawn up [Fig. 4], which organises these recommendations in a timeline, based on its own criteria. This proposal can serve as a basis for further work, in which a prioritisation of this list of recommendations is carried out based on different criteria - such as impact, feasibility, cost or political will - with the aim of designing a more robust and applicable roadmap.

Recommendations:

- Have specialised technical support in participatory processes, incorporating territorial dynamisation, community mediation and facilitation.
- Expand environmental education actions to foster a participatory culture from the grassroots level.
- Facilitate access to information and adapt formats for different audiences.
- Encourage the creation of permanent and not only sectoral spaces for dialogue, open to citizens with prior information and pedagogy.
- Promote more inclusive deliberative processes, beyond formal consultations.
- Incorporate digital tools for citizen participation.
- Balance the representation of sectors within the council, strengthening the involvement of neighbourhood groups, non-associated citizens and youth.
- Create monitoring systems using specific indicators on citizen participation (see Table 6).
- Extend the participation mechanisms contemplated in water planning.
- Creation of permanent working commissions within the council.
- Strengthen the binding role of the collegiate participation bodies in decision-making.
- Creation of local participation councils, coordinated with the central participation council.

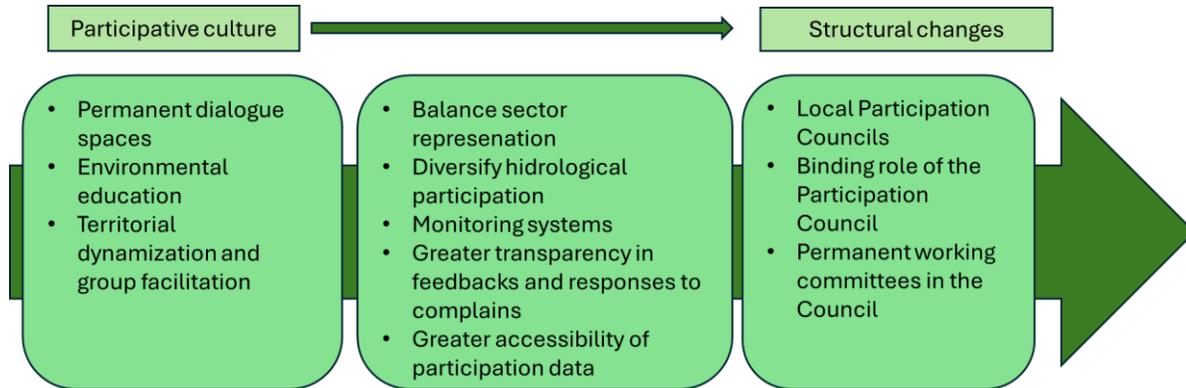


Figure 4. Proposed roadmap for citizen participation in Doñana.

Indicator	Description	Unit
Number of participatory channels available	Measures the variety of existing formal and informal spaces for participation.	N
Frequency of participatory meetings	Evaluates how often formal participatory spaces are convened	N./year
Diversity of actors represented	Analyses the heterogeneity of the participants: administration, private sector, NGOs, neighbourhood platforms, young people, women, migrants...	N of groups involved
Level of access to information	Assesses whether citizens have easy, comprehensible and early access to relevant information for participation.	N of information formats and channels used
Number of contributions received	Number of citizen comments, allegations or proposals during consultation or planning processes.	N
Rate of incorporation of proposals	Percentage of citizen contributions that are incorporated in the final documents or decisions.	Proposals considered/ Proposals submitted

Presence of feedback mechanisms	Indicates whether the institutions inform participants about how their contributions have been considered.	N of feedback channels
Satisfaction of participants	Degree of participants' satisfaction with the process, collected through surveys or interviews.	Survey (1-10)
Impact Assessment	No. of impact evaluation reports of citizen participation tools and activities	N

Table 6. Proposed indicators of citizen participation.

1. CONCLUSIONS AND METHODOLOGY ASSESSMENT

The analysis developed in this report reflects a long history of citizen participation in the Doñana Natural Area, while at the same time highlighting important weaknesses in current participation mechanisms. Despite the existence of formal structures such as the Participation Council and regulatory channels that recognise the right to participate in environmental decision-making, the real influence of citizens and social actors in management remains limited.

The main conclusions drawn are:

- 1- The consultative and non-binding nature of most participation instruments, which generates a perception of ineffectiveness and citizen disaffection.
- 2- Under-representation of certain groups, especially young people, rural women, migrants and non-associated citizens.
- 3- Strong technification of the processes, with language and formats that make it difficult to access information and understand the content of the plans.
- 4- Lack of traceability in the integration of citizen contributions, which reduces the transparency and credibility of the processes.
- 5- Valuable but not very sustained past experiences, which generates mistrust about the real usefulness of participation and contributes to disaffection with participation.
- 6- The importance of institutionalising local participation structures, which allow for greater territorial representation and continuity over time.

With regard to the application of the "Citizen Engagement Assessment" methodology, the results obtained show that it offers a useful, replicable and adaptable basis, which has enabled the development of a complete, contextualised analysis aimed at improving citizen participation in Doñana.

The main strengths of the application of this methodology to the Doñana case study are based on having a clear and adaptable structure, which provides an orderly and flexible guide, necessary to address participation in complex socio-ecological contexts. Furthermore, the inclusion of the analysis of the local context has allowed the subsequent quantitative and qualitative analyses to be framed, and the section on "proposals for improvement" allows the most important results to be synthesised, closing the report in a constructive way that is open to future work. It also highlights the potential of the methodology to analyse and compare case studies on a large scale and in very different contexts, due to its transferability and adaptability. With regard to the limitations encountered when applying the proposed methodology, the lack of real quantitative data on citizen participation in Doñana stands out, as there are no centralised and accessible sources. On the other hand, the lack of clear guidelines for analysing the quality of the participatory tools and establishing a roadmap has required the application of our own criteria, which reduces the scalability of the analysis and its comparison with other case studies.

In summary, the Citizen Engagement Assessment methodology offers a structured and useful basis for assessing citizen participation in complex territories such as Doñana, being very effective for systematising a multi-level analysis, connecting social and institutional dimensions and guiding proposals. However, its application to the case of Doñana shows that its effectiveness depends to a large extent on the availability of quantitative data and the criteria applied for the critical analysis of existing tools and the roadmap proposal.

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Annex 5: Replication assessment for WEF E Nexus CGE models – Seine aval and Corsica basins

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EXECUTIVE SUMMARY

Computable General Equilibrium (CGE) models are powerful tools for assessing how economic and environmental changes affect markets, sectors, and households. Extending these models to capture the **Water-Energy-Food-Ecosystems (WEFE) nexus** provides valuable insights for sustainable resource management. While agriculture and energy are typically included in existing models, integrating water and ecosystems requires additional, often specialized, datasets. The feasibility of building WEFE nexus CGE models for river basins depends on **data availability**. Social Accounting Matrices (SAMs), the foundation of CGE models, are usually collected for administrative regions but not for natural units like river basins. Approximations are possible when river basin boundaries align with administrative regions (e.g., NUTS2 regions in Europe), where SAMs already exist. Physical Water Accounts (PWAs) and sectoral data on water, energy, and food are essential for properly representing the WEFE nexus, while ecosystem data remain the most challenging to include. In practice, developing new datasets is possible but requires significant **time, funding, and institutional support**. Thus, assessing data availability is essential for developing WEFE nexus CGE models for river basins.

1. Introduction

Computable General Equilibrium (CGE) models are quantitative economic models that represent the entire economy as a system of interdependent markets, agents, sectors, and production factors. They are commonly used for impact analysis, policy evaluation, and economic assessment. In this way, CGE models help assess the effects of changes in the economy or policy (e.g., changes in prices or taxes), as well as changes related to the environment (e.g., impacts caused by climate change). CGE models exist at the level of world regions, individual countries, and subnational regions.

WEFE nexus CGE models capture the four pillars of the WEFE nexus: W(ater), E(nergy), F(ood), and E(cosystems). Traditionally, CGE models represent economic production through the most important sectors of the economy. In many regional CGE models, agriculture and energy are included as production sectors, thereby covering the F(ood) and E(nergy) pillars. However, representing the W(ater) and E(cosystems) pillars requires specific extensions to the standard CGE framework.

Figure present schematically the frameworks of WEFE nexus and CGE models. In the project InnWater, the WEFE nexus pillar of primary interest is “water”) the blue arrow on the grey background). For the CGE model, water enters the economic system as a production factor (e.g., groundwater or surface water). The production factor water enters production processes directly (e.g., as irrigation water in agriculture) or it is processed before as piped water by the water provider. Piped water is supplied to other industries and households.

The intersectoral linkages between water and the other WEFE nexus pillars are defined by water usage for consumption or production. Industries using raw water reduce natural water resources and

emit pollutants into the water bodies as ecosystems (the “ecosystem” pillar). Energy is used to produce water and food. However, energy consumption creates emissions to the environment (CO₂ emissions) as linked to the ecosystem pillar. Energy production also requires water, e.g., cooling water. The production of food (i.e., the food pillar) requires water and, at the same time, contributes to the pollution of water bodies as ecosystems (e.g., by the application of fertiliser and pesticides). Finally, raw water is processed as piped water and consumed by households as drinking water. In InnWater, the REWEFE model is developed to analyse the interactions between water use, energy and food production, ecosystems and economic activities on Reunion Island.

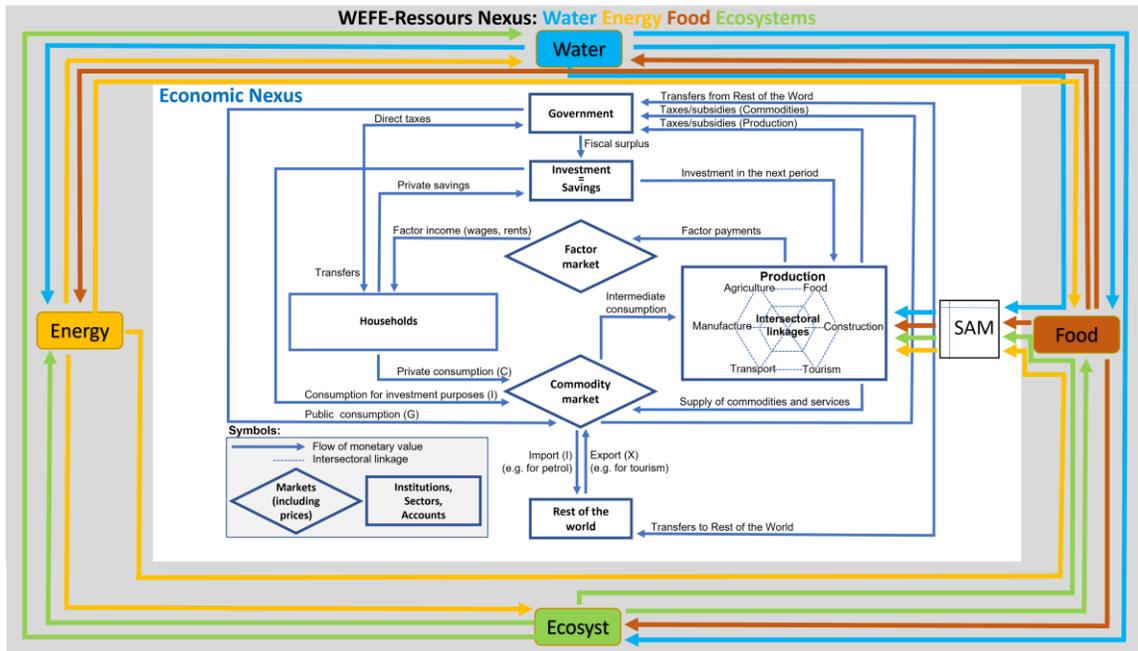


Figure 1: WEFE nexus and CGE model

Note: Graph adapted from Henseler et al. (2022)

CGE models are based on macroeconomic statistical data, typically provided in Social Accounting Matrices (SAMs). The macroeconomic information contained in the model’s database determines what can be represented within the CGE model. Representing the WEFE nexus pillars in a CGE model requires the inclusion of corresponding data in the SAM. Building WEFE nexus CGE models for river basins (or other study regions) involves two main challenges: A suitable SAM must be available—either as an existing dataset or constructed from scratch, which requires intensive data collection and labour. The necessary data for representing the WEFE nexus pillars in the SAM must be accessible.

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2. Methodology

2.1 Social Accounting Matrix to represent River Basins

A **Social Accounting Matrix (SAM)** is an economic data framework that gives a complete picture of all transactions and transfers between different economic agents (households, firms, government, and the rest of the world) over a given period, usually one year.

SAMs are most often built for **administrative regions**, where macroeconomic data are systematically collected. The most common case is at the **national level**, since the necessary statistics—such as input–output tables, national accounts, balance of payments, trade data, treasury data, and household or enterprise surveys—are usually available. In some cases, **regional SAMs** also exist at smaller scales, such as departments, counties, municipalities, or cities.

For **natural regions** (like river basins), building a SAM is more challenging because economic statistics are rarely collected for such areas. Natural regions are generally defined for the management of natural resources (such as water) and are based on geographic or geological boundaries (rivers, mountains, forests, climate zones, etc.). Since macroeconomic statistics are not typically needed for resource management, they are usually not available for these regions. However, when the boundaries of one or more administrative regions closely match those of a natural region, a SAM can be used to represent it.

Table 1 shows that, for the CGE pilot and replication sites, the river basins correspond to administrative regions (European NUTS-2 level). For the islands of **La Réunion** and **Corsica**, the river basin boundaries match the administrative borders exactly. In the case of **Seine-Aval**, the administrative region of **Haute-Normandie** (Upper Normandy) provides a good approximation of the river basin.

Table 1: Administrative regions approximating the river basins and availability of SAM

	La Réunion	Seine-Aval	Corse
Administrative region	La Réunion (NUTS2)	Upper Normandy (NUTS2)	Corse (NUTS2)
Coverage	exact	approximated	exact
SAM available	Yes, provided by the OMEGA project: Croissant et al. (2023)	Yes, provided by the regional model RHOMOLO: García-Rodríguez et al. (2023, 2025)	Yes, provided by the regional model RHOMOLO: García-Rodríguez et al. (2023, 2025)

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2.1 Splitting accounts of existing SAM

In the regional SAMs for the pilot and replication sites **La Réunion**, **Seine-Aval**, and **Corsica**, the **WEFE nexus pillars** are not explicitly represented as separate accounts. **Water (W-pillar)** and **Energy (E-pillar)** are combined into a single account. **Food (F-pillar)** is represented through the agriculture account and is further aggregated within manufacturing (as food processing). **Ecosystems (E-pillar)** are not included in the SAM at all.

Therefore, the regional SAMs need to be **partially disaggregated and extended** in order to properly represent the WEFE nexus pillars (for a detailed example for Réunion Island, see Henseler 2025). Table 2 provides an overview of **the implicit representation of the WEFE nexus pillars** in the regional SAMs.

Table2: Administrative regions approximating the river basins and availability of SAM

	La Réunion	Seine-Aval	Corse
Water (W-Pillar)	Aggregated in an account with electricity, water supply, sanitations, waste services	Aggregated in an account with mining and quarrying, electricity, water supply, sanitations, waste services; Data sources: García-Rodríguez et al. (2023,2025). Cordier, (2011)	Aggregated in an account with mining and quarrying, electricity, water supply, sanitations, waste services; Data sources: García-Rodríguez et al. (2023,2025), BRGM (2025), DREAL Corse (2025)
Energy (E-Pillar)	Primary energy (petrol) as a commodity, coal aggregated in other industries, electricity aggregated with water supply, sanitations, waste services	Primary energy (petrol), coal aggregated in other manufacturing), electricity aggregated with water supply, sanitations, waste services	Primary energy (petrol, coal aggregated in other manufacturing), electricity aggregated with water supply, sanitations, waste services
Food (F-Pillar)	Agriculture and food processing separate accounts	Agriculture separate accounts, food processing aggregated in manufacturing	Agriculture separate accounts, food processing aggregated in manufacturing
Ecosystems (E-Pillar)	Environmental data not represented in SAM, representation by satellite accounts.	Environmental data not represented in SAM, representation by satellite accounts.	Environmental data not represented in SAM, representation by satellite accounts.

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2.2.1 Water (W-Pillar) in the SAM

Disaggregating water from an aggregate account requires information on the value of water used by different sectors as:

- **a production factor** (e.g., groundwater extracted by water suppliers to produce piped water, or surface water extracted by agriculture for irrigation),
- **an intermediate commodity** (e.g., piped water used by industries), or
- **a final consumption good** (e.g., piped water consumed by households).

In addition to water supply and use, **wastewater treatment services (sanitation)** may also be important for representing the **W-pillar** in a WEF E nexus CGE model.

If statistics on water extraction or consumption are available, these can be used directly to derive values in the SAM. If monetary data are not available, **physical quantities of water** can be converted into monetary values of water extraction and consumption. Such data on extraction and use are provided in **Physical Water Accounts (PWA)**. Beyond serving as a basis for valuation, PWAs can also be used to build a **satellite account** that represents physical water quantities and supports the inclusion of the **ecosystems (E) pillar**. Table 3 presents an overview of the data availability of data to disaggregate the water pillar.

Table 3: Availability of data to represent water in the SAM

	La Réunion	Seine-Aval	Corse
Data on extraction costs and prices	Special reports, see Henseler (2025)	Agence de l’eau Seine-Normandie (2024), Agence de l’eau Seine-Normandie (2025)	Agence de l’eau Rhône-Méditerranée-Corse (2024)
Physical Water Accounts	Special reports, see Henseler (2025)	BNPE (2025), SIDESA (2025), Comité de bassin Seine-Normandie (2025)	BNPE (2025), Comité de bassin de Corse (2025)

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2.2.2 Energy (E-Pillar) in the SAM

Disaggregating electricity from an aggregate account requires information on the value of electricity used by different sectors as an **intermediate commodity**. Similar to the case of water, the value of electricity consumption can be obtained directly as **monetary data** from statistical databases or reports, or it can be derived from the **quantities of electricity consumed**.

The production and consumption of **primary energy sources** (e.g., petroleum, coal, gas) are, in some SAMs, shown separately, while in others they are aggregated into broader accounts. Gas is often grouped together with electricity and water. If other primary energy sources are not represented individually, they may be included within the commodity accounts of other industries. Disaggregating these values requires **detailed information**, which can be drawn from specialized reports and databases.

Table 4: Availability of data to represent energy in the SAM

	La Réunion	Seine-Aval	Corse
Electricity and gas	See Henseler (2025)	INSEE (2024), SDES (2025), Datagouv (2025)	INSEE (2024), SDES (2025), Datagouv (2025)

Primary energy (petrol, coal)	OMEGA SAM (Croissant et al. 2023), see Henseler (2025)	INSEE (2024), SDES (2025), Datagouv (2025)	INSEE (2024), SDES (2025), Datagouv (2025)
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2.2.3 Food (F-Pillar) in the SAM

In most SAMs, **agriculture** is represented as a separate account, sometimes also including **fisheries and forestry**. This account can be considered a representation of **food** in WEF nexus models. In some cases, the agricultural sector is further **disaggregated into subsectors (e.g., cropping, livestock)**.

Some SAMs also include an aggregate or differentiated **food processing sector**, which can represent the **F-pillar** without further modification. However, if modelling the food processing sector as part of the F-pillar is required and it is not separately represented in the SAM, it can be **disaggregated** from the aggregate account where it is included, using statistics from reports or databases.

Table 5: Availability of data to represent food in the SAM

	La Réunion	Seine-Aval	Corse
Agriculture	In the OMEGA SAM (Croissant et al. 2023), as aggregate sector with fishery and forestry	In the RHOMOLO SAM as aggregate sector with fishery and forestry; Data sources: García-Rodríguez et al. (2023,2025)	In the RHOMOLO SAM as aggregate sector with fishery and forestry, Data sources: García-Rodríguez et al. (2023,2025)
Food processing sectors	In the OMEGA SAM (Croissant et al. 2023), as aggregated sector	Aggregated in RHOMOLO SAM in manufacturing; Disaggregation possible based on data sources: Agreste (2025a), Agreste (2021), Chambres	Aggregated in RHOMOLO SAM in manufacturing. Disaggregation possible based on following data sources: Agreste (2025b), DRAAF Corse, (2024), DRAAF Corse (2018),

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2.2.4 Ecosystems (E-Pillar) in the SAM

In most SAMs, **ecosystems** are not explicitly represented, since they are not usually accounted for in monetary terms. The monetary valuation of ecosystems or environmental services is challenging; however, **environmental economic accounts** provide a framework for including such information in a SAM.

If monetary valuation is not the primary objective, **physical values** can also be used to represent the environmental or ecosystem dimension. These physical values can be included in **satellite accounts** as supplementary information to the SAM. While the SAM itself is consistently based on monetary values, satellite accounts can provide data in other units, externally to the SAM. In this way, data such as **emissions, water extraction, or water use** can be incorporated into the CGE model database without affecting the internal consistency of the SAM.

Table 6: Availability of data to represent ecosystems and environment in the SAM

	La Réunion	Seine-Aval	Corse
Water quantities (PWA)	Special Reports, for a detailed description see Henseler (2025)	BNPE (2025)	BNPE (2025), Eaufrance — SIE Corse (2023)
Greenhouse gas emissions	Computed emission coefficients, for a detailed description see Henseler (2025)	According to the method described in Henseler (2025)	According to the method described in Henseler (2025)
Water pollutants	Special reports of emissions and from sectors and households; for a detailed description see Henseler (2025)	Agence de l’eau Seine-Normandie. (2019,2022). SIAAP (2023), DREAL Normandie (2025); Office International de l’Eau. (2002), GIP Seine-Aval, 2025; According to the method described in Henseler (2025)	Office de l’Environnement de la Corse (2023), Agence de l’eau Rhône-Méditerranée-Corse. (2024), DREAL Corse (2025), Office International de l’Eau (2002); According to the method described in Henseler (2025)

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5.Results

Table 7 summarises the expected data availability for the **Seine-Aval** and **Corsica river basins**, compared with the **Réunion Island river basin**. The table shows that for Réunion Island, as the pilot site for developing the CGE model, all the required data were available. For the replication sites, macroeconomic data in the form of a **Social Accounting Matrix (SAM)** are available, at least at a **reasonably approximated level**. The WEF nexus pillars—Water (W), Energy (E), and Food (F)—can be disaggregated in the existing SAM using data available online (in databases, reports, or studies). Although the datasets themselves have not yet been downloaded, their availability is assumed, and additional options for retrieving them are expected once the publishing institutions are contacted.

Data representing the **Ecosystem (E) pillar** are less readily available. Various sources provide information on environmental issues (see Table 6), but for the specific purpose of building a CGE model, requesting data directly from these institutions may be necessary. Often, data on water pollution are provided as point measurements of concentrations, while the **absolute quantities of**

pollutants entering the water are not presented. Deriving **aggregated quantity data** for a river basin may therefore require additional computations or specific data requests from the relevant institutions.

Representing the environmental pillar in terms of **economic behaviour or scenarios** within the CGE model may also require targeted data surveys in the corresponding river basins. For the pilot site, La Réunion, a survey was conducted to assess the **value of coral reefs** (e.g., willingness-to-pay as an indicator of the value of specific environmental services). This information can be **incorporated into the CGE model** as scenario inputs or used to derive a monetary value for ecosystem services. For the **Seine-Aval** and **Corsica river basins**, the relevant ecosystem services still need to be identified according to local priorities, and corresponding surveys should be designed and conducted.

Table 7: Overview availability of data

	La Réunion	Seine-Aval	Corse
Macroeconomic data for CGE model calibration (i.e., SAM)	yes	yes	yes
W(ater) pillar	yes	yes	yes
E(nergy) pillar	yes	yes	yes
F(ood) pillar	yes	yes	yes
E(cosystem) pillar	yes	t.b.c.	t.b.c.

6. Conclusions

The assessment of data availability for constructing a **Social Accounting Matrix (SAM)**, and for extending it to a WEF E nexus SAM following the methodology outlined in Henseler (2025), indicates that the necessary **datasets are accessible for the replication sites Seine-Aval and Corsica**. While the concrete tasks of data acquisition, detailed analysis, and the computation of monetary values and proportional disaggregation within the SAM remain to be undertaken, the present evaluation provides sufficient evidence to affirm the feasibility of developing WEF E nexus CGE models for these sites.

Concerning the development of CGE WEF E nexus models for new river basins (or other regions), we can conclude that the decision to build such a model for a study region **requires an initial assessment of data availability**.

In principle, it is always possible to construct a regional SAM as the database for any region. However, this **can be costly if no SAM already exists** for the study area and a new one must be developed. Building a new SAM requires gathering macroeconomic data, which, if not statistically recorded, would need to be collected through surveys. While in theory macroeconomic data can be surveyed for any region, in practice the **costs may be too high** and ensuring consistent data collection can be challenging.

When evaluating the **feasibility of building a WEF E nexus CGE model** for a river basin (or any other natural region), the availability of data should be carefully checked—for instance, whether a SAM representing the region already exists or whether macroeconomic data are available to construct one. For Europe, regional **SAMs are available at the NUTS2 level** for the base year 2017. These data, published by the European Commission’s Joint Research Centre (JRC) (García-Rodríguez et al.,

2025,2023), can serve as a starting point for constructing a river basin SAM, as river basin boundaries can often be approximated by aggregating or matching NUTS2 regions.

Furthermore, to represent water extraction and usage, **physical water accounts (PWAs)** need to be available. These are often provided **at the level of administrative regions** (e.g., NUTS2) or for larger hydrological units such as river basins or administrative sub-catchments. The **availability of such data varies by country** and depends on national statistical systems.

Thus, the ideal requirements for building WEFE nexus CGE models are:

- The river basin **approximately corresponds** to the borders of NUTS2 regions for which regional SAMs are available.
- The river basin **corresponds to administrative sub-catchments** for which PWAs are available (i.e., sectoral extraction and usage data).
- The river basin corresponds to regions for which other statistical data representing the WEFE nexus are available.

With these requirements in place, constructing WEFE nexus CGE models for river basins follows the same principles as constructing other regional CGE models: **the feasibility depends on the availability of statistical data** to build the SAM and the model. If new economic data must be collected to create a database for the CGE model, then data availability effectively constrains what can be modelled. However, with **sufficient time, funding, and human resources**, regional SAMs or the necessary statistical datasets can be newly developed for many potential regions of interest.

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Annex 6: Applicability of the MicroSimulation Model - Greece



Feasibility Report on the Implementation of the Microsimulation Tool in Greece

Executive Summary

This report assesses the feasibility of deploying the InnWater microsimulation model in Greek water sector. Overall feasibility is rated as **HIGH**, provided that:

- 1- Local tariff structures are correctly parameterized.
- 2- Household-level microdata is ingested.
- 3- Demand elasticities and policy narratives are adapted to reflect local conditions.

A phased pilot study could be launched for a sample of selected providers, offering valuable insights to inform tariff setting and social policy design. Stakeholder engagement should be maintained throughout implementation.

1. Legal and Regulatory Framework

Greece's legal and policy framework for the water sector emphasizes transparency, efficiency, sustainability, and social equity. In particular:

- Law 5037/2023 defines the responsibilities of the Regulatory Authority for Energy, Waste and Water (RAAEY), aligning regulatory principles with national and EU obligations.
- Joint Ministerial Decision ΥΠΕΝ/ΓρΓΓΦΠΥ/103755/2994/2024 (JMD) sets out the methodology for water service costing and tariff setting, based on three key principles:
 - i. Full cost recovery (including environmental and resource costs)
 - ii. Affordability for users

iii. Financial and environmental sustainability

- Alignment with the Water Framework Directive

2. Key Institutional Roles

In Greece there is a very large number of water service providers (400+ providers).

- Water providers include municipal enterprises (ΔΕΥΑ), municipalities and the two major urban utilities (EYDAP in Athens and EYATH in Thessaloniki), which are multi-stakeholder owned companies.
- Organizations of Land Improvements (OEBs) are also subject to the framework, though they are not primary domestic suppliers.

RAAEY, as the Regulatory Authority, ensures compliance with the legal framework and methodology. RAAEY directly approves tariffs for EYDAP and EYATH, while for all other providers, tariff approval is issued by the Regional Decentralized Administrations based on RAAEY's binding opinion.

3. Applicability of the InnWater Microsimulation Model in Greece

The InnWater microsimulation model is a web-based decision-support tool designed to simulate household-level water demand and billing under various tariff scenarios. It evaluates outcomes across five key pillars:

- 1- Affordability
- 2- Incentive effects of pricing
- 3- Economic efficiency
- 4- Equity
- 5- Cost recovery

The ongoing reform of water sector and regulatory oversight in Greece presents a timely opportunity to pilot the model and generate evidence-based insights for policy design and implementation.

3.1 Affordability Metrics

Water costs in Greece are generally low in urban centers but significantly higher in rural areas and on the islands. The tool uses income quintiles to evaluate affordability. It identifies households that exceed affordability thresholds, which is crucial for designing and targeting social tariffs, as required by Greek law. The incorporation of regional poverty data will enhance the granularity of affordability analysis.

3.2 Tariff Structures

Greece's legal framework (JMD) mandates the use of fixed and variable (increasing block) tariffs, which align well with InnWater's modular tariff design¹ (Leten J., n.d.) (Method - InnWater, n.d.).

3.3 Household Consumption Patterns

The model incorporates household heterogeneity, using demographic variables such as age, education, and household size. Research indicates that water demand in Greece shows low price elasticity and is influenced more by socio-demographic factors than by income (Kostakis, 2021) (Vagiona D., 2009) (Reynaud A., 2015). The tool enables local scenario modeling tailored to specific population profiles.

In particular, the study conducted by Kostakis I. (2021) draws on data from the 2019 Greek Household Budget Survey for Athens and employs a range of econometric techniques—including OLS, IV/2SLS, seemingly unrelated regressions, and quantile regressions—to examine the impact of price, income, and socio-demographic factors on household water consumption. Some of the key findings related to price indicate that residential water demand in Athens is highly price-inelastic.

The estimated own-price elasticity is small in absolute terms and insufficient to suggest that moderate price increases would lead to substantial reductions in water consumption, confirming the results of earlier empirical studies. Regarding income and socio-demographic factors, the study finds that disposable income has a negligible effect on water consumption, with near-zero elasticity in the specifications used. In contrast, variables such as household composition, age structure, education level, and dwelling type exhibit stronger and statistically significant associations with consumption patterns.

In summary, the analysis suggests that socio-demographic and behavioural variables provide a better explanation for cross-household variation in water use than income.

3.3 Environmental and Resource Cost Integration

InnWater supports the simulation of full-cost recovery, including environmental and resource costs, in accordance with the EU Water Framework Directive and Greece's legal framework (JMD).

3.4 Regional Customization

The socio-economic and hydrological diversity of Greece (particularly between the mainland

and island regions) highlights the value of regionalized modeling. InnWater's flexible architecture allows geographically customized simulations to support localized decision-making. This feature could also be relevant in regions with seasonal water stress or tourism-driven demand surges.

3.5 Institutional Capacity

Greece possesses strong academic and institutional capacity in microsimulation modeling, with experience from projects such as SimAthens (urban poverty modeling using spatial microsimulation) (Panori A., 2017).

For water-specific applications, collaboration among RAAEY, universities, and research institutes can provide technical expertise and operational support.

4. **Data Landscape**

The Regulatory Authority for Energy, Waste, and Water (RAAEY) has initiated a systematic data collection process from water providers. However, the sector's fragmentation (with 400+ providers) means that assembling complete and meaningful datasets will take time.

The effective deployment of the InnWater microsimulation tool depends on integrating detailed demographic, socio-economic, consumption, pricing, and environmental data. Key data sources and current limitations include:

4.1 Socio-Economic Data

- The Hellenic Statistical Authority (ELSTAT) provides granular data through the EU-SILC and Household Budget Survey (HBS), covering income, expenditures, education levels, and household composition.
- These datasets do not include water consumption or metering data. To achieve local-level resolution (especially in smaller municipalities or islands) additional targeted surveys may be necessary.

4.2 Water Consumption Data

- Consumption data is held by individual water providers but is not systematically linked to socio-economic datasets.
- RAAEY has begun compiling sector-wide consumption data, though harmonization and standardization across providers remains a challenge.

4.3 Tariff Data

- Domestic water tariffs typically include fixed charges, volumetric pricing (often in

increasing blocks) and wastewater fees. Social tariffs for vulnerable households are mandated and increasingly applied under national legislation (Kanokoudis V., 2016).

- While RAAEY is actively collecting updated tariff data, coverage is still incomplete, as many providers are currently updating their tariffs to comply with the requirements of the legal framework (JMD).

4.4 Climate Data

- Climate and hydrological data are not integrated with household-level consumption data, limiting the ability to perform climate-sensitive demand modeling.

5. Feasibility Assessment

- Technical feasibility: **HIGH**. The MMS architecture (Flask back-end, Angular front-end) already supports modular tariffs, affordability indicators, and dashboarding. Greek-specific parameters can be added without refactoring core logic.
- Data feasibility: **MEDIUM-HIGH**. EU-SILC/HBS provide robust socio-economic baselines; utility billing databases enable local calibration and scenario testing after anonymization and DPA compliance.
- Institutional feasibility: **HIGH**. The ongoing national tariff methodology and RAAEY oversight create a clear policy window; major utilities have the capacity and incentives to engage in pilots.

Risks:

- i Delays in obtaining additional data collection and sharing – will be mitigated through standard data-sharing process.
- ii Heterogeneity of municipal tariffs – will be mitigated through configuration templates.
- iii Potential public sensitivity around tariff changes – transparent communication with stakeholders using microsimulation model dashboards and narratives.

6. Recommendations for Tool Localization

To ensure relevance and usability in the Greek context, the following adaptations are recommended:

Tariff Module Localization: Implement Greek-specific elements: fixed fees, block pricing, wastewater charges, social tariff structures and the inclusion of seasonal tariffs where applicable.

Demand Module Calibration: Replace demonstration demand functions with elasticities from Greek studies.

Affordability Indicators: Align with Greek CAR/PAR thresholds and poverty lines. Add toggles for social tariff eligibility to simulate inclusion/exclusion effects.

Geospatial Aggregation: Adapt reporting modules to reflect Greek administrative units (e.g. municipalities), supporting spatial analysis of distributional impacts (Klassert C., 2018) (Meran G., 2009).

7. Suggested Pilot Plan

Phase	Duration	Key Outputs
Scoping	4 weeks	Given the large number of providers, we need to identify a subgroup of one or more pilot providers and ensure their commitment and ability to contribute to this work.
Data gathering / management	6-8 weeks	<p>Gather tariff structures (most providers currently are updating their tariffs to meet the requirements of the Joint Ministerial Decision).</p> <p>The tariff information will come directly from the providers in scope.</p> <p>Household microdata: income, consumption, demographics (via ELSTAT, utilities).</p> <p>Collect climate & water availability data (need to consider the best way of doing so).</p>

Calibration	4 weeks	Localize elasticity estimates (could use data from existing studies in Greece). Input Greek socio-economic data.
Policy Scenarios	2 weeks	Run scenario analysis.
Briefings & Rollout	2-4 weeks	Run workshops and refine the scenarios and the analysis based on feedback from stakeholders (providers, municipalities, policy makers).

Note: The suggested timeline has been based on a previous small-scale project undertaken in Athens (Panori A., 2017).

8. Conclusions

Greece is well-positioned to implement a pilot of the InnWater microsimulation tool. With regulatory reform underway and foundational data sources available, the tool can support evidence-based, equitable tariff setting.

A phased deployment, starting with selected providers or regions, is recommended. Early pilots will help validate the model, refine calibration parameters, and inform broader rollouts as national data systems mature.

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Annexes

Annex I – Example of the current tariff structure

There is currently no standardized tariff structure applied uniformly across all providers. The design and breakdown of tariffs are at the discretion of each individual provider, with only the fixed and volumetric components being commonly observed across the sector.

As an example, we present below the tariff structure used by one of the country's major providers, who serves most of the population.

Fixed part (depending on water meter size)

Water Meter size (inches)

½",

5/8",

and

¾"

1"

1½"

2"

3"

4"

6" and above

Consumption bands

Domestic (incl. vulnerable/low income households)

0 – 5m³

5 – 20m³

20 – 27m³

27 – 35m³

Non-Domestic

1. Industrial - professional

0 - 1000m³
Over 1000m³

2. Public sector
3. Charity
4. Water supply of islands
5. Networks for private legal entities
6. Ship supply
7. Fire hydrants
8. Unfiltered water
9. Bilateral contracts with Industrial companies

Wastewater Disposal Fees at Wastewater Treatment Plants

- A) For tankers with a capacity of up to 15 tons
- B) For tankers with a capacity of more than 15 tons to 20 tons
- C) For tankers with a capacity of more than 20 tons to 25 tons
- D) For tankers with a capacity of more than 25 tons

Sanitation services

It is defined as 75% of the value of consumed water for each consumer category, with discount tiers for specific industrial and commercial users, as well as meters in designated areas for irrigation of green spaces.

Annex II - Descriptive statistics on drinking water production, household consumption, and access to sanitation services

Indicator	Value (recent)	Source / Notes
Safe / Safely-managed Drinking Water Access	~ 98.9 % of population using safely managed drinking water services (2022)	World Bank / SDG indicator 6.1.1 for Greece. (Trading Economics)
People using safely managed sanitation services	~ 91.7 % (2020)	WHO/UNICEF JMP data. (indexmundi.com)
Public Water Supply: Households (total volumes available for household supply)	~ 1,149 million cubic metres (1.149 billion m ³) in 2023	OECD / CEIC "Greece Public Water Supply: Households" dataset. (CEIC Data)



INN WATER

Average consumption (or per capita / per person estimates)	~ 177 litres per person per day	“Baseline assumptions” in the EU Commission/EUR-Lex report for Greece. (EUR-Lex)
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Annex 7: Applicability of the MicroSimulation Model – The case of Gijón (Spain)

Author: *María A. García-Valiñas*

This report is aimed to assess the replication of the Innwater microsimulation tool to the case of Gijón, a medium-size municipality in Northern Spain. Spain is considered as a water-stressed country based on its water use index (Tausová et al., 2022), as water consumption exceeds 20% of its long-term annual average of available water. Useful information to use the tool in this specific case will be provided. Moreover, this report describes not only information sources and special difficulties in the replication, but also some possible extensions in some of the modules.

First section describes previous literature related to residential water demand estimation in Spain, with special attention in the Northern area of the country. Moreover, a discussion on datasets availability in Spain will be shown. In the second section water tariffs in Spain are briefly described, including some key references in this field. The case study is framed in the third section, providing some demographic and economic features to be considered in the replication, and describing water tariffs complexity in Gijón. Section fourth include some concluding remarks and recommendations.

1. Residential water demand in Spain

1.1 General remarks

The literature related to residential demand function estimation is broad around the world. In this respect, there are some exhaustive literature reviews (Arbués et al., 2003; Worthington and Hoffman, 2008; Nauges and Whittington, 2010; Termes-Rife and Bernardo, 2015; Reynaud, 2015; Reynaud and Romano, 2018; García-Valiñas and Suárez-Fernández, 2022) that have analyzed the main explanatory factors and methodological approaches. García-Valiñas and Suárez-Fernández (2022) indicate that academia has evolved from traditional topics—for instance, price elasticity estimation—to much more innovative subjects, such as information, experimental design or attitudinal features.

In this section we will show the main papers estimating residential water demand in Spain, with special attention on those located in the North of the country. A simple model for residential water demand is as follows:

$$Q = f(P, Y, X) \quad (1)$$

Where Q represents tap water consumption, P and Y denote water price and income, respectively, and X is a set of exogenous factors that explain residential water use levels. Equation (1) is usually estimated in an isolated manner, but it is possible to find a few papers using equation systems. Suárez-Varela (2020) proposed the Quadratic Almost Ideal Demand System (QUAIDS) to estimate residential water demand.



Price is probably the most frequently discussed variable in this literature, because the presence of non-linear schedules generates endogeneity and price perception problems (Arbués et al. 2003; García-Valiñas and Suárez-Fernández, 2022). Anyway, residential water demand is price inelastic, with elasticities below to 1. Table 1 displays a summary of the main studies estimating residential water demand function in Spain. Those papers considering information related to the North of Spain are marked in grey colour.

As it is possible to observe in Table 1, most papers are using microdata at the household level. Moreover, although heterogeneity in terms of functional forms is high, some of them are using a functional specification based on a Stone-Geary utility function. This special form allows for capturing a “minimum threshold” of water consumption which does not respond to price or income changes. Table 2 show the estimates for the minimum threshold estimated¹. Minimum threshold estimated ranged from 64.16% to 73.70% of actual water consumption. Those findings are in line with literature in other developed countries.

¹Balado-Naves et al. (2025) do not provide threshold estimates, since the aim is estimating the efficient level of water consumption.

Table 1.- Main studies estimating residential water demand in Spain

Reference	City/Region	Households' level data	Year	Functional form	Price variable	Price elasticity
Barberán et al. (2000)	Zaragoza	Yes	1995-1998	Linear	Two-period lagged daily bill	-0.003 to -0.67
Martínez-Espiñeira (2002)	Several municipalities in the North of Spain	No	1993-1999	Linear	Nordin specification	-0.12 to -0.28
Arbues et al. (2004)	Zaragoza	Yes	1996-1998	Log-linear	Oppaluch specification	-0.03 to -0.05
Martínez-Espiñeira and Nauges (2004)	Seville	No	1991-1999	Stone-Geary	Nordin specification	-0.07 to -0.13
García-Valiñas (2005)	Seville	Yes	1991-2000	Linear	One-period lagged average price	-0.46 to -0.55
García-Valiñas (2005)	Gijón	Yes	1991-2000	Linear	Two-period lagged average price	-0.04 to -0.05
Arbués and Villanúa (2006)	Zaragoza	Yes	1996-1998	Linear/Log-linear/ Log-log	Several specifications	-0.08
Martínez-Espiñeira (2007)	Seville	No	1991-1999	Linear	Nordin specification	-0.1 to -0.5
Roibás et al. (2007)	Seville	Yes	1991-2000	Linear	Two-period lagged average price	-0.36
Arbués et al. (2010)	Zaragoza	Yes	1996-1998	Log-linear	Two- period lagged daily bill	-0.26 to -1.31
García-Valiñas et al. (2010)	Several municipalities in the South of Spain	No	2005	Stone-Geary	Average price corresponding to 10 m ³ /month	-0.06
Reynaud (2015)	Several EU countries	No	2004-2011	Log-log	Average unit cost	-0.10 to -0.21
Pérez-Urdiales et al. (2016)	Granada	Yes	2009-2011	Linear	Average price	-0.30 to -0.49
Hoyos and Artabe (2017)	Spain	Yes	2012	Log-log	Average price	-0.22 to -1.31 (North regions)
Roibás et al. (2019)	Seville	Yes	1991-2000	Stone-Geary	Marginal Price	-0.29 to - 0.43
Suárez-Varela (2020)	Spain	Yes	2006-2012	QUAIDS/ AIDS/Linear/Log-linear/ Log-log	Average price	-0.40 to -0.95
Balado-Naves et al. (2024)	Gijón	Yes	2017- 2021	Stone-Geary	Nordin specification	-0.01 to -0.50

Source: own elaboration

Table 2.- Stone-Geary specification: Minimum threshold estimates

Reference	Actual consumption (liters/day/person)	Estimated threshold (liters/day/person)
Martínez-Espiñeira and Nauges (2004)	213	157
García-Valiñas et al. (2010)	171	112
Roibás et al. (2019)	307	197

Source: own elaboration

Some recent papers consider new methodologies, as in Balado-Naves et al. (2025), where a demand frontier approach is used to estimate the efficient amount of residential water consumption. This methodology could be easily included in the microsimulation model (Demand module). These authors found that average efficient consumption level was estimated at 163 liters per day for households living on apartments, while the efficient level raises up to 238 liters per day when household were living in single family houses. Moreover, this paper also shows that well informed households are more sensitive to price changes².

1.2 Data sets available in Spain

Most datasets used in the studies displayed in Table 1 are built by the authors, and significant efforts are needed since water utility is providing water consumption information and sometimes, that information is complemented conducting surveys (Barberán et al., 2000; Arbués et al. 2004; Pérez-Urdiales et al., 2016; Balado-Naves et al. 2025).

A few papers (Hoyos and Artabe, 2017; Suárez-Varela, 2000) have used a public database on households' expenditures (Spanish Survey of Family Budget), available at Statistical National Institute (INE)³. However, this survey does not include information on goods' quantities neither prices. Moreover, INE is also periodically conducting the *Survey on Water Supply and Sewerage*. Information of database at regional level was used

² This result was apparently not observed in Pérez-Urdiales et al. (2016), who include a dummy variable for households being aware of the tariff structure.

³ For further information, check www.ine.es.



by Reynaud (2015) to estimate residential water demand in Spain. However, no disaggregated information at municipal level is provided.

Moreover, the Ministry of Territorial Policy and Democratic Memory is periodically conducting the *Survey of Local Infrastructure and Facilities*. This survey reports information related to municipalities smaller than 50.000 inhabitants. Some features related to the state of infrastructures and the quality of local public services (including water services) are included. However, no information on bigger municipalities is considered.

Definitively, there are still some gaps related to information and data sets in the water Spanish Sector. Significant efforts may be made to improve the availability of data adequate to implement economic analysis of water sector in Spain. As mentioned before, public information is not enough to properly estimate urban water demand functions. In any case, a microdata set elaborated in the NEWTS project framework would be available from July 2027 (Nudges for Economics of Water Tariffs, Water JPI 2018 Joint Call on Sustainable Management of Water Resources - WaterWorks2017). This database would allow the replication of the microsimulation model for the case study considered in this report (Gijón, Asturias).

2. Water tariffs in Spain

Most information in this section is taken a recent survey on urban water tariffs for water supply and wastewater services in the most populated cities in Spain (Arbués and García-Valiñas, 2020; García-Valiñas and Arbués, 2021). Spain is a federal country where subcentral governments (regional and local) are autonomous entities with different responsibilities in the design of water policies (Calatrava et al., 2015). The extremely atomized local panorama (more than 8,000 municipalities) results in a highly complex system with a wide range of water price levels and structures.

There is also heterogeneity when considering water services management framework. Urban water services could be provided by the public sector through local entities (municipal services, consortium of municipalities and/other administrations, or public companies) or indirectly, with private companies' participation. Additionally, not all water cycle services are provided by the same organization. Different stages (supply, sewerage, and wastewater treatment) can be managed by different institutions (public or private) according to different criteria.

Regarding the structure, the standard tariff has a two-part structure, consisting of a fixed charge plus a variable charge. On the one hand, the fixed charge should be set to cover the costs of being connected to the public water network, it is a connection fee linked to the instantaneous water flow contracted (Arbués and García-Valiñas, 2020). This charge is usually dependent on the meter size, but not dependent on water consumption. It is also considered as a tool to guarantee that water services providers secure stable monthly revenues.

On the other hand, the volumetric charge is based on the water consumed. In most Spanish cities, metered water is billed on a monthly, bimonthly, or quarterly basis depending on the city. Most cities design the variable part for supply services as an



increasing block tariff (IBT). However, this schedule is less popular when designing wastewater tariffs (García-Valiñas and Arbués, 2021). Some Spanish cities located in different areas include free allowances or minimum water use for basic levels of water consumption included when paying the fixed charge.

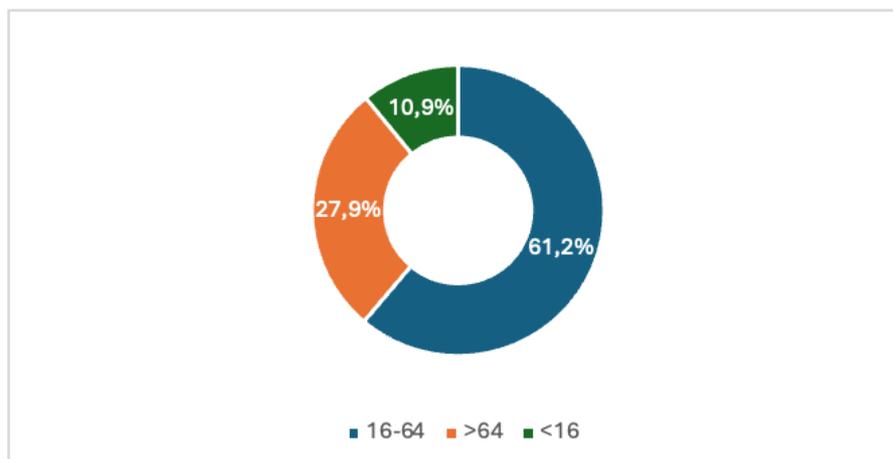
Finally, when attempting to deal with affordability issues, specific policies are commonly applied (OECD, 2003). The first mechanism consists of direct income support policies. Thus, low-income consumers may be eligible for direct income assistance or water service vouchers from the public sector. An alternative option consists of designing special tariffs applicable to the targeted groups to achieve equity aims. This second mechanism is the most popular option in Spain (Arbués and García-Valiñas, 2000). So special tariffs (Note that it is also possible to find special tariffs not exclusively related to equity aims. For instance, some of them are related to efficient behaviour or the presence of collectively metered buildings) for large and/or low-income households are frequently developed. However, there are some municipalities where direct income-support policies are preferred (i.e., Gijón).

3. Case study: Gijón

3.1 Basic background

The case study in this report is Gijón, is a medium-size municipality located in the western district of the Cantábrico River Basin (The Cantábrico River Basin includes two districts: Northern Western and Eastern. This River Basin is an attached agency of the Ministry of Ecological Transition and Demographic Challenge), in the north of Spain (Asturias). Gijón registered 268,561 inhabitants in 2024 (INE, 2024a), and a surface of 181.7 km². This municipality is characterized by mild temperatures, and it is a popular touristic destination during the summer. In 2024, The city received 173,148 tourists between June and September, being the 18% foreign visitors. Moreover, this municipality has an aged population structure. Table 1 shows that in 2024, almost 28% of the population was 65 or more years old.

Table 3.- Population structure: age



According to the National Taxation Office (AEAT, 2022), the average gross per capita income in Gijón was 30,540 €, being the 4th richest municipality in Asturias. The at-risk-poverty-rate is registered at 15.4% in Asturias (INE, 2024b). Moreover, the Observatory for Social Services in Asturias (OBSERVASS, 2021) displays several poverty indices in the region, using information from the Households Income Distribution Atlas (INE, 2024b).

Table 4.- Poverty indices in Asturias

	Asturias	Gijón
Population with equivalised income below 5,000 € (%)	5,4	5,3
Population with equivalised income below 7,500 € (%)	10	10,1
Population with equivalised income below 10,000 € (%)	17	16,9
Population with equivalised income below 40% of median income (%)	8,2	8,3
Population with equivalised income below 60% of median income (%)	16,5	16,5

Source: Own elaboration from OBSERVASS (2021)

3.2 Water tariffs in Gijón

EMA (Empresa Municipal de Aguas de Gijón) is a 100% public company which provides water services in Gijón and other neighbouring municipalities. In 2023, this water utility provides the service to 56,921 customers, whereof 33,156 were residential individually metered connections, while 6,710 were residential collectively metered condominiums (113,831 users). Abstracted water in 2023 was 21,834,493 m³ and water billed to residential users was 13,533,875 m³ (EMA, 2023). According to EMA, around 3% of subscribers are not connected to sanitation or sewerage network, so they are not billed for these services. Total costs for services provision amounted at 24,314,462 € in 2023.

Water tariffs in the municipality are approved by the City Council and they comprise distribution and sewerage services. Sanitation services are provided by the Regional Government though CADASA (Consortio de Abastecimiento de Aguas de Asturias) and a tax is set to support maintenance, operation and management cost of water sanitation in the region. Tables 5 to 7 explain tariffs and taxes applied in the municipality, with a description of the main components of water bill for residential users. Bill is charged to users every two months.



Table 5 displays the service fee of the tariff applied for water services in 2025. This fee is set to cover the expenditures on the network maintenance and repairs. In the case of supply service, this fee depends on meter size (diameter). Moreover, households who rent the meter instead of buying it must pay an extra fee for the meter's maintenance and renovation (2.16 €/two months⁷).

Table 5.- Fixed service fee for water supply and sewerage in Gijón: Residential water users 2025

Meter size (mm.)	Supply	Sewerage
	(€/two months)	(€/two months/condominium unit)
7 to 15	5.6699	3.2442
20	8.7518	3.2442
25	12.0612	3.2442
30	16.4736	3.2442
40	32.9222	3.2442
50	48.7866	3.2442
65	73.1511	3.2442
80	103.9068	3.2442
100	171.8744	3.2442
125 and 150	341.3880	3.2442
200 and 250	671.6560	3.2442

(*) no VAT (10%) neither regional tax included
 Source: Own elaboration based on BOPA (2024).

Table 6 show the variable part of the tariff is based on an increasing block schedule, while sewerage tariff is a uniform price. Note that a special water supply tariff (with two increasing blocks instead of three) is applied to collective metered households. In this case, tiers are referred to the average consumption per condominium unit.

⁷No VAT (21%) included.

Table 6.- Variable charges for water supply and sewerage in Gijón: residential water users, 2025

General tariff	Special tariff (+)	General tariff		Special tariff (+)	
		Supply	Sewerage	Supply	Sewerage
Blocks	Price (*)				
(m ³ / two months)	(€/m ³)				
Up to 30 m ³	0.3965	0.1982	0.3965	0.1982	
From 31 m ³ to 50 m ³	0.5842	0.1982	0.5842	0.1982	
More than 50 m ³	0.7468	0.1982			

(*) no VAT (10%) included (+) Applied to collective metered condominiums with more than 4 units. Not applicable to condominiums built from 2007 onwards.

Source: Own elaboration based on BOPA (2024).

As can be seen in Table 6, the progressivity of the tariff for households with individual meters is in principle more intense (3 blocks) than in the case of households categorized as special domestic use (2 blocks). This difference means that there are fewer incentives to save for households located in condominiums metered with a single meter⁸

. These tariffs would change if switching on the Emergency scenario according to the regional drought special planning (Northern Western Action Plan in the event of Drought, 2018). In particular, and for individually metered households, the second-tier prices would be multiplied by 2, while third-tier prices would be multiplied by 3. For the special tariff applied to collective metered households, the prices of the second tier would be multiplied by 2.

On the other hand, urban water users are taxed by the Environmental Tax on Water Use.



This tax, created and managed by the regional government, has an extra-fiscal nature, is applicable throughout the Principality of Asturias, and is levied on water consumption to promote a rational and efficient use of water, as well as to obtain resources to preserve, protect, improve and restore the water environment.

⁸ Note also that, in the case of special domestic use, the threshold that delimits both blocks refers to the average consumption per condominium unit in the building. In this sense, the existence of unoccupied units in this type of building may further reduce the incentives to save water.

Article 72 of Legislative Decree 1/2014, of July 23, which approves the revised text of the legal provisions of the Principality of Asturias regarding Own Taxes, defines the taxable event of this tax as "any potential or actual use of water from any source, by reason of the effect that its direct discharge or through sewage networks may have on the environment". The purpose of this definition is to link the taxation of water consumption to the environmental damage that users cause to water resources. Likewise, its collection is fully earmarked for investment, operation, maintenance, and management of wastewater treatment works and facilities.

Table 7 shows the structure of the regional tax, with its fixed and variable elements, apparently adopting a similar form than the water supply tariffs described above:

Table 7.- Structure of the Environmental Tax on Water Use: Residential water users, 2024

Variable fee		
Fixed fee (*) (€/two months)	Categories	Tax rate (*)
	(m ³ / two months)	(€/m) ³
6.0000	Up to 30m ³	0.3993
	From 31m ³ to 50m ³	0.4792
	More than 50m ³	0.5590

(*) VAT exempt

Source: Own elaboration based on BOPA (2014).

The most interesting aspect of this tax is that the structure adopted by the variable part of the quota that depends on consumption becomes super-progressive. This means that the tax is applied by categories or classes, applying the same tax rate to the entire tax base (3 consumed). A priori, this type of structure generates much stronger incentives to save water. However, fixed fee has a significant weight on the tax bill, especially for low-consumption levels. For instance, for a monthly consumption by 9 m³/user (close to the average water consumption for the average household size in Gijón), the representative household would pay 6.59 €, with a fix charge at 46% of global tax bill.

4. Concluding remarks

This report provides discussion on some basic information to replicate the microsimulation model to the case study of Gijón. This medium-size municipality located in the North of Spain presents some especial features that should be considered in the analysis.

On the one hand, it has an aged population, with more than 25% of inhabitants older than 65 years old. This demographic feature affects the Population module and could also impact public policies design. In this context, the use of technological appliances when implementing informative or nudging campaigns is not easy (for instance when informing about a tariff change or when explaining water bill), since sometimes, aged people are not familiar with this kind of tools.

On the other hand, water tariffs are characterized by a non-linear schedule and a super-progressive regional tax that would require a specific modelling in the microsimulation tool. Specific complexity of Spanish water prices and fiscal federalism would be an issue in the replication of the microsimulation model (Tariff module), since there are several taxes and charges related to the water cycle.

Regarding databases, there would be data set available in July 2027 to replicate the model with this case study. Moreover, additional information has been provided in this report (useful in the Population module) . However, there are still some information shortages in the field of water resources in Spain. Since the approval of European Water Framework Directive, no significant improvements have been detected in public databases related to residential water consumption.

In any case, previous literature estimating residential water demand in the North of Spain found these users highly inelastic to price reforms. This finding, useful in the Demand module, is close to the results found in other studies located in Spain or similar areas in Europe. Moreover, there is still room in the microsimulation tool to apply alternative

methodologies. In this respect, the Demand module could be extended to detect water waste or inefficiencies in the use of water, as in Balado-Naves et al. (2025).

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Annex 8: Applicability of the MicroSimulation Model – Lithuania

Replication expert: Martynas Maksimovas

1. GENERAL PROVISIONS ON DETERMINATION OF DRINKING WATER SUPPLY AND WASTEWATER MANAGEMENT SERVICE PRICES

General provisions on determination of drinking water supply and wastewater management service prices are stated in the Law of the Republic of Lithuania on Drinking Water Supply and Wastewater Management (thereafter – Drinking water law). They set general rules on how prices are constructed.

The methodology for setting prices for drinking water supply, wastewater management, and surface wastewater management services (hereinafter – Methodology) regulates the pricing of drinking water supply, wastewater management, and surface wastewater management services.

The purpose of the Methodology is to create preconditions for implementing the objectives set in the Drinking water law, as well as to enhance the stability of Lithuania's water management sector's investment environment and the transparency of pricing for drinking water supply, wastewater management, and surface wastewater management services.

Prices for drinking water supply, wastewater management services, and surface wastewater management services are determined based on non-discrimination and principles specified in Article 18 of Drinking water law¹, as well as on costs for individual activities in the drinking water supply and wastewater management sectors, as defined by the Methodology approved by the drinking water regulator - State Energy Regulatory Council (thereafter – SERC).

Drinking water suppliers and surface wastewater managers plan expenses and revenues in accordance with infrastructure development plans approved by municipal Councils and action plans prepared under rules approved by the Minister of Environment. These action plans encompass at least five years and are approved by the board of the drinking water supplier or surface wastewater manager (if no board is formed, by the municipal executive authority). The plans describe activities, owned assets, operational directions, necessary investments, infrastructure conditions, measures for rational use of natural resources, pollution reduction, service quality improvement, drinking water supply, and wastewater management infrastructure development, acquisition, and renovation measures, along with expected operational changes in costs, funding needs, sources, and projected impacts on service prices. They also include other information necessary to ensure reliable consumer access to drinking water and wastewater management services, as well as surface wastewater management services.

¹ Article 18. Cost recovery and “Polluter Pays” principles:

1. The cost recovery principle in the field of drinking water supply and wastewater management (including stormwater) services means that the prices for drinking water supply and wastewater management services must cover the

necessary expenses required for providing these services, ensuring the long-term operation, renovation, and development of drinking water and wastewater infrastructure, enabling consumers and users to access drinking water and receive wastewater treatment services under acceptable conditions, as well as contributing to environmental pollution reduction and the rational use of water resources.

2. The “polluter pays” principle in the field of wastewater management means that the costs of wastewater (including stormwater) treatment must be covered by the individuals who receive drinking water supply and/or wastewater and stormwater treatment services.

Drinking water suppliers, guaranteed water suppliers, and surface wastewater managers coordinate investments with the SERC. Investments not approved by the SERC cannot be recognized as justified for determining state-regulated prices.

Wastewater management and surface wastewater management service prices for commercial customers, excluding consumers, are determined considering pollutant quantity, nature, and concentration.

Drinking water suppliers prepare and submit to the SERC the draft base prices for drinking water supply and wastewater management services. Surface wastewater management service providers submit the draft base prices for surface wastewater management services, adhering to the methodology for setting surface wastewater management service prices approved by the Council. Along with the draft prices to be coordinated, drinking water suppliers and surface wastewater management providers present the rationale for the price proposals and company operational plans. Upon receiving the draft base prices, the SERC sets the base prices for drinking water supply and wastewater management services and surface wastewater management services no later than within two months. They assess whether the prices cover the necessary cost corresponding to the efficiency indicators set by the SERC for the provision of drinking water supply and wastewater management services as well as other associated essential expenses, including returns on investments. If not all data and/or documents are submitted, or additional information is received, the timeline for establishing the base prices for drinking water supply and wastewater management services starts on the day all the necessary data and/or documents and information are provided. When setting prices, the SERC evaluates the return on investments and the justification of operational expenses, establishing efficiency indicators for the provision of drinking water supply and wastewater management services.

Base prices for drinking water supply and wastewater management, and surface wastewater management services are determined for a five-year period.

In the first year of validity of the base prices, the prices for drinking water supply and wastewater management services and surface wastewater management services are equal to the base prices for these services.

The base prices for drinking water supply and wastewater management services and surface wastewater management services set by the SERC are recalculated each year. Base prices are not recalculated if the criteria established in the methodology for setting drinking water supply and

wastewater management service prices, approved by the SERC, are maintained. Recalculated base prices for drinking water supply and wastewater management services and surface wastewater management services remain valid for 12 months from their effective date.

Drinking water suppliers, adhering to the Methodology, prepare and submit to the Council the draft recalculated base prices for drinking water supply and wastewater management services. Surface wastewater management service providers submit the draft recalculated prices for surface wastewater management services to the SERC following the methodology approved for these services. Along with the recalculated draft prices for coordination, drinking water suppliers and surface wastewater management providers present the rationale for price proposals. Upon receiving the recalculated draft base prices for drinking water supply and wastewater management services, the SERC sets these recalculated base prices within two months. If not all data and/or documents are provided, or additional information is received, the timeline for recalculating the base prices starts on the day when all necessary data and/or documents and information are submitted.

When setting base prices for drinking water supply and wastewater management services and recalculated base prices each year, the SERC evaluates whether the new prices would make the monthly payment for services by consumers exceed 4% of the average monthly family income. Data is obtained from the State Data Agency. If it is determined that payments for services would exceed the 4% threshold, the Council sets the base or recalculated price for these services so that it corresponds to 4% of the average family income.

The implementation of the principles outlined in Article 18 of this law and the assessment of whether the new service prices would not exceed 4% of the average monthly family income is carried out annually by the SERC by December 31 of the calendar year. This is done in accordance with the Council's approved procedures for assessing the technological, financial, and managerial capacities of drinking water suppliers and wastewater managers and the methodology for setting drinking water supply and wastewater management service prices. The results of this assessment are communicated to the relevant municipality and the Ministry of Environment within 10 working days.

A public water supplier or regional public water supplier, providing public drinking water supply and/or wastewater management services in at least one public drinking water supply territory of a municipality, must supply drinking water and provide wastewater management services under the same conditions and prices to all commercial customers and consumers of the same category. Surface wastewater management service providers must provide services under the same conditions and prices to all commercial customers of the same category.

Prices for drinking water supply and wastewater management services and surface wastewater management services may be differentiated based on costs, commercial customer and consumer categories, purchase and sale locations, supply and consumption limits, consumption seasonality, the quantity, nature, and concentration of discharged pollutants. Differentiation principles must be justified, objective, transparent, and non-discriminatory.

Commercial customers and consumers are categorized based on the ways drinking water supply and/or wastewater management services are provided, economically justified commercial customer decisions regarding the discontinuation of infrastructure operation and the transfer of wastewater for treatment to a wastewater manager, aiming to reduce negative impacts on human health and the environment, and payment for provided drinking water supply and wastewater management services (in apartments or other premises, at intake points), and seasonality.

If a drinking water supplier provides wastewater treatment services with increased and specific pollution, the supplier prepares and submits a proposed price for such services following the calculation procedures approved by the SERC for wastewater treatment prices for increased and specific pollution. These proposals, along with supporting documents, are submitted to the Council. The SERC, using the approved calculation procedures, sets the price for wastewater treatment for increased and specific pollution. Funds collected from these services are allocated to the development of drinking water supply and wastewater management infrastructure and/or to improving the quality of wastewater management services.

The baseline pollution levels for wastewater, exceeding which additional charges for wastewater treatment are applied to specific commercial customers, are determined by the settlement procedures approved by the Government for the supply of drinking water and wastewater management services.

If the average change in tariffs and rates for electricity and/or gas used for drinking water supply, wastewater management, and surface wastewater management services exceeds 30%, drinking water suppliers and surface wastewater management providers, adhering to the Methodology, prepare and submit justification for additional charges related to energy cost changes to the Council. Based on the justification received, the Council determines an additional pricing component for energy cost changes, which remains valid until the end of the base pricing period for that year.

Definitions used in the Methodology:

Necessary cost – the minimum expenses required by a drinking water supplier and surface wastewater manager during the validity period of base prices, essential for the secure and reliable provision of drinking water supply, wastewater management, and surface wastewater management services; long-term operation, renovation, and development of infrastructure; ensuring accessibility to quality services; reducing environmental pollution; and rational use of water resources.

Drinking water extraction – collecting water that meets legal safety and quality requirements or is suitable for preparation into drinking water from aquifers or natural sources using specific equipment.

Drinking water preparation – improving the properties of natural water through physical, chemical, and biological methods to meet legal safety and quality requirements and satisfy

consumer needs.

Drinking water delivery – a set of technical and organizational measures ensuring water delivery to consumers and commercial customers.

Pre-inlet water losses – the difference between extracted water and the amount sold to consumers due to losses in reservoirs, treatment facilities, and pipelines.

Drinking water supply – activities involving technical, organizational, and financial measures required for water extraction, preparation, delivery, and sale to commercial customers and/or consumers.

Multi-apartment network losses – the difference between water supplied to a building and the amount sold to residents.

Drinking water supply and wastewater management activities – water supply and wastewater management.

Return on investment rate – the rate covering the cost of utilized capital.

Pricing regulation period – the duration for which base prices are set.

Wastewater sludge – sludge produced during domestic, communal, or similar wastewater treatment.

Wastewater sludge management – processes like thickening, anaerobic treatment, drying, incineration, composting, and disposal of treatment sludge or compost.

Wastewater collection – gathering wastewater from its source and transporting it via networks.

Wastewater treatment – removal of pollutants from wastewater.

Wastewater management – legally defined activities including collection, storage, transport, treatment, and disposal of treated wastes or sludge.

Recalculation reporting period – the 12 months prior to the preparation of recalculated price drafts.

Extraordinary recalculation reporting period – the period for which electricity and/or gas costs are not covered under existing pricing, up to 12 months prior to the preparation of recalculated price drafts due to tariff changes exceeding 30%.

Surface wastewater management – includes collection, transport, treatment, and accounting of surface wastewater and primary handling of sludge generated during treatment.

Regulatory authority – the SERC or municipal authority responsible for overseeing licensed

or regulated activities and determining base and recalculated prices.

Seasonal customer – a commercial customer who consumes at least 80% of their annual water usage within four consecutive months.

2.CLASSIFICATION OF THE CONSUMERS AND COMMERCIAL CUSTOMERS

Consumers are classified into the following categories:

- Consumers purchasing drinking water and wastewater management services at the inlet of apartment buildings or the inlet of individual residential communities;
- Consumers purchasing drinking water and wastewater management services for apartments;
- Consumers purchasing drinking water and wastewater management services at the inlets of individual houses or other premises intended for personal, family, or household use;

Commercial customers are classified into the following categories:

- Seasonal commercial customers;
- Commercial customers purchasing drinking water for heating premises and providing it to consumers and commercial customers, drinking water for hot water preparation and providing it to consumers, as well as drinking water for agricultural use, excluding groundwater used for processing agricultural products and manufacturing food or non-food products for sale;
 - Commercial customers purchasing drinking water supply and wastewater management services for household and commercial purposes, as well as purchasing drinking water for hot water preparation and supplying it to commercial customers;
 - Commercial customers purchasing drinking water for bottling and sale;
 - Commercial customers purchasing surface wastewater management services;
 - Commercial customers who have made decisions to abandon the operated infrastructure and transfer wastewater for treatment to a wastewater manager, aiming to reduce negative impacts on human health and the environment;

Also, there are other commercial customers and consumers for whom differentiated pricing for drinking water supply and wastewater management services may be applied under Article 33, Paragraph 18 of the Drinking water law².

3.RULES FOR PRICING DRINKING WATER SUPPLY AND WASTEWATER MANAGEMENT, SURFACE WASTEWATER MANAGEMENT SERVICES

Drinking water supply, wastewater management, and surface wastewater management services price types:

- The price for drinking water supply services only;

- The price for drinking water supply and wastewater management services;
- The price for wastewater management services only;
- The price for surface wastewater management.

When determining the base prices for drinking water supply, wastewater management, and surface wastewater management services, the following are considered:

- The scope of costs attributable to respective business units and services in the last reporting period year;
- The volumes of provided services in the last reporting period of drinking water supply, wastewater management, and surface wastewater management services;
- The values of benchmark indicators (excluding surface wastewater management services). Benchmark indicators are calculated by the Council according to the Council approved Description of Comparative Analysis of Drinking Water Supply and Wastewater Management Services. If the efficiency of a specific group of business units exceeds that of an individual business unit, the costs for that business unit are adjusted to match its group's efficiency, following documented factors and reasonable explanations. These adjustments are spread over a 5-year

² 18. Prices for drinking water supply and wastewater management services and surface wastewater management services may be differentiated based on costs, subscriber and consumer categories, purchase and sale locations, supply and consumption limits, consumption seasonality, the quantity, nature, and concentration of discharged pollutants. Differentiation principles must be justified, objective, transparent, and non-discriminatory.

period upon request from the business unit. Conversely, if a business unit's efficiency exceeds its group's efficiency, its factual costs are determined;

- Planned changes in business activities of the business unit in the first year of the regulatory period and the implementation of investment plans approved by the Council impacting expenses, including returns on investments;
- Significant post-reporting period events impacting on the size and structure of expenses;
- The justification for the changes in cost scope provided by the business unit;
- If energy resources (electricity, technological fuel) and materials costs reflected in recalculated prices differ significantly from the actual costs recorded in the third year of the price validity period, this difference is accounted for during the base price calculation for the next adjustment.

All costs incurred by the business unit must be allocated to business units and services per the Rules for Separation of Accounting of Drinking Water Supply and Wastewater Management, Surface Wastewater Management Services and Related Requirements Guide.

The scope of variable costs attributable to a specific regulated price service for a single base period year is determined as the sum of cost groups attributable to the service and related

investments approved by the Council. These costs are defined using the Methodology's guidelines. For efficiency evaluation, the Council determines specific tasks.

Key Expenses and Regulations for Price-Regulated Services

- Electricity expenses for premises heating, lighting, ventilation.
- Fuel expenses for transportation are determined using the same methodology points and appendices.
 - Heat energy expenses follow identical guidelines as electricity and fuel.
 - Depreciation costs.
- Maintenance and repair follow Methodology points regarding necessity and allocation.
- Personnel expenses including wages calculated based on average national industry rates but not exceeding set limits, social taxes and insurance contributions as legally required and safety and additional personnel-related costs within defined boundaries.
 - Other tax expenses that are regulated by active taxation laws.
 - Financial costs are included provided they are deemed necessary for regulated services.
- Administrative expenses follow evaluation methods as outlined in the Methodology appendices.
 - Marketing and sales expenses are subject to similar guidelines.
 - Other costs are vetted for relevance and compliance.
 - Investment returns.

Volumes of the services provided for the base price calculation are determined considering:

- the actual volume realized in the last reporting period for drinking water supply and wastewater management, stormwater management services;
- the justification of reasons provided by the Drinking water supplier and surface wastewater manager explaining the actual volume changes in realized quantities;
- the justification of reasons provided by the Drinking water supplier and surface wastewater manager explaining anticipated volume changes in realized quantities;
- the actual volume of water losses up to the water supply pipeline in the last reporting period, but no greater than 20%. The Council, considering the Activity and Development Plan, has the right to set tasks for reducing water losses in water networks for Drinking water suppliers and surface wastewater managers;
- the actual volume of infiltration in sewerage networks during the last reporting period, but no greater than 20%, and in cases of mixed sewage, no greater than 35%. The Council, considering the Activity and Development Plan, has the right to set tasks for reducing infiltration in sewerage networks for Drinking water suppliers and surface wastewater managers;
- the effect of measures implemented under the Activity and Development Plan in the first year of the base price validity period for drinking water supply and wastewater management, stormwater management services;
- actual, but no greater than 2%, drinking water losses in apartment building networks

caused by discrepancies in water metering equipment readings between the main water metering devices installed at the apartment building's inlet and those installed in apartments. If it is technically or otherwise impossible to install main metering devices at the inlets of apartment buildings (more than 30% of the inlets lack main metering), the actual drinking water losses in apartment building networks are determined based on the average indicator of the respective Economic Entity group, as per the Comparative Analysis Description. If it is impossible to establish an average indicator for drinking water losses in apartment building networks due to insufficient data, the actual losses are determined based on the average indicator of all Drinking water suppliers and surface wastewater managers. The Council publishes the average indicators for Drinking water supplier and surface wastewater manager groups and all Drinking water suppliers and surface wastewater managers on its website by July 1 of each year.

4.SUMMARY OF REQUIREMENTS RELATED TO PRICING

Procedure for setting basic prices for drinking water supply and wastewater management as well as surface wastewater management services:

Drinking water suppliers and surface wastewater managers, following the Methodology, prepare and submit to the Council drafts of basic prices for drinking water supply and wastewater management as well as surface wastewater management services no later than 4 months before the end of the current regulation period. Along with the submitted price drafts, Drinking water suppliers and surface wastewater managers shall provide:

- A request specifying the proposed basic prices for drinking water supply, wastewater management, and surface wastewater management services;
- An explanatory note specifying:
 - Activities carried out;
 - Assets owned, held in trust, or used based on usage rights;
 - Infrastructure operational conditions (drinking water quality, quality of treated wastewater, the number of consumers in the serviced area, the percentage of consumers receiving centralized drinking water supply, the percentage of consumers receiving centralized wastewater management services, and other information);
 - Main reasons for changes in sales and expenses (changes in the serviced area, changes in drinking water consumption, changes in costs, etc. To justify planned wage increases, an order regarding planned wage adjustments should be provided as announced by the Ministry of Finance);
- A development and operational plan for at least five years, prepared according to the Rules for Preparing Operational Plans for Drinking Water Suppliers and Wastewater Managers, approved by the board of the drinking water supplier and wastewater manager or surface wastewater manager (if no board is formed, then by the executive body of the municipality);
- Statistical reports for the reporting year:
 - Declaration of the fee for mineral resources, water, and construction soil;
 - Declaration of the environmental pollution tax from stationary and mobile sources;
- Profit (loss) statement for the reporting year;

- Realized volume of services for drinking water supply, wastewater management, and surface wastewater management services during the reporting period;
- Value of long-term assets during the reporting period;
- Data about the number of employees and their average monthly wages;
- Electricity consumption during the reporting period;
- Direct costs for drinking water supply, wastewater management, and surface wastewater management services during the reporting period and for service maintenance;
- Indirect costs during the reporting period and for service maintenance;
- Allocation of indirect service maintenance costs to business units and services;
- General (administrative) costs for service maintenance during the reporting period;
- Allocation of general (administrative) costs for service maintenance to business units and services;
- Pricing table for the reporting period;
- Pricing table for service maintenance;
- Annual cost changes for drinking water supply, wastewater management, and surface wastewater management services during the reporting period after the commissioning of newly renovated or newly operational long-term assets;
- Pricing table for the base year;
- Results of other activities during the reporting year.

The Council shall establish the basic prices for drinking water supply, wastewater management, and surface wastewater management services no later than two months from the date of receipt of the draft basic prices for these services. If not all data and/or documents are submitted or if additional information is received, the term begins from the date of submission of all required data and/or documents and information. When establishing the basic prices for drinking water supply, wastewater management, and surface wastewater management services, the Council evaluates the justification of operational expenses and determines the efficiency indicators for the provision of drinking water supply and wastewater management services.

Procedure for determining recalculated basic prices for drinking water supply and wastewater management, as well as surface wastewater management services:

Drinking water suppliers and surface wastewater managers, following the Methodology, prepare and submit to the Council, no later than 4 months before the end of the current regulatory period, projects for determining recalculated basic prices for drinking water supply and wastewater management, as well as surface wastewater management services. Along with the submitted pricing projects, economic entities provide:

- a request indicating the recalculated basic prices for drinking water supply and wastewater management, as well as surface wastewater management services, requested for approval;
- an explanatory note specifying the main reasons for changes in costs and revenues. To justify changes in labor costs, an order regarding planned wage increases issued by the Ministry of Finance is provided;
- calculations of price changes to determine recalculated basic prices;
- recalculated basic prices.

The Council determines the recalculated basic prices for drinking water supply and wastewater management, as well as surface wastewater management services, no later than 2 months from the date of receiving the recalculated pricing projects. If not all the required data and/or documents are submitted or if additional information is received, the term starts from the date of submission of all data and/or documents and information;

The basic prices for drinking water supply and wastewater management services, recalculated basic prices for drinking water supply and wastewater management services, basic prices for surface wastewater management services, and recalculated basic prices for surface wastewater management services take effect no earlier than 30 calendar days after their public announcement by the economic entity and are applied from the first day of the following month. The recalculated basic prices for drinking water supply and wastewater management, as well as surface wastewater management services, remain valid for 12 months from the date of entry into force.

5.A SURVEY OF THE ECONOMETRIC STUDIES

There are no econometric studies on drinking water price conducted in Lithuania.

The same was stated in a European Commission Joint Research Centre report from 2015, that explicitly notes that no household water demand function estimates were found for Lithuania at the time³. The study aimed to model household water demand across all EU-28 countries using consistent econometric methods, but Lithuania was among the ten countries lacking such data.

In 2022, the OECD has published work on water supply and wastewater treatment reform in Lithuania, which touches on pricing and efficiency, though not through econometric modeling.⁴

There is a study conducted in 2005 by a Master's degree student on drinking water pricing: "The singularity of water services rate pricing and economical substantiation".⁵ It does not implement any econometric models but analyses some indicators that could be usable when performing an econometric study.

Here is an abstract of that study: "This master final paper formulates pricing of water sector services, analyzes sustainable price for water services, evaluates tax rates, paid for water, from every water user. The purpose of this paper is to find out reasons, which are damaging for JSC "Šiaulių vandenys" future efficiency and viability. It analyzes and systemizes theoretical and practical research from scientific, methodological and publicist literature, along with special research water methods. The hypothesis of this master paper was substantiated only partly, because an efficiently water pricing depends not only from water service company, but from political, legal and environmental frames as well, which come directly from the State government and EU directives."

Recently SERC updated the Description of Comparative Analysis of Drinking Water Supply and Wastewater Management Services where some benchmarking indicators are calculated

using econometric modeling. Mostly those indicators relate to human resource management and are used to calculate efficient levels of personnel needed based on volumes of services, numbers of customers and types and amounts of the managed infrastructure.

³ Reference No. 5

⁴ Reference No. 4

⁵ Reference No. 7

6. IDENTIFICATION OF DATA TO ENABLE THE ESTIMATION OF AN ECONOMETRIC MODEL OF HOUSEHOLD WATER DEMAND FOR LITHUANIA

As stated above, there is no possibility to gather any information regarding water demand elasticity from any survey in Lithuania. An econometric model could be constructed from data available from the State Data Agency and conducting a survey.

There we can get independent indicators such as water price, income levels, household sizes diversity and construct an econometric model:

$$\text{Water_Consumption}_i = \beta_0 + \beta_1 \cdot \text{Water_Price}_i + \beta_2 \cdot \text{Income}_i + \beta_3 \cdot \text{Household_Size}_i + \beta_4 \cdot \text{Urban}_i + \varepsilon_i$$

If drinking water consumption elasticity considering low- and high-income households should be calculated, then additional data would be needed to collect directly from Drinking Water Supply and Wastewater Management companies.

There is an additional study, conducted by Environmental Protection Agency, in 2015 named “Economic analysis of water use and recovery of costs incurred in providing water services.”⁶ This survey is a statistical analysis of data and doesn’t have any modeling, but it can be used as a resource of required data.

There is a Master’s degree thesis study done in 2006 named: “The tendencies in variations of water demand”.⁷

Here is an abstract: “The tendencies of changes in water consumption are discussed in this final master’s studies research during different periods. The object of the research was chosen the biggest Lithuanian cities such as Vilnius, Kaunas, Klaipeda, Panevezys and Siauliai, also the lower reaches of the Nemunas, the basins of the Venta-Lielupe and the Neris.

The purpose of the research is to collect and to analyze the data about the water consumption and its tendencies of changes and to do the analysis of factors, which influence water consumption. This research paper analyses factors, which could influence the increase or decrease of water consumption. These factors might be the decrease of production amount, increasing water tariffs, the establishment of water-meters, low incomes of citizens, old water-

supply systems, which influence bad water quality for consumers. Whereas designed water-supply do not match current standards of water consumption, water is held there for too long and this could influence connecting new water consumers. However at present land's economy revives, the GDP is increasing and so the incomes of citizens increase too, which influence the increasing standards of water consumption, although they have not reached the level of the standards in 1989-1990.

Analyzing statistical data about water consumption there was looked for a connection between the amount of consumed water and unemployment. Also analyzing the dependence on middle income and the level of water consumption, there was estimated quite high correlation grade R- 0.6. The data given by the Department of Statistics shows, that the average consumption

⁶ Reference No.3

⁷ Reference No.6

of water in urban area is about 90 liter per person, and the average water consumption in rural area is about 70 liter per person. It would be averagely about 80 liter per person, this is less than the recommended amount of water, which is essential to maintain people's hygiene.

The tendencies of changes in water consumption the mostly depend on incomes of citizens, the low price of water tariffs and the unemployment rate.”

7.REPLICATION ASSESSMENT FOR THE MICROSIMULATION MODEL

In general, with some modifications, this model can be adopted in Lithuania. As mentioned earlier, there are no econometric studies performed on the subject, but there is a pool of statistical data available to build a model from scratch. On the other hand, there are some differences, that derive from the differences in French and Lithuanian water pricing regulation. These differences will be emphasized when discussing each module separately.

7.1 GENERAL DATA INPUT

The user is asked to input initial information that is in possession of a water manager. Therefore, this data could be input by a water manager, a municipality or a regulator. In another case questionnaires could be developed to gather data from water managers. Each water manager operates in the boundaries of the corresponding municipality (more or less), therefore, the data would prove the view of a corresponding municipality.

7.2 POPULATION MODULE

The Population module contains statistical data on the households. This data includes household income, household size (number of people), number of children, number of working

adults, number of non-working adults. This data is available from the databases managed by the state. Information in relation to equipment, such as garden, pool, Maison, Retraité, Proprio is not available. To obtain this information some research should be done.

7.3 TARIFF MODULE

Most differences in the regulation affect this module. In Lithuania there are no two-part tariffs as well as no IBT tariffs. All customers pay for the consumption of water and use of sewage services according to the volumes in cubic meters.

Taxation is similar, only values differ, therefore only amendments in values would be necessary.

Cost structure is the same in all countries. Only proportions may vary. No amendments would be necessary in this part.

Social data. There are no social related incentives or discounts provided by the water manager. There is only one threshold embedded in the law – water bill may not exceed 2 percent of household income. This test is important when calculating prices and must be considered.

7.4 DEMAND MODULE

As mentioned earlier, almost no econometric studies were performed to measure water demand elasticity in relation to its price. Performing this study would give a better understanding of relationships of water demand to its price, size and income level of the household.

7.5 INVOICES MODULE

This module used data from abovementioned modules. Therefore, no major changes would have to be made to data input. On the other hand, it considers IBT consumptions, which does not apply in the case of Lithuania.

8. **CONCLUSION**

Even though in Lithuania water prices are relatively low (water consumption and sanitation service bills account for about 1 percent of an average household income) and demand elasticity is low, implementation of such model would be feasible to forecast a change in prices in the near future. The significant increase in water and sanitation prices might happen in near future due to the fact that infrastructure, built using EU funds, is aging and will require heavy funding from consumers. In that case water and sanitation prices will have a bigger impact on households' spendings.

Taking into consideration the differences between Lithuanian and French law some adjustments in the model will have to be taken. Those adjustments will involve programming works as well as adoption to the specifics of users in Lithuania. Modification of the model could

take about 24 months and cost around 120.000 Euros.

REFERENCES

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2. “Methodology for setting prices for drinking water supply, wastewater management, and surface wastewater management services”, Approved by the State Energy Regulatory Council, 2006-12-21, No. O3-92.
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4. OECD (2022), Reform of Water Supply and Wastewater Treatment in Lithuania: Practical Options to Foster Consolidation of Utilities, OECD Studies on Water, OECD Publishing, Paris, <https://doi.org/10.1787/f966a980-en>.
5. Reynaud A. Modelling Household Water Demand in Europe - Insights from a Cross-Country Econometric Analysis of EU-28 countries. EUR 27310. Luxembourg (Luxembourg): Publications Office of the European Union; 2015. JRC96268.
6. Renata Šukaitytė, “The tendencies in variations of water demand” [2006], Master’s degree thesis, Lithuanian University of Agriculture.
7. Agnius Virbukas, “The singularity or water services rate pricing and economical substantiation” [2005], Master’s degree thesis, Šiauliai University.

APPENDIX 1

Base Prices for Water Supply and Wastewater Management Services (Excl. VAT)

1. Drinking Water Supply and Wastewater Management Services

1.1 For apartment consumers:

- **Total price:** €3.26/m³
 - Drinking water supply: €1.27/m³
 - Wastewater management: €1.99/m³
 - Collection: €0.67/m³
 - Treatment: €0.75/m³
 - Sludge management: €0.57/m³

1.2 For consumers in individual houses or premises for personal/family/home use:

- **Total price:** €3.20/m³
 - Drinking water supply: €1.24/m³
 - Wastewater management: €1.96/m³
 - Collection: €0.66/m³
 - Treatment: €0.74/m³

- Sludge management: €0.56/m³

1.3 For commercial users using services for household and commercial needs, or for preparing hot water:

- **Total price:** €3.35/m³
 - Drinking water supply: €1.40/m³
 - Wastewater management: €1.95/m³
 - Collection: €0.66/m³
 - Treatment: €0.73/m³
 - Sludge management: €0.56/m³

1.4 For commercial users using water for heating premises, preparing hot water, or agricultural activities (excluding underground water used for processing and selling food/non-food products), and for users in apartment or individual house associations:

- **Total price:** €3.19/m³
 - Drinking water supply: €1.24/m³
 - Wastewater management: €1.95/m³
 - Collection: €0.66/m³
 - Treatment: €0.73/m³
 - Sludge management: €0.56/m³

2.Surface Wastewater Management

- **Base price:** €0.25/m³

3.Additional Charges for Exceeding Pollution Limits

- BOD₇ concentration (per 100 mg/l above base): €0.013/m³
- Suspended solids (per 100 mg/l above base): €0.005/m³
- Nitrogen (per 10 mg/l above base): €0.002/m³
- Phosphorus (per 1 mg/l above base): €0.0001/m³

4.Treatment of Delivered Dried Sludge

- **Price:** €39.90/t.

APPENDIX 2

In 2023, 70 economic entities held drinking water supply and/or wastewater management licenses, while 5 economic entities provided only surface wastewater management services. Council-regulated drinking water suppliers and/or wastewater managers supplied drinking water and/or provided wastewater management services to 1.18 million consumers and 43.2 thousand commercial users.

In 2023, 136.53 million m³ of drinking water was extracted and 182.31 million m³ of domestic and industrial wastewater was treated.

The volume of water sold was 107.7 million m³ in 2023, while the volume of wastewater treated was 107.7 million m³ in 2023.

Utility expenditure like electricity, water, and gas in Lithuania ranges from 3% to 10% of total expenses with 6% being the average. The average monthly cost of utilities is 140 EUR with 14 EUR and 2,000 EUR being the upper and lower limits.

Statistics on household example:

Number of households 

		Number of households thousand									
		2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Urban and rural areas	Republic of Lithuania	1,331.6	1,391.6	1,357.0	1,321.7	1,308.3	1,347.9	1,395.7	1,471.1	1,557.0	1,665.9
	Capital Region	374.1	394.3	384.5	385.2	394.0	412.9	425.5	444.5	482.2	516.2
	Vilnius county	374.1	394.3	384.5	385.2	394.0	412.9	425.5	444.5	482.2	516.2
	Central and Western Lithuania Region	957.5	997.3	972.5	936.4	914.3	935.0	970.2	1,026.5	1,074.8	1,149.8
	Alytus county	69.5	72.2	74.0	69.0	65.8	68.7	69.0	72.1	75.8	80.4
	Kaunas county	261.1	268.0	266.5	262.8	254.7	263.2	285.1	304.5	307.4	333.7
	Klaipėda county	147.3	153.7	151.5	149.3	150.7	152.6	153.4	165.1	178.9	190.9
	Marijampolė county	69.6	71.8	66.8	65.0	62.0	64.1	62.7	64.2	66.4	69.8
	Panevėžys county	106.5	110.6	107.3	101.8	97.9	100.4	106.2	110.4	115.9	125.6
	Šiauliai county	126.1	130.2	125.6	120.2	117.7	117.0	122.0	131.5	142.0	151.5
	Tauragė county	48.3	51.1	46.4	43.6	43.0	40.7	40.9	48.0	49.2	49.8
Telšiai county	62.5	68.7	64.7	60.9	60.9	63.4	65.2	65.8	68.7	73.4	
Utena county	66.6	71.0	69.8	64.0	61.5	64.9	65.7	65.1	70.5	74.7	
Urban areas	Republic of Lithuania	899.6	940.3	907.6	905.3	914.4	950.1	986.5	1,054.4	1,118.0	1,197.6
	Capital Region	x	x	x	x	x	x	x	x	x	x
	Vilnius county	x	x	x	x	x	x	x	x	x	x
	Central and Western Lithuania Region	x	x	x	x	x	x	x	x	x	x
	Alytus county	x	x	x	x	x	x	x	x	x	x
	Kaunas county	x	x	x	x	x	x	x	x	x	x
	Klaipėda county	x	x	x	x	x	x	x	x	x	x
	Marijampolė county	x	x	x	x	x	x	x	x	x	x
	Panevėžys county	x	x	x	x	x	x	x	x	x	x
	Šiauliai county	x	x	x	x	x	x	x	x	x	x
	Tauragė county	x	x	x	x	x	x	x	x	x	x
Telšiai county	x	x	x	x	x	x	x	x	x	x	
Utena county	x	x	x	x	x	x	x	x	x	x	
Rural areas	Republic of Lithuania	432.0	451.3	449.4	416.4	393.9	397.8	409.2	416.6	439.0	468.4
	Capital Region	x	x	x	x	x	x	x	x	x	x
	Vilnius county	x	x	x	x	x	x	x	x	x	x
	Central and Western Lithuania Region	x	x	x	x	x	x	x	x	x	x
	Alytus county	x	x	x	x	x	x	x	x	x	x
	Kaunas county	x	x	x	x	x	x	x	x	x	x
	Klaipėda county	x	x	x	x	x	x	x	x	x	x
	Panevėžys county	x	x	x	x	x	x	x	x	x	x

Annex 9: InnWater Governance platform – Middle Sava basin, Slovenia

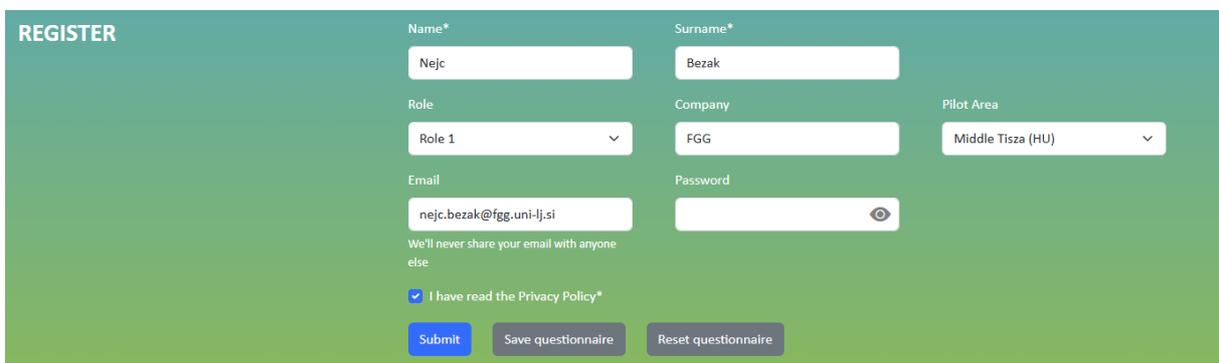
Initial evaluation of the InnWater platform from the user-experience perspective

Author: Nejc Bezak

Water Governance Tool

Possible improvements:

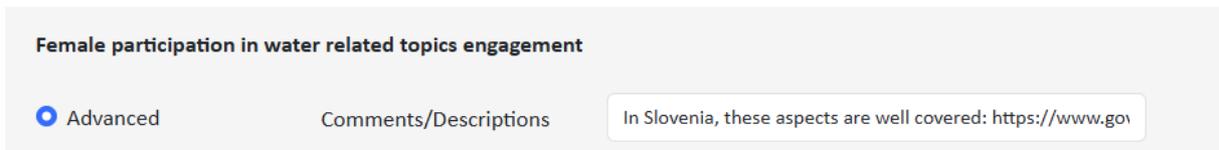
- 1) Section at the end does not work (i.e., Save questionnaire only exports it to the pdf and nothing is sent to the e-mail, also there is no point in putting the password):



- 2) During the export/print to the pdf, some windows are clipped:

Question 32

Are there mechanisms implemented to ensure female participation in water related engagement?



So only part of the text is seen in the pdf.

- 3) It would be better to divided the questions into several sub-pages, maybe each Section could have its own web-page (sub-page).
- 4) Q/A at the end of Results could work better, if specific question is asked about the results of governance assessment, the answers are not always correct, are actually there are mostly not correct.

Positive aspects:

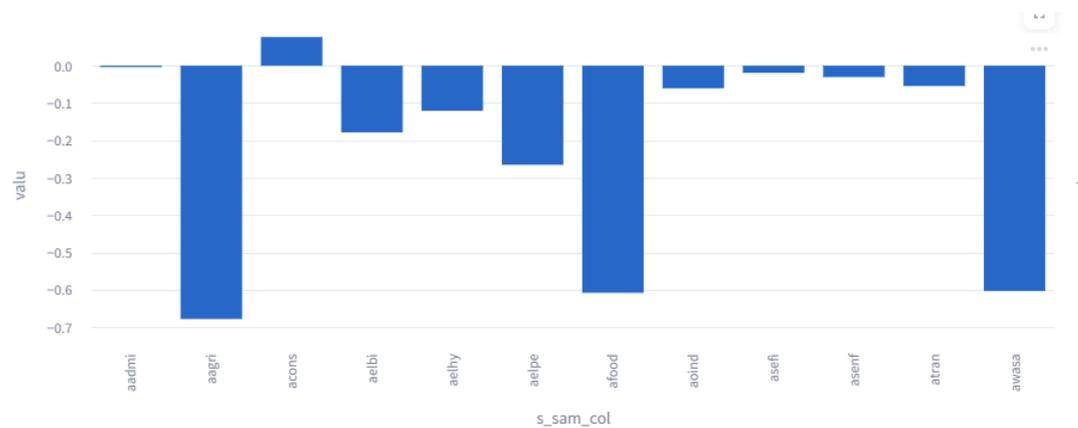
- 1) Answers are stored in the browser even if tab is closed.
- 2) Background colours are good to separate questions/answers.
- 3) In the Results section, Examples are useful to see some case studies.

- 4) Visual representation of results using spider graph is nice, maybe you could add buttons on the graph where user could click and get more info about how to improve specific section/category.

CGE Model

Possible improvements:

- 1) Some introduction text could be added at the start with some background info (why is this important, how the model/tool can be used, etc.). Why these scenarios. Etc. Similar as for the Water Governance Tool.
- 2) It would be very nice if user could change the % of increase/decrease for specific scenario. That would make tool much more interactive.
- 3) Variables on the graphs (valu on y-axis) should be better explained, are there units missing?



- 4) Four digits are maybe too much to show in the tables (also in the plots when moving mouse over the plot the value could be rounded to maybe 2 digits):

acons	0.0769
aelbi	-0.1788
aelhy	-0.1207
aelpe	-0.2655
afood	-0.6084
aoind	-0.0606
asefi	-0.019
asenf	-0.0302
atran	-0.0543
awasa	-0.6034

- 5) Maybe show positive bars in blue and negative in red or something similar?
- 6) I do not really complete understand the model (not my field) but is there possibility to show some temporal changes?
- 7) Would it be possible to combine scenarios?

Positive aspects:

- 1) Graphs are interactive, they can be moved up and down.
- 2) The same for Tables, good to have a download option.

Knowledge Assistant

Possible improvements:

- 1) Maybe a direct link to listed deliverable could be added:

D2.1: Enhanced water governance assessment tool



- 2) It is not possible to ask multiple questions at the same time, when "Start a new query" is selected, previous answer is deleted.
- 3) The tool results could probable be improved, for example:

 **User Message**

List partners in the InnWater project?

 **System Message**  

The InnWater project encompasses a diverse collaborative framework of partners with specific roles across various work packages aimed at enhancing water governance and promoting sustainability in water systems. While the exact list of partners may not have been previously provided in the retrieved documents, the context indicates that there are several key groups involved.

1. **Pilot Site Leaders:** These partners are identified as lead institutions within the InnWater project, tasked with managing the water governance assessment processes and engaging with the InnWater Steering Committee.
2. **Work Package 2 Partners:** These partners act as facilitators, providing support to the Pilot Site Leaders in conducting the water governance assessment, convening stakeholder workshops, and facilitating discussions among stakeholders.
3. **Stakeholders:** The project also involves a wide array of stakeholders, including government authorities, civil society organizations, non-governmental organizations, industry representatives, financial institutions, and community groups. Their engagement is vital for ensuring the inclusiveness and effectiveness of water governance assessments.

To get a complete list of specific partner organizations involved in the InnWater project, check the documents retrieved which may provide further information on each partner and their contributions to this initiative.

Can I help you with another issue?

Positive aspects:

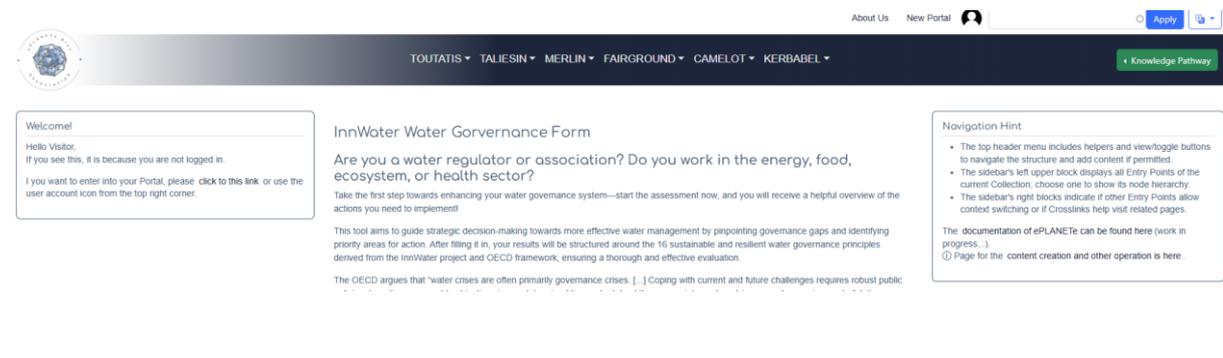
- 1) Text generator works quite fast (also in other tools).

- 2) There is an option to provide positive/negative feedback (thumbs up/down).

Platform

Possible improvements:

- 1) Text at the top is not in English but I assume that this will be improved:



Second evaluation of the InnWater platform and tools from the user-experience perspective

Author: Nejc Bezak

Water Governance Diagnostic Tool

Available at: <https://innwater.eurecatprojects.com/innwater/>

Possible improvements:

- 5) Sometimes the web-page automatically moves to another question, for example if I try to answer Question 32 (select "In progress" tab), the web-page automatically goes to Question 9.
- 6) In the upgraded version there is an option to Save progress and Retrieve Questionnaire. However not all questions are saved, for example answers to Question 33 are not saved and empty answers are provided when I try to use the Retrieve Questionnaire.
- 7) Maybe it would be good to add some descriptive information for the REGISTER section at the end. Also, the Pilot Area and Company (and Role) are kind of redundant at the moment.
- 8) It would be better to divided the questions into several sub-pages, maybe each Section 14 could have its own web-page (sub-page).

- 9) For the InnWater Assistant that can be accessed with “Chat with us bottom”, when I click enter on keyboard it closes, I can still open it and access the answer but it would be easier if the Assistant would not close.

Positive aspects:

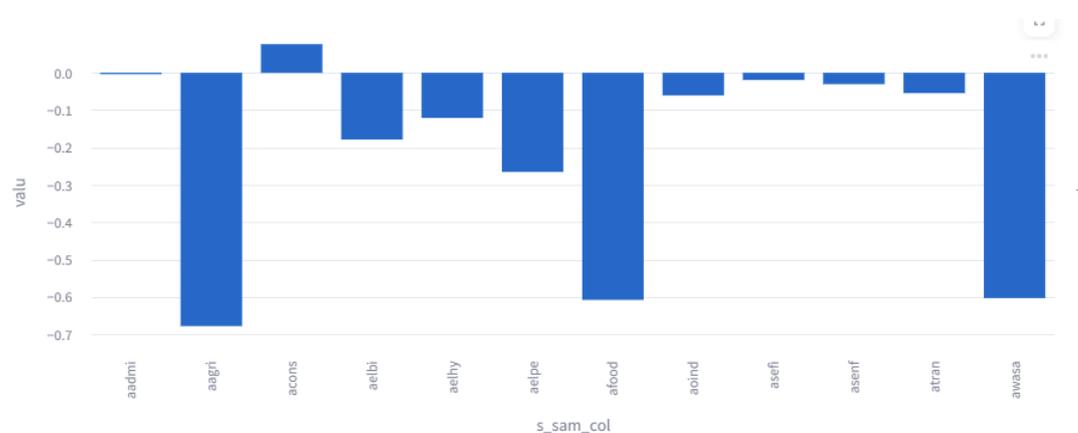
- 5) Answers are stored in the browser even if tab is closed. Reset questionnaire works well.
- 6) Background colours are good to separate questions/answers.
- 7) In the Results section, Examples are useful to see some case studies.
- 8) Visual representation of results using spider graph is nice, also buttons on the graph are nice where you can see additional explanation.
- 9) Q/A at the end of Results has been improved, I tried several questions (e.g., What is circular economy, How can I apply circular economy, Who are the most relevant stakeholders for flood risk reduction?, How will climate change impact on the flood risk in central Europe) and the answers were quite good in most cases.
- 10) The multi-language option works well, if answers to Assistant are asked in other language there is also response in this language, which is nice.

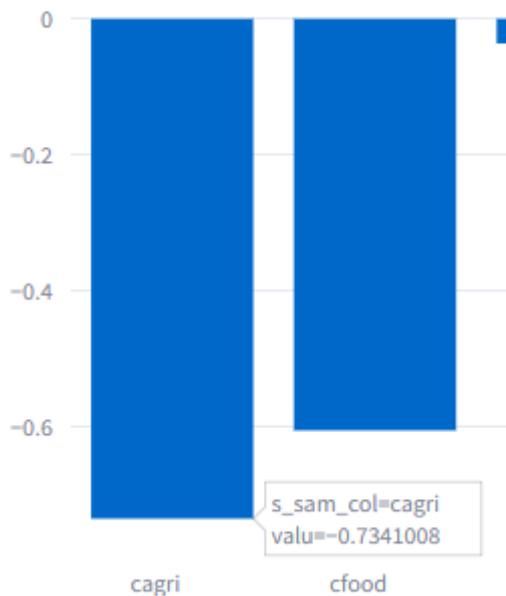
CGE Simulation Model

Available at: <https://innwater.eurecatprojects.com/cge/>

Possible improvements:

- 8) It would be very nice if user could change the % of increase or decrease or change some specific model setting or parameter for specific scenario. That would make tool much more interactive and it would be possible to evaluate different options.
- 9) Variables on the graphs (value on y-axis) should be better explained, are there units missing? Also, the word “valu” is used, probably a typo. Additionally, the x-axis labels are not the most informative, since it is not clear what for example “s_sam_col” means. The same applies for labels that are shown when mouse is put on the specific bar on the graph.





10) Four digits are maybe too much to show in the tables (also in the plots when moving mouse over the plot the value could be rounded to maybe 2 digits):

acons	0.0769
aelbi	-0.1788
aelhy	-0.1207
aelpe	-0.2655
afood	-0.6084
aoind	-0.0606
asefi	-0.019
asenf	-0.0302
atran	-0.0543
awasa	-0.6034

11) Maybe show positive bars in blue and negative in red or something similar?

12) I do not really complete understand the model (not my field) but is there possibility to show some temporal changes (i.e., how do model results change with specific year)?

13) Would it be possible to combine scenarios (e.g., water scarcity and water price increase)?

Positive aspects:

- 1) Nice to see that the introduction text has been added.
- 2) Graphs are interactive, they can be moved up and down. There are a lot of interactive options (e.g., save png, zoom in, zoom out, etc.).
- 3) The same for Tables, good to have a download option. It is good that table can be sorted based on the specific column.
- 4) It is nice to see that indicators can be added or removed.

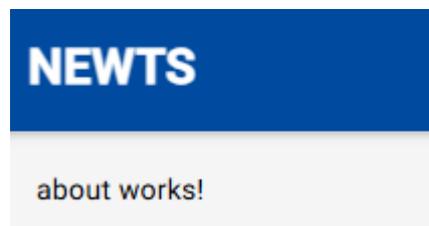
- 5) The interactive Q/A tool (Start a conversation) has been improved. An option to provide positive/negative feedback (thumbs up/down) has been removed.

Water Tariff Dashboard

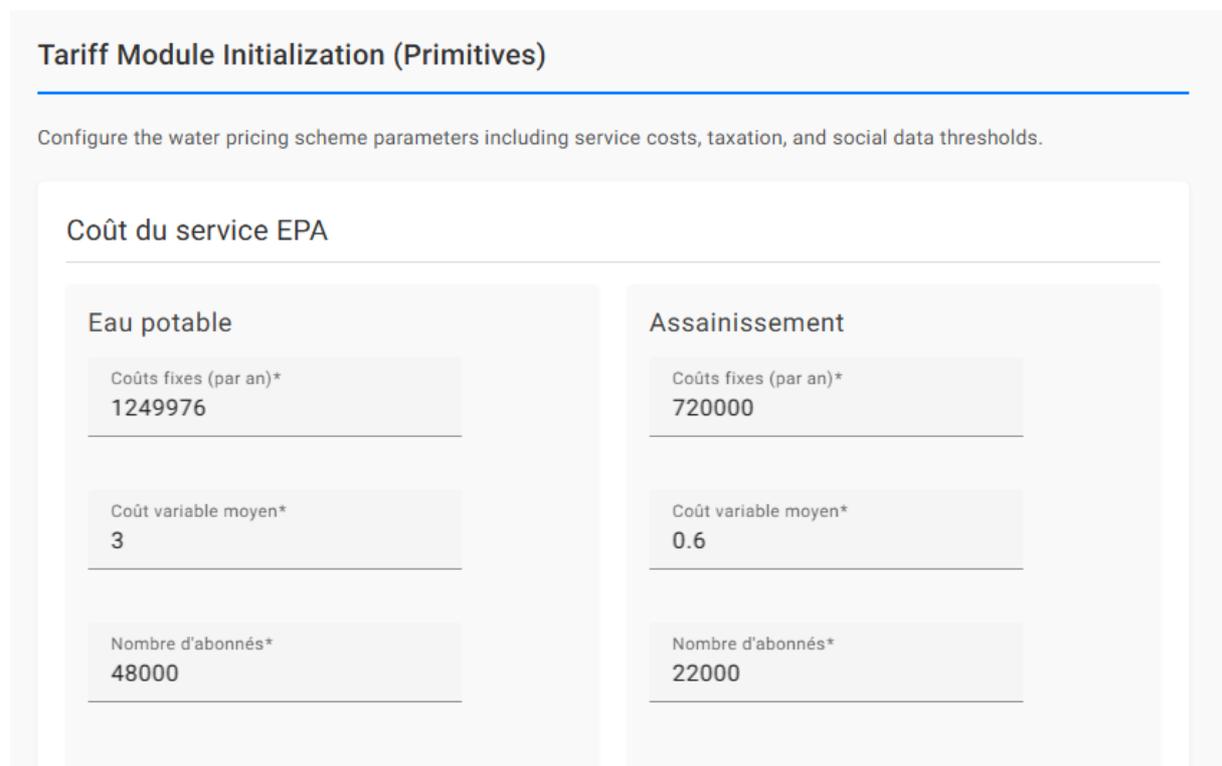
Available at: <https://innwater.eurecatprojects.com/msm/>

Possible improvements:

- 1) The About bottom at the top right does not work yet:



- 2) Some text is still in French:



Coût du service EPA	
Eau potable	Assainissement
Coûts fixes (par an)* 1249976	Coûts fixes (par an)* 720000
Coût variable moyen* 3	Coût variable moyen* 0.6
Nombre d'abonnés* 48000	Nombre d'abonnés* 22000

- 3) Final simulations do not yet work:

Launch Simulation

After configuring all the parameters in the previous tabs, you can now launch the simulation.

Nombre de périodes*

4

Nom simulation*

10

[object Object]

Send pre simulation

- 4) Regarding login options, it would be probably good to have the “Password Reset” or “Password Lost” option included.

Positive aspects:

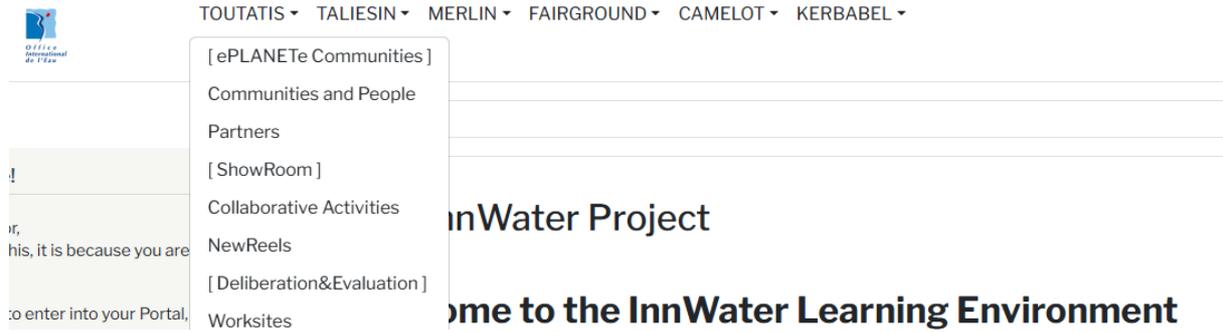
- 1) Nice to see that the introduction text has been included on the first page.
- 2) Chat with us seems to work well.
- 3) I was able to log in to the web-page (although no conformation e-mail was sent to me regarding this).
- 4) It is very good to see that the model parameters can be changed (e.g., larger, smaller value, adding, removing parts of the model, etc.).
- 5) It seems that previous simulations will be saved, which is a good addition to the tool.

InnWater Governance Platform

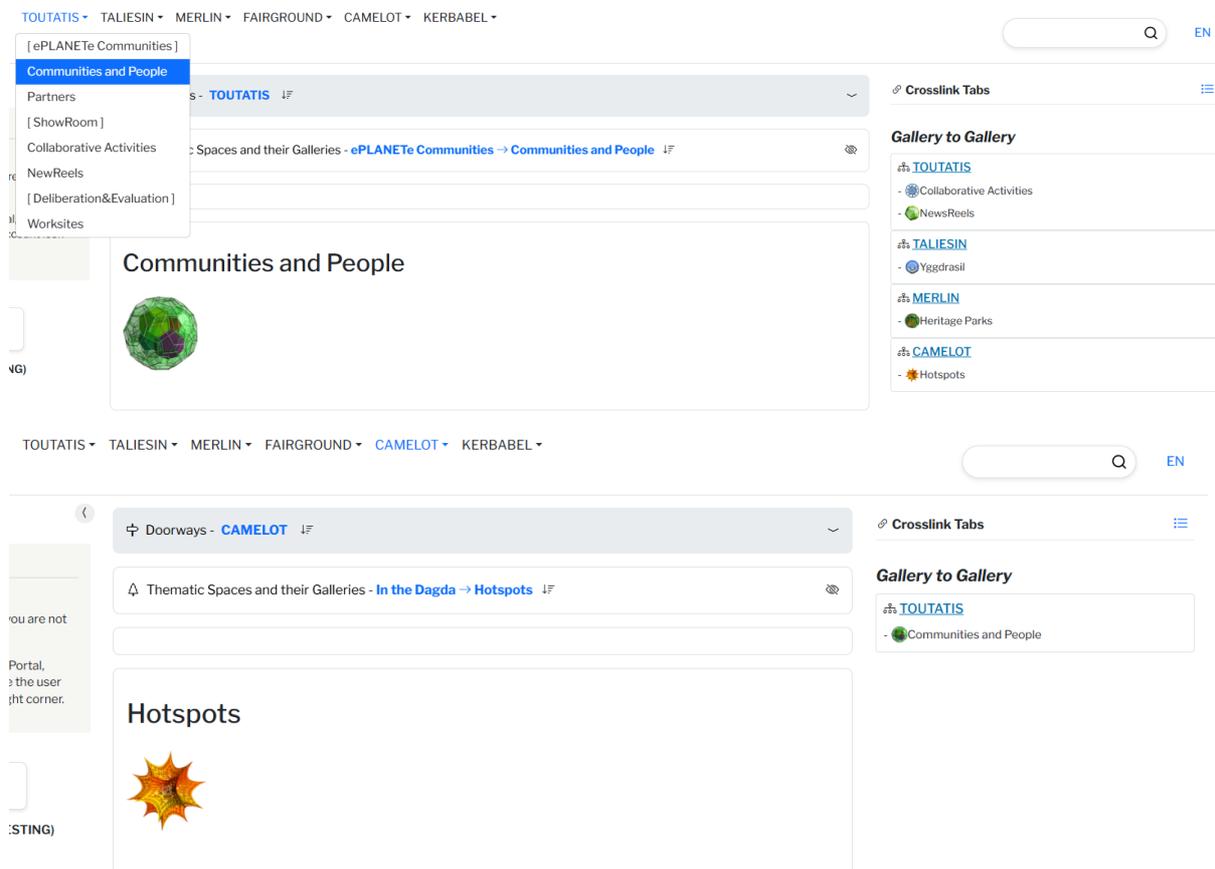
Available at: <https://le.innwater.eu/node/2387>

Possible improvements:

- 2) Text at the top of the web-page is not in English (I am not sure how I got to this web-page but if I click at the bottom: Copyright L'Association ePLANETe Blue ©2024 - vAlpha7.2 I, Legal Notice, Contact can access it again):



3) Link in the drop down menu are mostly empty or there is some information that is not really clear to the user:



4) If one selects the top left window (yellow circle another web-page (not related to the InnWater project) is shown:



TOUTATIS ▾ TALIESIN ▾ MERLIN ▾ FAIRGROUND ▾ CAMELOT ▾ KERBABEL ▾

Doorways - **Default View** ↓

Welcome!

Hello Visitor,
If you see this, it is because you are not logged in.

If you want to enter into your Portal, please [click to this link](#) or use the user account icon from the top right corner.

Login

u're currently exploring(TESTING)

Welcome to the OIEau ePLANETe v2024-Alpha7.2 platform

ePLANETe is a rich **multi-Portal environment**.

OPTAIN users, please click on the logo to get back to the project home page or [use this direct link](#).

Other users, please use the Project Switcher(click on the project name) to go to your project.

5) The option to change the language at the top right side does not work:

Q EN

You may change direction and follow another Composite Knowledge Pathway

Default view [The SMMAAD-Project Portals

- EN
- FR
- CS
- HU
- PL
- NB
- NN
- LT
- SV ✓
- LV
- DE
- IT
- SL

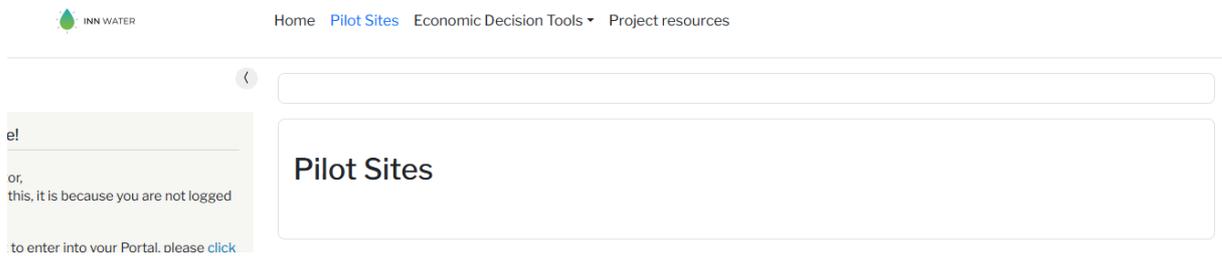
6) There are some links to other projects:

SMMAAD and Project Portals - **The InnWater Project** ↓

▼ ALL

- OPTAIN Learning Environment ↗
- Through the TALIESIN Doorway ↗
- The SPONGESCAPES project ↗
- The InnWater Project ↗
- GOVAQUA project ↗

7) The overall structure of the web-page is quite confusing, there are some links that open some irrelevant content, some buttons do not work, so web-pages are empty:



8) The only useful and clear content is the description on the start web page:

The InnWater Project

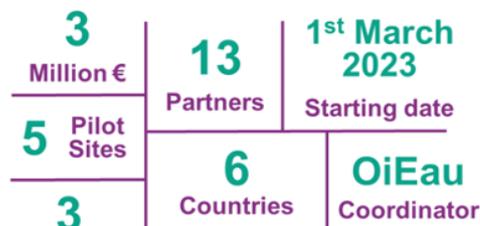
Welcome to the InnWater Learning Environment

InnWater is a European project funded by Horizon Europe. It supports a transition toward more sustainable, inclusive, and resilient **water governance** across Europe. The project brings together researchers, public authorities, citizens, and stakeholders from the water, energy, food, and ecosystems sectors to design and test **innovative governance practices**.

To share these innovations widely and encourage their replication, InnWater created a digital platform: the **Learning Environment**.

It is an open space to **learn, explore, and interact** with key tools, methods, and real-life examples of how water governance can be reimagined and improved.

Learn more about the project on our website: [INN WATER](#)



To share these innovations widely and encourage their replication, InnWater created a digital platform: the **Learning Environment**.

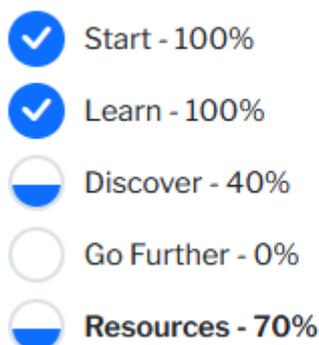
It is an open space to **learn, explore, and interact** with key tools, methods, and real-life examples of how water governance can be reimagined and improved.

9) But there are no direct links to access these tools.

10) It is not clear what these percentages at the left mean:

You're currently exploring(TESTING)

Resources



11) When I tried to create new account, this did not really work:

Unable to send email. Contact the site administrator if the problem persists.

Thank you for applying for an account. Your account is currently pending approval by the site administrator. In the meantime, a welcome message with further instructions has been sent to your email address.

12) The search tool at the top right side does not really work:

Home Pilot Sites Economic Decision Tools ▾ Project resources

economic tool Q EN

Search Results

Displaying 1 - 3 of 3

Search Hint

Enter a word or phrase and press Enter. You can sort the results using the columns next to the search box. You'll also see some options to refine your search based on the results. The search facets proposed is still a WORK IN PROGRESS...

Q Search Hint

13) Or it gives some results not related to the InnWater project:

me Pilot Sites Economic Decision Tools ▾ Project resources

hydrology

following restoration of a ... Tue, 10/14/2014 - 13:13	Area(aka Level or Site) ALL		
Impact Assessment Of Urbanisation On Hydrology For The River Tolka In Dublin, Ireland: A Case Study Of Remote Sensing Supported Hydrological Modelling ... 6988 ... Impact Assessment Of Urbanisation On Hydrology For The River Tolka In Dublin, Ireland: A Case ... Tue, 10/14/2014 - 13:03	Collection(aka Doorway or Gallery) Source Pathway(aka Context) Default view Area(aka Level or Site) ALL	3	Source
Leaky Dams as Nature-Based Solutions in Flood Management Part II: Mechanisms, Effectiveness, Environmental Impacts, Technical Challenges, and Emerging Trends. Hydrology ... Impacts, Technical Challenges, and Emerging Trends. Hydrology ... Thu, 07/03/2025 - 10:10	Collection(aka Doorway or Gallery) Sustainable Ideas and Actions Pathway(aka Context) Default view Area(aka Level or Site) ALL	2	Source
Hydrology Report Oroklini Marsh, Cyprus ... 6102 ... Hydrology Report Oroklini Marsh, Cyprus ... Tue, 10/14/2014 - 12:57	Collection(aka Doorway or Gallery) Source Pathway(aka Context) Default view Area(aka Level or Site) ALL	1	Source

Home Pilot Sites Economic Decision Tools ▾ Project resources

You are in this Project: **Innwater**

The page you are trying to view is associated to other(s) Project(s). Choose the one you are targetting:

- [SPONGESCAPES](#)
- [The OIEAu ePLANeTe Platform](#)

[Close](#)

Leaky Dams as Nature-Based Solutions in Flood Management Part II: Mechanisms, Effectiveness, Environmental Impacts, Technical Challenges, and Emerging Trends. Hydrology

Year 2025

14) Overall assessment, web-page still needs a lot of work since at the moment it is quite confusing in terms of content and a lot features do not work.

Annex 10: InnWater Governance platform - Turkey

InnWater Platform Tools Replication Assessment

Author : Burcu Yazici (SUEN)

Feedback and Recommendations

The scope and technical depth of the work behind this assessment tool are highly commendable. It is evident that an immense amount of effort has been invested in its development. We are pleased to see that our initial feedback regarding the clarification of economic parameters has been incorporated into the modules, which significantly improves the tool's clarity for respondents.

To ensure the tool's success across a wider range of users with diverse professional backgrounds, we provide the following recommendations for further refinement:

Presentation of Analysis Results

Currently, the results of the analyses are presented using abbreviations of economic parameters that may be unfamiliar to users without a specialized economic background.

- **Recommendation:** If possible, we suggest adopting a reporting format similar to the one used in the first part of this study (governance assessment tool). Providing a narrative that explicitly outlines the "pros and cons" of the results would make the analysis more accessible, interpretable and actionable for all stakeholders.

Simplification of Technical Modules

- **Demand Module Equation:** If feasible, the equation within the demand module should be simplified or presented in a more intuitive format to facilitate easier understanding.
- **Terminology and Perception Parameters:** The current explanation of the "perception parameter"—specifically the references to *Nordin* and *Taylor* consumers—is quite academic. For non-economists, these distinctions can be confusing.
- **Recommendation:** We suggest replacing or supplementing these references with a simplified explanation of how consumer behavior shifts in response to marginal vs. average pricing.

Accessibility and Conclusion

If this tool is intended for a multi-disciplinary user base, its effectiveness will be greatly enhanced by using simplified terms and a more straightforward presentation format for both questions and results.

We are grateful for the opportunity to have contributed to this project. Lastly, to better understand the overall framework, we would appreciate further clarification regarding the

interrelation and functional link between the **Governance Assessment Tool** and the **Replication Assessment Tool**.

We would also appreciate it if a results analysis could be conducted and shared in light of the inputs we provided for Istanbul, so that we better understand the linkage between the inputs and outputs and be able to draw conclusions/recommendations for the Istanbul case.

Annex 11: Application of the Environmental and Resources Costs (ERC) – Italy (Pô River Basin)

Application of the Environmental and Resource Costs (ERC) related to the water services to support the implementation of NbS in the Po River Basin in Italy

Author: Giacomo Laghetto (Etifor)

Summary

This document presents a methodology for the application of Environmental and Resource Costs (ERC) in the water services sector, adopted by the Po River Basin Management Authority (ADBPO) in Italy as a result of the replication action of the InnWater project. The integration of ERC, in line with the European Water Framework Directive, seeks to account for the ecological and resource costs arising from water usage, including damage to ecosystems and lost opportunities for alternative water use. The study outlines the regulatory framework in Italy, identifies barriers to the effective implementation of ERC, and presents solutions to address these challenges. The role of Nature-Based Solutions (NbS) in mitigating environmental impacts is highlighted, with a focus on the LIFE Brenta 2030 project as a key example of ERC application.

1. Replication site

1.1 Context: Po River Basin

The Po River Basin, located in northern Italy, is one of the most important and extensive river basins in Europe. Covering an area of approximately 71,000 square kilometres, it stretches across the regions of Piedmont, Lombardy, Emilia-Romagna, Veneto, and a small part of Trentino-Alto Adige. The basin is dominated by the Po River, the longest river in Italy, which flows eastward for about 652 kilometres before emptying into the Adriatic Sea. The Po River is fed by numerous tributaries, including the Ticino, Adda, and Tanaro rivers, and it plays a crucial role in the hydrology, agriculture, and economy of the region. The basin is characterized by a diverse landscape that includes the alpine mountains to the north, fertile plains in the central area, and the Adriatic coastline to the south. The region is renowned for its rich biodiversity, particularly in wetlands, and for being an essential agricultural hub, with vast areas dedicated to the cultivation of rice, cereals, vegetables, and fruits. Urbanization, however, has put significant pressure on the basin, contributing to water pollution, flood risks, and habitat degradation. As such, the Po River Basin has been the subject of extensive environmental management efforts, aiming to balance its ecological preservation with the needs of agriculture, industry, and human settlement.

1.2 Subject: Po River Basin Management Authority

The Po River Basin Management Authority (Autorità di Bacino Distrettuale del Fiume Po, ADBPO) is a public institution responsible for coordinating the integrated management of the Po River Basin. Established to ensure sustainable water management, the Authority oversees the planning and implementation of policies related to water resources, flood risk management, and environmental protection within the basin. It operates in alignment with European directives, particularly the Water Framework Directive (2000/60/EC) and focuses on balancing the needs of various stakeholders, including municipalities, industries, and agriculture, while safeguarding the

river's ecosystems. The Authority works to prevent pollution, optimize water usage, and address climate change impacts, such as droughts and floods. By fostering cooperation among the regions it covers, the Authority plays a key role in promoting sustainable practices and enhancing the resilience of the Po River Basin to environmental challenges.

1.3 Replication objective

In this replication site and involving ADBPO, the Horizon Europe InnWater project aims at exploring the possibility to apply the environmental and resource costs (ERC) related to the water services.

2. Current state of the art: the regulation and its pilot applications

2.1 Regulatory framework

This paragraph is a synthesis of what presented in (Leonardi, et al. 2021).

The first acknowledgement of the need to integrate the environment into water services dates back to the adoption of the **Water Framework Directive (WFD)** by the European Parliament and Council in 2000 (2000/60/EC), which **establishes the polluter/user pays principle**. Article 9 also explicitly states that member states should strive to ensure the full coverage of water service costs (*'full' cost recovery principle*), including environmental and resource costs (ERC).

Water Framework Directive – Article 9 “Recovery of costs for water services” (paragraph 1)

*Member States shall take account of the principle of recovery of the costs of water services, **including environmental and resource costs**, having regard to the economic analysis conducted according to Annex III, and in accordance in particular with the polluter pays principle.*

Environmental costs are defined as “**the costs referring to the damage that water uses cause to the environment, ecosystems, and other users of the environment** (e.g., a reduction in the ecological quality of aquatic ecosystems or the salinization and degradation of fertile soils),” while resource costs are “**the costs of lost opportunities that other water uses suffer due to exploitation of the resource beyond its natural rate of recharge or recovery** (e.g., over-abstraction of groundwater)” (Common Implementation Strategy Working Group 2 (WATECO) 2002).

The Directive prescribes the application of environmental and resource costs to polluters/users but does not provide methodological guidance on calculating these costs. Specifically, there is considerable difficulty in distinguishing some resource costs from environmental costs since the former also includes the costs of damage to other users of the resource, and the latter refers to the costs of lost opportunities imposed on other water uses due to intensive exploitation.

Fifteen years after the promulgation of the Water Framework Directive, the Italian legislation adopts

the provisions of Article 9 through the **Decree 39/2015** of the Ministry for Environment, Land and Sea Protection (the current Ministry of Ecological Transition) - “Regulation containing the criteria for defining the environmental and resource costs for the different sectors of water use.” This decree **identifies the water uses and proposes a general methodology for applying the “user/polluter pays” principle for the several uses** (drinking, hydroelectric, agricultural, industrial, mineral water extraction).

The decree identifies three categories of costs related to water uses and services:

1. **FINANCIAL COSTS:** Costs associated with the provision and management of water uses and services, attributable to an economic activity or transaction that makes use of the water resource as a consumption good or production factor. They include operating, maintenance, and capital costs.
2. **ENVIRONMENTAL COSTS:** Costs related to the damage that the use of water resources causes to the environment, the ecosystem, or other users. They are defined as the expenses, interventions and obligations for the restoration, reduction or containment of the damage produced by water uses and are to be charged directly to the party that uses the resource or benefits from a water service.
3. **RESOURCE COSTS:** Costs of lost opportunities imposed on other users due to intensive exploitation of resources beyond their restoration and natural replacement level. They must consider the opportunity cost on both a spatial and temporal scale. Thus, a resource cost exists if the economic value (current and future) that would result in the case of its best alternative use is greater than the economic value of the water in the activities in which it is currently allocated.

2.2 ERC application at the national level

At Italian level, principles of Article 9 of the Water Framework Directive and DM 39/2015 only find application (mainly theoretical) in the integrated water service (IWS), instead the other water services still need to integrate the ERC in their cost recovery methods.

The Regulatory Authority for Energy, Networks and the Environment (ARERA), which defines the tariff system at the national level, identified, through the publication of the **Deliberation 580/2019/R/IDR, the criteria to explicit the Environmental and Resource Costs in the investment plans of Enti di Governo d’Ambito** and determines among the local charges “the implementation of specific measures related to the protection and production of water resources or the reduction/elimination of environmental damage.”

In December 2023 ARERA, through the **Deliberation 639/2023/R/IDR approved the new National Water Tariff Method titled “MTI-4”**, still in force. That tariff method almost confirms the criteria for the ERC calculation mentioned in the previous paragraph.

157

ARERA’s new criteria introduce two main innovations. First, terminology: costs that were previously not classified as “environmental costs” or “resource costs” can now be explicitly

identified as such. Second — and this would be the true innovation in the drinking water sector, water utilities are now allowed to recover, through tariffs, the costs of mitigation and compensation measures addressing their environmental impacts and missed opportunities — including the implementation of Nature-based Solutions (NBS), provided that their qualitative and quantitative benefits for the water resource can be demonstrated. Saying that the ERC application is more theoretical than practical means recognise that, until now, it has been mostly a terminology exercise without significant repercussions in terms of interventions and management approaches.

The LIFE Brenta 2030 project is to be mentioned among the best practices, being the first one in Italy that, working side by side with ARERA, facilitated the identification of criteria for ERC in the investment plan and, thanks to the plurality of stakeholders involved and the wide range of skills and professionalism present in the working group, took the first steps towards creating a pilot funding mechanism for Nature-Based Solutions and implementing a system of Payments for Ecosystem Services (PES) in the Middle Brenta basin. These steps allowed to improve a critical area for drinking water supply and achieve the sustainable development goals of the UN Agenda 2030.

2.3 Barriers and solutions for the adoption and implementation of ERC

As mentioned above, the *'full' cost recovery* principle, introduced by Article 9 of the Water Framework Directive is about ensuring the full coverage of the costs related to the water services, including environmental and resource ones. This principle can be read as follows:

- FULL COST: this is a direct link to the Article 5, which is about the **economic analysis** of water use that each Member State shall ensure that for each river basin district. Article 9 specifies that this analysis should also consider the environmental and resource costs.
- RECOVERY: this word is about the *polluter/user pays* principle and implies that (considering users instead of polluters) the cost must be directly sustained by the water users.

Trying to make a synthesis of all the information provided above, 2 main barriers and 1 solution can be highlighted for the ERC implementation at national level.

Barriers:

1. Cultural barrier: the new principles are difficult to be translated into planification, guidelines and precise regulation on using the ERC for investing in nature conservation are lacking;
2. Technical barrier: water managers don't have specific economic (and, sometimes, operating) competences for a correct environmental accounting of the water services.

Solutions:

- Raising awareness among river basin management authorities and organizations, also building competences and capacities where needed;
- Improve clarity and efficacy of the existing tools that can facilitate a systemic adoption and application of the ERC: first of all, the economic analyses that the river basin management district authorities are drafting for the river basins.

3. Definition of a methodology to integrate environmental tariff and taxation in the water services in the Po River Basin

Within the InnWater project, a networking and lobby activity has been conducted by Etifor to select the best replication site (ADBPO) and define a proper methodology for the replication of that specific project action. We met several times with ADBPO, who finally agreed to commit for facilitating the systemic and transversal ERC application at district level by drafting an implementation plan. The plan includes all the steps described in the following table.

Implementation steps (what)	Description (how)	Deadlines
1. Governance assessment	Local assessment through the application of the Water Governance Assessment Tool provided by InnWater. Etifor will provide guidance and information on how to perform the assessment; ADBPO will run the assessment. Objective: to highlight governance gaps, justifying the following steps.	October 2025
2. Training on water governance innovations	The training, provided by Etifor, will include references to the recent EU Roadmap towards Nature Credits and EU Water Resilience Strategy and present a range of possibilities for the environmental cost recovery in the water services (eg. ERC, activation of water-PES schemes, etc.)	November 2025
3. Economic analysis to quantify the impacts of the water services on biodiversity	The analysis will integrate the existing one (Art. 5 WFD) and consists in 3 phases: <ol style="list-style-type: none"> 1. Biophysical and economic quantification of the impacts. This can be done by the adoption of different methodologies (land-use-based analyses aimed at assessing habitat quality, benefit transfer, analyses based on water withdrawal data in the sectors considered, demand curve methods/ indirect estimation methods, etc.); 2. Estimation of the costs for impact reduction, mitigation and compensation measures; 3. Analysis of existing financial instruments, evaluation of the component relating to 	August 2026

	<p>the disclosure of the environmental costs of the resource (ERC) and of the degree of circularity of the same.</p> <p>The analysis will be performed by Etifor.</p>	
4. Stakeholder animation and engagement for the activation of a water-PES scheme	<p>Etifor will support ABDPO in the following activities:</p> <ol style="list-style-type: none"> 1. Preliminary analysis of the water services in which a PES scheme for can be activated; 2. Stakeholder analysis; 3. Meeting with selected stakeholders; 4. Evaluation of the costs and benefits associated with the variation (incremental or decremental) of the level of provision of ecosystem services identified as priorities for the PES. 	May 2027
5. Feasibility study for the activation of the water-PES scheme	<p>Etifor will conduct a final reporting activity providing ADBPO with a synthesis of the previous step that will also include a draft of the water-PES contract.</p>	September 2027

4. Conclusion

The application of Environmental and Resource Costs (ERC) is crucial to ensuring the full recovery of water service costs, as outlined by the European Water Framework Directive (WFD). However, the practical implementation of ERC faces significant challenges. Cultural barriers, stemming from a lack of familiarity with environmental accounting and the absence of clear regulatory guidelines, complicate the process. Additionally, the technical barrier of insufficient expertise in economic assessments for water management remains a key obstacle. Despite these challenges, there is a growing effort to integrate ERC into water services, particularly through the support of projects like LIFE Brenta 2030 and InnWater, which have demonstrated the viability of applying ERC within local water management frameworks.

Solutions to these barriers include enhancing awareness among water management authorities, developing specific training programs, and refining existing tools for economic analysis. This approach will help bridge the knowledge gap and promote the systemic adoption of ERC principles across the water sector. The next steps involve increasing the participation of stakeholders, fostering collaboration for the implementation of Nature-Based Solutions (NbS), and further refining the economic methodologies for quantifying the impacts of water services on biodiversity within the economic analysis foreseen by the WFD. The success of such initiatives could ultimately contribute to more sustainable water management practices, aligning with both ecological and socio-economic objectives.

Common Implementation Strategy Working Group 2 (WATECO). «EU Guidance Document: Economics and the Environment. The Implementation Challenge of the Water Framework Directive.» 2002.

Leonardi, Alessandro, Giuseppina Cristofani, Giulia Amato, e Carlo Zanetti. Drinking Water and Environment: Towards a Zero Impact Service. LIFE Brenta 2030, 2021.

Annex 12: Citizen science solutions related to water quality testing - Osijek-Baranja county, Croatia

Citizen Science Replication Assessment - Replication Site: Osijek-Baranja Region, Croatia

Authors : Matej Marušić & Lidija Maurović Koščak

INTRODUCTION

This report summarises the findings of the citizen science replication assessment conducted by the organisation OSPERA in the Osijek-Baranja region (eastern Croatia), as part of the InnWater project. The assessment explores current practices in surface water monitoring, public engagement, and the potential for scaling up citizen science approaches in water quality data collection.



Photo 1: Logo of a new citizen science initiative (citizen community called Pannonian Ranger) working as a part of the Osijek-Baranja Citizen Science Hub

4.1 INTERVIEW WITH EXPERTS

As a methodology of this assessment, OSPERA decided to establish a pilot Citizen Science Hub in Osijek-Baranja. Before starting with a citizen science activities, also as a part of preparation for the InnWater Water Governance Assessment Tool, two interviews were organised with representatives of local institutions:

- a. Mr. Ivan Damjanović – head of department for projects and international cooperation in [Teaching Institute of Public Health in Osijek](#) (Nastavni zavod za javno zdravstvo u Osijeku) 162
- b. Vlatko Rožac, pHD – head of science department in [Public Institution](#)

Kopački rit
Nature Park (Javna ustanova „Park prirode Kopački rit“):

Aim of these meetings was to collect input for responses to key assessment questions and to check potential for collaboration on practical citizen science activities. Both experts were very supportive and interested to follow the development of the pilot activities. Their input is presented in the Section 5: Key Assessment Questions.

4.2 DRINKABLE RIVERS CITIZEN SCIENCE PROGRAMME

After a very positive feedback from experts, OSPERA Association decided to apply Osijek-Baranja Citizen Science Hub to the onboarding programme of [the Drinkable Rivers initiative](#). Our request was approved and the following task was to complete 11 educational modules (online). Additionally, two online onboarding sessions were organised to meet with other CS initiatives who joined Drinkable Rivers Citizen Science programme.

The next milestone was the arrival of the measurement kit. Content of the kit is visible at the Photo 1.



Photo 2: Drinkable Rivers measurement kit

First measurement is planned for September 2025 and collected water quality data will be uploaded to [the Drinkable River Data Platform](#).

4.3 DANUBE4ALL (HORIZON EUROPE) AND IMPETUS CITIZEN SCIENCE PROGRAMME

Among many other objectives, [DANUBE4all](#) project aims to support new Citizen Science

initiatives in the Danube Region. This is why Osijek-Baranja Citizen Science Hub was noticed by the consortium and introduced to the [IMPETUS Accelerator programme](#). The 3rd Open Call for new Citizen Science Initiatives was published and OSPERA applied proposal under the name „Osijek-Baranja Citizen Science Hub“ which was selected to receive support from the IMPETUS Accelerator as one of the 33 global initiatives.

Osijek-Baranja Citizen Science Hub



☰

Short Name
CSH-OB (Panonian Ranger)

Formal Name
Osijek-Baranja Citizen Science Hub

Contact Person
[Matej Marušić](#)

Institution/Organisation
OSPERA

Website
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Social Media
 [@udrugaospera](#)

“ We are empowering communities in Osijek-Baranja county through citizen science to protect local ecosystems and shape sustainable future! ”

Summary

The Osijek-Baranja Citizen Science Hub is a new platform that enables citizens in Eastern Croatia to take part in environmental monitoring and stewardship. Led by the Ospera Association, the project focuses on biodiversity, water, and soil quality in the Osijek-Baranja region, including the Kopački Rit Nature Park. Through field activities such as BioBlitz, PermaBlitz, and water testing (at Drava River), and supported by co-creation workshops, the Hub mobilises schools, families, students, and underrepresented groups. Participants will collect and interpret environmental data, co-design action plans, and contribute to policy dialogue.

The Hub promotes inclusion, science literacy, and local ownership, and supports ongoing efforts to protect Kopački Rit, including the initiative for its designation as a National Park. It will serve as a model for regional citizen science, strengthening the link between communities and nature while contributing to EU environmental goals.





Photo 3: CSI platform profile of the Osijek-Baranja Citizen Science Hub

Considering the specific objectives of the Call, to receive support, besides to the water quality (which was the only initial focus), citizen science activities related to the biodiversity and soil quality were also introduced.

OSPERA Association received € 20.000 to start with the citizen science activities in Osijek-Baranja county. Project is implemented from July 2025 to January 2026.

4.4 KEY ASSESSMENT QUESTIONS

a) Who collects water quality data in the replication site, and in the respective country?

In Croatia, official surface water quality monitoring is conducted by the Croatian Waters (Hrvatske vode), the national water management agency. Monitoring is performed according to the EU Water Framework Directive and includes monthly or quarterly sampling at selected stations, primarily for compliance and reporting purposes.

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In addition, academic and research institutions such as the Faculty of Agrobiotechnical Sciences

Osijek and the Ruđer Bošković Institute carry out water quality research, typically on a project basis.

In the Osijek-Baranja region specifically, no formal citizen science initiatives are currently active in the field of water quality monitoring. However, several nature conservation NGOs, fishing associations, and schools have expressed interest in participating in such initiatives. Prior efforts have mostly been educational in nature, e.g. project GLOBE in Elementary school Antun Mihanović from Osijek.

b) Is the data sufficient to determine the health of rivers and *water* status?

Official monitoring data is generally sufficient for legal compliance and national reporting, but it lacks public accessibility. There is limited spatial coverage outside key monitoring stations, and temporal gaps which may reduce the capacity to identify short-term pollution events or some specific seasonal trends.

Citizens and local stakeholders often lack access to this data, which limits awareness and engagement. Thus, there is room to complement official monitoring with citizen-collected data, especially in areas not covered by institutional efforts (e.g. microplastics)

c) How receptive are members of the public or other groups to collecting water quality data?

The replication site shows strong potential for citizen engagement. During informal consultations and pilot workshops conducted by OSPERA, interest was expressed by:

- Primary school teachers,
- Local environmental NGOs and
- Local public institutions representatives.

There is a visible enthusiasm for practical learning, especially when linked to tangible local environmental issues, e.g. possible consequences from [Osijek plastic depot fire](#).

What was revealed during the interviews with experts is that institutions in Croatia involved in water quality assessment are very skeptical about the quality of data obtained from citizens and that currently they are not willing to use it in their analyses and reports.

d) Do people already collect data?

Currently, there is no structured citizen science water monitoring in the Osijek-Baranja region. However, some data collection occurs through:

- School-led science projects (e.g. [GLOBE projects](#))
- Occasional university fieldwork involving student volunteers (e.g. [ZOA Student Association](#))
- Isolated NGO campaigns focused on river clean-ups (e.g. [Zelena Čistka](#))

Therefore, the region can be considered at the very beginning of its citizen science journey, with excellent preconditions for scaling up. The Osijek-Baranja Citizen Science Hub aims to formalise and coordinate these efforts.

CONCLUSION

The Osijek-Baranja region demonstrates promising potential for implementing citizen science approaches in surface water quality monitoring. While institutional monitoring by Croatian Waters and academic actors is well established, there are clear gaps in local-level engagement and public access to data. Citizen science could help complement official efforts and raise awareness, but the validity and usability of citizen-generated data remain a concern among key institutions.

The replication assessment confirms:

- a) The absence of structured citizen science data collection systems in the Osijek- Baranja region;
- b) The availability of international platforms, such as the Drinkable Rivers data interface, which can support data reporting;
- c) A strong interest and willingness of local stakeholders (e.g., schools, NGOs, individuals) to get involved.

Mentioned willingness does not automatically translate into long-term engagement, particularly when it comes to schools and public institutions. These actors face administrative and staffing constraints, and their participation requires dedicated follow-up projects with targeted budgets.

Potential for replication:

The establishment of the Osijek-Baranja Citizen Science Hub, supported by the IMPETUS Accelerator and connected to Drinkable Rivers and DANUBE4all, offers a solid foundation for piloting and adapting citizen science approaches. If successful, the model could be replicated in other regions in Croatia, and similar regions (across Southeast Europe) where institutional monitoring is centralised and public participation remains underdeveloped.

Identified barriers:

- Institutional scepticism regarding the reliability of citizen-collected data;
- Lack of core funding to cover administration, coordination, and technical support;
- Challenges in integrating activities into school systems, given the current lack of financial and human resources;
- Need for simple, user-friendly digital tools, available in Croatian language;
- Ensuring long-term volunteer motivation beyond one-time campaigns.

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Recommendations:

To address these barriers and unlock the replication potential:

- Secure funding for follow-up projects, with budgets covering human resources for coordination and engagement (especially important for schools);
- Consider co-financing models: e.g., initial contributions from businesses or communities should be co-financed by regional or national funding programmes;
- Build institutional trust by including data calibration, validation steps, and joint activities with official bodies, covering potential gaps (e.g. contaminants which are still not monitored);
- Start citizen science events within the local community to attract new participants and to keep those already involved informed and motivated.

With the first citizen water quality monitoring planned for September 2025, the Osijek- Baranja Citizen Science Hub will serve as a test case for implementation of participatory water quality research in a setting with some public interest but still very limited institutional support. The lessons learned here will be valuable not only for Osijek-Baranja County but for other regions in Croatia (and potentially beyond) exploring similar models.

Annex 13: Citizen science solutions related to water quality testing – Warta River Basin Poland

Citizen Science Replication Assessment - Replication Site: Warta River basin, Poland

Authors :Envica Weronika Warachowska

INTRODUCTION

This report examines the current state of citizen science initiatives for water quality monitoring in the Warta River Basin, Poland, as part of the InnWater project. The assessment explores current practices in surface water monitoring, public engagement, and the potential for scaling up citizen science approaches in water quality data collection.

1. STAKEHOLDERS CONSULTATIONS

Within the InnWater replication assessment for Warta River basin in Poland stakeholders consultations were performed preceded by legal frameworks, literature and other relevant documents review. Basing on the review a several groups of interested parties were selected:

- Institutional representatives: Inspector of the Provincial Inspectorate for Environmental Protection in Poznań; Deputy Director of the Catchment Management Board in Poznań; Specialist of the Water Management Information System Department in the Regional Water Management Board in Poznań.
- Citizen science project representatives: WWF Social Water Monitoring project; Adam Mickiewicz University Student Scientific Circle of Geographers, Hydrology Section;
- Citizen scientists participating in: WWF Social Water Monitoring project; Adam Mickiewicz University Student Scientific Circle of Geographers, Hydrology Section;
- Other groups of interest: “Hydroni” Foundation; Faculty of Engineering and Technical Sciences, University of Zielona Góra; potential volunteers.

The most represented group were citizen scientists actively participating in water quality data collection and potential volunteers interested in such activities, mostly students and graduates (age group <29, app. 70%), less often middle-aged (age group 30-59, app. 25%) and rarely old-aged (age group >60, app. 5%). Within the examined group, no relevant gender predominance was identified, with men constituting a slight majority (54%).

In-depth interviews were conducted concerning participants perspectives on citizen science. Four thematic fields were covered:

- the assessment of the current state of citizen science and public engagement in water quality data collection,
- personal experience in the water quality data collection process,
- observed barriers for public participation in water quality data collection,
- possible development paths for citizen science in Poland

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Additionally, actions were taken to participate in the existing citizen-science initiatives concerning

the collection of river quality data – WWF Poland Foundation Community Monitoring pilot program “River Guardians” (“Strażnicy Rzek”) and Adam Mickiewicz University Student Scientific Circle of Geographers, Hydrology Section. Undertaken actions made it possible to gain insight into existing initiatives and the procedures applied within their frameworks.

Within the scope of participation in the WWF initiative, contact was established with the representatives of the initiative, during which the process of volunteer recruitment was presented, the training methodology was discussed, and the set of measurement instruments provided to volunteers was outlined.

During the meeting with the geographical research society, the methods of data acquisition and data management were discussed.

A limitation of the applied methodology may concern the representation of specific stakeholder groups. The in-depth interviews were conducted within a group directly interested in the state of the environment and willing to participate in initiatives involving the collection of data on river water quality. The conducted research did not consider the group of potential volunteers who have not previously been engaged in environmental issues.

There are also significant differences regarding the representation of various age groups. Young people (under the age of 29) constitute by far the largest group, which on the one hand may reflect, to some extent, the actual demographic structure of individuals interested in the subject of the research, but on the other hand may also constitute a limitation of the study.

2. KEY ASSESSMENT QUESTIONS

a) Who collects water quality data in the replication site, and in the respective country?

Water quality data collection in Poland is mainly conducted within the official institutional framework and is primarily conducted by several official Polish institutions:

- The National Water Management Authority (State Water Holding Polish Waters) – coordinates water management activities across Poland at various levels. The National Water Management Authority is responsible for nationwide water management policies, coordination, and strategic planning. Regional Water Management Boards operate across different river basin districts to implement water management plans. Catchment Management Boards are responsible for water management (including water quality data collection) within river catchments. Water Management Stations are responsible for current supervision and technical maintenance of rivers, embankments, and other water management infrastructure.
- The Inspectorate for Environmental Protection – serves as the primary regional monitoring authority, conducting regular assessments of the rivers water quality as part of the local monitoring system for separate rivers.
- The Institute of Meteorology and Water Management – provides meteorological and hydrological data support.

Water quality data collection is strongly supported by academic and research institutions.

Citizen science is an approach that is not well established and not practically applied in institutional water quality monitoring at the national level. There are, however, some bottom-up initiatives in specific regions in Poland. These initiatives are mostly coordinated by academia within the

research projects and student scientific circles.

Water quality data collection in the Warta River Basin is primarily conducted by several institutions at the regional level:

- The Provincial Inspectorate for Environmental Protection (WIOŚ) in Poznań is responsible for water quality data collection and operates the main monitoring network with 11 observation stations along the Warta River and additional stations on major tributaries. A wide range of parameters are measured (dissolved oxygen, BOD₅, TOC, pH, temperature, phosphates, total phosphorus, total suspended solids, total nitrogen, coliform count, among others);
- Poznań University of Life Sciences conducts extensive research on Warta River water quality, analyzing parameters including BOD₅, TOC, pH, temperature, total nitrogen, and total phosphorus. Researchers examine the influence of dam reservoirs, urban impacts, and long-term quality trends.
- Adam Mickiewicz University in Poznań operates the Integrated Monitoring of Natural Environment - Poznań-Morasko Station, which monitors the Różany Strumień catchment that drains into the Warta River. The station conducts comprehensive environmental monitoring including surface water quality, groundwater, precipitation chemistry, and biological indicators.
- University of Łódź researchers conduct spatial variability studies of water flows and quality parameters in the upper Warta catchment.

b) Is the data sufficient to determine the health of rivers and water status?

Both at the national and replication site scales the data gathered within the institutional monitoring system are sufficient to generally assess the water quality. However, significant limitations are observed, especially in the coverage of the data at the basin scale, frequency of data collection, and coordination challenges. Small water bodies remain largely unmonitored, and the monitoring frequency is often insufficient to capture short-term pollution events and other water quality changes.

c) How receptive are members of the public or other groups to collecting water quality data?

The current research reveals growing public receptivity to citizen science initiatives in Poland. Also in the Warta River basin, a growing interest is observed, especially expressed in the increased number of volunteers in recent years.

There are, however, differences in the perception of such issue by different groups of interests:

- Members of the public (volunteers and potential volunteers) are willing to gather data on water quality. They perceive citizens science and public participation as very important in the water monitoring system. Volunteer water quality data collection is perceived as an opportunity for knowledge extension, sharing interests with other people, and a way to participate in the protection and improvement of the environment at a local scale. The water quality data gathered by local communities and volunteers are considered viable and important in river health assurance. The majority of volunteers and potential volunteers included in the research are young people and the older-aged group is underrepresented. There are, however, significant differences in the perception of roles in the collection of water quality data across different age groups. Younger respondents recognize the significant role of the state and its responsibility for water quality monitoring, yet regardless of state action they are willing to engage in bottom-up initiatives. In the older age group, there is a stronger expectation of active involvement of the state, with the activities of local communities perceived as having a supplementary role.

- Citizen science project coordinators perceive volunteering water quality data collection as viable and important. However, some limitations are observed, especially regarding the quality of data, time and spatial data resolution, and still insufficient number of volunteers. They see great potential in citizens science in water quality monitoring, but strong systematization of the process is required. This group is entirely dominated by middle-aged individuals, experienced and educated in environmental sciences. Their awareness of the importance of water quality monitoring is very high.
- Institutional representatives are the most sceptical group regarding citizens engagement in water quality data collection. They do see the potential in such engagement, however, existing barriers are considered significant, and the data gathered by the public cannot be used to support the river monitoring system. Significant improvements must be made to introduce citizen science as real support for existing methods.

d) Do people already collect data?

There are several initiatives in Warta River basin basing on citizens engagement, such as:

- WWF Poland Foundation Community Monitoring pilot program “River Guardians” (“Strażnicy Rzek”) – The program aims to protect the most valuable sections of small and medium-sized rivers in Poland (such as THE Warta River and its tributaries). River guardians (volunteers engaged in the project) are trained and equipped to monitor one of the chosen 2 km sections of a river. The scope of volunteer monitoring depends on the chosen package and may cover: dissolved oxygen, pH, temperature, turbidity, conductivity, total nitrate, nitrite, chloride and sulphate. Volunteers are required to gather the data twice a year and report it in a digital online form.
- Adam Mickiewicz University Student Scientific Circle of Geographers, Hydrology Section – Students gathers the data on several small rivers in the Warta River basin (dissolved oxygen, pH, temperature, total suspended solids, turbidity, conductivity, total nitrate, nitrite, chloride and sulphate, BOD₅, and TOC) with a frequency of once per month.

CONCLUSION

Citizen science represents a viable and valuable approach for enhancing water quality monitoring in the Warta River Basin and in Poland, with significant potential to address current monitoring gaps and engage local communities in environmental protection and enhancement. While substantial barriers exist, particularly around institutional coordination, data quality assurance, and volunteer retention, the region possesses favourable conditions for successful implementation, including strong academic institutions, growing environmental awareness, and strong willingness to participate by local communities.

The key to success lies in developing integrated approaches that combine citizen science with existing institutional monitoring systems, supported by comprehensive training programs, appropriate technology, and long-term funding commitments. By addressing the identified barriers through strategic partnerships and program design, citizen science can contribute significantly to protecting water quality in the Warta River Basin while fostering greater public engagement in environmental decision-making.

Identified barriers:

- Data quality – existing citizen science initiatives provide necessary training and technical

support (including necessary equipment), however, the process of data collection is not standardized, monitored, and supervised. Also, mistakes may occur more frequently with inexperienced volunteers.

- Data resolution – the coverage of data gathered within citizen monitoring is irregular regarding space and time. Only some parts of the rivers are monitored, and data gathering frequency is not sufficient to capture short-term pollution events and other water quality changes.
- Volunteer engagement – the number of volunteers is increasing, but there is still a strong necessity to expand the idea of citizen science to ensure adequate spatial coverage of gathered data. The idea of citizen-science is still not enough introduced in local communities and is not well recognized in some demographics, especially in older-aged group. Furthermore, young volunteers struggle with staying engaged over a long period of time.
- Coordination and administration – citizen science in Poland lacks strong support for coordination and administration. It is represented by bottom-up initiatives all having their own regulations, databases and know-how. There are no standardized guidelines to gather standardized data at the national or even basin scale.
- Limited trust in citizen-generated data – institutional actors perceive volunteer data collection as having great potential for the future, but due to data limitations (mentioned above) gathered data are not perceived as reliable and of appropriate quality.
- Costs – volunteer training and equipment as well as administration and coordination generate significant costs.
- Legal framework limitations – the existing legal framework surrounding water monitoring in Poland presents barriers to citizen science, as the law requires specific competences of data collectors, and the data collection process must be established within the existing institutional system.

Recommendations:

To successfully implement citizen science for water quality monitoring in the Warta River Basin, some recommendations may be formulated:

- Coordination and management – gathering data of high quality requires coordination and management of the entire process, including training, field data collection, data registration, and validation. Clear protocols for data gathering, sharing, and validation that meet both scientific standards and regulatory requirements should be developed and disseminated.
- Citizen science initiatives promotion and local communities encouraging – Citizen science initiatives are undertaken in the replications assessment site, however, they are not actively promoted. Local communities are not aware of their existence, and citizens are not encouraged to participate in such initiatives. This applies in particular to individuals in the older-aged group (60+), who less frequently, or less proficiently, use online platforms where such initiatives are more often promoted.
- Scientific institutional support – institutional and research actors should contribute by providing methodological guidance and data validation.
- Long-term funding commitment – from both public and private sources is crucial for

program sustainability.

- Standardized training protocols – existing citizen science has developed training protocols for all volunteers that seem to be a crucial element for ensuring the quality of gathered data.
- Quality Assurance – data quality seems to be a crucial barrier to the practical usability of citizen-gathered data. Standardized methods of quality assurance should be the strong basis for well-developed citizen-science projects. Robust data validation protocols that include expert review, cross-verification with official monitoring data, and statistical quality control measures appears to be crucial.
- Community network building – helps maintain volunteer engagement and creates social support systems for participants.
- Technology Integration – user-friendly (mobile) applications and portable monitoring tools may encourage more volunteers to participate in water quality data collection. This may also support data quality assurance, as well-designed tools may help eliminate human mistakes.

The citizen science approach holds significant potential for implementation in Poland. While people are willing to participate in data collection, it is essential to introduce solutions that enable effective management of the water monitoring process.

A promising solution appears to be the integration of institutional water monitoring currently operating in Poland with community-based monitoring, managed by institutional actors and supported by research and academic entities with data gathering methods and data validation. Public participation in data gathering may exert substantially greater pressure on public administration bodies, which can contribute to improving the overall quality of the national water monitoring system.

Effective water quality monitoring can be achieved by strengthening cooperation among all actors already engaged in data collection. Institutional actors should retain responsibility for managing the entire process and for fulfilling their statutory obligations in the field of water monitoring, while simultaneously drawing upon the engagement of local communities. Such community involvement can both enhance the scope of collected data and foster broader public acceptance of governmental water management initiatives. The academic actors can benefit from both institutional and community-generated data, thereby expanding knowledge of water quality at both local and national scales.

Annex 14: Citizen engagement solutions related to water retention on land - Bodrogeköz, Northeast Hungary

Interviews with local farmers in the Bodrogeköz about their cultivation methods and their opinions on landscape-level water replenishment and water management

Author : Barnabás Körmöndi

The Bodrogeköz, in Northeast Hungary, has a continental climate. During a year, both inland water shortages and droughts can cause severe problems not only for agriculture but also for local citizens. The study site is located in the northern part of the microregion, adjacent to the Slovakian border.

The area was a coherent wetland in the past; only the vegetated sand dunes were inhabited. 150 years ago, the implementation of river regulation and parallelly the drainage of extended wetlands through dense canalization started. Also, deforestation took place, and the ratio of arable land has gradually emerged. The microclimate, parallel with the regional climate trends, became drier.

Over the past three decades, land ownership has become increasingly centralized, and today, there are hardly any farmers left who have farming as their main occupation, and even the number of those who farm as a secondary occupation is declining. Livestock farming, which had been a sustainable form of agriculture in the region for centuries, has also declined significantly. The interviewed farmers have lands mainly in the northern part of the micro-region. Five interviews were conducted who mostly run family businesses and use a high degree of mechanization. The area cultivated by each interviewee varies between 150 and 1,500 hectares, partially owned and partially leased (prices have risen significantly in recent years).

Only one farmer is involved in animal husbandry, raising cattle, while the others are exclusively engaged in crop production, focusing on 4-5 crops, which they sow in rotation (sunflower, wheat, corn, rapeseed). During the growing season, cattle are grazed, while during the winter, they are kept in barns. The animals are grazed in stages, using different pastures from time to time to avoid overgrazing. Mowing is also carried out in stages to improve biodiversity. Organic manure is used in crop production, thus reducing the need for chemical fertilizers. The maintenance of this type of farming is largely due to agricultural subsidies. The leasing fees make the subsidies essential to make ends meet at the end of the year.

In the case of farmers engaged solely in crop production, the amount of utilized fertilizer has declined significantly in the last 5 years. On the one hand, this is partially due to a drastic increase in prices, while on the other hand, environmental awareness and conscious farming practices have strengthened. In typically compacted soils, nutrients have difficulty moving into the deeper layers, so less is needed than in less compacted soils. In most cases, only nitrogen supplementation is necessary, as most farmers have been switching to no-till farming to a significant extent or completely for more than a decade. This is less common among farmers who cultivate large areas of land over 500 hectares.

Initially, plowing was abandoned in lower-lying areas because precipitation conditions and waterlogging meant that soil cultivation could only begin very late in the spring season, and even then, only with great difficulty. No-till farming allows for less soil disturbance and produces

similar average yields with significantly fewer working hours and fuel consumption. Saving time is extremely important for a family business, and plant residues left on the field cover the soil without being plowed under and contribute to nutrient replenishment as they gradually decompose, eliminating the need for excessive use of fertilizers.

The use of pesticides has also declined significantly as a result of growing environmental awareness. The majority of surveyed farmers use herbicides no more than twice a year, mostly immediately before sowing, after which the weeds help to retain water and increase local air humidity. No-till farming has significantly reduced the intensity of weed infestation; for example, ragweed has been suppressed, while at the same time, the living conditions for certain weeds have improved significantly.

Environmentally conscious solutions in crop production come with additional agricultural subsidies; they do offer significant advantages in terms of cost-effectiveness and time investment, based on year-end accounts. However, the subsidy system in its current form is essential for financing developments and wages.

From the point of view of preserving and possibly improving biodiversity, I considered it very important to present the farmers' attitudes before moving on to the central topic of water retention.

The area is densely interwoven with former river bends, and all the farmers interviewed were concerned with water management and water governance issues. A decade ago, the shallow backwaters, which dried up during summer, were plowed and cultivated depending on the rainfall conditions of the given year. This is because property boundaries are rather imprecise in marking the boundaries of wetlands, or in the case of shallower areas, they are not separated at all. In drought years, such areas and their surroundings yielded outstandingly, so considerations of protecting the natural environment were generally pushed into the background. This was not possible in the deeper backwaters, which have open water surfaces even in the driest years, but their vegetation has become increasingly species-poor, while still providing an outstanding habitat for wildlife. The vast majority of backwaters are currently replenished only by precipitation and water collected from their surroundings.

In recent years, changes to the subsidy system, which now supports the preservation of ecological values and the abandonment of cultivation in lower-quality areas, have created opportunities for the restoration and preservation of former oxbow lakes. As part of the aforementioned change in approach, farmers are increasingly striving to achieve profitable yields with as little energy investment as possible, taking into account the characteristics of the landscape. Accordingly, in order to reduce both waterlogging and drought damage, ditches are dug in waterlogged areas during dry periods so that water collects in as small an area as possible, thus leaving the largest possible area cultivable and allowing waterlogging to seep away in the area instead of being drained away. Farmers have recognized the importance of preserving water in the landscape, even if it means some loss of yield. Inland water may cause damage in small areas, while drought causes crop losses at the landscape level, which has become increasingly common in recent years, but the funds available for damage mitigation are far from sufficient to cover the losses that occur year after year.

Under current conditions, the area's canal network serves to drain inland waters as quickly as possible, but thanks to the slight slope, it could easily be converted with minimal intervention to support water replenishment and water management. Two larger water bodies are currently supplied with water from the Bodrog River, which are located in the immediate vicinity of the towns of Karcsa and Pácin and also serve recreational purposes. Flood waves on the Bodrog River can only be tapped through a sluice gate during certain water level intervals. This allows water to be fed into the area by gravity through a canal that forms the state border. Due to its nature, permission from the Slovak water authorities is required to start the water release. Due to the narrow floodplain of the Bodrog River, it is characterized by fast-flowing flood waves, which allow only a limited amount of water to be released into the landscape. Due to the low gradient mentioned above, it may take several days to fill the components of the planned system, so depending on the nature of the flood wave, it may not be possible to replenish the water in each component on an annual basis. Water replenishment by pumping is possible for a significant part of the year, but it is an extremely costly solution that is not profitable for farmers. In cases of extreme necessity, it may be used with special state subsidies.

All farmers agree that controlled and regulated water replenishment would greatly contribute to improving water management in the region, and most of them would support the maximum amount of water that can be introduced economically. All farmers independently own one or more backwaters adjacent to the main drainage canal system, or are the almost exclusive owners of arable land surrounding low-lying areas owned by the water authority. The ownership situation would therefore make it possible to supply water to the landscape in consultation with a small number of farmers, but the current condition of the channels, their neglect, and the lack of regular maintenance pose further difficulties. All of the farmers surveyed have machinery that could help with the maintenance of the canals, but coordination with the water authorities is difficult. All of the backwaters are silted up, so dredging is essential to make them suitable for holding significant amounts of water. We plan to create an organizational structure whose primary tasks will be to coordinate with the water authorities and to plan and coordinate activities. The organizational structure is still under development, but it is encouraging that farmers have a positive attitude towards landscape-level water replenishment. Most of them recognize that Bodrogköz is not suitable for intensive arable farming, but the current agricultural support system and market conditions force them into a difficult position. Unfortunately, based on previous experience, farmers are quite skeptical about cooperation, but self-organized cooperation and mutual assistance can also be observed, which can greatly improve efficiency and strengthen the community spirit.

Annex 15: Citizen engagement solutions related to water retention on land - Ústí Region (Czech Republic)

Perceptions of Climate Risks and Water Retention Strategies among Farmers in the Usti Region

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Executive summary

Farmers in the Usti region are already facing the tangible consequences of climate change, particularly recurring droughts, erosion, and declining groundwater levels. These risks directly threaten crop yields, livestock management, and ultimately the economic viability of farms. While subsidies remain essential for financial stability, their design and administrative requirements are often perceived as misaligned with on-the-ground realities, at times discouraging rather than enabling sustainable practices.

Beyond economic concerns, farming is also motivated by family heritage, attachment to land, and community reputation. These values support a willingness—though unevenly distributed—to implement measures that improve water retention and landscape resilience. Farmers have adopted a range of responses, from soil management and crop diversification to buffer strips, hedgerows, and small ponds. However, broader implementation is hindered by high costs, fragmented property structures, and bureaucratic burdens. Positive examples of collaboration with municipalities and environmental organizations show that partnerships, combined with consistent state support and advisory services, could play a decisive role in overcoming these barriers and strengthening resilience in the region.

Introductory and contextual information

The Usti region, located in the north of the Czech Republic (see Fig. 1) is increasingly exposed to the effects of climate change, which are reshaping the functioning of the local hydrological cycle. In the broader Central European context, the overall volume of annual precipitation remains relatively stable, but its distribution is changing significantly (Zeder & Fischer, 2020). Rainfall now tends to occur less frequently, yet in more intense downpours, while rising average temperatures accelerate snowmelt and shorten periods of snow cover. These shifts amplify hydrological extremes: floods and flash floods are becoming more common, while severe droughts and declining groundwater recharge threaten water availability over longer timescales (Křištofová et al., 2022).

Figure 1: Location of the Usti region in the Czech Republic



Addressing these challenges requires measures that enhance water infiltration and retention across the landscape. Green and hybrid retention solutions—such as wetlands, ponds, buffer strips, or soil conservation techniques—offer a particularly promising approach (Calliari et al., 2022; Solheim et al., 2021). By design, they are multifunctional: in addition to mitigating droughts and floods, they contribute to improving microclimatic conditions, enhancing biodiversity, and supporting the ecological stability of the countryside. However, the success of such measures depends critically on the motivation and willingness of landowners (Vanino et al., 2023; Wheeler & Lobley, 2021), especially farmers, to implement them and to cooperate with neighboring land users when interventions extend across property boundaries.

To explore these dynamics, we conducted face-to-face interviews with six farmers representing different sizes, production focuses, and types of farming systems. The interviews aimed to capture their perceptions of climate-related risks and their attitudes toward the implementation of water retention measures. The qualitative data were evaluated through interpretative content analysis, enabling us to identify recurring themes, motivations, and barriers across diverse farm types.

Table 1: Description of interviewed farmers

Farmer No.	Owned/rented land	Type of farming	Intensity of farming	Time-frame and form	Perceived risks
F1	350 ha of own land, permanent grasslands	Certified eco-farm, 190 cows for meet	220 ha used for mowing, 130 ha used as pastures	Family farm consolidated around 1991, second generations of owners	Droughts
F2	50 ha of which 25 owned and 25 rented	Fruit trees (on 30 ha), grasslands, fields	Main focus on fruit production	Started in 1998 as family farm and continue till now	Droughts
F3	1700 ha, of which 600 ha owned, the rest rented	Hops, grassland, fields	Intensive production of hops	In 1993, the cooperative with 100 members was launched and has been stable since then .	Droughts, water erosion
F4	750 ha, of which 675 owned, the rest rented	Certified eco-farm, 500 cows for meat, forests	Mostly pastures, about 30 ha used for growing additional food for cows	Family farm started in 1993, first and second generation	Droughts
F5	90 ha, of which 3 owned and the rest rented	Various types of production (cereals, winter/spring barley, mustard, rapeseed)	Conventional farming	Started in 2021 on the new land	Soil degradation, erosion
F6	310 ha of which 230 owned, the rest rented	Various types of production (rapeseed, winter wheat, winter barley), few permanent grasslands	Conventional farming	Family business started in 1994	Erosion

Source: Authors

Results

Perceived water related risks

For the interviewed farmers, the most pressing environmental challenge is the increasing frequency and intensity of droughts. In drought years, securing sufficient fodder for cattle has become a serious problem. Farmers explained that they often had to purchase feed from outside sources at high cost, which significantly increased production expenses and directly threatened the economic sustainability of their businesses (F1, F4).

Farmers emphasized that drought is not always a continuous state throughout the year, but when comparing conditions year after year, a clear trend emerges: water availability is becoming more uncertain and less reliable (F2). Long-term observations confirm these perceptions. One cooperative farmer reported that their own measurements over a 20-year period clearly demonstrate a rising incidence of drought conditions—both within single seasons and across consecutive years (F3).

The year 2018 was repeatedly mentioned as a turning point, when an exceptionally severe drought caused critical feed shortages and prevented expansion of cattle herds (F1). Farmers also noted a decline in groundwater levels in their localities. However, they observed that atmospheric moisture, at least so far, still provides enough water to sustain meadows. Even so, the situation is precarious, and any prolonged dry spell quickly results in visible stress on grasslands and fodder supply (F1).

Beyond climate-driven drought, farmers pointed out that they face other immediate risks that can suddenly affect production. For example, in cattle farming, livestock diseases were identified as short-term threats comparable in seriousness to water scarcity. The combination of long-term climatic risks and short-term shocks contributes to a sense of unpredictability: as one farmer remarked, “we simply do not know what will happen next year” (F1).

Soil erosion also emerged as a related concern. One of the large-scale farmers highlighted increasing problems with water erosion on sloped fields, which further aggravates the drought issue by reducing the soil’s ability to retain water (F3). Similarly, another farmer referred to erosion risks on their land as a persistent challenge (F6). Another farmer (F5) described degraded patches of land where crops no longer grow due to past intensive use, noting that soil fertility and structure improved only after repeated use of manure and cover crops. This indicates concerns about soil degradation and erosion, even if not explicitly framed as such by the farmer. These risks illustrate that water scarcity and land degradation are interconnected problems, intensifying each other in ways that directly affect agricultural production.

Overall, the interviews show that farmers perceive climate change not as an abstract future risk, but as a tangible and growing challenge already shaping their management decisions and economic prospects.

Perceived economic viability of farms

Across all interviews, economic viability was identified as a decisive factor shaping farming practices and future prospects. Farmers repeatedly emphasized that their livelihoods are directly dependent on farming income, which means that any external shock—whether environmental,

regulatory, or market-related—has immediate and serious consequences (F1, F2, F3). Profit from production remains the backbone of financial stability, but in most cases, this profit alone is not sufficient to secure long-term sustainability.

Subsidies therefore play a crucial role in maintaining the cashflow of farms, especially in less-favoured areas (LFA), where natural conditions limit agricultural productivity. Farmers highlighted that without this financial support, their operations would be at risk of instability or even collapse. The reliance on subsidies is particularly evident for smaller or medium-sized farms, where reduced subsidy levels or cuts in support schemes could jeopardize daily operations and limit opportunities for innovation or investment (F1, F2, F3, F6). This view is confirmed by another farmer, who stressed out that without subsidies his farming would not be economically sustainable (F5).

This dependency on external financial instruments underscores the vulnerability of farming businesses to policy changes. Adjustments in subsidy schemes or shifting conditions for eligibility often create uncertainty, forcing farmers to navigate a fine balance between regulatory compliance and the practicalities of efficient farm management. Farmers emphasized that sudden shifts in policy conditions often undermine long-term planning (F4, F5). As such, economic viability is not understood merely as the ability to generate profit, but as a fragile equilibrium between production, subsidies, and the broader policy environment in which farmers operate.

Other motivations for farming

Beyond financial considerations, the interviews revealed that farming is also sustained by strong non-economic motivations. For many of the family farms, agriculture is deeply rooted in family history and identity, which provides an important sense of continuity and pride. Farming is therefore not perceived solely as a business activity, but also as a way of life that links generations and maintains cultural traditions within rural communities. This attachment strengthens the resilience of farmers to external pressures, as the commitment to continue farming often goes beyond short-term profitability.

A further driver of motivation is the farmers' positive relationship to the land itself. Several respondents expressed a strong emotional and ethical attachment to the soil and to the localities in which they live. Maintaining a healthy landscape was described not only as a production necessity, but also as a moral responsibility. In this sense, the pursuit of environmentally friendly practices is tied to farmers' reputations within their communities: having a "good image" among neighbors and demonstrating stewardship of the land was highlighted as a meaningful motivation (F4).

Taken together, these factors show that small and middle size farming in the Usti region cannot be explained solely through economic rationality. While subsidies and market stability are necessary conditions for viability, intangible motivations such as family heritage, identity, and local reputation significantly influence how farmers approach land management and environmental stewardship.

Implemented water retention or storage measures (if any)

When asked about already applied measures, farmers pointed above all to soil management practices as the foundation of water retention on agricultural land. Good soil structure was considered essential for improving infiltration and reducing runoff. For example, one cooperative farmer emphasized strategies such as the incorporation of farmyard manure, the use of winter crops, careful ploughing practices, and the selection of more resilient varieties as key elements of their approach (F3). These measures reflect an awareness that water retention starts with the everyday choices farmers make in managing soil fertility and crop rotations (F5).

Some farmers also adopt direct technical measures to address acute water shortages. During drought years, one cattle farm had to provide water to livestock via cisterns, illustrating the high costs and logistical demands of ensuring animal welfare under extreme conditions (F1). Others focus on reshaping the agricultural landscape to strengthen its ecological functions. For instance, a certified eco-farmer highlighted efforts to reintroduce buffer strips, hedgerows, and small ponds, with the aim of diversifying the landscape, improving microclimatic conditions, and enhancing water retention (F4). These initiatives were not implemented in isolation but in cooperation with other actors, reflecting a willingness to combine ecological motivations with practical collaborations.

Overall, the range of measures already implemented demonstrates that farmers do not perceive water retention as a single, one-off intervention, but as a portfolio of practices integrated into broader land management strategies. While some measures are reactive and short-term (such as supplying water by cisterns), others represent long-term investments into the resilience of the landscape (such as hedges, ponds, or improved soil management). Together, they indicate both the diversity of responses and the uneven capacities of farms to act, depending on their size, resources, and production orientation.

Other strategies to cope with climate risks

Beyond direct water retention measures, farmers described a wide array of strategies aimed at adapting to changing climatic conditions. One common approach has been the adjustment of crop and tree species to varieties better able to withstand drought stress. Both fruit producers and arable farmers indicated that ongoing experimentation with different crops is essential to reduce vulnerability to increasingly erratic rainfall and temperature regimes (F2, F3). This reflects a pragmatic orientation: while large infrastructural solutions may be out of reach, everyday agronomic choices can still increase resilience.

In livestock farming, securing sufficient water resources was a recurrent theme. Some farmers considered drilling wells on meadows to supply cattle, but the prohibitive costs discouraged them from pursuing this option (F1). Others described efforts to work with existing landscape features, such as old pond structures that still partially hold water. Farmers attempted to reshape soils around these areas to enhance retention, though their technical knowledge and financial capacity to restore such features were limited. As one farmer noted, they were interested in wetland restoration but wary of bureaucracy and permitting requirements. Their priority remained ensuring water and forage availability for cattle, yet they expressed openness to dialogue on ecological restoration (F1).

Eco-oriented farmers reported more proactive landscape-scale measures. One farm reduced the size of plots and supported structural diversity through the creation of pools, wetlands, and smaller field parcels. They not only monitored how these interventions functioned during dry periods but also identified additional sites where new measures could be developed (F4). Similarly, conventional farmers also recognized the role of smaller-scale interventions. One introduced grass buffer strips to reduce erosion and enhance infiltration (F5). Another emphasized soil protection through conservation tillage, maintaining plant residues on fields, interim cropping to ensure permanent cover, and the upkeep of solitary trees and hedgerows as multifunctional landscape elements (F6).

Taken together, these strategies illustrate both the diversity of farmer responses and the complexity of climate risks. While drought remains the dominant concern, it often intersects with erosion, declining soil fertility, and regulatory constraints. Farmers therefore adopt a mixture of incremental adjustments, opportunistic experiments, and landscape interventions, balancing immediate production needs with long-term stewardship. The evidence points to a significant capacity for adaptation, though unevenly distributed across farm types and constrained by financial, technical, and bureaucratic barriers.

Plans for the future measures and perceived barriers

When reflecting on possible future actions, farmers often mentioned irrigation as a desirable but difficult goal. For fruit producers, irrigation systems are seen as the most direct way to secure yields against increasing droughts (F2). However, the lack of accessible water sources makes such investments unrealistic under current conditions. Similarly, some farmers acknowledged that measures such as wetlands or polders could, in principle, improve resilience, but stressed that suitable locations on their land are limited and that natural water supply is insufficient to maintain such structures (F2, F3). Others expressed interest in expanding existing retention features—such as pools or wetland areas—and in continuing the gradual diversification of fields and pastures to improve water balance in the long run (F4). Across the interviews, farmers' future visions thus combine technical infrastructure, ecological solutions, and incremental adjustments, but always framed within the practical limits of their land and resources.

At the same time, numerous barriers were identified that make the implementation of such plans difficult. The most immediate obstacles are financial: large-scale retention measures require substantial upfront investment, which many farms cannot afford without state support (F2, F3). Nevertheless, one of the farmers (F4) emphasized that they are willing to invest their own funds in adaptation measures, which shows that the motivation to protect the landscape goes beyond purely economic calculations. Farmers also emphasized the burden of bureaucracy, with frequent changes in subsidy conditions and complex permitting procedures discouraging experimentation (F1, F2). In several cases, they described a “dual reality,” where one farm exists on paper to meet administrative criteria, while another—more practical one—operates in everyday practice. Property structures further complicate action, as fragmented ownership makes it difficult to plan and implement measures across larger areas.

Another disincentive stems from the way current policies treat landscape features. Farmers noted that creating or registering elements such as pools or trees can reduce maintenance subsidies. If a tree in a pasture dies or is struck by lightning, the farmer is obliged to replace it and complete additional paperwork, which many prefer to avoid altogether (F1). These

administrative burdens create a strong incentive to maintain the status quo rather than pursue new measures. As one farmer concluded, water retention or countryside stewardship is often treated as a “bonus” or hobby to be pursued in leisure time, rather than as a core component of farm business—unless financial rewards and regulatory clarity improve significantly (F2, F4).

What could help to retain or store more water?

Farmers were very clear that the decisive factor enabling broader implementation of retention measures is financial support. Several explicitly called for the state to cover either the full costs or at least a major share of investment, including pre-financing, which is critical for farms that cannot afford to wait for reimbursement (F2, F3). Without such assistance, many measures remain aspirational rather than realistic options. The view that the state should take the lead—by both initiating and financing interventions—was widely shared. Farmers stressed the importance of consistent policies and credible examples provided by public authorities, which could serve as models for local implementation.

Alongside financial support, farmers also highlighted the importance of knowledge exchange and professional guidance. They expressed a strong interest in dialogue, sharing good practices, and reconciling competing interests among stakeholders. In this regard, the presence of certified advisors was mentioned as particularly valuable. Just as farmers rely on advisors in other parts of their business, they saw potential in specialized guidance for water retention, which could help translate complex ecological and technical requirements into practical on-farm decisions (F1).

Positive experiences with collaboration were also mentioned as enabling factors. Eco-oriented farmers, for example, benefited from partnerships with environmental organizations that provided access to funding for activities such as tree planting or pond renewal. In these cases, the farmer’s role was to provide land and take on maintenance responsibilities after establishment, while external actors covered investment costs (F4). Such collaborations not only reduced financial risks but also built trust and mutual recognition between farmers and conservationists. Taken together, these experiences suggest that meaningful support for water retention will require a combination of financial instruments, advisory services, and cooperative partnerships.

Role of subsidies, GAEC and CAP

The interviews revealed a somewhat ambivalent view of subsidies and regulatory frameworks such as the Good Agricultural and Environmental Conditions (GAEC) criteria. On the one hand, subsidies were recognized as an indispensable part of farm income, typically covering around 10–15% of total revenues in larger farms (F3). For smaller family farms that often choose the path of certified eco-farming, GAEC requirements did not appear to present major obstacles. In these cases, compliance is largely consistent with their broader production philosophy, and the administrative burden is manageable.

On the other hand, GAEC obligations were frequently described as impractical or even counterproductive. One farmer criticized the mandatory establishment of narrow buffer strips along streams, calling such measures “agricultural nonsense” that complicates operations without delivering clear benefits (F3). One of the farmers (F6) criticized the one-size-fits-all approach to measures, arguing that they were pointless in cases where the farm already applied

soil conservation technologies, and therefore described them as an unnecessary administrative burden. Farmers also noted that some subsidy schemes designed to support green measures are poorly aligned with actual practices. For instance, buffer strips may be subsidized as if they were permanent grassland rather than arable land, resulting in lower payments. This discrepancy was considered unfair and demotivating: as one farmer put it, the state requires certain measures but is reluctant to adequately compensate farmers for them (F3).

Overall, while subsidies remain a crucial lifeline, the way they are structured sometimes discourages rather than promotes the implementation of retention and conservation measures. Farmers stressed that unless financial support is better aligned with ecological goals, such policies risk being perceived as bureaucratic obligations rather than genuine incentives for sustainable land management.

Other actors and cooperation

Collaboration with external actors emerged as a complex issue. While farmers generally expressed openness to cooperation, they often underlined the practical difficulties of finding suitable opportunities or partners. In several cases, the main obstacle was simply the lack of appropriate land on which joint measures could be implemented. One fruit farmer noted that even if they were willing to collaborate, they did not see viable spaces within their property where shared water retention projects could be realized (F2). Similarly, another large-scale farmer acknowledged awareness of institutions such as State River Basin Administrators or the Agency for Nature Protection but described their actual connections with these bodies as minimal (F3).

The history of land ownership also plays an important role in shaping attitudes toward cooperation. In some contexts, past conflicts over land redistribution during the 1990s privatization continue to cast shadow on relations between neighbors. One farmer described these unresolved issues as an enduring barrier that undermines trust and makes collective action difficult (F1). Medium-sized farms, in particular, seemed less compelled to collaborate unless circumstances forced them to, whereas very small-scale cattle farmers sometimes shared machinery or resources out of necessity.

Nevertheless, positive examples of cooperation were also present. In some municipalities, constructive dialogue with local leadership created opportunities for joint activities, such as tree planting along roadsides or pond restoration. Farmers who worked with municipalities or conservation agencies stressed that consistent and community-oriented local leadership was key to enabling such partnerships (F1, F4). An eco-farmer provided a concrete case where collaboration with conservation groups made it possible to restore pools and reintroduce trees, with NGOs mobilizing resources for implementation while the farmer committed to long-term maintenance (F4).

Although the GAEC framework formally allows for cooperative implementation of some measures, the interviews suggested that farmers do not view it as a practical pathway for collaboration. In practice, cooperation is more likely to emerge informally at the village level, often depending on trust, leadership, and the availability of external resources. This highlights that while policy frameworks may set the conditions, it is local relationships and shared interests that ultimately determine whether collaboration around water retention takes place.

Summary of the broader picture in the Usti Region context

The interviews highlight that farmers in the Usti region are already experiencing the impacts of climate change in tangible ways. Droughts were consistently identified as the most pressing water-related risk, undermining both crop production and livestock farming. Erosion and declining groundwater levels add further pressure, creating a situation in which water scarcity and land degradation reinforce each other. For many, the year 2018 represented a clear turning point, illustrating how extreme climatic events can suddenly threaten both production and economic viability.

Economic considerations remain central to all farming strategies. While production revenues provide the main income, subsidies are indispensable for maintaining cashflow and stability, particularly in less-favoured areas. Yet, the very structure of subsidies and regulatory schemes such as GAEC often generates frustration, as farmers perceive them as misaligned with practical realities. In several cases, environmental requirements were described as demotivating or unfairly compensated, turning potentially useful measures into administrative burdens rather than incentives.

Despite these challenges, motivation for farming goes beyond economics. Family heritage, attachment to the land, and the desire to maintain a good reputation within local communities are powerful drivers that encourage continuity and stewardship. These values are reflected in the willingness of some farmers (especially eco-oriented ones) to implement retention measures such as hedgerows, ponds, or buffer strips. Even among conventional farms, there is evidence of incremental adjustments to cropping patterns, soil management, and field structure to cope with changing conditions.

However, the capacity to implement broader water retention strategies is constrained by significant barriers. High investment costs, limited technical knowledge, and complex property structures hinder action, while bureaucratic procedures and inconsistent subsidy rules further discourage experimentation. Farmers repeatedly stressed that water retention is often perceived as a “bonus” activity rather than an integrated part of farm management—unless financial support, advisory services, and regulatory frameworks are better aligned with practical needs.

Finally, cooperation with other actors remains limited but shows potential. While historical legacies and land ownership conflicts sometimes obstruct collaboration, positive examples exist at the municipal level and in partnerships with conservation organizations. These cases demonstrate that when external actors mobilize resources and local leadership is supportive, farmers are willing to provide land and commit to maintenance. Strengthening such partnerships, together with consistent state involvement and financing, could significantly expand the scope for effective water retention in the region.

Policy recommendations

The survey revealed that most farmers in the Usti region are already seeking to adapt to climate change. However, their motivation to implement water retention measures is constrained by multiple barriers. Addressing these obstacles would substantially increase their willingness and capacity to expand such efforts.

Financial incentives: Subsidy systems should be redesigned to better reflect environmental outcomes. Water retention measures should be compensated, payments should take into account not only the actual costs of implementing them, but also the long-term environmental benefits. This would avoid situations where the introduction of these measures leads to a reduction in farm incomes and where farmers are therefore less motivated to implement them more widely. The timing of support is equally important, introducing mechanisms for pre-financing or co-financing would alleviate cash flow problems, especially for small and medium-sized enterprises that cannot afford to wait for later reimbursement.

Administrative overkill: Farmers identify excessive administrative burden as one of the main barriers. Simplifying these rules and making them more predictable would encourage farmers to implement new measures, which are often seen as bureaucratic obstacles rather than opportunities to improve the landscape.

Advisory services: An important prerequisite for the wider implementation of adaptation measures is the strengthening of cooperation and expert support at the local level. Municipalities can play a key role as coordinators, connecting farmers, conservation organizations and water management institutions. Positive examples show that where local leadership can mobilize resources, farmers are willing to offer land and ensure long-term maintenance. The availability of expert advice is equally essential, the creation of a network of certified advisors specialized in water retention and soil management would provide farmers with practical know-how. The combination of local cooperation and targeted advice can thus significantly increase the effectiveness and sustainability of adaptation measures.

What to do or not to do?

The results and policy recommendations stated might be summed up into following actions:

- Provide upfront financial support, not delayed reimbursements – farmers repeatedly stressed they cannot pre-finance retention measures; liquidity constraints limit action.
- Simplify administrative procedures, don't complicate them – bureaucracy and changing rules are major demotivators and barriers.
- Ensure stability and predictability of subsidy schemes, avoid frequent policy shifts – uncertainty over subsidy conditions undermines long-term planning.
- Align subsidies with ecological goals, don't penalize environmental measures – current schemes sometimes reduce payments for trees, ponds, or buffer strips, discouraging implementation.
- Support advisory services and local coordination, don't rely solely on top-down regulation – farmers explicitly asked for expert guidance and locally-based facilitation.
- Encourage cooperative projects with municipalities or NGOs, not isolated farm efforts – positive examples of pond and tree restoration arose from such collaborations.
- Recognize non-economic motivations, don't frame stewardship only through profit – attachment to land, heritage, and community reputation significantly shape willingness to act.

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