NEXOGENESIS
STREAMLINING WATER RELATED POLICIES

Deliverable 5.5

Implementation report for Adige CS

Lead: Eurac Research
Date: February 2025

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Project Deliverable

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Abstract

This Deliverable (D5.5) presents the implementation of the Adige Case Study throughout the first 42 months of NEXOGENESIS (September 2021-February 2025). It summarises activities related to the different Work Packages of the project, and outcomes related to: governance assessment, conceptual and system dynamics modelling, and stakeholder engagement. The Deliverable builds on Milestones 15 and MS, synthesizing the case study coordination and execution, and highlighting lessons learned and experiences to date.

Keywords

Adige, case study, stakeholder engagement, policies, models, implementation, roadmap, lessons learned, recommendations

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Abbreviations/Acronyms

CIR	*Critical Implementation Risk*
CS	*Case study*
D	*Deliverable*
KPI	*Key Performance Indicator*
M	*Month*
MS	*Milestone*
NEPAT	*Nexus/NEXOGENESIS policy assessment tool*
NXG	*NEXOGENESIS project*
PMT	*Project Management Team*
SH	*Stakeholder*
SLNAE	*Self-Learning Nexus Assessment Engine*
STC	*Scientific and Technical Committee*
WEFE	*Water, energy, food, and ecosystems*
WP	*Work package*
WS	*Workshop*

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1 Introduction

1.1 Project Summary

Water, energy, food, and ecosystems (WEFE) are interconnected and comprise a coherent system (nexus), which is characterized by complexity and modulated by climatic and socio-economic drivers. Within the nexus, economic development (including optimal trade, market, and policy solutions) is hampered by constraints of natural resource availability which are often interconnected. In addition, the adoption of a sectoral approach in developing and implementing policies may affect nexus characteristics, which in turn can affect decision-making and policy formulation and their implementation.

NEXOGENESIS (NXG) develops and validates:

a) a coherent cross-sectoral policy-making framework at different scales addressing climate and socio-economic change, as well as stakeholder behavior and transboundary (diplomacy) issues, developed for and validated by stakeholders, policymakers, and academics;
b) a Self-Learning Nexus Assessment Engine (SLNAE) exploiting reinforcement learning, and supporting streamlining water-related policies into the WEFE nexus;
c) a WEFE Nexus Footprint, accompanying the SLNAE.

Please note that the Self-Learning Nexus Assessment Engine (SLNAE) is hereafter referred to as the nexus/NEXOGENESIS policy assessment tool (NEPAT). This is because this new term is more intuitive for non-project/non-expert readers.

NXG applies its approach to ***five case studies (CS): four European and one in Southern Africa*** (Figure 1). Through these CSs, strong stakeholder engagement and validation of output, the project will improve policies and policy-making processes to enhance cooperation and help the EU achieve targets related to the Water Framework Directive, the greener CAP, Green Deal ambitions, as well as ambitions on water diplomacy.

The five CSs comprise diverse spatial, social and cultural characteristics, and have a history of development challenges. They also feature strong WEFE nexus relations, with the potential for disruption from policy implementation, allowing for an assessment of how water-related policy can be streamlined into the nexus. They allow for out-scaling to broader regions and, due to the diversity of cases and the coherent framework, wider-scale out-scaling to other regions globally will be possible. Dedicated CS partners offer access to stakeholder consultation at different tiers, ensuring maximum engagement and project impact.

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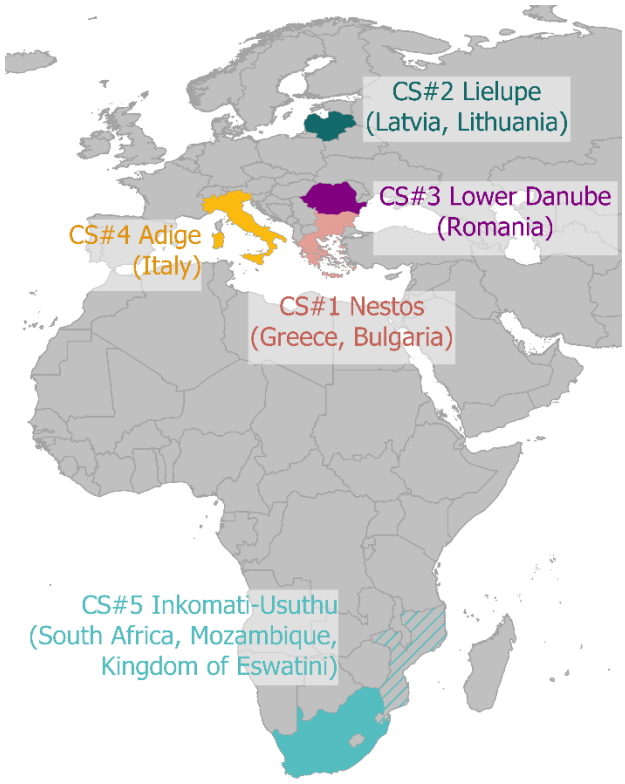
Figure 1: Map of the case studies



Two of the CS, Nestos and Lielupe, are “frontrunner” CSs (see Table 1), which means that they conduct CS activities slightly earlier (ca. 2 months) than others (so called “followers”) to identify potential problems, redundancy or shortcuts in the applied methodology.

Table 1: Overview of the five case studies

Case Study Name	Countries	Project Category
Nestos/Mesta	Greece (GR) Bulgaria (BG)	frontrunner
Lielupe	Lithuania (LT) Latvia (LV)	frontrunner
Jiu, Lower Danube	Romania (RO)	follower
Adige	Italy (IT)	follower
Inkomati-Usuthu	South Africa (RSA)	follower

1.2 Goals of the report

This deliverable builds on MS15 and MS23 and summarizes the CS implementation and stakeholder co-creation activities during the first 42 months of the project (September 2021-February 2025) as well as providing an overview of the planned activities for the final months of the project. It further synthesizes the CS coordination and execution led by WP5, and concludes with emerging CS-specific lessons learned and experiences. The deliverable specifically summarises: CS activities outlined in the NXG Roadmap (MS2), the

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communication activities relevant for CSs presented in the NXG Internal Communication Plan (MS5), the SH identification process to generate the stakeholder register for each CS described in the NXG Stakeholder Register (MS6), the monitoring activities outlined in the NXG monitoring plan (MS8) as well as the conceptual and system dynamics modelling (M12 and M18) with their implementation and the ongoing testing in the NEPAT tool (M20 and M24). Note that KPIs and risks are being reported by the co-ordinator of NXG (WP7). A full description of the case study co-ordination process in WP5 is provided in Annex 1.

1.3 Methodology to build the report

A transdisciplinary co-creation approach has been incorporated to integrate knowledge and experiences at different levels within the project by applying an iterative process for building, refining, and improving this second intermediate report. The document has been developed during months 30-42 of the project to summarize the CS implementation and stakeholder co-creation activities. The initial outline for this deliverable is based on Milestones 15 and 23 and was internally developed internally and discussed within WP5. After initial elaboration of the document, the draft of the report was sent to leads of all CSs for their inputs and suggestions.

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2 Description of the case study

2.1 Basic characteristics

The Adige River flows in the southern-eastern Alps starting from the Italian-Swiss-Austrian border at the elevation of 1586m a.s.l.. and ending in the Adriatic Sea after 409 km (Figure 2). The Adige River flows through the territories of the Province of Bolzano (62% of the overall river basin surface), the province of Trento (29%) and the Veneto region in the provinces of Verona, Belluno, Padova, Rovigo and Venice (9%; Chiogna et al., 2016). With a size of about 12,100 km^2 is the third largest Italian river basin and the second longest river (Diamantini et al., 2018).

The case study area covers 369 municipalities with a total of about 1,600,000 inhabitants. Specifically, 28.33% of the total population live in the Province of Bolzano, 21.43% live in the Province of Trento, 34.71 % in the Province of Verona, 3.80% in the Province of Vicenza, 1.03% in the Province of Belluno, 1.03% in the Province of Padova, 5.64% in the Province of Rovigo, 4.13% in the Province of Venezia and 0.11% in Switzerland (Autorità di Bacino del Fiume Adige, n.d.).

Winter and summer tourism also play an important role with the total population often increasing by five to six times in many parts of the upper basin, with consequences for the management of water, energy and waste. Several hydropower dams and plants are located in the upstream part of the basin and produce renewable energy which often exceeds energy demand. The mountain landscapes are characterized by intensive cultivation of apple orchards, which provide more than 15% of European apple production (South Tyrol in Figures, 2021). The downstream part of the basin is characterized by intensive anthropogenic land use, with vineyards and cereals as the main irrigated cultivations.

The Adige River Basin is characterized by different cultural, linguistic (i.e. south Tyrolean, Ladin and Italian), economic and legislative autonomy levels which challenge the management of common resources from upstream to downstream. During extreme conditions, such as droughts and floods, disputes and tensions arise in relation to water management and governance.

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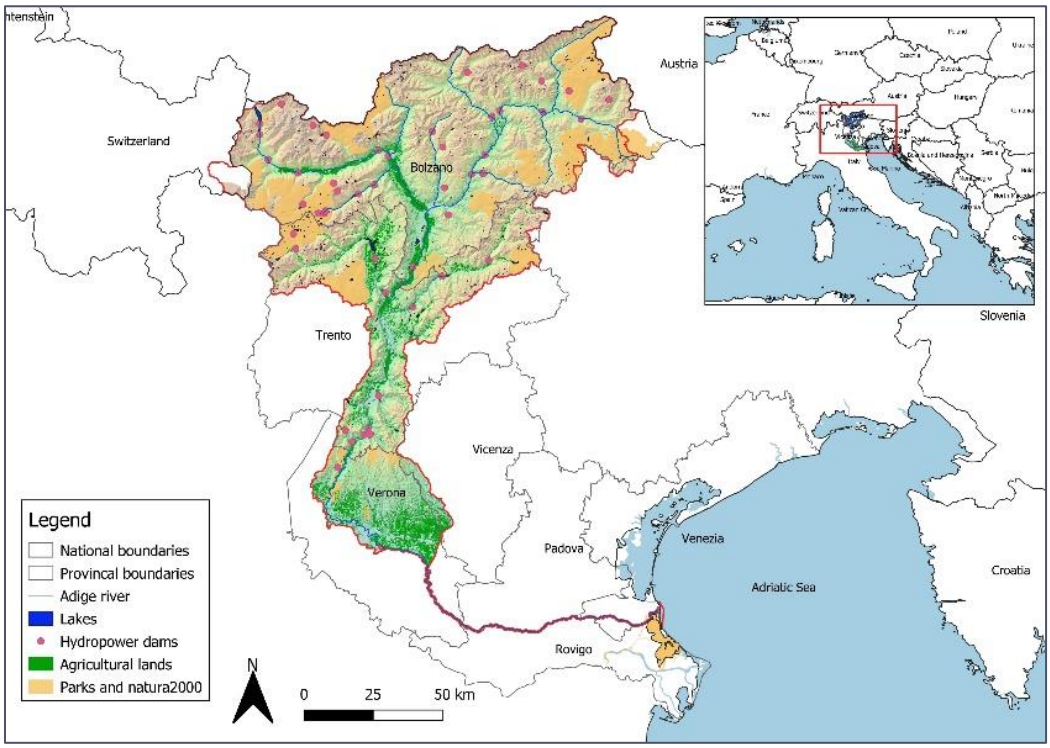
Figure 2 : The Adige River Basin case study in Italy



2.2 Description of the nexus components

2.2.1 Water

Water has always been considered abundant in the Adige River Basin due to the high upstream rainfall during summer and significant contributions from snow and glaciers melt during spring and summer (Terzi et al., 2021). Such conditions supported many anthropogenic activities to grow, relying on high water consumption. However, the basin's complex and diverse water use system has led to disputes and tensions in achieving multi-sector and geographically equitable water management and governance, especially under extreme conditions.

Water availability in the basin varies significantly between its upper and lower regions. The upper part of the basin is characterized by cold, dry winters and summer rainfall maxima, with water resources accumulating as snowfall and glacier growth at higher altitudes during winter. These reserves are mobilized in spring, contributing substantially to the river streamflow. In contrast, downstream areas experience hot summers and two distinct precipitation peaks in autumn and spring. Large dam reservoirs in the upper basin act as buffers, regulating variations in water availability and supplying water to key sectors, including hydropower, agriculture, domestic use and ecological needs.

Climate change is greatly altering this delicate balance, affecting rainfall and snowfall patterns and impacting the seasonal availability of water. These changes influence artificial lakes and hydropower production, affecting the timing and quantity of water flow to downstream users. Socio-economic factors further complicate the situation; while seasonal tourism increases

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water demand during winter and summer, a trend of depopulation in mountainous areas is shifting water demand closer to urban centres (Scuttari et al., 2018).

Water quality is another critical dimension. In both upper and lower parts of the basin, maintaining specific quality parameters is essential for ecosystems and human activities. Downstream, where agricultural activities dominate, factors such as pH, temperature, and dissolved oxygen must be carefully managed to ensure productivity. Similarly, the domestic sector requires adherence to quality standards set by the Health Ministry to guarantee safe drinking water.

The ongoing combination of: (i) climate change effects on temperature, rainfall, and snowfall; (ii) increasing anthropogenic water demand; and (iii) a lack of trust and synergy among provinces exacerbates water tensions and disputes across sectors and regions. Seasonal tourism adds pressure, especially for snow production and accommodation facilities.

2.2.2 Energy

Hydropower is the primary energy production sector within the Adige River Basin. Historically, 28 artificial dams were constructed in the Alps to enhance water storage capacity, creating reservoirs with a total capacity of 560.59 million cubic meters (Autorità di Bacino del Fiume Adige, n.d.). These reservoirs supply water to 61 hydropower plants, which collectively have an installed power of 1,150 MW. On average, the energy produced exceeds local demand, making hydropower a fundamental part of the region's industrial economy. However, recent drought events in 2015 and 2017 have heightened concerns about water quantity and quality, leading to conflicts over competing water uses (Chiogna et al., 2018; Laaha et al., 2017; Stephan et al., 2021; Terzi et al., 2021).

Hydropower plays a crucial role in the Water-Energy-Food-Ecosystems (WEFE) Nexus of the Adige River Basin, influencing the timing and availability of water for other users. Although hydropower is often categorized as a non-consumptive use, the water channelled through penstocks is temporarily unavailable for other withdrawals. This can exacerbate daily and seasonal fluctuations in river streamflow, impacting downstream users and complicating adherence to minimum ecological flow requirements mandated by regional laws during periods of reduced water availability (Piano Generale di Utilizzazione delle Acque Pubbliche - Trento, 2006).

The hydropower sector is also influenced by external socio-economic factors, such as fluctuating energy prices, which can significantly alter energy demand patterns. This is particularly challenging during periods of high demand coinciding with reduced water levels in reservoirs.

In addition to hydropower, other renewable energy sources contribute to meeting energy demand in the basin. Photovoltaic, biogas, and wind energy installations have a combined installed power of 415.3 MW, 95.7 MW, and 0.4 MW, respectively, in the upper part of the basin (Comuni Rinnovabili Trentino/Alto-Adige, 2018). These energy sources support diverse needs, including industrial production, residential consumption, food production, and water treatment.

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While artificial reservoirs provide a critical buffer for water supply, balancing energy production with water availability and ecological requirements remains a significant challenge.

2.2.3 Food

The diverse climate and landscape of the Adige River Basin shape agricultural practices and food production, resulting in distinct characteristics between the upstream and downstream regions. In the mountainous upper basin, intensive apple orchards and vineyards dominate, with apple production accounting for over 15% of European output (South Tyrol in Figures, 2021). Vineyards, producing high-quality wines, are a prominent feature of both the upper and downstream landscapes.

Irrigation practices vary depending on the crop and region. In the upper basin, steep valleys require significant amounts of water for irrigation, especially during the summer. While vineyards are typically irrigated using efficient drip systems, apple orchards often rely on less water-efficient sprinkler systems (Zanotelli et al., 2019). In the flat downstream areas, irrigation supports the cultivation of cereals and maize, with water drawn from nearby channels or wells.

Livestock production is another key component of the food sector, with intensive livestock farming concentrated in the downstream flatlands. Major production areas include Verona (29%), Padova (19%), Vicenza (18%), and Bolzano (17%) (Piano di gestione dei bacini idrografici delle Alpi orientali, 2010). However, both intensive crop cultivation and livestock farming significantly impact water quality. Nutrient and chemical loads, including nitrogen and phosphorus, are discharged into rivers, hindering the achievement of good ecological status in downstream areas.

The impacts of upstream water management extend to the river delta, where reduced water availability can affect ecosystems and fisheries.

2.2.4 Ecosystems

The Adige River Basin encompasses a highly heterogeneous landscape, ranging from the mountainous areas of Trentino-Alto Adige, with extensive forests and glacial systems, to the flat Veneto region, characterized by the river delta and wetlands. The mountainous area south of the Adige-Isarco-Rienza hydrographic ridge is divided into two sections by the Adige River below Bolzano. The western section features a glacial mountain system, while the eastern section rises to notable peaks such as Latemar (2,846 m a.s.l.) and Catinaccio d'Antermoia (3,004 m a.s.l.). Approximately 80% of the basin's total area (9,700 km²) has distinctly mountainous characteristics, dominated by woodland, pioneer vegetation, and rocky outcrops. The lowland environment is limited due to the basin's natural conformation, transitioning into a displuvial area at Albaredo.

These varied landscapes support a range of ecosystems that deliver essential ecosystem services (ES), classified into four categories: regulating, supporting, provisioning, and cultural. Climate and land-use changes, including shifts from traditional to intensive

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agricultural practices, pose potential risks to landscape quality, biodiversity, and water resources (Miglietta et al., 2021).

In terms of **regulating services**, the Adige River Basin plays a vital role in regulating carbon storage and water quality. Ecosystems within the basin sequester significant amounts of carbon, mitigating climate change (Gaglio et al., 2020). However, the intensification of crop production, requiring higher fertilizer application, has increased nitrogen loads, affecting water quality. This regulatory function is crucial for maintaining water and food security (FAO, 2014).

Supporting services, such as biodiversity, are closely linked to water quality. The loss of biodiversity has cascading effects on both ecosystems and human populations. Maintaining specific water quality parameters is essential for the preservation of biodiversity, highlighting the interconnected nature of ecosystem health and water management.

Provisioning services, including the supply of energy, food, and water, are central to the Adige River Basin. These services demonstrate a dual interaction, as they both depend on and are provided by ecosystems. Agricultural practices, hydropower, and domestic water needs exemplify the reliance on the basin's ecosystems for provisioning services.

Cultural services hold particular importance in the Adige River Basin, as individuals often perceive the cultural and social values of ecosystems more directly than their biophysical contributions (Schirpke, 2022). Key cultural services are linked to tourism and recreation, with natural parks and summer and winter activities playing significant roles.

Despite the broad array of services provided by the Adige River Basin, a general decline in ecosystem service provision has been observed, with a notable increase in the relevance of regulating services due to agricultural and urban expansion (Jorda-Capdevila et al., 2019).

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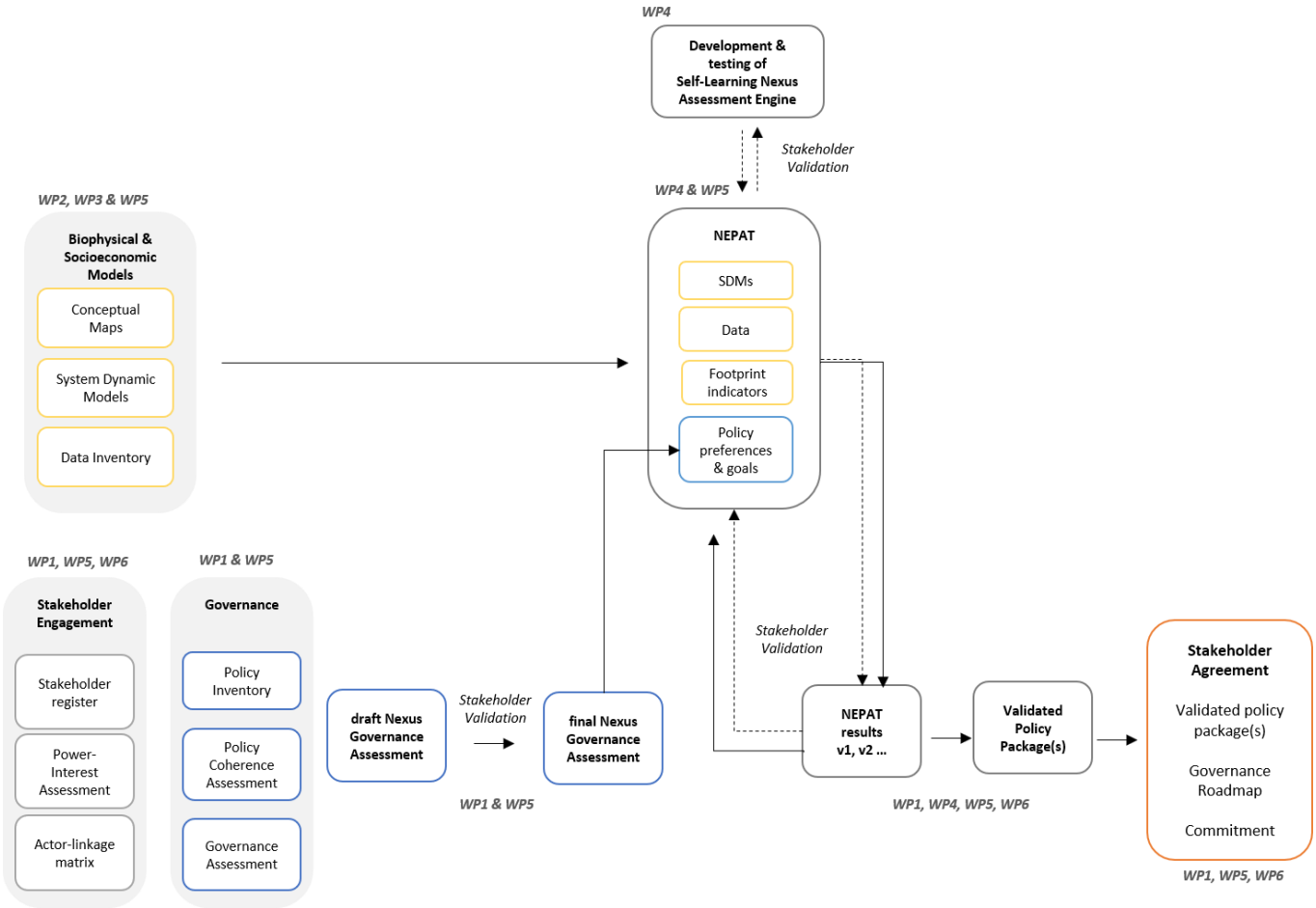
3 Implementation of the case study work in WPs 1-6

This section describes the activities conducted in the Adige CS within each WP of NEXOGENESIS. Figure 3 provides an overview of the NXG approach, showing the outputs from each WP and how the WPs are connected. A full list of all individual activities performed during the project can be found in Annex 2.

Figure 3: Overview of the NXG approach, showing the main activities in WP1-6 and the connections between WPs (figure produced by Sabina Khan, UFZ)



3.1 From stakeholder perception to nexus governance assessment (WP1)

The NXG project builds on a coherent cross-sectoral policy-making framework at different scales addressing climate and socio-economic change, as well as stakeholder behavior and transboundary (diplomacy) issues. WP1 specifically focuses on the co-creation of WEFE nexus governance and water policy streamlining. Thus, WP1 creates a water-energy-food-ecosystem (WEFE) nexus governance assessment tool (NXGAT), which is used in the course

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of the project to measure the quality of existing and potentially future WEFE nexus governance regimes.

3.1.1 Governance assessment in the CS

In the Adige CS the interviews were conducted in person between 4 and 12 October 2022, starting from the downstream region of Veneto and proceeding upstream to the provinces of Bolzano and Trento. The interview programme was developed together with University of Tours (Claudia Cirelli) and KWR (Stefania Munaretto), who were then in charge of conducting the interviews. At least two CS representatives were always present at the interviews.

After conducting the interviews in person, a few additional stakeholders were interviewed online (December 2022). Overall, 25 stakeholders were interviewed (by the end of December 2022). The number of stakeholders taking part in each interview varied, ranging from one single stakeholder to up to five different ones, sometimes occupying a similar role and sometimes different ones (e.g. director & employee, strategic & technical etc). The institutions or companies who took part to the interviews are reported in Table 2.

Table 2: Overview of the SH interviews conducted in late 2022

Stakeholder(s) number	Institution / Company	Region	Sector(s)	Date & Location
1	ANBI Veneto- Regional Association of Consortia for the Management and Protection of Land and Irrigation Waters	Veneto	Water-Agriculture	4.10.2022; Venice
2	Eastern Alps District Basin Authority	Adige River Basin	Water	4.10.2022; Venice
3	Confagricoltura Rovigo (provincial agricultural association)	Province of Rovigo (Veneto)	Food	5.10.2022; Rovigo
4	Acquevenete- Water utility	Veneto	Water	5.10.2022; Monselice
5 & 6	Veneto Region-Irrigation and reclamation department	Veneto	Food-Water	6.10.2022; Mestre
7 & 8	Municipality of Rosolina	Rosolina (Veneto)	All	6.10.2022; Rosolina
9	Legambiente Rovigo/Veneto (Environmental association)	Province of Rovigo & Veneto	Ecosystem	6.10.2022; Rovigo
10	Fishermen Association of Verona- APPV	Province of Verona (Veneto)	Ecosystem -Food-Water	6.10.2022; Verona
11, 12, 13	Hydro Dolomiti Energia & Dolomiti Edison Energy	Trentino	Energy	10.10.2022; Trento
14	WWF Trentino	Trentino	Ecosystem	11.10.2022; Trento

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Stakeholder(s) number	Institution / Company	Region	Sector(s)	Date & Location
15, 16	Amateur Fisherman association of Trentino	Trentino	Ecosystem -Food-Water	11.10.2022; Trento
17, 18	Bauernbund Südtirol-Agricultural association	South Tyrol	Food	12.10.2022; Bolzano
19, 20, 21, 22, 23	Province of Bolzano: (i) department of mountain basins (ii) Civil protection (iii) Hydrology and Dams Office (iv) Office for sustainable management of water resources (v) water protection/quality office	South Tyrol	Water	11.10.2022; Bolzano
24	Permanent Committee for the Defence of Trentino's Waters	Trentino	Ecosystem- Water	15.12.2022, online
25	Energy Federation South Tyrol-SEV	South Tyrol	Energy	21.12.2022, online

The interview data depicted a variegated situation and diversity of opinions not only across the downstream and upstream SHs, but also across the different sectors. The main challenges identified were connected to water availability more than water quality. This results in conflicts between the hydropower and agriculture (vineyards and apple orchards) sectors, sometimes leaving not enough water for the optimal functioning of the ecosystems. As a result, the most critical SHs proved to be the ones representing the Ecosystem sector. The other interviewees, on the other hand, recognised a moderate level of integration and consideration at least across two of the WEFE sectors.

The results of the governance assessment have been further elaborated by WP1 and a deeper insight into the level of integration and existing policy gaps can be found in D1.2 *Governance and Policy Assessment in the Case Studies.* The results of the governance assessment found that the current governance regime is restrictive, but has potential for WEFE nexus governance. Restrictive characteristics include the existence of multiple decision-making actors but little co-ordination between them, fragmentation of regulatory instruments and responsibilities, and a lack of trust between different jurisdictions in the basin. However, there is potential for WEFE nexus governance because of the polycentric nature and flexibility of the system, and the existence of stakeholders who have the expertise to implement a more nexus-based approach to resource management.

3.1.2 Integrating nexus governance and policy knowledge into modelling and NEPAT

The first step to integrate governance and policy knowledge into the modelling was to map and analyse the main relevant policies. This was undertaken in a desk analysis of main policies relating to the four sectors. Due to our specific competences, we also included a couple of policies about risk management and prevention. As shown in Figure 4, we identified 24 main policies (eight for water, four for ecosystems, six for agriculture, four for energy, one for risk,

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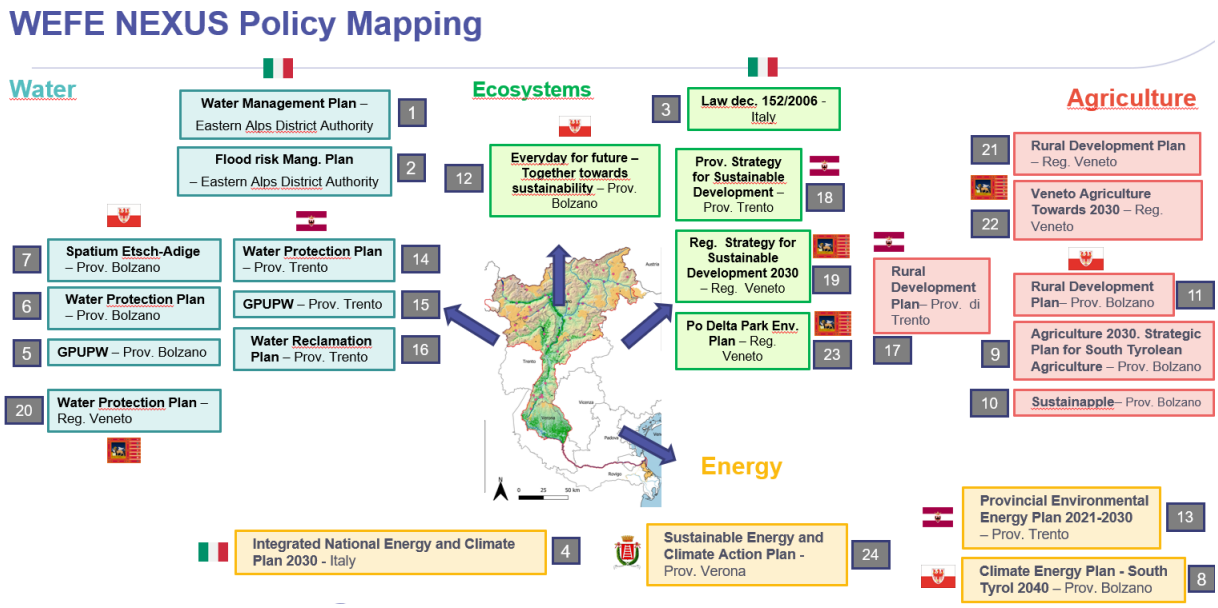
and one shared by the water, ecosystems and risk sectors). These policies relate to five different governance levels:

- one law decree and one plan at Italian State level;
- two plans by the Eastern Alps District Authority, at interregional level (corresponding to the Adige river catchment level);
- four policies (one plan, three strategies) at Veneto Region level;
- seven policies (four plans, three strategies) at Bolzano-South Tyrol provincial level;
- six policies (five plans, one strategy) at Trento provincial level;
- one policy at Verona Municipal level;
- two policies at local level (one Regional Park in Veneto and one river contract in South Tyrol).

Figure 4: WEFE Nexus policy mapping for the Adige river CS



All polices were analysed by extracting the main information (related to sector, issue date, validity, main goals, targets, and policy tools) and the main cross-sectoral references, including goals, targets, and tools, where mentioned. Due to our specific competences, we also added "Climate" to the four WEFE sectors, which refers to climate mitigation and adaptation measures. As shown in Table 3, most policies have weak cross-sectorial integration (that is, they only mention one or more of the other sectors). Policies that are most cross-sectoral (they refer to specific tools, instruments or targets of other sectors) are in the Province of Bolzano, with two related to water and one to agriculture. The least cross-sectoral policies seem to be an interregional policy on water and a regional one on ecosystems.

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*Table 3: Overview of the policy coherence assessment for the Adige river CS.*Policy under review at the time of the analysis*

	Sector	Admin. Level	Policy name	Water	Energy	Agricult.	Soil	Ecosyst.	Climate
1	Water	Eastern Alps District Authority	Water Management Plan						
2	Water	Eastern Alps District Authority	Flood risk Management Plan						
3	Ecosystems	Italy	Law dec. 152/2006						
4	Energy; Climate	Italy	Integrated National Energy and Climate Plan 2030						
5	Water	Prov. Bolzano	General Plan for the Use of Public Waters						
6	Water	Prov. Bolzano	Water Protection Plan						
7	Water	Prov. Bolzano	Spatium Etsch-Adige River Contr.						
8	Energy; Climate	Prov. Bolzano	Climate Energy Plan - ST 2050*						
9	Agriculture	Prov. Bolzano	Agriculture 2030. Strategic Plan for South Tyrolean Agriculture						
10	Agriculture	Prov. Bolzano	Sustainapple						
11	Agriculture	Prov. Bolzano	Rural Development Plan						
12	Ecosystems	Prov. Bolzano	Everyday for future						
13	Energy	Prov. Trento	Prov. Env. Energy Plan 2021-2030						
14	Water	Prov. Trento	Water Protection Plan						
15	Water	Prov. Trento	General Plan for the Use of Public Waters						
16	Ecosystems	Prov. Trento	Water Reclamation Plan						
17	Agriculture	Prov. Trento	Rural Development Plan						
18	Ecosystems	Prov. Trento	Prov. Strategy for Sustainable Development						
19	Ecosystems	Veneto Region	Reg. Strategy for Sustainable Development 2030						
20	Water	Veneto Region	Water Protection Plan						
21	Agriculture	Veneto Region	Rural Development Plan						
22	Agriculture	Veneto Region	Veneto Agriculture Towards 2030						
23	Ecosystems	Veneto Region	Po Delta Park Env. Plan						
24	Energy; Climate	Prov. Verona	Sustainable Energy and Climate Action Plan						
					Not applicable	Strong integration	Weak integration	No integration	

3.1.3 Co-creation of policy packages, governance roadmap and stakeholder agreement

The work with co-creation of policy packages, the governance roadmap and the final stakeholder agreement has been developed with WP1 task leaders, online meetings within WP5, support from WP2 and WP3, and with three kinds of SH contributions:

- A few bilateral meetings with some relevant institutional SHs (e.g. Province of Bolzano and Trento, Veneto Region officers).
- 15 interviews undertaken with the support of WP1 (KWR and Univ. Tours) during fieldwork to assess WEFE governance along the Adige river between October and

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December 2022 (25 stakeholders previously listed in the *Governance assessment in the CS* section).

- Discussion and active contribution of SHs during workshops.

Initially, the co-creation of policy packages has been mainly undertaken through desk-based analysis, resulting in the tools, targets and measures shown in the WP4 *Identification of relevant policy scenarios which sustain initial development of NEPAT* section below. These results were presented and discussed in the second workshop within four working groups, one for each sector: the SHs who attended the meetings actively commented on the results and gave their contributions using Post-It notes on flipcharts. Those initial SH comments and the results of the WEFE governance assessment fieldwork were integrated into the desk-based analysis to co-create the policy packages. The resulting policy packages were validated by SHs through bilateral meetings and workshop 3, during which ad-hoc break out groups were set up to cover all the WEFE sectors.

The proposed policy packages are a compromise between SH interests, the available data as well as the possibility to modify the available modelling approaches (provided by the hydrological and system dynamic models and by WP2) to include the identified set of packages. This latter condition is mainly due to different mismatches between the SH needs and the actual models development. For example, SH needs were often provided working on a provincial or regional level while the modelling activities considered the Adige River basin as a whole without addressing specific sub-basins conditions at a policy level. Moreover, in some cases the policy instruments across the WEFE sectors provided qualitative objectives and information and had to be adapted to feed the selected models with quantitative data and targets.

The proposed and selected policies, concurring to different policy goals, were then implemented in the NEPAT.

The governance roadmap is being co-developed and presented to selected stakeholders in bilateral meetings in the last months of the project. The final version will additionally be presented to a broader range of stakeholders, at the final case study event, the so-called Adige Water Fair, occurring in May 2025. The governance roadmap will include strategic goals resulting from the stakeholder engagement process (e.g. achieving a Transboundary River Monitoring Program: moving towards a shared and uniform hydrological model for the river basin, closing data gaps using standard protocols). Roadmap priorities will therefore not be informed by the NEPAT, given its current limitations. In this context, the results of the NEPAT will be used for awareness raising and to stimulate the discussion.

Due to the outcomes of some online meetings and the joint fieldwork with KWR and Univ. Tours, it has been agreed that a river contract for the whole Adige River as a final achievement of the project may be rather ambitious and problematic. A more achievable goal is set to a ‘shared intentions document’ among the institutional actors and SHs in the water, energy, agricultural and ecosystem sectors during the final stakeholder event of the Adige Water Fair. In particular, the document aims to include the definition of objectives and tools for the integrated management of resources in the Adige River Basin, the identification of ongoing and future challenges as well as required changes and solutions. For example, the collection

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and sharing of data, exchange of experiences and good practices, shared projects for the development of new knowledge, infrastructural and/or technical measures.

3.2 From biogeophysical modelling to baseline scenarios (WP2)

WP2 focuses on identifying and bringing together relevant nexus data, creating a coherent scientific portfolio of data across case studies to characterize physical, environmental and socio-economic components under current and future climate change conditions through the coming century. The portfolio is developed in line with a set of selected IPCC scenarios, as a combination of shared socioeconomic pathway (SSP) and representative concentration pathway (RCP) scenarios. The goal is to provide data support for each case study (WP5) concerning appropriate nexus data combinations and modelling design for WP3 and WP4 and under SH acceptance and co-development in WP1 and WP5, in order to characterize relevant case-specific biophysical-human interactions between nexus components.

3.2.1 Data from global datasets and models

The activities carried out in WP2 provided a portfolio of consolidated future biophysical and socio-economic data trends for each case study to characterize climatic, hydrological, environmental, and socio-economic variables. Data from several sources (such as: Inter-Sectoral Impact Model Intercomparison Project (ISIMIP), the COordinated Regional climate Downscaling EXperiment (CORDEX), High Resolution Model Intercomparison Project (HiResMIP), Hydrology-related climate impact indicators Copernicus C3S and Global Biodiversity (GLOBIO) model for policy support) was screened and made available to the case studies and covering climate, water, agriculture, terrestrial biodiversity, biomes, and permafrost sectors.

Moreover, primary socio-economic data was made available using the CGE models (GTAP global social accounting matrix) complemented by multiple sources such as regional statistics. Future scenarios were retrieved from the quantitative repositories available at IIASA and interacting with the MAGNET model to downscale national level projections to grid cell resolution (providing information such as agricultural land use). Specific information on the process and resulting variables are reported in D2.1.

Overall data coming from WP2 was used whenever possible to feed the work carried out in WP3 using system dynamics modelling and other locally applied models.

3.2.2 Co-creation of technical and transdisciplinary knowledge

The co-creation work started with an initial discussion aimed at understanding the entry points of policies into the conceptual model. Such activity was developed to identify how policies are or are not addressing the WEFE Nexus. Discussions and exchanges were also developed within the WP2 working team regarding data needs, in particular focussing on the climate scenarios to be used within the hydrological modelling for the Adige River Basin. The

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conceptual model was also developed, consulting the overview/list of technical data/variables which was provided as a result of the WP2 activities.

Overall, the need for indicators and targets both for the conceptual model and the policy packages aims to improve the understanding of those quantitative and qualitative variables involved into the WEFE Nexus that can be translated into quantifiable data to be integrated into system dynamics modelling.

3.3 From conceptual model to complexity science modelling and WEFE nexus footprint (WP3)

WP3 forms the link between the biophysical modelling (WP2) and stakeholder input (WP1), and integrates the outcomes of these WPs through novel complexity science approaches to assess the impacts of water-related policies in a nexus context in the CS under different scenarios, according to the requests of WP5 and the stakeholder input and recommendations from WP1.

3.3.1 Overview of interrelationships among WEFE Nexus components

The main nexus links relate to the existing water tensions and disputes arising during periods of extreme water availability conditions within the CS area. Climate change is already having a generally negative effect on all the WEFE sectors, impacting the amount of available resources while increasing the overall demand, especially during spring and summer periods. External socio-economic pressures are also acting in terms of impacts related to urban areas (i.e., land use change and population increase), with depopulation occurring in mountain territories. The water component is directly connected in terms of quantity and quality with all the other nexus components due to their need for hydropower and food production and ecosystem vitality. Moreover, while some ecosystems depend on the supply of water coming from upstream, they also can buffer and improve the availability and quality of water downstream. The food sector is dependent on the available ecosystem services coming from the surrounding ecosystems, while expanding and often overtaking ecosystem land for agricultural production.

3.3.2 Main WEFE Nexus challenges

The main WEFE Nexus issues are related to the concurrent impacts of climate change on water availability, especially upstream on glaciers and snow cover, and the use of water for downstream anthropogenic activities. This is particularly clear between the energy and food sectors, with intensive hydropower production upstream (reservoirs mostly driven by the energy market) and the agricultural needs downstream.

Another important issue involves the food and ecosystem nexus components in the delta area. In this case, low-efficiency irrigated agriculture competes with and depends on the water

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needed for a healthy delta ecosystem. Such conditions are further exacerbated by the high numbers of tourists, with peak tourism seasons contributing to the increase in water consumption for domestic uses.

Finally, the limited cooperation among the different provinces due to cultural, geographical and historical peculiarities intersect and are reflected in a unique autonomy governance setting. This further exacerbates impacts on the end-of-the-basin users, especially given an upstream low appreciation of potential downstream consequences and the low direct economic profits generated from the delta system when compared to upstream areas.

3.3.3 Conceptual Model

The understanding of the WEFE Nexus components and their relations within the Adige River Basin began with the collection of peer-reviewed literature, grey literature and newspaper articles dealing with the water management topic. The information gathered in this initial phase was used in combination with expert-based discussions to develop a first conceptualization of the sectors involved in the WEFE Nexus for the Adige River Basin and the definition of their exchange of material or pressures.

The conceptual diagram was developed and validated through the inputs provided in two workshops held online in May 2022 and in person in Trento 2022 with the main river basin SHs (e.g., from local authorities, academics, decision-makers, environmental associations and hydropower managers). During the first workshop, SHs were asked to provide inputs on the critical issues characterising the WEFE sectors of the Adige River Basin, the causes underlying such challenges, and the available and missing tools to address them. This allowed the collection of local knowledge, pinpointing the main WEFE sectors and interconnections to start building the conceptual model.

During the second workshop, the conceptualization was used to guide the discussion, collect further information and validate the identified sectoral interactions. Each participant had the possibility to prioritize the existing connections and to add others according to their sectoral and local knowledge.

In the conceptual diagram (Figure 5), the main sectors of the WEFE Nexus are illustrated: water, energy, food, ecosystem and ecosystem services, climate, land use and cover changes, and socio-economic. The focus was on identifying and qualitatively characterizing the relations between the WEFE sectors as well as the pressures from external components on the system (i.e. climate and socio-economic drivers). In the conceptual diagram, the main interrelationships among the identified sectors are represented, identifying two different types of interconnections:

i. *red arrows* represent pressures coming from climate conditions, socio-economic components, and land use/cover changes (e.g., changes in temperature and precipitation);
ii. *blue arrows* represent the flows of material going from one sector to the other (e.g., water or energy).

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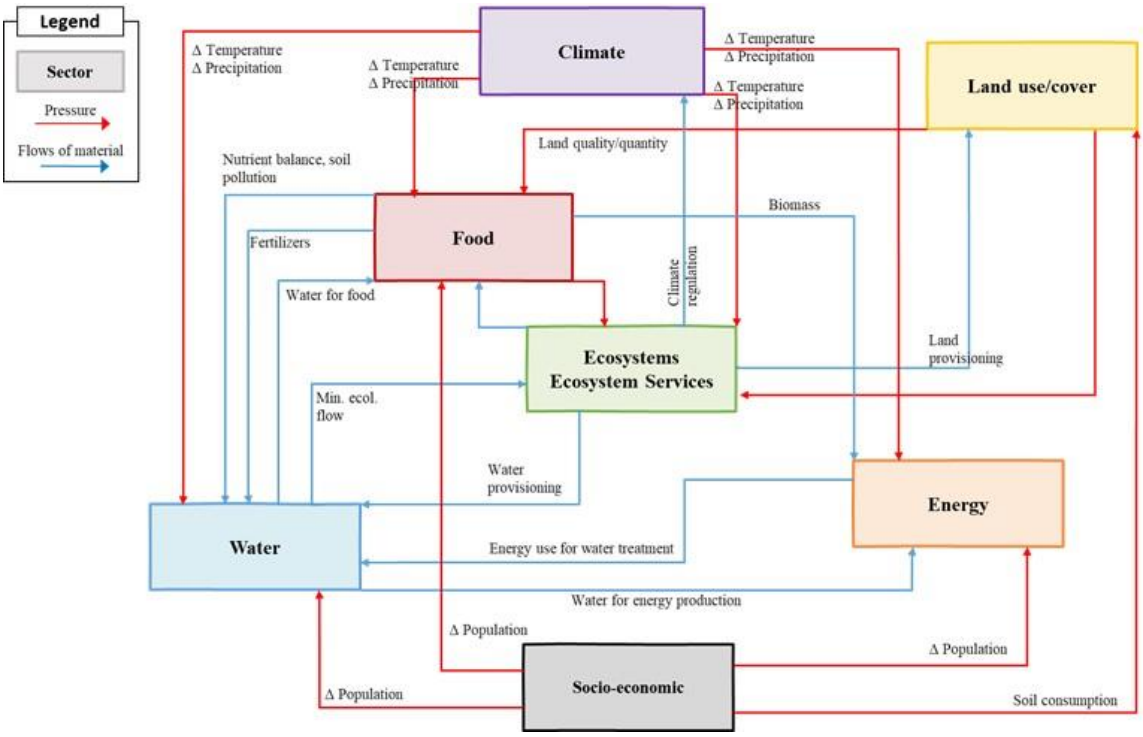
Figure 5: Conceptual model for the WEFE Nexus within the Adige River Basin case study



Detailed sectoral models are also provided in the NXG Deliverable 3.1, *Conceptual models completed for all the case studies*, December 2022 (pp. 41-49).

3.3.4 System Dynamic Modelling approach

The activities focussed on translating the conceptual models into a Causal Loop Diagram (CLD). This conceptualization allowed for a better representation of each interrelationship within the WEFE Nexus and the identification of potential reinforcing and balancing loops.

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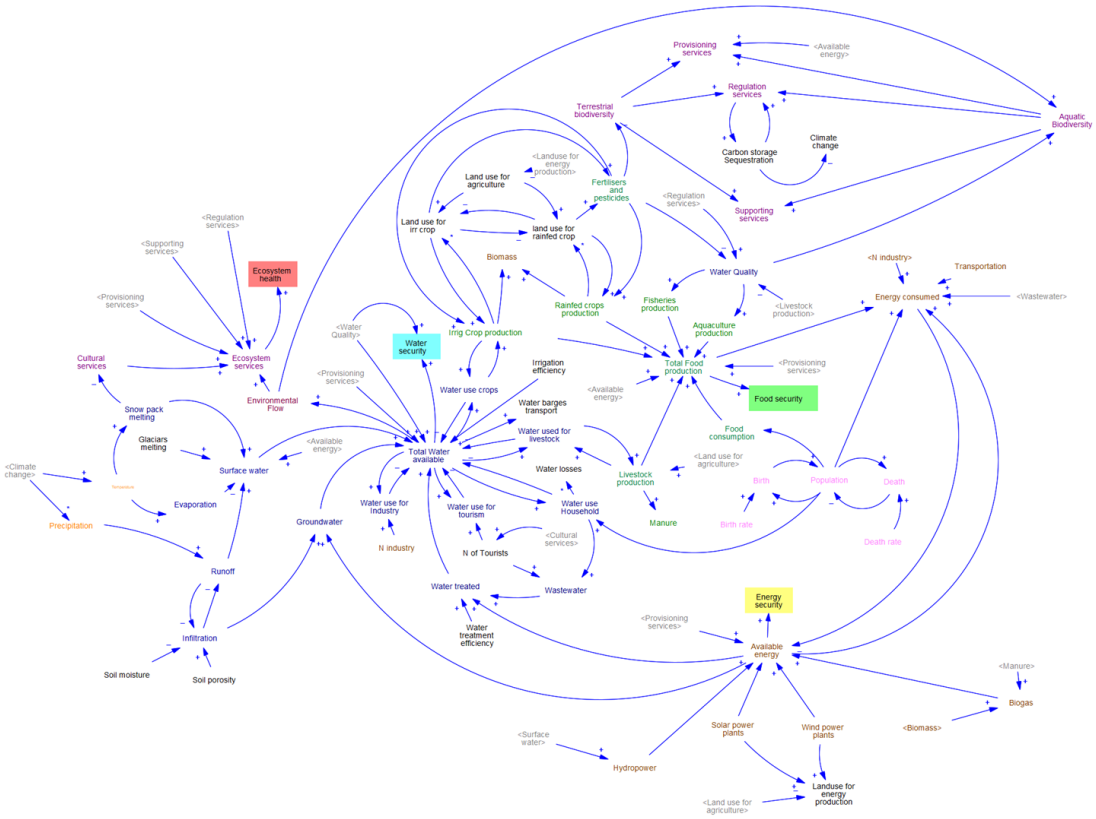
Figure 6: Causal Loop Diagram of the WEFE sectors for the Adige River Basin.



The CLD was developed together with the Institute for Water Education (IHE) in order to bring local knowledge closer to practical CLD development expertise. Some specific characteristics generally considered in WEFE analysis were here not further represented given their; (i) limited influence on the overall WEFE nexus over the whole Adige River Basin (e.g., minor crop types or water users), (ii) influence over global processes (i.e., local GHG emissions on global climate change effects), or (iii) effects of international trades on local conditions which are beyond the scope of this representation (e.g., export/import of goods). Given the objective of providing a high-level understanding of the WEFE Nexus in the Adige River basin, external drivers of socio-economic processes and climate change were also not represented. Moreover, the developed conceptualizations accounted for the Adige River basin as a whole, capturing macro conditions and processes occurring within the entire Adige River basin.

The causal loop diagrams provided the foundations for the subsequent development of the stock-and-flow system dynamics model (SDM). In particular, the SDM incorporate data and inputs from WP2 as well as local data and the application of multiple models. In particular, given the high interest and confidence from the hydrological office of the province, the hydrological model was here considered as the flagship model to build up a strong collaboration and credibility since it is already in use by some of the key stakeholders. For these reasons, we validated it on local conditions and used it to engage with stakeholders and build a trustful relationship based on robust evidence. The hydrological model performance, as well as the low flow model performance is reported in Figure 7.

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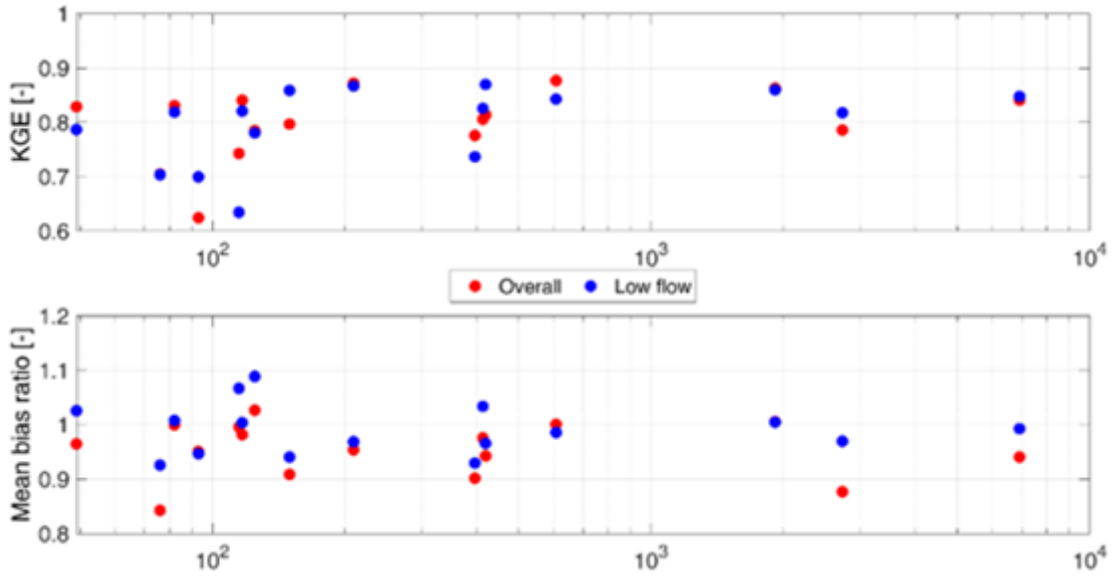
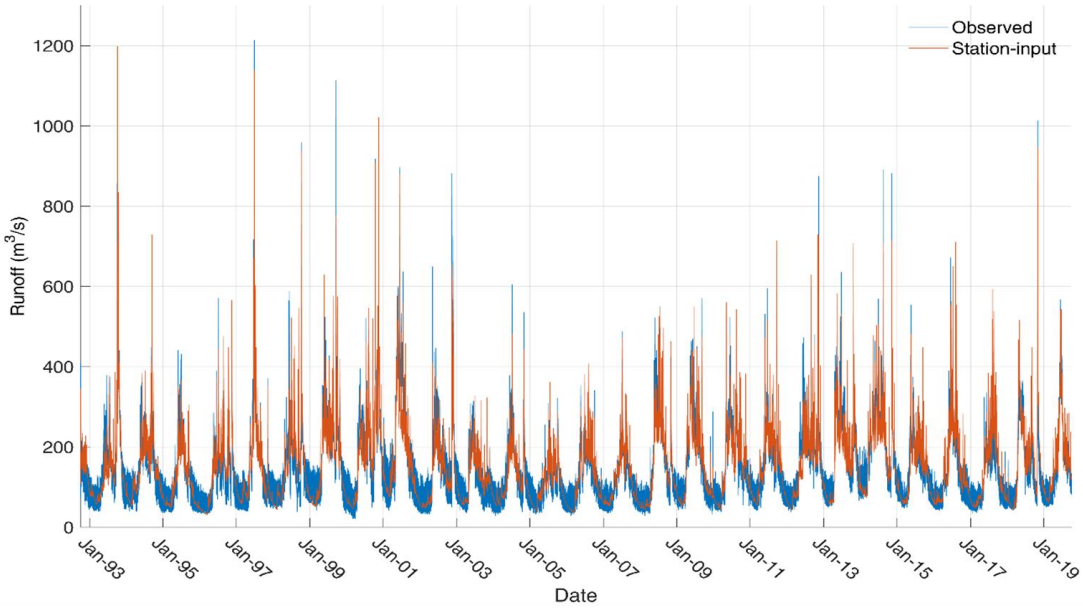
Figure 7: Hydrological model performance for the upstream part of the Adige River Basin calculated over the baseline period.



The streamflow simulations conducted for Bronzolo demonstrated strong performance in replicating the observed streamflow measurements, as illustrated in Figure 8. The results indicate that the model accurately captures the temporal patterns and magnitudes of streamflow, providing confidence in its ability to represent the hydrological dynamics of the river at this location. This alignment between simulated and measured data highlights the reliability of the model for assessing water resources and streamflow variability under current and potential future conditions.

Figure 8: Time series at an hourly time scale of the river discharge (runoff) at the Bronzolo outlet with observed (blue line) and modelled (red line) values. Calibration 2003-2019 and validation 1992-2003, squared-R of 0.82 (calibration and validation) and Kling–Gupta efficiency of 0.89 (calibration) and 0.85 (validation).



Future scenarios of streamflow values shows moderate differences across the implemented climate scenarios. Boxplots were generated to emphasize the differences across climate scenarios for each of the three climate models (GFDL, IPSL, and MPI) over the months of a

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hydrological year spanning October to September (Figure 9 and Figure 10). Notably, the RCP2.6 scenario exhibits both greater variability and higher mean values compared to the reference period across all months, with a significant increase in outliers, particularly for maximum values. In contrast, the RCP8.5 scenario presents higher mean values during the winter months, highlighting the impact of rising temperatures on snow and glacier melt dynamics.

Figure 9: Boxplots of runoff values for the reference period and for the MPI climate scenario for RCP2.6 and 8.5

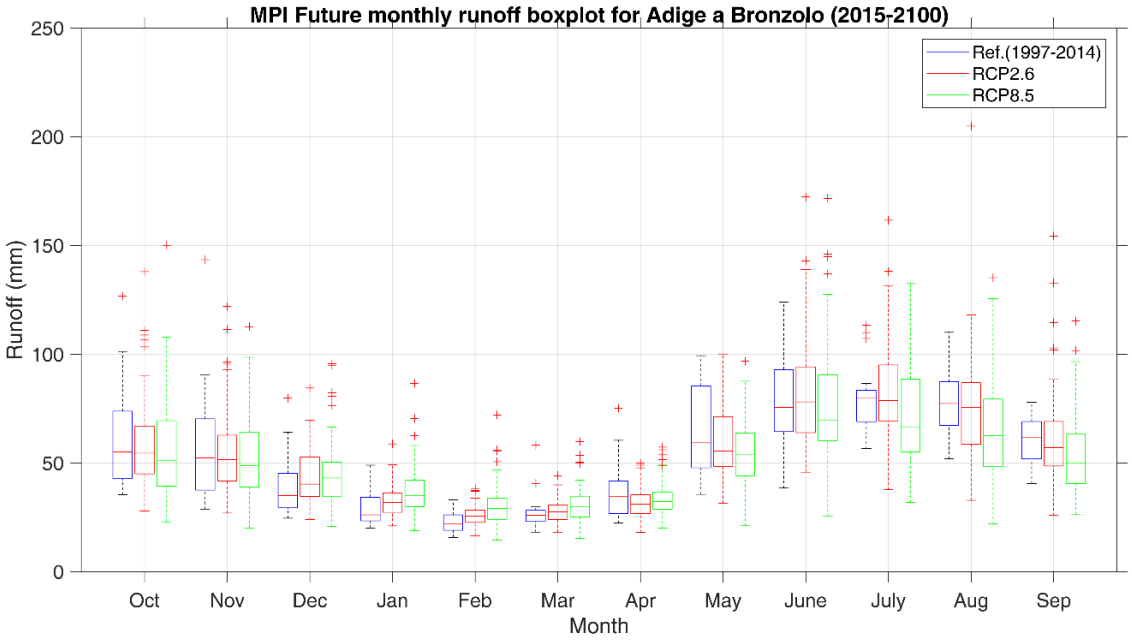
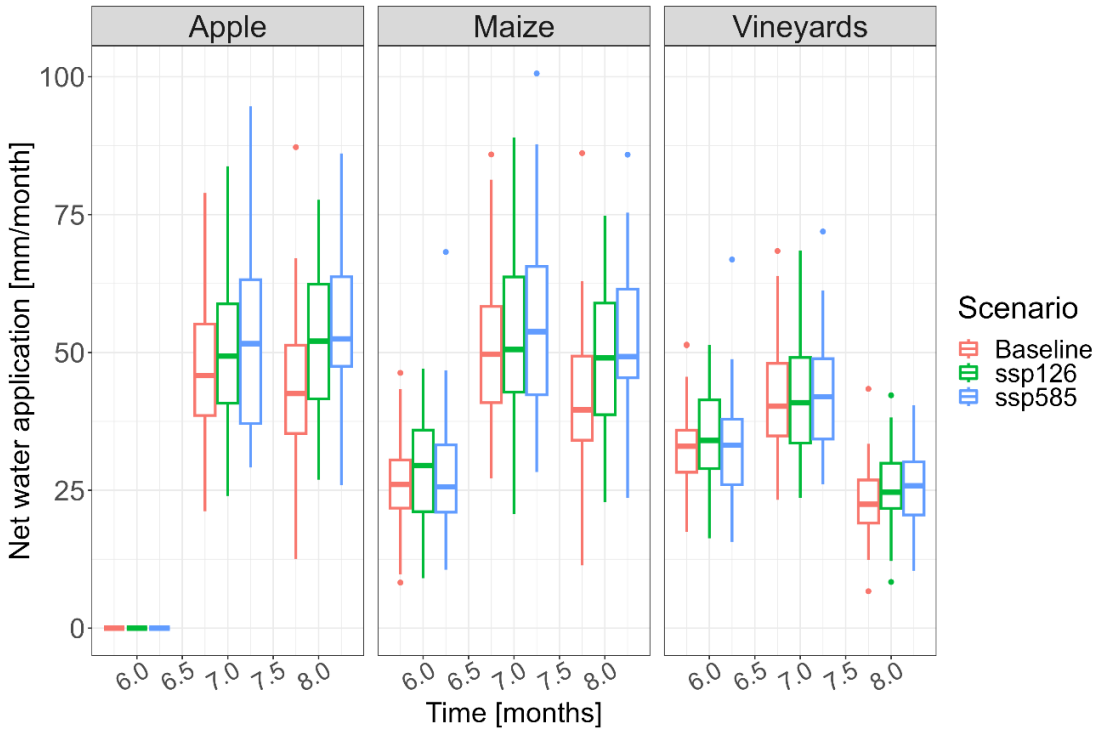


*Figure 10: Boxplots of net water application (mm/month*ha) for the reference period and for the RCP2.6 and 8.5 climate scenarios*



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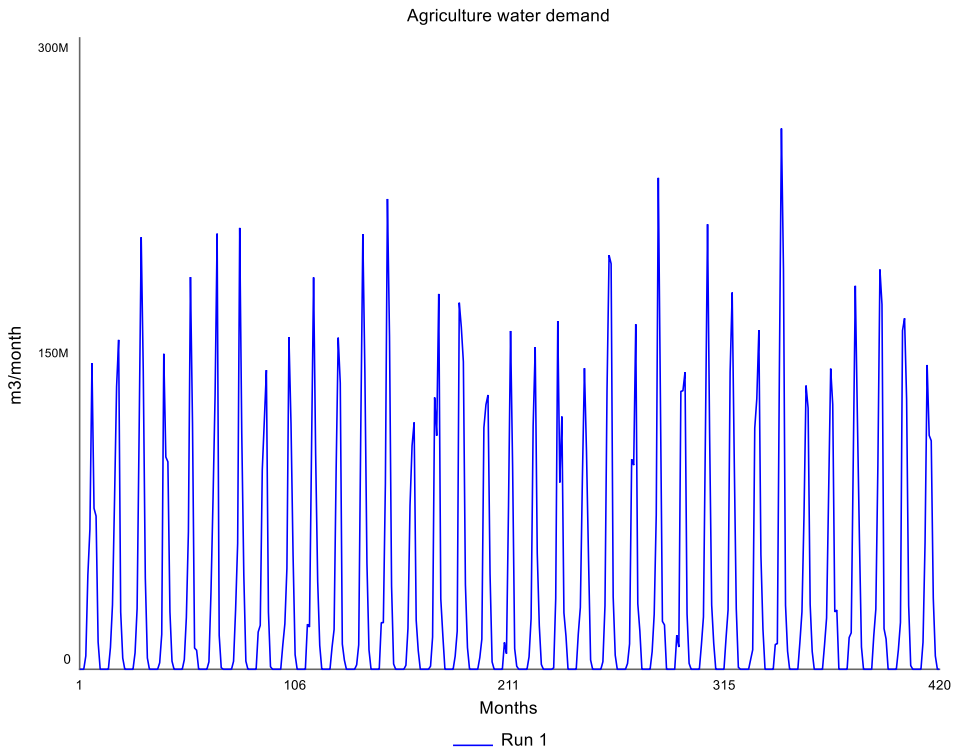
In the food security sector, the two climate scenarios analyzed indicate a moderate increase in water demand necessary to sustain the optimal growth of the selected crops (apples, maize, and vineyards). This trend is attributed to rising temperatures, which elevate evapotranspiration rates during the growing seasons, leading to higher water requirements for all crop types. Additionally, the boxplot representation effectively highlights the variability in future net water applications across the Adige River Basin pointing to the need of considering a quite broad range of uncertainty associated to crop-specific water requirements.

Similarly, the overall trend of agricultural water demand (Figure 11) show seasonal patterns from 2015 until 2050 for RCP2.6 with an increase of single months spiking in the overall trend and hence requiring increases in the water need for their irrigation.

Figure 11: Overall water demanded in agriculture (considering all crop types of apple, maize, vineyards and grassland)



For the population sector, future growth rate scenarios for the overall population (Figure 12) indicate increases in terms of both residents and tourists within the Adige River Basin. In particular, future tourist presences under rcp2.6 and SSP4 shows its weight on the overall numbers. This trend underscores the steady increase of demographic trajectories associated with the socio-economic pathways, with SSP4 projecting a high population increase.

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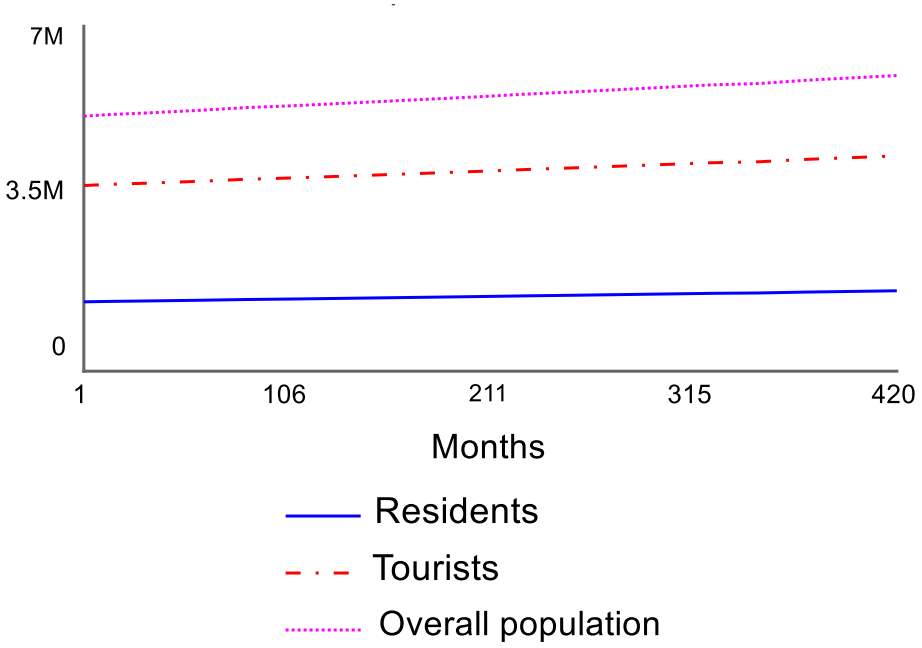
Figure 12: Future population (residents, tourists and overall population) for the SSP2.6 future scenario



3.4 From nexus governance and complexity science modelling to nexus policy assessment tool NEPAT (WP4)

The objective of WP4 is to develop the nexus policy assessment tool (NEPAT) to distil integrative policies that maximize the overall nexus benefits while dealing with conflicting nexus decisions and objectives.

3.4.1 Identification of relevant policy scenarios which sustain initial development of NEPAT

As mentioned in the WP1 *Co-creation of policy packages, governance roadmap and river contract* section, the first phase of the co-creation of relevant policy packages was undertaken by considering one main goal per sector, then identifying main measures, targets and tools (if any), which were collected through the policy and policy coherence analysis. These main four goals have been identified, beginning with the results of the first workshop, a few bilateral meetings with some institutional stakeholders, and first hints collected during the governance assessment fieldwork along the Adige river. As the figures below show, the first potential main goals were identified as:

- water saving in agriculture for the agriculture sector *(*Figure 13);
- increasing the soil biological index for the ecosystems sector (Figure 14)
- increasing renewable energy production for the energy sector (Figure 15);
- maintaining ecological flow for the water sector (Figure 16)

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Each figure shows existing measures, tools and potential targets which could support to achieve the identified goal. Some of them (e.g. the energy sector) can also appear problematic, since not clearly addressing the WEFE nexus at the whole catchment level.

Figure 13: Initial main policy goal, measures and tools identified in the agriculture sector

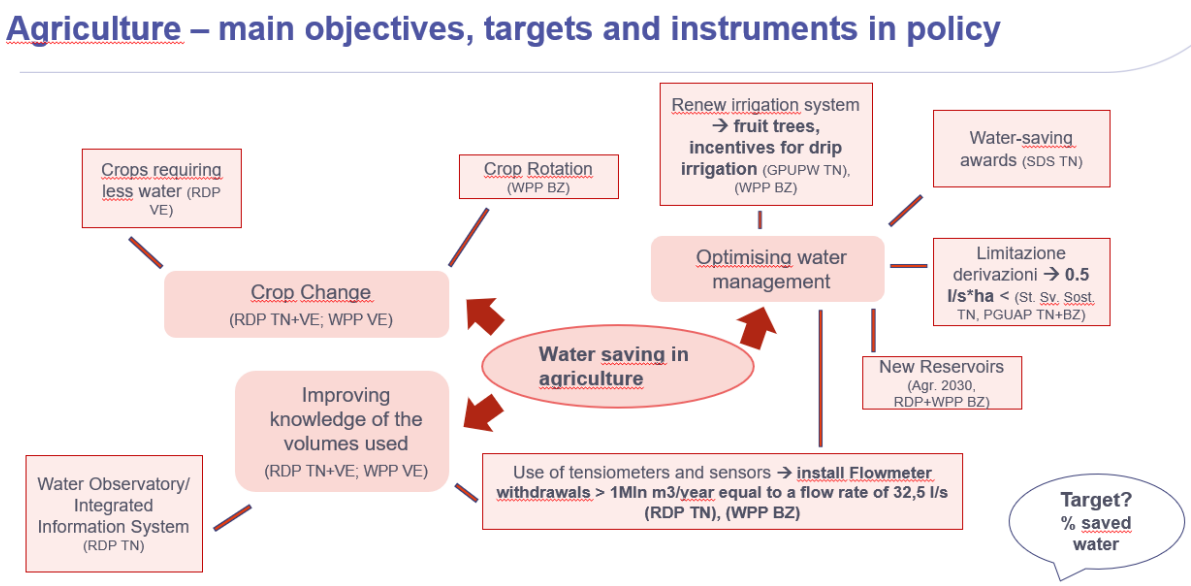

Figure 14: Initial main policy goal, measures and tools identified in the ecosystems sector

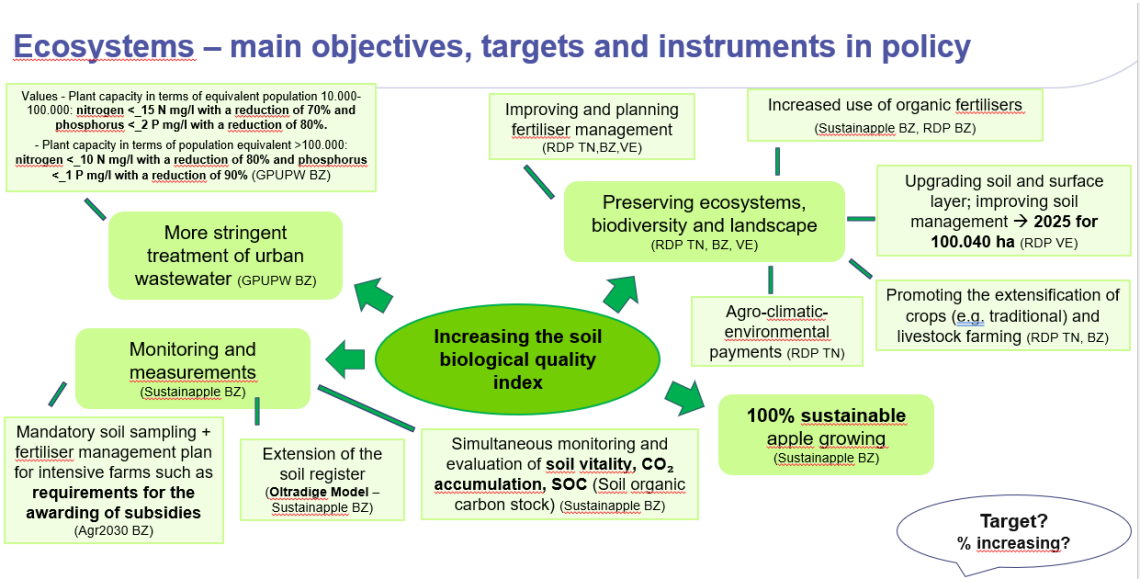

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Figure 15: Initial main policy goal, measures and tools identified in the energy sector

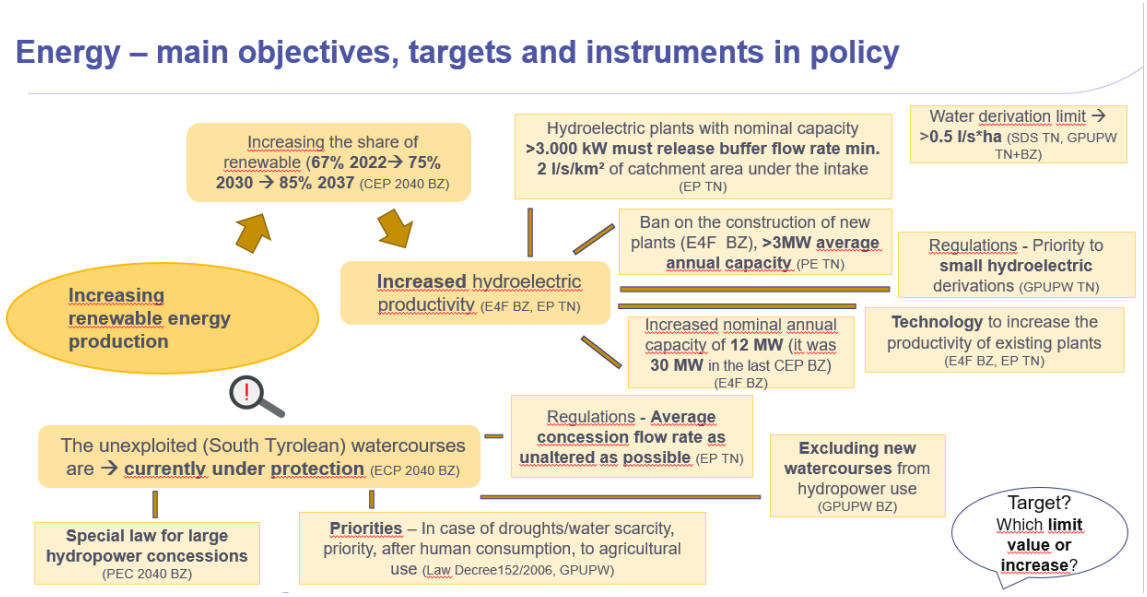
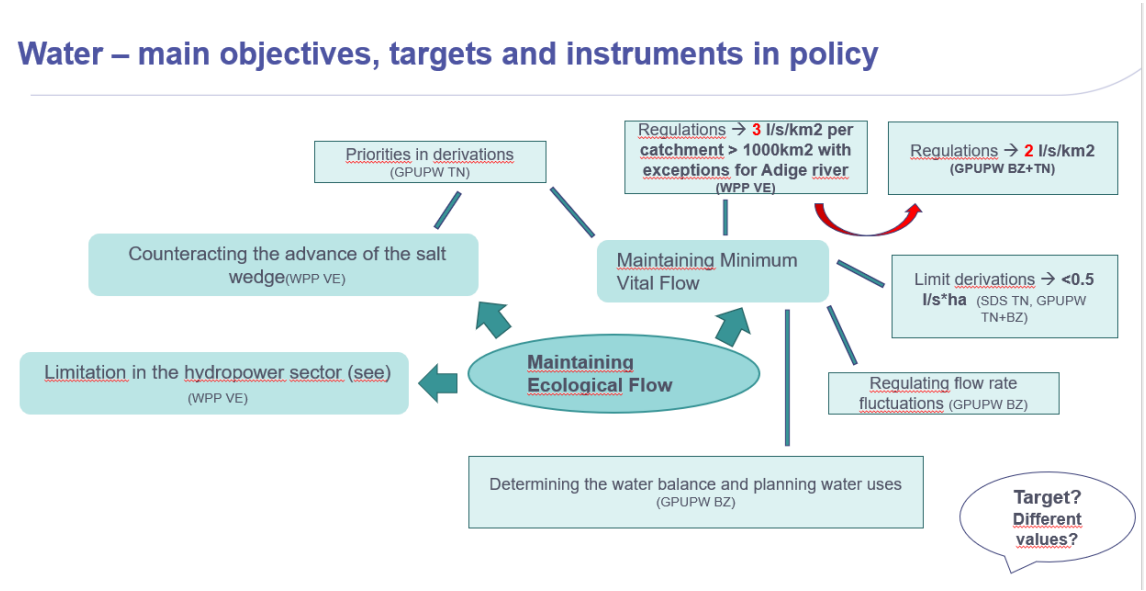


Figure 16: Initial main policy goal, measures and tools identified in the water sector



This overview of preliminary sectoral policy goals and instruments was so discussed during the second workshop, held in October 2022. In this setting, the stakeholders were asked to express their preferences and to include any missing goal and instrument. This helped to better define and pinpoint all the potential relevant features to be included in the NEPAT, leading to a preliminary draft of goals and instruments.

Following this, we developed numerical targets for the policy objectives. The analyzed policies in the policy inventory often did not provide numerical targets. Therefore, we prepared policy instruments that were used to consult the key stakeholders to design targets. This occurred either via email or through bilateral discussions.

The final draft of policy goals and instruments resulting from the above-mentioned activities is presented in Table 4. These were validated during the third stakeholders' workshop in early

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July 2023, resulting in a final list of policy goals and instruments, highlighted in bold in the same table.

Table 4 - Final draft of the policies presented to the stakeholder in WS3 in July 2023. The policies in bold are those selected after the related workshop session.

Sector that adopts/ implements the policy	Existing vs. desired policy	Policy instrument	Scale of implementation
Agriculture	Existing	**Subsidies to farmers for the adoption of more water-efficient irrigation technologies**	South Tyrol part of the river basin
			Trentino part of the river basin
			Veneto part of the river basin
Agriculture	Existing	**Incentives for saving water (requires introducing flow meters + Integrated information system)**	South Tyrol part of the river basin
Agriculture	Existing		Trentino part of the river basin
Agriculture	Desired		Veneto part of the river basin
Agriculture	Desired	**Incentives to farmers for crop conversion**	South Tyrol part of the river basin
Agriculture	Desired		Trentino part of the river basin
Agriculture	Existing		Veneto part of the river basin
Agriculture	Existing	Incentives to farmers for using organic fertilizers	South Tyrol part of the river basin
Agriculture	Existing		Trentino part of the river basin
Agriculture	Existing		Veneto part of the river basin
Energy	Existing	**Incentives for PV installation**	South Tyrol part of the river basin
Energy	Existing		Trentino part of the river basin
Energy	Desired		Veneto part of the river basin
Ecosystems	Desired	**Regulations on landscape diversity**	South Tyrol part of the river basin
Ecosystems	Desired		Trentino part of the river basin
Ecosystems	Desired		Veneto part of the river basin
Water	Existing	**Adjusting water withdrawal regulation for agriculture (requires: introducing flow meters + Integrated information system)**	South Tyrol part of the river basin
Water	Existing		Trentino part of the river basin
Water	Existing		Veneto part of the river basin

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Water	Desired	**Regulations on construction of new hydropower plants / basins**	South Tyrol part of the river basin
Water	Existing		Trentino part of the river basin
Water	Desired		Veneto part of the river basin
Water	Existing	**Public investment to construct new multi-functional water reservoirs**	South Tyrol part of the river basin
Water	Existing		Trentino part of the river basin
Water	Existing		Veneto part of the river basin
Water	Desired	**Integrated information system on salt wedge intrusion**	Veneto part of the river basin
Water	Existing	**Regulation on status of the minimum ecological flow**	South Tyrol part of the river basin
Water	Existing		Trentino part of the river basin
Water	Existing		Veneto part of the river basin
Water	Existing	**Regulation on nitrogen and phosphorus for urban water treatment**	South Tyrol part of the river basin
Water	Desired		Trentino part of the river basin
Water	Desired		Veneto part of the river basin

During workshop 3, the previously identified policy goals, targets and instruments were presented to the stakeholders in a plenary. The stakeholders were then divided in break out groups, trying to keep a balance among WEFE sectors and administrative areas. At least one moderator from the NXG project was present in each breakout group.

In particular, the participants were asked to vote instruments that could be used to achieve the objectives and targets for each WEFE sector. For each instrument, when available, quantitative targets (either previously provided by stakeholder themselves or found in policies) were presented. Stakeholder were also asked to provide clarifications regarding such targets. For the water sector we had previously identified six instruments, for food four instruments and for energy and ecosystems only one each, so the discussion focussed more on proposing additional instruments. Each group addressed all the WEFE sectors. For each sector a slide was presented to guide the discussion and to write notes as well as the stakeholder preferences. The results were then reported back to the plenary (including the votes) and discussed jointly. Overall stakeholder preferences varied from upstream to downstream as well as across different sectors, since one of NEPAT goals is to foster discussions over policy implementation, most of the proposed instruments were applied for the three sub-areas of the basin, when relevant, although the interest or preference might have been expressed from one specific area.

Overall, the policies identified and selected for integration into the NEPAT tool were modified to ensure both their applicability in the developed models as well as their compatibility with the project's goals and timing. Some of these policies were adjusted and translated into

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numerical values to enable their inclusion in quantitative models, such as water savings in agriculture or the shift in crop types. Others were substantially revised or removed for two main reasons: first, following stakeholder feedback during Workshop 3, which highlighted the need to align policies with practical priorities; and second, due to the necessity of identifying quantifiable and model-compatible policies. For example, policies on changes of the minimum ecological flow were not implemented due to the hydrological model setting which did not allow us to directly modify it or the applied policies in the energy sector considered the reduction of energy demand rather than an increase in production or the removal of policies dealing with soil as this sector was not covered in any of the implemented models. The need of identifying quantifiable and model-compatible policies was critical for ensuring that the selected policies could be effectively linked to the variables within the SDM, while staying within the project's resource and time constraints for simulations.

The revised policies are so presented in Table 5, while the selected goals in Table 6.

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Table 5 Selected policies for the Adige Case Study. The sector reported here refers to the sector in which the policy is entering the SDM.

Policy ID	Sector	Short name	Long description
1	Water	Increase drip irrigation	Increase from 79% to 90% and 100% of orchards to drip irrigation by 2030
2	Water	Increase drip irrigation	Increase from 64% to 90% and 100% of vineyards to drip irrigation by 2030
3	Land Use	Increase irrigated area	Increase from 59% of irrigated area of maize to 70% by 2030
4	Land Use	Increase irrigated area	Increase from 55% to 70% of the irrigated area of vineyards over the total area of vineyards by 2030
5	Land Use	Increase irrigated area	Increase from 89% of irrigated area of orchards to 100% by 2030
6	Land Use	Conversion to vineyards	Decrease of orchards area from 9% to 4,5% converting to vineyards (which will change from 8% to 15%) by 2030
7	Land Use	Conversion to vineyards	Decrease of arable land (seminativi) area from 19% to 10% to vineyards (which will change from 8% to 17%) by 2030
8	Water	Reduce leakages	Reduce domestic water use leakage severity from 40% to 30% by 2040
9	Water	Reduce water consumption for residents	Reduce domestic water consumption of residents from 7,5m3/capita month to 4,5m3/capita month by 2040
10	Water	Reduce water consumption for tourists	Reduce water consumption of tourists from 22,5m3/capita month to 13,5m3/capita month by 2040
11	Population	Limit tourist number of stays	Setting a limit to number of tourist stays to 4,1 milion of stays per year
12	Energy	Reduce energy consumption	Reduce domestic energy consumption of residents from 125kwh/capita month to 100kwh/capita and of tourists from 300 kwh/capita month to 250kwh/capita month by 2040

Table 6 Selected policy goals and associated targets for the Adige Case Study

Goal ID	Nexus performance goal (derived from existing policies or more ambitious than existing policies)	Policies with Direct impacts	Target associated to objective
1	Increase water use efficiency/Save water in agriculture	1, 2, 3, 4, 5, 6, 7	To save 25% of water used (average annual usage compared to the baseline) for agricultural purposes by 2040
2	Reduce population water consumption	8, 9, 10, 11	Reduce population water consumption of 15% by 2050
3	Reduce population energy consumption	11, 12	Reduce population energy consumption of 20% by 2050

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3.5 Stakeholder engagement and stakeholder workshops (WP5)

3.5.1 Overview of current stakeholder landscape

Table 7 provides an overview of the SHs identified in the Adige CS and Table 8 shows the categorisation of the SHs.

Table 7 - Overview of identified SHs in the case study

	Preliminary	Without consent	With consent (PPCF)
No. of total identified SHs	150	129 (86%)	21 (14%)

Table 8 - Categorization of stakeholders (SHs) in the case study based on different criteria

Categories	Number
By Tier[1]	
Tier 1	17
Tier 2	1
Tier 3	3
By occupation	
1. Civil society	3
2. Public initiatives	0
3. Policy makers at local level/municipalities	0
4. Policy makers at national level	0
5. Agricultural authorities and representatives	1
6. Energy authorities and representatives	2
7. Water management authorities and representatives	7
8. River basin authorities and representatives	0
9. Environmental protection authorities and representatives	4
10. Business/private or public enterprises	2
11. Media/science communicators	0
12. Other consortium members (a.k.a. internal stakeholders)	0
13. Academia	2
By interest and power (only 1 option)	
High Interest - High Power (HI-HP)	5
High Interest - Low Power (HI-LP)	3
Low Interest - High Power (LI-HP)	0

[1] Tier 1: This tier includes stakeholders that will be directly engaged in the project implementation and/or outcomes and are strongly case-specific (e.g., representatives of the local municipality, civil society organisations -CSOs-). SHs will potentially collaborate (they might be informed or consulted only) in the processes of development of the models and nexus policy assessment tool, and analysis and validation of policy suggestions.
Tier 2: This tier includes stakeholders with an interest in the application of project results and products. A wider constellation of interested SHs (e.g., local government, European policy departments -EC DGs-, stakeholders in different basins) who wish to utilise the NXG engine may be engaged.
Tier 3: This tier includes stakeholders with a general interest in the project. This is a wide group of stakeholders for the dissemination of outcomes which could include neighbouring basin or country authorities, business or private enterprises, and national planning agencies.

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Low Interest - Low Power (LI-LP)	2
Female	5
Male	15
Other	0
By WEFE sector (multiple options)	
Water	15
Energy	4
Food	3
Ecosystems	6
By actor-links (multiple options)	
Conflict	5
Complementary	17
Cooperation	15
Non-existent	99
Blanks	0

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3.5.2 Summary of engagement activities

A summary of the engagement activities conducted by August 2024 is shown in Table 9.

Table 9 - Overview of engagement activities

	Co-exploration	Co-design		Co-development	
	Information	**Consultation**	**Involvement**	**Collaboration**	**Empowerment**
Stakeholder category (expected - given NXG aim)	All categories, especially marginalized groups	All categories	All categories, in particular sectoral authorities and other potential users of NEPAT.	All categories, with particular focus on the sectoral authorities and the provincial/ regional policy makers.	Research and academic sector, provincial/ regional sectoral authorities and policy makers, marginalised actors (i.e. environmental associations).
Power and Interest (PI)	All but particular emphasis on low P-high I & low PI	All	High PI, but also high P-low I and low P-high I	Medium to high PI	High I with both high and low P
CS focus and activity	Informing about coming events and results on held workshops and modelling results (e.g., email, newsletter).	Consulting on perceptions of current issues (e.g., institutional, political context, awareness of water resources, missing/marginalized stakeholder (groups) and how to best reach out to them. Activities: WP1 governance assessment interviews, surveys during workshops.	Identifying and discussing policy needs, fostering exchange between SHs from different sectors and regions through workshops, bilateral meetings and interviews.	Engaging in bilateral meetings, interviews, workshop participatory sessions for framing the issue, co-designing features of the tools and reducing conflicts.	Participation in workshops, bilateral meetings and activities for dialogue and trust building.

3.5.3 Summary of workshops

WP5 supports the application of the NXG approach in the five case studies. NXG builds on co-creation, both within the consortium and with stakeholders. Thus, CS workshops with stakeholders are an important building block of the stakeholder engagement strategy. Table 10 provides a summary of the workshops that have taken place to date. The gender balance of participants at the workshops is included below the table.

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Table 10 : Summary of workshops, including main goals, structure, outcomes, experiences and lessons learned

Workshop No.	Goals	Structure, activities	Main outcomes	Experiences (positive/ negative)	Lessons learned
1	Start the stakeholder engagement process and trust building by: • presenting the project and its objectives • group brainstorming on the nexus interconnections, conflicts, and policies or instruments to manage such conflicts and resources.	**Plenary session:** presentation of NEXOGENESIS project, WP activities and characterization of the Adige River basin. **Working group session** to discuss specific issues concerning major conflicts in the Adige River Basin, how to manage them and how these have been managed (e.g. available and missing tools).	- Water scarcity as main driver of conflicts among all WEFE sectors; - Fragmented governance and lack of a coordinating body with legislative and decisional power at basin level; - Lack of cross-sectoral planning in the WEFE nexus.	- SHs had the opportunity to talk and express their opinion, even partially; - SHs were able to join easily (even if some did not know the details of the project content in advance) as no travelling was requested; - SHs from different sectors, expertise and areas met for the first time; - It was easy to record the plenary and track SHs' comments; - A few fundamental SHs were missing.	The breakout groups were useful to allow more people to express their opinions. Smaller groups would have encouraged this even more. Having virtual Post-It notes helped to keep track of SH inputs and to foster a group discussion. An in-person workshop would have helped to create a more direct relationship among us and the SHs (incl. a more inclusive participatory process).
2	• Validating the conceptual model with the stakeholders (incl. pinpointing most relevant nexus interconnections) • Starting the discussion on the policy packages: selecting policy objectives, goals,	**Introductory plenary session:** presentation of general context and of project objectives. **Interactive activity 1:** conceptual model discussion for validation in working groups (including an online group.	• Stakeholders contributed to the validation of the conceptual model by adding missing arrows and assigning scores to the existing ones • The policy objectives identified for the policy	The involvement of the Province of Trento as co-organiser of the workshop allowed greater SH engagement (at least for the Province of Trento) and greater media attention. Other positive aspects: the presence	The in-person workshop allowed better interaction compared to the online (first) workshop. Handing out individual papers (on the

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	instruments for the WEFE sectors.	**Interactive activity 2:** policy packages working groups (per WEFE sectors) to identify the objectives and targets to be achieved for each sector and to select the instruments that could be used to achieve such objectives.	packages were mainly qualitative, so work needs to be done to move from qualitative to quantitative targets.	of the hydropower and water utility sectors; the possibility to meet stakeholders in person Points to be improved: a few fundamental SHs were missing; overlapping with interviews from WP1.	conceptual model) and Post-It notes helped to break the ice and make everybody contribute to the discussion (many contributions in both activities 1 & 2). Suggestions: Hold two workshops (downstream and upstream) or find a better way to attract distant stakeholders; have a longer workshop, with some activities in the afternoon for selected stakeholders.
3	• Presenting the governance assessment results and asking SHs for feedback • Validating the policy packages for the WEFE sectors • Presenting and discussing the application of the hydrological model • Understanding stakeholder perspectives regarding the SH engagement process	**Introductory plenary session & governance assessment results:** informative session on the project aims and achieved results, with space for discussion and comments (with the help of guiding questions) **Working group:** discussion and voting on policy instrument selection **Plenary on application of hydrological model:** frontal presentation2, held by Eurac, followed by a discussion	• The stakeholders generally agreed with the points brought by the governance assessment; • The validated version of the policy packages encompasses 12 different instruments; however, upstream and downstream stakeholders would like to test different instruments	• The topics addressed by NXG are of high importance and interest for the involved stakeholders, so although the workshop was held online, SHs provided inputs and feedback. • Being held online, there was the possibility for the downstream and upstream stakeholders to interact (which would have not been possible in two in-person separate workshops)	• Stakeholders have limited resources to interact with the project, therefore they refrain in joining workshops which are too long and which require travelling too much. The workshop was indeed too long to be held online,

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		Interactive activity in plenary on evaluation of the stakeholder engagement process: presentation, followed by discussion with help of guiding questions and polls	• The need for data collection and sharing was brought forwards during different sessions of the workshop	• Upstream stakeholders participated more than downstream stakeholders (opposite from previous workshops)	with many session/topics addressed. The SHs by the end were probably tired and interacted in a limited way. Fewer topics/sessions should be included in following workshops. • Finally, the SHs underlined the need to set different targets and personalise the selected instruments for different administrative areas of the basin; this is however unfeasible under current modelling/data availability conditions.
4	SH were not asked to join a fourth workshop in the Adige CS due to SH fatigue (another workshop took place in the same period about another project online tool for water scarcity with	• **Bilateral discussions on policy goals** to be implemented in NEPAT as well as the possible results which will be obtainable through NEPAT	• The final policies targets and goals were selected. • The technological literacy and interest differed across the	• Not all participants were equally tech-savvy, leading to a varied pace in understanding and engagement.	• Different projects which address similar topics and the same stakeholders should propose

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	the Trento stakeholders). Instead, bilateral discussions took place with a limited number of SH.	• **Workshop of other Horizon 2020 project:** exploration of stakeholder capabilities using a DSS to address water scarcity, through interactive group sessions.	various stakeholder groups.	• Some stakeholders recalled NXG and NEPAT during the other project workshop. • The hydropower and river basin authority joined the other project workshop, while they are usually not present at NXG ones.	different outputs (e.g. not similar DSS tools). • The following functionalities were mentioned as important: saving simulations, Italian language, simple front-end with few parameters to select, login only for advanced users, clear step-by-step instructions.

Table 11 Number of stakeholders who attended the different workshops (male and female), excluding NEXOGENESIS project partners.

Workshop No.	Males	Females
Workshop 1	22	11
Workshop 2	18	9
Workshop 3	18	9
Workshop 4	Not applicable	Not applicable

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3.5.4 Summary of the effects of the engagement activities

During the first year of the project, SHs were involved in the project through different activities: two workshops, bilateral meetings, and the WP1 governance assessment interviews. The participating SHs proved to be very interested in the project and its topics once they became involved in the activities. Indeed, the vast majority actively participated in the discussions during the workshops and interviews. However, gaining their initial attention and commitment proved to be a challenge.

After the first workshop, the Province of Trento (Provincial Agency for Water resources and Energy-APRIE) showed particular interest in the project and offered to be co-organiser of the second workshop. The involvement of the Province of Trento allowed achievement of greater stakeholder engagement (at least for the Province of Trento) and greater media attention compared to the first workshop. In particular, the Province of Trento is interested in acquiring system knowledge to be used as a basis for the update of water-related policies which is due to take place in the coming years. This is in line with the selected mode of co-creation “Researching solutions", which focuses on the co-creation of knowledge to support evidence-based decision-making, influencing policies and interventions (Chambers et al., 2021).

In addition, SH composition is changing throughout the project development: many SHs who attended the first workshop did not attend the following workshops, and new ones started attending only later in the project. However, we managed to engage *stakeholders from sectors missing at the first workshop (who either joined the second / third workshop or the interviews).*

These included the following:

- Agricultural representatives/associations of the Province of Bolzano
- Energy and water companies
- Drainage boards
- River Basin Authority (Eastern Alps District Authority)
- Environmental associations
- Veneto Region officers

This fulfils, on the one hand, our ambition to empower less powerful and marginalised stakeholders (i.e. environmental associations) and, on the other, with the creates a cross-catchment dialogue for a coordinated management using a reframing problems approach (i.e. by involving the overarching River Basin Authority).

Finally, the different formats adopted for stakeholder engagement revealed benefits and challenges. The online format allowed the involvement of stakeholder from opposite sides of the basin as no travelling was requested. However, the in-person workshop allowed for a better interaction among the different groups of stakeholders. Bilateral interviews (e.g. WP1 GAT) proved to be effective to ensure deeper knowledge and exchanges of perspectives.

3.5.4.1 Adjusting the SH engagement plan

Overall, the SH engagement activities (e.g., WP1 interviews, WS1, WS2) included a wide variety of stakeholders, covering all the WEFE sectors and different provinces. Several stakeholders missing from the first workshop were then involved in the second workshop and

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in WP1 interviews, which were organised in quick succession. However, some actors could not join both activities. In the future, the overlap of activities should be avoided to enable broader participation in the workshops. In addition, more bilateral meetings should be organized as these proved to be effective for going into more detail (e.g., providing quantitative figures, policy specific references, etc.). This is fundamental for the development of policy packages.

Only a few stakeholders filled in the WP5 questionnaire; therefore, effort was put at project level to better gather information in the future on the evaluation of stakeholder engagement activities (e.g., organizing a specific participatory session during the workshop). Half of those who decided to fill in a questionnaire gave answers that could be related to modes of co-production. Their answers fitted better with two different kinds of co-production (called 'Navigating differences' and 'Empowering voices') than the one selected by the CS leaders (called 'Researching solutions'). Future engagement processes should therefore ensure the provision of enough time and space for high-interest and low-power stakeholders to share their views and expertise in open discussion as well as a further consideration of relationship-building activities.

More effort was put into engaging the SHs from the Province of Bolzano, as these were lacking in the second workshop. A bilateral meeting was organized with representatives from the Province to discuss the hydrological model and increase the interest in the project. Moreover, strong effort was put into creating tighter contacts with the downstream stakeholders. The third workshop saw indeed a great participation of this group of stakeholders, with a lower participation of the upstream stakeholders. Stakeholder sustainment proves to be indeed of great important at this stage of the project. Finally, effort has continued to obtain the participation of the Eastern Alps River Basin Authority to further workshops and discussions, given their fundamental role within the river basin. Given the past difficulties to involve as many SH as possible into the workshops of Nexogenesis, we are planning a large final multi-project and multi-institution event focusing on water management in the Adige River basin (called the "Adige Water Fair"). This event aims to bring together all Adige river basin stakeholder, private companies dealing with water and research institutions with ongoing and future water-related projects to discuss about the most pressing challenges, barriers, needs and solutions for a fair and shared water management, which will be reported into a charter of intent agreed by all parties. The aim for the last months of the project is therefore to attract all SH in the Adige Water Fair, present them results from the many activities as well as lay the foundation for future collaboration and work to improve water management beyond the duration of Nexogenesis.

3.6 From policy recommendations to impact maximization (WP6)

We contributed to WP6 through the following activities:

- Support to website development and social media posts, in particular regarding the Adige CS.
- Translation of communication material into Italian (e.g. NXG poster and flyer).
- Participation in the exploitation workshop during the Riga Partner Meeting.
- Development of the Policy Impact Strategy specific for Eurac, responsible for the Adige CS.

In particular, in the latter, we identified the following policy influence objectives:

- Exploring the level of policy integration following the WEFE nexus approach.

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- Identifying possible policy gaps and entry points to develop improved and integrated policies for the WEFE Nexus.
- Fostering a more effective and integrated management of the WEFE Nexus.

3.6.1 Impact maximisation

As the project progressed, we captured stories of change in the Policy Impact Log, which helped us track the impact of our efforts.

One key question we often ask ourselves is: what has been the most significant change we've observed in our stakeholders? This includes shifts in their attitudes, how they interact with us, and how they collaborate with one another.

One clear observation is that stakeholders were more drawn to technical and data-driven discussions, such as those on hydrological modelling and quantitative analysis, compared to conversations focused on the nexus itself. For instance, workshops and bilateral meetings centered around these topics have attracted more interest. It seems that stakeholders were particularly engaged in knowledge production, data collection, and sharing rather than in dialogue and group-oriented activities. A possible reason for this could be that various administrative areas use different hydrological models. Some stakeholders have expressed a desire to compare these models to encourage the development of a more unified approach.

At the same time, stakeholders recognized the importance of adopting a nexus perspective. They actively participated and showed genuine interest during workshops and bilateral exchanges. However, maintaining this engagement between meetings—especially through email communications—remains a challenge. Interactions outside these sessions tend to be slow and require considerable effort to sustain. This highlights the need for an effective strategy to maintain stakeholder interest and ensure their involvement in the project.

As for understanding what exactly caused these changes—whether it was a specific activity, interaction, or type of knowledge generated—this is something we plan to reflect on and discuss further in the last event.

One of the most significant moments occurred during a stakeholder engagement session for a related initiative. A key stakeholder from the Province of Trento, with whom we had previously conducted bilateral meetings, advocated for the NXG approach to the river basin authority. This stakeholder demonstrated a strong understanding of the nexus concept, articulating its potential applications and emphasizing the value of the project's findings for river basin management. This unanticipated development underscores the depth of engagement and alignment with the project's vision among certain stakeholders, offering a glimpse into the broader influence NXG could achieve.

Despite these encouraging signs, we continue to face substantial challenges in achieving the policy impacts we initially envisioned. As a result, we have had to recalibrate our expectations, recognizing that while the project's results offer important insights at the basin level, their direct applicability to provincial decision-making may be limited.

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Stakeholders have consistently highlighted the importance of basing policy decisions on precise, high-quality data. They have also stressed the need for transparency regarding data quality, from raw inputs to model interpretations. However, the current process of co-developing models has revealed certain limitations, including insufficient monitoring, data collection gaps for specific processes, and restricted access to shared datasets. These challenges not only impact the reliability of the NEPAT tool but also constrain its potential to serve as a catalyst for meaningful policy shifts.

Nevertheless, the project has highlighted the challenges in water governance, critical gaps in the availability and sharing of robust data. By identifying these issues, we are well-positioned to propose concrete steps for developing a more reliable system dynamics model and enhancing the NEPAT tool for future applications.

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4 Lessons learned and experiences

The main identified nexus challenges that we are addressing within the Adige CS are:

- Hydropower production strongly influences the amount and timing of the Adige River flow for downstream users.
- At the same time, lowland users rely heavily on water resources for agriculture (e.g., apple orchards, vineyards, crops) and for drinking purposes.
- Additionally, tourism affects the total water demand, especially for snow production and accommodation facilities.
- The above-mentioned intensive water uses, as well as water scarcity, can lead to a lack of guarantee of minimum ecological flow. Moreover, river ecosystems are threatened by saltwater intrusion from the delta.
- Future climate-change induced shifts in the river flow regime can further affect seasonal water availability.

Some initial lessons learned are reported as follows:

1. Although the Permanent Observatory on Water Uses was established by the Eastern Alps River Basin Authority, a lack of an overarching authority with executive power was identified by the SHs. During drought events, the Observatory can only act as an advisor and decisions are taken by underlying bodies such as the two Autonomous Provinces and the Veneto region. Moreover, although droughts can be foreseen months in advance, decisions are usually taken under emergency situations.
2. Environmental associations are regularly not deeply involved in decision-making; for instance, they do not sit at the Observatory table. The environmental sector is therefore not represented in decision-making, underlining the importance of including Ecosystems in nexus thinking.
3. The diverse and opposed interests in water in the upstream and downstream areas are characterised by different cultural, linguistic, economic, and legislative autonomy levels.
4. Consequently, a basin logic is usually not adopted: each sector is aiming at securing the necessary amount of water to their needs.

The part played by local SHs from diverse sectors in the overall process of CS development and the outcomes of the case studies are:

- The Province of Trento proved to be particularly interested in the project and would like to use the knowledge emerging from project activities as a basis for updating local water-related policies. They consequently offered to be co-organisers of the second workshop.
- Environmental and fishermen associations were particularly interested in joining project activities, mainly to make their voices heard by more powerful actors. This underlines the importance of the project in empowering marginalised actors.

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4.1 Implementing the SHE plan

The SHE steps have been definitely useful in selecting the stakeholders, while it proved to be more challenging to apply suggestions moving forward in the process e.g. management and sustainment.

Overall, the suggestions make sense but some are more feasible than others, depending on the specific context of the CS. Some are more feasible than others in practice. For example, it would be good to have a professional moderator but we do not have the budget to pay for this. It is also challenging for us to bring everyone together in the same room as we cannot pay everyone for their travel.

Evaluations: They helped reflecting ourselves on the process and its goals. However, the questionnaire and workshop activities increased the length of the workshop substantially. If we had a full day workshop or even 1.5 days we would happy to take the time for this type of evaluation process. When we only have 3-4 hours online and the attention of SH is limited (e.g. cameras turned off), it is difficult to obtain feedback on a survey. In the third workshop, most of the SHs stayed for that session, however only few filled in the questionnaire. The SHs were probably tired and interacted in a limited way as this occurred at the end of the WS. Moreover, the session took a very long time to prepare (e.g. adapting and translating the slides & questionnaire).

4.2 Reflecting on / Improving the SHE process

The organization of workshops involving a large number of stakeholders (SHs) should start well in advance, ideally 4-6 months prior, to ensure sufficient time to secure participation from most SHs. Hosting an online workshop can facilitate broader participation and promote interaction between upstream and downstream stakeholders. However, the online format does have its limitations in fostering deeper interactions.

Workshops should be designed with a balanced agenda, avoiding an overload of activities or inputs for the SHs. Instead, they should include enough time for discussions, meaningful interactions, and the collection of SHs' needs and feedback. Additionally, bilateral exchanges with a smaller number of key stakeholders can be highly effective. These one-on-one interactions allow for a clear presentation of project goals and the status of ongoing activities, fostering close and long-term collaboration.
Workshop planned to have many different activities also require a high level and effort organization in order to make all the information accessible to the participants. Often the limited time available to explain these concepts in detail can pose challenges. This makes breakout group discussions particularly difficult when it comes to maintaining the stakeholders' interest and engagement.

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4.3 Modelling results and SH interactions

Regarding the use of tools (models, SDM and NEPAT) to support the overall process bridge the gaps and help understanding the Nexus:

- The conceptual model discussion during the second workshop helped the involved SHs to adopt a nexus lens when considering water-related issues.
- The development of the conceptual model supported exploratory literature and data analysis to be coupled with information collected during the participatory activities with local SHs.
- The hydrological model discussions foster engagement and attract stakeholders to the workshops. The more technical stakeholders are able to provide feedback and suggestions, however associations and sectoral representatives have more difficulties in understanding such results, which are at the basis of the following steps (e.g. SDM, NEPAT).
- Setting up the SDM and consequently the NEPAT proved to be challenging both in terms of data collection and in the limitations for modelling the selected policy instruments. This is mainly due to the unavailability of local/provincial data, which forced the development of a higher level NEPAT which provides results at the basin scale rather than at the provincial one.
- The NEPAT might be too complex for SHs (very many options and their combinations), a bit of a black box for both less technical and more technical stakeholders.
- Pinpointing the policies which require to be updated helps to identify those stakeholders which might be interested in using the NEPAT for such a purpose.
- SH prefer to have bilateral exchanges targeted to their own field of expertise during which they get updated on any quantitative results and provide feedback on data and model needs they might have.
- Given the high level of modelling capabilities and expertise from the Adige River Basin SH, any results presented to them should have followed a robust and possibly already known modelling approach and validation procedure that should be explained to them.
- Using models that are in use by some of the SH (e.g., hydrological model) will increase by far the chances to have fruitful exchanges and long-term collaboration with the SH.
- Involved some of the SH experts in the scientific publications coming out of the project.
- Define a strategy beyond the lifetime of a project in order to guide research on a topic and attract interest and participation from the local SH on long-term activities.
- It is very important to listen to the critics and complaints coming from the SH from a general point of view (ranging from available data, models, type of interactions, fragmentation of contacts…etc) as in many cases they can be interpreted as requests for changes.
- SH are not interested in a specific project, but rather on a specific topic and they tend to forget what a project is about since they receive many similar requests from multiple projects.

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- Following up complaints from different stakeholders regarding the many requests from multiple projects (eventually even from the same research institution) we decided to set up one large event instead of two different workshops where multiple projects and multiple institutions gather together to discuss about shared issues with the same SH.

4.4 The overall NXG co-creation approach

It is crucial to involve interested stakeholders, or "champions," early in the process, ideally at the proposal stage. These champions can play a key role in supporting the organization of stakeholder events, which is especially beneficial for a research institution. Their involvement would not only help promote events but also facilitate stronger engagement and retention of (other) stakeholders throughout the project.

While the topics addressed by NXG are highly relevant and of significant interest to the stakeholders, their ability to engage with the project is often constrained by limited resources. Stakeholders tend to be highly active during workshops; however, maintaining bilateral interactions both before and after these events proves to be slow and challenging.

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Annex 1: WP5 – Description of Case Study Coordination

WP5 supports the implementation of the NXG approach in the five CSs through:

a) the development of a roadmap that guides the work of CSs in NXG;

b) the management of internal communication between CSs and WPs;

c) the development and implementation of a stakeholder engagement strategy;

d) the continuous coordination and monitoring of all CSs activities.

Special emphasis is placed on the provision of guidelines and training supporting stakeholder engagement processes in the five CSs, as stakeholders provide valuable inputs to the WPs (WP1-4). The WP5 guidance leads to better integration of the project results coming from the different WPs. This work helps to maximize the impact of the project (WP6).

The work of WP5 is complementary to Task 1.3 in WP1. Task 1.3 ensures the coordination of WPs1, 2, 3, 4 and in particular the timely and effective flow of information between the technical WPs (2, 3, 4) and the policy and governance work package (WP1) based on the input received from stakeholders from CSs. As such, WP5 work connects all the other WPs in the project. An overview of the links between WP5 and other WPs is presented in Figures 7 and 8 in MS2 - *Roadmap for Case Study Work/Activities in NEXOGENESIS*.

Throughout WP5 (months 1-48), five (5) tasks, seven (7) deliverables and six (6) related milestones are set with specific dates and timelines. A timeline of these WP5 activities can be found in MS2 - *Roadmap for Case Study Work/Activities in NEXOGENESIS*, Figure 9. They all require close collaboration of the WP5 team with each CS lead and coordination with other WPs. CS leaders play a critical role in co-developing the guiding documents (e.g., the CS roadmap) by expressing their needs, their preferred mode of communication, their ability to contribute with local knowledge, and by validating the developed guidelines, documents, and roadmap.

The first milestone of WP5 (MS2 – *Roadmap for Case Study Work/Activities in NEXOGENESIS*) concerns the development of a roadmap for CS work with the aim of guiding CSs in NXG and more particularly their contribution to each WP. It constitutes a timeline for all relevant activities described in relation to the work and needs of all relevant WPs (WP1-4).

The second milestone of WP5 (MS5 – *Internal Communication Strategy*) is a practical resource that fosters the communication between CS leaders and WP leaders, but also supports the exchange of relevant information/experience among the leaders of different CSs as further explained below.

The third milestone of WP5 (MS6 – *Stakeholder Register*) presents the stakeholder (SH) identification process to generate the SH register for each CS. This document reports on the steps and considerations given to CS-leads for the identification of the respective relevant SHs. It also provided preliminary results for each CS including the categorization of different SH groups according to their engagement interest and function.

The fourth milestone (MS8 – *CS Monitoring Plan*) includes activities to enable WP5 to monitor the CSs work and potential amendment actions (if needed, in the case of delayed work). Its

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aim is to facilitate the progress of the CS activities, thereby ensuring a successful implementation of the project work in each CS.

The fifth milestone (MS15 – *Intermediate report on case study implementation and co-creation activities*) provides detailed internal monitoring of case study implementation activities during months 1-18 of project (September 2021-December 2022).

The sixth milestone (MS23- *Second intermediate report on case study implementation and co-creation activities*) summarizes the implementation of the roadmap and stakeholder engagement strategy in the case study, building on MS15 and covering the first 36 months of the project (September 2021-August 2024), synthesizing the CS coordination and execution led by WP5, and highlighting emerging CS-specific lessons learned and experiences

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Annex 2: Schedule of all activities performed

The following table provides an overview of the activities performed in the project to February 2025.

Date	Type of Activity	Purpose	Participants
Autumn 2021-Winter 2022	SH mapping	Identifying main stakeholders representing the different WEFE sectors and provinces/regions of the CS (incl. assessing interest/power, tier and categorisation).	WP5 and SH inputs
Autumn 2021	Privacy policy & NXG leaflet translations	Translation of text to Italian for the use within the Adige CS.	WP5 and WP6
Dec 2021-Jan 2022	Definition of stakeholder engagement (SHE) aims	Identification of main aims for the SHE activities with Adige CS.	WP5
Nov 2021-Mar 2022	SH bilateral meetings	Introducing the project to SHs and better understanding of case study context.	Province of Bolzano and Trento, Environmental agency Veneto
Jan-May 2022	Preparation and conduction of Workshop 1	Introducing the project to SHs and build interest and commitment (incl. coordination with WPs for workshop organisation).	33 SHs and 16 NXG consortium members
Spring 2022-Autumn 2022	Development of conceptual models (top level and sectoral)	Identifying main interlinkages, resources flow and conflicts across WEFE sectors in collaboration with SHs and WP3 (incl. contribution to D3.1).	WP3 and CS stakeholders
Spring 2022-Autumn 2022	Hydrological model development (first steps)	Data collection (incl. discussions with WP2) and testing of model for subsections of basin.	University of Padova and WP2
Jan-Nov 2022	Policy mapping and coherence assessment	Identification and analysis of main policies in place across provinces/regions and sector within the CS.	WP1
Summer 2022	SH bilateral meetings	Meetings with SHs for data collection and Workshop 2 co-organisation.	Mainly with Province of Trento
Sep 2022	Participation in Riga Partner Meeting		
Sep-Oct 2022	Preparation and conduction of Workshop 2	Validating the conceptual model and starting the discussion on policy packages (incl. coordination with WPs for workshop organisation).	31 SHs and 8 NXG consortium members
Sep-Dec 2022	Development of draft policy packages	Identification of preliminary policy goals, objectives and instruments for NEPAT policy packages.	WP1 and SHs

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Sep-Dec 2022	Organisation and conduction of WP1 interviews	Helping WP1 to organise interviews for governance assessment and participation in interviews.	25 SHs across the CS
Autumn 2022	Stakeholder analysis and engagement plan	Identification of Actor Linkages (ALMs) and scoring for the definition of SHE mode.	WP5
Jan- Feb 2023	Work at policy package template	Filling in Policy Package template (incl. update of policy instruments based on stakeholder interviews)	
Mar 2023	Finalisation of governance assessment	Discussing results (governance assessment matrix) with WP1, providing inputs based on CS knowledge	WP1
Mar-May 2023	SH bilateral meetings and email exchange	Data collection, presenting hydrological modelling and policy package discussions	Regione Veneto, Province of Trento, University of Padova
Apr-Jul 2023	Preparation and conduction of Workshop 3	Presenting governance assessment results, validating policy packages, understanding stakeholder perspectives regarding the SH engagement process	27 SHs across the CS and 10 NXG consortium members
Jul 2023	Conduction of focus group on policy coherence	Discussing and validating policy coherence analysis results with CS stakeholders	SHs and WP1
	Data collection	Data collection for hydrological model and SDM development, including discussions with WP2	SHs and WP2
	Improvement of hydrological model	Modules: snow, crop requirements	
Sep 2023	Participation in Tours Partner Meeting		
Dec 2023	SH bilateral meetings	Meetings with SHs for data collection, presenting hydrological modelling, policy package discussions and NEPAT expectations	Province of Bolzano, Province of Trento
Jan 2024	Modeler meeting in Delft		WP3
Jan 2024	WP1-WP5 meeting in Berlin	Discussing stakeholder agreement and governance roadmap (incl. WS5 & 6 goals and organisation)	WP1 and WP5
Mar 2024	Policy Package in-person meeting	Co-developing policy package with WP1	WP1
May 2024	SDM development	Development of System Dynamics Model (SDM) in Stella	WP3
June 2024	Integration of policy package into SDM	Adjustment of policy packages based on data availability and modelling capacities	WP3
July 2024	Implementation of SDM in NEPAT	Collaboration with WP4 for implementation of SDM with policy package integrated in the NEPAT	WP4
September-November 2024	Review of NEPAT results and functionalities	Exchanges with WP4 to improve the NEPAT visualization and operations	WP4
October-December 2024	Organisation of the final event (WS5- WS6) « Adige Water Fair »	Coordination with case study partners and local stakeholders of the Adige river basin to organize a final large event on a shared Adige water management	WP5
December 2024-January 2025	Improvement of the SDM in the NEPAT	Interactions with WP4 to add scenarios and improve the WEFE footprints calculation and their visualization in the NEPAT tool	WP3 and WP4

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Continuous	Coordination meetings	Regular coordination between downstream (CMCC) and upstream (EURAC) Adige working groups.	WP5
Continuous	Communication activities	News about the activities in the case study (text, images, videos, interviews etc).	WP6

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