NEXOGENESIS

STREAMLINING WATER RELATED POLICIES

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D1.2
Governance and Policy Assessment in Case Studies

Project Deliverable

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Abstract

The purpose of the Deliverable 1.2 (D1.2) is to illustrate the methodology developed by NEXOGENESIS to study the water-energy-food-ecosystem (WEFE) nexus governance and policy coherence and to present and reflect on the results of its implementation in the five NEXOGENESIS case studies.

Part A presents the methodological aspects of the WEFE nexus governance and policy coherence assessment, building on elements already presented in the D1.1 on the stakeholders' co-creation approach for WEFE nexus governance.

Part B presents the implementation of the method in the five case studies: the Nestos/Mesta River basin in Bulgaria and Greece, the Lielupe River basin in Latvia and Lithuania, the Adige River basin in Italy, the Inkomati River basin in South Africa and the Jiu River basin, a tributary of the Danube, in Romania.

After illustrating the data collection, consisting of interviews during field visits, focus groups and workshops either in person or on-line, the results are presented and recommendations are proposed to urge for more cross-sectoral collaboration and WEFE nexus governance in the case study regions.

Finally, the general conclusions and recommendations are presented, including a tentative outline of the next steps for co-creating stakeholder agreements at the catchment scale in the five NXG case studies.

Keywords

Governance, water-energy-food-ecosystems nexus, NXGAT, policy coherence, cross-sectoral collaboration.

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Executive summary

This Deliverable 1.2 (D1.2) provides a description of the water-energy-food-ecosystem (WEFE) nexus governance and policy coherence in the five case studies of the project NEXOGENESIS. The target audience of this report are actors and institutions at all scales in the WEFE nexus domains such as water, energy, agriculture and environment, who are interested in and have the power and capacity to initiate a bottom-up stakeholders' co-creation process for fostering transition towards WEFE nexus governance, with a particular focus on water management organisations such as river basin organisations, including transboundary ones.

The NEXOGENESIS WEFE nexus governance and policy assessment, as part of the broader NEXOGENESIS stakeholders' co-creation approach for WEFE nexus governance developed in D1.1, serves the purpose of supporting the stakeholders' co-creation of bottom-up solutions to urge for more cross-sectoral collaboration, which in turn will contribute to improving sustainability in the case study regions. To this purpose, case study leaders were invited to participate to all interactions with stakeholders during interviews, focus groups and workshops and played a crucial role in identifying and engaging with the relevant stakeholders.

Part A of this report presents the methodological aspects of the WEFE nexus governance and policy coherence assessment, which builds on elements already presented in the D1.1. This part of the report gives details on the content and use of the Nexus Governance Assessment Tool (NXGAT). The NXGAT is composed of 5 dimensions (actors and networks, levels and scales, problem perspectives and goals ambitions, strategy and instruments, responsibilities and resources) and 5 criteria (comprehensiveness, coherence, flexibility, intensity of actions and fit). The dimension strategy and instruments in its quality of coherence is studied in greater depth using a specific policy coherence assessment approach consisting of a policy inventory and coherence assessment completed through an iterative process of interactions among the governance assessment team, the case study leaders and stakeholders.

The data used to support the qualitative analysis of the current state of cross-sectoral governance consists of field data obtained through semi-structured interviews conducted during a site visit. The process of selection of stakeholders to interviews is important in the limits of the analysis, even if the methodology does not aim to be statistically representative of all the positions of the stakeholders. The aim is to capture the multi-level governance of all sectors of the WEFE (Water, Energy, Food, Ecosystems) nexus as applied in the case studies. Consequently, the selection of stakeholders to be interviewed should reflect the diversity of actors and levels of decision-making in each sector of the nexus (water, food, energy and ecosystems). This approach was applied to each case study, with stakeholder selection supported by the case study manager and local experts from the governance assessment team, who also participated in the interviews. However, while we engaged with representatives from all

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sectors and different levels of government, our study does not aim to cover every possible viewpoint. It is not an exhaustive survey.

The selection of respondents was carefully based on several criteria:

Co-construct the list of stakeholders to be interviewed: Case study leaders, experts in environmental, climate, engineering, and social sciences, worked closely together to identify stakeholders from the nexus research domains (water, agriculture, energy, ecosystems). Additional contacts were sought when a domain, administrative level, or gender balance was missing. Several meetings with case study leaders and WP1 helped to finalize the list before fieldwork began.

Bottom-up approach: The project adhered to a bottom-up co-construction approach, meaning the research team worked closely with case study managers to avoid bypassing them in stakeholder engagement. This collaboration maximized local involvement and impact, facilitating the development of a network across different sectors and administrative levels, which proved valuable during the design phase of the policy package. This network effect was observed in several NEXOGENESIS case studies after the interviews.

Governance representation and diversity: The representativeness of the stakeholders also reflects the state of governance:

The ability of case study leaders to engage all sectors and levels indicates the strength of their networks and the condition of interconnections across governance levels and sectors. Invitations have consistently extended at national level though responses were not always forthcoming, especially for one cross-border case study, likely due to the geopolitical significance of water resources and associated energy production. Engaging at the national level, as in the Jiu case study, would have been beneficial but was not the primary aim of the bottom-up approach.

The case study leaders' success in mobilizing all sectors also highlights the operational dynamics of local administrations and how decision-making levels are linked. For example, in the Lielupe case, where the expert pool is small, it was easier to secure interviews across all administrative levels, whereas in other cases, administrations were less responsive.

While the diversity of sectors was represented in all case studies, the number of stakeholders per sector varied. Thus, our conclusions should be viewed as a grounded analysis based on the perspectives of the stakeholders we interviewed. This study does not claim to be exhaustive but offers real insights into governance based on the perceptions and discourses of the actors involved at a given time.

Finally, our results were discussed with local experts before finalizing the deliverables. They were also reviewed with local experts ahead of the third workshop of NEXOGENESIS for each case study, where findings were debated with all stakeholders, not just those interviewed. These exchanges with stakeholders from various decision-making levels and nexus sectors ensure the consistency and validity of the results.

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To summary, local experts were involved in most phases of the analysis of the governance and policy coherence of the WEFE nexus, including:

- preparation of the field visit
- selection and invitation of stakeholders interviewed
- face-to-face interviews for the governance analysis
- online focus group of the policy coherence analysis
- validation of the results of the governance analysis
- participation to all cocreation meetings of the project
- presentation of the results of the governance and policy analysis to the stakeholders at the occasion of workshops

These various stages of exchange with local stakeholders across different decision-making levels and nexus areas support the reliability of the results.

Part B of this report presents the implementation of the NXGAT and policy coherence assessment approach in the five project case studies: the Nestos/Mesta River basin in Bulgaria and Greece, the Lielupe River basin in Latvia and Lithuania, the Jiu River basin in Romania, the Adige River basin in Italy and the Inkomati-Usuthu River basin in South Africa. After illustrating the data collection consisting of interviews during field visits, focus groups and workshops either in person or on-line with in addition some contextual information of the case study, the results are presented and recommendations are proposed to urge for more cross-sectoral collaboration and WEFE nexus governance in the case study regions.

The implementation of the governance and policy coherence assessment methodology is described for each case study, and for each country for the two transboundary case studies (Mesta/Nestos and Lielupe) in the respective case study chapter. The governance assessment conducted using the NXGAT in each case study complemented with the policy coherence analysis permitted to identify the main barriers and the main leverages for more cross-sectoral governance. These can be found at the end of each case study chapter along with recommendations to urge for more cross-sectorality in the case study region. Both barriers, leverages and recommendations were discussed with stakeholders engaged in each case study at the occasion of the third NEXOGENESIS stakeholders' workshop.

A brief description of the organisation of the fieldwork in each case study, including the number of interviews conducted and the type of stakeholder organisations met, is provided. This is followed by a summary of the main questions and findings of the analysis of WEFE governance and policy coherence in each case study.

- Between 11 and 15 July 2022, the field visit of the nexus governance assessment took place in the **Mesta-Nestos transboundary River basin**. Three members of the governance assessment team (UNT, KWR) conducted a total of 15 interviews (9 in Greece and 6 in Bulgaria) and interviewed a total of 27 stakeholders (14 in Greece and 13 in Bulgaria). Unfortunately, it proved

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impossible to interview stakeholders form the national ministries both in Bulgaria and in Greece. Therefore, the results are based on input from the local and regional level. **In Greece** the interviews were conducted in English and, when needed, instantly translated to the Greek language was performed by our member of the consortium of the municipality of Nestos. WEFE sector management representatives at municipal level for two municipalities, the National Agency for the Environment and Climate Change, the Irrigation District Organisation, the Directorate (at regional level) for Agriculture, the Region of Eastern Macedonia and Thrace, academics from the Democritius University of Thrace, the Fisheries Institute and the Water Management Agency were met. **In Bulgaria**, the interviews were conducted with the help of an interpreter for translation into English. This interpreter remained the same for all the interviews. Municipal and regional level were covered for the 4 WEFE nexus sectors represented by the regional administration management of dams, the union of green Energy producers, the directorate of the west Aegean River basin directorate of the ministry of environment and water, the regional inspectorate of environment and water, sectoral experts of three municipalities, Environmental NGO for birds protection, farmers.

- Between 6 – 10 June 2022 and between 14 – 17 September 2022, the field visit of the nexus governance assessment took place in **the Lielupe River basin**. Five members of the governance assessment team (UNT, KWR) conducted 18 interviews (**10 in Latvia and 8 in Lithuania**) some were individual, others collective interviewing a total of 37 stakeholders (11 in Latvia and 13 in Lithuania, 25 women and 12 men). The interviews were conducted in English and, when needed, instantly translated to the local language (Latvian and Lithuanian). Representatives from the Ministries of Agriculture, Environment and Energy of both countries, as well as representatives from the Water Agency and local authorities: county, municipality and region (Latvia, Zemgale region) were met. NGOs and local associations for environmental protection and tourism, as well as representatives of protected areas. The 4 NEXUS sectors were comprehensively covered by the interviews conducted.
- Between 17 – 21 October 2022, the field visit of the nexus governance assessment took place in the **Jiu River basin**. Three members of the governance assessment team (2 from UNT, and 1 from UFZ) conducted a total of 10 interviews in Romania and interviewed a total of 31 stakeholders. An additional interview was conducted remotely with a stakeholder who had already been interviewed during the field visit on 23 March 2022 for more in-depth questions about the water sector. The interviews were conducted in English with the help of translation by our case study manager who participated in the interviews. Representatives of all levels of governance, from local to national, and all sectors were interviewed, with the Romanian Farmer's club, the environment protection agency of Dolj, a focus groups of Academics of the Faculty of horticulture of the University of Criova, Regional Development

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Agency South-West, Gorj County Council, NGO Valea Jiuliu Coalition, Department of Sustainable Development, National Administration of Meteorology, Romanian Waters and the Jiu River Basin Authority.

- Between the 4th and 12th of October 2022, the field visit of the nexus governance assessment took place in the **Adige River basin**. Five members of WP1 NEXOGENESIS project (UT and KWR) with three EURAC and CMCC members leading the case study, conducted a total of 17 interviews (4 in Bolzano province, 5 in Trento province, 8 in Veneto region and 1 for the Eastern Alps Hydrographic district) including a group interview (5 people of province of Bolzano) with 18 different stakeholders (public administrations, territorial authorities, companies, or civil organisations) for a total of 27 people (6 women and 21 men). The interview campaign attempted to cover as much as possible - within the limits of the availability of the actors contacted in advance by EURAC colleagues - the four nexus sectors in the three different administrative areas (autonomous provinces of Bolzano and Trento and the Veneto region). The team therefore met with local administrations at three levels: local, provincial and regional, as well as district level, fishermen's associations, environmental protection associations, land reclamation and irrigation consortia, energy production companies and associations, water supply companies and farmers' associations.
- Between 13 and 24 February 2023, three members of the governance evaluation team (2 from UFZ, 1 from UNT), in the presence of the case study manager, interviewed 23 people in the **Inkomati-Usuthu River basin.** The interviews were semi-structured group interviews, all conducted in English. Interviewees covered all four sectors of the WEFE nexus and local and regional levels of governance, with the interview of: The power generation representatives of two companies, the water representatives of the Mbombela Water and Sanitation Department, the Komati Basin Water Authority and the Inkomati-Usuthu Catchment Management Area, the Department of Agriculture, Agrarian Reform and Rural Development and Agri SA Mpumalanga Landbouw, the Mpumalanga Parks and South African National Parks, and the Department of Forestry, Fisheries and the Environment.

The current governance system is restrictive for a greater orientation of the WEFE nexus in the five NEXOGENESIS case studies. The main issues and conclusions are summarised below.

The Mesta-Nestos River basin extends over parts of Greece and Bulgaria, over 30% of which are designated as Natura 2000 sites. This large area of Natura 2000 sites reflects the ecological importance of the Mesta-Nestos basin, but also presents challenges as conservation efforts must be balanced with the demands of agriculture, industry, water and energy in the region. Intensive agricultural activities in the Nestos delta require a high availability of water for irrigation, which competes with the demand for energy production upstream. Due to climate change, existing cross-border agreements need to be updated. Floods are an issue in both countries, while droughts

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are a problem especially downstream in Greece. Agreements on water flows between the two countries have been in place since the 1990s, but the monitoring of flows is neither systematic nor transparent, making it difficult to update these agreements. Cross-sectoral management of natural resources in the river basin is not a priority in either country. One key reason for this lack of cross-sectoral coordination is the predominantly top-down, sectoral governance model in both countries, which offers limited flexibility for new initiatives. Consequently, while there is general acknowledgment of the need for cross-sectoral management, no one is actively advocating for change in this direction.

In the Lielupe River Basin, agricultural practices in Lithuania as in Latvia have led to a decline in the quality of natural habitats, especially wetlands and forests, which are essential for ecosystem health and water filtration (water pollution, especially nitrates, is a major problem). The legacy of Soviet-era land drainage systems and intensive agriculture has also left lasting traces, contributing to current pollution and to modify river flows and drainage patterns. Governance of the WEFE nexus in the Lielupe River Basin is characterized by centralized control, sectoral silos, and limited cross-sectoral cooperation. Cross-sectoral governance remains a challenge, but there is potential for improvement, especially if local governance is strengthened and cross-sectoral demands are expanded. When there's a mismatch between stakeholders and the problems facing the basin - nitrate pollution, hydro-morphological changes, biodiversity protection, soil quality erosion, or lack of expertise and resources - actors' strategies are not aligned, and the current governance model limits the basin's capacity to implement effective cross-sectoral strategies.

The Jiu River basin which contributes to the River Danube, faces significant environmental, energy, and water-related challenges. Pollution from mining and coal extraction has degraded water, air, and soil quality, while deforestation and habitat destruction, where they occur, threatens local biodiversity. The reliance on coal for energy contributes to air pollution and climate change. Energy dependence on coal contributes to air pollution and climate change. Hydroelectric power stations, although they provide renewable energy, have an impact on ecosystems, making their development difficult. Inadequate wastewater treatment leads to water pollution, which is exacerbated during droughts. As far as governance of the WEFE nexus is concerned, national ministries often operate in silo, with a short-term perspective, and lack a unified cross-sectoral vision that could guide long-term solutions. The significant gap in environmental awareness and education, which affects both the public and decision-makers, is an impediment. To remedy this, the Ministry of Sustainable Development, at national level, is encouraging the intensification of environmental awareness and education initiatives at all levels and on all scales. However, while a number of strategies exist in different sectors, there is an urgent need for better coordination between the various stakeholders. To address these issues, the Romanian government started an initiative to bring together and converge strategies in order to simplify the overall strategy for sustainable development and climate change adaptation at national level.

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In the Adige River basin the competition for water resources is intense to support domestic energy production, year-round tourism and intensive agriculture - particularly for apples, wine and horticultural products - as well as to ensure sufficient water flows for river ecosystems, the study assessed the extent to which water, land and ecosystem management in the basin takes account of the interdependencies between these sectors. The analysis of governance reveals a multi-scale, multi-stakeholder water management system, with a multitude of instruments that are often uncoordinated and inconsistent in their objectives. In this context, the main stakeholders in the WEFE sectors interact and create synergies at different levels and in different scales, but mainly at the local level. Stakeholders generally have the know-how to support more cross-sectoral management, but some stakeholders and sectors lack the financial and human resources to do so (the basin authority, which has the broadest cross-sectoral vision). There is a shared vision of the problems associated with the basin's resources and ecosystems, but the strategies for dealing with them remain rooted in sectoral priorities and management within regional and provincial political and administrative boundaries.

In the Inkomati-Usuthu River basin, there is a lack of coherence among actors, networks, resources, and responsibilities, as well as insufficient action and resource allocation. This is compounded by the complexity of governance across multiple levels and sectors, which limits coordinated and effective responses. Key barriers include the absence of cross-sectoral policies, low awareness of integrated management, poor inter-sectoral communication, and weak enforcement. However, levers for improvement exist: the system's short-term flexibility enhances adaptive capacity, the SDGs provide an entry point for cross-sectoral management, and multi-level governance, especially at regional and local levels, offers potential for better nexus alignment. Improving wastewater treatment and allocating more resources for law enforcement and compliance monitoring are crucial for achieving nexus goals and ensuring policy implementation and accountability.

The main findings and reflections on the overall investigation across the five case studies are described as lessons learned. First a reflection on the success of the methodology and the characteristics of its implementation in the case studies is presented. The context of Nexogenesis and the support of the case study leaders is an important point of the implementation. It facilitates interactions with stakeholders and also asks the governance assessment team to explain the need to interview stakeholders case study leaders do not already interact with. Second, after illustrating similarities and differences among the case studies regarding the state of the WEFE nexus governance and policy coherence, a comparison between WEFE nexus governance in European cases versus one non-European case in South Africa is presented. The state of the governance is far from reaching WEFE nexus targets in all case studies. However, sustainable development goals, but also EU strategies for energy transition and adaptation to climate change are urging for more WEFE governance at national and regional level. Locally, we observed that two domains are used to work under close cross-sectorality interactions. WEFE nexus ambitions, even

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at transboundary scale, are targeted at the occasion of EU projects, but thus with no time continuity. For all case studies and with different contexts, environmental expertise is lacking at all levels and all scales, with a negative impact on the capacity to urge for more WEFE nexus governance and policy coherence. The two European international case studies lack a transnational board of directors, which hinders the exchange of knowledge, resources, and collaboration on shared problems. While establishing a formal board is a long-term perspective, waiting without taking action could be detrimental. It would be more effective to explore alternative solutions, such as bottom-up initiatives at the local level, to address this gap in the meantime. The NEXOGENESIS project is at the halfway point at the time this report was written and offers the opportunity to pursue discussion with stakeholders to activate levers.

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Introduction

This Deliverable 1.2 (D1.2) provides a description of the water-energy-food-ecosystem (WEFE) nexus governance and policy coherence assessment in the five case studies of the NEXOGENESIS project. The target audience of this report are actors and institutions at all levels in the WEFE nexus domains such as water, energy, agriculture and environment who are interested in and have the power and capacity to initiate a bottom-up stakeholders' co-creation process for fostering transition towards WEFE nexus governance, with a particular focus on water integrated management organisations such as river basin organisations, including transboundary ones.

The NEXOGENESIS WEFE nexus governance assessment aims to foster collaboration among stakeholders engaged in case studies to create bottom-up solutions to urge for more cross-sectorality. This, in turn, will contribute to improving sustainability in the case studies and region. For this purpose, case study leaders were invited to participate in all interactions with stakeholders during interviews, focus groups and workshops and played a crucial role in identifying and engaging with the relevant stakeholders.

Part A of this report presents the methodological aspects of the WEFE nexus governance and policy coherence assessment, building on some elements already presented in the D1.1 on the co-creation approach of the WEFE nexus governance.

The first chapter illustrates the Nexus Governance Assessment Tool (NXGAT) composed of 5 dimensions (actors and networks, levels and scales, problem perspectives and goals, ambitions, strategy and instruments, responsibilities and resources) and 5 criteria (comprehensiveness, coherence, flexibility, intensity of actions and fit). The dimension strategy and instruments in its quality of coherence is studied in greater depth using a specific policy coherence assessment approach consisting of a policy inventory and coherence assessment completed by an iterative process of interactions with case study leaders and stakeholders. As an addition to D1.1, this report presents the policy coherence assessment scoring matrix.

The second chapter illustrates the NXGAT implementation methodology, including the preparation of the interviews, the analysis of the data and scoring of the NXGAT matrix in a multi-disciplinary fashion by the governance assessment team.

Part B of this report presents the results of implementing the governance and policy assessment method in the five project case studies: the Nestos/Mesta River basin in Bulgaria and Greece, the Lielupe River basin in Latvia and Lithuania, the Adige River basin in Italy, the Inkomati-Usuthu River basin in South Africa and the Jiu River basin, a tributary of the Danube, in Romania. Four case studies are in Europe, thus complying with the water framework directive.

For each case study, a brief presentation of the geographical characteristics, the socio-economic context and the institutional regime is provided. After explaining the data collection, the results of the assessment are provided and the main blockages and

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levers for change identified. Based on these, recommendations to urge for more cross-sectoral collaboration and WEFE nexus governance in the case study regions are suggested. Finally, lessons learned from the 5 case studies are presented with recommendations for the next steps for the ongoing stakeholders' co-creation process in the case study regions.

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Part A: Methodological aspects of the WEFE Nexus governance and policy coherence assessment

The first two chapters illustrate the NXGAT and its implementation methodology. The third and fourth chapter present the policy coherence approach and its implementation methodology.

1. The Nexus Governance Assessment Tool (NXGAT)

The NXGAT has been developed starting from the Governance Assessment Tool (GAT) of Bressers et al. (2015). A detailed illustration of why and how the GAT has been selected as starting point for the NEXOGENESIS governance assessment can be found in D1.1. Below we provide the rationale for the NXGAT and a detailed illustration.

An extensive literature review was conducted in D1.1 primarily focused on water-related governance assessment tools (Hüesker et al., 2022). These tools address water's role in wastewater treatment (Koop et al. 2017), water scarcity and drought (Bressers et al., 2015; Koop et al. 2017), flood risk (Alexander et al., 2016; Koop et al. 2017; OECD, 2018; Williams et al., 2018; O'Riordan et al., 2021), water cooperation (Dai, 2021), water resources management, and water service provision (OECD, 2018; O'Riordan et al., 2021). Designed for various purposes, these tools are meant for different implementation levels. In particular, the GAT by Bressers et al. (2015) functions at multiple levels and is adaptable to local and intermediate contexts like river basins or provincial regions.

The GAT was developed as a model for analysing governance systems in relation to water management. Water governance is the combination of the relevant multiplicity of responsibilities and resources, instruments and strategies, awareness of problems and goals, actors and networks, levels and scales that forms a context that, to some degree, restricts and, to some degree, enables actions and interactions for any issue mainly related to water and / or climate change risks. The GAT provides governance analysis and expert recommendations, supplemented by a user guide for managers to self-assess water governance strengths and weaknesses. This user guide offers a description of the method originally designed for extreme drought preparedness (Bressers et al., 2013).

The theory at the core of the GAT is a theory of policy implementation called Contextual Interaction Theory (Bressers and Kuks 2004; Bressers 2009; de Boer and Bressers

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2011). Such theory views implementation processes not as top-down application of policy decisions, but as multi-actor interaction processes that are ultimately driven by the actors involved. The theory is based on a conceptual framework that aligns the motivations, ideas, and resources of people to their applicable contexts. It uses this to assess the ability of the governance instruments and structures to support the implementation of given policies and achieve expected goals. Normally Contextual Interaction Theory is used to produce academic studies for policy implementation, whilst the GAT applies it to the needs of practitioners who are interested in understanding their own contexts. Because this theoretical framework recognises the prominent role of actors and their characteristics in policy implementation within a particular context, actors and their main characteristics are placed in the middle of Bressers et al. analytical model. This approach steers, but does not determine, the outcome of water management activities undertaken by relevant stakeholders.

The GAT is depicted as a matrix in which five governance dimensions are evaluated according to four qualitative governance criteria. The criteria are supposed to evaluate the quality of the governance dimension with regard to sustainable resource management. The GAT explores whether all dimensions of the governance system are 1) coherent (reinforcing, not contradicting), 2) flexible (multiple pathways to adaptation outcomes are considered to increased resilience), 3) intense (there is some sense of urgency to change the status quo for adaptation processes), and 4) that all relevant elements described above are taken advantage of (extent) (Bressers et al. 2015).

The GAT has been chosen as basis for developing a WEFE nexus governance assessment approach to be applied in NEXOGENESIS because it encompasses the most relevant governance dimensions and quality criteria and also includes nexus governance characteristics and challenges. However, the original framework is not able to address all nexus governance challenges, such as issues related to fit, policy coherence, power imbalances and multiple views and perspectives. The governance quality criteria ‘fit’ was added to the tool to be able to account for governance challenges related to scalar fit and scalar strategies as identified in the literature (see chapter 2 of D1.1 and Pahl-Wostl (2021)). The work performed to adapt the GAT of Bressers et al. (2015) is explained in detail in D1.1. The existing GAT questions to score the quality of the governance dimensions were adapted into questions that fit better with the nexus. In particular, additional questions were added for newly identified WEFE nexus governance characteristics.

The NXGAT is now made up of five dimensions and has now five quality criteria as defined here below. The definitions were adapted from Bressers et al. (2015) except for the fit quality criteria, which was newly created for the purposes of WEFE nexus governance assessment.

Governance dimensions:

(1) Levels and scales: The administrative levels and the biophysical scales involved in the WEFE nexus domains and their interdependencies.

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(2) Actors and networks: The involved actors and networks in the WEFE nexus governance system, their roles, potential conflicts and power relations.

(3) Problem perspectives and goal ambition: The various perspectives, ambitions and levels of awareness of WEFE nexus stakeholders about nexus issues.

(4) Strategies and instruments: The policy instruments and strategies available to address WEFE nexus issues.

(5) Responsibilities and resources: The available resources and responsibilities as well as their distribution to address WEFE nexus issues.

Quality criteria:

(1) Comprehensiveness: The degree to which all relevant elements of the WEFE nexus are taken into account in each of the governance dimensions.

(2) Coherence: The level of contradiction or reinforcement of the relevant WEFE elements in each of the five governance dimensions.

(3) Flexibility: The presence of alternative opportunities to achieve the WEFE nexus goals and if this flexibility is supported by the governance system.

(4) Intensity of the action undertaken: The level of action taken towards a more WEFE nexus-oriented governance regime in each of the five governance dimensions.

(5) Fit: The degree to which WEFE institutional levels (local, regional, national and transnational), stakeholders´ priorities, social interactions, policy instruments and responsibilities correspond to the bio-physical scales and dynamics of the WEFE nexus issues (Pahl-Wostl et al., 2021; Vatn and Vedeld, 2012).

Nexus domain: the water, energy, food and ecosystem elements of the nexus. We refer to domain instead of the commonly used term sector because strictly speaking the ecosystem is arguably not an economic sector (e.g. there is no ecosystem industry as there is water, energy or food industry).

The NXGAT matrix

The intersection of the five governance dimensions and five quality criteria generates a 5x5 matrix. Per each of the 25 cells of the matrix a number of questions are formulated that should be answered to collect the required information for performing the assessment (Table 1). The purpose of the NXGAT matrix is to help researchers know which information to collect, how to interact with stakeholders to assess each cell and then how to score each cell during interviews with stakeholders.

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Table 1 : Matrix of the WEFE nexus governance assessment tool (NXGAT): questions to collect data for the assessment

Quality of water-energy-food-ecosystem nexus governance system					
Governance dimensions	**Comprehensiveness** *The degree to which the current governance system includes relevant WEFE nexus elements*	**Coherence** *The degree to which the elements of the governance system are strengthening rather weakening each other*	**Flexibility** *The capacity of the current governance system to provide different pathways towards WEFE nexus governance*	**Intensity of action** *The capacity of the current governance system to urge more WEFE nexus oriented actions*	**Fit** *The degree to which the current governance system matches ecosystems properties and functions*
Actors and networks	To what extent are relevant actors and networks from the WEFE domains involved equally and meaningfully in the governance of the WEFE nexus? Who are key actors and networks in the governance of the WEFE nexus? Who is not involved or excluded? To what extent are relevant actors and networks from the WEFE domains involved equally and meaningfully in the governance of the WEFE nexus?	How cooperative and how strong are interactions between actors and networks across the WEFE nexus? Do actors and networks trust and respect each other and have established collaboration they can build on to foster WEFE nexus synergies and manage trade-offs?	To what extent can WEFE power constellations or leadership shift, and is it possible to include new actors and networks if useful? To what extent is the governance of the WEFE nexus contested and negotiated by actors and networks? Can key actors or networks (like bridging organisations) act meaningfully in support of the WEFE nexus governance?	How do certain actors or networks urge change of the WEFE nexus governance regime effectively and continuously? Are there any actors or networks able to exert influence unilaterally?	To what extent are the current WEFE actors the most appropriate to deal with the nexus interlinkages?
Levels and scales	Are all relevant WEFE domains across institutional levels and scales represented and involved in nexus governance? Who is missing? To what extent can the WEFE nexus governance system be characterized as polycentric?	Do WEFE domains work together across governance levels and scales in a coordinated manner, which fosters coherence? To what extent are vertical and horizontal synergies and mutual dependencies across levels and scales recognized?	Do WEFE domains work together across governance levels and scales in a coordinated manner, which fosters coherence? To what extent are vertical and horizontal synergies and mutual dependencies across levels and scales recognized?	Is there a strong drive or action undertaken from a certain level or domain to urge WEFE nexus governance change on other levels and scales?	To what extent do the nexus interlinkages correspond to the structural levels of governance at which they are currently dealt with?
Problem perspectives and goals ambitions	To what extent are different perspectives about WEFE nexus interlinkages and related problems and ambitions taken into account in the single WEFE domain and in the WEFE nexus decision-making? To what extent are the WEFE nexus actors aware of the vertical and horizontal inter-dependencies (synergies and trade-offs) across WEFE nexus domains?	To what extent do the various actors' policy goals and perspectives across WEFE nexus support each other (synergies) or are in competition or conflict with one another (trade-offs)	Are there opportunities to re-assess priority of WEFE domain goals? Where are these opportunities located in the WEFE nexus? Can multiple WEFE policy goals be optimized and perceived problems be solved in nexus governance packages deals?	To what extent are the goal ambitions and the problems perceived moving away from a single resource centric view towards a perspective on nexus governance which effectively urges change? What is the perceived urgency of WEFE nexus problems by actors across the WEFE nexus?	Do the perceived problem perspectives and goal ambitions account for the nexus interlinkages?
Strategies and instruments	What types of measures & instruments (including monitoring and enforcement instruments) are included in the policy strategy of each WEFE nexus domains? What is missing? What different strategies and instruments exist to prevent and manage power imbalances and conflicts among the WEFE nexus actors?	To what extent are measures and instruments cross-domain and reinforcing each other? To what extent is the incentive system based on synergies across WEFE nexus domains? Are there any overlaps or conflicts of incentives created by the policy instrument across the nexus domains? Are trade-offs related to costs and benefits and to distributional effects across the WEFE nexus domains considered?	Are there opportunities to combine or make use of different types of (legal, policy, economic, etc.) instruments across WEFE nexus domains? Are there alternative choices? Are legal frameworks, policy instruments and measures robust and flexible, i.e. adjustments are possible and relatively easy to implement (including financing systems)?	To what extent do policy instruments stimulate desired behavior and deviate from current practices? To what extent WEFE nexus strategies and instruments foster sustainable and integrated WEFE nexus management?	To what extent do policies and instruments match the nexus interlinkages?
Responsibilities and resources	To what extent are responsibilities about WEFE nexus issues clearly assigned and facilitated with resources and organisational structures? Are actors with the right expertise and capacity involved in the WEFE nexus management decisions? Which expertise is missing or even excluded? To what extent are there power imbalances and conflicts among the WEFE nexus actors regarding responsibilities and resources?	To what extent do the assigned responsibilities for integrated WEFE nexus management create struggles or cooperation within or across institutions and domains? How do the functional differences of WEFE actors affect power distribution, legitimacy and exercise in the WEFE nexus decision-making? Could one actor act alone as a result of power allocation? Are there any allocated responsibilities and resources to manage WEFE nexus issues in an integrated manner? What are they? Are they legitimate?	To what extent is it possible to pool the assigned responsibilities and resources without compromising accountability and transparency?	Is the amount of allocated resources sufficient to implement the measures needed for the intended change across nexus domains? In which domains are resources more scarce for implementing change? To what extent do the key institutions in the WEFE nexus drive changes to other institutions in the nexus toward more nexus integration? To what extent are the entrepreneurial agents of change enabled to gain access to resources, seek and seize opportunities, and have meaningful influence on the nexus governance regime?	To what extent do the allocated responsibilities and resources match the scale of the nexus interlinkages?

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Interview guide

The questions presented in Table 1 are to be answered by experts through interviews with relevant stakeholders. Table 1 questions are articulated in a number of questions to be asked to stakeholders which are formulated in non-technical language. To this purpose, an interview guide has been developed for each case study, with questions common across cases and case specific questions. The guide was prepared in English to allow the governance assessment team to agree on its content and everyone to conduct the interviews. The interview guide is reported in Annex 1.

Scoring system of the NXGAT matrix

The scoring of each cell of the NXGAT matrix is done in two steps. First, the governance assessment team answers the main evaluation question of each cell (presented here in Table 2) based on the answers to the interview questions. Then, based on the answers to the main question, the governance assessment team gives a score using the scoring system presented in Table 3. At the end of the process the matrix is filled in with a synthesis of the interview data analysis produced by all the members of the governance assessment team. The score of each cell is agreed among all members of the governance assessment team. A final score is attributed to each quality criteria for all governance dimensions. The final score is still based on qualitative assessment and not an average of the 5 cells' score. This explains why very high + high + low + low + low = low; while for another case very low + low + very low + low + low = very low. This is the result of expert judgement of the importance of each cell in the overall criteria's score.

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Table 2 : Matrix of evaluation questions to assess WEFE nexus governance orientation

Quality of water-energy-food-ecosystem nexus governance system					
Governance dimensions	**Comprehensiveness** *The degree to which the current governance system **includes** relevant WEFE nexus elements*	**Coherence** *The degree to which the elements of the governance system are strengthening rather weakening each other*	**Flexibility** *The capacity of the current governance system to provide different pathways towards WEFE nexus governance*	**Intensity of action** *The capacity of the current governance system to urge more WEFE nexus oriented actions*	**Fit** *The degree to which the current governance system matches ecosystems properties and functions*
Actors and networks	To what degree are relevant actors and networks affected by or affecting WEFE nexus domains involved?	To what degree are interactions of relevant actors and networks across WEFE nexus domains cooperative, solid and based on trust?	To what degree does the governance system allow to include new actors or shift the lead from one actor to another when needed?	To what degree is there pressure from a relevant actor or actor coalition across WEFE nexus domains towards behavioral change or management reform?	To what degree relevant actors and networks across WEFE nexus domains are appropriate to deal with ecosystem properties and functions?
Levels and scales	To what degree are relevant levels and scales across WEFE nexus domains involved?	To what degree do relevant levels and scales across WEFE nexus domains work together, acknowledging interdependencies and trusting each other?	To what degree does the governance system allow to change levels and/or scales at which WEFE nexus issues are addressed?	To what degree is there pressure from relevant levels and/or scales across WEFE nexus domains towards behavioral change or management reform?	To what degree do relevant levels and scales of the governance system match ecosystem properties and functions?
Problem perspectives and goals ambitions	To what degree are various problem perspectives and goal ambitions across WEFE nexus domains taken into account?	To what degree are problem perspectives and goal ambitions across WEFE nexus domains mutually reinforcing?	To what degree does the governance system allow to re-assess goals across WEFE nexus domains and combine multiple goals in package deals as needed?	To what degree do problem perspectives and goal ambitions across WEFE nexus domains urge for WEFE nexus orientation?	To what degree do problem perspectives and goal ambitions across WEFE nexus domains take into account ecosystem properties and functions?
Strategies and instruments	To what degree do relevant strategies and instruments include WEFE nexus orientation?	To what degree are relevant strategies and instruments across WEFE nexus domains mutually reinforcing?	To what degree does the governance system allow to combine or make use of different strategies and types of instruments across WEFE nexus domains?	To what degree do relevant strategies and instruments across WEFE nexus domains urge WEFE nexus oriented behavior or management reform?	To what degree do relevant strategies and instruments across WEFE nexus domains take into account ecosystem properties and functions?
Responsibilities and resources	To what degree are responsibilities and resources clearly assigned to support WEFE nexus-oriented management?	To what degree do responsibilities and resources across WEFE nexus domains lead to cooperation among these domains?	To what degree does the governance system allow to pool assigned responsibilities and resources across WEFE nexus domains without compromising accountability and transparency?	To what degree do responsibilities and resources across WEFE nexus domains urge implementation of WEFE nexus oriented actions?	To what degree are the assigned responsibilities and resources across WEFE nexus domains appropriate to deal with ecosystem properties and functions?
Overall scoring	Very high / High / Low / Very low	Very high / High / Low / Very low	Very high / High / Low / Very low	Very high / High / Low / Very low	Very high / High / Low / Very low
Concluding evaluation	Supportive / Moderately Supportive / Restrictive / Highly restrictive				

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Table 3 : Matrix of scores to assess WEFE nexus governance orientation

	Quality of WEFE nexus governance system **Very low / low / high / very high supported with justification in each cell of the matrix (one sentence)**				
Governance dimensions	**Comprehensiveness** *The degree to which the current governance system **includes** relevant WEFE nexus elements*	**Coherence** *The degree to which the elements of the governance system are strengthening rather weakening each other*	**Flexibility** *The capacity of the current governance system to provide different pathways towards WEFE nexus governance*	**Intensity of action** *The capacity of the current governance system to urge more WEFE nexus oriented actions*	**Fit** *The degree to which the current governance system corresponds to ecosystems properties and functions*
Levels and scales	To what degree are relevant actors and networks affected by or affecting WEFE nexus domains involved? **Very high:** All relevant actors and networks affected by or affecting WEFE nexus domains are involved. **High:** The majority of relevant actors and networks affected by or affecting WEFE nexus domains is involved. **Low:** A limited number of relevant actors and networks affected by or affecting WEFE nexus domains are involved. **Very low:** The relevant actors and networks affected by or affecting WEFE nexus domains are not involved.	To what degree are interactions of relevant actors and networks across WEFE nexus domains cooperative, solid and based on trust? **Very high:** Interactions of relevant actors and networks across WEFE nexus domains are fully cooperative, solid and based on trust. **High:** Interactions of relevant actors and networks across WEFE nexus domains are mostly cooperative and solid and based on trust. **Low:** Interactions of relevant actors and networks across WEFE domains are little cooperative, solid or based on trust. **Very low:** Interactions of relevant actors and networks across WEFE nexus domains are neither cooperative nor solid and also not based on trust.	To what degree does the governance system allow to include new actors or shift the lead from one actor to another when needed? **Very high:** The governance system easily allows to include new actors or shift the lead from one actor to another when needed. **High:** The governance system allows to include new actors or shift the lead from one actor to another when needed in some situations. **Low:** The governance system makes it difficult to include new actors or shift the lead from one actor to another when needed. **Very low:** The governance system does not allow to include new actors or shift the lead from one actor to another when needed.	To what degree is there pressure from a relevant actor or actor coalition across WEFE nexus domains towards behavioral change or management reform? **Very high:** There is very strong pressure from a relevant actor or actor coalition across WEFE nexus domains towards behavioral change or management reform. **High:** There is strong pressure from a relevant actor or actor coalition across WEFE nexus domains towards behavioral change or management reform. **Low:** There is weak pressure from a relevant actor or actor coalition across WEFE nexus domains towards behavioral change or management reform. **Very low:** There is no pressure from any relevant actor or actor coalition across WEFE nexus domains towards behavioral change or management reform.	To what degree are relevant actors and networks across WEFE nexus domains appropriate to deal with ecosystem properties and functions? **Very high:** Relevant actors and networks across WEFE nexus domains are appropriate to deal with ecosystem properties and functions. **High:** Relevant actors and networks across WEFE nexus domains are appropriate to deal with/manage ecosystem properties and functions in some situations. **Low:** Relevant actors and networks across WEFE nexus domains are little appropriate to deal with ecosystem properties and functions. **Very low:** Relevant actors and networks across WEFE nexus domains are inappropriate to deal with ecosystem properties and dynamics.
Actors and networks	To what degree are relevant levels and scales across WEFE nexus domains involved? **Very high:** All relevant levels and scales across WEFE nexus domains are involved. **High:** The majority of relevant levels and scales across WEFE	To what degree do relevant levels and scales across WEFE nexus domains work together, acknowledging interdependencies and trusting each other? **Very high:** Relevant levels and scales across WEFE nexus domains always work together acknowledging interdependencies and trust each other.	To what degree does the governance system allow to change levels and/or scales at which WEFE nexus issues are addressed? **Very high:** The governance system easily allows to change levels and/or scales at which WEFE nexus issues are addressed. **High:** The governance system allows to change	To what degree is there pressure from relevant levels and/or scales across WEFE nexus domains towards behavioral change or management reform? **Very high:** There is very strong pressure from the relevant levels and/or scales across WEFE nexus domains towards behavioral change or management reform.	To what degree do relevant levels and scales of the governance system match ecosystem properties and functions? **Very high:** Relevant levels and scales of the governance system fully match ecosystem properties and functions. **High:** Relevant levels and scales of

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	nexus domains are involved. **Low:** A limited number of relevant levels and scales across WEFE nexus domains are involved. **Very low:** The relevant levels and scales across WEFE nexus domains are not involved.	**High:** Relevant levels and scales across WEFE nexus domains most of the time work together, acknowledge interdependencies and trust each other. **Low:** Relevant levels and scales across WEFE nexus domains rarely work together, rarely acknowledge interdependencies and have little trust on each other. **Very low:** Relevant levels and scales across WEFE nexus domains do not work together, do not acknowledge interdependencies and/ or do not trust each other.	levels and/or scales at which WEFE nexus issues are addressed in some situations. **Low:** The governance system makes it difficult to change levels and/or scales at which WEFE nexus issues are addressed. **Very low:** The governance system does not allow to change levels and/or scales at which WEFE nexus issues are addressed.	**High:** There is strong pressure from relevant levels and/or scales across the WEFE nexus domains towards behavioral change or management reform. **Low:** There is a weak pressure from relevant levels and/or scales across the WEFE nexus domains towards behavioral change or management reform. **Very low:** There is no pressure from relevant levels and/or scales across the WEFE nexus domains towards behavioral change or management reform.	the governance system mostly match ecosystem properties and functions. **Low:** Relevant levels and scales of the governance system hardly match ecosystem properties and functions. **Very low:** Relevant levels and scales of the governance system do not match ecosystem properties and functions.
Problem perspectives and goal ambitions	To what degree are various problem perspectives and goal ambitions across WEFE nexus domains taken into account? **Very high:** All problem perspectives across WEFE nexus domains are taken into account and are translated into WEFE nexus goal ambitions. **High:** The majority of problem perspectives across WEFE nexus domains are taken into account and most of them are translated into WEFE nexus goal ambitions. **Low:** A limited number of problem perspectives across WEFE nexus domains are taken into account and only a few are translated into WEFE nexus goal ambition. **Very low:** Problem perspectives across WEFE nexus domains are not taken into account and there is no WEFE nexus goal ambitions.	To what degree are problem perspectives and goal ambitions across WEFE nexus domains mutually reinforcing? **Very high:** Problem perspectives and goal ambitions across WEFE nexus mutually always reinforce each other. **High:** Problem perspectives and goal ambitions across WEFE nexus most of the time mutually reinforce each other. **Low:** Problem perspectives and goal ambitions across WEFE nexus rarely mutually reinforce each other. **Very low:** Problem perspectives and goal ambitions across WEFE nexus never mutually reinforce each other.	To what degree does the governance system allow to re-assess goals across WEFE nexus domains and combine multiple goals in package deals as needed? **Very high:** The governance system easily allows to re-assess goals across WEFE nexus domains and combine multiple goals in package deals as needed. **High:** The governance system allows to re-assess goals across WEFE nexus domains and combine multiple goals in package deals as needed in some situations. **Low:** The governance system makes it difficult to re-assess goals across WEFE nexus domains and combine multiple goals in package deals as needed. **Very low:** The governance system does not allow to re-assess goals across WEFE nexus domains, and combine multiple goals in package deals as needed.	To what degree do problem perspectives and goal ambitions across WEFE nexus domains urge for WEFE nexus orientation? **Very high:** Problem perspectives and goal ambitions across WEFE nexus domains very strongly urge nexus orientation. **High:** Problem perspectives and goal ambitions across WEFE nexus domains urge nexus orientation. **Low:** Problem perspectives and goal ambitions across WEFE nexus domains weakly urge nexus orientation. **Very low:** Problem perspectives and goal ambitions across WEFE nexus domains do not urge nexus orientation.	To what degree do problem perspectives and goal ambitions across WEFE nexus domains take into account ecosystem properties and functions? **Very high:** Problem perspectives and goal ambitions across WEFE nexus domains always take into account ecosystem properties and functions. **High:** Problem perspectives and goal ambitions across WEFE nexus domains most of the time take into account ecosystem properties and functions. **Low:** Problem perspectives and goal ambitions across WEFE nexus domains rarely take into account ecosystem properties and functions. **Very low:** Problem perspectives and goal ambitions across WEFE nexus domains never take into account ecosystem properties and functions.

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Strategies and instruments	To what degree do relevant strategies and instruments include WEFE nexus orientation? **Very high:** All relevant strategies and instruments include WEFE orientation. **High:** The majority of relevant strategies and instruments include WEFE orientation. **Low:** A limited number of relevant strategies and instruments include WEFE orientation. **Very low:** Relevant strategies and instruments do not include WEFE nexus orientation.	To what degree are relevant strategies and instruments across WEFE nexus domains mutually reinforcing? **Very high:** Relevant strategies and instruments across WEFE nexus domains always reinforce each other. **High:** Relevant strategies and instruments across WEFE nexus domains most of the time reinforce each other. **Low:** Relevant strategies and instruments across WEFE nexus domains rarely reinforce each other. **Very low:** Relevant strategies and instruments across WEFE nexus domains never reinforce each other.	To what degree does the governance system allow to combine or make use of different strategies and types of instruments across WEFE nexus domains? **Very high:** The governance system easily allows to combine or make use of different strategies and types of instruments across WEFE nexus domains. **High:** The governance system allows to combine or make use of different strategies and types of instruments across WEFE nexus domains in some situations. **Low:** The governance system makes it difficult to combine or make use of different strategies and types of instruments across WEFE nexus domains. **Very low:** The governance system does not allow to combine or make use of different strategies and types of instruments across WEFE nexus domains.	To what degree do relevant strategies and instruments across WEFE nexus domains urge WEFE nexus oriented behavior or management reform? **Very high:** Relevant strategies and instruments across WEFE nexus domains strongly urge WEFE nexus oriented behavior or management reform. **High:** Relevant strategies and instruments across WEFE nexus domains urge WEFE nexus oriented behavior or management reform. **Low:** Relevant strategies and instruments across WEFE nexus domains weakly urge WEFE nexus oriented behavior or management reform. **Very low:** Relevant strategies and instruments across WEFE nexus domains do not urge WEFE nexus oriented behavior or management reform.	To what degree do relevant strategies and instruments across WEFE nexus domains take into account ecosystem properties and functions? **Very high:** Relevant strategies and instruments across WEFE nexus domains always take into account ecosystem properties and functions. **High:** Relevant strategies and instruments across WEFE nexus domains most of the time take into account ecosystem properties and functions. **Low:** Relevant strategies and instruments across WEFE nexus domains rarely take into account ecosystem properties and functions. **Very low:** Relevant strategies and instruments across WEFE nexus domains never take into account ecosystem properties and functions.
Responsibilities and resources	To what degree are responsibilities and resources across WEFE domains clearly assigned to support WEFE nexus-oriented management? **Very high:** Responsibilities are clearly assigned across WEFE nexus domains and fully supported with resources to allow WEFE nexus management. **High:** The majority of responsibilities are clearly assigned and sufficient resources are allocated across WEFE nexus domains to support WEFE nexus management. **Low:** Few responsibilities are	To what degree do responsibilities and resources across WEFE nexus domains lead to cooperation among these domains? **Very high:** Responsibilities and resources across WEFE nexus domains always lead to cooperation among these domains. **High:** Responsibilities and resources across WEFE nexus domains most of the time lead to cooperation among these domains. **Low:** Responsibilities and resources across WEFE nexus domains rarely lead to cooperation among these domains.	To what degree does the governance system allow to pool assigned responsibilities and resources across WEFE nexus domains without compromising accountability and transparency? **Very high:** The governance system easily allows to pool assigned responsibilities and resources across WEFE domains without compromising accountability and transparency. **High:** The governance system allows to pool assigned responsibilities and resources across WEFE domains without compromising accountability and	To what degree do responsibilities and resources across WEFE nexus domains urge implementation of WEFE nexus oriented actions? **Very high:** Responsibilities and resources across WEFE nexus domains very strongly urge implementation of WEFE nexus oriented actions. **High:** Responsibilities and resources across WEFE nexus domains strongly urge implementation of WEFE nexus oriented actions. **Low:** Responsibilities and resources across WEFE nexus domains weakly urge implementation of WEFE nexus oriented actions.	To what degree are assigned responsibilities and allocated resources across WEFE nexus domains appropriate to deal with ecosystem properties and functions? **Very high:** Responsibilities and resources across WEFE nexus are always appropriate to deal with ecosystem properties and functions. **High:** Responsibilities and resources across WEFE nexus domains are most of the time appropriate to deal with ecosystem properties and functions. **Low:** Responsibilities and resources across WEFE nexus domains

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	clearly assigned and only limited resources are allocated across WEFE nexus domains to support WEFE nexus management. **Very low:** Responsibilities are unclear across WEFE nexus domains and resources are insufficient to support WEFE nexus management.	**Very low:** Responsibilities and resources across WEFE nexus domains do never lead to cooperation among these domains.	transparency in some situations. **Low:** The governance system makes it difficult to pool assigned responsibilities and resources across WEFE domains without compromising accountability and transparency. **Very low:** The governance system does not allow to pool assigned responsibilities and resources across WEFE domains without compromising accountability and transparency.	**Very low:** Responsibilities and resources across WEFE nexus domains do not urge implementation of WEFE nexus oriented actions.	are rarely appropriate to deal with ecosystem properties and functions. **Very low:** Responsibilities and resources across WEFE nexus domains are never appropriate to deal with ecosystem properties and functions.
Overall score	*[Very low / low / high / very high]*	*[Very low / low / high / very high]*	*[Very low / low / high / very high]*	*[Very low / low / high / very high]*	*[Very low / low / high / very high]*
Concluding evaluation: highly restrictive / restrictive / moderately supportive / supportive	The current governance system is [*highly restrictive/ restrictive/moderately supportive/ supportive*] towards WEFE nexus governance				

Stakeholders' self-scoring

At the end of each interview stakeholders are asked to give an overall score of the level of cross-sectoral integration of the WEFE nexus domains according to their knowledge and perception based on the following scoring scale:

0 = silo approach; no substantial integration between the domains

1 = two domains have good level of integration

2 = three domains have good level of integration

3 = all domains have good level of integration

This self-scoring step is performed for several reasons. First, it helps the governance assessment team assess the level of understanding stakeholders have about the WEFE nexus concept. Second, interpreted together with the interview data, it allows making assumptions on the most connected sectors and to provide examples. Third, when multiple stakeholders from the same or different sectors are present at the interview, it prompts discussion about their different perception of sectors integration depending on a person's day-to-day job, knowledge, expectations thus helping explain the score.

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2. NXGAT implementation methodology

This section presents how the NXGAT is implemented in each case study. The main objective is to adapt the tool to the context of each case study and to each stakeholder interviewed, while maintain the integrity of the tool and methodology developed.

Composition of the governance assessment team

Numerous nexus studies show that bringing together diverse knowledge and scientific disciplines into a transdisciplinary team provides a significant advantage in understanding nexus interlinkages, related problems and solutions. This is because in transdisciplinary team people can understand different perspectives, embrace varied logics and values, build a common language, appreciate and negotiate different solutions, and reshape power dynamics between disciplines and between scientists and practitioners (Howarth and Monasterolo 2016). Following this logic, the GAT itself, upon which the NXTGAT was developed, was designed to be implemented by an interdisciplinary team (Bressers et al., 2016, p. 61).

Accordingly, the NXGAT was also designed to be implemented by an interdisciplinary team of experts, including also individuals knowledgeable about the case study under investigation (governance assessment team). In the NEXOGENESIS project, the NXGAT was implemented by an interdisciplinary team of researchers (the governance and policy experts of work package 1 – WP1) with the support of one or two project partners from the case studies who are designated as local experts. The presence of one or more local experts during the interviews is important. This ensures that the results and conclusions are firmly rooted in the local context. This governance assessment team was thus composed of a minimum of 3 and a maximum of 6 people and the composition of the team per each case study investigation was decided by the WP1 partners. Case study partners contributed to identify the interviewees, participated to the interviews, helped with translation when needed, and contributed to the reflection on the results. The inclusion of case study partners proved already crucial to maximize the impact of NEXOGENESIS as they have established relationships with the relevant stakeholders.

Per each case study the governance assessment team:

- planned the interviews
- participated to the interviews
- participated to the team discussion at the end of the interview campaign
- analysed the data and provided feedback on the results (case study partners).

Field visit preparation

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The NXGAT methodology requires to conduct interviews with stakeholders of all nexus domains (water, energy, agriculture, environment) at all levels and scales (local, regional, national and transboundary when concerned). To this purpose, per each of the NEXOGENESIS case studies a field visit was planned. The planning started 2 months ahead of the visit. WP1 and case study partners discussed over 2-4 preparatory meetings the stakeholders to interview. The interviewees were selected through a combination of purpose sampling and snowball sampling (Bernard, 2008). The purpose sampling was based on the criteria that there should be at least one interviewee per WEFE nexus domain across different scales (national, regional, local) and that the public, private and NGOs sectors should be represented across these sectors and scales. This criteria was applied to each country involved in the case studies (for the transboundary cases this meant two countries). From the point of view of selecting the stakeholders to be interviewed, we did not ask case study leaders and team members to adopt a real gender approach in selecting the stakeholders, that is to say to target an equal number of women and men in positions of responsibility. The Italian Adige site and the Greek-Bulgarian Mesta-Nestos site have the lowest proportion of women interviewees (22% and 32% respectively), while the Latvian-Lithuanian Lielupe case study has the highest proportion with 68% women in the panel of interviewees, followed by the Romanian Jiu case study with 58% women in the panel of interviewees and a low proportion of 43% for the South African case study. This gives an average of 55% male and 45% female respondents, with only one case of a non-binary person.

However, depending on the availability of stakeholders, an attempt was made to respect a gender balance. And, when needed, some additional interviews were carried out on-line. Without a truly oriented approach to a gender analysis of governance it is difficult to interpret these data. This is certainly a factor to be taken into account in future analyses.

The selection of the person to interview within a specific stakeholder group was made by the case study partners, depending on their knowledge of the case study context, their network and their capacity to reach out to specific individuals. Overall, 15 to 20 stakeholders across all nexus domains and scales were interviewed per country (leading to higher numbers for the transboundary case studies).

Once the list of interviewees was agreed, the case study partners planned the interviews and the field visit agenda. Sometimes 2 to 3 stakeholders were of the same or different domains or organization were interviewed together. These people sometimes knew each other. Such form of small group interview yielded relevant information, although probably different than a one-on-one interview.

Interview process

Each interview started by briefly introducing the governance assessment team and the NEXOGENESIS project. This was done by the case study partner or by the lead of the governance assessment team for that specific case study. The interview was framed as a discussion on cross-sectoral collaboration and integration and as part of the

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NEXOGENESIS process of exchange with local stakeholders to be continued for the duration of the project. Then the stakeholders were invited to sign the consent form for the interview and to be engaged, if they wished, in the project activities. At this point the interviewee was invited to introduce himself, including his background and professional position and activity within the organization. Depending on the context of the interview, at times the interview started with first an introduction of the project and then a round table of introductions of the governance assessment team and of the interviewee(s).

Adaptation of the interview guide to each case study

An interview guide structured around 25 main questions was used to frame the interviews, was followed during the interviews. Interviews are generally conducted in English. When the interviewee does not speak English or their English is not very fluent, translation is used, either by local colleagues (Lielupe) or by a translator (Nestos-Mesta, Bulgaria). Whenever possible, interviews are conducted in the local language. This was the case for Adige, where the interviews were conducted in Italian, because two members of the WP1 team speak Italian.

The guiding principle of the interview was to explore some aspects of each dimension and each criteria of the NXGAT with every interviewee. The discussion was therefore tailored to each stakeholder, depending on professional position and activity, specific case study circumstances, how the discussion developed and time constraints. A minimum of 1.5 hours was required for each interview, and even more when translation was needed. At the end of each interview all interviewees were asked a question about their perception of the current state of inter-sectoral collaboration and integration in their context.

3. The policy coherence assessment approach

The policy coherence analysis in NEXOGENESIS aims to assess the level of coherence between different WEFE nexus policies relevant to the (transboundary) river basin case studies. To assess policy coherence in the case studies, NEXOGENESIS adopts a simplified version of the tool adopted by Papadopoulou et al. (2020), which was developed by Nilsson et al. (2017).

There are two main differences between the NEXOGENESIS policy coherence assessment and the approach adopted by Papadopoulou et al. (2020) after Nilsson et al. (2017): the complexity of the scoring system and the object of assessment. The original tool used by Nilsson et al. (2017) measures the interaction between pairs of policy goals via a 7-point scoring scale ranging from cancelling (-3) to indivisible (+3). Papadopoulou et al. (2020) indicate that this tool is complex and time-consuming to use. For this reason, we simplified the coherence analysis. Instead of a 7-point scale,

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we opted for a 4-point scale (Table 4): “no coherence”, “weak coherence”, “strong coherence”, and “not applicable”. Furthermore, while Nilsson et al. (2017) assess coherence between pairs of policy goals, the NEXOGENESIS approach assesses coherence by checking to what extent sectoral policy documents (e.g., water policy documents) account for expected cross-sectoral interactions (e.g. interactions between water and energy, water and agriculture, water and ecosystems).

Table 4: Scoring system in the NEXOGENESIS policy coherence assessment

	Not applicable	**No coherence**	**Weak coherence**	**Strong coherence**
DEFINITION	The policy document is **not expected to refer to other sectors** or sectors’ policies.	The policy document **does not refer** to other sectors or sectors’ policies although impacts and/or potential synergies exist.	The policy document **only mentions/ acknowledges** possible impacts/ synergies with other sectors or sectors’ policies but there are no mandatory measures.	The policy document **prescribes specific measures** to ensure that impacts on other sectors are managed and/or synergies exploited.

To assist the case study leaders in conducting the policy coherence assessment, WP1 developed a policy inventory Excel database

To facilitate the assessment of policy coherence in the case studies, WP1 developed a policy inventory Excel database (see Figure 1 and Figure 2) that includes:

- Instructions to fill in the policy inventory: including instructions on how to find policies and populate the database;
- The scoring system: An explanation of how to score the level of policy coherence and the scoring scale;
- A list of examples of policy instruments: An overview of typologies of policy instruments and their definitions;
- Policy data fields: Under this tab, all relevant policies are stored, summarised and their level of coherence provided.

The next section describes how to populate the policy inventory and conduct the policy coherence assessment in detail.

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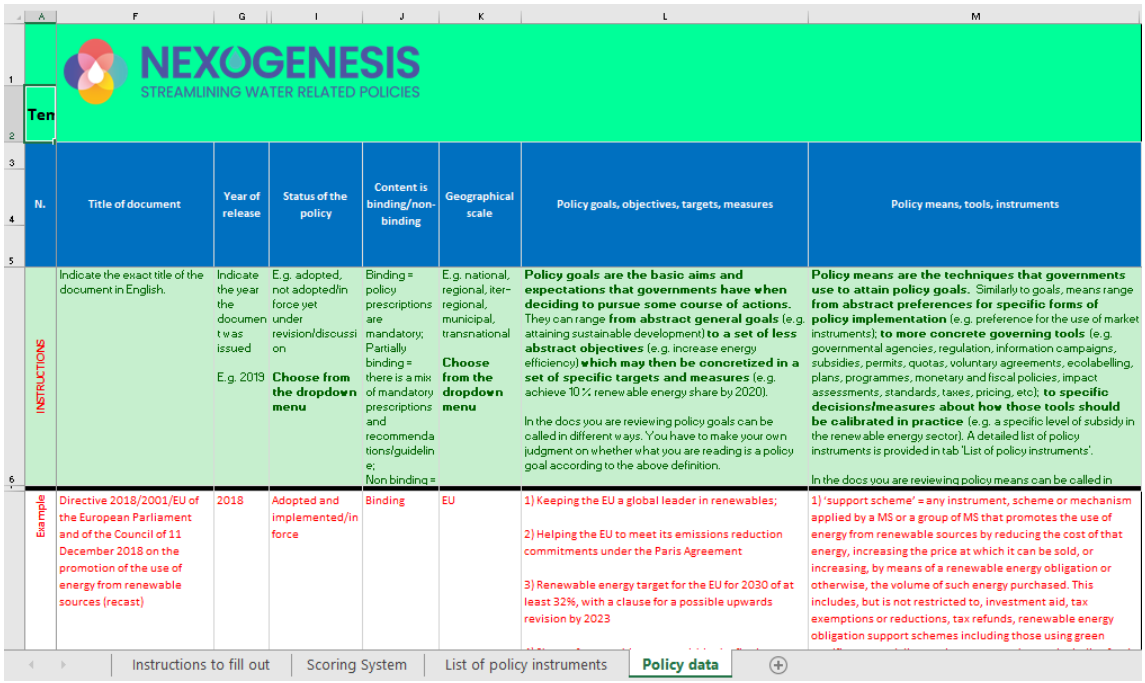

Figure 1: Example of policy inventory

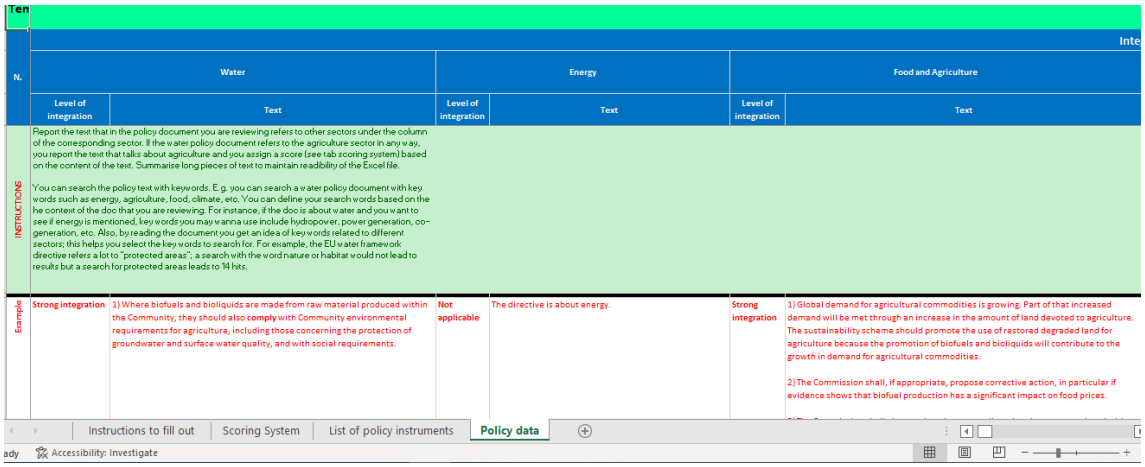

Figure 2 Example of policy coherence analysis in the policy inventory

4. Policy coherence assessment implementation methodology

The policy coherence assessment is made up of four steps. First, identification of relevant policies at different levels i.e. EU, national, regional and local level. Second, analysis of the policy documents and populating the policy inventory. Third, assessment of policy coherence based on expected policy interaction. Finally, is the validation of the policy coherence analysis. These steps are described in more detail in the following paragraphs.

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Step 1: Identifying relevant policies

The aim of this step is to identify the most up-to-date policies and legislation for the relevant WEFE nexus sectors in the case study region and store it in the policy inventory database. It was the responsibility of each case study partner to identify relevant policy documents (plans, programmes, strategies, roadmaps, etc.) from governmental and intergovernmental authorities at transnational, national, state, federal, regional, provincial, municipal scale and legislations (both binding and non-binding). Documents for all WEFE nexus sectors needed to be included along with other sectors when relevant to the case study (e.g. climate, land use, tourism, etc.). Because it is impossible to cover all existing policies and legislations, it was important to select the policies relevant to the case study based on identified nexus problems, the current political debate and the specific project needs. Project needs were discussed by the case study leads with WP1, WP2, WP3, and WP4. WP1 set up one-on-one meetings with each case study to explain the process. This step was conducted for each country involved in the transboundary case studies and the countries of the national cases.

Step 2: Analysing the policies and building the policy inventory

In this step, the content of the policy documents stored in the policy inventory was analysed. To populate the policy data tab, case study partners first did a quick scan of the document to become familiar with its structure and content. Then, they read the document in detail to extract relevant information and store it in the database. This include: the country to which the policy document applies; the policy area; the type of document; the name of the organisation that released the document; the title of the document; the year of release; the time horizon of the policy document; the status of the policy; whether it is legally binding or not; the geographical scale of the document; the policy goals, objectives, targets and measures; the policy tools and instruments; and the expected revision of the policy.

Step 3: Analysing policy coherence

The policy coherence analysis was conducted on the selected policy documents in each case study. The scoring was based on the scoring scale illustrated in Table 9. To ensure robustness of the assessment, results were triangulated. First, local partners with nexus expertise scored the coherence between the policies, substantiating the score with examples from the policy documents. This was done for each policy document in the database. The governance assessment researchers from the NEXOGENESIS team with expertise in environmental policy and governance, reviewed the policy coherence scores in the policy inventory based on the evidence provided by the local researchers. If the NEXOGENESIS team interpreted the policy coherence scores differently than the local partners, the local partners and the

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NEXOGENESIS team discussed the score together until an agreement was reached. These results were visually reported in a matrix (see Figure 3).

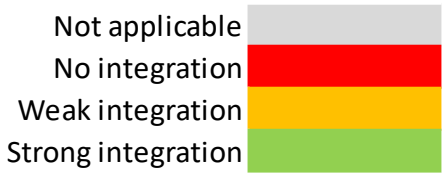

Figure 3 Policy coherence scores

Step 4 Validating the policy coherence analysis

The policy coherence analysis was discussed with local stakeholders during a focus group with the aim of validating it. One key stakeholder from each WEFE sector was invited, resulting in a total of 4 participants per each case study focus group.

The focus group participants were selected based on their experience with the implementation of the policies and across different administrative levels. The focus group lasted between 1.5-2 hours depending on the need for translation. During the focus group, the stakeholders were asked to validate the policy coherence found in the policy documents presented in the matrix (see Figure 4). There was also a reflection on whether the degree of policy coherence found in the policy documents was also visible in policy implementation practice. Specifically, the stakeholders discussed the policy instruments based on the following questions: 1) How does this policy work in practice? 2) How does the implementation of this policy affect the WEFE sectors? 3) What needs to change to make the implementation of this policy more effective? During the focus group, 3-4 specific policy instruments were discussed. These were selected based on the most relevant WEFE nexus problems in the case study.

Sector	Policy	Water	Energy	Food/ Agriculture	Land/ Soil	Biodiversity/ Ecosystems	Climate
Water	Water law						
Water	Ordinance No.1 from 10.10.2007 on the exploration, use, and protection of groundwaters						
Water	Law on Regulation of Water Supply and Sewarage Services						
Ecosystem	Environmental Protection Act						
Cross-sectoral	Disaster Protection Act						
Energy	Energy Act						
Energy	Energy from Renewable Energy Act						
Climate	Climate Change Mitigation Act						
Water	Regulation No. 2 on the protection of waters against nitrate pollution from agricultural sources						

Figure 4 Example of policy coherence matrix Mesta-Bulgaria

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Part B: Results of the governance and policy coherence assessment in the case studies

The governance assessment were conducted between June 2022 and February 2023 and the policy coherence assessment between June 2023 until July 2023. The assessments aim to identify barriers, cross-sectoral opportunities, and empowering case study leaders toward enhanced WEF nexus governance orientation via stakeholder engagement and co-creation.

The results are presented case study by case study in similar fashion

First, the case study's geographical, socio-economic, and institutional context is outlined, emphasizing key challenges across each WEF domain. Second the findings and interpretation of NXGAT and policy coherence are presented. Last, conclusions on the state of WEF nexus governance orientation are drawn, analyzing key barriers and leverages at both national and transboundary river basin levels.

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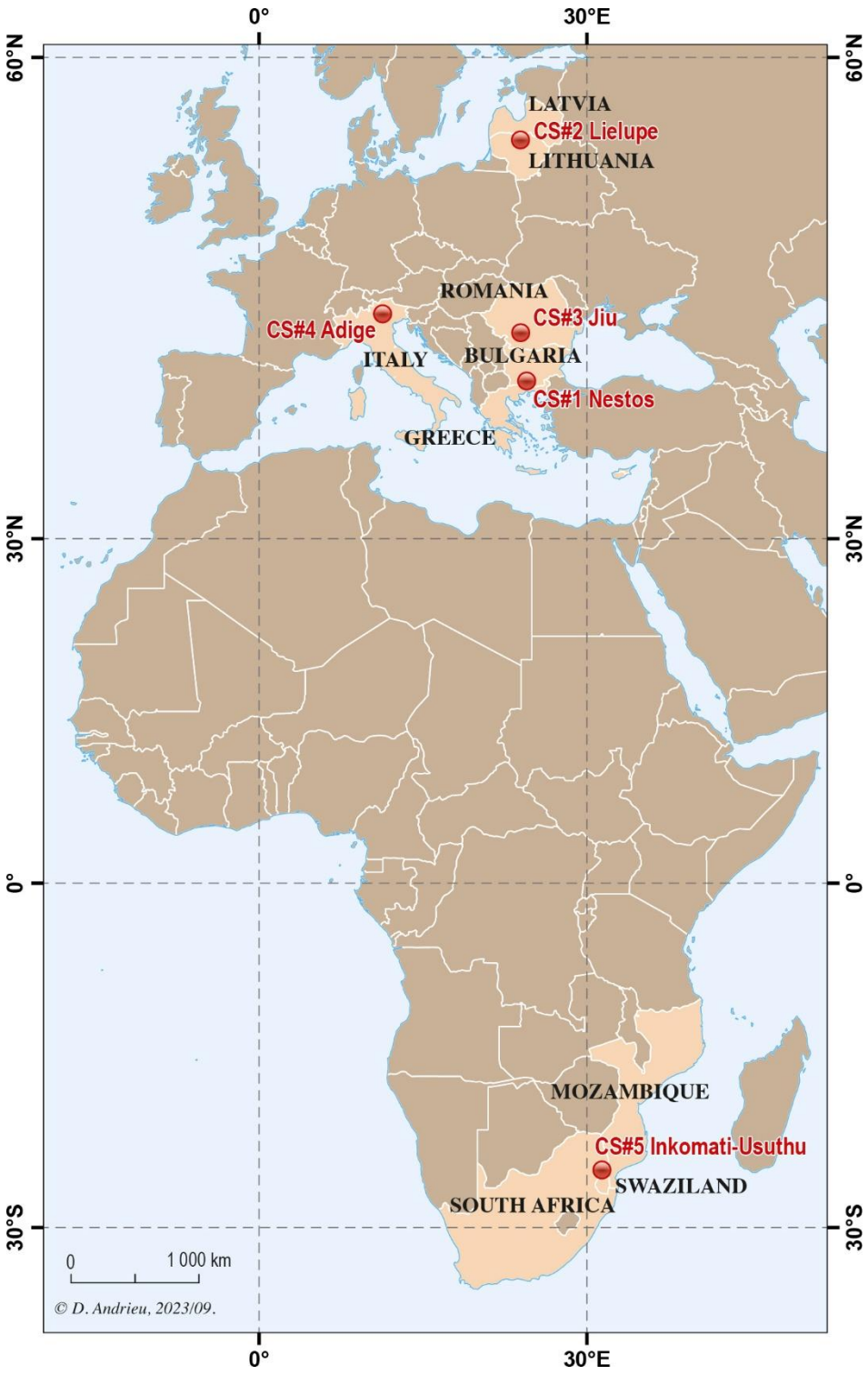

Figure 5: Location of the five NEXOGENESIS case studies

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1. Nestos-Mesta River

1.1. Context and case study description

1.1.1. Biophysical information

The Mesta-Nestos river basin is a transboundary river that flows between Greece and Bulgaria (Figure 6).

Figure 6: Localisation of the Nestos-Mesta catchment flowing to the Mediterranean Sea

The Nestos-Mesta catchment spans 6,178 km², with nearly 60% in Bulgaria (Mesta) and the remainder in Greece (Nestos). Originating in the Rila mountains, the river flows into the Thracian Sea (NSI, 2017). The Nestos River, 230 km long, has a drainage area over 5,000 km², passing through gorges in Pirin and Rila (MEECC, 2020). The

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river's slopes are steep, surrounded by mountains (Deligiorgis, 2015). Before reaching the Aegean, it forms the Nestos Delta, a crucial agricultural area.

The Nestos basin is geopolitically significant, providing vital water for irrigation and energy production in Greece. It includes two NATURA 2000 areas (Skoulikaris, 2008). The delta has soils prone to erosion, and soil types are classified into five broad groups (Psilovikos, 1990, Nakos, 1997).

The climate varies across the basin: the upper Mesta and Nestos are sub-alpine, while the lower part is Mediterranean. Rainfall averages 810 mm in Bulgaria and 790 mm in Greece, with significant snow in the mountain areas. The Greek part has an average annual temperature of 15.4°C (Skoulikaris, 2008). The karst system in the basin has a water potential of over 105 million cubic meters, with groundwater linked to the Nestos River (Figure 7).

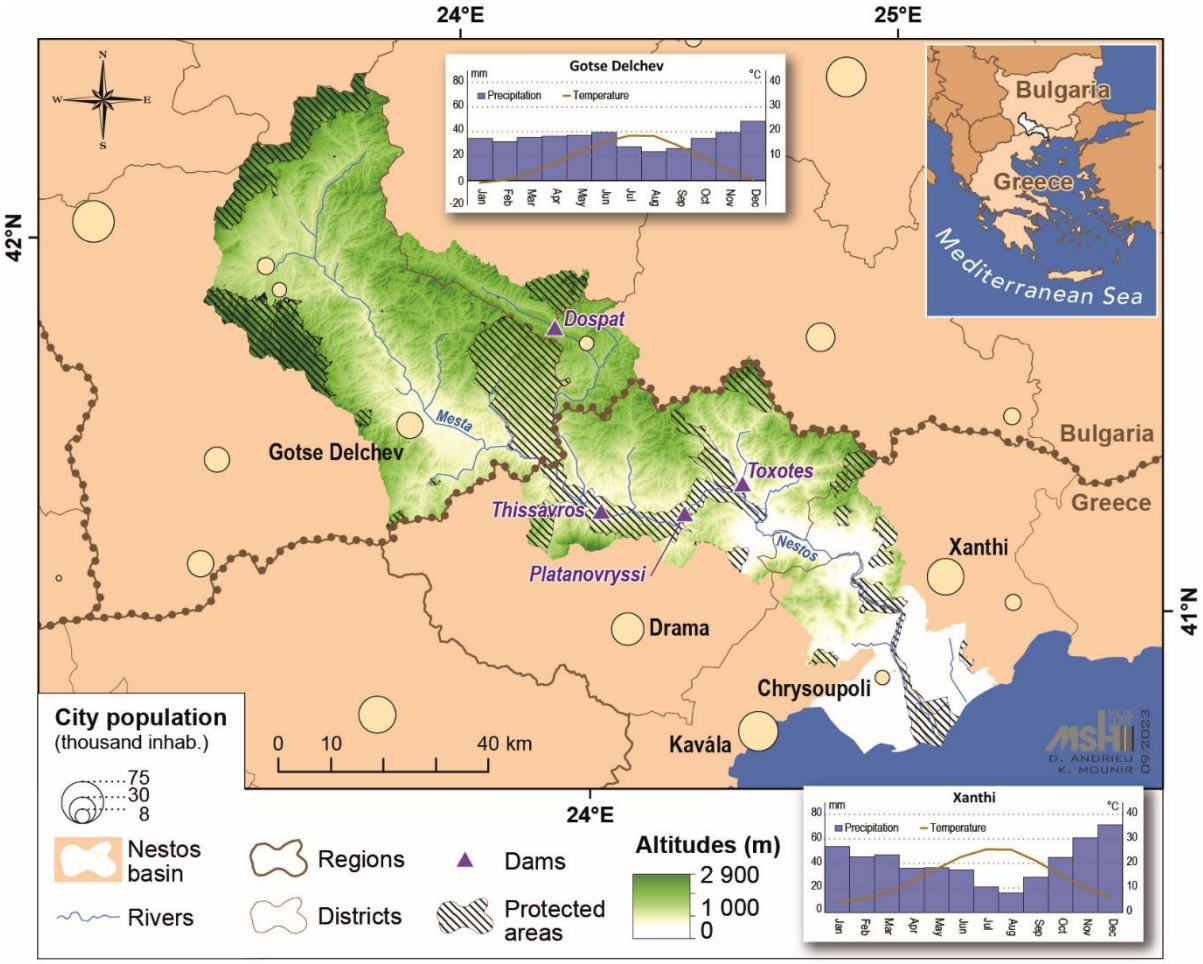

Figure 7: Location of dams in the Nestos/Mesta River

The mean monthly flow of the stream during the period 1965 to 1990 was rarely more than 150 m^3/s. The minimum flow for the Nestos stream was typically less than 10 m^3/s. Despite the artificial flow of the dams, the downstream flow is still maintained at over 6 m^3/s for environmental conservation.

The various gauge stations are located in areas that are upland. The Ministry of Agriculture has been in charge of the quality and quantity of the streams at these sites.

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The data of the various gauge stations have been available in digital form since 2001, but the historical measurements are still being kept in paper form. The data of the Temenos station can be accessed through the World Monitoring Organisation programme. However, it stopped recording its historical measurements in 1997 (Skoulikaris, 2008).

According to the Köppen climate classification system, the climatic domain of Xanthi corresponds to a "Csa" climate, indicative of a Mediterranean climate characterized as a warm temperate climate with dry summers and mild, wet winters. In summary, the climatic gradient within the Nestos/Mesta basin transitions from a northern humid continental climate to a southern Mediterranean climate.

Critically, the Nestos Basin, especially its coastal and low-altitude regions, is becoming increasingly vulnerable to climatic shifts. Recent trends highlight a growing frequency and intensity of drought events, signifying a clear departure from historical norms (Mylopoulos Y. et al., 2004, OECD, 2019).

1.1.2. Socio-economic activities and context

Population

The Mesta basin spans eleven municipalities in Bulgaria, divided between the Blagoevgrad and Smolyan districts, with a population of about 190,000. The Greek part, located in the prefectures of Drama, Kavala, and Xanthi, is sparsely populated in the mountainous areas, with 42,000 people mainly in the Nestos delta. The main river, Nestos, flows into the Sea of Maritsa, and the largest town in the Greek region is Chryssoupoli, with 8,800 residents (Skoulikaris, 2008).

Water uses in Mesta-Nestos basin

The Mesta River is primarily used for electricity production and irrigation. In Bulgaria, the catchment area is semi-arid, with the highest irrigation rates in the country (up to 400 m^3/s), mostly through inefficient surface irrigation. In Greece, the Nestos River is also used for hydropower and irrigation, with water flow regulated to meet seasonal needs, though fluctuating flows complicate irrigation and delta management. Groundwater in the Nestos Delta is increasingly overused, leading to saltwater intrusion.

- **Agriculture**

The basin consists mostly of natural grasslands and forests (75.4%), with agriculture occupying 20.3%. In Bulgaria, traditional mountain agriculture prevails, with non-irrigated crops common in the upper plains. In contrast, Greece's Nestos Delta is highly productive, with over 15,000 hectares of irrigated land. Main crops include rice, sugar beets, cereals, and increasingly kiwis and asparagus, much of which is exported (Skoulikaris, 2008; Karasani et al., 2022). The delta's irrigation system is fed by the

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Toxotes dam, which supplies water to both the Kavala and Xanthi districts (Koutrakis et al., 2018).

Energy

Greece has three hydropower plants: Thissavros, Platanovryssi, and Toxotes. Thissavros, with a capacity of 384 MW, is the largest. The new Temenos dam (2019) adds 19.5 MW to the system (Dimopoulos, 2018). In Bulgaria, the Dospat dam, built for hydroelectric power, diverts water to the Teshel hydroelectric plant but does not directly affect the Mesta River (Skoulikaris, 2008).

Ecosystem Management

The Mesta River basin is home to several national parks and protected areas, including Pirin and Rila National Parks in Bulgaria, and the Nestos Aesthetic Forest and Delta in Greece, both under the Natura 2000 program (Ilchev, 2013; Skoulikaris, 2008). The delta supports diverse habitats, including saltwater lagoons, which are crucial for local biodiversity.

Tourism

The Nestos Delta is a key destination for eco-tourism, with its wetlands, forests, and protected areas. The Mesta basin in Bulgaria also attracts visitors, particularly to the Rhodopes, Rila, and Pirin mountains, known for skiing, summer tourism, and UNESCO-listed sites.

Water Supply and Use

In Greece, agriculture accounts for 80% of water use, and freshwater is increasingly sourced from desalination (IRENA, 2015). Karstic springs in Kavala provide water for municipalities, while in Bulgaria, small Soviet-era dams supply domestic water and irrigation. The irrigation infrastructure is underdeveloped, and industrial activities mostly rely on groundwater (OECD, 2020).

Wastewater Treatment

In Bulgaria, only Bansko and Razlog have wastewater treatment facilities, while Gotse Delchev lacks such infrastructure. In Greece, Chryssoupoli has a treatment plant, but nearby towns discharge raw sewage into the Nestos River (Papachristou, 1994; Darakas, 2002).

1.1.3. Policy and administrative context

Bulgaria is a unitary republican State. The head of government, the Prime Minister, holds the most powerful executive position. The head of State, the President, primarily holds representative powers as well as limited veto powers. Parliament is unicameral and comprises the National Assembly which is composed of 240 directly elected

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deputies. The President of Bulgaria is also directly elected by the people[1].The Republic has three levels of governance: central, districts and municipalities. The country territory is organised in 6 planning regions, 28 districts (planning region and district representing the regional level, the capital counting for one)[2] and 265 municipalities. In 2020 the Parliament amended the Regional Development Act[3] to reduce the number of strategic documents and simplify the management of operational programmes. Administrative districts (*oblasti*) also known as "lower-level regions", are devolved divisions of the central government and are not directly elected. The municipality (*obshtini*) constitutes the only level at which self-government is exercised.

Greece is a parliamentary republic with a unitary, decentralized structure, consisting of central and local self-government levels. The central government operates through ministries, while local governance is exercised at the regional and municipal levels. Since 1986, Greece has undergone decentralization, establishing 13 regions[4], followed by elected prefectures in 1994, and the Kallikratis programme in 2010, which reorganized territorial divisions by merging municipalities. As of 2011, Greece has seven Decentralised Administrations, 13 regions, and 325 municipalities. These decentralized administrations are state units headed by officials appointed by the central government. The decentralized structure aims to enhance local governance, with regions managing regional affairs and municipalities handling local affairs[5]. The principles of decentralization and local self-government are enshrined in the Greek Constitution, and regions are tasked with implementing policies that align with national and European goals for sustainable development and social cohesion.

1.1.4. Key challenges for WEFE nexus and transboundary

- **In the Mesta-Nestos** the cross-sectoral issues relate to regulating the flow of water between upstream and downstream, given that large quantities of water are used upstream for hydroelectricity and intensive agriculture in the delta, while the delta is subject to a Mediterranean climate, which leads to a high demand for irrigation. Climate change is exacerbating the need for water throughout the catchment. Another major problem is the presence in the river of a large amount of waste, particularly from upstream, while a large part of the river and associated land are in Natura 2000 areas that need to be preserved. These are cross-border issues.

[1] https://portal.cor.europa.eu/divisionpowers/Pages/Bulgaria-Introduction.aspx

[2] https://european-union.europa.eu/principles-countries-history/country-profiles/bulgaria_en

[3] https://dv.parliament.bg/DVWeb/showMaterialDV.jsp?idMat=146602&fbclid=IwAR3mpfbJjh-tm9qB2zq3RSfdrXr8vQ_hUBOHBa2xPqIDoUb-GIEiixvA0Ec

[4] https://portal.cor.europa.eu/divisionpowers/Pages/Greece.aspx

[5] https://portal.cor.europa.eu/divisionpowers/Pages/Greece.aspx

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- **Transboundary agreements on the Mesta/Nestos regarding water flows**

The international treaties that have been signed between Greece came into force in 1996 in Greece. *"The two Parties have agreed to exchange information regarding the quality and quantity situation of the Nestos waters. The exploitation rights of the transboundary waters for Greece was fixed to 29 percent."* Since the signature, no international board or committee has been in force to support this exchange of information (Mylopoulos, 2004; Giannias, 2020 ; Karasani et al., 2022).

In his study, Skoulikaris (Skoulikaris, 2021) explains the pressures identified on water resources in the Bulgarian part of the Mesta/Nestos basin are linked to water diversion to the neighbouring Maritsa sub-basin (UNECE, 2011). This water is used for the Dospat both for hydroelectric power production and irrigation needs for agriculture (Zarris et al., 2011). The issue of inflows of polluted water into the downstream part of the basin is also an important issue, both for water quality and ecosystems (Natura 2000 areas in particular but also for fish migration), irrigation (agriculture) mentioned in the second environmental assessment (UNECE 2011) and reported several times in the literature of the early 21st century (Darakas 2002; Papachristou et al. 2000 ; Skoulikaris, 2021).

1.2. Results of nexus governance assessment and policy coherence analysis in the Mesta-Nestos River

Between 11 and 15 July 2022, the field visit of the nexus governance assessment took place in the Nestos-Mesta river basin. Three members of the governance assessment team (UNT, KWR) conducted a total of 15 interviews (9 in Greece and 6 in Bulgaria) and interviewed a total of 27 stakeholders (14 in Greece and 13 in Bulgaria).

During the interviews the respondents mentioned important stakeholders that were not scheduled for interviews yet. Interviews were arranged based on their contacts. The interviews were semi-structured group interviews and lasted between 1 to 5 hours when a field trip was included. The interviews were conducted in English and when needed instantly translated to the local language. There was one exception in which the interview was conducted in English with instant translation in Italian as common language.

As for all field work, there were some constraints. Some interviewees did not show up to the interviews and had to be either rescheduled or replaced. Unfortunately, it proved impossible to interview stakeholders form the national ministries. Therefore, the results are based on input from the local and regional level. During the focus group on the Greek side of the river basins, only representatives from the ecosystem and water

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sector attended. Therefore, the policy coherence scores are only validated with stakeholders from the ecosystem and water sector (Table 5).

Table 5 Overview stakeholders involved in NXGAT interviews and focus groups for policy coherence for both Bulgaria and Greece

When	What	Number of stakeholders	Men	Women	Men (%)	Women (%)
14-15 July 2022	Interviews NXGAT Bulgaria	13	9	4	69	31
27 March 2023	Focus group Bulgaria	3	2	1	67	33
11-13 July 2022	Interviews NXGAT Greece	14	11	3	79	21
31 May 2023	Focus group Greece	3	1	2	33	67

1.2.1. In Bulgaria

Analysis of governance system by criteria for each dimension and scoring

- **Comprehensiveness**

Actors and networks - All stakeholders feel involved in the Basin Council and are invited to participate to it. However, decisions are not taken at this level. Despite the importance of agricultural activity in the basin, there is no agricultural network apart from the national level. There does not seem to be a strong lobby of the energy sector either. While there is a lobby for hydroelectric power production, this lobby is not very influential and there is no possibility, because of natural protection regulations, to develop this type of energy. On the other hand, environmental associations are strongly represented at the international, national, regional and local levels. As a result, the score is **"high"**: The majority of actors and networks concerned with the WEFE nexus areas are involved.

Levels and scales - The basin council seems to be the level where stakeholders meet and discuss. The basin council is composed of around 30 people from all sectors and participation is through invitation. All levels and scales are invited to participate to the meetings organised by the river basin directorate council, but there are no specific criteria for invitation. Sometimes invitations depend on the issue in question. At the local level, there is no transboundary interaction, even though the local stakeholders would like to see more local transboundary interaction especially on solid waste management issues. Transboundary interaction only occurs at the national level. As a result, the score is **"high"**: The majority of relevant levels and scales across WEFE nexus domains are involved.

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Problem perspectives and goal ambitions - The main problems mentioned by the stakeholders are flooding, nitrate pollution from agriculture and small non-functioning sewage plants, loss of biodiversity, solid waste pollution and natural waste in the riverbed. While these problems are recognised, only a few are translated into objectives and ambitions. This is mainly due to the wider governance problem of the bureaucracy in Bulgaria, where decision-making is strictly top-down, with long processes, without taking into account local and regional perspectives. As a result, the score is **"low"**: A limited number of problem perspectives across WEFE nexus domains are taken into account and only a few are translated into WEFE nexus goal ambitions.

Strategies and instruments - Bulgarian national law is strongly based on EU law, meaning there is a certain level of integration. However, the process of harmonization is still in progress and according to those interviewed, is creating a number of legislative ambiguities, such as in the area of environmental impact assessment. The NGOs are therefore free to provide data and information on the existing biodiversity which could be impacted by projects of renewable energy. This hinders the development of renewable energies in a country where 33% is under Natura 2000 protection. As a result, the score is **"high"**: The majority of relevant strategies and instruments include WEFE orientation.

Responsibilities and resources - The responsibilities seem to be clearly assigned on paper. Most stakeholders mention that there are clear structures. According to the interviewees resources at the regional level are not perceived as sufficient, they are, on the other hand, sufficient at the municipal level. However, the municipal level has little power over river management and in particular cannot act on the riverbed without authorization. As a result, the score is **"high"**: The majority of responsibilities are clearly assigned, and sufficient resources are allocated across WEFE nexus domains to support WEFE nexus management.

Conclusion - The overall assessment of the comprehensiveness is **"high"**: The majority of actors and networks, and levels and scales concerned with the WEFE nexus areas are involved especially on the river basin level. The majority of relevant strategies and instruments include WEFE orientation on paper. This stems from the harmonisation of Bulgarian national law and EU legislation. Except for the regional level, the stakeholders indicated that the majority of responsibilities are clearly assigned, and sufficient resources are allocated across WEFE nexus domains to support WEFE nexus management. Despite the lack of local and regional transboundary interaction and the limited translation of problem perspectives into goal ambitions due to the high level of bureaucracy and strict top-down governance system, the comprehensiveness of the Bulgarian governance system is high.

- **Coherence**

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Actors and networks - The quality of interactions between SHs and actors and networks seem to be good and frequent when it comes to water quantity management. There are few interactions in the context of water quality or land use. While there are no open conflicts, but there is no common strategy for resource management either. Moreover, there seems to be distrust between the different WEFE sectors. As a result, the score is **"low"**: Interactions of relevant actors and networks across WEFE domains are little cooperative, solid or based on trust.

Levels and scales - There is no structured communication and coordination across the various levels and scales and the governance system is strictly top-down. Decisions and strategies are made at the national level, to be applied at the directorates (regional level) and municipal level. For each decision to be taken at the national level by request of the local level (e.g., permits), the waiting time is either very long or there is no response at all. Transboundary contacts must be initiated at the national scale. Moreover, there seems to be a lack of trust which is reflected in the "conspiracy feeling" expressed by some representatives of the Bulgarian energy sector that Greek environmentalists are plotting against dam projects in Bulgaria. In addition, there seems to be a misunderstanding on the sources of solid waste pollution in the river which crosses Bulgaria to reach Greece from the flows. Transboundary cooperation on river basin monitoring is further hindered by Bulgaria's bureaucracy as official requests must be made, which takes time. As a result, the score is **"very low"**: Relevant levels and scales across WEFE nexus domains do not work together, do not acknowledge interdependencies and/ or do not trust each other.

Problem perspectives and goal ambitions - The different domains have a strict sectoral view and are sometimes even in conflict. For example, representatives from the energy sector feel that their renewable energy plans are blocked by the environmental domain. Also, there is no exchange between farmers and other sectors regarding the need to prevent diffuse pollution. In the same way, energy production does not seem to be seen as an issue while there is the need to switch to more renewable energy production. At the moment, only solar energy has the possibility to develop, but is not strongly supported by incentives. As a result, the score is **"very low"**: Problem perspectives and goal ambitions across WEFE nexus never mutually reinforce each other.

Strategies and instruments - The strategies are sectoral oriented and come from the national level, making it difficult to solve interrelated problems at the local level. However, the next RBMP has to include the flood risk and climate change and drought plan. The non-governmental environmental domain is very well structured and organized at all levels and scales, and therefore they can provide environmental impact studies that can constrain the development of renewable energy. As a result, the score is **"low"**: Relevant **strategies and instruments** across WEFE nexus domains rarely reinforce each other in practice.

Responsibilities and resources - Although the local level seems to be able to design local strategies in line with the national strategies, stakeholders mention that there

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seem to be too many institutions that require different permits, and the timing is incoherent. For example, sometimes farmers' contractual right to use water for irrigation expires before the irrigation permit itself is issued. Regarding the river, municipalities cannot act directly on the river, except during crisis, such as flooding. For any other reason, the municipality asks for permission (for cleaning for example), and either has to wait a long time or does not receive an answer at all. As a result, the score is **"low"**: Responsibilities and resources across WEFE nexus domains rarely lead to cooperation among these domains.

Conclusion - The overall assessment of the coherence is **"low"**: Interactions of relevant actors and networks across WEFE domains are hardly cooperative, solid or based on trust. There is no common vision to address problems. Relevant levels and scales across WEFE nexus domains do not work together, do not acknowledge interdependencies and/ or do not trust each other. This mainly stems for the strict top-down governance structure in Bulgaria and the level of bureaucratic requirements. This hinders local and regional transboundary cooperation which is currently characterised by distrust. Problem perspectives and goals have a strong sectoral orientation and are sometimes even in conflict with each other. Strategies and instruments of the different WEFE domains are not coherent in practice. The responsibilities and resources do not foster cooperation between the WEFE domains this stems from the high level of bureaucracy in the Bulgarian governance system.

- **Flexibility**

Actors and networks - Despite the very top-down nature of the governance system, it allows for new actors to join under certain circumstances. For example, the governance system is relatively open at the level of the regional management. The river basin management is free to invite whoever it wants to the board and can easily adapt the list of participants according to the topics or issues raised by the stakeholders from all domains. As a result, the score is **"high"**: The governance system makes it easy to include new actors or shift the lead from one actor to another in some relevant situations.

Levels and scales - The governance system is strictly top-down. The regional and local level can only implement measures prescribed by the national level. As a result, the score is **"very low"**: There is no pressure from relevant levels and/or scales across the WEFE nexus domains towards behavioural change.

Problem perspectives and goal ambitions - The high level of bureaucracy and the strict top-down governance system make it difficult to combine policy objectives. The new River Basin Management Plan needs to be combined with the Flood Risk Management Plan and the Climate Change and Drought Plan. As a result, the score is **"low"**: The governance system makes it difficult to re-evaluate objectives across all areas of the WEFE nexus and to combine several objectives in global agreements, if necessary.

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Strategies and instruments - Relevant strategies and instruments across WEFE nexus domains do not urge WEFE nexus oriented behavior or management reform mainly because of the bureaucracy requirements. In fact, while administrative requirements are important, the administration takes a long time to answer when it answers. For example, stakeholders from the energy sector mentioned that permits for renewable energy constructions are not given because of the long process in which required documents expire. As a result, the score is **"low"**: The strict top-down governance system very weakly urge to combine or making use of different strategies and types of instruments across WEFE nexus domains.

Responsibilities and resources – It seems difficult to reassign responsibilities. For example, the hydropower sector tries to develop projects with other EU countries, but hydropower energy development is blocked by national law. As a result, the score is **"very low"**: The governance system does not allow to pool assigned responsibilities and resources across WEFE domains without compromising accountability and transparency.

Conclusion - The overall assessment of the flexibility is **"very low"**: While the governance system is flexible in terms of including new actors and networks, especially and the regional level, and that some policy objectives will be combined, the strict top-down nature and the high level of bureaucracy of the governance system makes is difficult to move across levels and scales and combine strategies and resources and responsibilities.

- **Intensity of action**

Actors and networks - The WEFE domains do not have a strategy to interact with other domains, except for the environmental domain whose main objective is to protect the environment, and which is not open to seeking synergies with other domains. As a result, the score is **"very low"**: There is no pressure from any relevant actor or coalition of actors across the WEFE nexus to better manage the WEFE nexus.

Levels and scales - The top-down nature of the governance system even seems to hinder more WEFE oriented management. As a result, the score is **"very low"**: There is no pressure from relevant levels and/or scales across the WEFE nexus domains towards behavioural change or management reform.

Problem perspectives and goal ambitions –There is hardly any pressure from any relevant actor or coalition of actors in the WEFE nexus areas for behavioural change or management reform. The question of solid waste pollution all over the country is illustrating the very low level of environmental awareness and the necessity of intensifying environmental education. Regarding the energy transition, the pressure for more interaction is coming from the private sector of the energy as renewables developments, wind, solar or hydro requires environmental impact permits or agricultural land. However, it is mainly a question of obtaining permits. As a result, the

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score is **"low"**: Problem perspectives and goal ambitions across WEFE domains weakly urge nexus orientation.

Strategies and instruments - Natura 2000 is an instrument that urges for more cross sectoral interaction for the efficient protection of the biodiversity. However, stakeholders mention that there is no monitoring of permit requirements in practice. While the EC urges for transition and resilience objectives and SDGs, the instrument gaps do not permit any strategy to urge for more WEFE nexus orientation. As a result, the score is **"low"**: Relevant strategies and instruments across WEFE nexus domains weakly urge WEFE nexus-oriented behaviour or management reform.

Responsibilities and resources - While a lack of financial resources is not mentioned by most stakeholders as a barrier, some stakeholders mention that the level of bureaucracy hinders attracting foreign private investors to foster renewable energy infrastructure for example. Moreover, stakeholders do mention a lack of expertise, especially at the regional level. As a result, the score is **"low"**: Responsibilities and resources across WEFE nexus domains weakly urge implementation of WEFE nexus-oriented actions.

Conclusion - The overall assessment of the intensity of action is **"low"**: There is no pressure from any actor, network or level or scale for more WEFE nexus-oriented management. While there are some strategies and instruments that could urge for more WEFE oriented management, in practice these instruments are very weak because of the lack of monitoring and the difficulties to obtain permits. Lastly there is a lack of expertise, and the bureaucracy holds off foreign investors.

- **Fit**

Actors and networks - Specifically, stakeholders have not expressed interest in, nor are they prepared to engage in, more holistic natural resource management. Except for the environmental domain which is organised. As a result, the score is **"very low"**: The relevant actors and networks in the WEFE nexus areas are not well suited to deal with the properties and functions of ecosystems.

Levels and scales - The inflexible top-down governance system makes it difficult to address the WEFE nexus issues at the appropriate scale. For example, the regional and local level could be the appropriate level to take action, but do not have a legal mandate to do so. As a result, the score is **"very low"**: Relevant levels and scales across WEFE nexus domains are inappropriate to deal with ecosystem properties and dynamics.

Problem perspectives and goal ambitions - There seems to be very little environmental awareness and the objectives and ambitions are very sectoral and therefore do not take into account the interdependencies. As a result, the score is **"very low"**: The problem perspectives and goals in the WEFE nexus domains never take into account the properties and functions of ecosystems.

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Strategies and instruments - While on paper there are some policy instruments that take into account ecosystem properties, the lack of monitoring and implementations make the strategies and instruments unequipped to take the ecosystem properties and functions into consideration. As a result, the score is **"very low"**: Relevant strategies and instruments across WEFE nexus domains never take into account ecosystem properties and functions.

Responsibilities and resources - There is a high level of bureaucracy and a real lack of environmental expertise in institutions. As a result, the score is **"very low"**: Responsibilities and resources across WEFE nexus domains are never appropriate to deal with ecosystem properties and functions.

Conclusion - The overall assessment of the fit is **"very low"**: The actors and networks, levels and scales, and responsibilities and resources are not appropriate to deal with the ecosystem properties and functions. This mainly stems from the rigid top-down governance system and a lack of expertise and interest in other domains. Both problem perspectives and goal ambitions and strategies and instruments across the WEFE domains do not take the ecosystems properties and functions into account. This stems mainly from a lack of awareness, strict sectoral view, and ineffective monitoring systems.

As the result, the matrix of the overall scoring is as follows.

Table 6: Matrix of the overall scoring in the Mesta River in Bulgaria

Dimensions / Criteria	Comprehensiveness	Coherence	Flexibility	Intensity of action	Fit
Actors and networks	HIGH	LOW	HIGH	VERY LOW	VERY LOW
Levels and scales	HIGH	VERY LOW	VERY LOW	VERY LOW	VERY LOW
Problem perspectives and goals ambitions	LOW	VERY LOW	LOW	LOW	VERY LOW
Strategies and instruments	HIGH	LOW	LOW	LOW	VERY LOW
Responsibilities and resources	HIGH	LOW	VERY LOW	LOW	VERY LOW
Overall assessment	HIGH	LOW	VERY LOW	LOW	VERY LOW
Concluding evaluation	The current governance system is highly restrictive toward WEFE nexus goverance				

Policy coherence analysis results

The validated results of the policy coherence analysis for the Bulgarian part in the Mesta/Nestos river basin are presented in Figure 8. During the focus group, the stakeholders agreed mostly with the level of policy coherence as found in the policy documents by the local partners, only two scores were changed. First, the level of policy coherence between the water ordinance and the food domain was changed into

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a high policy coherence as this ordinance requires permits for irrigation. Second, the level of coherence between the energy act and the food domain was deemed high according to the stakeholders.

Sector	Policy	Water	Energy	Food/ Agriculture	Land/ Soil	Biodiversity/ Ecosystems	Climate
Water	Water law						
Water	Ordinance No.1 from 10.10.2007 on the exploration, use, and protection of groundwaters						
Water	Law on Regulation of Water Supply and Sewarage Services						
Ecosystem	Environmental Protection Act						
Cross-sectoral	Disaster Protection Act						
Energy	Energy Act						
Energy	Energy from Renewable Energy Act						
Climate	Climate Change Mitigation Act						
Water	Regulation No. 2 on the protection of waters against nitrate pollution from agricultural sources						

Not applicable
No integration
Weak integration
Strong integration

Figure 8 Validated results of policy coherence analysis Mesta-Bulgaria

Figure 8 shows the results of the policy coherence results for Bulgaria. The ecosystem/biodiversity domain seems to be well integrated into the policies of the other policy domains. This confirms the strong position on the ecosystem domain as mentioned during the NXGAT interviews. Interestingly, the climate domain does not seem to be very well integrated in the other domains. This was a surprise to the stakeholders as they see the climate and climate change as an important factor influencing the other domains. Similar perceptions were expressed regarding the relation between land/soil and water. While the policy documents might not reflect a connection between soil/land and water, the stakeholders indicated that in practice there is an important relation and would like to see this better reflected in future policies.

The figure shows that the assessed policies in Bulgaria show a quite high level of policy coherence overall. This can be explained by the harmonisation process of the Bulgarian law with EU legislation. This is in line with the high score on comprehensiveness of the strategies and instruments in the NXGAT. Similar to the low score in the coherence of strategies and instruments in the NXGAT, the stakeholders during the focus group indicated that while they mostly agree that the scores in Figure

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8 reflect the reality of the policy documents, the scores do not reflect the degree of policy coherence in practice. Unfortunately, the stakeholders indicated that there was not enough time to discuss this discrepancy. Moreover, policy coherence was said to be a sensitive topic, making it difficult to find stakeholders willing to discuss this topic.

Self-scoring of cross-sectoral management by stakeholders

To the question *"if you were to **score cross-sectoral management** in the river basin concerning the problems we discussed, which score would you give between 0 (no cross-sectoral management) and 3 (good cross-sectoral management)?"* the **average** value given in response is **2.1**, as the regional level scored 2 and the local level scored 2?3.

We only met with regional actors, which are devolved departments of central government and local actors.

The regional actors we met all gave governance **a clear score of 2**. They felt that the sectors interacted well, but that there was still room for improvement.

- The director of the stern Aegean Basin Directorate confirms that the organisation holds meetings with representatives from all sectors whenever necessary.
- For the representative of the Regional Administration for the Management of Dams, the sectors have good relations with each other, although he sometimes admits that some inspection organisations don't always show understanding for the problems of the administrations.
- For the director of the Union of Green Energy Producers in Bulgaria, there is interaction in theory, but in practice there is no cross-sectoral management.

The average score for the **local level is 2.3:**

- Representatives from local administrations and organisations give an even higher score than the regional level, **3.** Based on our question, this means that three sectors interact, taking into account each other's needs
- For the representatives of the municipalities of Gotse Delchev and Garmen, who are responsible for environmental issues, and for the representative of the bird protection NGO, there is interaction between the sectors. They speak about interaction more than intersectorality. Most of all, they talk about ecosystems and relations with local authorities or, in the case of NGOs, with national or even international authorities or organisations. An example of this interaction is that this NGO is always invited to participate when there is a conservation project.
- In complete contrast to this score of 3, a farmer interviewed who owns about 400 hectares near Gotse Delchev gives a score of 0. This is because, according

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to him, each institution works autonomously – there's no synergy, no organisation, too much bureaucracy.

The score given by Bulgarian stakeholders is surprisingly high compared to the results of the governance analysis, which shows a system that is rather "very restrictive" in its orientation towards intersectorality.

We can hypothesise that, on the one hand, the self-scoring result has more to do with interactions between administrations than with cross-sectoral initiatives, and, on the other hand, it tends to refer to policy instruments that can take account of interdependencies, but whose implementation can be and remains difficult. On the ground, intersectionality is still far from being put into practice (permits, water quality control, buffer zones, etc.).

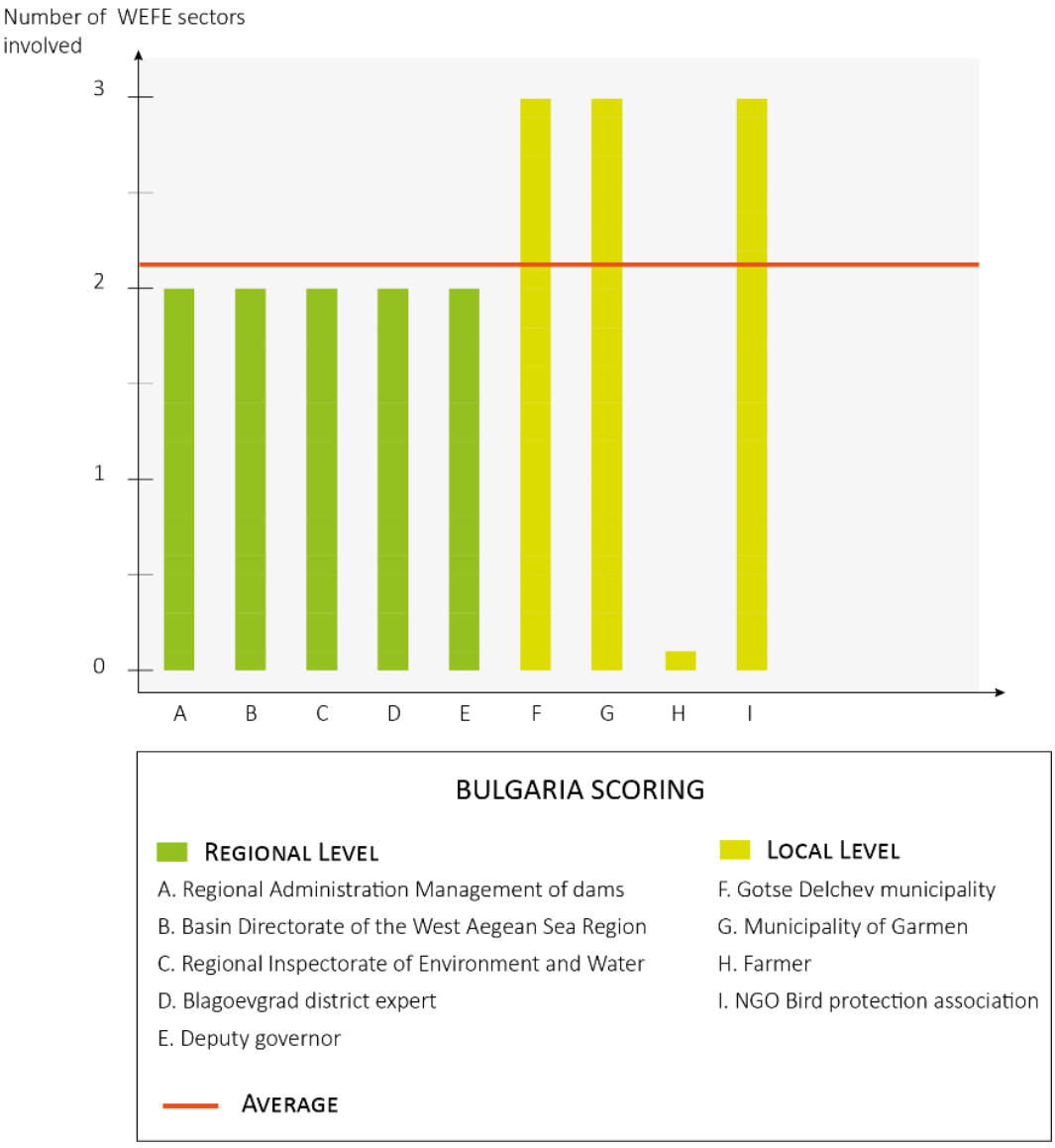

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Figure 9: Self-scoring by stakeholders interviewed of the WEFE nexus governance orientation in the Mesta/Nestos River in Bulgaria

1.2.2. In Greece

Analysis of governance system by criteria for each dimension Iand scoring

- **Comprehensiveness**

Actors and networks - Most of the actors are involved. However, this sometimes leads to having too many actors involved to address a certain issue. Full decentralisation of the water directorate of Thrace (region level affected at the Prefecture of Kavala) for the RBMP should ensure the participation of all stakeholders representatives' in the elaboration of the next RBMP As a result, the score is **"high"**: The majority of the **actors** in the various domains are involved.

Levels and scales - There are 3 levels active in the Nestos RB: Local, regional and national. The majority of the levels is involved in the decision-making process (national, regional) but the local level could be more involved. However, this is currently being improved. As a result, the score is **"high"**: The majority of relevant levels and scales across WEFE nexus domains are involved.

Problem perspectives and goal ambitions - The stakeholders do acknowledge similar problems such as high-water flow fluctuations (floods, destruction of micro habitats, limited water availability), water pollution, maintaining a minimum ecological flow, and the transboundary river agreement with Bulgaria. Despite acknowledging the common problems, each domain has a very sectoral vision on how to address these issues. However, younger people seem to acknowledge the intersectoral nature of these problems and therefore also the solutions. As a result, the score is **"high"**:

Strategies and instruments - Most strategies are designed at national level by the respective ministry. There are many different policy instruments that could support the WEFE orientation (buffer zones, Natura 2000, UNESCO heritage, EIA, etc.). For the new RBMP, the Water Directorate of Eastern Macedonia and Thrace will integrate the consequences of this plan for other areas of WEFE. The Water Management Directorate plans to introduce (i) monitoring of water consumption and (ii) payment for water in the new Xanthi irrigation district. As a result, the score is **"high"**: The majority of the relevant strategies and instruments have a WEFE orientation.

Responsibilities and resources - Some stakeholders report that responsibilities are clearly assigned but the regional and local levels sometimes compete for responsibility for project implementation. In addition, the transboundary status of the river complicates interventions in the riverbed. Although there is some continuity in funding

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(through national and EU funding), there is a lack of human resources at each level. As a result, the score is **"low"**: Few responsibilities are clearly assigned, and only limited resources are allocated across WEFE nexus areas to support the management of WEFE nexus.

Conclusion - The overall assessment of comprehensiveness is **"high"**: The majority of both the relevant actors and network and levels and scales are involved in the decision-making process. Moreover, there is a shared understanding of the main problems in the river basin. However, the different WEFE domains do have a strong sectoral orientation. In relation to the strategies and instruments, in theory there are many instruments available that could foster the transition to WEFE nexus governance, and most responsibilities are clearly assigned. However, there is a lack of both human and financial resources.

- **Coherence**

Actors and networks - There is little trust, collaboration or recognition of interdependencies between the actors in the different WEFE domains. There is even conflict between the agriculture and energy domains over land use. Even within the agriculture sector there is conflict. There are some examples of good collaboration between the irrigation district (food) and hydropower plant (energy). The national NGO has good trusting relationships with most actors. As a result, the score is **"low"**: Interactions of relevant actors and networks across WEFE domains are hardly cooperative, solid or based on trust.

Levels and scales - While the different levels and scales are not in conflict, they do not have a shared vision either. The RBMP is for example nationally designed (with the exception of the most recent version) while there are local differences. There also seems to be some distrust between the different levels on their respective capabilities to take adequate action. The national and regional levels work more closely together than the local level. As a result, the score is **"low"**: Relevant levels and scales across WEFE nexus domains rarely work together, rarely acknowledge interdependencies and have little trust on each other.

Problem perspectives and goal ambitions - There is a lot of competition for resources between the different WEFE domains – ecosystem versus food, energy (hydro/solar) versus food and ecosystems, energy (hydro) versus flood management. There is also competition within the food domain between upstream and downstream intensive agricultural districts. Water stress is expected to increase in the future, as agriculture demands more and more water for irrigation. As drinking water is produced from sources elsewhere, stakeholders believe that there is sufficient water in the region. Farmers and local authorities consider the level of the rivers as a problem (flooding). As a result, the score is **"low"**: Problem perspectives and goal ambitions across the WEFE nexus rarely reinforce each other.

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Strategies and instruments - The Greek national level is a powerful actor promoting different strategies: energy (solar, wind), agriculture (new drip irrigation system in Xanthi) and environmental issues (Natura 2000, creation of NECCA). However, these strategies create conflicts over resource management at the local level. Although the Nestos River is in a protected area, but there is a hydroelectric dam upstream that affects the natural flow of the river. Greek national legislation has taken some initiatives to promote synergies, but these are still in their infancy. As a result, the score is **"low"**: The relevant strategies and instruments in the WEFE nexus areas rarely reinforce each other.

Responsibilities and resources - The strong influence of the national government is mainly focused on sectoral developments. However, the RBMP, for example, has recently come under the responsibility of the East Macedonia-Thrace Water Directorate, which aims to integrate more other areas into the new RBMP. The establishment of NECCA (local representation of the national Ministry of Environment) is also a step towards a more integrated management of the WEFE, but it also lacks human resources. As a result, the score is **"low"**: The responsibilities and resources between the WEFE nexus areas rarely lead to cooperation between these areas.

Conclusion - The overall assessment of coherence is **"low"**: There is hardly any trust, collaboration or recognition of interdependencies between the actors in the different WEFE nexus domains and there are even conflicts within the actors of one domain. In addition, there is hardly any trust and collaboration between the different levels and scales. The competition around resources results in very few shared goal ambitions and the relevant strategies and instruments in the WEFE nexus areas rarely reinforce each other in practice. Lastly, the responsibilities and resources between the WEFE nexus areas rarely lead to cooperation between these areas.

- **Flexibility**

Actors and networks - In the energy sector, private energy companies have emerged in the region and there are foreign companies assisting municipalities to set up geothermal infrastructure. In addition, the region of Eastern Macedonia and Thrace is the only region to have Vice governor for fisheries as they are crucial for the local economy and ecosystem. As a result, the score is **"high"**: The governance system allows to include new actors.

Levels and scales - It is difficult to change levels and scales in the Nestos river basin. Nestos is a transboundary river, and the river is therefore the responsibility of the national government. This makes it virtually impossible for the local government to intervene in the river (e.g., flood prevention measures). Only when there is an emergency the municipality can take action. In every WEFE sector there is a strict national law. As a result, the score is **"low"**: The governance system makes it difficult to change levels and/or scales at which WEFE nexus issues are addressed.

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Problem perspectives and goal ambitions - The governance system makes it difficult to re-evaluate targets across all areas of the WEFE interface and to combine several targets in global agreements, if necessary. At the national level, the energy field is prioritised over other fields. The war in Ukraine has intensified this prioritisation, especially for hydropower. For the other domains, it is difficult to reassess the objectives and domains. As a result, the score is **"low"**: The governance system makes it difficult to re-assess goals across WEFE nexus domains and combine multiple goals in package deals as needed.

Strategies and instruments - There are many different policy instruments that allow for a choice or combination of instruments in theory. In practice, they are not always implemented. An example of a combination of policy instruments is the proposal to declare the Nestos Gorge a UNESCO heritage site in addition to the Natura 2000 status. As a result, the score is **"high"**: The governance system allows for the combination or use of different strategies and types of instruments in the areas of the WEFE link in some situations.

Responsibilities and resources - In case of an emergency, it is possible to pool responsibilities and resources. For example, in the case of floods, municipalities receive additional resources and are given additional responsibilities to manage the river, but these responsibilities are temporary in relation to crisis management. Pooling of resources and responsibilities is not mentioned in the context of droughts. As a result, the score is **"high"**: The governance system allows to pool responsibilities and resources allocated in the different areas of the WEFE without compromising accountability and transparency in some situations.

Conclusion - The overall assessment of flexibility is **"high"**: Despite the difficulty in changing levels and scales and re-evaluating targets across all areas of the WEFE interface and to combine several targets in global agreements, if necessary. The governance system does allow the inclusion of new actors, and combine different strategies and instruments, and pool resources and responsibilities in certain situations.

- **Intensity of action**

Actors and networks - Actors in the food (fishery) domain take initiatives for synergies between the food and ecosystem domain. The actors in the ecosystem domain recognise the interdependencies and take some initiatives, but the organisation is in its early stages. While there is not a strong drive here, an upward trend can still be seen. As a result, the score is **"low"**: There is some pressure from several actors towards a more WEFE nexus-oriented management.

Levels and scales - The Greek national level is a very influential actor, but it is currently sectoral oriented. The regional level could play an intermediary role between the different levels and scales, but it does not do so at the moment. As a result, the

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score is **"very low"**: There is currently no pressure from the different levels and scales to manage more towards the WEFE nexus.

Problem perspectives and goal ambitions - The perspectives of the problems and the ambitions of the objectives in the WEFE nexus areas are only weakly conducive to nexus orientation. Only in emergencies, such as floods, do the different WEFE domains act intensively to solve the problem at hand. In normal situations, the representatives of the ecosystem domain push for a more holistic view. The organisation responsible for this area is relatively new. As a result, the score is **"low"**: Problem perspectives and goal ambitions across WEFE nexus domains weakly urge nexus orientation.

Strategies and instruments - The RBMP, for example, exists on paper and is not implemented in practice. Stakeholders mentioned that although there is an abundance of laws, these need to be modernised. In addition, there is a lot of bureaucracy which slows down development. Only the Natura 2000 status of the river gives some direction towards a more cross-sectoral management. As a result, the score is **"very low"**: The relevant strategies and instruments in the WEFE nexus areas do not encourage WEFE nexus-oriented behaviour or management reform.

Responsibilities and resources - According to stakeholders, there are already not enough resources for day-to-day operations and therefore not enough for more cross-sectoral management either. Some private investors are contributing to the development of solar energy, but they do not encourage synergies with other sectors (which often leads to conflicts with the agricultural sector). However, the Ministry of Rural Development and Food is planning to create a new public-private partnership to foster synergies between the agricultural and energy sectors. As a result, the score is **"low"**: Responsibilities and resources in the different areas of the WEFE interface provide little incentive for the implementation of the initiative.

Conclusion - The overall assessment of intensity of action is **"low"**: There is only some pressure from the actors and networks in the region towards more WEFE nexus-oriented management. The same is true for the problem perspective and goals, except for emergency situations. The relevant strategies and instruments in the WEFE nexus areas do not encourage WEFE nexus-oriented behaviour or management reform due to the abundance of outdated laws and regulations. Responsibilities and resources in the different areas of the WEFE interface provide hardly any incentive for the implementation of the initiative as there is a lack of human resources for day-to-day operations. Lastly, the most powerful scale, the national scale, is mainly sector oriented and therefore does not push towards more WEFE nexus governance.

- **Fit**

Actors and networks - The current actors are not always well suited to managing ecosystem properties. They are still sector-focused and there are no collaborative councils or organisations that can address cross-sectoral issues in a holistic way. As

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a result, the score is **"low"**: Relevant actors and networks across WEFE nexus domains are little appropriate to deal with ecosystem properties and functions.

Levels and scales – The relevant levels and scales of the governance system are not well-suited to manage ecosystem properties. However, the recent establishment of the Natural Environment and Climate Agency at national level (NECCA), which operates at local level for natural areas, is a step in the right direction. Furthermore, a decentralisation process is underway and the new RBMP will be designed at the local level by the decentralised water district of Eastern Macedonia and the Water Directorate of Thrace. As a result, the score is **"low"**: Relevant levels and scales of the governance system hardly match ecosystem properties and functions.

Problem perspectives and goal ambitions – There is very little indication that the problem perspectives and goal ambitions take the ecosystem properties and functions into account. Most actors' perspectives are sector oriented. However, interviewees mentioned a shift in perspectives in especially the younger generation of farmers. Moreover, NECCA and the Governor of Fisheries seem to understand the impacts that different nexus domains have on each other and tries to create synergies. As a result, the score is **"low"**: Problem perspectives and goal ambitions across WEFE nexus domains rarely take into account ecosystem properties and functions.

Strategies and instruments - Although there are some initiatives around the new RBMP and, of course, through Natura 2000 areas, implementation in practice is proving difficult. In addition, bureaucracy and lengthy processes for fulfilling legal requirements make intersectoral work difficult. As a result, the score is **"low"**: The relevant strategies and instruments in the WEFE nexus areas rarely take into account ecosystem properties and functions.

Responsibilities and resources - The irrigation dam, which controls water levels in the river, is managed by agricultural stakeholders, who have a strong interest in agriculture rather than the ecosystem. National legislation is said to be not adapted to local problems. In addition, river basin data is from the 1960s, which is a problem in designing the RBMP. As a result, the score is **"low"**: Responsibilities and resources in the WEFE nexus areas are rarely appropriate to address ecosystem properties and functions.

Conclusion - The overall assessment of fit is **"low"**: Most actors and networks are very sector oriented. Despite noticing an upward trend, the levels and scales do not yet match the ecosystem properties and functions. Similarly, the available strategies and instruments do not take the ecosystems functions into consideration. The stakeholders showed no indication that the problem perspectives and goal ambitions take the ecosystem properties and functions into account. Moreover, the assigned responsibilities and resources almost never appropriate to deal with the problem at hand.

As the result, the matrix of the overall scoring is as follows.

Table 7: Matrix of the overall scoring in the Nestos River in Greece

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Dimensions / Criteria	Comprehensiveness	Coherence	Flexibility	Intensity of action	Fit
Actors and networks	HIGH	LOW	HIGH	LOW	LOW
Levels and scales	HIGH	LOW	LOW	VERY LOW	LOW
Problem perspectives and goals ambitions	HIGH	LOW	LOW	LOW	LOW
Strategies and instruments	HIGH	LOW	HIGH	VERY LOW	LOW
Responsibilities and resources	LOW	LOW	HIGH	LOW	LOW
Overall assessment	HIGH	LOW	HIGH	LOW	LOW
Concluding evaluation	The current governance system is **restrictive** toward WEFE nexus goverance				

Policy coherence analysis results

Figure 10 shows the results of the policy coherence analysis for Greece. The Greek policies show a lower level of policy coherence compared to their Bulgarian counterpart. The policy coherence analysis confirms the high comprehensiveness and low coherence in strategies and instruments as found in the NXGAT.

The results of the policy coherence analysis show that the highest level of integration exists between policies for the energy sector and the climate sector. The land/soil sector and the ecosystem sector seem to have the least coherence with policies from the energy sector. Interestingly, policies from the water sector do not seem very coherent with the other sectors, while policies from the energy, food and biodiversity/ecosystem sector do seem to take the water sector into account. Policies from the food and agriculture sector only show strong integration with the water sector. The results were validated by local stakeholders. While they mostly agreed with the scores, stakeholders also indicated that for some policies they expected a higher level of coherence than was found in the policy documents, as they do have an impact on other sectors in practice.

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Sector	Policy	Water	Energy	Food/ Agriculture	Land/ Soil	Biodiversity/ Ecosystems	Climate
Water	Law 3199/2003 on the protection and management of water resources - Reconciliation with the WFD 2000/60/EC						
Water	Legislative Decree 51/2007 on the determination of measures and procedures for the integrated protection and management of water resources in compliance with the WFD 2000/60/EC						
Water	Measures for the protection of groundwater from pollution and deterioration in compliance with the European Directive 2006/118/EC						
Water	Assessment and management of flood risk in compliance with the provisions of the European Directive 2007/60/EC						
Water	General rules regulating the costs and pricing system of water services. Method and processes for recovery of costs for water services and relevant water uses						
Energy	Special legislative framework of spatial planning and sustainable development for the renewable energy sector and the respective strategic environmental impact assessment						
Energy	Electricity production from RES and cogeneration of high performance electricity and heat						
Energy	Promotion of cogeneration from two or more types of energy - Issues concerning Mesochora hydroelectric power project						
Energy	Operation of electricity markets and natural gas markets - Research, production and transmission networks for hydrocarbons						
Energy	Support electricity production from RES and high performance electricity and heat production from cogeneration - Legal and operational separation of natural gas supply and distribution						
Energy/ Climate	Ratification of the National Energy Plan for Energy and Climate						
Agriculture/ Food	Pesticides market in Greece - Rational use of pesticides						
Agriculture/ Food	Development of the aquaculture sector						
Food	Administrative measures, processes and penalties for the implementation of EU and National legislation in the sectors of food, feed, health and protection of animals						
Biodiversity/ Ecosystems	Preservation of Biodiversity						
Biodiversity/ Ecosystems	National Strategy for biodiversity between 2014-2029 and 5-years action plan						

Not applicable
No integration
Weak integration
Strong integration

Figure 10: Validated results of policy coherence analysis Nestos-Greece

Self-scoring of cross-sectoral management by stakeholders

To the question *"if you were to **score cross-sectoral management** in the river basin concerning the problems we discussed, which score would you give between 0 (no cross-sectoral management) and 3 (good cross-sectoral management)?",* the **average** value given in response is **1.3.**

- the national level scored **1.3**;
- the regional level scored **1.1**;
- the local level scored **1.6.**

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- **At national level**: **Score 1.3**

The two NECCA (Natural Environment & Climate Change Agency) staff members both give a score of 2. This is because they believe that there is real interaction and consideration of the needs of the ecosystem by farmers and the tourism sector (as a water sector). Farmers and the tourism sector provide valuable support. The NECCA organisation has no real links with the energy sector, which is more controlled at national level. They cooperate locally with a wide range of stakeholders of the protected areas.

On the other hand, an environmental expert, a professor at the University of Democritus, gave a score of 0. The existing plans to expand irrigation areas and agricultural activity in the delta plain will have an impact on the delta's ecosystems, in addition to the impact on water availability that hydropower already has, so that according to this expert the WEFE nexus coherence is completely denied here.

The representative from the Fishery Institute, a national research centre, believes that there is hardly any cross-sectoral cooperation. Between two sectors like agriculture and energy (reuse of manure to produce energy for instance) there are initiatives, but there are none systematically. Hence the score of 1 with expected improvement in the near future.

- **At regional level: Score 1.1**

The representative from the Directorate of Agricultural Economy and Veterinary (Xanthi Prefecture) gives a score of 1, slowly approaching 1.5. Things could improve if there were changes at central government level: *"There is a need for a better framework/working directive, we could move more quickly towards inter-sectorality"*. People are ready, but they need a clear directive.

The Governorate of Eastern Macedonia and Thrace Region for Fisheries Policy scores higher, giving a score of 2, as agriculture and environment and water are exchanging regarding the fisheries protection.

The Water Directorate of Eastern Macedonia – Thrace gave a score of 0.5 and 1 (2 people) because there is intersectorality only in emergency situations, such as floods. When it is necessary to act together with the agricultural sector, it happens. Otherwise, in his opinion, farmers feel generally unconcerned the water sector.

- **At the local level: Score 1.6**

It is at this local level that the score is highest, although still modest at 1.6.

The local irrigation organisation (using water from the Toxotes dam) gave a score of 2, because he believes that the three sectors (agriculture, energy and ecosystems) are capable of talking to each other and taking into account the impact of each on the other.

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The representatives of the municipalities of Topeiros (2 people) gave a score of 1 and 2.

They explained the score of 1 by the fact that the problems caused by agriculture on the drinking water supply or the environmental impact of an energy plant are sometimes taken into account. However, there is still a lot to be done to achieve real intersectorality. One stakeholder from public works gave a score of 2, because he believes that agriculture, water supply and the environment communicate and cooperate on a regular basis.

Compared to Bulgaria, Greece's score is closer to the results of the governance analysis, which concludes that the system is "restrictive" in terms of cross-sectoral management. In the downstream section of the basin, interests linked to energy production and agricultural activities prevent greater attention being paid to the needs of ecosystems which, although protected by a NATURA 2000 site, are still perceived to be under threat.

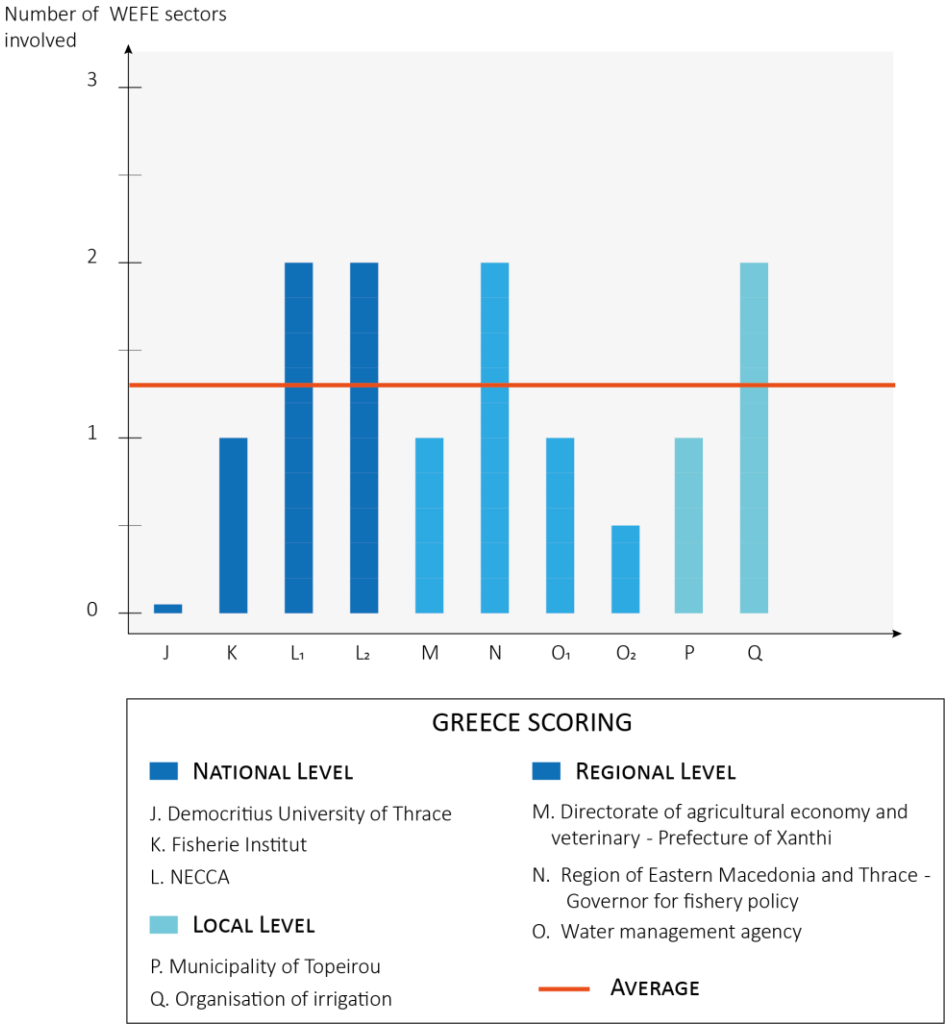

Figure 11: Self-scoring by stakeholders interviewed of the WEFE nexus governance orientation in the Mesta/Nestos River in Greece

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1.3. Concluding evaluation of the Mesta-Nestos River

1.3.1. Concluding evaluation for each country

Bulgaria

The current governance system is **“highly restrictive”** because:

- The centralised and hierarchical administrative context;
- The time needed for administrative tasks due to bureaucracy;
- Fragmentation of responsibilities across administrative organisations;
- The sectoral economic vision of the WEFE domains;
- Environmental protection vs renewable energy production: Need for cross-sectoral collaboration;
- High policy coherence on paper is result of coherence of EU policies from which the Bulgarian policies are derived.
- EU climate policy is integrated into national policies. However, despite the integration, national climate policy is not yet implemented according to the stakeholders interviewed".

Greece

The current governance system is **“restrictive”** because:

- The centralised and hierarchical administrative context;
- Lack of structured communication between levels;
- Lack of trust between WEFE domains;
- Numerous Greek policies across WEFE sectors only recognise sectoral interdependencies to a limited extent.

1.3.2. Barriers and levers at the river basin level

Barriers

- Bureaucracy takes up a lot of time and human resources;
- Lack of knowledge about transnational agreements results in misunderstandings
- The levels in both countries do not trust other levels to find solutions to the problems they face;

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- No communication on the monitoring of water quality and flows in the river
- Lack of local human and financial resources.

Levers

- At regional scale (directorate) the interrelations seem to be frequent and good in each country. This regional level could be the right one to promote more cross-sectoral orientation
- The creation of a National Environment and Climate Change Agency (NECCA) with local offices (in Greece) could be used as a step towards strengthening mediation for the protection of local ecosystems
- The need of renewable energies will urge for more cross-sectoral interactions which can support the development of bottom-up initiative within and across countries

1.3.3. Recommendations to urge for more WEFE nexus governance and transboundary cooperation

Some key results of the investigation are presented below and are meant to help stakeholders (i) move towards cross-sectoral resource management in Bulgaria, in Greece and in the river basin; and (ii) provide some pathways on how the current cross-border cooperation could impact cross-sectoral resource management in the river basin.

Hydraulic complexity of the system

The Mesta-Nestos basin is a complex hydraulic river basin. As a result, stakeholders in the two countries have very different perceptions and understandings of water issues, the interconnections of resources at the basin ecosystem level and the interdependencies between upstream and downstream resources. Specifically, the analysis shows that there is a low level of knowledge and awareness about the hydrological processes of the river, and about the impact of upstream water use on downstream water quality and quantity. For example, Bulgarian stakeholders reported that the dams on their territory (in particular the dam on the Dospat River) do not play a significant role in the downstream water level fluctuations. In their view, the climate governs the Mesta water levels, while downstream the Greek dams regulate the Nestos Delta water levels. In contrast, in the Greek part of the basin, where the extended dam's system is crucially important for the entire irrigation network of the delta and its ecological functioning, some interviewees indicated that the Nestos Delta water level fluctuation is the result of the management of the upstream dams in Bulgaria.

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Lack of trust between local – regional – national levels within and across the two countries hampers bottom-up initiatives to urge for more cross-sectoral and transboundary cooperation

Another element that does not seem to favour fruitful cross-sectoral and cross-border cooperation is the mistrust at regional and local level in both countries towards the respective national authorities, as well as between the two countries, resulting from the lack of clarity regarding cross-border agreements on the volumes of water flowing from Bulgaria to Greece. Negotiations take place at the state level, and the interviews showed that hardly any information reaches the local actors. The upstream and downstream interviewees did not seem to be sufficiently informed about the cross-border agreements and initiatives. To the stakeholders' knowledge, these agreements and initiatives exist only on paper and have neither yet been implemented nor are already showing effectiveness. This poor information sharing is one of the contributing factors to the lack of a shared vision among cross-border actors on the river basin as a whole.

Flood and droughts are the main river basin issues but managed in silo

Bulgarian and Greek interviewees across WEFE sectors consider extreme weather events to be the most important problems. Floods are an issue in both countries, while droughts are a problem especially downstream in Greece. Despite acknowledging that climate change is going to worsen these problems, the impact of climate change on the basin's water resources was only mentioned as a problem by actors working on ecosystem conservation, but they did not indicate any adaptation strategy or measure.

Cross-sectoral management of river basin resources is not on the decision-makers agenda

Cross-sectoral management of natural resources in the river basin is not on the agenda of policy makers of both countries. One of the reasons for hardly any cross-sectoral management is that the governance model in both countries is typically top-down steering and sectoral oriented with little flexibility for governance change. In this context, the actors interviewed do not seem to know how to address cross-sectoral interdependencies. As a result, although there is recognition of the need for it, there are no actors pressing for change in this direction.

Levers for more transboundary cooperation to urge for more WEFE nexus governance

The analysis revealed several levers that, if properly exploited, could promote greater interaction between WEFE sectors at the sub-basin level, but also at transboundary level. In particular, the need to manage Natura 2000 areas located upstream and downstream in the river basin can represent an opportunity to urge for more

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transboundary exchanges and more cross-sectoral management. Although the Natura 2000 sites are country based, management actions need to be agreed to by both upstream and downstream countries if the ecological functions of the basin are to be preserved effectively. Regional authorities from the two countries currently responsible for the revision of river basin management plans (RBMPs), the Eastern Macedonia-Thrace Water Directorate in Greece and the West Aegan River Basin Directorate in Bulgaria, appear to be best placed to facilitate the dialogue among cross-sectoral stakeholders for the management of natural resources in the basin, including ecosystems. The fact that these organisations operate at ecosystem scale within the respective countries has several advantages. First, they can understand problems and find solutions that take into consideration resource interdependencies from an ecosystem perspective. Second, they are strategically placed between national governmental organisations and local stakeholders. This facilitates information flow across levels within each country as well as the building up of relationships that can support the establishment of collaboration across scales. Finally, the proximity of these two organisations with the national governments, coupled with their knowledge of the local stakeholders and of the river basin ecosystem and resource management issues, places them in the position to facilitate cross-border stakeholder dialogue, provided that the two river basin organisations first establish and consolidate collaboration among themselves. This can start with small scale, local cross-border initiatives in the river basin, which could provide the basis for new national river basin management agreements.

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2. Lielupe River basin

The Lielupe River is a transboundary river located in the North-Eastern part of Europe. It is a transboundary river with Lithuania upstream and Latvia downstream, and which flows to the Baltic Sea. General information regarding water, energy, agriculture and environment to contextualise the case study are described below.

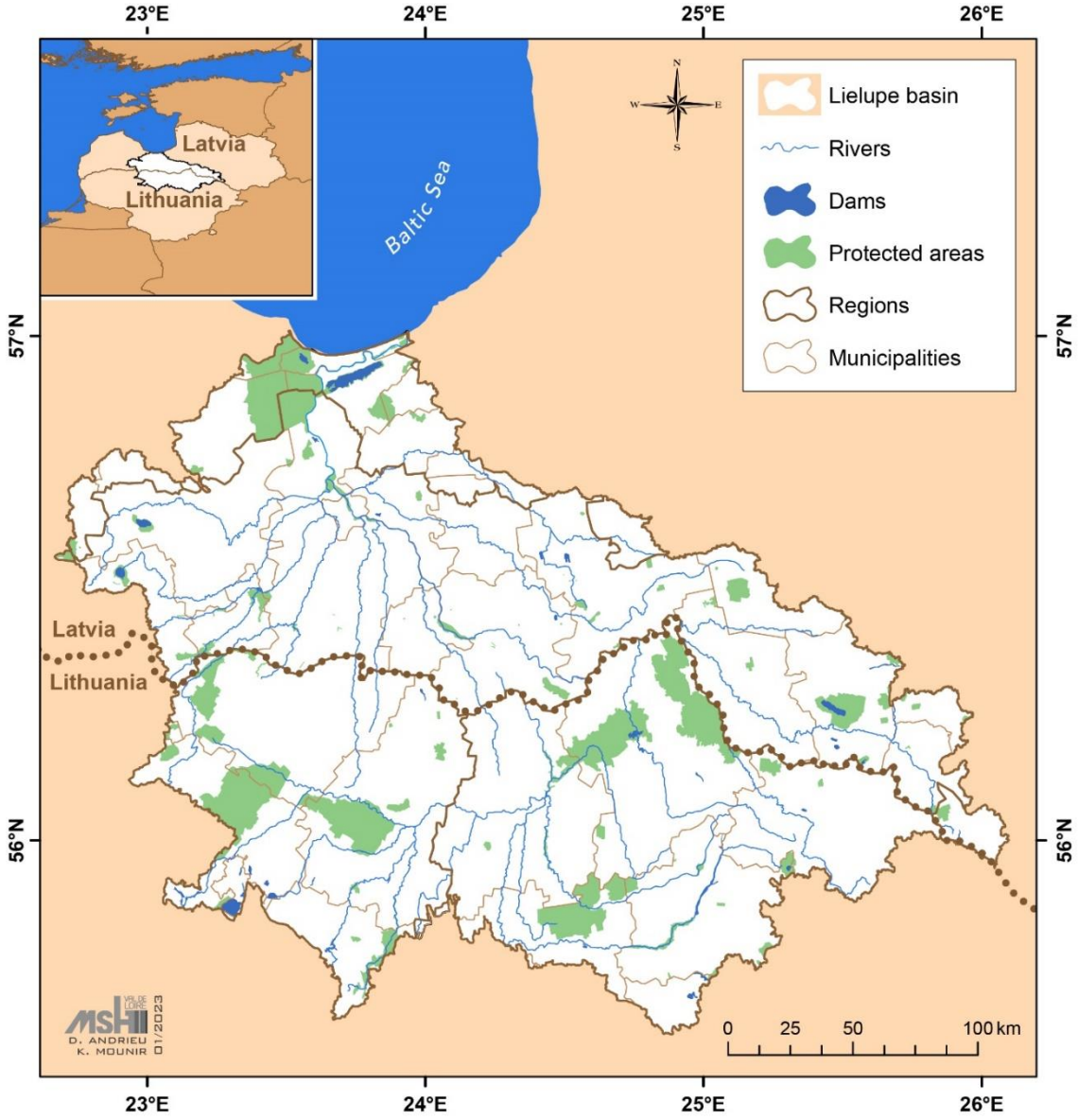

Figure 12 : Map of the Lielupe river basin in Lithuania (upstream) and Latvia (downstream)

2.1. Context and case study description

2.1.1. Biophysical context

The Lielupe River basin, covering 17,600 km², spans Latvia and Lithuania, with half located in Latvia. The river originates in Latvia at the confluence of the Musa and

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Nemunelis (Memele) rivers, which have sources in Lithuanian bogs and highlands, respectively, and flows into the Baltic Sea. The basin is characterized by a lowland landscape with numerous tributaries originating in Lithuania.

Table 8: Lielupe river basin areas in Lithuania (upstream) and Latvia (downstream) (AAA, 2010)

Lielupe River Basin			
Area	Country	Country's share	
17,600 km²	Latvia	8,662 km²	49.2%
	Lithuania	8,938 km²	50.8%

Source: Environmental Protection Agency, Lithuania.

Surface water resources generated in the Latvian part of the Lielupe basin are estimated at 1,844 × 10^6 m^3/year, and groundwater resources at 63.34 × 10^6 m^3/year, adding up to a total of 1,907 × 10^6 m^3/year (Lalit, 2017).

In the Lithuanian part of the basin, there are six reservoirs (> 1.5 km length and > 0.5 km² area) and 11 lakes (> 0.5 km² area). During the last 30 years, four droughts occurred in Lithuania, which have been categorised as natural disasters. As a consequence, a decrease of water levels in rivers, lakes and wetlands was registered. The droughts also resulted in agriculture production losses, increased amounts of fires, decreased amount of oxygen in water bodies and other effects (UNECE, 2007; Nazarenko et al. 2023).

Geologically, the Lielupe basin has thin Quaternary layers, with common deposits of limestone, clay, dolomite, marl, and glacial meltwater sediments (VARAM, 2009). The area also has deposits of peat and is characterized by sandy bedrock and limnoglacial clay soils, with alluvial and peat soils prevalent in agriculture (LCEGM, 2021). Peatlands in the Lielupe Basin are thus crucial for hydrological balance, biodiversity, and carbon storage, but they face pressures from agriculture and extraction. Historically, large areas of peatlands in the Lielupe Basin have been drained for agricultural use and peat extraction. Drainage alters the natural water retention of peatlands, reducing their ability to absorb excess water and leading to more frequent and severe flooding in other parts of the basin.

The climate is classified as "Dfb" under the Köppen system, features cold winters and mild summers, influenced by the Baltic Sea. Key locations like Jurmala (sea level) and Birzai (53 m elevation) experience average January lows of -3.49°C and -5.99°C, respectively, and July highs around 17.6°C to 17.8°C. Precipitation varies, peaking in summer and lower in winter, with Jurmala receiving 607.69 mm annually and Birzai 680.10 mm.

Water resources in the Latvian portion are estimated at 1,907 million m^3 annually, combining surface water and groundwater, 1,844 × 106 m3/year, and at 63.34 × 106 m3/year respectively (Lalit, 2017). Lithuania has over 29,000 kilometers of rivers, most of which are relatively small, which play a central role in the country's hydrology and

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economy. Lithuania is also known for its numerous lakes, with over 4,000 in total. Lakes serve as important sources for local water supply, recreation, and biodiversity. The Lielupe Lithuanian portion of the basin includes six large basins and eleven lakes (

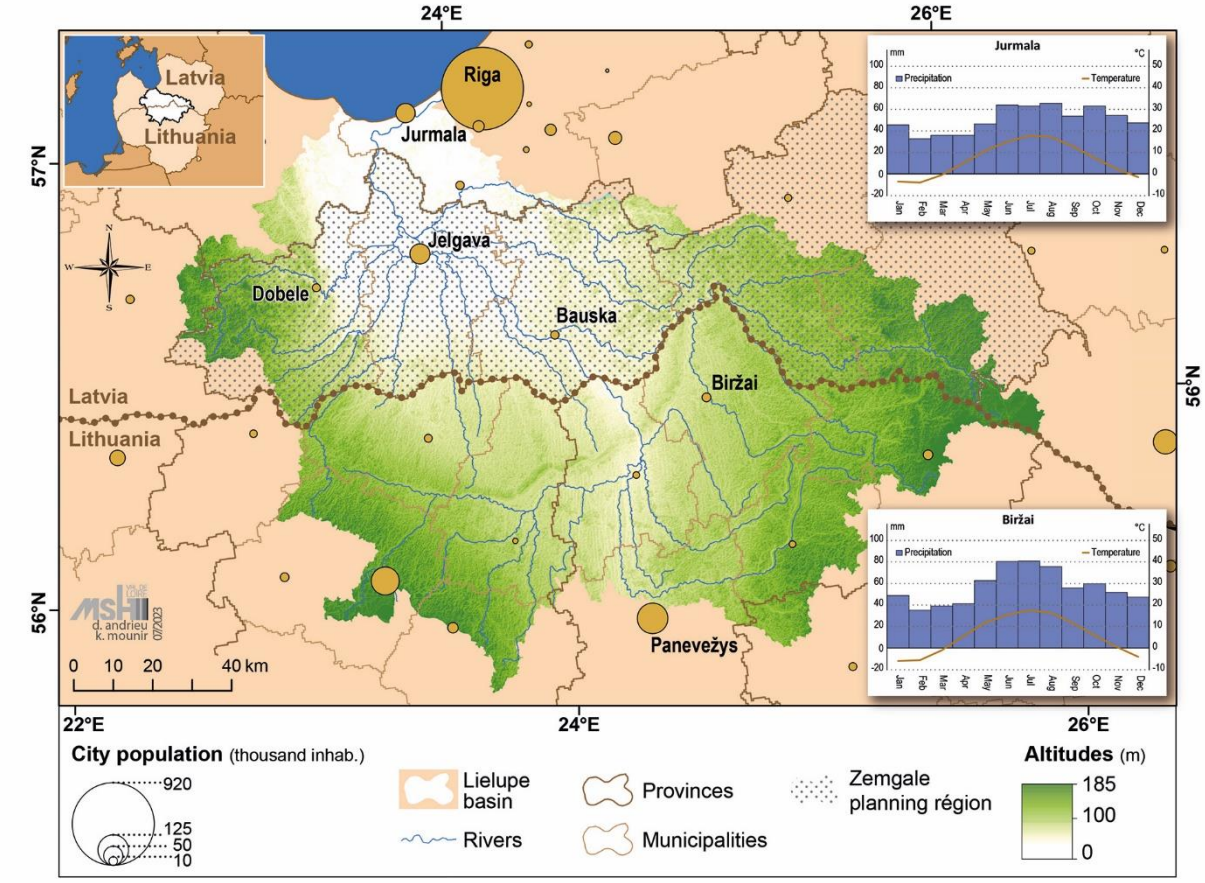

Figure 13).

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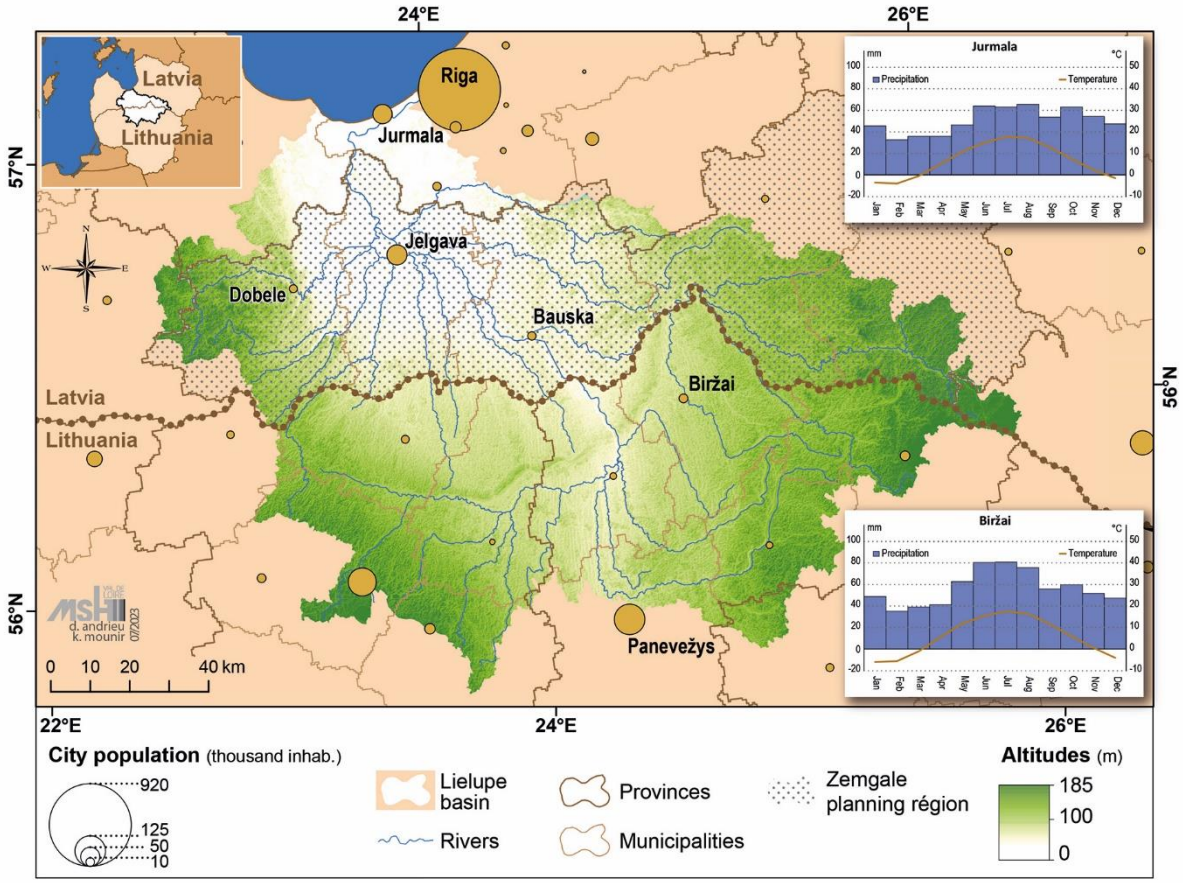

Figure 13: Tributaries of the Lielupe basin and elevation in the cathment area

The hydrological situation in the Lielupe basin is sensitive to climatic disturbances. In particular, the occurrence of heavy rainfall provokes episodic flooding, especially in spring, due to the increased influx of meltwater. In addition, the periodic droughts underline the basin's exposure to climatic extremes (OECD, 2019).

2.1.2. Socio-economics sectors

In 2009, according to the Lielupe River Management Plan, there were more 700,000 inhabitants in the Lielupe river basin (320,000 inhabitants in the Latvian part and 390,000 inhabitants in the Lithuanian part) (UNECE, 2011). Higher densities are in urban areas, particularly in and around Riga, which lies near the mouth of the Lielupe. Other notable towns within the basin include Jelgava and Bauska, which serve as regional centers. The Lithuanian portion of the basin is predominantly rural characterized by lower population densities, aging demographics, and a declining population due to out-migration to cities and abroad. Agriculture remains a primary occupation in these areas, with family-owned farms and small settlements.

The breakdown of economic activities and land use is as follows: 51% of the land is used for agriculture, 34% for forestry, 11% for grassland and, to a lesser extent, 2% for industry and domestic water use, and 1% for wetlands (UNECE, 2011).

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Agriculture occupies a large portion of the Lielupe River Basin, covering around 52% in Latvia and an even greater area in Lithuania. This sector is the primary source of nutrient pollution, contributing 73% of nitrogen and 37% of phosphorus loads in the Latvian part of the basin, leading to shallow groundwater contamination in some areas. Nutrients from forestry activities are less significant, accounting for 12% of nitrogen and 8% of phosphorus in the Latvian portion (UNECE, 2011; EC, 2022).

Hydropower in the basin is represented by 18 small hydropower stations and numerous regulated water bodies, creating local hydro-morphological changes (Figure 14).

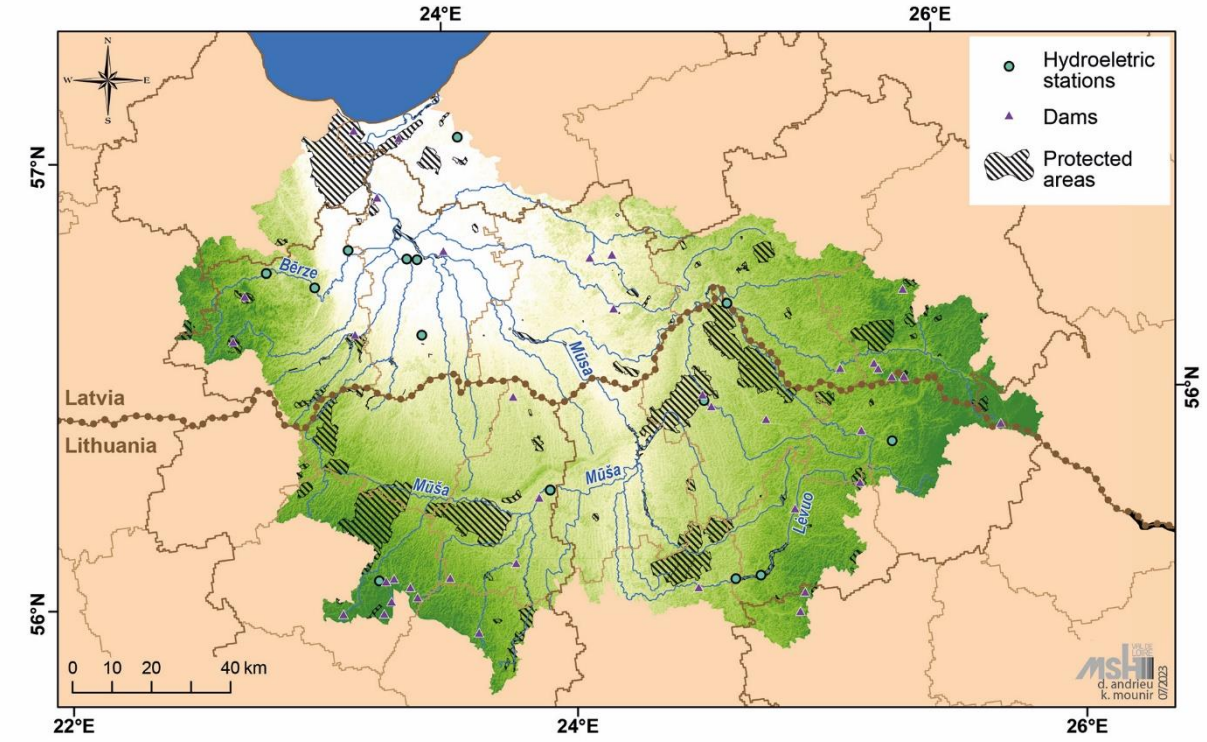

Figure 14: Localisation of dams and main hydroelectric stations.

Ecosystems and water quality

In Latvia – According to the river basin management plans, 51% of the surface water bodies are currently considered to be of high or good ecological quality (EC, 2022). The main cause of inadequate surface water quality is eutrophication from point and diffuse sources, morphological changes in rivers and an influx of biogens from neighbouring countries via transboundary watercourses. In the Lielupe River, the concentration of nitrogen is higher due to intensive agriculture in this region. Recent trends (EC, 2022) indicate a small increase in nitrogen concentrations in all rivers. More than 70% of the total nitrogen and more than 40% of the total phosphorus inland load is caused by various human activities. The main source of nitrogen is agriculture while the main source of phosphorus is municipal and industrial wastewater (EC, 2019; EC, 2022). Water protection is one of the main priorities in the environmental protection

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policy of the country. Good results have already been achieved up to now and wastewater treatment has improved significantly (EC, 2022).

In Lithuania – The most important sources of water pollution are diffuse pollution loads from agriculture, point pollution loads from discharges of wastewater treatment plants, surface run-off and industrial wastewater in towns and settlements (FAO, 2016; OECD, 2019). The quantitative and chemical condition of most of the groundwater basins is good and are monitored (Näslund, et al., 2012). Climate change will increase the vulnerability of the Lielupe River during summer, as well as altering spring and autumn floods. Reduced flows will adversely affect water quality in summer, and increased maximum lake temperatures will accelerate eutrophication processes (Climate Adaptation, 2015; FAO, 2016).

Political and administrative context

Latvia is a parliamentary democracy and a unitary state. Ministries are responsible for policy design, while subordinate agencies deliver public services giving the central government substantial fiscal control. The central government plays a dominant role in public expenditure. Following a 2009 administrative reform, Latvia is divided into **110 municipalities and 9 cities**, each with equal authority, except for Riga, which has additional responsibilities. Regional governance is organized into five planning regions, created by voluntary cooperation among municipalities and recognized by law. These regional governments play an important role in development and spatial planning, organization of public transport and management of investment programmes, including the European Union funds. However, these regions are not formal administrative divisions (Reinholde, 2018).

Lithuania, is a parliamentary democracy and decentralized unitary state. The country is divided into **10 regions** and **60 municipalities**, with the abolition of regional administrations in 2010 limiting regions to territorial and statistical functions, while municipalities hold self-governing authority, with both state and municipal budgets operating independently (Nakrošis, 2018).

Both Latvia and Lithuania share commonalities in their parliamentary democratic frameworks and unitary structures, with local governance primarily vested in municipalities. While Latvia's planning regions are not administrative divisions, Lithuania abolished its regional administrations, further centralizing power at the municipal level. The decision-making processes in both countries reflect a balance between political consensus and administrative professionalism, with an increasing influence of international standards and recommendations in shaping policy (Nakrošis, 2018).

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2.1.3. Key challenges for WEFE nexus and transboundary

In the Lielupe River basin, the most important interdependencies between water, energy, food and ecosystems are as follows:

- Nutrient Pollution and Eutrophication: Intensive agriculture, while essential for food production, introduces excess nutrients to water bodies, impacting water quality and ecosystem health.
- Balancing hydropower, industry and ecosystem preservation: While hydropower supports renewable energy goals, it impacts on river ecosystems which are not all well preserved. Efforts are underway to improve waste management, including the reconstruction of landfills and remediation of closed industrial and municipal dump sites (UNECE, 2011).
- Restoration of Peatlands: peatlands face pressures from agriculture and extraction. Peatlands provides multiple benefits across the nexus by enhancing water retention, improving water quality, supporting biodiversity, and acting as carbon sinks. Their restoration can help mitigate some of the trade-offs between agriculture and ecosystem health.

Regarding cross-border interactions, there are joint initiatives between two countries regarding monitoring and management efforts to improve water quality in the Lielupe. Both Latvia and Lithuania have implemented initiatives to reduce nutrient pollution, improve wastewater treatment and monitor water quality under the guidance of the European Union's Water Framework Directive.

2.2. Results of the WEFE nexus governance assessment and policy coherence analysis in the Lielupe River

Between 6 – 10 June 2022 and between 14 – 17 September 2022, the field visit of the nexus governance assessment took place in the Lielupe River basin. Five members of the governance assessment team (UNT, KWR) conducted a total of 18 interviews (10 in Latvia and 8 in Lithuania) and interviewed a total of 37 stakeholders (11 in Latvia and 13 in Lithuania).

The interviews were semi-structured group interviews and lasted between 1-3 hours. The interviews were conducted in English and, when needed, instantly translated to the local language.

The focus groups for the validation of the policy coherence assessment took place in June 2023 both in Latvia and Lithuania. Participants were selected based on purpose sampling (Bernard, 2017). One representative from each WEFE nexus domain that has experience with implementing policies in practice was invited by case study

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leaders, and participated when available. The focus groups were conducted in English and being instantly translated to the local language.

Table 9: Overview of stakeholders involved in NXGAT interviews and focus groups

When	What	Number of stakeholders	Men	Women	Men (%)	Women (%)
6-10 June 2022	Interviews NXGAT Latvia	19	6	13	32	68
15 June 2023	Focus group Latvia	6	3	3	50	50
14-17 September 2022	Interviews NXGAT Lithuania	18	6	12	33	67
15 June 2023	Focus group Lithuania	4	0	4	0	100

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2.2.1. In Latvia

Analysis of governance system by criteria for each dimension and scoring

- **Comprehensiveness**

Actors and networks - Actors and networks declared to be highly connected in the country due mainly to its size. They gain knowledge about the decision-making process through informal interactions. Stakeholders explain this as a result of the (small) size of the country. Stakeholders are engaged within cities, educational settings, and other national contexts. As a result, the score is **"high"**: The majority of relevant actors and networks affected by or affecting WEFE nexus domains is involved.

Levels and scales - Not all levels are equally represented in the decision-making process (the national level is represented the strongest). By law, ministries submit their projects to other ministries for consultation, but the development and coordination of important directives (e.g., nitrates, or WFD) remains the responsibility of the ministry that has jurisdiction. The governance system is top-down. For example, not all municipalities are involved in environmental issues. The Zemgale regional level, despite its planning activities and organizational presence particularly through European projects, does not hold a significant role in the political and administrative decision-making processes of the RBMP and water pollution mitigation measures." As a result, the score is **"low"**: A limited number of relevant levels and scales across WEFE nexus domains are involved.

Problem perspectives and goal ambitions – Nitrate and water pollution at river basin level are identified as the main problems according to the food and ecosystem domains. Latvian stakeholders believe that significant sources of pollution stem from upstream discharges. Furthermore, past land developments and the use of resources, legacy of the Sovjet era, has led to different perceptions on major problems such as floods and drainage. As a result, the score is **"low"**: A limited number of problem perspectives across WEFE nexus domains are taken into account and only a few are translated into WEFE nexus goal ambitions.

Strategies and instruments - At the country level, there are strategies and instruments dedicated to sectoral issues that can be used to develop cross-sectoral solutions. The country is using all that is available at the European level and tries to get more operational supports from the European Commission. As a result, the score is **"high"**: Most of the relevant strategies and instruments include WEFE orientation.

Responsibilities and resources - In Latvia, responsibilities are clearly assigned even if there is a lack of both expertise and resources. As a result, the score is **"high"**: The majority of responsibilities are clearly assigned and sufficient resources are allocated across WEFE nexus domains to support WEFE nexus management.

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Conclusion - According to the previous results, the overall assessment of the comprehensiveness is **"high".**

- **Coherence**

Actors and networks - The actors of the WEFE sectors have different views and objectives. Not only between nexus domains, but also across different administrative levels (e.g.: *"It's easy to defend the renewable energy at national scale while it is not at local scale, because citizens do not want any wind-parks in their territories"*). As a result, the score is **"low"**: Interactions of relevant actors and networks across WEFE domains are little cooperative, solid or based on trust.

Levels and scales - There seems to be no clear vision for each level and scale on intersectoral policy coherence. Actions carried out do not always follow the same objectives. There is clearly a lack of coordination. Mostly, the administrative levels do not work together, except when "consultations" are proposed. As a result, the score is **"low"**: Relevant levels and scales across WEFE nexus domains rarely work together, rarely acknowledge interdependencies and have little trust in each other.

Problem perspectives and goal ambitions – In recent year only the food and energy domains developed synergies. Such as biogas production from incineration of biomass and sludge. The Ukranian war and the consequential energy crisis has led to new synergies between different domains. As a result, the score is **"low"**: Problem perspectives and goal ambitions across WEFE nexus rarely mutually reinforce each other.

Strategies and instruments - There are institutional venues (named consultative boards or inter-ministerial coalition board) where representatives of the different ministries involved in resource management (water, soil, ecosystems, energy production, etc.) can deal with the resources management issues on an intersectoral basis. However, the decisions of the institutional venues are not binding. In the same way, European projects function as venues for collaboration and knowledge exchange that can promote intersectoral collaboration. As a result, the score is **"low"**: The governance system makes it difficult to combine or make use of different strategies and types of instruments across WEFE nexus domains.

Responsibilities and resources - There is little coherence between the actions of sectors at the national level. At the municipal and regional level, synergies are possible but not often implemented. As a result, the score is **"low"**: Responsibilities and resources across WEFE nexus domains rarely lead to cooperation among these domains.

Conclusion - According to the previous results, the overall assessment of the coherence is **"low"**.

- **Flexibility**

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Actors and networks – In theory, stakeholders can participate in the decision-making process but in practice the methods for integrating new members into committees are selective and the committees do not permit to increase the number of members. For instance, the inclusion of new members in the river basin consultancy board depends on the vote of the existing members. Although there are opportunities to participate, especially for associations, enrolment remains limited to the current participating organisations. In order for a new SH to enter, one SH has to leave. As a result, the score is **"low"**: The governance system makes it difficult to include new actors or shift the lead from one actor to another when needed.

Levels and scales - There is some flexibility, but it is difficult to assess the efficiency of the interactions between all levels and scales. All interviewed SHs seemed open to participate in the decision-making process. However instead of decentralizing the power of ministerial services, they prefer expansion of their authority and expertise through increasing their team. As a result, the score is **"high"**: The governance system allows to change levels and/or scales at which WEFE nexus issues are addressed in some situations.

Problem perspectives and goal ambitions - There is a reassessment of priorities regarding renewable energy. The Ministry of Economics understands the need to support SDGs and to develop alternative energy sources. The Ministry of Environment is also very active in this policy area. As a result, the score is **"high"**: The governance system allows to reassess goals across WEFE nexus domains and combine multiple goals in package deals as needed in some situations.

Strategies and instruments - Some compromises are succeeding to change programmes, such as (1) buffer zones as a trade-off between the ecosystems and food domain and farmers; (2) environmental impact assessment rules that are under development to support the renewable energy, but slowed down by lack of legislation. As a result, the score is **"high"**: The governance system allows to combine or make use of different strategies and types of instruments across WEFE nexus domains in some situations.

Responsibilities and resources - Some opportunities for more cross-sectoral collaboration and synergies can be expected through the creation of the new "novads" (group of municipalities) scale. Their actions will be prompted by the imperative for expanded adoption of renewable energy sources, encompassing environmental impact assessment and facilitating inter-sectoral deliberations as well as engagement with citizens. As a result, the score is **"high"**: The governance system allows to pool assigned responsibilities and resources across WEFE domains without compromising accountability and transparency in some situations.

Conclusion - According to the previous results, the overall assessment of the flexibility is **"high".**

- **Intensity of action**

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Actors and networks – While the actors need to comply with the EU requirements (mostly relating to environmental issues), They do not have the capacity to implement all the requirements at the same time. There is also a severe lack of expertise in environmental and energy domains that limits the capacity for action and change. As a result, the score is **"low"**: There is weak pressure from a relevant actor or actor coalition across WEFE nexus domains towards behavioural change or management reform.

Levels and scales – While the regional level emphasizes the main challenges in the river basin, including cross-sectoral management needs, it does not have the resources (financial) or the mandate to change things beyond its participation in EU projects. As a result, the score is **"low"**: There is some pressure from relevant levels and/or scales across the WEFE nexus domains towards behavioural change or management reform.

Problem perspectives and goal ambitions - The need for more cross-sectoral actions is recognized by stakeholders interviewed but, in practice, they express that none of them are implemented. As a result, the score is **"very low"**: Problem perspectives and goal ambitions across WEFE nexus domains do not urge nexus orientation.

Strategies and instruments - There are strategies and instruments such as the creation and meeting of Collective board of different ministries at national level to bring the different WEFE sectors. Moreover, by law, ministries submit their projects to other ministries for feedback. This could be a good starting point to foster intersectoral actions. As a result, the score is **"low"**: Relevant strategies and instruments across WEFE nexus domains weakly urge WEFE nexus-oriented behaviour or management reform.

Responsibilities and resources - There is a general lack of environmental expertise at the different administrative levels. This hinders knowledge exchange and cooperation for river management. According to the interviewees, it is difficulty to attract experts due to non-competitive salaries and work pressure. Moreover, for some disciplines there is also a lack of education. Regarding resources, a major part of environmental measures are implemented through EU funded projects. Meaning there is no continuity of finance after the project ends. As a result, the administrative departments at the heart of these issues would do not have the resources and knowledge to move forward. As a result, the score is **"very low"**: Responsibilities and resources across WEFE nexus domains do not urge implementation of WEFE nexus-oriented actions.

Conclusion - According to the previous results, the overall assessment of the intensity of action is **"very low".**

- **Fit**

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Actors and networks – While the actors are well connected in Latvia, there is no dedicated service or expert(s) to address cross-sectoral concerns. The regional level could play this role but has neither the resources nor responsibilities (power) to do so. However the Ukranian war and energy crisis increased the need for alternative and renewable energy source. This creates pressure and momentum for the energy, agricultural, and environmental domain to collaborate more in the near future. As a result, the score is **"low"**: Relevant actors and networks across WEFE nexus domains are little appropriate to deal with ecosystem properties and functions.

Levels and scales - The regional actors consider the regional level as most appropriate to deal with cross-sectoral challenges. However, it is difficult to say whether the current administrative levels responsible for intersectoral management are the appropriate level given the lack of human and financial resources to deal with these issues. As a result, the score is **"low"**: Relevant levels and scales of the governance system hardly correspond to ecosystem properties and functions.

Problem perspectives and goal ambitions – While there are some attempts for more intersectoral ambitions, problem perceptions are still very sectoral oriented. The various sectors (water, energy and food production) operate in a "closed circuit". As a result, the score is **"low"**: Problem perspectives and goals across WEFE nexus domains rarely take into account ecosystem properties and functions.

Strategies and instruments -Lielupes RBMP could foster cross-sectoral interactions if only the prescribed actions were legally binding. As a result, the score is **"low"**: Relevant strategies and instruments across WEFE nexus domains rarely take into account ecosystem properties and functions.

Responsibilities and resources – Local river management "competence" (resources and responsibility) is missing. Some actions are carried out within EU project. However, this means that there is no continuity of funding and therefore actions. As a result, the score is **"low"**: Responsibilities and resources across WEFE nexus domains are rarely appropriate to deal with ecosystem properties and functions.

Conclusion - According to the previous results, the overall assessment of the fit is **"low"**.

As the result, the matrix of the overall scoring is as follows.

Table 10: Matrix of the overall scoring

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Dimensions / Criteria	Comprehensiveness	Coherence	Flexibility	Intensity	Fit
Actors and networks	HIGH	LOW	LOW	LOW	LOW
Levels and scales	LOW	LOW	HIGH	LOW	LOW
Problem perspectives and goals ambitions	LOW	LOW	HIGH	VERY LOW	LOW
Strategies and instruments	HIGH	LOW	HIGH	LOW	LOW
Responsibilities and resources	HIGH	LOW	HIGH	VERY LOW	LOW
Overall assessment	**HIGH**	**LOW**	**HIGH**	**VERY LOW**	**LOW**
Concluding evaluation	**The current governance system is restrictive toward WEFE nexus goverance: justification with barriers and levers**				

Policy coherence analysis results

The results from the policy coherence analysis in Latvia were mostly confirmed by the stakeholders in the focus group. The only adjustment made based on stakeholders' feedback was "strong integration" of the *National energy and climate plan* with the climate sector. This score was changed to "not applicable" since the document stems from both climate and energy policy sectors.

The highest level of coherence is found in policy documents that ar specifically designed to be cross-sectoral such as *the sustainable development strategy*. This is the only policy document that is strongly coherent with all the WEFE sectors. Other cross-sectoral policies target two or three specific policy sectors at most such as the *law on pollution* for example. Sectoral policies show a lower degree of policy coherence. Especially policies from the energy sector seem strictly sectoral focused. However, the stakeholders mentioned that they expect increased collaboration between the energy sector and the other sectors due to energy crisis and the increased need for alternative energy sources. The scores of the policy coherence analysis confirm the low score on coherence of the strategies and instruments as found in the NXGAT.

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Sector	Policy	Water	Energy	Food/ Agriculture	Land/ Soil	Biodiversity/ Ecosystems	Climate
Water	Lielupe River Basin District Management Plan and Flood Risk Management Plan						
Water	Water Management Law						
Water, agriculture	Requirements regarding the protection of water, soil and air from pollution caused by agricultural activity						
Food	Action plan for development of biological farming						
climate, ecosystems, water	The 2021-2027 environmental policy guidelines						
Land-use, food, agriculture	Amelioration law						
Land-use, agriculture	Land Management law						
Energy, water, land, climate, ecosystems,	Latvia 2030 - Sustainable development strategy of Latvia until 2030						
Food, Energy, Land use, Climate	Latvian Bioeconomy Strategy 2030						
Agriculture, forestry, fishery	Law: On Agriculture and Rural Development						
Ecosystems, species	Law on the Conservation of Species and Biotopes						
Food, agriculture, energy, climate,	Law On pollution						
Energy, Climate	National Energy and Climate Plan for 2021-2030						
Energy	Energy Law						
Energy	Cabinet of Ministers Regulations N. 560 "Regulations on the Production of Electricity from Renewable Energy Sources, as well as						
Ecosystems, land use	Law On Specially Protected Nature Territories						
Climate, water, agriculture	Latvian National Plan for Adaptation to Climate Change until 2030						
Climate	Latvia's National Climate Change Adaptation Strategy						

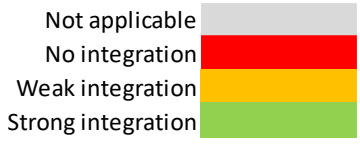

Figure 15 results policy coherence analysis Latvia

Self-scoring of cross-sectoral management by stakeholders

To the question *"if you were to **score cross-sectoral management** in the river basin concerning the problems we discussed, which score would you give between 0 (no cross-sectoral management) and 3 (full cross-sectoral management)?"*, the **average** value given in response is **1.2** (and:

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- the national level scored 1.1;
- the regional level scored 1.3;
- the local level scored 1.1.

At national level

- The Latvian Environmental and Geology and Meteorology Center scored 0 and 1 because 1) there is just one case where water and energy work together and 2) the source of the problem is that there are sometimes conflicts between sectors. In addition, more and more farmers are starting to take environmental needs into account (e.g., buffer zones);
- The Ministry of Economics scored 1.5 because *"cross-sectorality is improving with environment and climate change*";
- The Latvian Water and Wastewater Works Association scored 1 because "*there are only interlinkages between water and ecosystems*" sectors used to work together. Now, energy is coming on board as water companies are putting solar energy into the network, but due to difficulties have yet to do the same with energy, so it is still not really effective. Thus, it is scored 1 with improvement at the current time.
- The Latvia Fund for Nature association scored 1.5 because *"there is a kind of collaboration but at local scale and only time to time – global collaboration is improving but to slowly".*

At regional level

- The Zemgale Regional Energy Agency scored 1.5 because *"sectors are inclined to work together on some issues, the links do exist, there are weekly meetings and lots of exchanges"*;
- The Zemgale Planning Region scored from 1 to 3:
    - 10 years ago, the score would have been 1; it's still the minimum scoring for specific projects;
    - In some cases, and regarding WEFE nexus, the score would be 2. For instance, with Lithuania on the water issue for tourism, so it is even transboundary, etc.
    - There are some cross-sectoral projects that would be scored 3, but not very many.

At local level

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- The Salgale Parish (County) scored 1.5 because there is an obvious lack of financial resources: "*it very much depends on national priority – what for and where to allow money? "*, *"there is always a lack of money, not a lack of cooperation"* and "*people that initiate cooperation are not sustainably supported by institutions"*;
- The Bauska Municipality scored 1 because *"it's improving, the situation forces us to collaborate on more than 2 sectors"*.

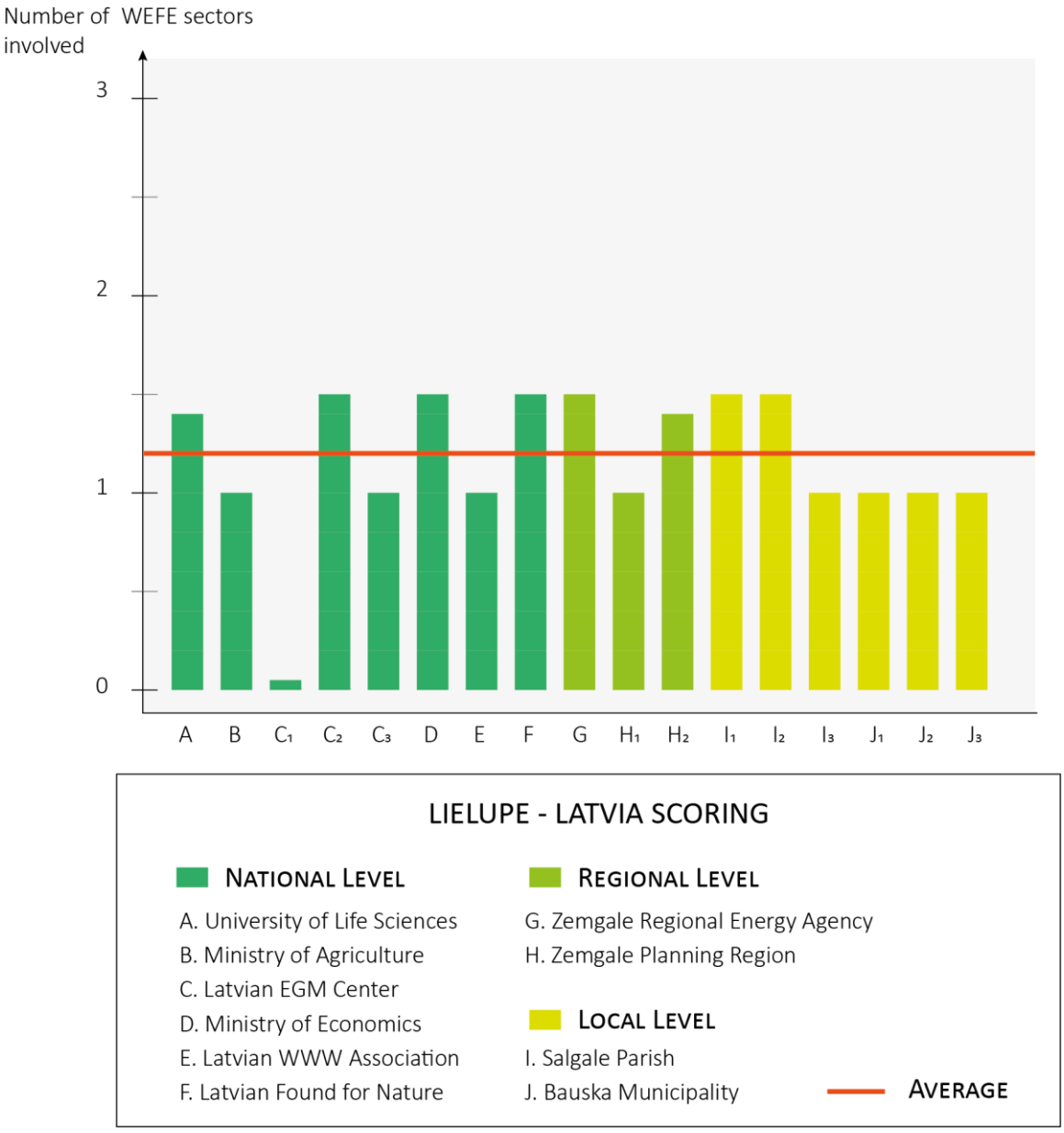

Figure 16: Self-scoring by stakeholders interviewed of the WEFE nexus governance orientation in the Lielupe river basin in Latvia

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2.2.2. In Lithuania

Analysis of governance system by criteria for each dimension and scoring

- **Comprehensiveness**

Actors and networks - Local authorities do not feel heard by the national level and are solely implementing national decisions. Despite official consultation processes they do not feel that their opinion is taken into consideration. The municipalities interact mainly with ministerial agencies. The agencies in turn provide research and recommendation to the ministries and feel occasionally heard. Other stakeholders suc as entrepreneurs are also mentioned as excluded from different decisional process. *Stakeholders mentions that during the consultation process all key stakeholders are involved and participating. But the involvement process could start earlier"* As a result, the score is **"low"**: A limited number of relevant actors and networks affected by or affecting WEFE nexus domains are involved.

Levels and scales - At the moment the national level is the only level involved in the river basin management plan. Even at national level, the plan is mostly in the hands of the Ministry of Environment. The regional level has not existed since the reform linked to the integration of EU. The municipal level is not taken into account in the strategic phase, they are only required to execute the plan at local level. Indeed, the decision-making process is top-down. As a result, the score is **"low"**: A limited number of relevant levels and scales across WEFE nexus domains are involved.

Problem perspectives and goal ambitions - Stakeholders agree on and are aware of the most important natural resources issues (nitrates pollution, hydromorphological changes, protection of biodiversity, soil quality erosion etc.) and lack of expertise and resources) They are aware of vertical and horizontal interdependencies between sectors (especially at national level) and of the effects of different sectorial activities involved in the WEFE nexus. However, action to address these interdependencies is still limited. As a result, the score is **"high"**: The majority of problem perspectives across WEFE nexus domains are taken into account and most of them are translated into WEFE nexus goal ambitions.

Strategies and instruments - At the national level there are some strategies in place that take several sectors into consideration, such as *the decarbonation strategy, climate change* and *energy strategy and national water energy*. However, due to limited resources, the policies seem difficult to implement in practice. There are subsidies and compensation measures that are also in place to support more cross-sectoral interactions. As a result, the score is **"high"**: The majority of relevant strategies and instruments include WEFE orientation.

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Responsibilities and resources - The responsibilities are clearly assigned for sectoral issues, but not for cross-sectoral issues. Despite EU policies progressively adopting a more cross-sectoral approach, responsibilities within Lithuania to comply with these cross-sectoral requirements is difficult and are yet to be assigned. A lack of human resources at all levels complicates this. However, a public sector reform is underway to enhance salary competitiveness with the private sector, aiming to attract a greater number of individuals. As a result, the score is **"low"**: Few responsibilities are clearly assigned and only limited resources are allocated across WEFE nexus domains to support WEFE nexus management.

Conclusion - According to the previous results, the overall assessment of the comprehensiveness is **"low"**.

- **Coherence**

Actors and networks - At the national level, actors from different sectors started to collaborate through an inter-ministerial board. Some ministries are closer connected such as the ministry of energy and ministry of environment than others. Collaboration with local actors is less stable and regulated as there is there is no structure for collaboration between the national and local actors and therefore less frequent. Moreover, there is a certain level of distrust between some actors (e.g., there is distrust between the farmers and the municipalities and the Ministry of Environment). As a result, the score is **"low"**: Interactions between relevant actors and networks across WEFE domains are hardly cooperative, solid or based on trust.

Levels and scales – Lithuania has a top-down governance system with few meaningful interactions and producing non-reciprocal relationships between the different administrative levels. Only on a project basis as at the occasion of EU projects, are there some good collaborations. As a result, the score is **"low"**: Relevant levels and scales across WEFE nexus domains rarely work together, rarely acknowledge interdependencies and have little trust in each other.

Problem perspectives and goal ambitions - While most actors agree on water pollution problems due to eutrophication in the Lielupe river basin, the strategies of the actors are not aligned. They have different goals. For instance, intensive agricultural practices (agricultural sector) vs reduction of intensive farming (environmental sector). Some stakeholders mentioned a *"tunnel vision".* As a result, the score is **"low"**: Problem perspectives and goal ambitions across WEFE nexus rarely mutually reinforce each other.

Strategies and instruments - Some legislative initiatives aim to provide more flexibility in applying the brakes on access to land in order to accelerate the development of renewable energies such as wind and solar plants. This creates tensions between sectors and ministries in charge). As a result, the score is **"low"**: Relevant strategies and instruments across WEFE nexus domains rarely reinforce each other.

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Responsibilities and resources - The responsibilities and resources are not fairly distributed between domains, even at national level. Some ministries hold more funds, creating unequal relationships between for example the ministry of agriculture and the ministry of environment. The Ministry of Agriculture and farmers hold the CAP budget while the ministry of environment is dependent on this budget to implement its environmental protection policies. At the same time funds allocated for renewable energy development, important in the context of the energy crisis, create friction with the ministry of agriculture over land competition. As a result, the score is **"low"**: Few responsibilities are clearly assigned and only limited resources are allocated across WEFE nexus domains to support WEFE nexus management.

Conclusion - According to the previous results, the overall assessment of the coherence is **"low"**.

- **Flexibility**

Actors and networks - The governance system is currently not very flexible and top-down. However, some sectors, such as intensive agriculture, are challenging the consideration of other sectors and are trying to negotiate a more cross-sectoral management of resources. Municipalities are not involved in the decision-making process. As a result, the score is **"very low"**: The governance system does not allow to include new actors or shift the lead from one actor to another when needed.

Levels and scales - There is some degree of flexibility to address local issues through international lobbies, but there is not a lot of flexibility within the country. The relationships are shaped by the top-down system. Where municipalities have to implement measures from the national level. However, for some the management of some resources, such as protected areas, services from both national and local (at the level of the protected areas) are in permanent contact. As a result, the score is **"low"**: the governance system makes it difficult to change levels and/or scales at which WEFE nexus issues are addressed.

Problem perspectives and goal ambitions - In the context of the energy crisis, policy goals are reassessed, e.g. the suggestion more for flexible legislation for using agricultural land to meet the needs for renewable energy. However, it also generates new rivalries (land for energy use *vs* agriculture use; or sea for energy as for windparks use *vs* fishing use). As a result, the score is **"low"**: The governance system makes it difficult to re-assess goals across WEFE nexus domains and combine multiple goals in package deals as needed.

Strategies and instruments - It is possible to introduce new strategies, but not without negative effects. Strategies are introduced to further develop specific sectors, but not to foster cross-sectoral management. As a result, the score is **"low"**: the governance system makes it difficult to combine or make use of different strategies and types of instruments across WEFE nexus domains.

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Responsibilities and resources – The EU pushes for more cross-sectoral management requiring re-assignment of some responsibilities. While this might offer opportunities, all stakeholders mention a lack of expertise and human resources resulting a more complex and non-transparent situation. Therefore possibility of pooling resources seems difficult. As a result, the score is **"low"**: The governance system makes it difficult to pool assigned responsibilities and resources across WEFE domains without compromising accountability and transparency.

Conclusion - According to the previous results, the overall assessment of the flexibility is **"low"**.

- **Intensity of action**

Actors and networks - Environmental organizations are urging for change, but are not very influential. The private sector, especially the energy sector, is successful in pushing for renewable energy, which requires intersectoral collaboration. The Farmer lobby is also influential, but prefers to keep the status quo. Various ministries indicated that they could be the organization pushing for intersectoral collaboration, but have not really adopted this role in practice. As a result, the score is **"low"**: There is weak pressure from a relevant actor or actor coalition across WEFE nexus domains towards behavioural change or management reform.

Levels and scales - The European Commission is a strong force pushing for cross-sectoral collaboration through the Green deal. On the ministerial level, cross-sectoral actions are driven by policy objectives (for example solar and wind energy require input from the other ministries). There is an increasing awareness at the ministerial level for cross-sectoral interactions. As a result, the score is **"low"**: There is some pressure from relevant levels and/or scales across the WEFE nexus domains towards behavioural change or management reform.

Problem perspectives and goal ambitions - At the European level there is a vision and strategy in place for more cross-sectorality. This creates increased awareness at the national level, resulting in the start of a national vision. However, this vision is not yet in practice. The STRATA, the new established Government Strategic Analysis Center, is in charge of an ambitious initiative and has the potential to foster cross-sectoral collaboration. While the different sectors acknowledge the existence of the different problems, they do not share the perception of urgency on these problems. As a result, the score is **"low"**: Problem perspectives and goal ambitions across WEFE nexus domains weakly urge nexus orientation.

Strategies and instruments – In theory there are some policy instruments fostering cross sectoral management (e.g., peatland protection) but this is not yet reflected in practice. For example, the penalties for non-compliance with buffer zones are insufficient. It is still more cost-effective for the farmers to use the buffer zones for agriculture. As a result, the score is **"low"**: Relevant strategies and instruments across

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WEFE nexus domains weakly urge WEFE nexus oriented behavior or management reform.

Responsibilities and resources - Local authorities believe that they should have a more prominent role in driving change, but they do even not have resources to actually implement the strategic plans. At national level, administrative actors rather evoke the political will to carry changes. As a result, the score is **"low"**: Responsibilities and resources across WEFE nexus domains weakly urge implementation of WEFE nexus-oriented actions.

Conclusion - According to the previous results, the overall assessment of the intensity of action is **"low"**.

- **Fit**

Actors and networks – While actors are beginning to understand the benefits of cross-sectoral collaboration, currently the level and quality of the relationships is not adequate engage in cross-sectoral resource management. As a result, the score is **"low"**: Relevant actors and networks across WEFE nexus domains are hardly appropriate to deal with ecosystem properties and functions.

Levels and scales – While the cross-sectoral board of ministries could be the right format to foster cross sectoral management, but this needs to trickle down to lower levels of governance. The fact that Lithuania is a small country and therefore short links between different actors exist, could help. Municipalities could be important players at the river basin level, but lack mandate. As a result, the score is **"low"**: Relevant levels and scales of the governance system hardly match ecosystem properties and functions.

Problem perspectives and goal ambitions – Through the Green Deal requirements, at the national level a trend towards more cross-sectorality is slowly starting. A cross-sectoral working group has been created at the ministerial level, but it is in its infancy. Moreover, at the local level this trend has not been observed yet. As a result, the score is **"low"**: Problem perspectives and goal ambitions across WEFE nexus domains rarely take into account ecosystem properties and functions.

Strategies and instruments - The current instruments and strategies are not appropriate yet. While strategies at the national level slowly seem to be reformed, new effective measures need to be designed to actually enforce and implement these strategies. As a result, the score is **"low"**: Relevant strategies and instruments across WEFE nexus domains rarely take into account ecosystem properties and functions.

Responsibilities and resources - Many stakeholders believe that the municipal level is the most appropriate level to foster cross-sectoral management in practice. However, they lack both the resources (instruments, human, expertise) and mandate (only responsible for carrying out programmes of measures decided at national level). There is a big gap between the strategic plans at the ministerial level and the level of

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implementation at the local level. As a result, the score is **"low"**: Responsibilities and resources across WEFE nexus domains are rarely appropriate to deal with ecosystem properties and functions.

Conclusion - According to the previous results, the overall assessment of the fit is **"low"**.

As the result, the matrix of the overall scoring is as follows.

Table 11: Matrix of the overall scoring of the NXGAT implementation in the Lielupe cathment in Latvia

Dimensions / Criteria	Comprehensiveness	Coherence	Flexibility	Intensity	Fit
Actors and networks	LOW	LOW	VERY LOW	LOW	LOW
Levels and scales	LOW	LOW	LOW	LOW	LOW
Problem perspectives and goals ambitions	HIGH	LOW	LOW	LOW	LOW
Strategies and instruments	HIGH	LOW	LOW	LOW	LOW
Responsibilities and resources	LOW	LOW	LOW	LOW	LOW
Overall assessment	LOW	LOW	LOW	LOW	LOW
Concluding evaluation	The current governance system is restrictive toward WEFE nexus goverance				

Policy coherence analysis results

Figure 17 presents the results of the policy coherence analysis in Lithuania as validated by the stakeholders. Unfortunately, it proved difficult to have representatives from all WEFE sectors present to validate the scores. Therefore, the scores are only validated by stakeholders from the water and ecosystem domain. The stakeholders agreed with most of the scores. Only the score on the integration of the *climate sector* in the *river basin management plan* was changed from "strong integration" to "weak integration" after discussions with the stakeholders. It was also pointed out by the stakeholders that since 2023 a new sustainable development strategy has been in place for Lithuania. However, the document analysis was conducted in 2022 and therefore the "old" strategy is included in the analysis. The policy coherence analysis confirms the findings of low coherence between strategies and instruments of the NXGAT. Similarly to Latvia, the most coherent policies are the cross-sectoral designed policies. The policies stemming from the energy sector seem to be the least coherent with other sectors.

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Sector	Policy	Water	Energy	Food/ agriculture	Land/Soil	Biodiversity/ ecosystems	Climate
Water	Lielupe River Basin District Management Plan						
Water	Water Law						
Water	Water Development Program 2017–2023						
Water, agriculture	Regulation on the designation of control authorities for the approval and management of the description						
Land-use	Special Land Use regulations						
climate, ecosystems, water	National environmental strategy						
Land-use, food, agriculture	Land Reclamation Law						
Land-use	Natural Resources Tax Law						
Land-use, agriculture	Land law						
Energy, water, land, climate, ecosystems,	Sustaibale development strategy of Lithuania						
Agriculture, forestry, fishery	Law: On Agriculture, food and Rural Development						
Protected areas, including Natura 2000	Law on the protected areas						
Food, agriculture, energy, climate, water	Law on Environmental Protection						
Energy, Climate	National Energy and Climate Plan for 2021-2030						
Energy	Energy Law						
Energy	Renewable Energy Law						
Climate	National climate change management agenda						

Not applicable
No integration
Weak integration
Strong integration

Figure 17 Results policy coherence analysis in Lithuania

Self-scoring of cross-sectoral management by stakeholders

To the question *"if you were to **score cross-sectoral management** in the river basin concerning the problems we discussed, which score would you give between 0 (no cross-sectoral management) and 3 (good cross-sectoral management)?",* the **average** value given in response is **1.6**, as both the national and local levels scored 1.6.

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At national level

- The BEF Lithuania scored 0.5 for river basin because its knowledge *"is very limited*". From its perspective *"the cross-sectoral collaboration happens if there is a certain issue like floods*". However, the score is 2.5 for national level policy as *"the conversation started between sectors and it will go on. Everybody will see the benefits"*, so they have a very optimistic view of the potential of progress;
- The Viva-sol Association scored 1.5 because *"the ecosystem sector, the energy sector and maybe the water sector interact. But there is no interaction with agriculture"*; *"All these three are under the Ministry of Environment, while Agriculture has their own ministry";*
- The Ministry of Environment from the Nature policy group scored from 1.7 because *"theoretically it's possible to do some cooperation between 3 institutions. It is very difficult though, but it could be"*. *Also "the energy sector and the environmental sectors mostly work together effectively"*, the Ministry of Environment *"cooperates a lot with Agriculture, but it is not so successful, but they still need to work on this"*;
- The Ministry of Energy scored 2.5 because *"sectors are forced to be interconnected together, otherwise they can't do anything". "Very rarely there are expert groups from different ministries working on the same legislation";*
- Center for Environmental Policy scored 0.5 to 2 because *"the situation is getting better".* Ministries are becoming more open to intersectoral discussions. They are not as closed off as they were 10 years ago. The Green Deal presses for and pushes more intersectorality at national level. The Ministry of Agriculture needs to work with the Environment sector. And the Ministry of Energy has to comply with climate change regulations;
- Environmental Protection Agency scored 1.5 because *"cooperation depends on the issue and Green Deal policy"* and "*the majority of cooperation happens on legal level in EPA". "There is huge potential. Sometimes institutions are working separately and learn about issues from the media"*;
- The Lithuanian Energy Agency scored 1.5 because they have *"very limited interactions with water treatment, management or impact on water, even if it's improving at the moment". "Of course, there are always requirements in energy that could have an impact on those and there is discussion between ministries". "This is how the legislation is written. But most of the time one institution writes legislation and asks for input. There is no active co-creation, but there is consultation at the end. Very rarely there are expert groups from different ministries working on the same legislation*".

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At local level

- The Panevezys municipality scored 2 to 2.5 because *"municipality owns the energy and water companies. There is cooperation because they participate in planning. Energy and water and waste water, they really cooperate a lot. Related to climate issues, companies come up with innovations, but don't coordinate a lot with municipality".* In principle, *"cooperation happens on the specialist level above the legal requirements. When it comes to the issues that concern the territories, they know each other and cooperate. Related to waste management and tax issues, the dialogue is going on intensively how to satisfy the companies and citizens";*
- The Biržai district municipality administration scored 0.5 because *"this intersectoral work is only on theoretical level"*. They understand that they *"should do it, but in practice it doesn't happen".* They just start thinking about that they should do it. *"The awareness of the connection of different things in our life, the energy, food, environment everything is related. The European Union has promoted it. Not only requirement but also provides information"*.

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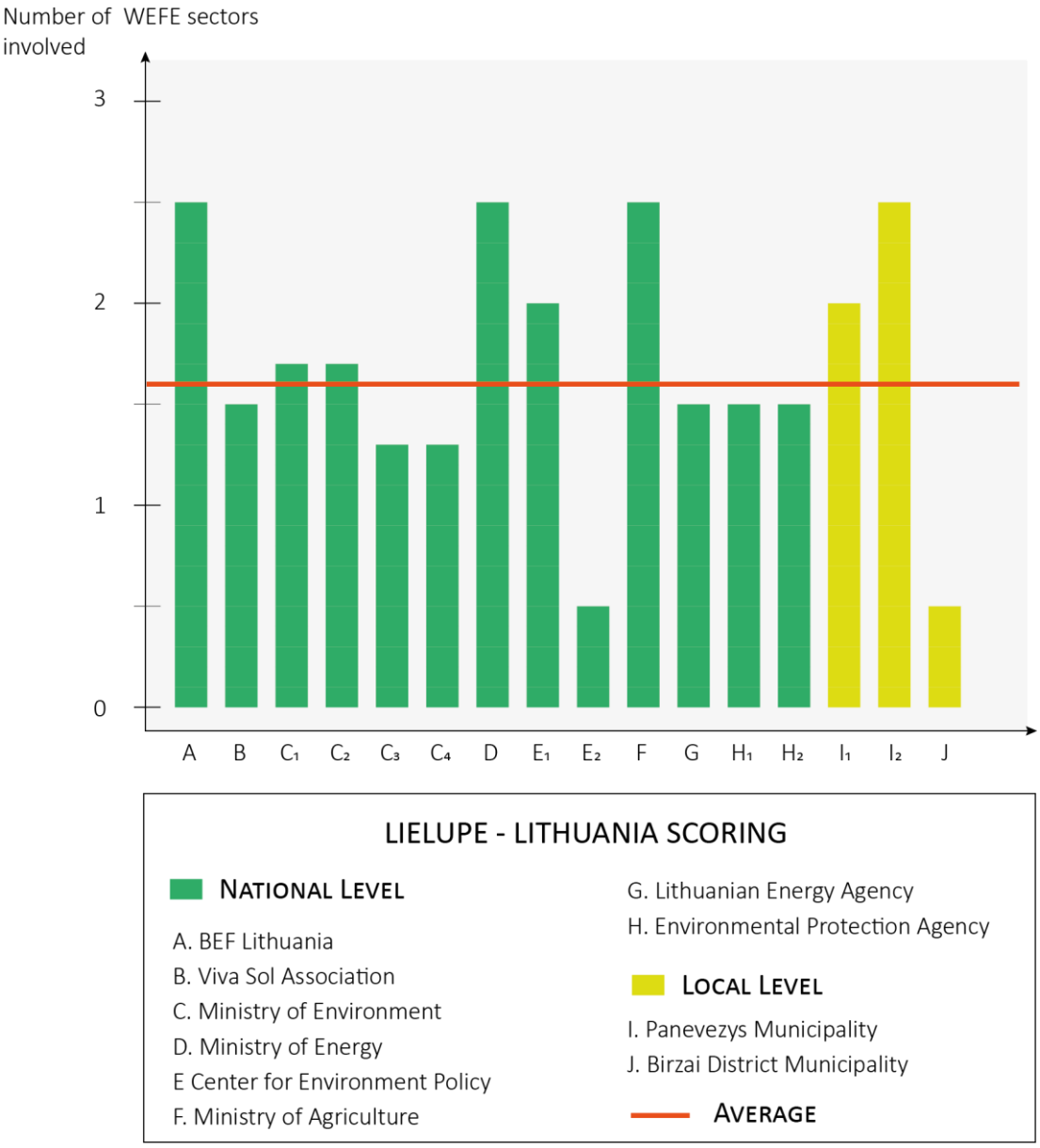

Figure 18: Self-scoring by stakeholders interviewed of the WEFE nexus governance orientation in the Lielupe River in Lithuania

2.3. Concluding evaluation of the Lielupe River

2.3.1. Concluding evaluation for each country

In Latvia

The current governance regime is **"restrictive"** towards WEFE nexus governance, because:

- Extreme top-down decision-making even at RBMP level;
- Lack of environmental expertise at national and local level;

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- The sectorial oriented perception of problems;

But the governance is **not completely "restrictive"** because:

- The regional level has a supra-local vision and the ability to link up with the European level, BUT without any power;
- The existence of an advisory council (interministerial coalition) where representatives of the various ministries are involved in resource management.

In Lithuania

The current governance system is **"restrictive"** towards WEFE nexus governance because of:

- Lack of involvement of local actors in the development of the RBMPs;
- Lack of mandate at local (municipal) scale while there is no regional scale;
- Lack of expertise and human resources at all levels.

But it is **not completely "restrictive"** because:

- Green Deal initiatives (pushed by EC) at national level supports cross-sectoral context;
- Development of renewable energies due to the energy crisis press for more cross-sectoral interactions;
- Initiatives to push for more cross-sectorality: STRATA initiative (Government Strategic Analysis Center), a working group set up at ministerial level is proactive.

2.3.2. Barriers and levers at the river basin level

Barriers

- Lack of experts and expertise;
- Lack of environmental awareness;
- Lack of involvement of local actors in the development of the RBMPs;
- Hardly any transboundary cooperation resulting in misunderstandings on water quality issues.

Levers

- Managers of sectors at national and regional level are connected;
- EU Green Deals increase environmental awareness;
- Existing motivation for more transboundary connection.

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2.3.3. Transboundary findings and recommendations to urge for more WEFE nexus governance and transboundary cooperation

Lack of environmental awareness and environmental education

Many stakeholders interviewed mentioned a lack of environmental awareness and environmental education. The River Basin Authority has already initiated some actions to improve environmental education but according to stakeholders, goals should be more ambitious than they are now.

Lack of environmental expertise at all levels and scales

Stakeholders mentioned a lack of environmental expertise at national and local level, in particular for wastewater treatment expertise. Both national and local level authorities have to increase their capacity (expertise and resources) to persuade environmental specialists to tackle environmental issues. However, experts are actually sector-oriented and sometimes incoherent with other sectors' priorities. To address this, the government started an initiative last year to bring together and converge strategies in order to simplify the overall strategy for sustainable development and climate adaptation at national level. This requires additional expertise from EU level, and now highlights the need to take into account cross-sectorality even more.

Lack of lack of involvement of local actors in the RBMP

Stakeholders see sectoral management as a top-down decision-making process. Local authorities mentioned that they feel their voice is not considered, even in river basin management plans. The low level of involvement of local stakeholders in the development of the river basin management plan limits the opportunities to develop a cross-sectoral view of river basin issues. Consequently, any efforts to bring other stakeholders to the table in the development of the river basin management plan would be extremely beneficial for all cross-sectoral interactions.

Opportunities to implement cross-sectoral actions

Despite the lack of environmental expertise, the small size of the country, the fact that actors know each other, and are in the same networks presents an opportunity to increase interactions between sectors and increase knowledge exchange.

Moreover, the European Commission is pushing for cross-sectoral collaboration through the Green Deal. This leads to increased awareness at the national level where ministries start to create a national vision for this. The question remains how to translate this into practice.

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Furthermore, benefiting from the motivation and involvement of border municipalities, there are two issues that present opportunities to build effective and operational and cross-sectoral cooperation:

The water quality: It is an issue both in Lithuania and in Latvia, mainly due to eutrophication due to the high quantity of nitrates in the waters. This problem concerns the WFD and the Nitrate Directive so that it is the responsibility of the water sector, the ecosystems properties and the agricultural sector. Harmonising water quality monitoring and water quality thresholds could be the preliminary topics at the agenda to start with operational actions both cross-sectoral and transboundary oriented.

The flood risk problem: Stakeholders in both countries agree that it is important to clean the river and to jointly implement coherent measures between upstream and downstream, as well as jointly developing information campaigns to raise awareness on the importance of respecting riparian ecosystems during cleaning activities.

Interactions in the context of these two main issues could be a starting point to initiate more regular interactions at the basin level, and then push for more joint management efforts and expand to other topics such as water quality monitoring, environmental awareness for the river, etc. This could also encourage greater involvement of local government stakeholders in the development of the river basin management plan, which has been declared with lots of possibilities of improvement, in order to provide more cross-sectoral interactions. The need to monitor water quality on a sustainable basis could allow for the creation of a transboundary and sustainable management body dedicated to the entire Lielupe River Basin.

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3. Jiu River

3.1. Context and case study description

3.1.1. Biophysical context

The Jiu River Basin spans several topographical units, descending from 2519 m in the north to 27 m in the south. It includes the Southern Carpathians, the Getic Subcarpathians, the Getic Piedmont, and the Romanian Plain, with the Petrosani Depression containing a coalfield in the upper part. The basin's mountainous region covers 23%, the hilly plateau area 69%, and the plain 8%, each with distinct hydrological features (Badea et al., 2001; Savin, 2003). The Jiu River, approximately 330 km long, is the main tributary of the Danube in southwestern Romania, originating in the Godeanu and Parâng mountains and flowing southward to the Danube (Badea et al., 2001; Savin, 2003). Administratively, the basin spans four counties: Dolj, Gorj, and Mehedinți (Oltenia) and Hunedoara (Transylvania) (Morosanu, 2019).

Climate characteristics

The Jiu River Basin, with a temperate-continental climate, experiences diverse climatic influences due to its varied geomorphology and proximity to the Mediterranean (Figure 19). The landscape ranges from the northern Parâng Mountains (up to 2519 m) to the southern plains, with elevations below 30 m in the Jiului and Danube floodplains. Rainfall and temperature patterns are illustrated by the cities of Petroșani (north) and Craiova (south). In 2000, both cities recorded their lowest annual precipitation (179 mm in Petroșani and 126 mm in Craiova), with Petroșani generally receiving more rainfall. Temperature trends show Petroșani's colder winters (avg. -4.72°C in January) and cooler summers (avg. 17.74°C in August), while Craiova experiences milder winters (avg. -1.83°C in January) and warmer summers (avg. 23.87°C in July) (Badea et al., 2001; Savin, 2003)[6].

[6]https://inundatii.ro/en/river-basins/jiu-river-basin/#:~:text=Climate%20of%20the%20river%20basin,of%20the%20Mediterranean%20climate%20influence.

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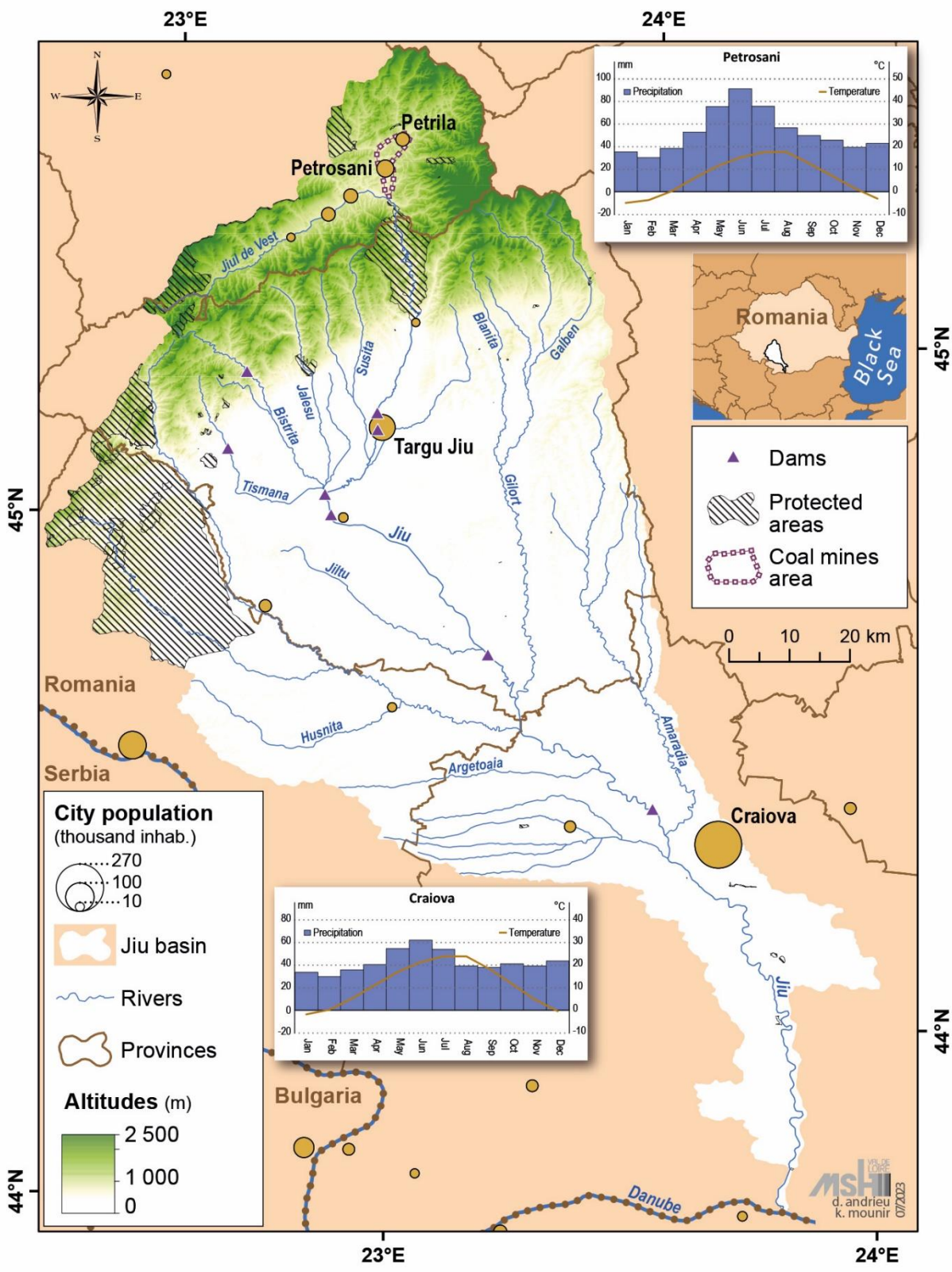

Figure 19: Hydrology of the Jiu River and location of main dams

Hydrological characteristics

The main rivers in Romania, originating primarily from the Carpathians, flow radially toward the Danube, which serves as the southern border with Serbia and Bulgaria,

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ultimately emptying into the Black Sea. Damming of rivers has created numerous reservoirs for various uses. Romania's surface water resources are estimated at 125 billion m³ annually, with groundwater resources at 9.6 billion m³. The Jiu River, one of Romania's larger tributaries (>4000 km²), drains a basin of 16,758.59 km², or 7.03% of the country's (ICPDR, 2020).

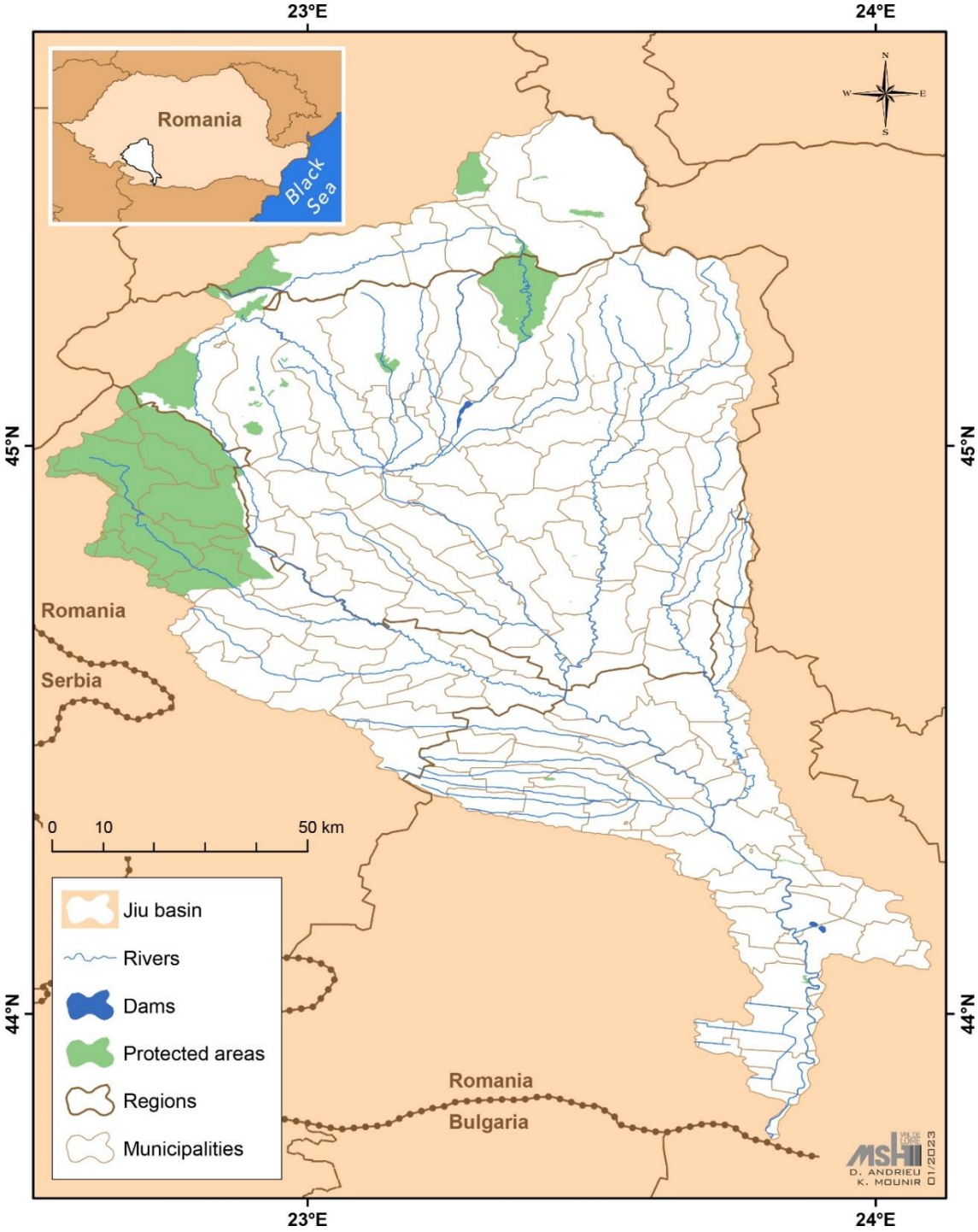

Figure 20: Drainage area of the Jiu River

The flow of rivers in the Jiu river basin is strongly affected by the large number of energy and flood defence works (Morosanu, 2019).

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3.1.2. Socio-economic sectors

Water

In Romania, about 70% of the population is supplied with centralized drinking water, mainly from surface waters (68%) and, to a lesser extent, from groundwater. Since 2018, 3,788 drinking water abstraction zones have been identified, with 358 from surface water and 3,430 from groundwater. The remaining 30% of the population relies on groundwater through individual wells (ICPDR, 2020). To protect water quality and reduce treatment needs, drinking water abstraction points are safeguarded with protection zones, particularly for groundwater resources, which often require no treatment. The Danube plain and delta, identified as high-risk areas for drought, will be further affected by climate change and reduced precipitation (WBG, 2018). As a key tributary of the Danube, the Jiu River is part of the International Commission for the Protection of the Danube River (ICPDR, 2021).

Agriculture, land uses and food production

In the Jiu, forests occupy about 30% of the area, covering mountainous and mountainous areas, while urban and rural areas occupy 17%. The other types of land cover occupy much smaller areas. Among them, water bodies hold about 1% of the total area of Jiu river basin (Morosanu, 2019).

Energy

Romania has historically relied on fossil fuels for energy, particularly coal and oil, with significant coal reserves in the Jiu Valley[7]. In Dolj County, two coal-based power plants were operational in 1989: Craiova 2, which continues to operate at 300 MW capacity, and Craiova 1 (Isalnita), which reached a capacity of 1,035 MW but now operates at 630 MW with only 2 of 8 units active. The Jiu River basin is also home to significant coal mining areas, including the Petroșani Depression (hard coal, Figure 19) and the Motru-Rovinari basin (lignite). Mining has impacted river water quality and sediment flows, with the Petroșani depression being a major source of water pollution in the Jiu River and its tributaries, while the impact of Motru-Rovinari remains less clear due to reduced mining activity after 1990 (Morosanu, 2019). Although nuclear power contributes significantly to Romania's electricity, it is not located in the Jiu basin[8]. Gorj County, largely within the Jiu catchment, is the second-largest electricity producer in Romania. However, Constanța, with energy primarily from coal-based thermal plants, is one of the country's most polluted areas. The Rovinari and Turceni power plants have seen significant reductions in capacity since their peak, resulting in a total loss of 1,720 MW (Morosanu, 2019).

[7] https://ourworldindata.org/energy/country/romania

[8] https://world-nuclear.org/information-library/country-profiles/countries-o-s/romania.aspx

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Ecosystems

Almost 23% of the Romanian territory is part of Natura 2000 network of sites under the Birds and the Habitats Directives (ICPDR, 2020). The Jiu Pass National Park is located in the Southern Carpathians, along the upper Jiu valley, embedded between the Vâlcan and Parâng mountains, in the northern part of county of Gorj.[9],[10],[11] The Valea Jiului region in Romania is located in the country's southwestern Transsylvania county and is bordered by the Parang Mountains and the Retezat Mountains. It is also known as the "Jiu Valley"[12].

3.1.3. Policy and administrative context

General division of powers

Romania is a semi-presidential, representative democracy where the Government is accountable to Parliament. The Prime Minister is appointed by the President after consulting with the majority parties. The government is supported by the Secretariat-General and the Chancellery of the Prime Minister. Administratively, Romania is divided into 41 counties, with communes, towns, and municipalities at the local level. A prefect, appointed by the central government, represents the government at the county level. Bucharest, the capital, has both municipality and county responsibilities. Local public affairs are managed by self-governing local authorities, including county and local councils. The local administrative level consists of 2,861 communes, 217 towns, and 103 municipalities.[13].

3.1.4. Key challenges for WEFE nexus

The Jiu River Basin faces WEFE challenges across the four domains. Agriculture heavily depends on water for irrigation, but over-exploitation and water scarcity, worsened by climate change, threaten crop productivity. Agricultural practices like deforestation and overgrazing degrade ecosystems, which in turn affects water regulation and quality. This creates competition for water between energy and

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[9] https://lacurile-sambotin.business.site/?m=true&fbclid=IwAR0blyGgGzEXoSvLyIlWeb5FFW3JeOLYyj2Qi4tnISBkaZBuSxfllpUALc8

[10] https://www.infopensiuni.ro/cazare-tismana/obiective-turistice-tismana/stancile-rafaila_8062

[11] https://www.wikiwand.com/fr/Parc_national_du_d%C3%A9fil%C3%A9_du_Jiu

[12] https://www.outnwild.com/valea-jiului-more-info/about-valea-jiului/

[13] Main source of information of the institutional regime context : https://www.sgi-network.org/2022/Romania/Executive_Summary
https://inundatii.ro/en/river-basins/jiu-river-basin/#:~:text=Climate%20of%20the%20river%20basin,of%20the%20Mediterranean%20climate%20influence

[51] https://www.outnwild.com/valea-jiului-more-info/about-valea-jiului/

[52] https://www.copernicus.eu/en/media/image-day-gallery/strong-impact-drought-danube-river

[53] https://www.trade.gov/market-intelligence/romania-irrigation-infrastructure

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agriculture, especially during droughts, impacting food security. Additionally, since the Jiu River is a tributary of the Danube, these environmental issues have transboundary impacts, requiring regional cooperation between Romania, Serbia, and Bulgaria for sustainable management.

The energy sector, particularly coal-fired power plants, also relies on large volumes of water for cooling, while mining activities in the Petroșani Depression polluted water sources, further reducing water quality for agriculture and ecosystems. Today, in the Petroșani region that was primarily associated with coal mining (mainly hard coal), most mines have been closed due to resource depletion, declining profitability and environmental concerns. In 2021, the last major coal mine in the region (the Lupeni mine) ceased operations, marking the end of large-scale mining in the Petroșani basin The region's economic conversion has become the major challenge.

3.2. Results of WEFE nexus governance assessment and policy coherence analysis in the Jiu River

Between 17 – 21 October 2022, the field visit of the nexus governance assessment took place in the Jiu river basin. Three members of the governance assessment team (2 from UNT, and 1 from UFZ) conducted a total of 10 interviews in Romania and interviewed a total of 31 stakeholders (Table 12)). One additional interview was conducted remotely with a stakeholder who was already interviewed during the field visit on 23 March for more in depth questions regarding the water sector.

The interviews were semi-structured group interviews and lasted between 1-3 hours. The interviews were conducted in English and when needed instantly translated to the local language. The case study leaders participated in all interviews to help with translations if needed. The stakeholders were interviewed in Craiova.

Table 12 Overview stakeholders involved in NXGAT interviews and focus groups in the Jiu River case study

When	What	Number of stakeholders	Men	Women	Men (%)	Women (%)
17-21 October 2022	Interviews NXGAT Romania	31	13	18	42	58
At the occasion of the Workshop3 23 May 2023	Policy coherence Romania	23	17	6	74	26

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Analysis of governance system by criteria for each dimension and scoring

- **Comprehensiveness**

Actors and networks - 9 out of 10 organisations mentioned that they are somehow involved in the decision-making process, but to a different extent. For example, some organisations have legislative power, managing authority, or co-developed strategies and are concerned with local implementation of policies. No interviewee explicitly mentioned any missing or excluded actors or networks in the decision-making process regarding WEFE governance. As a result, the score is "**high**": The majority of relevant actors and networks affected by or affecting WEFE nexus domains is involved.

Levels and scales - All levels are involved, and no level has been explicitly mentioned as missing. However, some stakeholders pointed out that the Romanian government system is highly centralized, and there is a necessity to decentralize power to lower levels, particularly at the regional and local (county) levels As a result, the score is **"high"**: The majority of relevant levels and scales across WEFE nexus domains are involved.

Problem perspectives and goal ambitions - All the WEFE sectors are concerned with resource management issues. But performance, competitiveness and revitalisation of the territories (road infrastructure, railway) are priorities at local and regional level. Developing these territories necessitates funding, and in order to secure EU funding, they must work towards the energy transition. However, this requires education and environmental awareness. Otherwise, mostly bilateral WEFE nexus domains objectives were high on the priority list: Wastewater management, recycling, water (especially flood and ecological flow), and ecosystems protection. As a result, the score is **"high"**: The majority of problem perspectives across WEFE nexus domains are taken into account and most of them are translated into WEFE nexus goal ambitions.

Strategies and instruments - A lot of strategies are available at regional and national level. The Climate Change Strategy (RO-Adapt) and the RBMP of the WFD being the most cross-sectoral ones. All domains are covered by strategies and related instruments. They are established on a bilateral basis, at most (agriculture and water; ecosystem and energy; etc.). As a result, the score is **"high"**: The majority of relevant strategies and instruments include WEFE orientation.

Responsibilities and resources - The responsibilities are clearly assigned at all levels. However, final decision regarding the allocation of resources for all levels is taken at national level, which has real decision-making power. At the national level, tthe Department for Sustainable Development urges for more cross-sectorality, but has no power and is not known at local level. The EU level urges the most for cross-sectorality through the energy transition including the allocation of resources. However, this does not seem to be well-known at the local and regional levels, and yet the Department for Sustainable Development is the institution that could promote cross-

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sectorality at the national level. Moreover, there is an urgent need for environmental expertise and for environmental education (to raise awareness and to improve performance). As a result, the score is **"high"**: Most of the responsibilities are clearly assigned, and sufficient resources are allocated across WEFE nexus domains to support WEFE nexus management.

Conclusion - According to the previous results, the overall assessment of the comprehensiveness for the Jiu case study is **"high".**

- **Coherence**

Actors and networks - It seems that the interactions between actors improved and became more cooperative throughout the years. Issues persist when actors aim to maintain the status quo to reduce additional efforts, or when certain requests arise at a particular level, such as matters related to financial considerations. Especially at national/ministerial level, cooperation is practically non-existent and therefore a lack of coherence. As a result, the score is **"low"**: Interactions of relevant actors and networks across WEFE domains are hardly cooperative, solid or based on trust.

Levels and scales - The interaction between levels and scales seems to be smooth. Moreover, no conflicts are mentioned. Vertical cooperation within one sector seems to function better than cross-sectoral horizontal cooperation. Regarding climate change, there is an Interministerial Committee for Climate Change which meets once a month to make different sectors collaborate to make laws and strategies coherent. As a result, the score is **"low":** Relevant levels and scales across WEFE nexus domains rarely work together, rarely acknowledge interdependencies and have little trust in each other, but is in progress.

Problem perspectives and goal ambitions - The regional agencies share a common goal for the region, and there is no conflict/competition over bilateral issues or objectives. In contrast, at the ministry level there is a siloed, short-term vision that is not in line with the local level. Moreover, there is a lack of trust in projects, primarily due to blockades imposed by NGOs following negative impact assessments. With the exception of the energy and water sectors, there are no significant conflicts between sectors. Compromises are reached, or subsidies are granted to compensate for any losses. However, the working programmes of the Department of sustainable development urging for more cross-sectorality, environmental awareness and education can press for more in a near future. But at the moment, the score is **"low"**: Problem perspectives and goal ambitions across WEFE nexus rarely mutually reinforce each other.

Strategies and instruments - An umbrella or a master plan is strongly needed to overcome the lack of coherence between strategies and instruments, and to prioritise the problems and goals expressed by all sectors. Cooperation between sectors other than water and environment, which fall under the same ministry, can be complicated at times. However, the RO-Adapt Strategy is under development to help all sectorial

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strategies converge into a consistent strategy to address climate change. This Climate Change Strategy is thus an on-going project that involves 12 sectors, with the plan for RO-Adapt is a strategy to become a law by 2030 to lead an action plan. However, the score is **"low"**: Relevant strategies and instruments across WEFE nexus domains rarely reinforce each other, however, progress towards more coherent strategies and instruments is expected in the future.

Responsibilities and resources - There are no financial tensions between sectors or institutions, as they all benefit from EU funds to carry out their tasks. Currently, the EU seems to be the actor proposing efficient tools to promote cross-sectorality through Just Transition Funds and Integrated Territorial Investment. This way the EU by-passes the national centralisation issue. since, at national level, the Department for Sustainable Development has no normative attribution to do so. As a result, the score is **"low"**: Responsibilities and resources across WEFE nexus domains rarely lead to cooperation among these domains.

Conclusion - According to the previous results, the overall assessment of the coherence is **"low"**.

- **Flexibility**

Actors and networks - The level of flexibility and openness to include new actors appears to be quite high. It is possible and relatively easy to include new actors, at least on paper. *"It's an open process, if you'd like to participate you can contact the parliament, they need to check some criteria but then you're invited to participate".* However, *"To participate, it's easy, to speak it's easy, to say something difficult is more difficult, to get the decision-makers to take something into account is also difficult".* As a result, the score is **"high"**: The governance system allows to include new actors or shift the lead from one actor to another when needed in some situations.

Levels and scales - There is not a lot of information on this criterion. Issues seem to be brought up to the next higher scale, i.e., local-county, county-regional, regional-national (same applies to implementation, just the other way around) and even though the national level *"seems quite flexible, however, commitment from other ministries can be limited as it means more work."* It seems to be possible to change the scale depending on the issue. However, some interviewees mentioned that the local level is not heard enough. As a result, the score is **"high"**: The governance system allows to change levels and/or scales at which WEFE nexus issues are addressed in some situations.

Problem perspectives and goal ambitions - For priorities established and funded by the EU, the strategy and time horizon is already determined. Whereas for priorities at the national level, legislation requires a public debate, making it possible to reassess and adapt rules. Nevertheless, the recent drought has changed awareness, making climate change adaptation a priority. This has led to a new plan for water safety, recovery and resilience funds and to new investment objectives. As a result, the score

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is **“high”**: The governance system allows to re-assess goals across WEFE nexus domains and combine multiple goals in package deals as needed in some situations.

Strategies and instruments - It seems relatively easy from relevant entities to manage resources and issues locally (e.g., Integrated Territorial Investment and Just Transition Funds), especially because this type of initiative is driven by the EU. The most innovative solutions rely on financial compensations, a strategic plan encompassing all strategies and new technologies to attract SMEs to improve the performance of territories. As a result, the score is **“high”**: The governance system allows to combine or make use of different strategies and types of instruments across WEFE nexus domains in some situations.

Responsibilities and resources - It seems easy to reassign responsibilities and resources at regional level (e.g., Regional Operational Programme) and to update the existing strategies (new entity in charge of the Climate Strategy Plan). This is not contextual at all, since the energy crisis has not redistributed responsibilities, priorities and resources related to resource management. For instance, the Department of Sustainable Development has no normative attributes to urge for more cross-sectorality. As a result, the score is **“high”**: The governance system allows to pool assigned responsibilities and resources across WEFE domains without compromising accountability and transparency in some situations.

Conclusion - According to the previous results, the overall assessment of the flexibility is **“high”.**

- **Intensity of action**

Actors and networks - The Department for Sustainable Development, the River Basin Authority and the National Administration of Meteorology are strongly urging for more cross-sectorality by inviting and contacting other domains to the decision-making process. As a result, the score is **“high”**: There exists strong pressure from a relevant actor or actor coalition across WEFE nexus domains towards behavioural change or management reform.

Levels and scales - The intensity of action of levels and scales seems low overall. Most levels and scales do not urge for change. However, the EU has a crucial and decisive role. It pushes and provides the funds for cross-sectoral management. At national level, the Department for Sustainable Development cannot, by itself and without normative attributes, push more for cross-sectorality than it does already. As a result, the score is **“low”**: There is some pressure from relevant levels and/or scales across the WEFE nexus domains towards behavioural change or management reform.

Problem perspectives and goal ambitions - *"It's a natural process"*. Because of climate change, all stakeholders realize the need for cross-sectoral resource management. However, only some of them already takes action to do so, for instance Romania Waters, National Administration of Meteorology, Just Transition Funds, Integrated Territorial Investment. The Department for the Sustainable Development is

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trying to get more power to move in this direction. Stakeholders mentioned after a cross-sectoral meeting, business-as-usual sectoral tasks still have to be managed. As a result, the score is **"low"**: Problem perspectives and goal ambitions across WEFE nexus domains weakly urge nexus orientation.

Strategies and instruments - There is not yet a cross-sectoral consultative board at the ministerial level. Therefore there is absence of policy instruments that stimulate cross-sectoral. Furthermore, the sustainability of instruments over time poses a significant challenge, as programs often conclude at the end of funding cycles and strategies undergo updates by various entities (meaning different skills, knowledge, etc.). As a result, the score is **"low"**: relevant strategies and instruments across WEFE nexus domains weakly urge WEFE nexus-oriented behaviour or management reform.

Responsibilities and resources - The current distribution of responsibilities and resources are sufficient to meet the challenges of cross-sectoral resource management, but only with the regional agencies and the territories concerned by EU funds (e.g., JTF and ITI). Too much changes and inertia due to political turnover are impacting the possibility to implement programme of measures. Moreover, the normative power of the Department for Sustainable Development and the establishment of an inter-ministerial consultative board with an agenda to follow are still missing. As a result, the score is **"low"**: Responsibilities and resources across WEFE nexus domains weakly urge implementation of WEFE nexus-oriented actions.

Conclusion - According to the previous results, the overall assessment of the intensity of action is **"low".**

- **Fit**

Actors and networks – According to interviewees, the relationships between actors and networks appear sufficient thus far, with indications of progressing towards greater cross-sectorality. However, collaborations remain within the respective sectors. As a result, the score is **"high"**: Relevant actors and networks across WEFE nexus domains are appropriate to deal with/manage ecosystem properties and functions in some situations.

Levels and scales - The current levels and scales, are the appropriate levels and scales to address water related cross-sectoral resources management issues such as river basin management at the catchment scale. This is not systematically the case across all levels and scales within the territory. At the regional level, the focus is more on energy transition.. As a result, the score is **"low"**: Relevant levels and scales of the governance system hardly correspond to ecosystem properties and functions.

Problem perspectives and goal ambitions - In general there is awareness about the interdependencies between sectors. However, with the exception for some specific clusters created specifically to adress cross-sectoral issues (e.g., Just Transition Funds), sectors are working in silo or bilaterally. As a result, the score is **"low"**: Problem perspectives and goal ambitions across WEFE nexus domains rarely take into account ecosystem properties and functions.

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Strategies and instruments - While most of the strategies and instruments could be suitable for addressing sectoral interdependencies, it appears that only those specifically designed to tackle climate change and water issues are widely regarded as legitimate for incorporating all sectors. Most strategies are developed sectorally oriented. However, the Department of Sustainable Development is advocating for the inclusion of SDGs and cross-sectoral synergies. Indicating a positive trend As a result, the score is **"very low"**: Relevant strategies and instruments across WEFE nexus domains never take into account ecosystem properties and functions.

Responsibilities and resources - At the national level, an inter-ministerial committee is missing and the Department for Sustainable Development lacks legitimacy. Furthermore, the turnover of responsibilities and discussions about allocated resources in each new political context do not support rapid improvements, and more importantly, do not establish a stable basis. Regarding resources, the financial resources and targets set by the EU are sufficient to implement intersectoral management. However reliance on EU funds means that there is no financial continuity. As a result, the score is **"very low"**: Responsibilities and resources across WEFE nexus domains are never appropriate to deal with ecosystem properties and functions.

Conclusion - According to the previous results, the overall assessment of the fit is **"low"**.

As the result, the overall scores are as follow:

Table 13: Matrix of the overall scoring of the Jiu River

Dimensions / Criteria	Comprehensiveness	Coherence	Flexibility	Intensity of action	Fit
Actors and networks	HIGH	LOW	HIGH	HIGH	HIGH
Levels and scales	HIGH	LOW	HIGH	LOW	LOW
Problem perspectives and goals ambitions	HIGH	LOW	HIGH	LOW	LOW
Strategies and instruments	HIGH	LOW	HIGH	LOW	VERY LOW
Responsibilities and resources	HIGH	LOW	HIGH	LOW	VERY LOW
Overall assessment	HIGH	LOW	HIGH	LOW	LOW
Concluding evaluation	The current governance system is restrictive toward WEFE nexus goverance				

Policy coherence analysis results

The results of the policy coherence analysis in the Jiu river basin are presented in Figure 21. The scores are based on the document analysis of the CS leads. The results were discussed with stakeholders during workshop 3. The document analysis shows a high-level of policy coherence in the policy documents. This seems to confirm the

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extent scores of strategies and instruments in the NXGAT showing that the majority of relevant strategies and instruments include WEFE nexus orientation. However, at first glance, there is a difference between the high degree of policy coherence found in the policy coherence analysis and the low score on coherence of strategies and instruments in the NXGAT. This can be explained by the selection of policy instruments in the policy coherence analysis. Half of the selected policies is cross-sectoral and therefore specifically designed to have a high level of coherence and only three sectoral policies are selected. Similar to what is found through the NXGAT the sectorally designed policies show lower degrees of coherence. However, it should be noted that these scores are still relatively high.

Sector	Policy	Water	Energy	Food/ agriculture	Land/Soil	Biodiversity/ ecosystems	Climate	Circular economy
Water	Jiu River Basin Management Plan							
Energy	National Integrated Plan for Energy and Climate Change 2030							
Food	National Strategic Plan 2023-2027							
Agriculture	National Strategy for Sustainable Development 2030 (cross-sectoral)							
Cross-sectoral	Economic, social and environmental development strategy Jiu Valley 2021-2030							
Cross-sectoral	National Strategy for Circular Economy							

Figure 21: Results policy coherence analysis Jiu

Self-scoring of cross-sectoral management by stakeholders

To the question *"if you were to **score cross-sectoral management** in the river basin concerning the problems we discussed, which score would you give between 0 (no cross-sectoral management) and 3 (good cross-sectoral management)?",* the **average** value given in response is **1.5** (Figure 22) and:

- the national level scored 1.4;
- the regional level scored 2.7;
- the local level scored 0.5.

At national level

- The Academics scored 1.5 because *"at least 2 institutions are acting in a sustainable way, but there is no institution to bring the 4 sectors together";*
- The National Administration of Meteorology scored 1.5 because *"the need is here, but the problem is linked to the political level: the Ministry of Agriculture is not in line with the Ministry of Environment";*
- The National Administration Romanian Waters scored 1.5 because *"they can't achieve a win-win situation"* and they are *"not quite confident for the future"*; but

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also scored 2 even if *"moving towards more cross-sectorality will be very challenging because water quantity will be a big problem, leading to water quality in some areas". "Drinking water is and will be the main problem"* they will have to face;

- The Department for Sustainable Development scored 1.5 because "*cooperation can happen between 2 or 3 sectors"* but even if the water sector and the ecosystem sector are under the same ministry*, "maybe for some projects they work in silo within the same Ministry";*
- The Romanian Farmers' Club scored 0 and 1 because *"projects can gather more sectors but it's not sustainable".*

At regional level

- The Regional Development Agency South-West scored 3 *because "all agencies within the region have common goals"*. "*When there is a regional initiative, all regional agencies are invited". "There are clusters and groups at regional level. There is also a permanent cross-sectoral working group, that is meeting regularly";*
- The Gorj County Council scored 1.5 because *"at local scale, all sectors are involved".* But "*at the scale of actions and benefits, the 4 sectors are not gathered at the same table even if they share the same goals. They are not at the same stage of process"*;
- The Environmental Protection Agency Dolj scored 2 because *"cooperation depends on projects and on requests",* but also scored 3 because the waterboard is pushing for cross-sectorality (cooperation with all domains).

At local level

- The Valea Juilui Coalition scored 0 and 1 because *"they don't know each other"* even if they have *"the same interests".* They "need to trust each other". They also lack environmental expertise as they do not have any expert in their board.

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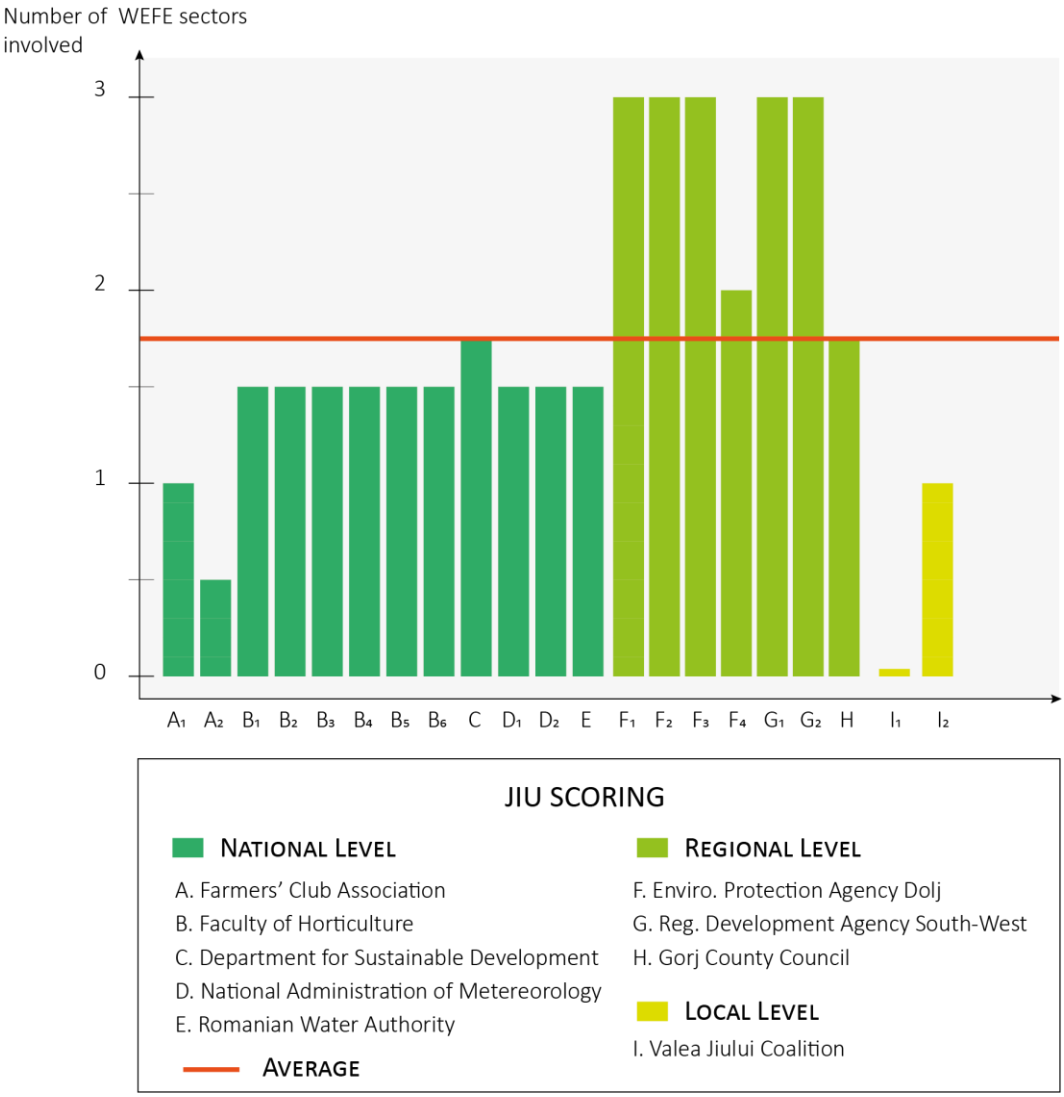

Figure 22: Self-scoring of cross-sectoral management by stakeholders of the Jiu case study

3.3. Concluding evaluation of the Jiu River basin

3.3.1. Concluding evaluation

The current governance system is **"restrictive"** towards WEFE nexus governance because of:

- Lack of coherence of governance at national, regional and local levels;
- Lack of intensity of actions;
- Lack of motivation to change.

But with a **tendency to be "supportive"** because:

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- There are a lot of strategies at regional and national levels that have the possibility to urge for more cross-sectorality: Just Transition Funds (Energy), RBM Plan (Water), Integrated Territorial Investment (Energy, Global economy, social issues, etc.), strategy for climate change at national level, etc.
- There has been an increase of cross-sectoral interaction and cooperation throughout the years. However, this does not support cross-sectoral action yet. Most likely because of over-commitment (additional work) and a lack of resources (human and others) and lack of motivation to change *"business-as-usual"* to more cross-sectoral interactions.
- Regional and local scales develop and push for more bottom-up approaches.
- The management of water brings most sectors to the table for cross-sectoral discussion.

3.3.2. Barriers and levers

Barriers

- Lack of attraction of Jiu territories: Difficulty to attract businesses to settle in the Jiu territory and to implement energy transition, which can urge for more cross-sectorality (renewable energies);
- Ministries have siloed short-term vision: National level ministries do not provide a complete and agreed cross-sectoral vision;
- Lack of environmental awareness and education;
- Need for an umbrella for the existing strategies: There are a lot of existing strategies in all sectors with potentiality to urge for more cross-sectorality. Need for harmonisation, prioritisation;
- The sustainability of instruments over time is a big issue (depending on the duration of funding). The challenge is how to implement them and make them long-lasting;
- Time allocated to bureaucracy;
- Go back to business as usual, even after cross-sectoral discussions.

Levers

- The Department for Sustainable Development urges for ecological transition and indirectly urges for more cross-sectorality;
- The regional development agencies do share a common goal for their region and could be the right level to urge for more cross-sectorality;
- There is currently an effort/improvement in the harmonisation of strategies at national level and across sectors coordinated at national level;

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- EU supports the development of territories in energy transition through diverse funds and subsidies: This is considered a lever, but only for a limited period of time;
- The need for renewable energies urges for more cross-sectoral interactions which can support the development of bottom-up initiatives in the Jiu territory and beyond.

3.3.3. Recommendations to urge for more WEFE nexus governance in the Jiu River

Some key results of the assessment are presented below, aiming to help stakeholders move towards more cross-sectoral resource management in the Jiu river basin.

Lack of environmental awareness and environmental education

Many stakeholders interviewed mentioned a lack of environmental awareness, environmental education, and environmental expertise across sectors and scales. Regarding environmental education, the Jiu River Basin Authority has already initiated some actions but according to stakeholders, goals should be more ambitious. At the national level, the Department of Sustainable Development promotes an intensification of environmental awareness and education actions at all levels and scales.

Existing strategies in all WEFE sectors with potential to urge for more cross-sectorality

Each WEFE sector has a separate strategy for sustainable development and climate adaptation with the potential to promote cross-sectoral resource management. However, these strategies are sectoral oriented and sometimes incoherent with other sectors' priorities. To address these issues, in 2022 the Romanian government started an initiative to bring together and converge strategies to simplify the overall strategy for sustainable development and climate adaptation at national level. This required additional expertise from EU level and highlights now the need to consider cross-sectorality more strongly.

Opportunities to increase policy harmonisation and implement cross-sectoral actions

When an overall strategy for sustainable development and climate adaptation is established, and in line with suggestions for more WEFE nexus-oriented management, the main goal is to implement it. From the interviews performed during NEXOGENESIS, it became clear that there is currently a gap between cross-sectoral cooperation and effective cross-sectoral action. Regardless of the quality of interaction during meetings or workshops, there is a tendency to continue business-as-usual, having no capacity to put impactful and lasting cross-sectoral actions on the agenda. To address current barriers, such as the lengthiness and complexity of bureaucratic

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processes, and the lack of environmental education and expertise, the question of identifying a governance body that could urge for more WEFE nexus-oriented management has been raised. This seems to be a good time to find solutions as the strategy for sustainable development and climate change adaptation will have to be implemented at all levels and at all scales. In fact, to implement an all-encompassing strategy for sustainable development and climate adaptation at all levels, different actions are required under an overarching directing body. The Department of Sustainable Development has the ambition to play such a role but is not in the position to do so and should be empowered to take such a role. However, the national level alone is not sufficient to push for more cross-sectorality at regional or local levels. To this effect, Romania's eight regional development agencies seem to have the potential to facilitate implementation of cross-sectoral actions, also at local level, and could thus be selected to support cross-sectorality and bottom-up approaches in connection with the national authorities.

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4. Adige River

The Adige is the second river in Italy in terms of length and the third in terms of catchment area, after the Po and the Tiber (Basin Authority). It rises in the Upper Venosta Valley at an altitude of 1,550 m above sea level and flows for 409 km through Alto Adige, Trentino and Veneto before reaching the Adriatic Sea. General information regarding water, energy, agriculture and environment to contextualise the case study are described below.

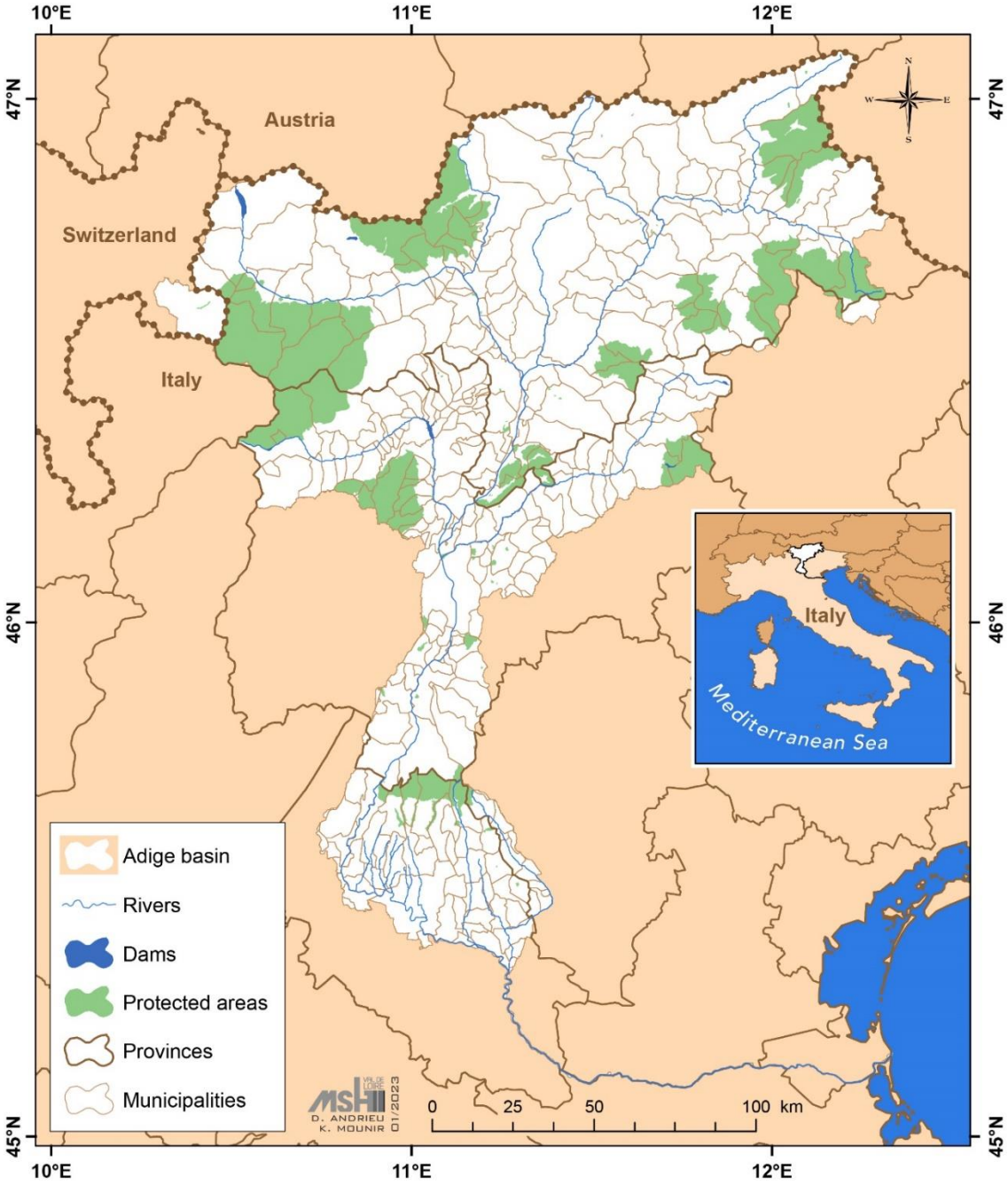

Figure 23: Location of the Adige River

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4.1. Context and case study description

4.1.1. Biophysical context

The Adige River is the second longest in Italy and the third in terms of catchment area. It originates in the Upper Venosta Valley, flowing for 409 km through Alto Adige, Trentino, and Veneto before reaching the Adriatic Sea. Its basin covers 12,100 km², extending across northern Italy, with a small portion in Switzerland (only 130 km2). The first section runs from Lake Resia to Merano (drained area of 2670 km2), then along the Adige valley to Trento (drained area of about 9,810 km²), and from Trento to Verona the valley is called Lagarina (about 11,100 km²). The territory of the provinces of Bolzano and Trento is predominantly mountainous, with very high elevations and softening in the valley bottoms of the Adige River and its main tributaries. The Veneto part of the territory includes the Lessinia mountain area, with moderate altitudes, and a part of the Veneto plain in the province of Verona, including the city itself. The Adige River then flows into the Adriatic Sea between the mouth of the Brenta River and the delta of the Po River as far as Albaredo (province of Verona), where it closes its basin because the high embankment does not allow tributaries to flow in and the river becomes a lowland river.

As far as the Province of Bolzano is concerned, out of a total area of 7,400 km², 7,192 km² belong to the Adige river basin (Provincia Autonoma di Bolzano, 2017). This means that 97% of the territory of Alto Adige belongs to the Adige river basin, (that is 59% of the territory of the entire basin), the territory of the Province of Trento occupies about 28% of the entire basin with a total area of 948 km2), the Veneto region about 12% and the remaining 1% corresponds to the territory of Switzerland.

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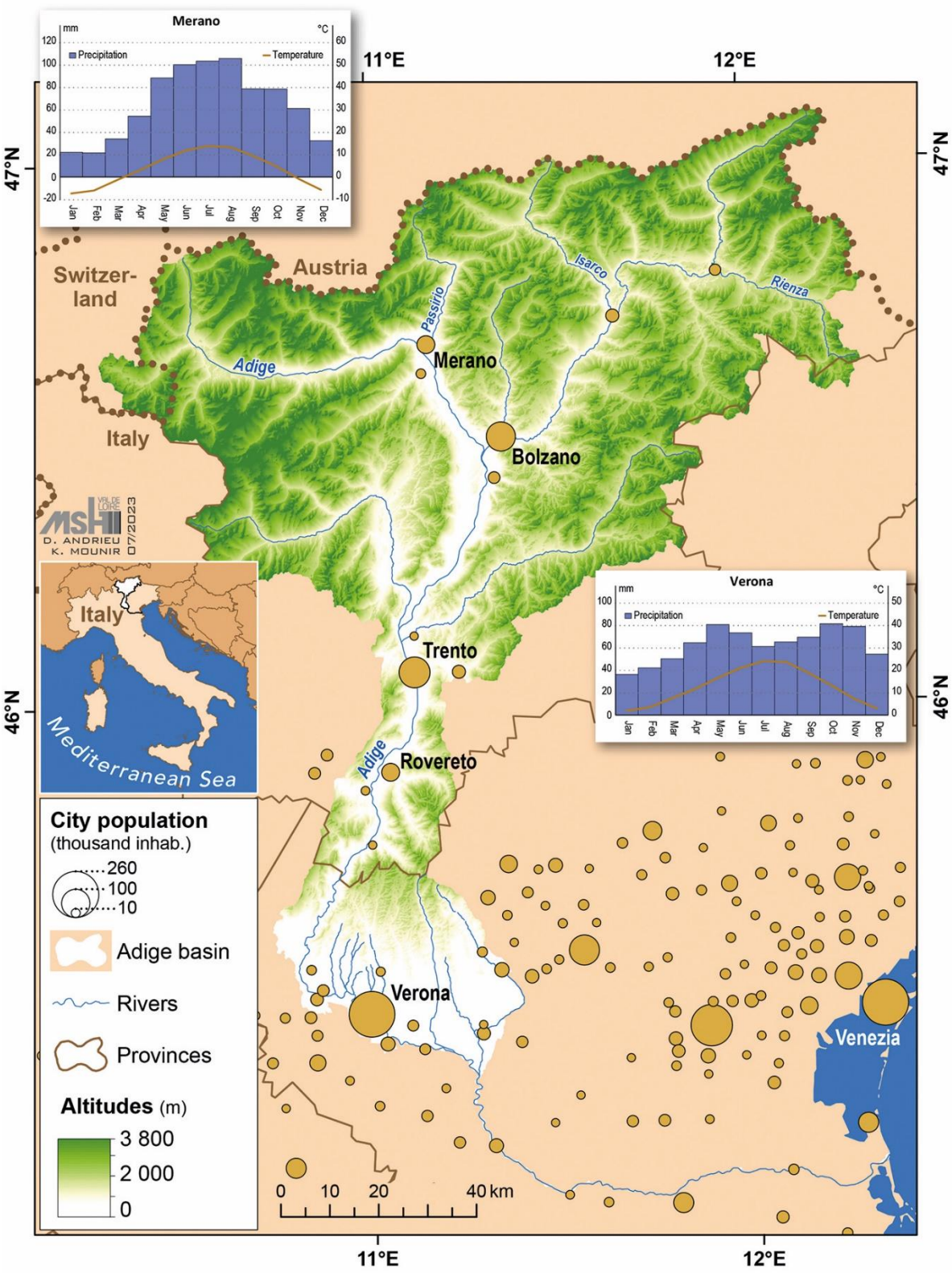

Figure 24: Topography, hydrography and main climate characteristics of the Adige River

Climate characteristics

The Adige Basin in Italy spans an elevation range from 200 m to 3900 m, and as a result, it displays a wide spectrum of climatic patterns significantly influenced by its varied topography. In the northern part of the basin, specifically in Merano, January

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temperatures show a significant decline, averaging at about -7.4°C. The summers in this area are cooler, with July temperatures averaging 13.8°C. Merano receives an annual precipitation of approximately 782 mm, with August recording the highest at 106 mm and February the lowest at 21.6 mm. According to the Köppen climate classification, Merano is classified under the "Dfc" category, which denotes a subarctic continental climate characterized by short, cool summers with humid seasons. Moving southwards to areas of lower altitudes, like Verona, the temperatures in January have a minimum of approximately 2°C and July sees a maximum of about 24°C. The yearly rainfall in this area amounts to approximately 760 mm, registering its minimum in January at 36.5 mm and peaking in May at 80.9 mm. According to the Köppen climate classification, Verona is categorized as "Cfa," indicative of a humid subtropical climate with some continental influence, resulting in relatively cold winters and warm summers. In summary, the Adige basin has a variety of climatic conditions: the northern regions have a subarctic continental climate, while the southern region has a humid subtropical climate.

Water resources

There are 546 lakes in the Adige basin, of which a relatively high percentage have a very small surface area of less than 1 ha. Most of them are of glacial origin and of modest size. Most of the natural lakes in the Alto Adige territory are in the high-altitude range, above 2,000 meters above sea level. The largest natural lake is Lake Caldaro.

In the Adige basin there are 298 glacial areas with a total surface area of 127.72 km²; in particular, in the province of the Alto Adige, 258 glacial areas with a total surface area of 108.19 km² have been classified (Provincia Autonoma Bolzano, 2017), while in the province of Trentino 40 glacial areas with a total surface area of 19.53 km² have been classified (Distretto Idrografico Alpi Orientali, 2016).

A peculiarity of the Adige basin is the fact that there are currently 31 reservoirs with different capacities, ranging from the maximum of 183 million m^3 for Lake Santa Giustina, 118 million m^3 for Lake Resia to the minimum of 90,000 m^3 for Lake Sarentino. In total, the artificial reservoirs in the Adige basin have a storage capacity of about 571 million m^3 (Distretto Idrografico Alpi Orientali, 2016). The network of reservoirs is quite old: the oldest reservoir dates to 1926, the most recent to 1991.

In recent years, water scarcity has become more pronounced in the Adige basin during early spring and late summer, driven by reduced snowmelt, decreased precipitation, and rising water demands during particularly dry with very little rainfall, leading to a water crisis in 2022 (Majone et al., 2016 ; Shrestha et al. 2023).

4.1.2. Socio-economic sectors

Population

The population of the Adige river basin is about 1,600,000 inhabitants. It covers one third of the territory of the Eastern Alps district, where 54% of the population of the

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basin live in 17 municipalities with more than 10,000 inhabitants (of which about 47% live in the four most urbanised areas: Merano, Bolzano, Trento, Rovereto and Verona). The remaining municipalities have fewer than 5,000 inhabitants. The population of the province of Bolzano is about 460,000 inhabitants, almost all of whom live in the basin and represent 28% of the total population of the basin. The population of the province of Trento is about 350,000 (74% of whom live in the basin) and represent about 21% of the basin population. The other two provinces that weigh in terms of population in the basin are Verona with about 570,000 inhabitants, of which almost 70% live in the basin representing 35% of the total population of the basin, and Rovigo with 92,000 inhabitants, representing 5.54% of the total population of the basin (38% of the provincial population lives in the basin). Finally, the remaining 10% of the population of the basin is represented by the provinces of Vicenza (3.80%), Belluno (1%), Padua (1%) and Venice (4%).

Agriculture

In the Adige Basin, agriculture varies by altitude and region. The mountain areas are primarily focus on grasslands, fodder crops, and forests, with forests covering 49% in Bolzano and 63% in Trentino. In these mountain areas, livestock, especially cattle, plays a central role, particularly in Bolzano, with over 10,000 farms at high altitudes. Trentino has about one-third of Bolzano's livestock farms, mainly focusing on cattle. Apples and vineyards dominate the valleys (e.g., Adige and Noce), with Trentino specializing in apple production and viticulture, and Alto Adige focusing on quality wines and mountain farming. In recent years, apple cultivation has expanded to higher altitudes. Heavily irrigated agriculture includes nearly 43,469 hectares, with substantial water concessions (e.g., 8,000 irrigation permits in Bolzano). Modern irrigation methods, like drip systems, are being adopted, especially in water-scarce areas.

Energy

The Adige Basin hosts a robust hydroelectric infrastructure, with 61 power plants, 34 of which generate over 650 MW. The basin's 28 reservoirs, split between Bolzano (15) and Trento (13), support energy production, but some only produce power based on natural water flow without regulation, depending on ecological flow and concessions. In Alto Adige, 936 hydropower plants supply the region, where large plants (over 3,000 kW) contribute 86.25% of electricity production, while smaller plants add less than 3%.

Hydropower is central in Trentino-Alto Adige/ Südtirol, which has 3,759 MW of renewable capacity, with hydro contributing 86.4% (3,247.5 MW), followed by solar (475 MW) and bioenergy (95.3 MW). The region generates 10,534 GWh/year in total, with renewable sources accounting for 89.1%, primarily from hydropower (91.8%) alongside smaller contributions from solar (4.5%) and bioenergy (3.7%). Wind energy remains minimal, at just 0.1 GWh/year. Notably, Trentino-Alto Adige ranks second in Italy for renewable energy use, with a 92.1% share, following Valle d'Aosta (Figure 25).

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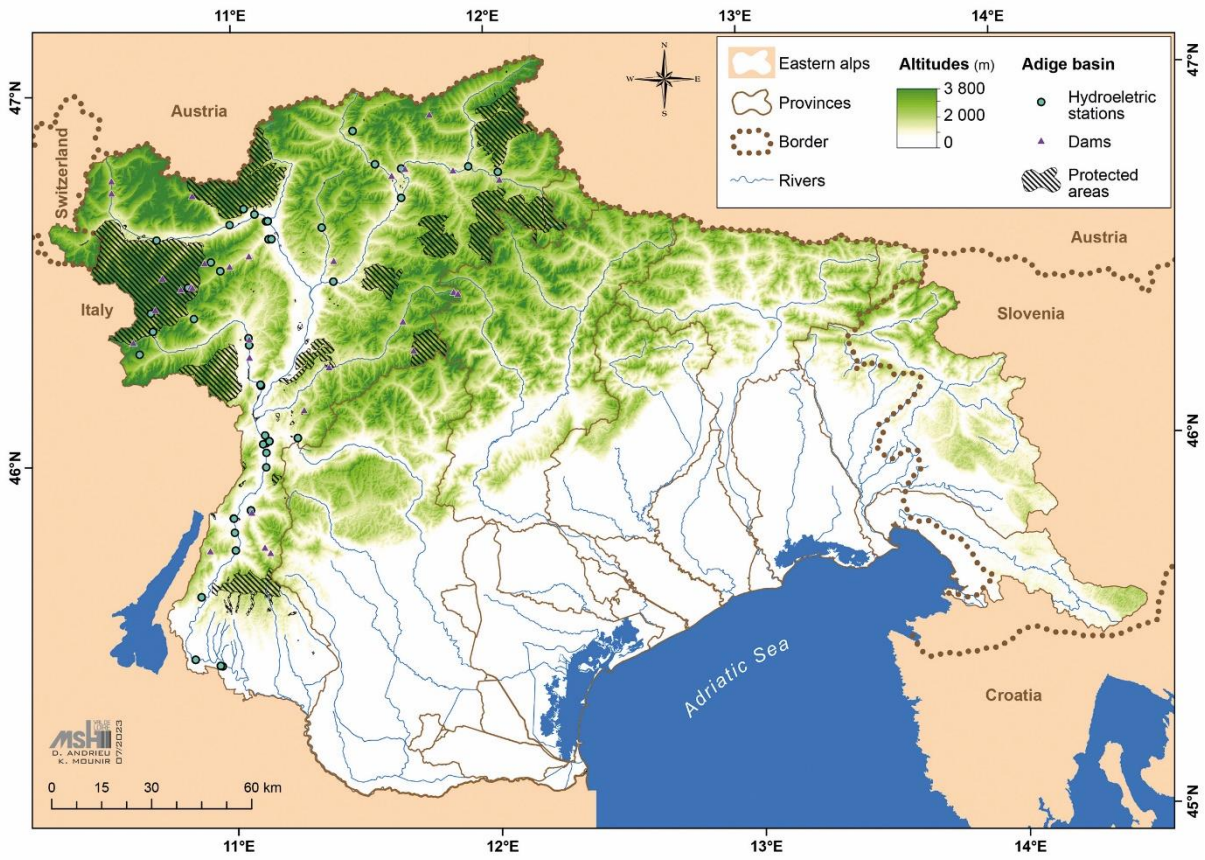

Figure 25: Hydroelectric stations in the Adige catchment

Ecosystems

The Adige basin's ecosystems are rich in biodiversity. In higher altitudes, forests (especially in Bolzano and Trentino, where they cover over 50% of the area) and grasslands support alpine flora and fauna. These areas are characterized by limited human intervention, though grazing and small-scale agriculture are common. The basin also contains a range of habitats along its river banks, which support native fish species, birdlife, and various aquatic plants. Wetlands and riparian zones contribute to flood control, habitat diversity, and nutrient cycling. Downstream, where agriculture intensifies, biodiversity is affected by land-use changes. Crop cultivation, especially apple orchards and vineyards, alongside pasture lands, leads to habitat fragmentation. In the Veneto region, intensive agriculture and urban expansion have increased stress on local ecosystems, reducing natural vegetation cover and affecting the integrity of riverine habitats.

In order to comply with the European Water Framework Directive, the autonomous provinces of Bolzano and Trento and the Veneto region have considered the use of different calculation tools for the determination of the value of the ecological flow to be applied to the main basin of the Adige River, taking into account uniform coefficients per sub-basin area. The autonomous province of Bolzano, according to the PGUAP in the version proposed on 23/07/2007, foresees a value of 2 l/s per km² of the basin concerned for the discharge. This value is considered to be a minimum rate, which

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must therefore be increased if necessary in order to guarantee the balance of the ecosystems involved and to preserve the ecological functionality of the aquatic environment. For granting new concessions, the ecological flow determination procedure imposed by the autonomous province of Bolzano requires the submission of the environmental impact assessment of the project, supported by limnological studies in the case of water catchments of 100 l/s or more.

The autonomous province of Trento has established the following unit coefficients for the ecological flow in the PGUAP in force for the Adige valley (between 1.5 and 2.1 l/s/km^2 depending on the season). Finally, the Veneto region, in its water protection plan, has set a uniform coefficient of 3 l/s/km^2 without any seasonal modulation. Applying this rule to the last stretch of the Adige River, whose basin closes at Albaredo, an ecological flow value of less than 40 m^3/s was calculated. This flow rate is clearly insufficient to counteract the rise of the saline wedge in low flow conditions more frequent in recent summer seasons, especially in relation to the proper functioning of the barrier installed to counteract this phenomenon, which only operates at flow rates higher than the ecological flow required by the regional regulations. The application of these different parameters along a watercourse is not sufficient to guarantee the ecological and biological functionality of the river. An experimental study has made it possible to define an ecological flow for a range that is never less than 10 m^3/s, with values generally in the order of 20 m^3/s (Sartori *et al*., s.d.).

Water

Concerning water quality, in the lower basin, nutrient runoff from fertilizers and pesticides has become a significant issue, particularly from orchards, vineyards, and cereal crops. High nitrate and phosphate levels from fertilizers contribute to eutrophication, which can lead to algal blooms and oxygen depletion, harming aquatic life.

In urbanized and industrialized areas, including parts of Bolzano and Verona, municipal wastewater and industrial discharges introduce heavy metals, organic pollutants, and sediments into the water system. Despite improvements in wastewater treatment, these pollutants still pose risks to downstream ecosystems.

The numerous dams and reservoirs for hydropower generation in the Adige basin modify natural flow patterns, impacting water temperature, sediment transport, and river ecology. The regulation of flow for energy production can reduce the flushing of sediments and pollutants downstream, leading to sediment buildup and reduced habitat quality for fish and other species. Moreover, the reduced flow affects the ecological health of the river, especially during dry seasons when water availability is low.

Italy is one of the Alpine countries most dependent on artificial snow, with 90% of its slopes covered (Legambiente 2023). The Trentino-Alto Adige snow-making system is organised around 59 reservoirs, evenly distributed between the two provinces (27 and 32 respectively). This increased water usage can strain local water sources and affect

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seasonal water availability, indirectly impacting river ecosystems. Today, most ski resorts, except for those at higher altitudes, are equipped with snow-making facilities. With 1 m³ of water it is possible to produce about 2.0-2.2 m³ of snow, but in order to guarantee a basic snow cover of about 30 cm at the beginning of the season, 1200-1300 m³ of water are needed per hectare of slope. The same amount of water is also needed during the season to maintain the snow cover. The amount of water required for snow-making in the absence of natural snow can vary according to exposure and slope gradient, but an average of 2,500 m³ of water per hectare per winter season is assumed. This results in a total requirement of about 6.4 million m³ of water per year (Provincia Autonoma di Bolzano, 2017). For Trentino, the PGUAP indicates a value of about 1,200,000 m^3/year.

4.1.3. Institutional regime context

Italy operates as a democratic republic with a bicameral parliamentary system and a multi-tiered structure of regions, provinces, municipalities, and metropolitan cities. The country has 20 regions, each with the authority to adopt its own statutes, along with the provinces, municipalities, and metropolitan cities. Fifteen regions, including Veneto, have ordinary status, while five, such as Trentino-Alto Adige, enjoy special autonomy based on distinct constitutional statutes, recognizing unique geographical or cultural characteristics. Trentino-Alto Adige is composed of the autonomous provinces of Trento and Bolzano, which have assumed nearly all regional powers and govern independently through their own institutions. The region primarily coordinates provincial policies and retains limited roles in land registration and civil security.

Challenges remain in defining the relationship between Italy's central government and local authorities, highlighting the need for a clearer distribution of responsibilities, adequate resources for local governance, and improved accountability measures.

4.1.4. Key challenges for WEFE nexus

- Seasonal Water Scarcity and Allocation: The reliance on water for hydropower, agriculture, and urban use, combined with seasonal variations, creates tension in allocating water equitably. Strategies like improved irrigation efficiency, water-saving technologies, and seasonal flow adjustments in dams could help balance water needs across sectors.
- Climate Change Adaptation: As climate change affects snowfall, precipitation, and temperature patterns, managing the timing and volume of water flows will become more challenging. Adaptation strategies, including improved water storage, conservation of alpine ecosystems, and sustainable agricultural practices, are essential for building resilience.
- Integrated Policy Approaches at basin scale: Addressing these interdependencies requires coordinated policies that integrate water, energy, agriculture, and ecosystem management at different levels and scales.

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- The excessive burden of regulations, the inability of local authorities to deal with critical situations and the bureaucratic slowness of the normal channels of public action too often requires that exceptional powers are granted to special authorities (the “commissari”).

4.2. Results of WEFE nexus governance assessment and policy coherence analysis in the Adige River

Between 4 –12 October 2022, the field visit for the nexus governance assessment took place in the Adige river basin. Two members of the governance assessment team (UNT, KWR) with three EURAC Research and Centro Euro Mediterraneo sui Cambiamenti Climatici - CMCC members leading the case study, conducted a total of 17 interviews (4 in Bolzano province, 5 in Trento province, 8 in Veneto region and 1 for the Eastern Alps Hydrographic district) including a group interview (5 people of province of Bolzano) with 18 different stakeholders (public administrations, territorial authorities, businesses, and civil organisations) for a total of 27 people.

The interview campaign attempted to cover as much as possible – within the limits of the availability of the actors contacted in advance by EURAC colleagues – the four WEFE nexus sectors in the three different administrative areas (autonomous provinces of Bolzano and Trento and the Veneto region). The team therefore met with local administrations at three levels: local (1), provincial (3) and regional (1), as well as district level (1), fishermen's associations (2), environmental protection associations (3), land reclamation and irrigation consortia (2), energy production companies and associations (2), water supply companies (1) and farmers' associations (2).

The focus group for the validation of the policy coherence assessment took place on 3rd July 2023. Only 3 stakeholders participated: 2 from the province of Bolzano (water and energy sector and 1 from Veneto region (agriculture sector).

Table 14 Overview stakeholders involved in NXGAT interviews and focus groups

When	What	Number of stakeholders	Men	Women	Men (%)	Women (%)
4-12 October 2022	Interviews NXGAT Adige	27	21	6	78	22
3 July 2023	Focus group Adige	3	3	0	100	0

Analysis of governance system by criteria for each dimension and scoring

- **Comprehensiveness**

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Actors and networks - At the level of each territorial unit (provinces and regions), there are networks of actors in contact with each other, with institutional and associative actors who know each other and regularly interact. The system is characterized by multiple centers of decision-making and power (a polycentric system) for the management of resources (especially water), which are not always coordinated. In this context, the District Basin Authority, which was only created in 2017, still faces difficulties in fulfilling its role and establishing its legitimacy vis-à-vis the other actors in the basin territory, in particular, with respect to the autonomous provincial administrations. In response to the infringement procedure brought against Italy by the European Commission for failing to fully implement the Water Framework Directive, permanent water uses observatories have been set up in Italian river basin districts. The purpose of the observatories is to facilitate and strengthen cooperation between the water resources management actors within each district, thereby providing guidelines for the regulation of abstraction and use and possible financial compensation in the event of drought and/or water scarcity. As such the observatories can be considered a WEFE nexus-oriented structure.

According to interviewees of the two autonomous provinces, the water use observatories should have a purely consultative role; according to the Veneto region interviewees, the water use observatory it should be given greater decision-making powers in times of crisis. Furthermore, according to the governmental actors interviewed, the observatory is a technical body and therefore not open to non-institutional actors, such as environmental associations, which, on the contrary, think that they should sit at the observatory table. Although the participation of environmental associations in the governance system is guaranteed in other arenas and through other means (e.g. public consultation), these participation forums do not always seem to allow for effective participation. For example, the timeframe for making observations in the public participation phases of environmental decision-making is too narrow. Finally, for the Basin Authority, the presence of environmental associations at the Observatory meetings is important, as they are perceived as interlocutors on the same wavelength regarding the protection of water resources and, more generally, ecosystems.

As a result, the score is **“very high”:** The governance system involves all relevant stakeholders in the WEFE domains.

Levels and scales - The institutional levels and management scales involved are the provincial level (the provinces of Trento and Bolzano) the regional level for Veneto and the district level of the hydrographic basin of the Eastern Alps, to which the Adige River belongs. For the management of drinking water and wastewater there is the scale of the ATOs – Ambiti Territoriali Ottimali – 4 in Alto Adige, 1 in Trentino and 8 in Veneto. The system can be considered polycentric in the sense that it involves numerous administrations and bodies at different levels in decision-making processes for the provision of services, the operation of facilities and the regulation of uses. These decision-making centers exist and operate simultaneously within a system in which no one actor has authority over the others and no ultimate authority.

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Decisions on the management of the basin's resources are taken at the level of each administrative unit (the autonomous provinces of Trento and Bolzano and the Veneto region), which do not have the same legislative, administrative and financial powers due to their different statutes and degrees of autonomy. At the local level, municipalities have a role in integrated water services (often participating in the ownership of water service companies), in river contracts and in the implementation of RBMP measures at the local level.

It is in this context that the river basin scale and a district vision for resource management struggle to gain traction. Some actors, such as ANBI – the National Association of Reclamation and Irrigation Consortia for Soil Protection and Water Management and environmental associations (WWF, Legambiente) consider the river basin scale to be the appropriate one for resource management. On the other hand, the autonomous provinces located in the upstream part of the basin, and the actors of the agricultural and energy sectors that carry out their activities in these provinces, consider that the management and decision-making scale must remain at the provincial level. Regarding the institutional stakeholders of the Veneto region, located downstream, they consider that in situations of conflict over water use or water crisis, the basin scale is the best one to deal with the problem.

As a result, the score is "**high":** The current system of governance includes all the relevant levels and scales involved in the WEFE sectors. However, the basin administration and management level is struggling to play its role.

Problem perspectives and goal ambitions - At the basin level, problem perceptions tend to converge around certain issues:

- The dominance of the hydropower sector, due to its strategic national importance for the energy sector;
- The land and water requirements of intensive agriculture, focused on products for national and international markets (apples and vineyards upstream and vineyards and horticultural products downstream);
- The vulnerability of the area to extreme events, both droughts and floods, is linked to climate change.

The severe drought that affected the Adige basin (along with other countries) in the summer of 2022 had a dramatic impact on the flow of the Adige River. It caused an exceptional episode of saline intrusion at the river's mouth, contaminating aquifers up to almost 50 km inland. Agriculture and river ecosystems were severely affected by the saline intrusion, and drinking water production was threatened in some areas. Although the signs were there in the spring, it was not until June, when some of the crops had been damaged, and after long and difficult negotiations between local governments up and down the river and the central government, that the situation was remedied.

As a result, the score is "**low**": Although there is a shared perception of the problems in the river basin, the objectives of the different actors to consider the

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interdependencies between the different nexus sectors do not have the same level of ambition and remain rather anchored in a sectoral vision.

Strategies and instruments - There is an extensive multi-scale and multi-level (provincial, regional and national) regulatory, planning and implementation framework. This has resulted in a stratification of instruments at different levels of the river basin scale. Since the creation of the District River Basins (2017), the District Basin Authority has been responsible for hydrogeological, flood and water management planning at this scale, and the District River Basin Plan should be the main instrument for achieving the environmental objectives required by the WFD. However, in the territory of the district in which the Adige River Basin is located, there are numerous water management instruments and regulations coming from the autonomous provinces and regions located in the basin, which are very specific. In this context, the RBMP, in its unified conception, still appears as an abstract option, since functional and territorial competences continue to exist between the State, the regions and the autonomous provinces.

Only a limited number of these strategies and instruments are truly nexus-oriented and only at the level of administrative units (mainly autonomous provinces). These include the Climate and Energy Plan of Alto Adige, the Public Water Use Plan (PGUAP) of the two provinces of Bolzano and Trento or the Sustainable Development Strategy of the three political entities. Other initiatives reflect synergies between nexus sectors, such as ecosystem services in agriculture (supported by land reclamation and irrigation consortia) or river re-naturalization projects in Alto Adige and Veneto.

Faced with the drought of summer 2022 and the demand for water by the agricultural sector in the downstream part of the basin, the energy sector and the provincial administrations of Trento and Bolzano, located upstream, argue that the strategy to cope with the effects of increasingly frequent and severe droughts downstream is to switch to less water-intensive crops: for example, to abandon rice cultivation. Another solution they suggest is to install more water-efficient irrigation systems - drip irrigation - in the downstream area. Farmers and the Veneto Regional Authority for Agriculture (downstream) stress the specificity of the agricultural areas near the estuary, which are flooded and have traditionally produced rice (a crop adapted to the area). Furthermore, the typical downstream crops (grains, corn) cannot be drop irrigated.

The agricultural sector is promoting at national level a program for the construction of more than 10,000 small reservoirs by 2030 throughout the country, including the Adige River basin. The "piano laghetti" – "ponds plan" – is a nexus-oriented proposal to provide water for irrigation, drinking water if needed, production of energy and environmental/water services. At high altitudes, it is becoming increasingly common to build small reservoirs to store rainwater. This is because the snow cover is decreasing. Reservoirs are therefore seen as the only solution to keep water in the region. In the upstream part of the basin, the province of Bolzano and the Alto Adige Farmers' Association justify the construction of reservoirs for irrigation purposes as a means of limiting the peaks of water abstraction from the rivers. However, this measure

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is assessed on a case-by-case basis, considering the impact on the landscape – a very important issue for the province (especially Bolzano) – and the acceptance of the population. Downstream, in the areas close to the delta, where drip irrigation is not applicable to cereal and rice crops, "low-tech" solutions are favored, such as the reuse of drainage water (normally discharged into the sea) or the storage of water by widening and damming sections of irrigation canals. Some actors, such as the land and water reclamation consortia, have pushed for a vision that considers ecosystem services and a more environmentally sensitive agriculture.

As a result, the score is **"low":** The governance system is a multi-scale and multi-level (provincial, regional and central) regulatory and implementation framework, but a limited number of these instruments are nexus-oriented.

Responsibilities and resources - The system is characterized by a fragmentation of responsibilities. Each institutional body with responsibility and decision-making power for the management of the WEFE nexus domains acts as a single responsible agent within the framework of its competencies. The system shows an overlapping of responsibilities in water and land planning, between different levels of water management, between the requirements of Italian and provincial laws and EU regulations. There is a real difficulty in ensuring coordination between the different actors responsible for resource management, between the Basin Authority and other political administrations (province and region). The complexity of the situation is illustrated by the legal disputes surrounding the creation of the District Basin Authority, which the autonomous provinces and the Veneto region consider to be "illegitimate" from a constitutional point of view, since it is assigned competences that are already provincial and regional. In this sense, according to the provinces, the River Basin Plan has been given priority over any other regional or provincial instrument, thus violating the spatial planning and water use competencies of these entities. In line with this thinking, provincial governments may provide data for district planning but consider themselves autonomous when it comes to water resource management.

In terms of financial resources, there are large disparities between the different entities in the river basin, due to the presence of two provinces with strong financial autonomy. These receive 9/10 of tax revenues collected in the territory and State taxes collected locally. At the level of the river basin, few resources are specifically allocated to the management of the WEFE nexus. The District Basin Authority lacks human and financial resources (it relies mainly on EU funding). In terms of knowledge, it also does not have direct access to all data regarding the amount of water from different administrative units (especially upstream of the river basin), which weakens its power base for coordination.

As a result, the score is **"low":** The system shows an overlap of responsibilities between management at the basin scale and at the scale of the political-administrative subdivisions. In terms of financial resources, there are large disparities between the different levels of the basin due to the presence of two provinces with a high degree of autonomy, particularly in the financial field.

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Conclusion - The overall assessment score for comprehensiveness is "**low**": Although the system is very comprehensive in terms of actors represented and well developed in terms of tools, it is not sufficiently integrated to urge WEFE nexus-oriented policy.

- **Coherence**

Actors and networks - The relationships between the main actors in the WEFE sectors at the level of the Adige river basin do not seem to be based on trust or systematic cooperation. However, the lack of coordination between actors also seems to stem from a lack of coherence in the national institutional and legal framework.

There are tensions between the actors and uses of water upstream and downstream (hydroelectricity upstream, intensive agriculture upstream and downstream, tourism upstream and downstream, ecosystems upstream and downstream). The different administrative entities (region and provinces) manage water in ordinary situations by referring to political-administrative boundaries and responding to sectoral economic logic. In situations of scarcity, tensions over different uses become pronounced. The basin authority is perceived by upstream stakeholders as “pulling water downstream”.

However, in emergency situations such as the water crisis of summer 2022, the institutional actors worked together in a decision-making context in which the central government (through the National Civil Protection) also intervened. The provinces and representatives of upstream sectors, especially the energy sector, had to make compromises. For example, they had to release more water from the hydropower dams to the benefit of the downstream agriculture and population. In this crisis context, the basin authority, through the "Permanent Observatory of Water Uses", has played a coordinating and negotiating role in the reallocation of water volumes to the different sectors.

Tensions also exist between water uses and sectors operating in the same territory. There are tensions between recreational uses of the river and agricultural activities (very intensive use of the land, even on the river bed) or energy use (hydroelectric micro power stations), or even between different services (engineering approach of Bacini Montani service versus the more ecological approach of the Sustainable Development Service of the Trentino Provincial Administration), within the same local administrative agencies.

At the basin level, there also seems to be no significant interaction between the nature conservation associations of different administrative divisions. These associations carry out their actions locally on the different rivers and tributaries.

At the local level there are examples of effective interactions between representatives of different sectors: for example, the ecological restoration of irrigation and rural canals carried out by land reclamation consortia in Veneto (Consorzio di Bonifica Adige-Po) that reduced the fragmentation of ecosystems and the impoverishment of landscapes, while at the same time allowing fish reproduction without compromising water availability for irrigation.

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As a result, the score is "**low**": The different actors in the river basin do not have a stable relationship of trust. At the scale of the Adige river basin, they cooperate mainly in emergency situations.

Levels and scales - At the basin level, the WEFE sectors interdependencies between upstream and downstream are known, but there is a lack of coordination between the different levels of government – national, regional, provincial. However, in crisis situations (drought emergency summer 2022), in the name of a state of emergency (compulsory administration and management) and "territorial solidarity", the different levels of government and the different territorial scales (basin, provinces, regions, etc.) agreed to negotiate to find solutions.

These negotiations took place within the framework of the "Permanent Observatory of Water Uses". It is at this water district level that the institutions involved in water management – representatives of the autonomous provinces, the Veneto region and the State, different sectors – reached agreements, after hard negotiations, to satisfy the exceptional water needs of the downstream areas. As an officer of the Veneto region told us in the interview "in the Observatory we negotiated every centimeter of the water level".

As part of the planning stage, in particular the water district planning, it is foreseen that there should be synergies between levels and scales of governance: for example, the Water Protection Plan of the autonomous province of Bolzano is an integral part of the Water Management Plan 2021-2027 of the Eastern Alps District, just as the Piano di Ambito (a planning tool for the drinking water sector on the territorial perimeters of the ATOs) are sectoral implementation tools of the District Water Management Plan at the ATO level.

At the level of each territorial subdivision (provinces and regions), there are interactions between WEFE sectors (hydroelectricity and irrigation in Trentino; hydroelectricity and fisheries in Alto Adige and Veneto, or between drinking water and irrigation in Veneto, or joint management of hydroelectricity between the two autonomous provinces for some facilities), also for negotiation purposes. Sometimes, even between representatives of the same sector, as in the case of the fishermen of Trentino and Veneto it is difficult to implement joint projects due to differences in financial resources and visions of the territory. In Veneto, in the different sub-basins of the regional territory (not in the Adige basin area), due to the intense conflicts linked to the different uses of water (agriculture, energy and tourism), especially in times of drought, a cooperation on the issue of ecological flow has been set up between the agricultural sector (ANBI), the energy sector (ENEL), the regional administration and the basin authority. Within the same administrative perimeter (region or province), there appears to be more self-regulation than at the basin level due to the proximity of the different users or institutional actors involved in resource management. However, in situations of scarcity, sectoral logics seem to prevail even within the same territories.

As a result, the score is **“low”**: The interdependencies between the different scales are known, but provincial and regional governments in the basin rarely work together,

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except in water emergency situations and when they do, it is from a position of mistrust. In this context it is difficult to establish the river basin scale as the appropriate scale for water and ecosystem management.

Problem perspectives and goal ambitions - There is a convergence regarding basin problems among different sectors. All relevant WEFE nexus are aware of the interdependencies between different sectors and of upstream/downstream interactions/interdependencies. However, sectoral economic logic dominates the objectives, which does not consider the real availability/status of resources (land, water, ecosystems). This increases rivalry, especially in summer when the water availability decreases while water demand for many water uses remains unchanged and even increases for irrigation, and drinking purposes associated to tourism.

In the upstream part of the basin, the reservoirs for power generation are considered a strategic resource. In addition to its national strategic importance, hydroelectricity provides the two autonomous provinces of Trento and Bolzano with substantial revenues. A sensitive issue in this context is the upcoming renewal of water permits for existing hydropower plants. On the one hand, the possibility of retaining energy revenues locally, coupled with the current energy crisis that has put energy security at the top of the national government's agenda, has created an interest in keeping hydropower production in the hands of national companies. On the other hand, pressure from the European Union to open the European energy sector to greater market competition (Bolkestein Directive) is challenging this local ambition.

In the downstream part of the basin, stakeholders see the upstream dams as a source of permanently available water, but this water is not equally accessible to all users, especially those downstream. In addition, the proliferation of micro-hydropower plants, which have been subsidised for more than a decade as a sustainable energy source (with EU funds), has been strongly criticised by local environmental organizations, fishermen's associations and water sports associations. In a context of scarcity, the plurality of water uses (drinking water, agriculture, energy, tourism, fisheries, water sports, ecosystems) leads to more water demand and less attention to interdependencies, increasing tensions between sectors. Although the impacts of climate change are becoming more extreme, the different sectors are not reducing the demand. However, some managers in the agricultural sector (land reclamation and irrigation consortia) believe that, faced with increasing water scarcity, younger generations of farmers are changing their approach to land and water use and are more concerned about protecting resources and ecosystems.

Ensuring minimum ecological flows in the Adige river basin is a real problem and often the reason for tension between the provinces of Trento and Bolzano, located upstream, and the administrations of the Veneto region, located downstream at the mouth of the river, where there is a large Natura 2000 wetland and sea level intrusion pressures. The demand for adequate ecological flows is still perceived as an obstacle to economic development by some agricultural and energy stakeholders (especially intensive agricultural producers and small-scale energy producers).

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As a result, the score is **"low"**: There is convergence between the different sectors in their perception of the problems. However, their objectives are rarely mutually reinforcing.

Strategies and instruments - The river basin is covered by a range of provincial, regional and district strategies and instruments. The District Basin Plan is developed at the Eastern Alps hydrographic basin scale, i.e., within a perimeter that considers upstream and downstream dynamics and processes and includes measures for soil and water protection and flood risk management. At the level of each Autonomous Province, there are the General Plans for Water Use (Piano Generale di Utilizzazione delle Acque Pubbliche - PGUAP), which have specific characteristics and cannot be compared with other existing instruments in the basin, such as the Water Protection Plan of the Veneto Region. This fragmentation and overlap of strategies and regulatory instruments also exist for the other WEFE sectors.

There is a lack of coherence between all these documents and strategies adopted at the scale of the river basin and the provincial and regional administrative jurisdictions (e.g., implementation of the European Directive to promote ecological flows vs. provincial permits for hydroelectric diversions; increase in energy concessions for micro-hydroelectric plants vs. ecosystem management).

Energy providers and the administrations of the provinces of Trento and Bolzano consider the implementation of the European directives on the liberalization of the energy market (Bolkestein directive) to be problematic, especially regarding hydroelectric concessions. There is thus a conflict between two management models: on the one hand, traditional local management carried out by a public-private partnership in Alto Adige and private management with public participation in Trentino, and on the other hand, private management of hydroelectric plants in the hands of an international private company that could win a tender. In the first configuration, the governments of two provinces (Trento and Bolzano) and the current operators want to maintain the current situation, even if the companies are asked to invest more in infrastructure and maintenance. The second configuration is not very popular because the arrival of a foreign operator, unfamiliar with the local context, could be less attentive to the needs and dynamics of the areas. However, such an operator could be eventually more efficient and innovative.

In agriculture, the Veneto Rural Development Plan encourages farmers (through subsidies) to buy water-efficient irrigation systems but, at the same time, all surveyed withdrawals have not yet been registered and granted a concession. In fact, there are 111 concessions in force against 161 counted withdrawals, and doubt of many more unaccounted, illegal wells. In other situations, where there is no irrigation consortium activity to secure water in the irrigation channels on a permanent basis, farmers still prefer to use illegal wells.

In Trentino, the decision by the Province of Trento to allow land reclamation and irrigation consortia to apply for access to additional water withdrawals from the river (and to approve them after an assessment), is considered detrimental to the ecological

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flow. Some fishermen's associations have appealed to the administrative court against the provincial government's decision. Another controversial measure is the construction of multi-purpose reservoirs for water storage. Environmental organizations are critical towards these reservoirs, arguing that they are essentially mono-functional and not multifunctional as stated. As the reality of existing reservoirs shows, these facilities are often infrastructure where different uses are in conflict, they argue. For these environmental organizations, the best strategy to protect water resources is to store water in the aquifers.

As a result, the score is **"very low"**: The system is characterised by fragmentation and overlapping of instruments across WEFE nexus domains, which never reinforce each other.

Responsibilities and resources - In the province of Trento, water is managed by a separate agency from that responsible for environmental protection. APRIE (Water Resources and Energy Protection Agency) deals with the planning and management of water resources and the management of large water infrastructures (hydroelectric plants). APPA (Environmental Protection Agency) deals with environmental quality (controls and permits) and planning. Another department deals with sustainable development and protected areas, including biodiversity. The administrative organisation of these three sectors of the nexus is thus very fragmented.

In the province of Bolzano, the Environmental and Climate Protection Agency combines the responsibilities for water protection, energy and the environment. In this case, the three sectors are highly clustered.

In the Veneto region, water, environment and climate are part of the same Directorate for the Environment and Ecological Transition, together with air and waste. Energy is managed in a separate unit, together with innovation. Here, there is more contact with the water and ecosystems sectors.

In the three political-administrative divisions, agriculture is part of a separate unit: with trade and crafts in Trentino, with tourism and forestry in Alto Adige and in a large directorate with territorial marketing, culture, tourism and sport in Veneto.

According to the interviewees, the different services in the different administrations are not always coordinated and sometimes are even in competition. At the basin level, this fragmentation and stratification of responsibilities for the management of WEFE nexus resources can create more friction than cooperation between the different resource management authorities (in planning, but also in implementation; see the legal conflict between the State and the Provinces over the extension of hydroelectric concessions, for example).

In terms of resources, there is unequal access to financial resources between the autonomous provinces (richer in tax revenues retained in the territory) and the Veneto region. This is reflected in the perception of an imbalance in the power and conditions of access to financial resources of upstream administrations compared to downstream ones.

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As a result, the score is **"low"**: The fragmentation of responsibilities at different levels and scales does not facilitate cooperation between the different sectors of the WEFE nexus.

Conclusion - The overall assessment score of coherence is **"low"** due to fragmented responsibilities and poor coordination between different agencies and organisations.

- **Flexibility**

Actors and networks - The governance system shows some flexibility in emergency situations. The provinces of Trento and Bolzano protect the competence and the legislative and executive powers that autonomy confers on them in resource management and limit the intervention of other actors at a larger scale, such as the Basin Authority. In emergency situations, however, the District Basin Authority seems to be able to play a more proactive role, particularly in negotiating the reallocation of resources through the work of the Water Uses Observatory. In this space, all actors make their contribution by agreeing to move their territorial power to find collective solutions. In a context where the effects of extreme weather phenomena will become more frequent, the role of the District Basin Authority and supra-local bodies such as the observatory could become more important.

As a result, the score is **"high"**: The governance is characterised by actors with a high degree of autonomy but can allow to include new actors in the decision-making process in emergency situations.

Levels and scales - The current management of WEFE nexus resources appears to be strongly rooted in regional and provincial political-administrative perimeters. However, in crisis situations, such as the drought in the summer of 2022, recourse to the "state of emergency" has made it possible to overcome the provincial and regional limits of water resources management and to resort to a district and national decision-making scale and to exceptional instruments[14], such as the use of special authority with exceptional powers in order to face critical situations, as the "Commissario" in the case of Veneto. In this case, the actors resorted to a strategic change of scale in order to pursue and defend their interests, since the crisis (which affected a large part of the basin) could no longer be resolved at the local level.

In a context where the effects of extreme phenomena will become more frequent, these kinds of changes of scale in resource management may become increasingly necessary and frequent.

[14] For example, special negotiating tables, access to civil protection funds to compensate farmers, derogations from the normal rules for hydroelectricity production, penalties for hydroelectric power plant operators who would have to pay when reservoirs are opened, and turbines are shut down for hydroelectricity production.

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As a result, the score is **"low"**: The governance system makes it difficult to change the levels and scales at which nexus issues are managed.

Problem perspectives and goal ambitions - The ambition of the targets is still very much rooted in a sectoral vision. National (and provincial) hydropower production targets frame and condition all other uses.

The hydropower sector responds to national economic and operational logics (it is integrated to national grid), but it is also strongly anchored in local political games. This exposes it to tensions, but also to a degree of flexibility.

The agricultural sector, which uses large quantities of water to irrigate crops of high economic value – vines and apples upstream and wheat, maize, soya, alfalfa, vegetables and rice downstream – claims strategic importance and is still not very resilient to water scarcity.

Domestic water use is legally prioritised, but the water demand generated by winter (including artificial snow) and summer tourism (included in domestic use), creates additional pressure on the resource. These additional demands can be guaranteed (as is in the case of the province of Trento) or limited (as in Bolzano) by means of specific measures taken by the local administrations.

Nevertheless, in the context of the drought that affected the basin in the spring-summer of 2022 (very low snowfall in the mountains), which severely affected agriculture and the environment, the priorities for uses (and to some extent the objectives) have been reassessed. The amount of water allocated to hydropower generation has been reduced to meet the needs of other uses (mainly agriculture and drinking water). In this context, the hydropower sector also claims a certain strategic importance in terms of national objectives, especially in view of the ongoing energy crisis.

As a result, the score is **"high"**: The governance system allows to re-assess goals across WEFE nexus domains and combine multiple goals in package deals as needed in some situations.

Strategies and instruments - The declaration of a state of emergency for drought in the summer of 2022 made it possible to respond to the exceptional water needs of the sectors in difficulty located downstream, agriculture above all. The autonomous province of Trento and the hydroelectric operators have, not without controversy and tension, exceptionally released water for agricultural areas downstream in the Adige-Po consortium.

For farmers in Trentino, a provincial decree allows them, in drought situations, to apply for permits to take additional water from the river for irrigation purposes, even at the expense of ecological flows.

In Veneto, the declaration of a state of emergency, including the appointment of a special authority (an extraordinary drought "commissario") has allowed access to exceptional funds to deal with the crisis.

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Despite the ability to react in crisis situations and the flexibility that these measures allow to deviate from the normal rules, the governance system does not allow for river basin management in a normal situation. Although there are tools and strategies at the basin level (District Basin Plan, Risk Management Plan), management remains anchored in provincial and regional administrative boundaries. The recent national reform (Lg. No. 221/2015 and Decree No. 294/2016), which aims to simplify and recognize planning competencies in a single body (District Basin Authority) by centralising the functions for the preparation of District Basin Plans and Framework Plans (including the Flood Risk Management Plan-PPGRA and the Water Management Plan-PGA), is not yet applied in practice.

In fact, the provinces, while tending to participate in the elaboration of the basin planning instruments, invoke their autonomy in the decision-making processes, rejecting the interference of other territorial entities and continuing to use their respective water and risk management plans (PGUAP for the provinces of Bolzano and Trento and the Water Protection Plan for the Veneto region). The District Basin Plan is effectively exhausted.

However, the drought situation in the summer of 2022 and the evidence of a decrease in annual precipitation and an increase in the frequency of extreme phenomena (heat waves, precipitation scarcity, and heavy rainfall) have also prompted the search for common and shared solutions from different sectors for both water and energy saving. One example is the construction of multipurpose reservoirs.

As a result, the score is **“high”**: The governance system is capable of proposing instruments to deal with negative impacts and to combine strategies, especially in exceptional situations.

Responsibilities and resources - In emergency situations, some responsibilities can be reassigned. In particular, the success in resolving tension and conflict in emergencies has given the District Basin Authority the space to negotiate a more central role in the management of the water resource. However, this does not mean that it receives more resources. In general, the use of emergency management creates flexibility but at the same time weakens the ordinary governance of WEFE nexus resources.

In fact, despite the system's capacity to redistribute responsibilities temporarily, such as the use of the figure of temporary and special administration – which implies the central government's decision to appoint a special authority “commissario” (which usually corresponds to the figure of the regional governor himself) or to appeal to the principle of solidarity between neighboring administrative entities (the two provinces in upstream portion of the basin and the Veneto region in downstream Adige) - the governance system does not seem to be able to combine the responsibilities and

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resources of different entities in order to promote a more integrated and sustainable management of resources in the basin[15].

As a result, the score is **"low"**: The use of emergency procedures creates flexibility, but the governance system makes it difficult to pool assigned responsibilities and resources across WEFE domains without compromising accountability and transparency.

Conclusion - The overall assessment score of flexibility is **"high"**: Actors and institutions have the capacity to adapt. The different adaptation strategies allow for greater interaction between the WEFE domains.

- **Intensity of action**

Actors and networks - The District Basin Authority is the actor that, because of its role and responsibilities, has a holistic view of the different uses at the basin level and promotes a more nexus-oriented approach to governance. In the discourses, the need for greater intersectorality in resource management is expressed by different actors and sectors: water utilities, ecosystem actors, land reclamation and irrigation consortia. Some initiatives are being promoted, e.g., by land reclamation consortia with producer members (restoration of irrigation channels, buffer strips, landscaping, quality crops), but behavioral changes in agricultural practices or land and water use take time and, above all, resources.

In practice, therefore, change seems to be strongly supported by actors with less decision-making power (the Basin Authority, environmental protection organizations such as Legambiente, WWF or fishermen's organisations) and is therefore still weak.

At the local level, in parts of the basin such as the Bolzano area, the cross-sectoral, i.e. horizontal, approach to the use of resources by actors from different sectors seems to be more developed. The river restoration work carried out by local authorities on the upper course of the Adige River, or its tributaries is another example to be followed in other areas of the basin, according to stakeholders representing ecosystem interests and issues.

As a result, the score is **"low"**: There is weak pressure from stakeholders across WEFE nexus domains towards behavioural change or management reform.

Levels and scales - The river basin scale and the governing river basin authority are the territorial framework and level that strongly push for WEFE-oriented governance. The role of the river basin authority is to ensure cooperation between the State and

[15] In March 2023, the PNRR (National Plan for Reconstruction and Resilience) allocated almost €20 million in exceptional funding to the regional authorities to deal with the effects of the drought. In Veneto the authorities plan the construction of an integrated system of works to counter rising salt wedge for Adige River, a dam and a reservoir.

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the autonomous regions and provinces in order to pursue the objectives of river basin management and governance.

For the two autonomous provinces of Trento and Bolzano, the provincial level and province boundaries remains the appropriate level and territorial framework for the management of natural resources, in accordance with the responsibilities and competences recognised to them by their autonomous statute.

The position of the Veneto region is less clear: although the regional level is considered the appropriate level for management, in times of crisis it has invoked the intervention of the district authority and the state of emergency, which implies decision-making processes at the national level and at basin scale.

For all other stakeholders, the perception of the appropriate scale to ensure nexus-oriented governance varies between sectors and activities. For representatives of the ecosystem sector, such as the fishermen of Trentino, local administrations remain the privileged interlocutors and those who can implement changes, even if the ecosystem functions and properties occurring at the scale of the river basin must be taken into account. The abolition of the provinces (a reform that has only affected ordinary regions, such as Veneto) has deprived the fishermen of Verona of an ally aware of the realities and needs of local ecosystems and of a source of funding. The more distant regional level may have other priorities when it is about territorial projects. For environmental associations (the Comitato di difesa delle acque del Trentino, Legambiente or WWF), it is the district scale and the basin authority that can push for more conscious ecosystem and cross-sector management.

The basin scale is not a reference area for the energy sector in Trentino and Alto Adige, for large hydroelectric plants, which operate at both national and local levels and have a strong impact on local administrations and territories. Production depends on demand and is regulated on a national scale and by fluctuations in the power market exchange but is also strongly linked to local processes (on the scale of Trento and Bolzano provinces). This is not only because of the presence of the hydropower plants in the territories and therefore the local impacts (negative environmental impacts and positive ones in terms of economic compensation), but also, and most of all, because the provinces are the holders of the rights of use and therefore the "arbiters" of the sector and at the same time the main shareholders of the main operators (Alperia in Bolzano and Hydrodolomiti in Trento).

Another level and scale that intervenes and influences the functioning of the hydroelectric sector is the European one, where the obligations linked to the opening of the concession market (Bolkestein Directive, 2006/123/EC) have led to political tensions between the Italian central government and the Trento and Bolzano provincial authorities and, in some cases, to the courts.

More recently, in the spring of 2023, the national government appointed an “emergency water commissario” and promulgated a national decree law (Urgent Provisions to Combat Water Scarcity) that established a "steering committee" (cabina di regia) to

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deal with the ongoing water crisis. The Steering Committee is responsible for directing, coordinating and monitoring the water crisis at the national level.

The environmental and river protection associations (Legambiente, WWF, Committee for the Defence of the Rivers of Trentino) are also involved and are pushing for greater consideration of interdependencies, highlighting the impact of hydropower and agricultural activities on watercourses and ecosystems in general.

In the case of other renewable energy production, such as photovoltaic or agro-voltaic, management appears to be more decentralised and developed at a municipal or even plot scale.

As a result, the score is **"high"**: The river basin district level exercise a strong pressure for WEFE-oriented management and behaviour change, even if the river basin authority has no decision-making power.

Problem perspectives and goal ambitions - Some sectors have the ambition to implement a more cross-sectoral management, e.g., the agricultural sector in Alto Adige is promoting the implementation of agro-voltaic systems; the land reclamation and irrigation consortia in Veneto are implementing measures for the management of the irrigation system to promote ecosystem services. The basin authority has a project to create an integrated database on the use of water resources. In general, however, most actors do not implement specific actions for fully WEFE NEXUS-oriented resource management but only for binary ones.

The emergency situation caused by the drought in the summer of 2020 (which is the driest in the historical record) and, more generally, the tangible effects of the increase in the frequency and intensity of extreme weather events, are changing the power dynamics around water resources, which are subject to greater tensions that go beyond the regional and local scale to include the basin. This context pushes actors to envision changes and design adaptation measures (reducing vulnerability and increasing the capacity to adapt of natural systems and socio-economic sectors).

The urgent need for a change in the resource management governance, more aware of and more oriented towards the interdependencies between sectors, is present and has been brought into the public debate by the issue of climate change, and the various impacts of the increase in the frequency and intensity of extreme weather events on all sectors highlight these interdependencies in a striking way. The communication and the initiatives taken by the public authorities (e.g. the work programme "Trentino Clima 2021-2023", the public data platform on climate change in Alto Adige and the Life project Veneto Adapt which has developed a methodology and tools for adapting urban areas to climate change) could help to change the perception of the problems and the issues at stake. However, this is not sufficiently managed to a high level yet. Some sectors have the ambition to operate a more cross-sectoral management but in practice, in most cases, only a few actors support NEXUS-oriented resource management with concrete actions.

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As a result, the score is **“low”**: Problem perspectives and goal ambitions across WEFE nexus domains weakly urge nexus orientation.

Strategies and instruments - Despite the existence of some NEXUS-oriented tools and strategies, the predominance of economic logics in the management of the energy and agricultural sectors does not yet sufficiently promote or push for changes in behaviour and management reforms (e.g. concessions for micro-hydropower plants continue to be granted despite the negative environmental impact on the river ecosystem; or permits are granted to use additional volumes of water from rivers for irrigation purposes to the detriment of the ecological flow; or contributions to snow-making operations).

According to some of the actors interviewed, it is not the instruments that are lacking, but rather a real cross-sectoral implementation strategy and, even more so, the political will to support and promote it.

The basin authority is the most committed of the various actors to a basin-wide and cross-sectoral vision. The "Permanent Observatory of Water Uses" – created to strengthen cooperation between the bodies involved in water resource management in the Adige basin – tries to push for more intersectorality at the basin level but lacks decision-making power. It is also planned to create a web platform that will bring together data from all the administrations (provinces and regions) to calculate the district's water balance as an aid to decision-making in the Permanent Observatory of Water Uses, but also to draw up the district's water management plan and allow medium to long-term forecasts.

The criticality of the drought situation for two consecutive years (2022 and probably 2023) obliges the different institutional actors and authorities to interact more intensively to define common strategies. It remains to be seen to what extent the water shock of last summer, which seems to be preparing for the next one, will be able to bring about changes.

As a result, the score is **“low”**: Despite the existence of some NEXUS-oriented tools and strategies, territorial and economic logics and dynamics weakly push for changes in behaviour and resource management.

Responsibilities and resources - Some representatives of WEFE domains (e.g., environmental agencies, river basin authorities) have the responsibility to push for WEFE nexus management. However, these actors do not have normative power to push for concrete actions oriented towards WEFE nexus management in a meaningful way. Also, some are lacking resources, as the Basin Authority. This web platform mentioned in the strategies and instruments section, however, is difficult for the Basin Authority to implement, as provincial water plans and balances already exist at the level and under the responsibility of the provinces.

In the spring of 2023, in view of the prolonged drought in 2022, the Eastern Alps Basin Authority received funds from the central government to deal with the drought, in

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addition to the creation of an “emergency drought commissario”[16]. Announcement of the creation of such an institutional figure has already provoked a reaction from the President of the province of Bolzano, who recalled the autonomous competence of the province over the land and water resources. In the case of the Adige River, the funds seem to be directed towards the creation of water-saving facilities for farmers in Veneto.

While water-saving systems in agriculture have been in place for some time in the provinces of Trentino and Alto Adige, the process is still underway in Veneto. The energy crisis is also affecting the agricultural sector by slowing down investments. The stakeholders interviewed from the different sectors of the WEFE nexus call for more financial resources to be allocated to the implementation of water and energy saving measures in agriculture and tourism.

Furthermore, stakeholders share that the transition to a more NEXUS-oriented management depends more on a clear political commitment to this model than on allocated resources and responsibilities.

As a result, the score is **“low”**: In the governance system the responsibilities and resources allocated to the relevant stakeholders allow for a relatively weak implementation of nexus-oriented actions.

Conclusion - The overall score for intensity of action is **“low”**: The different elements of the governance system aren't pushing for change. According to interviewees, there is a lack of political will for real change while stakeholders with weak decision-making power are the ones pushing hardest for a change to nexus-oriented management.

- **Fit**

Actors and networks - Sectors are still too compartmentalised and sectoral policies do not seem to take sufficient account of constraints imposed by water availability, pressures on soil or threats to aquatic ecosystems. The only non-institutional actors likely to be concerned with ecosystem properties and functions – such as environmental protection organisations (environmental NGOs, fishermen's associations, river protection organisations, river sports associations) – are present and voice in institutional and public spaces to inform and highlight policy failures regarding ecosystems, but they have no decisional power. In some cases, such as the Legambiente association in Veneto, they organise campaigns in collaboration with public environmental protection agencies, such as the itinerant campaign "Operazione Fiumi, Esplorare per Custodire – Operation Rivers, Explore to Preserve", which aims to raise awareness and inform citizens about the state of watercourses. However, this

[16] I In June 2023, the Drought Decree became a law, and one of the measures defined in the law is the creation of permanent district water use observatories, with the aim of making decision-making processes more efficient. This body, which currently exists on a voluntary basis, will thus be given greater importance and stability within the framework of basin-level governance.

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cooperation is neither systematic, nor is the expertise of these associations used consistently. Environmental organisations often complain that they are asked at the last minute to provide advice and recommendations on very voluminous documents in a very short time. They see this as a formal request rather than a genuine desire to cooperate and recognise their role. Governmental actors and sectoral representatives do not practice cross-sectoral management and do not try to adapt their actions to the ecosystem functions and properties.

As a result, the score is **"low"**: Relevant actors and networks across WEFE nexus domains are little appropriate to deal with ecosystem properties and functions.

Levels and scales - Water management is carried out at the political-administrative scale (provinces of TN and BZ and region of Veneto). Management at the river basin scale, although provided for by law, is difficult to establish. For the representatives of the provinces of TN and BZ and region of Veneto, the appropriate scale for cross-sectoral resource management must remain that of the administrative subdivisions (provincial and regional), even though for some actors (basin authorities and environmental actors) the basin scale is the most appropriate, especially about upstream-downstream interrelations.

The management of agricultural systems shows the limits of local and sectoral management, especially in the case of water emergencies and droughts, when the agricultural sector downstream of the basin is obliged to ask for water to the territories and political-administrative units upstream to guarantee the survival of the farms.

In the energy sector, the governance system differs both at the level of political-administrative units (the provinces of Trento and Bolzano with autonomous statute in the upstream part of the basin and the Veneto region with ordinary statute downstream) and at the level of the type of energy produced. In the hydroelectric sector, hydroelectric production is managed locally by the autonomous provinces, but responds to the logic of national and international demand and the market as noted above. Its management does not correspond to the functionality and characteristics of aquatic ecosystems, neither at local nor at river basin level. Here too, environmental associations (fishermen, river protection committees, etc.) systematically denounce the impact on ecosystems of micro-hydro power generation.

The current interactions and linkages between resource management actors at the basin scale to deal with/manage ecosystem properties and functions in some situations.

As a result, the score is **"low"**.

Problem perspectives and goal ambitions - For all the stakeholders interviewed in the upstream and downstream areas of the Adige basin, the effects of climate change, and in particular its acceleration, are evident: A rise in temperatures, an increase in drought periods and an increase in the frequency or intensity (depending on the area) of hydrometeorological extreme events are expected. As mentioned above, there are

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several points of convergence between the different stakeholders in their perception of the problems.

Public administrations generally follow the guidelines of national (or local) strategies for sustainable development, which are more aware of the interdependencies between environmental protection, food production and energy, but still far from a systematic and coherent translation into daily practice of a specific integration of the properties and functions of ecosystems. Although there is some ambition in the objectives to take greater account of other sectors, to protect ecosystems, in practice interventions still seem to be very much anchored in a sectoral and short-term vision.

As a result, the score is **"low"**: Problem perspectives and goal ambitions across WEFE nexus domains rarely take into account ecosystem properties and functions.

Strategies and instruments - There is a gap between the formulation of strategies and the implementation to put these strategies into practice with instruments and programme of measures.

The two autonomous provinces and the Veneto region have defined sustainable development strategies (Every day for the future – Insieme per la sostenibilità Alto Adige, Strategia Provinciale per lo Sviluppo Sostenibile Trentino, Strategia Regione Veneto per lo Sviluppo Sostenibile 2030) that are transversal to other provincial and regional planning and programming instruments for specific areas of intervention (including water, agriculture, energy, climate and ecosystems).

District river basin plans and other "piani stralcio", such as the hydrogeological plan, can in theory lead to more cross-sectoral and integrated management at the river basin level, but their implementation responds to short-term needs. The challenge for the River Basin Authority is to bring all the instruments to the supra-regional and provincial level. However, some new instruments, such as the Water Security Plans (Piano di sicurezza dell'acqua PSA) of the Veneto region, open up interesting perspectives because they focus on risk prevention "upstream" of the aqueduct, not only for the water entering the pipes, with particular attention to what could affect the sources of supply, but also the soil and ecosystems. In Alto Adige, the public authorities are planning to limit tourism to avoid pressures that would test the carrying capacity of the local environment including water and ecosystems.

For the energy sector and the protection of river ecosystems, the reduction of small diversions is being considered; for agriculture, the calculation of the environmental costs of irrigation concession fees is another option that can be considered, but it is still far from reorienting crops to less irrigation needs.

Also, during crisis, the ecological flow can be reconsidered with a possible extraction from the river for irrigation. Tools, skills and knowledge are available and more nexus-oriented measures and policies are envisaged, but the strategies implemented remain poorly adapted to deal with ecosystem properties and functions. River contracts could be a tool to facilitate WEFE nexus management at the local level, but are little used.

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As a result, the score is **"low"**: Relevant strategies and instruments which take into account ecosystem properties and functions are rarely also WEFE nexus oriented.

Responsibilities and resources - The system of responsibilities for water management is polycentric and organised around regional and local powers but keeps the Basin Authority at the center of the system, in line with EU directives. However, the Basin Authority has no real power as it 'plans but does not control', leaving the implementation of measures to the individual regions and provinces. This implies a mismatch between the responsibilities of the Basin Authority and the management of the river basin and, consequently, the ecosystems.

The situation for the energy sector is described above.

In the agricultural sector, the instruments of the PAC, which will be implemented in 2021-2027 and which are more environmentally oriented than in 2014-2020 (measures include the strengthening of cross-compliance, which makes direct payments conditional on stricter environmental requirements), should imply a greater responsibility for farmers to consider the impact of their activities on ecosystems. The diversity along the Adige basin relies also not only on farmers sensitivities, but also on their capacity to finance innovations. While in the upstream part of the basin, particularly in Alto Adige and Trentino, the agricultural sector has invested in very advanced water-saving technologies (50% drip irrigation, the other 50% sprinkler irrigation, little or no flood irrigation), in the downstream part of the basin, traditional irrigation systems persist. In addition, the cost of fuel to run the irrigation systems has increased this year. The declaration of a water emergency (for the second year in a row) has allowed the Eastern Alps Basin Authority to receive funds from the central government to cope with the drought. In the case of the Adige River, the funds will be used to support the agricultural sector in Veneto in order to finance interconnection systems, rainwater reservoirs, wastewater reuse and desalination plants.

As a result, the score is **"low"**: Responsibilities and resources across WEFE nexus domains are rarely appropriate to deal with ecosystem properties and functions.

Conclusion - The overall assessment of fit is **"low"**.

As a consequence, the overall scores of the NXGAT for the Adige River is as follows.

Table 15: Matrix of the overall scoring of the Adige River

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Dimensions / Criteria	Comprehensiveness	Coherence	Flexibility	Intensity of action	Fit
Actors and networks	VERY HIGH	LOW	HIGH	LOW	LOW
Levels and scales	HIGH	LOW	LOW	HIGH	LOW
Problem perspectives and goals ambitions	LOW	LOW	HIGH	LOW	LOW
Strategies and instruments	LOW	VERY LOW	HIGH	LOW	LOW
Responsibilities and resources	LOW	LOW	LOW	LOW	LOW
Overall assessment	LOW	LOW	HIGH	LOW	LOW
Concluding evaluation	The current governance system is **restrictive** toward WEFE nexus goverance				

Policy coherence analysis results

Figure 27 shows the results of the policy coherence analysis validated by the stakeholders.

Unfortunately, it was not possible to have the presence of representatives of all the WEFE sectors, nor of all the administrative territories corresponding to the basin, to validate the results.

The water and energy sectors for the province of Bolzano and the agriculture sector for Veneto validated the results. Stakeholders have therefore only commented on the tools that directly concern their sector.

Regarding the water sector in the province of Bolzano, the validation of the stakeholder confirmed the strong integration between the sectors, but with regard to the weak integration concerning climate issues, it was pointed out that the plan was outdated and that an update was planned, which would certainly take more account of climate change issues.

For the Veneto region, it was pointed out that the score of no integration with the energy sector was incorrect, as the plan foresees the production of biomethane from agro-livestock activities and also incentives. The score would therefore change from no integration to weak integration.

Finally, regarding the energy sector, for the province of Bolzano the score of strong integration is confirmed for the two sectors (water, agriculture) and weak integration for ecosystems. According to the stakeholder validation, the update of the second part of the "Alto Adige Climate Plan 2040", which is expected soon, could also change this score to a value of greater integration.

The coherence score for the strategies and instruments dimension of the NXGAT was "very low", mainly due to the fragmentation represented by the multiplicity of

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instruments for each territorial unit. If, at the level of the basin, there is little coherence between the numerous instruments emanating from the provinces and the region and which overlap, at the level of the three administrative units of the basin, the degree of coherence between sectoral policies varies: the analysis of policies carried out on a purely administrative territorial basis shows that there is greater coherence between instruments relating to different sectors precisely at the level of the territory of Alto Adige. Stakeholders confirm this finding. With regard to the other two territorial entities, the province of Trento and the Veneto region, the level of integration between the various sectoral policy instruments tends to be low.

Sector	Policy	Province / Region	Water	Energy	Agriculture	Soil	Ecosystems	Climate
Water	Piano di gestione delle Acque – Autorità di Distretto delle Alpi Orientali	Distretto Alpi Orientali						
Water	Piano di gestione del rischio alluvioni – Autorità di Distretto delle Alpi Orientali	Distretto Alpi Orientali						
Ecosystems	D.L.gs 152/2006 Testo Unico Ambiente	Ministero Ambiente						
Water	Piano Generale Utilizzazione Acque Pubbliche (PGUAP)	Prov. Bolzano						
Water	Piano di Tutela delle Acque (PTA)	Prov. Bolzano						
Water	Piano di Gestione Area Fluviale Adige "Spatium Etsch - Adige"	Prov. Bolzano						
Energy / Climate	Piano Clima Alto Adige 2040	Prov. Bolzano						
Agriculture	Agricoltura 2030. Piano Strategico per l'agricoltura dell'Alto Adige	Prov. Bolzano						
Agriculture	Sustainapple - strategia per lo sviluppo sostenibile della melicoltura altoatesina	Prov. Bolzano						
Agriculture	Piano di Sviluppo Rurale	Prov. Bolzano						
Ecosystems	Everyday for future – Insieme per la sostenibilità	Prov. Bolzano						
Energy / Climate	Piano Energetico Ambientale Provinciale 2021-2030	Prov. Trento						
Water	Piano di Tutela delle Acque 2022-2027 (PTA)	Prov. Trento						
Water	Piano Generale Utilizzazione Acque Pubbliche (PGUAP)	Prov. Trento						
Ecosystems	Piano Risanamento Acque	Prov. Trento						
Agriculture	Piano di Sviluppo Rurale	Prov. Trento						
Ecosystems	Strategia Prov. per lo Sviluppo Sostenibile	Prov. Trento						
Ecosystems	Strategia Reg. per lo Sviluppo Sostenibile 2030	Reg.Veneto						
Water	Piano di Tutela delle Acque	Reg.Veneto						
Agriculture	Piano di Sviluppo Rurale	Reg.Veneto						
Agriculture	L'Agricultura Veneta verso il 2030	Reg.Veneto						
Ecosystems	Piano Parco Delta del Po	Parco Regionale						
Climate	Piano di Azione per l'Energia Sostenibile e il Clima (PAESC)	Prov.Verona						
Energy / Climate	Piano Nazionale Integrato per l'Energia e il Clima 2030	Ministero Ambiente e Sicuerezza Energetica						

Not applicable
No integration
Weak integration
Strong integration

Figure 26: Results policy coherence analysis of the Adige River case study

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Self-scoring of cross-sectoral management by stakeholders

To the question *"if you were to **score cross-sectoral management** in the river basin concerning the problems we discussed, which score would you give between 0 (no cross-sectoral management) and 3 (good cross-sectoral management)?",* the **average** basin-wide self-score is **1.6**. This score shows a perception of rather weak interactions between sectors, at most between two sectors, although cross-sectoral awareness is increasing.

A more detailed analysis by territory and by sector reveals important nuances. For example, at the level of the three different political-administrative entities (Alto Adige, Trentino and Veneto) the self-assessments show a higher average value of 1.9 for Alto Adige and two lower values of 1.5 for Trentino and 1.4 for Veneto.

In the case of Alto Adige, the stakeholders consider that although the existing instruments (strategies and regulations) take into account interdependencies between sectors (in particular the strategy to cope with climate change) intersectorality is less applied in practice. At the level of this territory, the highest score is given by the representatives of the agricultural sector, the Alto Adige and Direct Farmers Union/Südtiroler Bauernbund, who assess the governance system with a score of 2.5. In this sector, there is consistency between instruments and policy implementation. The strong tradition of association and cooperation on a relatively small territory and the identity dimension as a cultural minority create, according to this actor, a favourable substrate for cooperation. Among other things, some choices such as agrovoltaics, according to this agricultural association actor, support the close interaction between agriculture, energy and the environment. A representative of the energy sector in the province of Bolzano considers that, at the scale of this territory, there are many synergies and actors aware of interdependencies. If at the scale of the provincial territory the score is 2.5, at the scale of the basin the existing potential needs to be improved and the actors state that more knowledge is needed to achieve greater synergies. Aside from the positive representations that actors may have of their territory, the policy coherence analysis shows that there is greater coherence between instruments related to different sectors precisely at the level of the Alto Adige territory.

In the case of Trentino, the self-scoring is 1.5. Actors related to the ecosystem sector score lowest on the intersectorality of the governance system. Although they recognise that on paper instruments such as the PGUAP integrate the various sectors and propose a series of measures to protect the resource and the environment and take account of the effects of climate change, in practice they consider that management remains sectoral in nature (cf. § Governance assessment). Interactions between the environmental sector and other sectors, in particular energy (especially fishermen and the energy sector), are recognised, but the activity of the industrial agricultural sector and its lobbying capacity remain a major obstacle to greater intersectorality at the provincial level. On the other hand, the highest score is given by the energy actors, the representatives of the hydropower sector, with a score of 2, because of their

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interactions with the agricultural sector (water for irrigation) and the environmental sector (irrigation activities and activities with fishermen).

In the case of Veneto, the value of 1.4 is the lowest for the whole basin. Two of the actors related to the agricultural sector and the hydraulic protection of the territory – ANBI (National Association of Land Reclamation Consortia) and the Adige-Po Land Reclamation Consortium – gave a value between 1 and 3, making a clear distinction between the interactions between the sectors at the level of the territory managed by the entity they represent, the consortium territory (therefore local scale), and the interactions at the level of the Adige basin. In the case of the Consortium territories, the different uses and sectors interact with each other for the management of soil and water resources – irrigation, hydrogeological protection, ecosystem with ecosystem services (AFI-Infiltration forest areas, creation of wetlands in riverbeds, buffer zones), but also for urban water management (canals and drainage facilities collect and remove rainwater and final sewage from sewerage networks). This means there is an awareness of the constant interaction between these three sectors and an understanding of their interdependence. The role of the Consortia and their ability to make different sectors interact simultaneously is also appreciated by the local authorities interviewed (municipality of Rosolina). However, in the Veneto region, for the drinking water sector (urban water), the level of interaction is still very low, and in a situation of increasing climate criticality, according to the sector representative, there is a need for long-term and not emergency-driven cross-sectoral planning, which is why the self-assessment remains low (1). From the point of view of one of the stakeholders representing the ecosystem, the fishermen, there are interactions and interdependencies that are taken into account, even if they do not cover all sectors. One example is the multifunctional reservoirs that serve several uses at the same time (firefighting, irrigation, fishing, energy). As a result, the self-assessment score is 2.

At the level of the Eastern Alps Hydrographic District, in which the Adige basin is included, the score is 2. Despite all the limitations that the implementation of dialogue between the different administrative actors in the basin, the basin authority considers that with the Observatory of Water Uses, a framework was created that reinforces the knowledge of the interdependencies of the sectors and brings them around the same table to make decisions together. Bringing them together is a good result and a step towards greater interaction.

From the point of view of a sectoral approach to the whole basin, the assessment translates the tensions between upstream and downstream uses, in particular the rivalries between energy and agricultural uses, which are particularly present in a drought context such as that of the summer of 2022. From an environmental point of view, the main interventions to protect the ecosystem (e.g. renaturation projects) remain localised in the tributaries of the Adige, and the river is perceived as a watercourse strongly conditioned and shaped by human activities, where it is difficult to intervene on a large scale.

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The **average score of 1.6** therefore seems to be primarily an assessment of the relationship between upstream areas, which are perceived as water-rich, and downstream areas, which are perceived as threatened by water shortages. Upstream, the perception is that there is more interaction between WEFE sectors, especially in Alto Adige; downstream, the perception is that management is more responsive to sectoral pressures.

At the basin level, the ecosystem stakeholders generally give the lowest scores, with an average of 0.8. It is the domain that suffers most from the other sectoral choices, which is mainly reflected in whether the ecological flow is respected. The energy sector gives the highest score in terms of cross-sectoral governance, with an average of 1.9, as hydropower (but also the other renewable energy sectors) – despite its weight and role beyond the basin and the current energy crisis – is perceived in interaction with the other sectors while respecting the ecological flows. Representatives of the agricultural sector give an average score of 1.7, with very large differences between upstream (2.5) and downstream (1).

Two other factors emerge from the analysis of the self-assessment: firstly, for half of the actors interviewed, the score given fluctuates between two values (for example, between 0 and 1 or between 1 and 2). Secondly, when giving a score, some stakeholders tend to emphasise a difference between theory and practice, pointing to a gap between the intersectoral content of some policy instruments (policies and regulations) and their translation into practice. Translated into the formula given by one actor, "*intersectoral governance cannot be only technical. It must be based on political decisions and interventions*".

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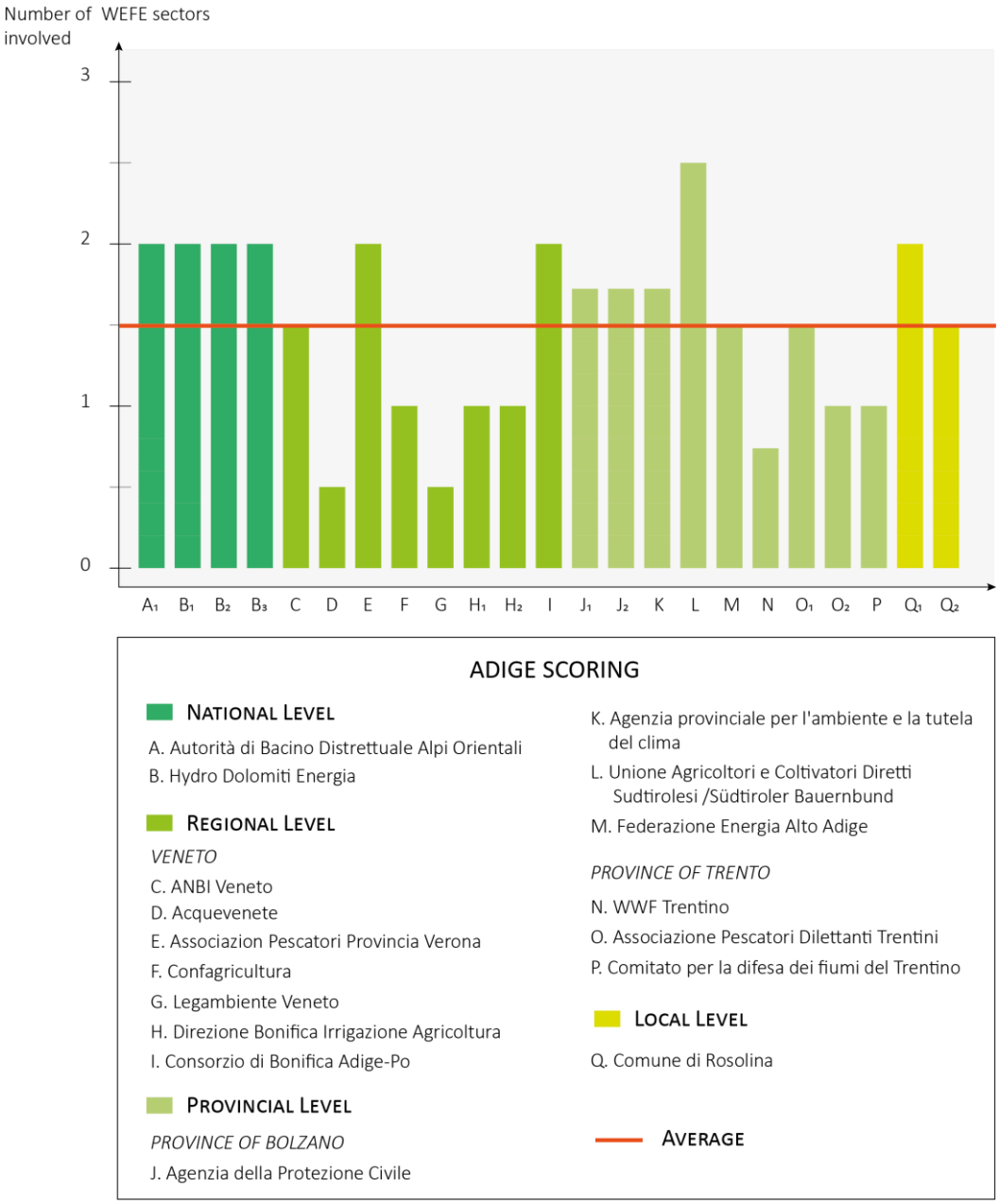

Figure 27: Self-scoring of cross-sectoral management by stakeholders of the Adige case study

4.3. Concluding evaluation of the Adige River

4.3.1. Concluding evaluation

The current governance system **is "restrictive" but has potential** for WEFE nexus governance.

The current governance system **is "restrictive"** towards WEFE nexus governance because:

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- Multiple centers of decision-making, but little coordination between different agencies and organizations
- Fragmentation of regulatory instruments and responsibilities
- A vision of problems and solutions focused on political-administrative boundaries, with little regard for a governance at river basin scale
- Lack of trust between different jurisdictions in the basin
- Lack of common agreements and rules for measuring flows in river basin segments between the different territorial administrations of the basin.
- The current energy crisis is having an impact on the use of water for hydroelectricity, exacerbating the tensions surrounding water use in the basin.

But the governance assessment shows that the system has **potential to move towards** WEFE nexus governance because:

- The polycentric nature of the system can allow for the involvement of a plurality of actors intervening at different scales and levels in the management of resources and territories
- Flexibility of the system and capacity for change
- Stakeholders have the expertise to implement a more nexus-based approach to resource management

Following the analysis, the main blockages and levers identified are listed below.

4.3.2. Blockages and levers

Barriers

- Multiple instruments with conflicting objectives;
- Problem-solving strategies focused on sectoral priorities;
- Resource management organized within regional and provincial administrative boundaries.

Levers

- Highly inclusive system;
- Capacity of the system, although only demonstrated in emergency situations, to reassess sectoral objectives and accept trade-off in resource management;
- Existing institutional framework at basin level - the Permanent Observatory of Water Uses - to facilitate exchanges and trade-offs, where the relevant actors of water management in the basin are present

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4.3.3. Recommendations to urge for more WEFE nexus governance

Some of the key findings of the assessment are presented below and are expected to help stakeholders move towards interregional and interprovincial cooperation that could have an impact on cross-sectoral resource management in the river basin.

- Lack of effective coordination between the different institutional actors of the composite decision-making system in the basin.

The current governance system is characterised by a great diversity and plurality of decision-making units for the management of resources (especially water), without effective coordination between them. Each institutional body with responsibility and decision-making power for the management of the WEFE NEXUS sectors acts as a single manager within the framework of its competences.

- Limited coherence between the various regulatory instruments of the different sectors

The multiplicity of centres with decision-making power over resources results in a multiplicity of regulatory instruments. These instruments are sometimes fragmented and overlapping, with objectives that are not always aligned, as they are mostly defined without taking into account the interdependencies between the different sectors.

- Focusing policy on sectoral priorities

Although the actors have the necessary know-how for a more cross-sectoral management and share a common vision of the problems affecting the river basin, the strategies to address them are mostly focused on the priorities of the different sectors.

- Limited capacity of the Eastern Alps basin authority to fully exercise its competences

In a framework where the different political-administrative actors (region and provinces) have strong political, legal and resource capacities to manage water, soil, energy, agriculture and ecosystems in ordinary situations, the District Authority - although it carries out activities in the field of hydrogeological planning (i.e. water, soil and ecosystems) at the basin scale - has limited decision-making powers and resources.

Opportunities to support more cross-sectoral governance

A first opportunity stems from the system's ability to involve key stakeholders in governance. In this sense, the polycentric nature of the system is not necessarily an

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obstacle to greater intersectorality, especially since it allows for the involvement of a plurality of actors at different scales and levels in the management of resources and territories. However, there is a need for greater coordination between the different actors.

A second opportunity is the system's ability to reassess sectoral objectives and accept compromises in resource management. Although the system only shows flexibility in emergency situations (typically water emergencies), this flexibility indicates a capacity for change. Paradoxically, the water crisis of the summer of 2022 opened a window of opportunity for greater coordination between the different territorial entities of the Adige basin: in the context of the meetings of the Permanent Observatory of Water Uses, coordinated by the District Authority, negotiations took place on the reallocation of water volumes between the different sectors and between the different territorial entities of the basin. The District Authority's current project to create a data platform with the aim of establishing a common framework for water data in the Eastern Alps District could be an opportunity to strengthen the District Authority's coordinating role without redistributing decision-making powers (a process that can be described as coordination through information). This could encourage the various stakeholders to move from information sharing to consultation and adopt an integrated vision of water resources and to sit down at the various tables proposed by the district authority, in particular that of the Observatory, beyond emergency situations and, over time, to build up a relationship of trust between the various territorial authorities and sectors in order to implement greater cooperation at a later stage.

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5. Inkomati-Usuthu River

The Inkomati-Usuthu is a transboundary river basin shared between Eswatini (formerly named Swaziland), South Africa, and Mozambique. It covers approximately 46800km², of which 2600km² (6%) are in Eswatini, 28700 km² (61%) in South Africa, and 15500 km² (33%) in Mozambique (upstream to downstream, respectively) (Slinger et al., 2010).

General information regarding water, energy, agriculture and environment to contextualize the case study is described below.

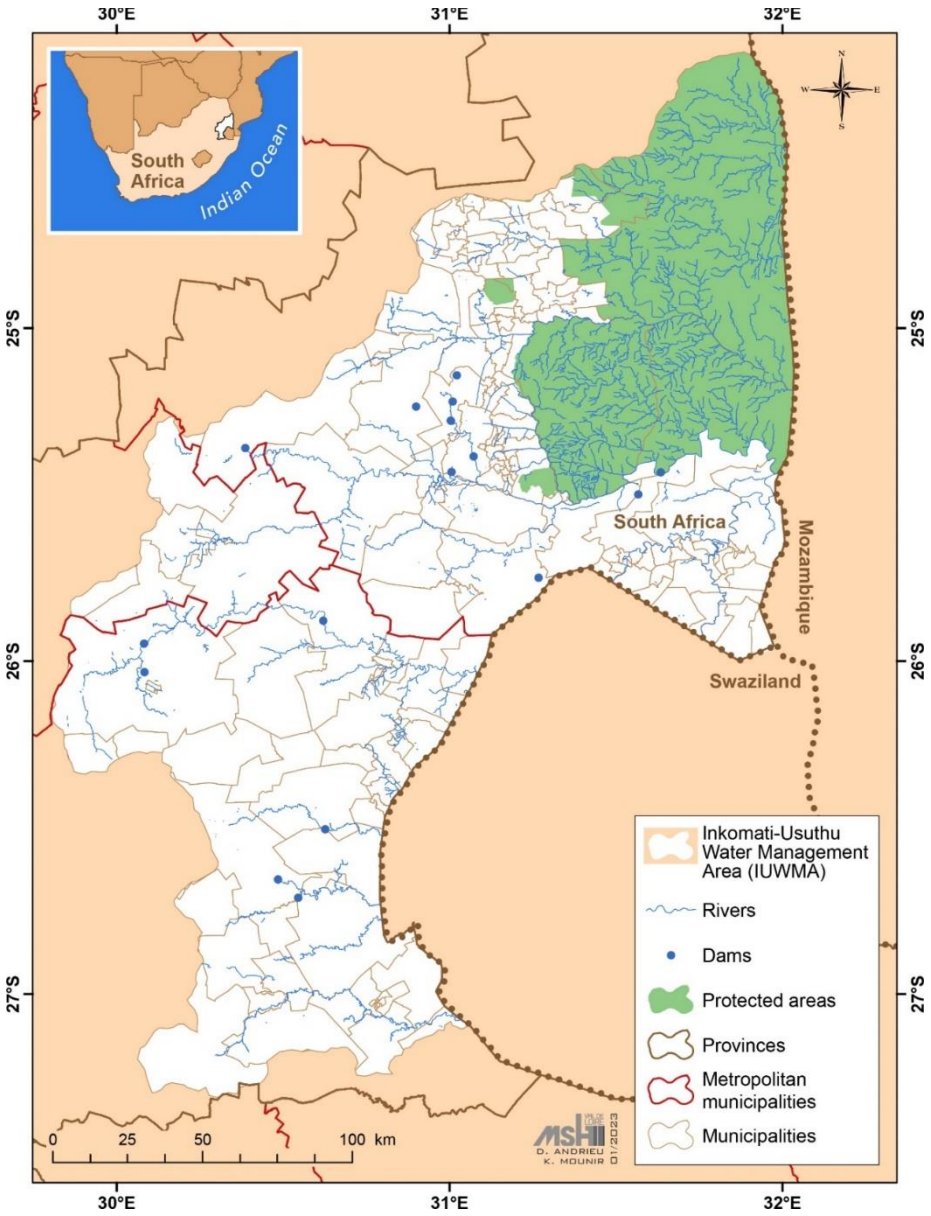

Figure 28: South Africa Case Study: Inkomati-Usuthu transboundary river basin

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5.1. Context and case study description

5.1.1. Biophysical basic information

The Inkomati-Usuthu Water Management Area (IUWMA) is located in Mpumalanga Province, South Africa, covering four main river catchments: Sabie-Sand, Crocodile, Komati, and Usuthu. These rivers flow eastward, merge in Mozambique to form the Inkomati River, and discharge into the Indian Ocean. The IUWMA spans three district municipalities and ten local municipalities, with about 37% of the Kruger National Park (KNP) within its area (Figure 28 ; Figure 29). The region supports diverse land uses, including irrigated agriculture, extensive afforestation, power station cooling (e.g., Eskom, Sasol Secunda), and urban, rural, and industrial demands. Water use in the area is dominated by irrigation (>50%), followed by inter-basin transfers for power generation, and forestry. Additionally, the IUWMA must meet ecological requirements and international water obligations to Mozambique.

The IUWMA is split by the Great Escarpment into the Highveld (western plateau) and the Lowveld (eastern area). The Highveld has a temperate climate, while the Lowveld is sub-tropical, leading to a rainfall gradient from west to east, with the Highveld receiving up to 1,200mm/year and the Lowveld as little as 400mm/year. Rainfall is seasonal, with wet summers and dry winters, and evaporation rates are high at about 1,900mm/year, creating increasing water deficits from east to west.

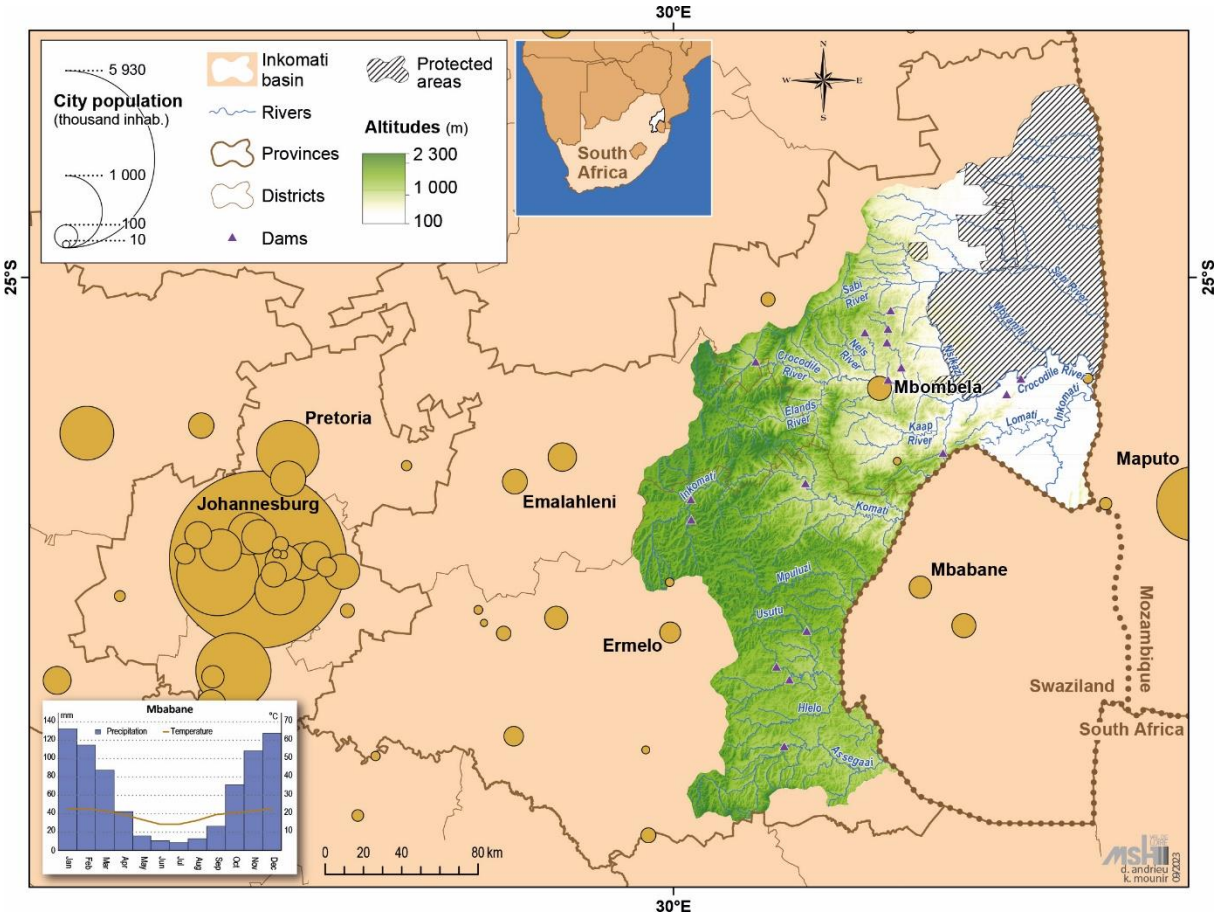

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Figure 29: Topography of the catchment and location of main cities

5.1.2. Socio-economic activities and challenges in sub-catchments of the Inkomati-Ushutu water management area

Water

There are over 90 dams along the river (JIBS, 2001 and Figure 29). The area developed for irrigation in the three countries in 1991 and agriculture and forestry (exotic forest plantations) continue to provide the mainstay of the economy. Agriculture is now the largest water use of stored water. Urban industry accounts for 12% of the total water withdrawals, non-urban industry accounts for 1.2% of the total water withdrawals and domestic use accounts for 12% of total water withdrawals.

Agriculture

Two crops dominate land use (area): rain-fed commercial tree plantations (3400 km^2), and irrigated sugarcane cultivation (428 km^2, excluding 108 km^2 in the Umbeluzi basin that is irrigated by the Inkomati River). The Inkomati basin, approximately 830 km^2 are irrigated, of which nearly 300 km^2 (36%) is used for sugarcane. The sugar industry dominates economic activity by providing direct employment for approximately 30,000 people.

Energy

Energy production is primarily driven by coal-fired power generation. The region is home to several power stations, including Eskom's power plants and the Sasol Secunda Complex, which are significant consumers of water for cooling purposes. These power stations play a major role in energy production in the region, with water being transferred from inter-basin systems to meet their cooling needs. Additionally, the presence of extensive afforestation, particularly in the Highveld area, also contributes indirectly to the energy sector by supporting biomass production, though coal remains the dominant energy source in this area.

Ecosystems

The Inkomati provides habitats for a rich variety of threatened species which wholly or partly depend on water and/or riverine habitats (40 bird species, 11 terrestrial mammal species, 12 fish species, and 8 reptile and amphibian species, 104 plant species). Some other water-dependent species provide essential economic and social services, especially for those in the lower socio-economic class. The minimum (ecological) flow of 2m^3/s is challenging.

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Transboundary agreements

In the Tripartite Interim Agreement (TIA), the three riparian countries agreed to permit water withdrawals to about 2,340 MCM/y by 2010. This represents 65 % of the Mean Annual Runoff (MAR). It also made an allowance for environmental flows. However, the increased withdrawal still raises issues of downstream impacts, in particular on the estuary.

5.1.3. Policy and administrative context

South Africa has three levels of government: national, regional, and local (metropolitan areas, district councils, and municipalities). Each level has its own legislative and executive powers, with advisory bodies of traditional leaders at the national and regional levels. The national government sets policy frameworks, while the regional level implements these policies, generally with some independence. Local governments handle service delivery, local economic development, capacity building, and district-wide planning. At the national and regional levels, government departments are grouped into "clusters" to foster integrated governance, including areas such as economic development, governance, social protection, international cooperation, and justice.

The Inkomati-Usuthu CMA (IUCMA) is mainly responsible for the coordination of water-related activities of organisations in Water Management Areas (WMAs), monitoring and control of water-use, administration of water licences, development of catchment management strategy, facilitating public participation and creating institutional structures and conditions for management. The Regional Office of the Department of Water and Sanitation and the IUCMA are responsible for the management of water resources. However, the ICUMA still reports to several government entities.

A transboundary Tripartite Permanent Technical Committee (TPTC) was established in 1983 to discuss water issues between the three countries. This updated in 2002 to develop joint projects and programmes to face hydrometeorological extreme events.

5.1.4. Key challenges for WEFE nexus and transboundary

Economic developments resulting in increased water use have been tremendous since the 1970s. By 2002, total net consumptive water use was estimated at 1,810 million m^3 per year. Water is used by (exotic) forest plantations, for domestic and industrial purposes and for irrigation (48 % of total water use). These extractions frequently lead to water shortages, given the high variability of flow, both within and between years. Water demand is highest in the drier Lowveld, where rainfall and runoff are limited. Between 2009 and 2018, rainfall has declined, and climate change is expected to worsen water stress, increasing extreme weather events. Water demand generally exceeds availability, resulting in surface water stress. Groundwater resources are depleting, though there is uncertainty due to a lack of recent studies. Water quality is

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mostly moderate to good, but is impacted by poor wastewater infrastructure, informal settlements, illegal connections, mining, land conversion, and agricultural pollution. The energy production is closely linked to water availability, with high water demand from both the power stations and irrigation activities, creating competition for resources and tensions. Political instability has further weakened legal and institutional frameworks

The four sub-catchments are facing major challenges due to their socio-economic activities and their difficulties in meeting growing demand in the context of increased pressure from climate change and droughts. This makes it impossible to meet Mozambique's international obligations.

5.2. Results of WEFE nexus governance assessment and policy coherence analysis in the Inkomati-Usuthu river basin

Between 13 – 24 February 2023, the field visit of the Nexus Governance Assessment took place in the Inkomati river basin. Three members of the governance assessment team (2 from UFZ, 1 from UNT), with the presence of the case study leader, interviewed 23 people (Annex 6).

The interviews were semi-structured group interviews and lasted between 1-2 hours. The interviews were conducted in English. Reaching the different places for interviews required travelling in long distances within the catchment.

The focus groups for the validation of the policy coherence assessment took place the 5June 2023. Participants were again selected based on purpose sampling (Bernard, 2008). One representative from each WEFE nexus domain that has experience with implementing policies in practice was selected. The focus groups were conducted in English.

Table 16 Overview stakeholders involved in NXGAT interviews and focus groups

When	What	Number of stakeholders	Men	Women	Non binary	Men (%)	Women (%)	Non binary (%)
13-24 February 2023	Interviews NXGAT South Africa	23	13	10	0	57	43	0
5 June 2023	Focus group South Africa	38	19	18	1	50	47	3

Focus group

The focus group happened right after the 3rd workshop on 15 June. Six main achievements came out of the focus group held online on 5 June 2023:

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- An idea of which instruments to include in the tool was provided by the stakeholders. This was determined through comments provided and preferences indicated by the stakeholders;
- Stakeholders provided feedback on the policy coherence assessment and governance assessment with points for the team to consider going forward;
- An idea of the type of stakeholder engagement valued by the stakeholders was provided;
- Interest expressed by stakeholders to get involved in the setup of a focus group with stakeholders who may be involved in maintaining the project outcomes once it is finished;
- Stakeholders appeared to be excited about the project and prospect of moving towards Nexus thinking, however, stakeholders expressed their concern about the outcomes of the project reaching decision makers. To this end, stakeholders would be interested in information on how the project will benefit those on the ground and how it will continue past the project end date;
- Stakeholders enjoyed the idea-sharing from the European partners.

Analysis of governance system by criteria for each dimension and scoring

- **Comprehensiveness**

Actors and networks - Most of the stakeholders are involved in the decision-making process. However, mining and municipalities mostly only attend committees or consultative boards, when it is a requirement for the licensing process. As a result, the score is **"high"**: The majority of relevant actors and networks affected by or affecting WEFE nexus domains is involved.

Levels and scales - All relevant **levels and scales** across WEFE nexus domains are involved, namely the international/transboundary level, national level, regional/ provincial level, catchment level, local/municipal level. As a result, the score is **"very high"**: All relevant levels and scales across WEFE nexus domains are involved.

Problem perspectives and goal ambitions - The most important problems are unauthorised mining activities, untreated sewage and littering, and load shedding. Most important goals relate to energy and food security and (economic) development of the region. As a result, the score is **"low**: A limited number of problem perspectives across WEFE nexus domains are taken into account and only a few are translated into WEFE nexus goal ambition.

Strategies and instruments - There is a discrepancy in terms of relevance and level of integration. The more relevant a policy is, the less integrated it seems to be. Thus,

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some include other sectors (e.g., Mpumalanga Biodiversity Sector Plan, Regional Integration Programme, Mpumalanga Spatial Development Framework, National Spatial Action Areas), but their relevance/impact seems limited. C**atchment Management Strategies (as part of the National Water Act)** and National Environmental Management Act could be exceptions, as they seem both relevant and integrated. As a result, the score is **"low"**: A limited number of relevant strategies and instruments include WEFE orientation.

Responsibilities and resources - Responsibilities are clearly assigned, only with regard to implementation and transboundary contexts, there is some confusion or overlap. Insufficient resources are a major issue, especially in three areas: 1. In municipalities and communities at local level (money, poverty, unemployment, skills, expertise, education and awareness), 2. For Law enforcement and implementation (at all levels), 3. In relation to lacking (political) willingness (energy and economic development are the priority at national level), accountability, and irresponsible behaviour. As a result, the score is **"low"**: Few responsibilities are clearly assigned and/or only limited resources are allocated across WEFE nexus domains to support WEFE nexus management.

Conclusion - The overall assessment of comprehensiveness is **"low".**

- **Coherence**

Actors and networks - Some actors, but by no means all, collaborate, however, to varying extents. There are tensions between the energy sector and all other WFE sectors. Additionally, there are conflicts within the energy sector, within the agriculture sector, between the ecosystem sector and some local communities, and between local municipalities and all WEFE sectors. As a result, the score is **"very low"**: Interactions of relevant **actors and networks** across WEFE nexus domains are neither cooperative nor solid and not based on trust.

Levels and scales - There seems to be a disconnect between different levels and scales involved, resulting in co-existence rather than cooperation or conflict. There is some incoherence between national and regional/local levels. As a result, the score is **"low"**: Relevant levels and scales across WEFE nexus domains rarely work together, rarely acknowledge interdependencies and have little trust on each other.

Problem perspectives and goal ambitions - Coherence of different problem perspectives and goal ambitions is quite low at national level (very siloed) and a bit higher at regional or local levels, as there is a common interest to develop the region. Coherence is highest between water and ecosystems, to some extent also water and agriculture. Most conflicts exist between energy and agriculture. As a result, the score is **"low"**: Problem perspectives and goal ambitions across WEFE nexus rarely mutually reinforce each other.

Strategies and instruments - The strongest incoherence exists between the energy (especially mining) and agriculture sector but also water and energy and water and

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agriculture. Most coherence is created by the ecosystem sector. Strategies and instruments of water and ecosystem are mutually reinforcing. There is some incoherence within the water sector, between water resources management (NWA) and water services (WSA). As a result, the score is **"low"**: Relevant strategies and instruments across WEFE nexus domains rarely reinforce each other.

Responsibilities and resources - Responsibilities assigned and particularly resources allocated are widely incoherent and lead to conflict. Especially between energy and water and within the water sector, assigned responsibilities lead to (partially very severe) conflicts. IUCMA was mentioned as promoting cooperation between WEFE sectors. Allocated resources create conflict because WEFE sectors are fighting over money. There is conflict between energy and ecosystem, energy and agriculture, energy and water and within the water sector. As a result, the score is **"very low"**: Responsibilities and resources across WEFE nexus domains do never lead to cooperation among these domains.

Conclusion - The overall assessment of coherence is **"low".**

- **Flexibility**

Actors and networks - There is flexibility, especially in a context of crisis or emergency, where new actors can be swiftly engaged and extraordinary bodies established. For example, during droughts or floods, new working groups can be established (e.g. Crocodile River or Olifant River Working Groups) to quickly re-allocate water uses and secure environmental flows. However, at times, flexibility and long-term stakeholder engagement can be impaired by the perception of a rigid or even dysfunctional management system. As a result, the score is "**high**": The governance system allows to include new actors or shift the lead from one actor to another when needed in some situations.

Levels and scales – There is flexibility because new levels can emerge easily (e.g., sub-catchment level, metropolitan area level, transfrontier landscape level), if circumstances require – indicating a willingness of stakeholders to work across scales (outside of their usual purview) to solve problems. At the same time, the governance system is very fragmented and rigid, inhibiting law enforcement and implementation at different levels, which impairs flexibility. As a result, the score is **"high"**: The governance system allows to change levels and/or scales at which WEFE nexus issues are addressed in some situations.

Problem perspectives and goal ambitions - The governance system seems to allow to change priorities, according to the current context. However, flexibility is lower at the national level compared to lower levels. As a result, the score is **"high"**: The governance system allows to re-assess goals across WEFE nexus domains and combine multiple goals in package deals as needed in some situations.

Strategies and instruments - Flexibility is overall high, especially in the short-term, in a crisis or emergency case (e.g., the use of Emergency Protocols, as part of General

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Authorisations, to catalyse immediate, on-the-ground action and bypass the latency of national policy). However, flexibility is impaired by the lengthiness and rigidity of bureaucratic and legal processes. As a result, the score is **"high"**: The governance system allows to combine or make use of different strategies and types of instruments across WEFE nexus domains in some situations.

Responsibilities and resources - In crisis situations or cases of emergency, the governance system seems very flexible to address the most pressing issues and effectively find solutions. However, at the same time, there are robust governance frameworks which provide structure and processes, which are duly followed, and that may inhibit the opportunity for adaptations. As a result, the score is **"high"**: The governance system allows to pool assigned responsibilities and resources across WEFE domains without compromising accountability and transparency in some situations.

Conclusion - The overall assessment of flexibility is **"high".**

- **Intensity of action undertaken**

Actors and networks - IUCMA is pushing most strongly for more cross-sectoral management, particularly through their river forums (IUCMA forum + 6 sub-catchment forums). However, some actors also mentioned that this effort is not sufficient and some sub-catchment forums show quite low impact. As a result, the score is **"very high"**: There is strong pressure from a relevant actor or actor coalition across WEFE nexus domains towards behavioural change or management reform.

Levels and scales – There is some pressure towards more cross-sectoral management, particularly at the provincial/regional/catchment levels. At the national level, every sector is moreso pushing forward their own mandate. As a result, the score is **"low"**: There is some pressure from relevant levels and/or scales across the WEFE nexus domains towards behavioural change or management reform.

Problem perspectives and goal ambitions - There is no real or clear ambition to shift towards more cross-sectoral management, except for the institutions that have the official and specific mandate do make an effort towards this outcome. Some individuals within organisations champion more nexus-oriented management, but it is not an established goal or ambition. As a result, the score is **"low"**: Problem perspectives and goal ambitions across WEFE nexus domains weakly urge nexus orientation.

Strategies and instruments - There are only two or three examples that can be seen as an attempt to foster cross-sectoral management such as the Catchment Management Strategies, Spatial Planning and Land Use Management Act or National Wetland Management Framework, but overall, the intensity remains very low. As a result, the score is "**very low**": Relevant strategies and instruments across WEFE nexus domains do not urge WEFE nexus-oriented behaviour or management reform

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Responsibilities and resources - There are some examples of assigned responsibilities (IUCMA, spatial planning unit of the Department of Agriculture, Land Reform and Rural Development) and allocated resources (World Bank, transfrontier landscape/regional level, IUCMA) that push for more cross-sectoral management. However, these are exceptions compared to the vast majority of responsibilities and resources that are not pushing at all. As a result, the score is **"very low"**: Responsibilities and resources across WEFE nexus domains do not urge implementation of WEFE nexus-oriented actions.

Conclusion - The overall assessment of intensity of action undertaken is **"low".**

- **Fit**

Actors and networks - The fit criteria seems to be met for the water, ecosystem and agriculture sectors, because actors are quite decentralised ("trickle-down representation"). However, the energy sector is poorly represented on a regional or local scale. As a result, the score is **"high"**: Relevant actors and networks across WEFE nexus domains are appropriate to deal with/manage ecosystem properties and functions in some situations.

Levels and scales - Levels and scales of the water and ecosystem sector seem to match ecosystem properties and functions, maybe of agriculture as well but for energy fit is not met. The energy sector is very top-down, centralised (in policy and planning) at the national level, and has no strong representation at lower levels which approximately inform planning and service delivery. As a result, the score is **"high"**: Relevant levels and scales of the governance system mostly match ecosystem properties and functions.

Problem perspectives and goal ambitions - Goals are still very much defined in a siloed way, "sector goals" have priority and interlinkages are not so much taken into account. For "lock-ins" or persisting problems, it is a bit different, as actors seem to realise that it is required to consider cross-sectoral interlinkages. As a result, the score is **"high"**: Problem perspectives and goal ambitions across WEFE nexus domains rarely take into account ecosystem properties and functions.

Strategies and instruments - Fit seems to be met for water and ecosystems, low for energy and uncertain for agriculture However, EAPs that are involved in the permitting processes for mining might be able to ensure that ecosystem properties and functions are considered, so in a way the ecosystem sector might be able to cover for the energy sector. As a result, the score is **"high"**: Relevant strategies and instruments across WEFE nexus domains most of the time take into account ecosystem properties and functions.

Responsibilities and resources - There are overlaps between the responsibilities of different departments. The Department of Agriculture, Land Reform and Rural Development. has an environmental planning unit and the Department of Forestry, Fisheries and the Environment and Department Water and Sanitation are concerned

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with (aquatic) ecosystem functioning; however, their individual and collective responsibilities still do not provide for effective management of ecosystem properties and dynamics. The same applies to the resources. There are also overlaps between KOBWA and IUCMA, therefore it is certain that fit has considerable room for improvement. As a result, the score is **"low**: Responsibilities and resources across WEFE nexus domains are rarely appropriate to deal with ecosystem properties and functions.

Conclusion - The overall assessment of fit is **"high".**

The overall scoring of the matrix of the NXGAT implementation is as follows:

Table 10: Matrix of the overall scoring for the Inkomati-Usuthu WaterManagement Area

SCORES GOVERNANCE ASSESSMENT - INKOMATI-USUTHU CATCHMENT MANAGEMENT AREA					
Dimensions / Criteria	Comprehensiveness	Coherence	Flexibility	Intensity of action	Fit
Actors and networks	HIGH	VERY LOW	HIGH	VERY HIGH	HIGH
Levels and scales	VERY HIGH	LOW	HIGH	LOW	HIGH
Problem perspectives and goals ambitions	LOW	LOW	HIGH	LOW	HIGH
Strategies and instruments	LOW	LOW	HIGH	VERY LOW	HIGH
Responsibilities and resources	LOW	VERY LOW	HIGH	VERY LOW	LOW
Overall assessment	LOW	LOW	HIGH	LOW	HIGH
Concluding evaluation	The current governance system is **restrictive** towards WEFE nexus goverance				

Policy coherence analysis results

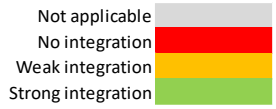

Figure 30 shows the results of the policy coherence analysis for the Inkomati-Usuthu case study. The results were validated by the stakeholders with a remotely focus group which was held after the third workshop. Unfortunately, the energy sector was missing in the focus group, therefore the results have been validated only with stakeholders from the water, ecosystem and food/agriculture sector. There seems to be a high level of policy coherence even within policies stemming from a single sector. The stakeholders' first impression was that the matrix indicated a too optimistic situation. Based on their feedback some scores were changed from strong integration to weak integration. This was done for: the Kruger National Park management plan and the energy sector, the National Protected Area Expansion Strategy for South Africa and the food sector, the Mpumalanga Biodiversity Sector Plan and the energy, food, and land/soil sectors. Similar to the findings of the NXGAT, there is a high level of policy coherence between the water sector and ecosystem domain. However, based on the

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analysis of these policy documents, it seems that not only policies from the ecosystem domain create most policy coherence. There are also cross-sectoral policies, and policies from the land/soil, and food sector that show strong integration with many other sectors. Despite the overall positive scores, the stakeholders mentioned that in practice the impacts of the coherence found in these policies are diminished by illegal activities, and the lack of coordination by different authorities with overlapping responsibilities.

Sector	Policy	Water	Energy	Food/ Agriculture	Land/ Soil	Biodiversity/ Ecosystems	Climate
Land use	National Development Plan						
Energy	Integrated Resource Plan (has been updated a multitude of times to reflect changes - latest is 2019)						
Food	The national policy on food and nutrition security for the republic of south africa						
Cross-sectoral	KNP Park Management Plan						
Ecosystem	National Protected Area Expansion Strategy for South Africa						
Ecosystem	Mpumalanga Biodiversity Sector Plan						
Cross-sectoral	Mpumalanga Spatial Development Framework						
Food	The Agriculture Integrated Growth and Development Plan						
Ecosystem	National Biodiversity Strategy and Action Plan						
Cross-sectoral	National Climate Change Adaptation Strategy						
Water	National Water and Sanitation Master Plan						
Energy	South Africa's Low Emission Development Strategy						
Energy	National Energy Regulator Act						
Ecosystem	National Environmental Management Act (Act 107 of 1998)						
Water	Tripartite Interim Agreement Between The Republic Of Mozambique And The Republic Of South Africa And The Kingdom Of Swaziland For Cooperation On The Protection And Sustainable Utilization Of The Water Resources Of The Incomati And Maputo Watercourses						

Not applicable
No integration
Weak integration
Strong integration

Figure 30: Results policy coherence analysis South African case study

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Self-scoring of cross-sectoral management by stakeholders

To the question *"if you were to **score cross-sectoral management** in the river basin concerning the problems we discussed, which score would you give between 0 (no cross-sectoral management) and 3 (good cross-sectoral management)?",* the **average** value given in response is **1.7** and:

- the national level scored 2.5;
- the regional level scored 1.6;
- the local level scored 2.

At national level

- The Department of Water and Sanitation scored 2.5 because "3 it is on paper but in reality, it would be 0". Nevertheless, they would not give a score of 3 or 0 because *"there is development. Water and Food have good relationships, and Ecosystems as well. But there are still issues with the Energy sector regarding energy production and water quality issues*".

At regional level

- ESKOM scored 2.5 because *"there is good interaction between Water and Energy and between Water and Agriculture*". Moreover, *"every forum has agricultural representation, as they are the biggest users of water";*
- The Department of Water and Sanitation, Regional Office Mpumalanga, scored 3 because *"There are interactions but they are not strong enough"*. In practice *"everyone is still trying to pull its own side; they are not embracing the same goals or interests: Mining doesn't have interest in Ecosystem, Food only care about Water, etc.";*
- The Mpumalanga Tourism and Park Agency scored 3 because *"they all interact but not quite in a collaborative way";*
- The Komati Basin Water Authority scored 2 because they are sceptical about the interactions between the Energy sector and the other 3;
- The Inkomati-Usuthu Catchment Management Authority scored 2 because they are missing cooperation between Energy and Agriculture: *"in times of water scarcity, we have an agreement with ESKOM that they are not allowed to pump during off-peak hours, so the river won't stop flowing. We tried to have this discussion with ESKOM and explain the problems with the flows, so we would need to release more water so it doesn't stop flowing. But then ESKOM said, no, but also for us it causes problems when our pumps only run during peak energy use times (morning and afternoon), so they must run off-peak. And if you run during peak hours, the costs for the irrigators increase".* But they also

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scored 3 because *"the stakeholder engagement plan looks at different levels (national, regional, local and public and private): we try to synergise everything to one central point of access"*. They are also participating in the climate change strategies of the province and there is a district development model driven by local government. All these are cross-cutting on WEFE sectors;

- The ex-IUCMA Board Secretary scored 0 because *"UCMA is a correct platform but having a platform does not equal pushing for more cross-sectoral cooperation. It is not sufficient"*;
- Mpumalanga Agriculture and South Africa Agriculture scored 0 because *"there are talks but translation into action is very low. Nexus thinking is not happening and certainly not to an extent that is impactful".*

At local level

- The local farmer scored 2 because *"the Ecosystems and Food (talking about Food apart from Agriculture) are not taken into account sufficiently. Is food production going to be enough for the population?* ". He is very sceptical about food security, it makes him worry about ecosystems: *"we are pushing limits".*

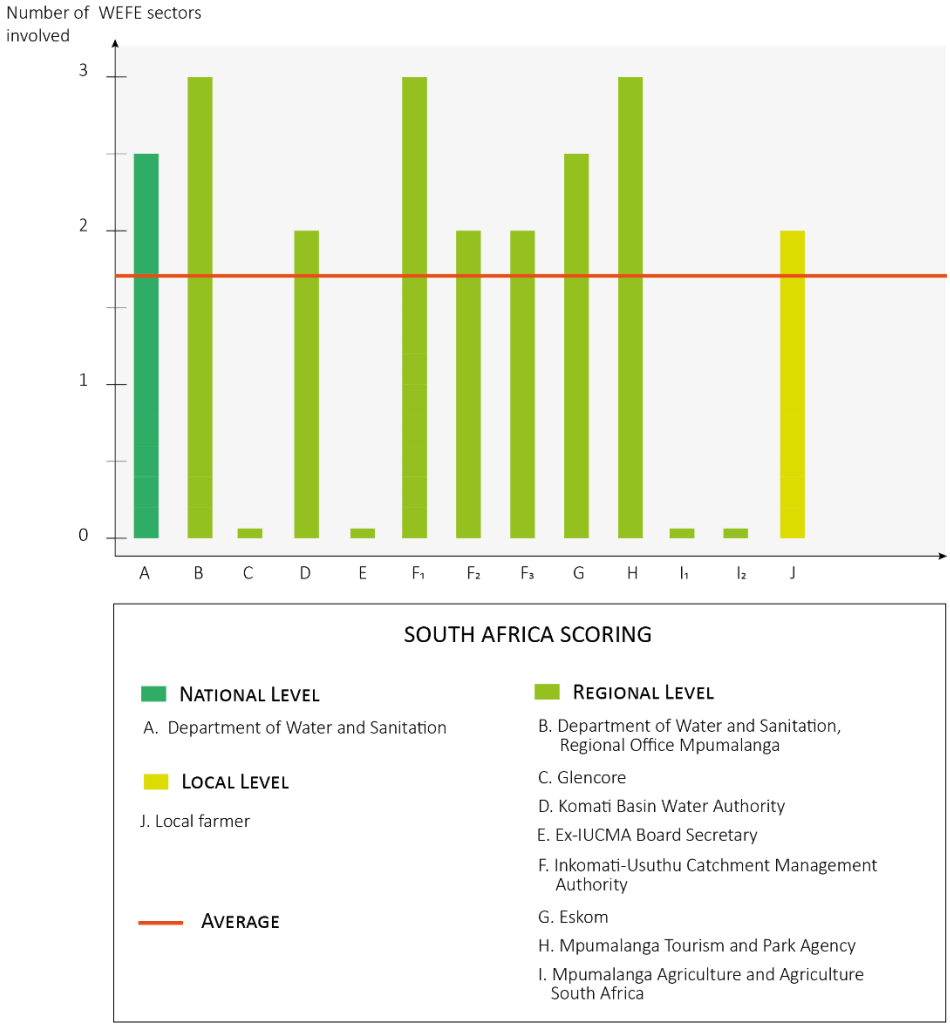

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Figure 31: Self-scoring of cross-sectoral management by stakeholders of the Inkomati-Usuthu River Basin (South Africa)

5.3. Concluding evaluation of the Inkomati-Usuthu River basin

5.3.1. Concluding evaluation

The current governance system is **"restrictive"** towards WEFE nexus governance because of lack of:

- Coherence of actors and networks and resources and responsibilities;
- Intensity of action of strategies and instruments and responsibilities and resources

But tendency to be **"restrictive"** because of:

- Comprehensiveness of levels and scales;
- Intensity of action undertaken by actors and networks.

5.3.2. Barriers and levers

Barriers

- Only few policies are inherently and purposely cross-sectoral;
- Low awareness of the need for cross-sectoral management in government departments;
- Lacking communication and cooperation between actors of different sectors > tendency to push own (sectoral) mandates;
- Non-compliance and lacking accountability leading to inaction.

Levers

- Short-term flexibility of the governance system results in high adaptive capacity;
- Sustainable Development Goals (SDGs) as entry point for cross-sectoral management;
- Multi-level cross-sectoral governance: regional and local levels show good potential for more WEFE nexus orientation;
- Scalar fit: Match between the scale of governance structures and the scale of bio-geophysical systems.

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5.3.3. Recommendations to urge for more WEFE nexus governance

Improved wastewater treatment

Improved wastewater treatment is a key driver for achieving multiple WEFE nexus goals, such as enhanced water and food security, increased water quality, compliance with water regulations, helping to establish cost-effectiveness in the long-term, and targeting poverty and marginalisation, especially in rural areas.

An integrated licensing system

An integrated licensing system for all land use types under the umbrella of NEMA could increase coherence of WEFE sectors, while always making sure that ecosystem functioning is not compromised.

A common digital information system

A common digital information system populated with nexus (not sector) data that is used by all WEFE sectors could help taking into account cross-sectoral impacts of policies and decisions, increase transparency, enhance mutual understanding, foster cross-sectoral cooperation and target excessive bureaucracy.

The allocation of more resources

The allocation of more resources (financial, human) to law enforcement and compliance monitoring would enhance policy implementation and ensure accountability, which is necessary to turn discussions to action and establish consequences for misappropriation and non-compliance.

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6. Lessons learned

6.1. On the method and its implementation

6.1.1. Success stories

The preparation of data collection

The field visit for the NXGAT implementation took place one year after the beginning of the project. The stakeholder engagement process was thus in an advanced stage and the case study partners were well informed and engaged in their case study work. This was useful to identify the stakeholders to interview for the governance assessment during the preparation of the field visit.

Furthermore, thanks to the good working atmosphere in the project and the professionalism of the case study partners, the WP1 governance assessment team was well received in the case study regions, which was well appreciated and contributed to the success of the field visits.

The policy inventory and coherence assessment, coupled with a description of the case study performed by the WP1 colleagues of the University of Tours for each case study provided important background information before the interviews. The case study description, integrated with additional information collected during the field visits, was then synthesised in this deliverable.

Density of information collected

The data collection via interviews during field visits was successful for all the five case studies. Stakeholders were happy to exchange and some were keen to talk more. In fact, most interviews lasted longer than initially planned as stakeholders wanted to continue the discussion.

The fact the governance assessment team was composed by more than one researcher facilitated note taking. Notes were then integrated at the end of each day and complemented by discussion among team members and eventually with additional material coming from the recordings.

Fit criteria as a novelty

The fit criterion, while initially seemed redundant for certain governance dimensions such as problem perspectives and goal ambitions, was in fact an opportunity to show stakeholders the importance of placing the sustainability of the river's ecological properties and functions at the heart of decision-making processes, and think beyond only ensuring water for all uses. Placing the ecosystem at the center of the nexus discussion during the interviews was a novelty that proved useful in assessing the motivations of stakeholders for cross-sectoral collaboration and their level of perception of environmental problems and ambitions in the case study.

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Consent form and interview recording

Except for one interview, it was possible to record all interviews. The consent form took on average about 5-8 minutes to be completed. It was observed that asking the stakeholders to sign the consent form at the beginning of the interview, either before or after a short introduction of the project and the purpose of the interview within it, made stakeholders feel more comfortable, thus facilitating a smooth discussion and trust building between the governance assessment team and the stakeholders.

Organization of the agenda of the interviews and the field visit by the case study leaders

The selection of the interviewees and the planning of the field visit took place over 2-4 meetings between the governance assessment team and the case study partners. Case study partners then reached out to the interviewees and planned the meeting with them. This approach was agreed within the NXG consortium and became part of the NXGAT methodology in order to avoid different people to reach out to stakeholders without coordination.

Nexogenesis is very lucky to have a very committed team to plan, organise, and execute all this work preparation regarding governance assessment in each case study. This does take commitment which we have, but requires a lot of time and effort which may not always be available. Having local partners explicitly in the project and process, with time and budget, is of much importance in all this process.

In addition, it was agreed with the case study partners that during the field work the governance assessment team could visit the river basin region and the river to explore as many aspects of the watershed as possible within the available time. This was essential to assess the complexity and diversity of the investigated areas in terms of landscape, culture, social and economic aspects. Even if all these aspects did not directly enter the analysis, they provided important background information to the governance assessment team to bring into the discussion with the stakeholders during the interviews.

Interdisciplinarity of the governance assessment team

The number of researchers participating to the field visit varied between 2 to 5, plus the case study partners (1-2 people). The number of researchers participating to the interviews has not been an issue for the interviewees, even when the team was composed of 5 researchers and 2 case study partners (Lielupe case study). The researchers explained the interviewees that the presence of multiple researches was necessary to ensure a plurality of perspectives on the data analysis. The presence of several researchers also contributed to enrich the discussion with the interviewees and had the practical function of ensuring good note taking. One team member was in the lead of the interview, while the others were taking notes. However, all researchers could contribute to the discussion and ask additional questions.

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Participation of the case study partners to the interviews

The case study partners that contributed to plan and organize the field work were also invited to participate to it. This had several positive implications for the progress of the NEXOGENESIS project in the case studies. First, it helped speed up the results validation process as the data upon which the analysis was based were collected together, notes were shared, integrated and agreed upon. Second, by participating to the interviews the case study partners were reassured that the content of the exchange between the researchers and the stakeholders would not jeopardize the relationships they have with them. Third, case study partners could learn new things about their own case study. Fourth, case study partners expanded their network with new stakeholders, and thus to involve them in the upcoming NEXOGENESIS workshops.

The NXGAT implementation as part of the stakeholder engagement process

The WEFE nexus governance and policy assessment was not conducted for only research purposes but also had the function to engage stakeholders in the project. Accordingly, the interviews were considered as a part of the stakeholder engagement process for the co-creation of bottom-up solutions for WEFE nexus problems. Before the beginning of each interview, the interview lead explained that the interview discussion could continue in the context of the next NEXOGENESIS workshop where the outputs of the analysis would be presented and to which the stakeholder was invited to participate to provide feedback on the results and contribute to define the next steps for the case study in the context of the project.

The excellent feedback from stakeholders on the interview

At the end of the interviews, interviewees repeatedly thanked the governance assessment team for the exchange. Some mentioned that the questions had forced them, sometimes with even a bit of difficulty, to think differently and that they found it useful. Not once interviewees asked to cut the interview short; on the contrary, it was often the governance team that had to leave to go to the next interview.

Self-scoring as a novelty

As part of the NXGAT methodology interviewees were asked at the end of the interview to score cross-sectorality in their region. This novel aspect of the governance assessment proved insightful for stakeholders and for the analysis. First, the self-scoring was always well received by stakeholders who took it very seriously and often indicated that this question, although difficult, stimulated them to reflect on the level of cross-sectorality in their region.

Second, the self-scoring allowed to synthesize the interviewees perspective on cross-sectorality. This synthesis results, together with additional, case specific examples provided by the interviewees to justify their answer, were used to corroborate the data analysis on cross-sectorality.

Finally, the analysis of the self-scoring per stakeholder category revealed that the perception of cross-sectorality changes according to stakeholder groups and

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administrative scale. These results were discussed with stakeholders at the NEXOGENESIS workshops to validate and, most of all, to reflect on the causes of the different perceptions of inter-sectorality according to the stakeholder's level or scale. Results were useful to engage stakeholders in the discussion of the governance needs to urge for more cross-sectorality at local level.

Governance and policy assessment of transboundary case studies

The NXGAT was developed to be implemented at national level. Thus, for the Lielupe and the Mesta/Nestos case study the tool has been implemented in each of the two countries sharing the river basin. However, by considering the transnational aspect as an additional decision-making scale in the governance dimension “levels and scales” of the NXGAT allowed to analyze the transboundary river basin without any difficulty. Furthermore, the fact that the two countries of each river basin are part of the European Union and have therefore to comply with the same supra-national regulation (e.g. Water Framework Directive, Renewable Energy Directive, Common Agricultural Policy), simplified the analysis of the transboundary aspects of each of the NXGAT governance dimensions.

The importance of face-to-face interviews for the stakeholders’ engagement process

Field work is not only a great experience for the researchers, but also a necessary step in the assessment process for the researchers to gain a thorough understanding of the case study and to create a relationship of trust with the stakeholders. The success of these field trips was demonstrated by increased number of stakeholders who engaged in the project activities in each study site after the field trips.

6.1.2. Limitations

Duration of the interviews

To discuss all cells of the NXGAT matrix, each interview lasted on average 1.5 hours. When translation was required, interviews lasted longer. Most of the time case study partners helped with the translation, and sometimes a translator was invited (in Bulgaria for instance). The presence of a translator was useful to convey the information, but this meant at least 2 hours for one interview, which could be a major constraint for the planning of the field trip and for the stakeholders.

Packed field trip agenda with little time for debriefing

Most of the time, the field trip was arranged so that all interviews could be completed within one week. This entailed a packed field trip agenda, with sometimes the team having to leave to go to the next interview while it was clear the stakeholders would have continued the conversation. Furthermore, there was little time for the team to debrief during the field trip. Extending the field trip to at least 1.5 weeks should be seriously considered to allow time for team debriefing on site. On site debriefing is

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important to maintain the team's focused as the amount of data being collected can be overwhelming, and to eventually ask for additional face-to-face interviews if gaps were found during the debriefing.

Time and effort-intensive data analysis

Roughly 80 interviews were carried out, totalling about 150 hours of recordings, along with 11 hours of focus group recordings. This amounted to around 300 pages of notes. Additionally, thorough desk research was needed to contextualize the interview data within the socio-economic, environmental, institutional, and political framework of the case study. The analysis involved iterative discussions and synthesis, demanding up to 8 hours per case study for the entire team, plus additional individual hours for result compilation and presentation to stakeholders.

Challenges in involving all WEFE sectors in focus groups for the policy coherence assessment validation

A sound validation of the policy coherence assessment validation rested upon the presence of all WEFE sectors at the focus group. However, it was not always possible to secure the presence of representatives from all WEFE nexus domains due to conflicting agendas and lack of time. Additionally, during the focus groups, it was necessary to take time to explain how the policy coherence was scored. It was important to make sure that all attending stakeholders understood the process so they could contribute effectively. All stakeholders, except for one representing the farming sector, grasped the validation process and were enthusiastic about delving deeper into the explored policies. However, this explanation cut the time for discussion of the policies shorter. As a result, some policies have not been thoroughly validated yet. Nevertheless, future opportunities will arise during upcoming workshops and activities with stakeholders in each case study, allowing for the further validation of these policies at a later stage.

Role of the case study in the selection and invitation of interviewees

Case study partners played a crucial role in identifying interviewees, planning interviews, and organizing the field trip. Specifically, researchers created stakeholder typologies for the interviews, based on the NXGAT method, while case study partners selected interviewees based on these types. Case study partners also managed the field trip's agenda and communication with interviewees. Researchers spoke to stakeholders for the first time at the interviews. This was a consortium decision to avoid multiple people to reach out to the same stakeholders; preserve established relationships between the case study partners and the stakeholders; and secure higher stakeholders participation as it was expected that stakeholders would respond positively to a request from a person within their network. However, this approach had limitations. In particular, sometimes the research team needed to talk to more stakeholders, but it was not possible because the case study partners were afraid of stakeholder fatigue and to jeopardize a consolidated, well-functioning interaction established within the project framework. This limitation became a research outcome,

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shedding light on case study partners' attitudes towards inter-sectoral collaboration and their perceived role in facilitating it. It also provided insights on the implementation of the methodology. The research team might have, in fact, inadequately communicated the importance of a good representation of stakeholders from all WEFE domain across different scales, likely due to time constraints during case study implementation.

Striking a balance between time, resources, and comprehensive data collection

When the field visit agenda did not permit longer or additional interviews, extra interviews were arranged remotely after the visit. While conducting more interviews could have yielded a more nuanced insight into the governance systems under study, the number of individuals interviewed across the five case studies was sufficient for a robust governance analysis. In the Jiu catchment, the case study partner's expertise and thorough knowledge of the local context compensated for the absence of certain local perspectives.

6.2. On the level of WEFE nexus governance and policy coherence

6.2.1. Similarities across cases

Problem perspectives and goals ambitions

All five case study regions experience the repercussions of increased weather extremes, particularly floods and droughts, to varying degrees. Flooding is a common concern across all the investigated case studies. However, the southern European countries are confronted with a more immediate challenge of drought (as indicated in Table 17). Notably, in all the case studies, there is an observed trend of increased water use for irrigation, with northern countries initiating crop irrigation for the first time.

Another common problem across case studies is aging water infrastructure (drainage, sewerage and drinking water infrastructure). This has severe implications in term of water losses due to leakage, and water quality due to pollution infiltrating into the infrastructure. A major challenge is related to the massive financial investment required to renovate and maintain the water infrastructure.

Across all cases, a lack of stakeholder awareness regarding WEFE interdependencies became evident during the governance assessment. Simply by conducting the field work, stakeholders across cases became more aware and interested in learning more about it.

Table 17: Problem perspectives according to stakeholders across the five NXG case studies

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		CASE STUDY				
ID	PROBLEM DESCRIPTION	LIELUPE	NESTOS MESTA	ADIGE	JIU	INKOMATI
	WATER					
W1	Water quality issue due to eutrophication: too many nitrates in the river	X	X		X	X
W2	Drought			X	X	X
W3	Salt wedge intrusion in the river			X		
W4	Groundwater pollution due to phytosanitary products			X		
W5	Competition of water uses with tourism sector water demand			X		
W6	Insufficient monitoring and data access	X		X		X
W7	Illegal wells			X		X
W8	Effects of climate change (low rainfalls, poor river flow, melting of glaciers, dry up springs)			X		X
W9	Floods	X	X		X	
W10	Low waste water treatment efficiency (in treatment or inexistance in small villages/remote areas)	X	X		X	X
W11	Unregulated extraction of materials for construction activities in the riverbed		X			
W12	Obsolete urban water infrastructure (e.g. sanitation, waste water treatment, water provision)					X
W13	Lack of expertise in water engineering	X	X			
W14	Illegal discharges of waste waters			X		X
W15	Increase of pressure on river flow by the multiplication of micro hydro power plants			X		
W16	Extension of water irrigation infrastructure due to extension of cultivated areas in alpine pastures			X		
W17	Need to apply new costing and pricing rules for water services		X			
W18	Pollution of the river coming from upstream	X	X			
	ENERGY					
N1	Renewal of hydro concessions in the context of the EU market of energy			X		
N2	Hydropower production is hindered by water allocated to agriculture for irrigation					X
N3	Development of renewable energy is hindered by strong ecological protection		X			
N4	Hydropower dams could be a solution for the ecological flow		X			
N5	Obsolete power energy related infrastructure (renewables and energy storage)					X
N6	High level of ecosystem protection hinders the development of reneweable energy		X		X	
N7	Unreliability of energy supply due to peaks in renewable energy consumption					X
	FOOD					
F1	Increase of monocultures in intensive way impacting soil qualities			X		X
F2	Economic rentability of farms due to market instability			X		
F3	Economic rentability of farms due to the traditional way of farming				X	
F4	Switch from non irrigated to water demanding crops (wheat, vineyards, kiwi, asparagus)		X	X		X
F5	Switch from alpine pastures to cultivated areas			X		
F6	Increase of energy costs for all food production sectors			X		
F7	Floods		X			
F8	Solar panels installation next to agricultural plots in gravitary irrigation systems		X			
F9	Need of a good water qualities for fishing		X			
F10	Old irrigation system provoking loss of water		X			X
F11	Increase of water demand for irrigation		X	X		
F12	Hydrogeomorphological changes impacts on river banks and on gains / losses in land properties		X			
F15	Soil quality erosion	X				
F16	Salinisation of agricultural areas next to the river mouth			X		
F17	Drainage system too hold to be efficient	X	X			
	ECOSYSTEM					
E1	Minimum ecological flow not guaranteed (putting wetlands at risk)		X	X	X	X
E2	Drying of wetlands because of a lack of ecological flows					
E3	Presence of litter in the river bed and river mouth		X	X		
E4	Destruction of habitats in the river (rectification of the river // release of sediments)			X		
E5	Impact of accidental pollution from chemical industries on drinking water resources			X		
E6	Alteration of the natural hydrological regime named hydropeaking (from dams)		X	X		
E7	Alteration of the natural river flow impacting fish migration		X			
E8	Lack of environmental awareness	X	X		X	
E9	Natural areas consumption for agriculture, or mining, or informal settlements, or urban areas					X
E10	Increase of pressure on river flow and ecosystems by the multiplication of micro hydro power plants	X		X	X	
E11	Habitat degradation and decreasing river continuity (need for more protected areas and fish pass)		X		X	X
E12	Lack of environmental expertise at local level	X	X		X	
E13	Sediment management in hydroelectric reservoirs impacting river beds and ecosystems			X		
E14	Conversion of alpine pastures to intense cultivated areas			X		

WEFE nexus governance at least between two domains

By exploring the 'intensity' criteria for all the governance dimensions, the researchers could assess to what extent actions urging for cross-sectoral cooperation are implemented in the case studies. In general, the national level, urged by the European Commission branches responsible for energy transition and SDGs, are increasingly elaborating cross-sectoral strategies. However, the implementation of such strategies at regional and local level does not always maintain such cross-sectoral approach.

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Then, when looking at the fit criteria, it is also clear that the motivations for more cross-sectorality are rarely based on the need to ensure the sustainability of the properties and the functionalities of the river basin. Thus, there is still room for improving sustainability of water uses in the areas investigated. These results are aligned with the scores stakeholders assigned to the level of inter-sectorality (self-scoring).

Lack of WEFE cross-sectoral responsibilities and resources

In general, local public authorities have little if not no decisional power for addressing local WEFE nexus issues, and thus it is difficult to implement bottom-up solutions to address them. Two European Commission instruments promote bottom-up solutions, addressing the issue of lack of local responsibilities and resources: the Just Transition Fund and the Integrated Territorial Investment tool. At the national level countries strongly support these mechanisms to enable transitions in different sectors (e.g. energy and water).

For the two transboundary river basins, upstream-downstream interactions revolve around water quality and solid waste removal from the river. Addressing these problems calls for reliable water quality and quantity monitoring systems and better cross-border water data exchange. Furthermore, the presence of significant amount of solid waste in the river, which has consequences not only for water quality but also in terms of increased risk of flooding, demands better cross-border coordination for joint cleaning up actions. However, one common challenge across borders is that local authorities find it difficult to obtain the permits for solid waste removal at different administrative scales.

A general lack of environmental awareness and environmental education

In all case studies, a lack of environmental awareness as result of insufficient environmental education was reported by interviewees. This makes the work of environmental experts challenging at all levels of decision-making, since it is often difficult to gain the required public support for environmental actions. The lack of environmental education is, unfortunately, a vicious circle that cannot be easily solved, by educating the very young (kids) and expecting them to educate their parents, as proposed by stakeholders during workshops as solutions.

Short-term flexibility

In all case studies, when a drought or a flood or an energy crisis triggers stakeholder discussions across the WEFE sectors, which often result in solutions that include rearranging responsibilities, additional funding and more willingness to share data and resources to deal with the consequences of these events. Although these are often a short-term fix to a set of persistent underling problems, the push that these events give to stakeholders to work together to find common solutions, allows sometime for change pathways to emerge. This is positive for cross-sectoral governance.

A motivation for more transboundary cooperation stemming from the NEXOGENESIS project

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As result of the NEXOGENESIS governance assessment field work, stakeholders of the two transboundary case studies, in particular at local level, became more aware of WEFE nexus transboundary issues and, as result of that, keen to engage into additional transboundary meetings and workshops to co-create joint actions.

6.2.2. Main common barriers to cross-sectorality

Highly bureaucratic governance systems

The level of bureaucracy was reported to take up a lot of time and human resources that could be used to cultivate interactions between WEFE sectors. The causes were linked to the lack of modernisation in the way they reported on their activities, with too many printed documents being circulated.

Lack of transboundary communication and cooperation

For the two transboundary case studies, namely the Lielupe and the Mesta/Nestos, the lack of an international board to manage the exchange of data, knowledge, and experience has several impacts. First, the stakeholders across WEFE sectors do not have a shared holistic vision of the complex hydrological functioning of the river, which is reflected in the different hydrological models they develop and use to make decisions. Furthermore, the lack of transparency on the transnational agreements managed at national level induces misunderstandings with local actors. Finally, the question of the harmonisation of monitoring water quantity and water quality is central when communicating the state of the river and the impacts of upstream and downstream activities. However, this cannot be solved without allocating additional responsibilities and resources to a transboundary governing body.

Lack of environmental expertise and environmental awareness

The lack of environmental expertise and human resources was mentioned in all case studies, and was sometimes considered more important than availability of financial resources. Sometimes, the lack of expertise implicates mistrust between stakeholders.

The unsustainability of instruments over time

Expertise and programmes fostering cross-sectoral measures mainly rely on European funded projects. Thus, resources, sometimes even human resources, are fully dependent on the duration of the funding and end with the completion of the project. The challenge is, when the experience is successful, to make them long lasting.

6.2.3. Main common levers to urge for more cross-sectorality

The energy ‘crisis’ and the European energy transition

The energy crisis has impacted the case study regions in different ways. Some regions have managed to adapt more effectively due to their access to renewable resources like wood or reserves of fossil fuels such as coal. The European energy transition policy

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plays a pivotal role in promoting increased collaboration and joint solutions across sectors. The tools proposed by the EC to support the transition are all urging for more cross-sectorality: these include the Just Transition Funds, Integrated Territorial Investment tool and the EU SDGs implementation approach. This is particularly important during the ongoing energy crisis, as there has been a resurgence in the use of fossil fuels as a response to energy dependency. Nonetheless, stakeholders across all the case studies view this as an unsustainable solution.

A cross-sector approach for accelerating renewable energy production

The need to increase renewable energy production urges for more cross-sectoral collaboration. With adequate supported and proper communication, bottom-up solutions could emerge and snow-ball at local, regional or national level. Furthermore, because all these new renewable energy projects will have to pass an environmental impact assessment, sectors at all level of decisions would be forced to interact, and eventually collaborate to mitigate impacts of the proposed projects. This urges for the co-creation of cross-sectoral strategies, with now an obligation of the energy sector to take part of the cross-sectoral exchanges.

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7. Recommendations for next steps

The NEXOGENESIS project is at the halfway point at the time this report was written and offers the opportunity to pursue discussion with stakeholders to activate levers. During the third stakeholder workshop (Workshop 3) organized by NEXOGENESIS partners, recommendations derived from the governance and policy coherence analysis were presented and discussed with stakeholders. Some could be implemented within the timeline of NEXOGENESIS while others may take longer discussions, beyond the project timeline, between stakeholders across multiple scales and, possibly with the engagement of also the NEXOGENESIS case study partners. Below the main recommendations are presented.

Share bilaterally validated hydrological data on the functioning of cross-border rivers

Negotiations about transboundary river management take place at the state level, and the interviews showed that hardly any information reaches the local actors. The upstream and downstream interviewees did not seem to be sufficiently informed about the cross-border agreements and initiatives. To the stakeholders' knowledge, these agreements and initiatives exist only on paper and have either not been implemented yet or are not yet showing effectiveness. This poor information sharing is one of the contributing factors to the lack of a shared vision among cross-border actors on the river basin as a whole.

For the two transboundary cases, the most important action is to keep the initiated contacts and transfer of knowledge to initiate specific actions. One important action would be to agree on the hydrological functioning of the river between upstream and downstream and to produce an information brochure in the different languages. One difficulty was to have a discussion on these two transboundary rivers at the national level. At the end of NEXOGENESIS, communicating our findings with proposed solutions to press for more transboundary cooperation could be an option.

These are the prerequisites for continuing discussions on cross-border agreements, already initiated during Workshop 3 for Mesta/Nestos and Workshop 3 and a dedicated workshop in Bauska in September 2022 for the Lielupe.

Increase environmental awareness

Many stakeholders interviewed mentioned a lack of environmental awareness and environmental education. Some actions to improve environmental education are present in all case studies at different scales, engaging also the authorities in charge of River Basin Management Plans, but according to stakeholders, goals should be more ambitious than they are now.

Involve stakeholders during the elaboration of the River Basin Management Plans

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Stakeholders see sector governance as a top-down decision-making process and in most cases local authorities mentioned that they feel their voice is not taken into account, even when it comes to river basin management plans. In addition, the low level of involvement of local stakeholders in the development of the river basin management plan limits the opportunities to develop a holistic view of river basin issues. Consequently, any efforts to bring other stakeholders around the table in the development of the river basin management plan would be highly beneficial for all cross-sectoral interactions.

Moreover, keeping interactions and communication routines between local and regional levels (which are most concerned by issues regarding the rivers) seems crucial in the quest to find cross-sectoral pathways by creating or maintaining trust within those decision levels.

Co-create pathways of organised and time-lined transboundary communication

Our two international case studies do not have a transnational executive board. This makes it difficult to organise the exchange of knowledge, experience, data and resources, and thus to find collective solutions to problems. Even if a formal board may be the right objective, this seems a long-term ambition. In the meantime, doing nothing and waiting for it could be detrimental. So, considering other options to fill this gap with bottom-up actions at local level may be wiser. Specifically, we could encourage local stakeholder across borders to self-organise and initiate small, joint actions with minimal costs, since lack of resources has been declared by stakeholders to be a constraint.

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9. Sources of information for maps

Location of dams and hydroelectric stations were collected from google Earth. Other spatial information for case studies were collected from the following data bases:

Nestos Basin

Cities (World Cities Database) https://simplemaps.com/data/world-cities

River (*Natural Earth)* https://www.naturalearthdata.com/downloads/10m-physical-vectors/10m-rivers-lake-centerlines/

Protected areas (EEA) https://www.eea.europa.eu/data-and-maps/explore-interactive-maps/european-protected-areas-1

Dam (SEDAC) https://sedac.ciesin.columbia.edu/data/set/grand-v1-dams-rev01

Administrative (IGISMAP) https://www.igismap.com/download-italy-administrative-boundary-shapefiles-regions-provinces-municipalities/

Lielupe Basin

Cities (World Cities Database) https://simplemaps.com/data/world-cities

River (*Natural Earth)* https://www.naturalearthdata.com/downloads/10m-physical-vectors/10m-rivers-lake-centerlines/

Protected areas (EEA) https://www.eea.europa.eu/data-and-maps/explore-interactive-maps/european-protected-areas-1

Dam (SEDAC) https://sedac.ciesin.columbia.edu/data/set/grand-v1-dams-rev01

Administrative (IGISMAP) https://www.igismap.com/download-italy-administrative-boundary-shapefiles-regions-provinces-municipalities/

Zamgale planning region (MEPRD-LV) https://data.gov.lv/dati/eng/dataset/regioni/resource/a5a16e53-8c21-4d3b-b15c-cc7175d90b3d

Jiu Basin

Cities (World Cities Database) https://simplemaps.com/data/world-cities

River (*Natural Earth)* https://www.naturalearthdata.com/downloads/10m-physical-vectors/10m-rivers-lake-centerlines/

Protected areas (EEA) https://www.eea.europa.eu/data-and-maps/explore-interactive-maps/european-protected-areas-1

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Dam (SEDAC) https://sedac.ciesin.columbia.edu/data/set/grand-v1-dams-rev01

Administrative (IGISMAP) https://www.igismap.com/download-italy-administrative-boundary-shapefiles-regions-provinces-municipalities/

Adige Basin

Cities (World Cities Database) https://simplemaps.com/data/world-cities

River (MapCruzin) https://mapcruzin.com/free-italy-arcgis-maps-shapefiles.htm

Protected areas (MapCruzin) https://mapcruzin.com/free-italy-arcgis-maps-shapefiles.htm

Dam (SEDAC, 2011) https://sedac.ciesin.columbia.edu/data/set/grand-v1-dams-rev01

Administrative (IGISMAP) https://www.igismap.com/download-italy-administrative-boundary-shapefiles-regions-provinces-municipalities/

Stations hydro-électrique :

(Tirol Atlas) https://tirolatlas.uibk.ac.at/maps/interface/thema.py/sheet?lang=it;menu_id=190

(Alperia) https://www.alperiagroup.eu/it/la-nostra-identita/la-nostra-energia/idroelettrico

UOM (SIGMA) https://sigma.distrettoalpiorientali.it/sigma/webgisviewer?webgisId=45

Inkomati Basin

Cities (World Cities Database) https://simplemaps.com/data/world-cities

River (DWS) https://www.dws.gov.za/iwqs/gis_data/river/All.html

Protected areas (Protected Planet) https://www.protectedplanet.net/region/AF

Dam (SEDAC) https://sedac.ciesin.columbia.edu/data/set/grand-v1-dams-rev01

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10. Sitography

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11. Appendices

Annex 1: Interview guide

Interview Guide

Introductory questions

1. Can you introduce yourself, your role in the organization you represent.
2. In which resource management is your organization involved? (water, land, ecosystems) and for which uses? (water, energy, food, ecosystems) in the river basin?

*Cross-sectoral= resource management based on an interconnexion/integration and collaboration of different sectors involved

GAT Dimensions	Questions	Remarks
	- **Extent** **Main question: all key actors are taken into account, (which one is missing)?** - To what extent is your organization involved in the decision-making process concerning the resources you mentioned? - Which other organization is involved in the management of these resources? - what are the key stakeholders that could be involved? - Which stakeholders are currently excluded? Why? - What role does your organization play or could play in the decision-making process for a cross-sectoral resource management?	

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Actors and networks	- **Coherence** **Main qst: What type of relationship do these actors have? Cooperation? Synergies? Rivalry, conflict?** - Which organizations do you interact with the most? For what purposes? - How would you define the quality of these relationships: rather cooperative? competitive? based on dependence? trust? Not fully trusting? - In your opinion, are there specific actors or groups that oppose a more cross-sectoral resource management in the river basin? - Do you interact (collaboration, knowledge exchanges…) with your counterparts in Lithuania concerning resource management in river basin Lielupe? - If yes - which ones and if not, why? - **Flexibility** **Main qst: Is it possible to involve new actors/institutions?** - Is it possible to involve new actors/organizations in the current resource management system? - If yes, which ones? - If not, why? - **Intensity of action undertaken**	

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	Main qst: is there an institution or body that strongly supports a change? - In your opinion, is there an organization or actor that strongly supports the interconnexion/integration and collaboration of different sectors (cross-sectoral) in the river basin? - In your opinion, who are the most influential actors in the decision-making process to move towards resource management based on an integration and collaboration of different sectors involved? (cross-sectoral) - **Fit** - In your opinion are the current relationships between all the stakeholders in the river basin capable and legitimate to move towards more cross-sectoral resource management?	
	- **Extent** - **Main qst: What are the different administrative and territorial levels currently involved in natural resource management in the basin? Which one is missing**	

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Levels and scales	- What are the different administrative levels and territorial scales currently involved in resource management in the river basin? - In your opinion, which one is missing? - In your opinion, what would be the right scale and administrative level to deal with issues related to cross-sectoral resource management? - **Coherence** **Main qst: Are the interdependecies and influences between different levels and scales taken into account** - To your knowledge, are administrative levels working together? - Are there mutual influences and dependencies between the different administrative levels and territorial scales involved in resource management? If so, how do they affect resource management? - Is the transboundary scale taken into account to manage natural resources at the scale of watershed? - **Flexibility** **Main qst: Is it possible to change scale depending on the issue?**	

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	- How is a local issue brought to the attention of the governing bodies of another level of decision making? - How are national or regional directives (in the sense of guidelines, recommendations) transferred to the local level? - Do you have any recent or past examples? - **Intensity of action undertaken** **Main qst: Is there a particular administrative level or territorial scale that is currently pushing/urging for sustainable cross-sectoral management?** - Is there a particular administrative level or territorial scale that is currently urging for sustainable cross-sectoral management? - Do you think this is the most appropriate level? - Is there one or several administrative levels that are decisive? - **Fit** - Do you think that the current institutions/ levels are the most appropriate ones to address the cross-sectoral resource management issues?	
	- **Extent**	

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Problem perspectives and goal ambitions	**Main qst: what are the most important natural resource management issues in the basin?** - According to you, what are the most important natural resource issues in the river basin? - What are the main problems you are facing? In your opinion, which other sectors are facing the same? - These different problems are they taken into consideration in an interconnected and integrated (e.g. cross-sectoral) decision making process? - **Coherence** **Main qst: To what extent are the different perspectives and goals mutually supportive or do they compete and conflict?** - In your opinion, are the objectives of each sector complementary, in competition or explicitly in conflict? - Are there trade-offs? - According to you, are the different resource users aware of the interdependence between different sectors, between different resource users, interdependence in the context of the same use, between upstream and downstream of the river, bordering countries? - **Flexibility**	

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	Main qst: Which priorities and the possibility to reassess these priorities - Which type of resource uses are defined as priorities in your sector and in the other sectors? - Is there the possibility to reassess these priorities? - To what extent do current water/energy/agricultural/environmental policies take into account goals of different sectors? - If not, what opportunities exist to move towards sustainable (e.g. long-term, robust, well supported financially and legally) cross-sectoral management that including policy goals from other sectors? - **Intensity of action undertaken** **Main qst: ambition to operate more cross-sectoral resource management** - To your opinion, is there in your sector the ambition to operate more integrated and interconnected resource management? Do other sectors share the same ambition? - Is this likely to change in the future ? - According to you, how urgent are the problems you mentioned before? Do other sectors, in your opinion, share this sense of urgency? - **Fit**	

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	- In your opinion, do the involved actors take the interconnections and interdependencies between the sectors into consideration when defining goals to address the problems you mentioned?	
Strategy and instruments	- **Extent** **Main qst: which measures and strategies do exist to take other sectors into account** - At present, which measures and strategies do exist to address your sector related resource issues? - How is your sector involved in the basin water management plan? - **Coherence** **Main qst: Do the existing instruments from different sectors reinforce or hinder each other?** - Do the existing instruments from different sectors reinforce or hinder each other? - In your opinion, are currently the costs and benefits of trade-offs equally distributed between the different resource users? - What tools do you have to manage cross-sectoral conflicts about resource uses? Can you provide some examples? - **Flexibility** **Is it possible to propose new (or combine) strategies or instruments to help limit negative impacts?**	

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	- According to you, what measures are currently in place to limit the negative impacts on the resources (water, land, ecosystems...) in the Lielupe basin and river? - To what extent is it possible to propose new (or combine) strategies or instruments to help limit negative impacts on natural resources? (resource.s stakeholder is involved in) -To what extent are there legal barriers to implement these new or combined policies? - Which sectors are innovating today? (to save resources) - **Intensity of action undertaken** **Main qst: to what extent do the available policy instruments stimulate an interconnected sectors management** - In your opinion, to what extent do the available policy instruments stimulate a cross sectoral management? - Do they promote a change in more collaborative behavior? - Are these instruments sustainable (e.g. robust, well supported financially, legally…) over time? - Do you think that the current integration of uses/sectors is sufficient? - If no, why? - What measures should be encouraged? - **Fit** - Are the current measures/instruments and strategies/policies appropriate to address the interdependencies between the sectors involved in natural resource management?	

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Responsibilities and resources	- **Extent** **Main qst: Are the responsibilities clearly assigned et supported** - Are the responsibilities clearly assigned? - Are they supported by adequate resources? - Which institution currently has the responsibility and resources to promote cross-sectoral resource management? - Is there a lack of expertise or resources to develop sustainable cross-sectoral management? - **Coherence** **Main qst: o what extent do assigned responsibilities create rivalries or promote cooperation within or between organizations** - Do you have sufficient resources to ensure your responsibility and mission? - To what extent do the distribution of responsibilities create rivalries or promote cooperation, synergies between the different actors of the sectors involved? - In your opinion, is the distribution of responsibilities and resources appropriate and fair to the objectives of cross-sectoral resource management in the basin? - Are there organization with more responsibilities and resources than other organizations? And are they able to push their own agenda forward? - **Flexibility**	

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	Main qst: Can responsibilities and resources be easily reallocated as contexts change? - What additional responsibilities or resources would be needed to facilitate management that takes into account the interconnections of different sectors? - **Intensity of action undertaken** **Main qst: Do the responsibilities and resources currently allocated stimulate a change** - To what extent are the institutions or organisations that you considerer as a key to cross-sectoral natural resource management able to drive changes? - If no, why? - If yes, how? - Is the current distribution of responsibilities and resources sufficient to meet the challenges of cross-sectoral natural resource management? - **Fit** - In your opinion, do the allocated responsibilities and resources allow the implementation of an interconnected and integrated sustainable management regard to the river?	

Final questions:

1. If you were to score cross-sectoral management in the river basin concerning the problems we discussed, which score would you give between 0 and 3, with 0 being there is no cross-sectoral management between the different sectors and 3 being there is good cross-sectoral management between the four sectors on these problems?

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2. According to you, what are the main changes to come in relation to these cross-sectoral issues in the Lielupe Basin?
3. Do you feel ready, well equipped to face these changes?
4. What changes would you recommend in relation to these cross-sectoral issues in the Lielupe Basin?

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Annex 2: Stakeholders interviewed in the Lielupe River case study

Latvia

ORGANISATION		NUMBER STAKEHOLDERS MET
University of Life Sciences, Jelgava	water	1
Dobele Farmers association	agriculture	1
Zemgale Planning Region	water	1
Zemgale Planning Region	energy	1
Zemgale Regional Energy Agency (NGO)	energy	1
Latvian Water and Wastewater Works Association	water	1
Ministry of Agriculture	agriculture	1
Ministry of Environment - Water division	ecosystems/water	1
Latvian Environmental Geology and Meteorology Center	ecosystems/water	1
		1
		1
Ministry of Economics	energy	1
Salgale Parish/County -environmental expert	ecosystems	1
Salgale Parish/County - education projects	ecosystems	1
Salgale Parish County -rural partnership lielupe	tourism	1
Latvia Fund For Nature	ecosystems	1
Bauska Municipality - Head of planning department	ecosystems/water	1
Bauska Municipality - environment, sports, building, water management		1
Bauska Municipality - environmental project manager		1
	TOTAL	**19**

Lithuania

ORGANISATION		NUMBER STAKEHOLDERS MET
Panevezys municipality, environmental protection, water and climate change adaptation	ecosystems	1
Panevezys municipality, deputy mayor, in charge of environmental issues	ecosystems	1
Environmental Protection Agency, pollution prevention department, water, and environmental impact assessment	ecosystems/water	1
Birzai Park	ecosystems	1
BEF (Baltic Environment Forum) Lithuania	ecosystems	1
Viva-sol Association	agriculture	1
Ministry of Environment, Pollution prevention policy group advisor	ecosystems	1
Ministry of Environment, Nature protection policy group	ecosystems	1
Ministry of Environment, Strategic department	ecosystems	1
Ministry of Environment, head of pollution prevention department	ecosystems	1
Ministry of Energy, supervisor development of National Energy and Climate action plan	energy	1
Environmental Protection Agency, Hydrography department	ecosystems/water	1
Center for Environmental Policy (NGO)	ecosystems	1
		1
Ministry of Agriculture, advisor	agriculture	1
Pakruojis district municipality administration, Ecologist	ecosytems	1
Biržai district municipality administration, Strategic planning department		1
Lithuanian Energy Agency, head of Climate change management department,	energy	1
	TOTAL	**18**

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Annex 3: Stakeholders interviewed in the Nestos/Mesta River case study

Bulgaria

ORGANISATION		NUMBER STAKEHOLDERS MET
regional administration management of dams	water	1
Union of Green Energy Producers	energy	1
		1
Regional governor		1
Directorate of the west aegean river basin directorate, Ministry of environment and water	water	1
Regional inspectorate of environment and water	water	1
Blagoevgrad district expert	ecosystems	1
Deputy governor		1
Municipality of Gotse Delchev		1
Gotse Delchev municipality	ecosystems	1
Municipality of Garmen	ecosystems	1
NGO bird protection association	ecosystems	1
Farmer	agriculture	1
	TOTAL	**13**

Greece

ORGANISATION		NUMBER STAKEHOLDERS MET
MUNICIPALITY OF NESTOS (Mayor)		1
Municipal service for water supply and sewerage, Mplity Nestos	water	1
Municipality of Topeirou		1
Natural Environnement, Climate Change Agency (N.E.C.C.A.), Unit of Nestos -Vistonida and Rhodope National Parks	ecosystems	1
		1
organisation of irrigation	agriculture	1
Directorate of agricultural economy and veterinary, Prefecture of Xanthi	agriculture	1
Region of eastern Macedonia and Thrace (governor for fishery policy)	ecosystems	1
Democritius University of Thrace	water	1
Democritius University of Thrace	water	1
Fischerie institut	ecosystems	1
Water management agency	water	1
		1
	TOTAL	**13**

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Annex 4: Stakeholders interviewed in the Jiu River case study

ORGANISATION	SECTOR	NUMBER STAKEHOLDERS MET
Romanian Farmers' Club	agriculture	2
Environmental Protection Agency Dolj	ecosystems	5
Faculty of Horticulture, University of Craiova	ecosystems	7
Regional Development Agency South-West	Regional/local authority	2
Gorj County Council	Regional/local authority	3
NGO Valea Jiuliu Coalition	ecosystems/energy	5
Department of Sustainable Development	ecosystems	3
National Administration of Meteorology	water/ecosystems	2
Romanian Waters (AMAR)	water	1
Jiu River Basin Authority	water	1
	TOTAL	**31**

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Annex 5: Stakeholders interviewed in the Adige River case study

ORGANISATION	SECTOR	Number of stakeholders met	POLITICAL ADMINISTRATIVE BODY
Distretto Alpi Orientali	water/energy	1	EASTERN ALPS HYDROGRAPHIC DISTRICT
ANBI - Associazione national Consorzi di Bonifica e Irrigazione, Veneto	agriculture	1	VENETO REGION
Acquevenete	municipal water	1	
Associazione Pescatori Provincia Verona	ecosystems	1	
Comune di Rosolina	agriculture	2	
	ecosystems		
Confagricoltura Rovigo	agriculture	1	
Lega Ambiente Veneto	ecosystems	1	
Regione Veneto, direzione Bonifica Irrigazione Agricoltura	agriculture	2	
Consorzio di Bonifica dell'Adige -Po	agriculture	1	
WWF Trentino	ecosystems	1	TRENTO PROVINCE
Comitato per la difesa dei fiumi del Trentino	ecosystem	1	
Hydro Dolomiti energia	energy	3	
Associazione Pescatori Dilettanti Trentini	ecosystems	2	
Provincia di Trento Agenzia Provinciale per le Risorse Idriche e l'Energia (APRIE)	water/energy	1	
Provincia di Bolzano: Agenzia Provinciale della Protezione Civile - Ufficio Centro funzionale della Protezione Civile	water	5	BOLZANO PROVINCE
Provincia di Bolzano: Agenzia Provinciale della Protezione Civile - Bacini Montani-Ufficio Dighe	water/energy		
Provincia di Bolzano: Agenzia Provinciale della Protezione Civile - Ufficio idrologia dighe	water/energy		
Provincia di Bolzano: Agenzia provinciale per l'ambiente e la tutela del clima - Ufficio tutela delle acque	ecosysistems		
Provincia di Bolzano: Agenzia provinciale per l'ambiente e la tutela del clima - Ufficio gestione sostenibile risorse idriche	ecosysistems		
L'Unione Agricoltori e Coltivatori Diretti Sudtirolesi/Südtiroler Bauernbund	agriculture	2	
Federazione Energia Alto Adige (SEV)	energy	1	
	TOTAL	**27**	

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Annex 6: Stakeholders interviewed in the Inkomati river case study

ORGANISATION	SECTOR	NUMBER STAKEHOLDERS MET
Eskom	energy	1
Glencore	energy	2
Department of Water and Sanitation (DWS), Mbombela Office	water	1
Mpumalanga Tourism & Parks Agency (MTPA)	ecosystems	2
South African National Parks (SANParks)	ecosystems	1
Komati Basin Water Authority (KOBWA)	water	1
Inkomati-Usuthu Catchment Management Area (IUCMA)	water	3
Agri Piet Retieff	agriculture	1
Agri SA Mpumalanga Landbouw	agriculture	2
Department of Agriculture, Land Reform and Rural Development (DALLRD)	agriculture	3
Department of Water and Sanitation (DWS)	water	2
Department of Forestry, Fisheries and the Environment (DFFE)	ecosystems	3
Ex-IUCMA Board Secretary + Consultant for municipalities	water	1
	TOTAL	**23**

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Annex 7: Gender balance of interviews and policy coherence focus group for the 5 case studies

When	What	Number of stakeholders	Men	Women	Non binary	Men (%)	Women (%)
4-12 October 2022	Interviews NXGAT Adige	27	21	6		78	22
3 July 2023	Focus group Adige	3	3	0		100	0
6-10 June 2022	Interviews NXGAT Latvia	19	6	13		32	68
15 June 2023	Focus group Latvia	6	3	3		50	50
14-17 September 2022	Interviews NXGAT Lithuania	18	6	12		33	67
15 June 2023	Focus group Lithuania	4	0	4		0	100
14-15 July 2022	Interviews NXGAT Bulgaria	13	9	4		69	31
27 March 2023	Focus group Bulgaria	3	2	1		67	33
11-13 July 2022	Interviews NXGAT Greece	14	11	3		79	21
31 May 2023	Focus group Greece	3	1	2		33	67
17-21 October 2022	Interviews NXGAT Romania	31	13	18		42	58
At the occasion of the Workshop3 23 May 2023	Policy coherence Romania	23	18	6		78	26
13-24 February 2023	Interviews NXGAT South Africa	23	13	10	0	57	43
5 June 2023	Focus group South Africa	38	19	18	1	50	47
	TOTAL	**225**	**125**	**100**	**1**	**55**	**45**

Annex 8: Additional information on the institutional regime context in Mesta-Nestos River basin

Bulgaria - General division of powers

Bulgaria is a unitary republican State. The Bulgarian head of government, the Prime Minister, holds the most powerful executive position. The head of State, the President, primarily holds representative powers as well as limited veto powers. Parliament is

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unicameral and comprises the National Assembly which is composed of 240 directly elected deputies. The President of Bulgaria is also directly elected by the people[17].

The Republic has three levels of governance: central, districts and municipalities. The country territory is organised in 6 planning regions, 28 districts (planning region and district representing the regional level, the capital counting for one)[18] and 265 municipalities. Districts mainly have statistical and administrative functions. The process of decentralisation at the municipal level started as early as the 1990s with the Local Self-Government and Local Administration Act; since then, municipalities have acquired administrative competences complemented by some financial autonomy in 2002.

In 2020 the Parliament adopted the law on amendment and supplement to the Regional Development Act[19]. The aims are to reduce the number of strategic documents and simplify the management of operational programmes.

It's important to note that administrative districts (*oblasti*) also known as “lower-level regions”, are devolved divisions of the central government and are not directly elected.

The municipality (*obshtini*) constitutes the only level at which self-government is exercised.

Bulgaria is a highly centralised State, as the national Council of Ministers directly appoints district governors and all districts are fully dependent on the State's budget, whereas Municipalities are less dependent on the State's budget.

The State authorities and their territorial sub-divisions exercise a control of legality over the acts of local government units.

Greece – General division of powers

Greece is a parliamentary republic. The Hellenic Republic is a unitary State organised on a decentralised basis: It has two levels of government, central government and local self-government. The former is exercised at central (ministries) and decentralised (local government) levels, while the latter is exercised at regional (regions) and local (municipalities) levels. Over the last few decades, Greece has undergone a process of decentralisation, which began in 1986 with the creation of 13 regions, was reinforced in 1994 with elected prefectures and the extension of the powers of municipalities, continued with the 2010 Kallikratis programme, which reorganised the territorial division by merging existing municipalities, and as of 2011 Greece has seven

[17] https://portal.cor.europa.eu/divisionpowers/Pages/Bulgaria-Introduction.aspx

[18] https://european-union.europa.eu/principles-countries-history/country-profiles/bulgaria_en

[19] https://dv.parliament.bg/DVWeb/showMaterialDV.jsp?idMat=146602&fbclid=IwAR3mpfbJjh-tm9qB2zq3RSfdrXr8vQ_hUBOHBa2xPqIDoUb-GIEiixvA0Ec

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Decentralised Administrations, 13 regions and 325 municipalities. The decentralised administrations are individual units of the State (decentralised State) and their heads are appointed by the central government. The former prefectures still largely exist, but are now called regional units and are administrative and territorial components of the regions[20].

The principles of decentralisation and local self-government are enshrined in the Constitution[21]. Regions are responsible for managing the affairs of their districts. They formulate, plan and implement policies at regional level within the framework of their competences, in accordance with the principles of sustainable development and social cohesion of the country, taking into account national and European policies.

Municipalities are responsible for managing local affairs. They manage and regulate all local matters in accordance with the principles of subsidiarity and proximity, with the aim of protecting, developing and continuously improving the interests and quality of life of local society[22].

The relationship between the two levels of local self-government is not one of control and hierarchy, but one of cooperation, developed in accordance with the law, joint agreements and the coordination of joint actions[23].

Water, Energy, Agriculture and Environment management

- **National management - Policy instruments**

The Ministry of Environment and Water is in charge of water and protected areas such has Natura 2000[24]. The recovery and resilience plan (RRP) for Bulgaria, with the information included in the National Energy and Climate Plan 2021-2030 and in terms of contribution to the Union 2030-2050 climate and energy-related targets and the objective of climate neutrality by 2050, has been accepted by the EC. Bulgaria has the highest carbon intensity in the EU, four times the EU average[25]. This RPP required a calendar for the phase-out of coal and lignite power plants and a regulatory cap on their carbon dioxide emissions applicable as of 1 January 2026.

[20] https://portal.cor.europa.eu/divisionpowers/Pages/Greece.aspx

[21] https://www.hellenicparliament.gr/UserFiles/f3c70a23-7696-49db-9148-f24dce6a27c8/001-156%20aggliko.pdf

[22] https://portal.cor.europa.eu/divisionpowers/Pages/Greece.aspx

[23] https://portal.cor.europa.eu/divisionpowers/Pages/Greece.aspx

[24] https://natura2000.egov.bg/EsriBg.Natura.Public.Web.App/Home/Documents

[25] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52022PC0172

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The authorities (from national to local) benefit from different types of support (law, action plan, strategy, etc.) to manage the resources on their territories (water, energy, food and ecosystem).

Each case study leader was asked, with the support of a policy inventory excel table containing explanations, to list and describe the most important policy instruments related to the WEFE sectors in the case study. The list is presented in the **Error! Reference source not found.** and in the **Error! Reference source not found.**.

In Bulgaria

Table 18: Main policy instruments related to the WEFE nexus in Bulgaria for the Mesta River basin

SECTOR	TYPE	LEAD	TITLE	LEVEL
Water	Law	Ministry of Environment and Water (MoEW)	*Water Law*	National
Water	Ordinance	Ministry of Environment and Water (MoEW)	*Ordinance No.1 from 10.10.2007 on the exploration, use, and protection of groundwaters*	National
Water	Law	Ministry of Regional Development and Public Works	*Law on Regulation of Water Supply and Sewage Services*	National
Ecosystem	Law	Ministry of Environment and Water (MoEW)	*Environmental Protection Act*	National
Energy	Law	Ministry of Energy	*Energy Act*	National
Cross-sector	Law	Ministry of Interior	*Disaster Protection Act*	National
Energy	Law	Ministry of Energy	*Energy from Renewable Energy Act*	National
Climate	Law	Ministry of Environment and Water (MoEW)	*Climate Change Mitigation Act*	Transnational
Water	Regulation	Minister of Environment and Waters, Minister of Agriculture, Minister of Health	*Regulation No. 2 on the protection of waters against nitrate pollution from agricultural sources*	National

In Greece

Table 19: Main policy instruments related to the WEFE nexus in Bulgaria for the Nestos River basin

SECTOR	TYPE	LEAD	TITLE	LEVEL
Water	Law	Greek Parliament	*Law 3199/2003 on the protection and management of water resources – Reconciliation with the WFD 2000/60/EC*	National
Water	Legislative Decree	Greek Parliament	*Legislative Decree 51/2007 on the determination of measures and procedures for the integrated protection and management of water resources in compliance with the WFD 2000/60/EC*	National
Water	Decision 39626/2208/E130 (2009)	Greek Parliament	*Measures for the protection of groundwater from pollution and deterioration in compliance with the European Directive 2006/118/EC*	National
Water	Common Ministerial Decision 31822/1542/E103 (2010)	Greek Parliament	*Assessment and management of flood risk in compliance with the provisions of the European Directive 2007/60/EC*	National
Water	Common Ministerial Decision 135275 (2017)	Greek Parliament	*General rules regulating the costs and pricing system of water services. Method and*	National

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			processes for recovery of costs for water services and relevant water uses	
Energy	Decision (49828-2008)	Greek Parliament	*Special legislative framework of spatial planning and sustainable development for the renewable energy sector and the respective strategic environmental impact assessment*	National
Energy	Law 3468/2006	Greek Parliament	*Electricity production from RES and cogeneration of high-performance electricity and heat*	National
Energy	Law 3734/2009	Greek Parliament	*Promotion of cogeneration from two or more types of energy – Issues concerning Mesochora hydroelectric power project*	National
Energy	Law 4001/2011	Greek Parliament	*Operation of electricity markets and natural gas markets - Research, production and transmission networks for hydrocarbons*	National
Energy	Law 4414/2016	Greek Parliament	*Support electricity production from RES and high-performance electricity and heat production from cogeneration - Legal and operational separation of natural gas supply and distribution*	National
Energy Climate	Decision 4/31-12-2019	Greek Parliament	*Ratification of the National Energy Plan for Energy and Climate*	National
Food	Law 4036/2012	Greek Parliament	*Pesticides market in Greece – Rational use of pesticides*	National
Food	Law 4282/2014	Greek Parliament	*Development of the aquaculture sector*	National
Food	Law 4235/2014	Greek Parliament	*Administrative measures, processes and penalties for the implementation of EU and National legislation in the sectors of food, feed, health and protection of animals*	National
Ecosystems	Law 3937/2011	Greek Parliament	*Preservation of Biodiversity*	National
Ecosystems	Decision 40332/2014	Greek Parliament	*National Strategy for biodiversity between 2014-2029 and 5-years action plan*	National

- **Water**

In Bulgaria - According to the Water Act, waters are managed at the national and the basin levels. The Ministry of Environment and Water (MoEW) proposes legislation and carries out the national policy for water management. The Water Management Directorate (WMD), under the Bulgarian Ministry of Environment and Water, is responsible for water management and for the implementation of the European environmental legislation, thus the Water Framework Directive, the Directive 2007/60/EC on the assessment and management of flood risks and Directive 2000/60/EC establishes a framework for the community action in the field of water policy. WMD responsible includes the central administration "Water Management" Directorate, an Executive Agency for Environment, four river basin Directorates (preparation and implementation of the RBMPs and FRMPs). For the Mesta River is the West Aegean directorate with Blagoevgrad center – and for the catchment areas of Struma and Dospat rivers too. 16 regional inspectorates and regional laboratories for environment are administrative structures of the Ministry, ensuring the implementation of the State policy on environmental protection at the regional level[26].

[26]https://www.developmentaid.org/donors/view/156439/ministry-of-environment-and-water-bulgaria

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They operate in one or more areas, having regulatory, informational and control functions. The control activities are related to prevention of pollution or damage, restoration of the environment from pollution or damage, protection of water from pollution, compliance with the requirements for ensuring environmentally-friendly waste management, protection of the elements of the National Ecological Network and biodiversity, and quality protection of atmospheric air.

Other relevant ministries for water issue include the Ministry of Regional Development[27] (for water supply, sewerage and waste water treatment systems and protection from the harmful impacts of waters (including floods) in urban areas); Ministry of Agriculture, Food and Forestry (MAFF)[28] that is the main consumer of water resources, manages irrigation systems and operates the state hydro-ameliorative fund for water management for irrigation of agricultural crops. It is also responsible for various drainage and protection facilities, such as dikes, retention dams and drainage fields. The other structures of the MAFF that have certain related powers are: The Executive Agency for Fisheries and Aquaculture[29], the Executive Agency for Forests, as well as the directorates of nature park of the MoEW; Ministry of Health[30] (quality control of drinking water, mineral water for health use and bathing waters).

The main legislation on the water sector of Bulgaria is the following:

- The Water Act regulates the integrated water resource management, including the requirements for ownership, management, operation, and planning of public water and sanitation assets and the duties of the Water Associations (for the regional operators) and Local Municipalities (for the small municipal operators);
- The Act on Regulation of Water and Sanitation Services provides norms for the national regulation of tariffs and quality of water and sanitation services, provided by the Energy and Water Regulatory Commission (EWRC).

In Greece - The water sector in Greece is managed at the national and regional levels. The Ministry of environment and energy[31] oversees strategic planning, development and evaluation of policy for rational and sustainable management of water services through the General Directorate for Water.

The General Directorate for Water in the General Secretariat of Natural Environment and Water in the Hellenic Ministry of Environment and Energy is assigned for regulatory competencies in the water sector in Greece.

The main responsibilities of the General Directorate for Water are:

[27] https://www.mrrb.bg/
[28] https://www.mzh.government.bg/bg/
[29] https://egov.bg/wps/portal/en/egov/institutions/agencies/ag0036
[30] http://www.mh.government.bg/bg/

[31] https://ypen.gov.gr/

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- to develop and implement all programmes related to the protection and management of the water resources of Greece;
- to submit pricing policy proposals to the governmental decision-makers (such as the National Water Committee);
- to carry out strategic planning; and
- to develop and evaluate policy for rational and sustainable management of water services.

The National Water committee is an interministerial body responsible for formulating the national water policy in a decisive role. The national water council advises and consults on water protection and management programmes. The water directorates (in total 13) of the decentralised administrations assist the General Directorate for Water on protecting, managing, monitoring and evaluating the water resources in their geographical jurisdiction. Water services are provided by 2 public companies (E.Y.D.A.P. for Athens and E.Y.A.TH. for Thessaloniki), 130 municipal water and sewage utility companies and 183 municipalities (WAREG, 2021).

Regional authorities are responsible for licencing discharges of industrial waste water and municipal waste water from treatment plants. In the environment domain, they are responsible for the guidelines on environmental policy.

All rivers in Greece are under the responsibility of several authorities. For transboundary rivers, the Ministry of Foreign Affairs[32] is also involved. Next are the Ministries of Environment, Agriculture and Economics. All the competent authorities are responsible for water quantity and quality management.

In 2017, Greece adopted its second round of River Basin Management Plans (RBMPs) under the Water Framework Directive (WFD) after a two-year delay (EC, 2019).

- **Ecosystems**

With the aim of implementing a modernised and contemporary system of governance for Protected Areas (PAs), the Ministry of Environment and Energy deemed it necessary to unify planning under one combined scientific, consulting and coordinating body for the effective organisation of governance and management of these areas. In year 2020 with the publication of Law 4685/2020 (Government Gazette A92/7.5.2020), the National System of Governance of Protected Areas is defined and the Natural Environment and Climate Change Agency (N.E.C.C.A.) is established.

- **Energy**

In Bulgaria, climate change is addressed by policies to foster photovoltaic, wind and water power stations. Prior to 2020, renewables in electricity production accounted for

[32] https://www.mfa.gr/en/index.html

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20% of final consumption (half of which is provided by water power stations). No new facilities were added to the system in 2021. Bulgaria delayed efforts to harmonise its laws and regulations with the EU Renewable Energy Directive, particularly with regard to independent power producers. No progress has been registered in plans to phase out two “unclean” thermal power plants (SGI, 2022).

In Greece, the National Energy and Climate Plan (NECP) outlines an evolution scenario for the energy system and proposes policies and measures for achieving the national energy and climate targets for 2030 and enabling the transition to a climate-neutral economy by 2050 (OECD, 2022). The NECP expects promotion of renewables in electricity generation and improvement of the conventional power system (decommissioning of all lignite power plants, expansion of the gas-fired power plant fleet, interconnection of certain islands with the mainland grid) to contribute the most to GHG emission reduction. Total primary energy supply (TPES) dropped significantly during the economic crisis and has remained stable since 2013. Oil is the dominant fuel, accounting for half of TPES, while domestic coal is the major source for generating electricity. Greece does not use nuclear energy and is not considering this option (ERMIS, 2019; OECD, 2020, ibid).

- **Transboundary agreements on the Mesta/Nestos regarding water flows**

Water governance in the Mesta/Nestos river basin has priorities but also gaps, in particular regarding the transboundary level (Karasani et al., 2022).

The negotiations between the two countries have started on 1964 and there were followed up by more meetings in 1975, 1982 and 1988. At these meetings the allocation of the river flow was the dominant issue and it was considered in terms of quantity in cubic meters. It was only after 1992 when the two countries agreed to talk on the basis of setting a percentage rather than a standard amount. Through a bargain-game between the two parties, where Bulgaria started at 20% allowance to Greece who initially demanded 1/3 (33%), they concluded to the 29% that was used in their final agreement (Mylopoulos, 2004; Giannias, 2020).

The international treaties that have been signed between Greece and Bulgaria as a result of these negotiations are:

- Athens 1964, dealing with the mutual utilization and management of the river’s water.
- Sofia 1971, an agreement was signed between Greece and Bulgaria for the establishment of a Greek-Bulgarian Committee that will deal with electrical energy issues and with the common management of water resources.
- In 1991, in order to respond to the new political and economic situation and EU directives, an Aide-Memoire was signed by the deputy-ministers of the Environment Ministries of Bulgaria and Greece concerning a project for monitoring of water quantity and quality in the Nestos River. The most important concern of the Greek side was to secure a standard amount of water resources. Nevertheless, the agreement has not been brought into action yet due to the

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lack of financial resources and the weakness and reluctance of local authorities to take forward its implementation.

- Thus, the latest agreement was agreed in 22nd of December 1995[33] and came into force in 1996 in Greece. *"The two Parties have agreed to exchange information regarding the quality and quantity situation of the Nestos waters. The exploitation rights of the transboundary waters for Greece was fixed to 29 percent."* Since the signature, no international board or committee has been in force to support this exchange of information.

In his study, Skoulikaris (Skoulikaris, 2021) explains the pressures identified on water resources in the Bulgarian part of the Mesta/Nestos basin are linked to water diversion to the neighbouring Maritsa sub-basin (UNECE, 2011). This water is used for the Dospat both for hydroelectric power production and irrigation needs for agriculture (Zarris et al., 2011). The issue of inflows of polluted water into the downstream part of the basin is also an important issue mentioned in the second environmental assessment (UNECE 2011) and reported several times in the literature of the early 21st century (Darakas 2002; Papachristou et al. 2000 ; Skoulikaris, 2021).

Annex 9: Additional information on the institutional regime context in Lielupe River basin

Latvia - General division of powers

Latvia is a parliamentary democracy and a unitary State. The Constitution of 1922 was reinstated on 21 August 1991, with the USSR recognising Latvia's independence shortly afterwards. Since the administrative territorial reform of Latvia in 2009, the country has been organised into 110 municipalities and 9 cities. All 119 local governments have the same level of authority aside from the capital city of Riga, which fulfils a range of additional functions. Regional governments (planning regions) are voluntarily organised by local government cooperation bodies, and are recognised in the legislation (Terauda et al., 2016; Reinholde, 2018).

According to the law on regional development, the regional level of government in Latvia consists of five planning regions councils which are indirectly elected by chairs of municipal councils. These regional governments play an important role in development and spatial planning, organisation of public transport and management of investment programmes, including the European Union funds. However, the

[33] https://www.ecolex.org/details/treaty/agreement-between-the-government-of-the-hellenic-republic-and-the-government-of-the-republic-of-bulgaria-for-the-use-of-the-nestos-river-waters-tre-148793/

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planning regions of Latvia are not administrative territorial divisions, since they are not mentioned in the law that prescribes the administrative territorial divisions of Latvia (Reinholde, 2018).

Latvia - Policy-making, coordination and implementation

State system – Latvia has a parliamentary and democratic regime with coalition governments. The government is formed by a Prime Minister upon the invitation of the President. However, both the government and the President are approved by the Parliament. The lifecycle of coalition governments is short; on average the government stays in power for around a year with some exceptions. Usually, the government exists of a coalition of political parties jointly holding more than 50% of the legislative seats. The ministries are distributed between the coalition parties. Sometimes, a position of minister of special affairs is created to reach political consensus on specific issues (like e-government, integration, EU structural support). The central level of government in Latvia is heavily involved in public service delivery, where the ministries are the main policy designers, but agencies subordinated to ministries deliver services. This is directly linked to public expenditure where the central level dominates the public spending arena (Reinholde, 2018).

Consultation for decision making – Latvia has developed a sophisticated consultation mechanism with social partners and NGOs. There has been a National Tripartite Cooperation Council since 1998, where representatives of the government, employers and trade unions discuss issues related to socio-economic development (e.g., social security, public expenditure, health care and employment). Since the Council is led by the Prime Minister, the Council decisions are expected to have an impact on policy implementation in the policy fields (Reinholde, 2018).

Line ministries, government departments or agencies responsible for specific policy areas or sectors within a government's organizational structure, have their own consultation bodies (e.g., advisory councils with representatives of NGOs and expert groups) to discuss and get support for their policies. To facilitate public participation and consultation, the government approved regulations on different procedures of public participation. Based on the regulation, there is a wide range of tools available for the public, such as public discussions, discussion groups, working groups, experts group, etc. However, the degree of institutionalisation and scope of topics differ among sectors and areas. In addition, public participation and consultations have been institutionalised at the government by the signing of a cooperation memorandum between the government and NGOs as early as 2005 allowing more and more NGOs to join the memorandum (Kuokstis et al; 2022). Originally, the memorandum was signed by 57 NGOs, and it had reached 404 signatures by 2016. The memorandum is tailored to ensure the effective representation of society in all stages of decision making, including the legislation drafting stage. There are regular meetings of the joint council regarding the implementation of the memorandum (with representatives from the civil service, NGOs, etc.) to monitor cooperation (Reinholde, 2018).

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Latvia - Division of responsibilities within each sector

Agriculture – The Ministry of Agriculture[34] is responsible for[35]:

- Overall legislation (in accordance with EU law);
- State forest services;
- The agricultural data center;
- Rural support service;
- Food and veterinary service;
- State plants service and State technical monitoring service.

Local municipalities are in charge of spatial planning and allocation of territories for agricultural use.

Energy – Energy policy is part of the national economic policy. The Ministry of Economics[36] is responsible for[37]:

- Efficient, safe, and high-quality energy supply;
- Promoting efficient use and balanced consumption of energy;
- Promoting economically justified competition;
- Facilitating the use of local, renewable, and secondary energy resources;
- Promoting the use of environmentally friendly technologies.

Local authorities are only responsible for street lighting.

Water – The Ministry of Environmental Protection and Regional Development[38] is in charge of[39]:

- Enforcement of water regulations,
- Coordination of public participation,
- Implementation of measures and coordination of bodies involved in their implementation,
- Support for the monitoring of surface water and groundwater, pressure and impact analysis,
- Support for the preparation of the plans and Programmes of Measures,

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[34] https://www.zm.gov.lv/en

[35] https://portal.cor.europa.eu/divisionpowers/Pages/Latvia-Agriculture.aspx

[36] https://www.em.gov.lv/en

[37] https://portal.cor.europa.eu/divisionpowers/Pages/Latvia-Energy.aspx

[38] https://www.mk.gov.lv/en/employee/maris-sprindzuks

[39] https://portal.cor.europa.eu/divisionpowers/Pages/Latvia-Water-Management.aspx

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- Oversight of the Regional Environmental Boards (responsible for water use permits),
- Implementation and supervision of drinking water and sanitation improvement projects.

The Latvian Environment, Geology and Meteorology Centre[40] (LEGMC) is in charge of:

- Monitoring and assessment of groundwater and surface water quality and quantity,
- Economic analysis,
- Pressure and impact analysis,
- preparation of the FRMPs (Flood Risk Management Plans), RBMPs (River Basin Management Plans) and programmes of measures and implementation of measures,
- Support for public participation,
- Support for River Basin management,
- Support for the assessment of flood risks.

One important Project for water quality recovery is the Life project named LIFE GoodWater IP namely “Implementation of River Basin Management Plans of Latvia towards good surface water status”[41] 2020-2027. It is coordinated by the Latvian Environment, Geology and Meteorology Center. Its objective is to reach the good ecological and chemical status of rivers, comprising the Lielupe River, with a focus monitoring fluxes and designing water pollution remediation.

The Latvian Institute of Aquatic Ecology is in charge of monitoring of surface waters, supporting the assessment of status of surface waters and pressure and impact analysis.

The Public Utilities Commission is responsible for the regulation of water service companies.

At local level, municipalities are responsible for supervision and management of:

- Water use, drinking water supply, sewerage and waste water treatment (and ownership of the companies providing these water services);
- Local water protection;
- Implementation of specific RBMP and FRMP measures.

[40] https://videscentrs.lvgmc.lv/

[41] https://webgate.ec.europa.eu/life/publicWebsite/index.cfm?fuseaction=search.dspPage&n_proj_id=7399#BENEF

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Ecosystems – The Ministry of Environmental Protection and Regional Development is in charge of[42]:

- Climate change issues; industrial pollution;
- Protection of species and habitats; construction control;
- Soil quality;
- Specially protected nature territories;
- Waste management;
- Water protection;
- State environment service inspectors.

Local authorities are responsible for implementation of environmental policy, waste management and water protection.

Lithuania - General division of powers

Lithuania declared independence in 1990 and adopted its current Constitution in 1992. Lithuania is a parliamentary democracy and a decentralised unitary State. The Lithuanian Parliament is called the “Seimas”. The 141 members of the “Seimas” are elected by a mixed system: half is elected in the single-member constituencies, using a two-round system, and the other half is elected in the multi-member constituencies, using a proportional representation system (Nakrosis, et al., 2018).

Lithuania is composed of 10 regions that are divided in 60 municipalities. On July 1st 2010, the regional administrations (Administrations of the Governor of the Region) were abolished. Currently, regions serve as territorial and statistical units only and their functions were distributed among municipalities and the central government bodies. Municipalities are the only self-governing authorities. According to the Constitution, the Lithuanian budgetary system consists of an independent State budget and independent municipal budgets. Municipalities have the right to establish local levies[43].

Lithuania - Policy-making, coordination and implementation

Type of executive government – Lithuania is a semi-parliamentary democratic republic. In terms of the nature of executive government, the country finds itself in between the extremes of majoritarianism and consensualism. There is a multi-party system in place, but the country also has a rather strong executive figure embodied by the President who is the head of State (Nakrošis, 2018).

Relations between cabinet ministers and senior civil servants – Relationship between ministers and senior civil servants has been largely influenced by two structural reforms at ministerial level undertaken in 2002 and 2009. In 2002, the

[42] https://portal.cor.europa.eu/divisionpowers/Pages/Latvia-Environment.aspx

[43] https://portal.cor.europa.eu/divisionpowers/Pages/Lithuania-Introduction.aspx

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number of vice-ministers, i.e. civil servants of political (personal) confidence, was brought down to one per ministry. Additionally, a new position of State secretary was created. Although the reform intended to raise the professionalisation of minister's immediate staff, the number of politically affiliated career civil servants increased in the Lithuanian civil service. In 2009, these reforms were reversed: The office of State secretary was abolished and the upper limit for the number of vice-ministers was raised to a maximum of four. The aim of this change was to expand the scope of ministers' political teams, thus weakening the incentives of appointing politically affiliated servants to career positions in the civil service (Nakrošis, 2018).

Sources and diversity of policy advice – Aside from senior civil servants there are other important sources of policy advice. Lithuanian decision-makers are usually quite attentive to the recommendations of the European Commission, OECD and other international expert institutions. Depending on their policy positions and beliefs, policy-makers are receptive to involving non-governmental academic experts. The Sunset Commission, for example, involved independent experts who advised the Government on ways in which efficiency and effectiveness in the performance of State institutions could be improved. Among many other initiatives, after the OECD review of regulatory policy in Lithuania, the Sunset Commission was granted an extended mandate to deal with better-regulation issues (Mangule et al. 2022). The Government's openness to policy advice, however, does not always translate into action. Major policy initiatives are usually driven by intra- or interparty agreements rather than by empirical evidence provided by experts (Nakrošis, 2018).

Policy decision-making: key actors and civic engagement – Inclusiveness in the country's decision-making process is mixed. Most Lithuanian interest associations, including employers' associations and trade unions, have a rather limited ability to formulate well-crafted policies, primarily due to the lack of skilled research staff. By comparison, business interest groups tend to have relatively strong abilities to provide policy proposals. Lithuania's system is pluralistic with a mixed representation of interest groups, but policy making is dominated by several large business associations across various sectors, and it pertains to any organization functioning under similar legal circumstances as NGOs. Civil society's engagement is facing substantial challenges in the country. Although there has been a steady increase in the number of civil society organisations (CSOs), the number of people fully and systematically engaged in policy making processes remains low. In 2014, only 8.9% of the population participated in societal movements (Nakrošis, 2018).

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Lithuania - Division of responsibilities within each sector

Agriculture – The Ministry of Agriculture[44] formulates public policy, organizes, coordinates and controls the implementation of the policy in the areas within the competence of the minister of agriculture[45]:

- Regulates the production of agricultural products and foodstuffs through economic measures;
- Carries out direct payments and compensatory allowance;
- Carries out intervention in buying-up;
- Promotes and establishes export and import procedures.

EU funding, such as the Common Agricultural Policy programme, is administered by the National Paying Agency under the Ministry of Agriculture.

Local authorities are responsible for:

- Participation in the administration of specific agricultural production quotas; registration of agricultural holdings and farms;
- Participation in the administration of activities related to declarations of agricultural land and crops;
- Implementation of programmes relating to the liquidation and monitoring of natural disasters, communicable diseases of animals, determination of losses and damages caused to the agriculture by hunted animals and wild animals belonging to the strictly protected species, etc.

Energy – The central Government (Ministry of Energy[46] and ministry of Environment[47]) is responsible for the overall energy policy. The National Energy Security Strategy contains the long term vision.

Local authorities are responsible for:

- Ensuring best strategy for state energy sector and effective energy activities;
- Ensuring continuity of energy supply and resources; determining energy efficiency requirements;
- Encouraging production and consumption of local renewable energy;
- Organising heating supply and drinking water; making arrangements for the lighting of the territories used for public needs;
- Declaring and lifting a municipal-level energy emergency;

[44] https://zum.lrv.lt/en/

[45] https://portal.cor.europa.eu/divisionpowers/Pages/Lithuania-Agriculture.aspx

[46] https://enmin.lrv.lt/en/

[47] https://am.lrv.lt/en/

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- in the event of a national level energy emergency, implementing the government's plan energy supply and/or energy sources;
- Public awareness and education campaigns promoting the efficient use of energy and energy sources;
- managing authorizations to engage in the wholesale and retail trade in bulk petroleum products and liquefied petroleum gas.

Water – The central Government (Ministry of Environment of the Republic of Lithuania, Environmental Protection Agency[48], Lithuanian Hydrometeorological Service[49], Lithuanian Geological Survey[50], Regional Environmental Protection Departments) is responsible for[51]:

- Legislation and regulation for water management and sustainability;
- Coordination and administration of the River Basin Districts;
- Development and approval of RBMPs and Flood risks management plans ()FRMPs and their measures;
- negotiation of international agreements for international river basin districts and coordination of their implementation;
- Implementation of the EU Drinking Water Directive, including testing of drinking water quality, coordination of public consultation, monitoring, pressure analysis and classification of the status of groundwater and surface bodies,
- Issuing of permits and control of water abstractions and wastewater discharges, organisation and coordination of water supply and wastewater treatment services.

Local authorities (municipalities) are responsible for water management at a local level, supply of drinking water and monitoring of sewerage systems.

Ecosystems – The Ministry of the Environment of the Republic of Lithuania was created in 1998, after transferring numerous functions from the Ministry of Construction and Urban Planning and forestry regulatory functions from the Ministry of Lands and Forests to the Ministry of Environmental Protection.The ministry of Environment is a large ministry with many areas of responsibilities. It oversees the environment and natural resources. It is in charge of the following:

- Climate change
- Ambient air quality
- Water
- Chemical substances

[48] https://aaa.lrv.lt/en/
[49] http://www.meteo.lt/en
[50] https://www.lgt.lt/index.php/en/
[51] https://portal.cor.europa.eu/divisionpowers/Pages/Lithuania-Water-Management.aspx

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- Environmental impact assessment
- Waste management
- Integrated pollution prevention and control
- Nature protection
- Forests
- Protected areas and landscape
- Territory planning and architecture
- Construction and housing

The Environment protection agency (EPA), is in charge of the environmental impact assessment of all projects on the territories and has sub-divisions in large cities.

It also has a hydrometeorological service based in Vilnius which is a state budgetary institution responsible for meteorological (including agrometeorological, aeronautical and marine) and hydrological observations and forecasts.

Water, Energy, Food and Ecosystem management

- **National management – Policy instruments**

The authorities (from national to local) benefit from different types of support (law, action plan, strategy, etc.) to manage the resources (water, energy, food and ecosystem).

The case study leaders provided the most important policy instruments related to the WEFE sectors in the case study. The list is presented in the Table 20 for the part of the Lielupe in Latvia and the Table 21 for the part of the Lielupe in Lithuania.

In Latvia

Table 20: Main policy instruments related to the WEFE nexus in Latvia for the Lielupe River basin

SECTOR	TYPE	LEAD	TITLE	LEVEL
Water	Law	Ministry of Environmental Protection and Regional development	*River Basin Management Plan*	Regional Provincial
Water	Law	Ministry of Environmental Protection and Regional development	*Water Management Law*	National
Water Food	CM regulation	Ministry of Agriculture, Ministry of Environmental Protection and Regional development	*Requirements regarding the protection of water, soil and air from pollution caused by agricultural activity*	National
Food	Action Plan	Ministry of Agriculture	*Action plan for development of biological farming*	National
Climate Ecosystem	Policy framework	Ministry of Environmental Protection and Regional development	*The 2021-2027 environmental policy guidelines*	National
Food	Law	Ministry of Agriculture	*Amelioration law*	National
Food	Law	Saeima (the Parliament) of the Republic of Latvia	*Land Management law*	National
Water Energy	Strategy	Saeima (the Parliament) of the Republic of Latvia		National

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Food Ecosystem			*Latvia 2030 - Sustainable development strategy of Latvia until 2030*	
Food Energy	Strategy	Ministry of Agriculture, Sustainable Agriculture Development Division, Agriculture Department	*Latvian Bioeconomy Strategy 2030*	National
Food Ecosystem	Law	Ministry of Agriculture	*Law on agriculture and rural development*	National
Ecosystem	Law	Ministry of Environmental Protection and Regional development	*Law on the Conservation of Species and Biotopes*	National
Water Energy Food	Law	Ministry of Environmental Protection and Regional development	*Law on pollution*	National
Energy Climate	Action Plan	Ministry of Economics	*National Energy and Climate Plan for 2021-2030*	National
Energy	Law	Ministry of Economics	*Energy law*	National
Energy	Cabinet of Ministers Regulations	Ministry of Economics	*Cabinet of Ministers Regulations N. 560 "Regulations on the Production of Electricity from Renewable Energy Sources, as well as on the Procedure for Pricing and Monitoring"*	National
Ecosystem	Law	Ministry of Environmental Protection and Regional development	*Law on Specially Protected Nature Territories*	National
Water Climate Food	Action Plan	Ministry of Environmental Protection and Regional development	*Latvian National Plan for Adaptation to Climate Change until 2030*	National
Climate	Strategy	Ministry of Environmental Protection and Regional development	*Latvia's National Climate Change Adaptation Strategy*	National

In Lithuania

Table 21: Main policy instruments related to the WEFE nexus in Lithuania for the Lielupe River basin

SECTOR	TYPE	LEAD	TITLE	LEVEL
Water	River Basin management plan	Ministry of Environment	*Lielupe River Basin District Management Plan*	Regional Provincial
Water	Law	National Government	*Wate Law*	National
Water	Law	National Government	*Water Development Program 2017–2023*	National
Water Food	Ministerial decree	Ministry of Agriculture	*Regulation on the designation of control authorities for the approval and management of the description of the requirements for the management of agricultural activities and the requirements for the use of fertilizers and plant protection products*	National
Climate Ecosystems Water	Policy framework	Parliament	*National environmental strategy*	National
Food	Law	National Government	*Land Reclamation Law*	National

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Food	Law	Parliament	*Land law*	National
Energy Water Food Ecosystem	Strategy	National Government	*Sustainable development strategy of Lithuania*	National
Agriculture Ecosystem	Law	Parliament	*Law on Agriculture, food and Rural Development*	National
Ecosystem, including Natura 2000	Law	Parliament	*Law on the protected areas*	National
Food Energy Climate Water	Law	Parliament	*Law on Environmental Protection*	National
Energy Climate	Action Plan	Parliament	*National Energy and Climate Plan for 2021-2030*	National
Energy	Law	Parliament	*Energy Law*	National
Energy	law	Parliament	*Renewable Energy Law*	National
Climate	Agenda	Parliament	*National climate change management agenda*	National

- **Transboundary management**

Coordination of some River Basin Management Plans' (RBMPs) elements between Lithuania and Latvia has occurred, but there is not yet a joint RBMP. There is an intergovernmental commission on transboundary cooperation between these two countries as a result of the "Agreement on Transfrontier Cooperation between the Government of Lithuania and the Government of Latvia" signed in 1999. This agreement enables the continuation of cooperation for a joint River Basin District Management Plan, aligned with the 2003 Technical Protocol of Cooperation in International River Basin District Management between the Ministries of Environment of Lithuania and Latvia. Moreover,the Lielupe, shared between Lithuania and Latvia, is included in the list of European Main Transboundary Surface Waters (UNECE, 2007).

Areas of cooperation include: characterisation of water bodies; monitoring and coordination of Programmes of Measures (PoM). In 2016 Latvian and Lithuanian experts both produced similar background documents for three river basins shared with Lithuania (Venta, Lielupe and Daugava RBDs) which were not officially approved because the adoption of the plans in Lithuania was delayed. The European Commission considered that further effort is needed to ensure effective coordination with neighbouring countries on all relevant aspects of the WFD, both with other EU member states as well as with non-EU countries. In the case of Lithuania and the Lielupe basin, the agreement covers characterisation of water bodies, monitoring and coordination of PoM (EC, 2019).

Cross-border projects - There are joint initiatives between two countries regarding the environment, research and innovation. They are mainly funded by EU Research programmes:

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- In 2016, as part of a ECO project[52], Latvia and Lithuania established a cross-border response team and early warning system to help handle any potential ecological disasters around the Lielupe river basin. This region is a high-risk area, as huge amounts of chemicals and oil derivatives are transported by rail, highway and pipeline. The ECO Lielupe project, financed by the European Regional Development Fund (FEDER), has equipped its intervention team with the most modern methods so that it can react quickly and eliminate any pollution resulting from accidents. The team consists of specialists from different localities in the region as well as from fire and rescue services in Jelgava, Latvia, and the border provinces of Siauliai and Panevezys. All team members regularly participate in training courses, during which they can improve their civil protection techniques. The early warning system uses the Internet connection and text messages to send the team quickly and efficiently to the scene. The procedure, which was tested in Jelgava, a town where the risk of flooding is particularly high, was later adopted by other localities in the region. The project has benefited relief efforts and municipalities on both sides of the border in terms of sharing knowledge, experience and know-how. This, in turn, has helped the project partners to better manage environmental disasters. Risk management standards in these cross-border regions have also been strengthened, as the joint response teams have more resources than if they operated separately.

- Latvian and Lithuanian partners (Riebini Municipality Council and Aglona Municipality Council in Latvia, Anyksciai and Moletai District Municipalities, Panevezys Municipality and Sartu and Grazute Regional Park Directorates in Lithuania) also signed a contract for the implementation of the project “Development of eco-tourism by using water resources in Latvia and Lithuania” (Learn Eco Travel[53]). The project is implemented with the aim of developing the attractiveness of the region by jointly improving tourist recreational places at water sites and creating new eco-tourism products and services, thereby increasing the number of visitors. The project focuses on promoting environmentally friendly travel and educating society on eco-tourism. In collaboration with the Latvian and Lithuanian institutions and tourism professionals involved in the project, new common tourism routes will be developed, which will also be suitable for people with disabilities. To increase the understanding of natural diversity of water objects, it is planned to develop an interactive mobile application for water quality determination.

[52] https://keep.eu/programmes/152/2007-2013-Latvia-Lithuania/

[53]https://2014-2020.latlit.eu/lli-349-development-of-eco-tourism-by-using-water-resources-in-latvia-and-lithuania-learn-eco-travel/?text

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- The Interreg VI-A Latvia – Lithuania Programme 2021-2027[54] was approved by governments of Latvia and Lithuania. It is co-financed by the European Regional Development Fund (ERDF) and the total available ERDF funding for the implementation of cross-border cooperation projects is 29 million euros. The aim of the programme is to strengthen cooperation between the border regions of Latvia and Lithuania. Support for cross-border cooperation activities is planned in four priority areas: strengthening institutional capacity and cooperation between citizens, green and sustainable development, a socially inclusive society and the economic potential of tourism, natural and cultural heritage. Beneficiaries will be able to receive co-financing for the implementation of project activities in the amount of 80% of the eligible expenses. Beneficiaries (project partners) can be national, regional, local public authorities, public equivalent bodies and NGO's. The programme area includes Kurzeme, Zemgale and Latgale regions in Latvia and Klaipeda, Telšiai, Siauliai, Panevezys and Utena counties in Lithuania.

Annex 10: Additional information on the institutional regime context in the Jiu River basin and the general WEFE nexus context

Institutional regime context

General division of powers

Romania is a semi-presidential, representative democratic republic, where the Government is directly accountable to the Parliament and the Prime Minister is appointed by the President after consultations with the majority parties. The Office of

[54] https://interreg.eu/programme/interreg-latvia-lithuania/#:~:text=The%20Interreg%20VI%2DA%20Latvia,%2C%20study%2C%20work%20and%20visit

[19] https://keep.eu/programmes/152/2007-2013-Latvia-Lithuania/

[20] https://2014-2020.latlit.eu/lli-349-development-of-eco-tourism-by-using-water-resources-in-latvia-and-lithuania-learn-eco-travel/?text

[21] https://interreg.eu/programme/interreg-latvia-lithuania/#:~:text=The%20Interreg%20VI%2DA%20Latvia,%2C%20study%2C%20work%20and%20visit

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the Government is formed by the Secretariat-General of the Government and the Chancellery of the Prime Minister[55].

The Romanian President is directly elected for a five-year mandate, for maximum two terms. The Romanian Parliament is bicameral and consists of the Chamber of Deputies composed of 329 directly elected deputies and the Senate composed of 136 directly elected senators. The Romanian Parliament has a four-year mandate[56].

According to Article 3(3) of the Constitution, the territory of Romania is divided into communes, towns and counties; the large towns (cities) are declared municipalities through a specific law. Towns having a large number of inhabitants and being of major economic, social, political and scientific importance at national level or meeting the necessary conditions for development in these fields may be classified as municipalities (Law 351/2001 with subsequent changes).

The Romanian counties are the administrative-territorial units at the intermediate level, while communes, towns and municipalities form the local administrative level. The intermediate administrative level consists of 41 counties. A prefect is appointed by the central government as a representative of the government at the county level. The Municipality of Bucharest (the capital of the country), holds both municipality and county competences.

The management of local public affairs is the responsibility of the self-governing deliberative local administrative authorities, namely the county council and the local councils. The local level comprises 2,861 communes, 217 towns and 103 municipalities.

Policy-making, coordination and implementation

Policy-making and general framework

The Romanian legislative framework, established through Law No. 281/2013 on decisional transparency, Law No. 544/2001 on free access to public information and Governmental Decision 775/2005 on the procedure for policy-making, allows the participation of the non-governmental sector and media representatives in the process of public policy-making. Nevertheless, this possibility is insufficiently utilised due to both a lack of transparency and recourse to public consultation and overriding proposals. Government decisions are the most common normative acts submitted for

[55] Main source of information of the institutional regime context : https://www.sgi-network.org/2022/Romania/Executive_Summary
https://inundatii.ro/en/river-basins/jiu-river-basin/#:~:text=Climate%20of%20the%20river%20basin,of%20the%20Mediterranean%20climate%20influence

[51] https://www.outnwild.com/valea-jiului-more-info/about-valea-jiului/

[52] https://www.copernicus.eu/en/media/image-day-gallery/strong-impact-drought-danube-river

[53] https://www.trade.gov/market-intelligence/romania-irrigation-infrastructure

[56] https://portal.cor.europa.eu/divisionpowers/Pages/Romania.aspx

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public consultations, while ordinances and ministry orders are less frequently put before the citizens (Stamule, 2018).

Public consultations can sometimes be only a formality, without any intention of actually considering civil society's objections. Without a culture of debate, the recommendations are taken into consideration mainly if they come from representative associations from the business sector, or from important unions (Stamule, 2018).

There is no law regulating lobbying activity, and there is no recognition of this, while think tanks are seldom used. Representatives of the trade unions and employers' associations, industry or business associations such as the ones for agriculture, express their interest and influence as regards the decision-making process (EU Parliament, 2019).[57]

Policy advice and changes in human resources

There is no strong tradition of policy advice in Romania and what little there is focuses on the work of the policy advisers. There are no private institutions with such responsibilities. Instead, there are some public institutions that guide the decision-making processes in several areas, especially for the budgetary and financial domains.

The consultation procedure and policy advice are fairly formal in the decision-making process. Consequently, Romania's public administration has been described as being governed through "emergency ordinances" (EC, 2020), which have been increasingly used by the Romanian Governments since their launch in 2005 (in order to bypass formalities), but with limited policy substantiation. The World Bank (2011) describes the situation as a "culture" of initiating policies without analytical foundation and impact assessment.

Division of responsibilities within each sector

The authorities (from national to local) benefit from different types of support (law, action plan, strategy, etc.) to manage the resources on their territories (water, energy, agriculture and ecosystem).

Agriculture – The Central Government (Ministry of Agriculture and Rural Development [58]) is responsible for[59]:

- the overall legislation in line with the Common Agriculture Policy;
- development strategy;
- national support programmes;
- agricultural trade;

[57] https://www.europarl.europa.eu/EPRS/Lobbying-transparency-comparative-analysis.pdf
[58] https://www.madr.ro/
[59] https://portal.cor.europa.eu/divisionpowers/Pages/Romania-Agriculture.aspx

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- land resources and land reclamation;
- national beekeeping programme;
- management of the European Agricultural Fund for Rural Development (EAFRD);
- oversight of the Rural Development Programme (RDP).

The counties' Departments of Agriculture are decentralised public services of the Ministry of Agriculture and Rural Development ensuring, at the county level, the implementation of policies and strategies in the area of activity of the ministry.

They provide specialised assistance to the local public administration authorities for the elaboration of a local action plan, which comprise the measures provided for the implementation of action programme for the protection of waters against nitrate pollution from agricultural sources, their deadlines and financing sources. They also provide specialised assistance to farmers, owners / administrators of farms that own animals, in the elaboration of an action plan at the farm level, which includes the measures provided in the action programme for the protection of waters against pollution with nitrates from agricultural sources, the deadlines for fulfilling their sources of funding.

The State is currently providing support for local farms in the interest of transforming lower-income households into commercially viable farms. Programmes enabling this are managed centrally but delivered at the local level. Local authorities can apply to implement projects utilising EAFRD or RDP funds. Approval is sought via regional and national managing authorities[60].

Energy – The central government (Ministry of Economy, Energy and the Business Environment[61]) is responsible for[62]:

- provision and implementation of strategy programmes to increase mineral resources;
- development of the regulatory and institutional framework necessary for achieving the strategic objectives in the following areas: energy conservation, recovery facilities, recycling and waste management, and, where appropriate, privatisation of companies;
- managing the international relations in the field of energy;
- application of the Treaty of Accession of Romania to the EU in the field of energy;
- ensuring the uniform application and the compliance of the activities with regulations in the field and the proper functioning of the institutions operating under its authority;

[60] https://portal.cor.europa.eu/divisionpowers/Pages/Romania-Agriculture.aspx
[61] http://economie.gov.ro/
[62] https://portal.cor.europa.eu/divisionpowers/Pages/Romania-Energy.aspx

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- public administration of mineral resources, transport, energy production and distribution, transport and oil and gas storage;
- management of EU funding in areas under its responsibility;
- two nuclear power stations[63].

The county council provides, according to its competences and according to the law, the framework for ensuring public services of county interest regarding community services of public utility of county and gas supply. The towns and communes are responsible for public lighting and network of supply of heat produced by centralised systems.

Water – The National Administration Romanian Waters[64] (NARW), including the River Basin Administrations has on its responsibility[65]:

- monitors and assesses status of groundwater and surface water, economic analysis, pressure and impact analysis,
- prepares the RBMP and the Programme of Measures (PoM) as well as the FRMPs,
- carries out public participation activities,
- implements measures in the PoM and the FRMPs,
- administers the dam and reservoir situated at the border between Romania and Moldova.

The Ministry of the Environment, Waters and Forests[66] drafts and enforces regulations, supervises the NARW.

There are no specific water competencies at regional level but locally, the Municipalities, Towns and rural Communes are responsible for water supply, sewerage and treatment of wastewater and pluvial waters, collective ownership of commercial regional operating companies providing water services.

Locally, the municipalities, towns and communes are responsible for water supply and sewerage and treatment of wastewater and pluvial waters.

[63] https://world-nuclear.org/information-library/country-profiles/countries-o-s/romania.aspx
[64] http://rowater.ro/default.aspx
[65] https://portal.cor.europa.eu/divisionpowers/Pages/Romania-Water-Management.aspx
[66] http://www.mmediu.ro/

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Figure 32: Romania's 11 Basin Water administrations (Source: ANAR, Agencies National Administration Romania "Romanian Waters")

Ecosystems – The Ministry of Environment, Water and Forests is responsible for overall legislative, policy-making, management, monitoring, inspection and control competences in the field of[67]:

- Strategic planning;
- Sustainable development;
- Environmental infrastructure and water management;
- Meteorology;
- Hydrology;
- Hydrogeology;
- Climate;
- Protected natural areas;
- Waste management;
- Management of hazardous substances;
- Biodiversity conservation;
- Management of air quality;
- Biosecurity and ambient noise levels; and
- Administration of forest management.

The ministry is also in charge of the implementation and coordination of the financial assistance granted by the EU in the field of environment and forests and of

[67] https://portal.cor.europa.eu/divisionpowers/Pages/Romania-Environment.aspx

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programmes financed from EU funds. Finally, the National Environment Protection Agency (NEPA) is the regulator in terms of environmental protection, according to art. 8 of GEO 195/2005 on environmental protection approved with amendments by Law 265/2006, as amended and supplemented. The National Environment Protection Agency (NEPA) is responsible for regulation in the area of environmental protection including permitting.

At regional level, county environmental protection agencies are public institutions with legal personality, subordinated to the National Environmental Protection Agency, having the status of the decentralised public services, financed from the State budget. Each county environmental protection agency meets at the county level, the tasks of the National Agency for Environmental Protection, respectively: Implementation of policies, strategies and legislation in the field of environmental protection at the county level, and also assessing the impact of certain public and private projects on the environment. The county environmental protection agencies issue regulatory documents on environmental protection, in accordance with the powers conferred by the National Agency for Environmental Protection, under the legislation in force. Moreover, the county council provides, according to its competences and according to the law, the framework for ensuring public services of county interest in the field of environment protection.

Each case study leader was asked, with the support of a policy inventory excel table containing explanations, to list and describe the most important policy instruments related to the WEFE sectors in the case study. The list is presented in the **Error! Reference source not found.**.

Table 22: Main policy instruments related to the WEFE nexus in Romania for the Jiu River basin

SECTOR	TYPE	LEAD	TITLE	LEVEL
Water	Law	Romanian Parliament	*Water Law 107/1996 with all amendments*	National
Water	Plan	National Administration Romanian Waters - River Basin Administration Jiu	*Jiu River Basin Management Plan*	Regional Provincial
Water	Plan	National Administration Romanian Waters	*National Plan for River Basins Management*	National
Water	Plan	National Administration Romanian Waters	*Jiu River Basin Management Plan for Flood Risk Management*	National
Water	Plan	ICPDR	*Danube Flood Risk Management Plan*	International
Energy	Strategy	Ministry of Investments and European Projects	*Jiu Valley Strategy*	National
Energy	Strategy	Ministry of Energy	*National Energy Strategy 2007 -2020*	National
Energy Climate Change	Plan	Ministry of Energy	*Integrated National Energy and Climate Plan*	National
Food	Strategy	Ministry of Agriculture and Rural Development	*National Strategic Plan 2021-2027*	National

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Climate change	Strategy	Ministry of Environment, Waters and Forests	*National Strategy for Climate Changes*	National
Ecosystem	Strategy Action Plan	Ministry of Environment, Waters and Forests	*National Strategy and Action Plan for Biodiversity Conservation for 2030*	European
Water Energy Food Ecosystem	Strategy	Romanian Government	*National Strategy for Sustainable Development 2030 Romania*	National
NextGenerationEU	Plan	Romanian Government	*National Plan for Recovery and Resilience*	National
Water	Plan	ICPDR	*Danube Flood Risk Management Plan*	Transnational
Water	Agreement	Romania & Serbia Governments	*Agreement between Romania and Serbia on sustainable management of water resources*	International cooperation - Bilateral
Ecosystem	Agreement	Romanian & Bulgarian Governments	*Agreement between Romania and Bulgaria on sustainable management of water resources*	International cooperation - Bilateral

Additional information on WEFE nexus sectors

Agriculture, land uses and food production

Land uses

Romania has considerable land resources. According to the statistics, 58% (14.63 mill. ha) is agricultural land; 34.82% forest and other land with forest vegetation (6.73 mill. ha); 1.52% waters (0.82 mill. ha) and 7% other land uses (1.62 mill. ha). Of the agricultural land, arable fields account for 64%; pastures 22%; hayfields 11%; vineyards 2% and orchards 1% (ICPDR, 2020).

In the Jiu, forests occupy about 30% of the area, covering mountainous and mountainous areas, while urban and rural areas occupy 17%. The other types of land cover occupy much smaller areas. Among them, water bodies hold about 1% of the total area of Jiu river basin (Morosanu, 2019).

Irrigation

Romania has a large national network of irrigation canals (EESA, 2021). However, this infrastructure has fallen into disrepair[68]. At present, less than 20% of the irrigation canal infrastructure is being utilized, irrigating less than 10% of Romania's arable land[69].

[68] https://www.trade.gov/market-intelligence/romania-irrigation-infrastructure

[69] https://www.trade.gov/market-intelligence/romania-irrigation-infrastructure#:~:text=Romania%20has%20a%20large%20national,10%25%20of%20Romania's%20arable%20land.

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The Ministry of Agriculture and Rural Development in Romania[70] launched a 1.6 billion U.S. dollar programme in 2022 to rehabilitate the primary irrigation canal networks. However, the allocated amount was insufficient to upgrade the entire canal system. Romania subsequently sought 0.5 billion USD in additional funds from the European Commission for the rehabilitation of secondary irrigation canals through the 2020-2027 Multiannual Financial Framework of EU's Common Agricultural Policy[71].

Energy

Romania's energy production is diverse[72], encompassing a mix of fossil fuels and renewable energy sources. The energy sector is evolving, with increasing emphasis on renewable energy development, energy efficiency, and reducing carbon emissions. The government has set goals to enhance the share of renewable energy in the energy mix, diversify sources, and improve energy sustainability.

Indeed, since the early 1990s, mining activity decreased abruptly given the post-communist industrial decline in Romania and the more recent environmental constraints imposed by the European legislation. However, Romania continues to rely on existing coal-fired power plants in order to maintain its energy security and a reasonable level of energy independence. Thus, in 2018, Romanian electric energy production was split between thermo-power (42%, of which coal 28%, hydrocarbons 14%), hydropower (28%), nuclear power (18%) and wind and photovoltaic solar energy (12%).

In 2020, electricity production in Romania was comprised of 12.4% wind power, 3.4% from photovoltaic solar panels, while 27.6% of the electricity production was coming from hydropower. In total, renewable energy production (wind, photovoltaic and biomass) amounted to 16%[73].

According to the country's National Institute of Statistics, energy output in Romania climbed by 5.3% in 2021 to 59 TWh, with 38% thermal, 29% hydro, 19% nuclear, 11% wind, and 3% solar, while imports increased by 6.7%to 8.1 TWh. Electricity consumption climbed by 4.2% to 55.7 TWh, while exports increased by 23% to 5.9 TWh[74].

[70] https://www.madr.ro/en/
[71] https://www.trade.gov/country-commercial-guides/romania-agricultural-sectors-machinery-and-equipment
[72] https://www.trade.gov/country-commercial-guides/romania-energy#:~:text=In%202020%2C%20electricity%20production%20in,biomass)%20amounted%20to%2016%25
[73] https://www.trade.gov/country-commercial-guides/romania-energy
[74]https://www.enerdata.net/publications/daily-energy-news/romanias-power-generation-increased-53-2021.html

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Romania seeks to derive more of its energy needs from renewable sources (PWC, 2020). The country is seen as a fast-growing market for wind energy in the Southeast European region, with installed wind generation capacity skyrocketing from as little as 7 MW in 2007 to 3,029 MW in 2019.

Coal mining

Historically, Romania has relied heavily on fossil fuels for energy production (e.g., in the Jiu valley). Coal and oil have been major contributors to the country's energy mix. Romania has significant coal reserves and operates several coal-fired power plants for electricity generation. Oil and natural gas extraction also play a role in energy production[75].

In the county of Dolj, there were only two power generation units in 1989, both operating around the city of Craiova and based on coal. One of them, Craiova 2, was completed shortly after the revolution and is still operating today at its maximum capacity of 300 MW. The other, Isalnita (Craiova 1), was commissioned in 1964 and gradually reached a capacity of 1035MW in 1989. In the meantime, only 2 of the 8 groups are still in operation, with a total capacity of 630MW.

The geological formations in the Jiu catchment area are very varied petrographically depending on the topography. Geologically, the Jiu catchment area is dominated by siliceous rocks (96.77%), with calcareous rocks (3.23%) in small areas in the upper part of the mountainous area and in the northern part of the Bahna and Opolnita sub-basins. In the lowland region, the soil types are distributed in bands along the Jiu River valley. The dominant class is Cernisols. In the western part, the predominant soils are Gleyic Luvisols and Chernozems, with high water storage capacity, which contributes to the groundwater recharge of the rivers during dry periods. In the floodplain of the Jiu River, the characteristic soil type is fluvisol (or alluvial soil) of the calcareous type.

In the hilly area (Getic Piedmont) and subcarpathian area, as well as in the intra-mountainous depressions, there is the domain of Luvisols (Eutric, Distric, Leptic, Gleyic, Orthic). Luvisols are particularly important in the hilly area and even in the Subcarpathians, existing in cohabitation with the brown clay-illuvial soils, in the areas with less important drainage. This class has two types present in the basin of the Jiu River: Luvosols and Preluvosols. As a location, Luvisols occupy large areas in interfluves. Preluvisols occupy large parts of hilly areas and are characterized by clay-oiluviation processes that lead to the formation of the Bt horizon [Geanana, 2004]. In the Mehedinți Plateau, along with the Luvosols often exist in cohabitation the brown-red soils (Cambisols) (Morosanu, 2019).

[75] https://ourworldindata.org/energy/country/romania

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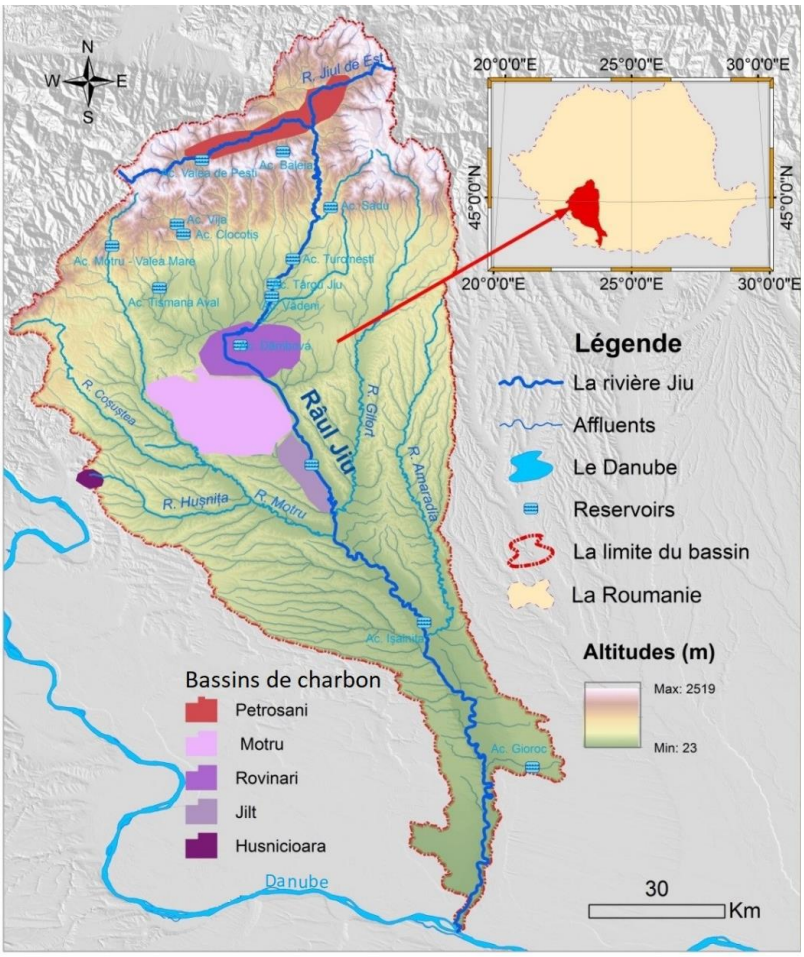

Figure 33: Main coal mining areas in the Jiu catchment (Morosanu, 2019)

One of the special economic features of the Jiu river basin is the presence of mining basins for coal. They are located in the upper Jiu basin, in the Petroşani depression (where there is mainly hard coal) and in the middle foothill area (lignite mining in the Motru-Rovinari basin). While hard coal is mined underground, lignite is extracted both by excavation, open-pit (in quarries), and underground mining. The presence of coal has prompted the development of the mining industry, which has led to changes in river water quality and hydro-sedimentary flows. The Jiu river basin is also known as one of the main suppliers of fine sediments in the Romanian Danube. Mining activity has left traces of coal in the alluvial deposits of the river. Among the two coal mining areas, the Petroșani depression has been recognised as the main source of water pollution in the Jiu River and its tributaries, while the influence of the Motru – Rovinari basin, is not yet fully proven and elucidated, on the one hand due to the reduction of mining activity after 1990 and on the other hand, due to the location of the operations further away from the Jiu River and its direct tributaries (Morosanu, 2019).

Nuclear energy

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Romania has a nuclear power plant located in Cernavodă, which currently operates two reactors. Nuclear power contributes a significant portion of the country's electricity, but which is not located in the Jiu basin[76].

Renewable Energy

The socialist regime had plans to develop some hydroelectric power plants on the Jiu River to the Danube, although these plans were never implemented. The planned 4-5 plants would have contributed about 100MW of renewable energy.

In the county, private investments have been limited to the construction of photovoltaic parks and have brought an increase in power to 68MW.

Romania has been actively developing its renewable energy sector. The country has significant potential for renewable sources, including wind, solar, hydroelectric, and biomass. Wind energy has experienced rapid growth, with the installation of wind farms in various regions. Solar power capacity has also been increasing with the deployment of photovoltaic systems. Biomass plays a role in heat and electricity production, utilising agricultural residues, wood, and energy crops. Hydropower, particularly small and medium-scale installations, has been a traditional source of renewable energy in Romania: In 2018 a surface water volume of over 366 bill. m^3 was used for hydropower production. Generally, these hydropower plants are located on the Danube River (Iron Gates I and II) and other tributaries (Olt, Arges, Somes, Bistrita, Lotru, etc.). Specific measures are planned or implemented in order to mitigate the impact of hydropower infrastructure works and for improving the longitudinal continuity of rivers and hydromorphological conditions (e.g., ecological flow, fish migrations conditions). Consequently, the development of this renewable energy is not on the agenda.

The county of Gorj, representing mainly the Jiu catchment areas, is the second county in terms of electricity production in Romania according to county. Constanta is also one of the most polluted counties in the country because 91% of the energy comes from the Rovinari and Turceni thermal power plants that operate on coal mined in the surrounding coal basins (as the one located in Petrosani where the mines have been closed very recently). In their heyday, these two thermal power plants operated at double capacity compared to today, Rovinari had a total installed power of 1720MW and today it still operates in 3 groups totalling 990MW and Turceni, in its historical maximum reached 2310MW and today 4 groups are still operating which totals 1320MW, which results in a total installed power loss of 1720MW.

On the hydropower investment side, in 1989 only one hydropower plant was completed from the grandiose hydropower development project of the Jiu River: The Turceni hydroelectric power plant. Another 7 hydroelectric plants were in various stages of construction, of which only the Targu Jiu hydroelectric plant (1997) and the Vadeni hydroelectric plant (2001) have managed to be completed until now. In the Jiului gorge, on the Livezeni – Bumbesti sector, investments were resumed for the Dumintra hydro-

[76] https://world-nuclear.org/information-library/country-profiles/countries-o-s/romania.aspx

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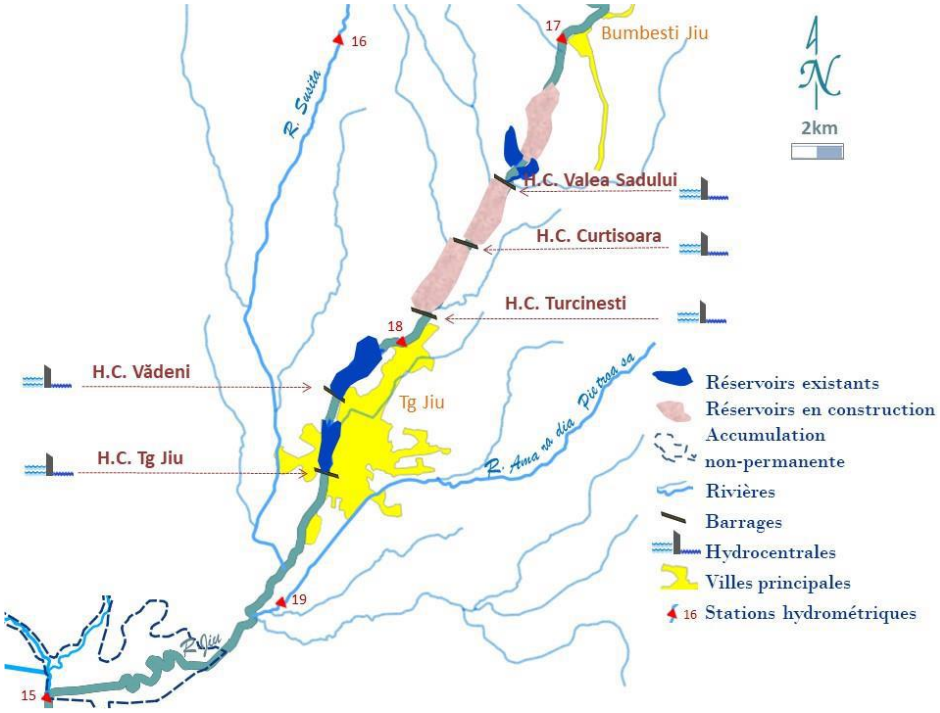
electric plant with 24.5MW and the Bumbesti hydro-electric plant with 40.5MW. However,due to the fact that in the meantime the Jiului gorge was included in the protected area and independent environmental protection bodies opened a lawsuit against the project to establish the legality of the investment, we can expect in the near future that there will be a negative opinion. This will mean the investment of over 200 million euros was in vain, even that a part must be demolished to restore the river bed to its original form. In addition to these projects completed or in the process of completion, there are 3 hydropower plants that have not been completed even today: The Valea Sadului hydroelectric plant and dam – 18.7MW, the Curtisoara hydroelectric plant 11MW and the Turcinesti hydroelectric plant another 11MW. These are only the investments that were started until 1989, but the old regime still planned the construction of approximately 10 hydropower plants on the Jiu River up to the point it flows into the Danube. Private investments in the energy sector were made by installing photovoltaic parks with a total power of over 30MW. On the hydropower side, after 2011, Hidroelectrica sold all the microhydropower plants it managed in the county and thus the capacities were refurbished and transferred to the private sector, but no new production units appeared[77].



Ecosystems

Almost 23% of the Romanian territory is part of Natura 2000 network of sites under the Birds and the Habitats Directives.

The Danube delta in Romania, covering 4,178 km², is the country's most important protected area. It provides a diversity of habitats for more 5,200 flora and fauna

[77] https://romania594.blogspot.com/2020/03/capacitati-de-productie-energiei_87.html

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species. The Danube Delta Biosphere Reserve covers 580,000 ha in Romania and is sub-divided into: Core areas of highest value and conservation priority (8.7%); buffer areas (38.5%) and economic areas (52.8%) where the majority of the 15,000 delta residents live. Thus, the Jiu basin, a tributary of this delta, is concerned with the protection areas located downstream (ICPDR, 2020).

- **Larurile sambotin**[78]

The Sambotin Lake is a fishing site located in Schela Commune of the county of Gorj.

- **Stancile Rafaila**[79]

Rafailă rocks are a protected area of national interest that corresponds to IUCN category III (geological and landscape nature reserve) located within the county of Gorj, in the administrative territory of the city of Bumbești, Jiu.

- **Defileul Jiului National Park**[80]

The Jiu Pass National Park is located in the Southern Carpathians, along the upper Jiu valley, embedded between the Vâlcan and Parâng mountains, in the northern part of county of Gorj. The area of the park is 11,126 ha. Besides, it was declared a protected area by government decision no. 2151 of 30 November (published in Monitorul Oficial no. 38 of 12 January, 2005) and represents an area with a great variety of flora and fauna specific to the Carpathians.

- **Delta Jiului**[81]

The Valea Jiului region in Romania is located in the country's southwestern Transsylvania county and is bordered by the Parang Mountains and the Retezat Mountains. It is also known as the "Jiu Valley". During the time of communism, the Valea Jiului region was heavily industrialised. However, after the collapse of communism, many of the mines in the area were closed. The Parang Mountains are considered to be one of the most spectacular mountain ridges in the Southern Carpathians and Romania. Its peak, which is known as Parngu Mare, is over 2,500 meters high.

- **Cascada Murga Parcul Național Defileul Jiului**

[78] https://lacurile-sambotin.business.site/?m=true&fbclid=IwAR0blyGgGzEXoSvLyIlWeb5FFW3JeOLYyj2Qi4tnISBkaZBuSxfllpUALc8

[79] https://www.infopensiuni.ro/cazare-tismana/obiective-turistice-tismana/stancile-rafaila_8062

[80] https://www.wikiwand.com/fr/Parc_national_du_d%C3%A9fil%C3%A9_du_Jiu

[81] https://www.outnwild.com/valea-jiului-more-info/about-valea-jiului/

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Annex 11: Additional information on the institutional regime and WEFE domains context in the Adige River basin

Institutional regime context

Italy is a democratic republic with a bicameral parliamentary system. The country is divided into regions (*regioni*), provinces (*province*), municipalities (*comuni*) and metropolitan cities (*città metropolitane*). The regions (20), provinces, municipalities and metropolitan cities may adopt their own statutes. There are fifteen regions with ordinary status (*regioni a statuto ordinario*), including Veneto; five regions, including Trentino-Alto Adige, have special forms and conditions of autonomy, according to their respective special constitutional statutes (*regioni autonome a statuto speciale*)[82], taking into account relevant geographical and/or cultural specificities. The region of Trentino-Alto Adige consists of the two autonomous provinces of Trento and Bolzano. However, almost all regional powers have been transferred to the two autonomous provinces, which exercise their power through their own institutions. The region has retained some functions in the areas of land registration and civil security, but its main role is to coordinate the policies of the provinces.

The relationship between the central government and local authorities has not yet reached a satisfactory balance. There is a need for a clearer division of responsibilities, sufficient resources for local authorities to carry out their functions, and improved accountability mechanisms.

Water, Energy, Food and Ecosystem management

The authorities (from national to local) benefit from different types of support (law, action plan, strategy, etc.) to manage the resources on their territories (water, energy, food and ecosystem).

Each case study leader was asked, with the support of a policy inventory excel table containing explanations, to list and describe the most important policy instruments related to the WEFE sectors in the case study. The list is presented in the Table 23.

Table 23: Main policy instruments related to the WEFE nexus in Italy for the Adige River basin

[82] The Statute of Autonomy is the constituent charter of the Region: it contains the indications concerning the organs of the Region, the two Provinces and, above all, the competences.

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SECTOR	TYPE	LEAD	TITLE	LEVEL
Water	District Management Plan	Eastern Alps District Authority	*Water Management Plan of the Eastern Alps Hydrographic District*	Inter-regional
Water	District Management Plan	Eastern Alps District Authority	*Flood Risk Management Plan of the Eastern Alps Hydrographic District*	Inter-regional
Water	Plan	Province of Bolzano	*General Plan for the Use of Public Waters (mentioned as PGUAP)*	Regional Provincial
Water	Plan	Province of Bolzano	*Water Protection Plan (mentioned as PTA or WPP)*	Regional Provincial
Water	River Contract	Province of Bolzano	*Adige River area management plan "Spatium Etsch – Adige" – Final report*	Regional Provincial
Energy Climate	Plan	Province of Bolzano - Environmental Agency + Energy Agency	*Climate Energy Plan - Alto Adige 2050*	Regional Provincial
Food	Plan	Province of Bolzano	*Agriculture 2030. Strategic Plan for Alto Adige agriculture*	Regional Provincial
Food	Strategic program	Province of Bolzano	*Sustainapple – Strategy for the sustainable development of Alto Adige apple cultivation*	Regional Provincial
Food	Plan	Province of Bolzano	*Rural Development Plan 2014-2020*	Regional Provincial
Ecosystem	Strategy	Province of Bolzano	*Every day for future – Strategy towards sustainability*	Regional Provincial
Energy	Plan	Province of Trento	*Provincial Environmental Energy Plan 2021-2030 (mentioned as PEAP)*	Regional Provincial
Water	Plan	Province of Trento	*Water Protection Plan 2022-2027 (mentioned as PTA or WPP)*	Regional Provincial
Water	Plan	Province of Trento	*General Plan for the Use of Public Waters (mentioned as PGUAP)*	Regional Provincial
Ecosystem	Plan	Province of Trento	*Water reclamation Plan*	Regional Provincial
Food	Plan	Province of Trento	*Rural development Plan 2014-2022*	Regional Provincial
Ecosystem	Strategy	Province of Trento	*Provincial Strategy for sustainable development*	Regional Provincial
Ecosystem	Strategy	Veneto Region	*Regional Strategy for sustainable development*	Regional Provincial
Water	Plan	Veneto Region	*Water Protection Plan*	Regional Provincial
Food	Plan	Veneto Region	*Rural development Plan 2014-2020*	Regional Provincial
Food	Strategy	Veneto Region	*Veneto Agriculture towards 2030*	Regional Provincial
Ecosystem	Plan	Regional Park	*Po Delta Park Environmental Plan*	Municipal Local
Climate Energy	Paesc	Province of Verona	*Piano di Azione per l'Energia Sostenibile e il Clima (PAESC)*	Regional Provincial
Energy Climate	Plan	MISE	*Integrated National Energy and Climate Plan 2030 (PNIEC)*	National

Detailed policy instruments and responsibilities

- **Water management**

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Legal status of water - According to the water law "*Disposizioni in materia di risorse idriche"* (5 January 1994, n. 36), all waters on the territory of the Italian State are public. All surface and underground waters are public, they constitute a common resource that must be safeguarded, and their use must respect the expectations and rights of future generations (art. 1). It follows that any use must be authorised by the public administration. To this end, a concession is granted based on an application for a specific use. No concession is granted for small sources of drinking water used by individual rural dwellings. The use of public water is subject to an annual fee, which varies according to the type of use.

Hydrographic Districts and District Basin Authorities - In Italy, Law 183/1989 (art. 12) establishes the Basin Authority for hydrographic basins of national importance. The Basin Authority is a mixed body, composed of the State and the regions, whose main task is the preparation of the Basin Plan and its implementation.

The national territory has been divided into seven river basin districts (L. 221/2015) with the aim of implementing the EU provisions of the Water Framework Directive (2000/60/EC) in 2006 (Legislative Decree No. 152 of 3 April 2006).

The EU Floods Directive (2007/60/EC) establishes in each River Basin District the District Basin Authority, which carries out the planning activities necessary for hydrogeological protection for the preparation of hazard and risk maps and for the protection of water resources and the aquatic environment. To this end, it draws up the District Basin Plan, gives its opinion on the consistency of national, regional and local plans and programmes concerning soil protection, combating desertification, water protection and water resources management with the objectives of the Basin Plan. It also carries out an analysis of the characteristics of the district, an examination of the impact of human activities on the state of surface water and groundwater, and an economic analysis of use.

The District Basin Authority contributes to the implementation of the activities that fall within the competence of the Ministry of Ecological Transition and, in addition to the planning activities already mentioned, to the information, participation and cooperation initiatives aimed at all subjects (public and private) working in the field of soil protection, rational use of water resources and environmental protection.

Although the district scale for water management has been provided for in national legislation since 2006 (national transposition of Directive 2000/60), the actual establishment of the new district river basin authorities has only taken place since 2017. This is relatively recent.

Public water services – ATOs (Ambiti Territoriali Ottimali) - In the 1990s, Italy undertook a reform and overhaul of the management of public water services. In 1994, the 'Disposizioni in materia di risorse idriche' or 'Galli' law (L.36/1994) reorganised all public water services - drinking water distribution, sewerage networks and treatment - under a single authority, the 'Autorità d'Ambito'. The principles underlying this reform were, first and foremost, territorial and industrial integration, thanks to the creation of

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ATOs, 'Ambito Territoriale Ottimale', optimal territorial management perimeters within which to reorganise public services in the water (and waste) networks; the regulations provide for ATOs as structures aimed at overcoming the fragmentation of existing municipal management by planning the integration of the various activities in the service cycle (supply, transport, distribution, collection and treatment of waste water). The "Autorità d'Ambito" must draw up a plan, the "Piano d'ambito", the instrument that defines the objectives for an efficient service in terms of coverage, price, cost, quality and saving of resources. In 2010, the Autorità d'ambito and the ATOs were redefined, giving priority to the criterion of provincial territory.

- **Responsibilities within each sector**

Water - The central government is responsible for national water legislation, including the laws transposing and implementing the Water Framework Directive (WFD), the Floods Directive and other EU water legislation, the coordination of the implementation of the WFD, the Floods Directive and other EU water legislation, the development of methods for setting water tariffs and the supervision of existing tariffs. The regions and autonomous provinces of Trento and Bolzano are represented in the Council (Permanent Institutional Conference) of river basin district authorities. The regions and autonomous provinces prepare regional water protection plans to support and implement RBMPs, carry out groundwater and surface water monitoring, enforce water legislation, contribute to river basin management plans (prepared by river basin authorities), they lead the preparation of flood risk management plans (FRMPs) at regional level (often coordinated by river basin authorities), implement the measures of river basin management plans and FRMPs at regional level, identify and supervise water service areas (ATO- Ambiti Territoriali Ottimali).

At the local level, municipalities are the owners of water service companies that manage drinking water supply, sewerage and wastewater treatment (ownership structures vary across the country), manage local water issues, implement RBMP and FRMP measures at the local level, and participate in river contracts for local participatory management of water bodies.

Energy - The competent bodies in the energy sector are the Ministry for the Environment and Energy Security (MASE) and the *Istituto superiore per la protezione e la ricerca ambientale* (ISPRA), a public research organisation with legal personality under public law, under the supervision of the Minister for the Environment.

In the energy sector, the central government is responsible for defining the basic principles for regulation by the Regulatory Authority for Energy Networks and the Environment (ARERA), which carries out regulatory and supervisory activities in the electricity, natural gas, import, export and storage sectors; and for setting targets and national programmes for renewable energy sources and energy conservation.

The regions draw up regional plans to identify the characteristics, size, user needs and availability of renewable energy sources, and indicate energy saving measures. In regulatory matters, the regional competence in energy management is limited by what

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is established in the national legislation, as it is a strategic sector of national importance. The remaining areas of regional legislation include, first, the siting of energy facilities; in particular, in the field of renewable energy, it has been found that the region cannot impose a general ban but can only identify sites that are not suitable for the installation of facilities. With the constitutional reform of 2001 (decentralization), among the new matters of concurrent legislation (between region and state) was also included that called "production, transportation and national distribution of energy": the state legislature should limit itself to laying down the fundamental principles, while it would be up to the decentralised legislatures to dictate the regulations necessary for their implementation (Bassi, 2014). It is therefore up to the regions, which are responsible for guiding and coordinating the local authorities in the tasks assigned to them, the administrative responsibility for energy saving and rational energy use. Some regions, including Veneto, have called for greater autonomy in energy matters, in particular as regards the management in full autonomy of the procedures for granting concessions for large hydroelectric installations, the collection of the related fees and the use of resources to promote the development of renewable energy sources and related research activities~~,~~ as well as the production, transport and distribution of energy, which are normally the responsibility of the central State.

For the autonomous provinces of Trento and Bolzano, their autonomy statutes grant them the power to enact legislation on "public water use" and "hydraulic works". In 2017, an amendment to the Statute of Autonomy, in agreement with the central government, regarding large hydroelectric concessions allowed for the strengthening of the competence of the provinces to legislate, within the framework of European Union law and the principles of national legislation, on the modalities, procedures and criteria for the granting of hydroelectric concessions. The new legislation also strengthens the role of the provinces and municipalities with regard to the spillover of financial resources from hydroelectric concessions.

Environment and ecosystems - The competent bodies in the sector are the Ministry for the Environment and Energy Security (MASE) and ISPRA.

Legislative competence in the field of the environment is reserved exclusively to State legislation. In the case of the autonomous provinces of Bolzano and Trento, although the environment and the ecosystem are not among the primary provincial competences, they have legislated on issues such as the protection of water from pollution, the preservation of biodiversity through the establishment of parks, soil protection and the limitation of air emissions. Some regions, such as Veneto, ask the State to legislate on the environment (differentiated regionalism).

In terms of action, the State is mandated to set uniform environmental protection standards throughout the country, while the regions (and autonomous provinces) are empowered to take action to define protection objectives and to manage them on the ground, from administrative powers to the implementation of environmental policies. Given the cross-sectoral nature of the issue, management is based on the principles

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of subsidiarity and cooperation between the different levels of government (European principle enshrined in the Maastricht Treaty in 1992).

Agriculture - Regarding agriculture, the central government is responsible for setting guidelines, and coordinating the national policy with European and international standards at the national level (Ministry of Agriculture, Food and Forestry).

Regional authorities are responsible for the relationships with the regions, the State and the European Union, to set up regional plan for agriculture; the control over the quality of the agricultural products; the agro-industrial development; the protection and promotion of the rural territory, irrigation and rural facilities; sustainable agriculture by the protection of fauna and flora, and finally controls of compliance with standards.

An important player in the agricultural sector is the Land Reclamation and Irrigation Consortium – Consorzi di Bonifica-, which is one of the main institutions for achieving the objectives of soil conservation and the use and management of water resources for the purposes of economic and social development, especially in relation to agriculture, and the protection of environmental resources.

Additional information on the institutional regime and WEFE domains context in the Adige River basin

Protected areas

In the overall Trentino - Alto Adige region (Trento province and Bolzano province), 24% of the territory is classified as protected area (20% Bolzano province and 28% Trento province), including Special Protection Areas (SPAs), Sites of Community Importance (SICs), and the Natura 2000 network.

In Alto Adige (the northern part of the Trentino-Alto Adige region) there are 7 provincial nature parks, part of the territory of the Stelvio National Park and part of the Dolomites World Heritage Site (9 Dolomite groups covering about 142,000 hectares, part of which is in the provinces of Bolzano-Alto Adige and Trento-Trentino, the rest is in Veneto-Belluno and the neighboring region of Friuli Venezia Giulia). The areas included in the Natura 2000 network sometimes overlap with ecosystems of provincial interest and are located within natural parks. There are 17 Special Protection Areas (SPAs) and 44 Sites of Community Importance (SCIs). From a regulatory point of view, these areas are protected by a provincial law – the Law "Territory and Landscape, 2018", which regulates the protection and enhancement of the landscape, the management of the territory and the limitation of land consumption.

In Trentino (the southern part of the Trentino-Alto Adige region), about 28% of the territory is covered by large protected areas (2 nature parks, Parco Naturale dell'Adamello and Parco Paneveggio Pale di San Martino and a national park of Stelvio), from the sites of the Dolomites, from the UNESCO Biosphere (Alpi Ledrensi), to a Ramsar area (Lago di Tovel), to the 154 Natura 2000 areas (135 Special Areas of Conservation and 19 Special Protection Areas), many of which are coordinated

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through networks of reserves. These are a way of managing and enhancing the existing Natura 2000 sites, provincial and local reserves, with a "bottom-up" approach. From a regulatory point of view, these areas are protected by a provincial law and by the transposition of European legislation (habitats and birds).

As far as the Adige basin is concerned, there are several protected areas in the basins of the tributaries such as the Noce or the Avisio, which mainly cover river areas. But there are also some near the cities of Trento or Rovereto on the Adige River.

As far as the Veneto Region is concerned, there are 6 parks (5 regional and 1 national), 19 nature reserves and 2 wetlands of international importance, covering a total of about 93,000 hectares, i.e. 5% of the regional territory. The Natura 2000 network, which includes 104 Sites of Community Interest (SCIs) and 67 Special Protection Areas (SPAs), covers 403,000 hectares. In total, the protected areas cover 23% of the regional territory (417,380 ha) and are mainly located in mountainous areas.

In the Adige basin, the Adige valley in the northern part of the province of Verona is a Natura 2000 site, as is the river delta in the municipality of Rosolina.

Land use

In the Adige basin, land use is linked to the morphology of the territory. About 90% of the territory has mountain characteristics with the presence of forests, meadows and pastures, rocky outcrops and glaciers. The lowland environment is limited by the natural conformation of the catchment area; the valley floors are the areas most affected by human activity and diversified in terms of land use. Urbanised areas mainly occupy the valley areas (3%). Agricultural areas occupy about 8 % of the land: 2.3 % maize or grassland, orchards (mainly apple orchards 2.8 %) and vineyards (2.9 %).

Agriculture and food production

Crops - In the higher parts of the basin, fodder crops are the main land use, mainly grassland, pastures and forests. In the province of Bolzano, 49% of the territory is covered by forests. For Trentino it is 63% of provincial territory (Provincia Autonoma di Trento 2019)[83]. For the two provinces of Bolzano and Trento, the agricultural activity mainly concerns the valley of the Adige, the Noce and the end of the other tributaries, with the cultivation of fruit trees and vineyards (La Jeunesse *et al.*, 2016; Cirelli, La Jeunesse 2019). In the province of Verona, the first cultivations of cereal crops are added to the above-mentioned crops.

Agriculture in Alto Adige is mainly based on fruit growing, viticulture and livestock farming. Fruit growing has become highly specialised, viticulture has focused on the production of quality wines, and mountain livestock farming is trying to exploit the new opportunities offered by interaction with the tourist and recreational sector.

[83] Foreste e fauna del Trentino, PAT 2019.

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In recent years, apple growing has continued to expand. This expansion is due, in particular, to the fact that apple growing has spread to the hills and mountains.

According to the national statistical institute (ISTAT) data (2021), there are 11,282 farms with irrigated areas, with a total of 43,469 irrigated hectares. According to the province of Bolzano, there are 8,000 irrigation concessions, corresponding to about 30 m^3/sec. Always according to the province of Bolzano, 95 % of irrigation depends on large reservoirs[84].

In Trentino, the average agricultural area used for permanent pasture and meadows in the Adige basin is 12,000 hectares. The fruit and vegetable sector is dominated by apple production. Out of a total of 10,716 hectares dedicated to apple production (ISTAT 2020), about 2,400 hectares (according to PGUAP Piano Generale di Utilizzazione delle Acque Pubbliche- 2006 data) are cultivated in the Adige basin. Another 6,500 hectares are in the Valle di Non, which is crossed by the Noce River, an important tributary of the Adige in Trentino. As for the irrigated area, of the approximately 121,000 ha of utilised agricultural area in Trentino, 22,700 ha are irrigated (ISTAT 2021). With regard to vineyards, of the 10,512 hectares cultivated in Trentino, about 6,200 are in the Adige basin (Provincia Autonoma Trento, 2006). In the case of Veneto region, there are almost 90,000 hectares cultivated (ISTAT 2021). In particular, the province of Verona, which lies within the perimeter of the Adige basin, tends to increase the area devoted to vines and apples.

For the time being, existing data on agricultural water use in the basin are very fragmentary. Systematic land use/cover data in the basin will be produced as part of the project, in particular by WP4.

Livestock - Livestock farming is the agricultural sector of reference for the mountain areas of the province of Bolzano. Most livestock farms are located at altitudes above 800 m. Cattle breeding predominates, with about 10,000 farms, mainly focused on milk production. Livestock farming occupies most of the utilised agricultural area. In addition, a large part of the arable land is cultivated with forage plants. In 2020, the share of holdings that have diversified into other remunerative activities related to agriculture is 24.7%. The most widespread related activities are agrotourism, practised by 65% of the holdings with related activities, forestry (20.4%), production of renewable solar energy (18.5%) and agricultural services for third parties (8.4%).

With regard to livestock farming, the number of holdings in Trentino is one third of that in the province of Bolzano, with 3,366 holdings, mainly with cattle.

Water uses

The Adige basin covers an area of about 12100 km^2 and also includes a small part of Switzerland (only 130 km^2): the first section runs from Lake Resia to Merano (drained area of 2670 km^2), then along the Adige valley to Trento (drained area of about 9,810

[84] Provincia di Bolzano

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km²), and from Trento to Verona the valley is called Lagarina (about 11,100 km²). The territory of the provinces of Bolzano and Trento is predominantly mountainous, with very high elevations and softening in the valley bottoms of the Adige River and its main tributaries. The Veneto part of the territory includes the Lessinia mountain area, with moderate altitudes, and a part of the Veneto plain in the province of Verona, including the city itself. The Adige River then flows into the Adriatic Sea between the mouth of the Brenta River and the delta of the Po River as far as Albaredo (province of Verona), where it closes its basin because the high embankment does not allow tributaries to flow in and the river becomes a lowland river. The Adige basin consists of 7 sub-basins corresponding to the main tributaries: Adige-Passirio, Rienza, Isarco-Talvera, Noce, Avisio, Adige-Fersina-Lenio, and Adige-Chiampo.

The basin also includes the Adige-Garda tunnel, which connects the Adige river to lake Garda. The tunnel is capable of draining flows up to a maximum of 500 m^3 /s, thus contributing significantly to the hydraulic safety of the downstream sections.

As far as the Province of Bolzano is concerned, out of a total area of 7,400 km², 7,192 km² belong to the Adige river basin (Provincia Autonoma di Bolzano, 2017). This means that 97% of the territory of Alto Adige belongs to the Adige river basin[85], (that is 59% of the territory of the entire basin), the territory of the Province of Trento occupies about 28% of the entire basin with a total area of 948 km2), the Veneto region about 12% and the remaining 1% corresponds to the territory of Switzerland.

The database of the province of Bolzano contains more than 14,000 concessions for different water uses. Among the most important uses, more than 10,000 are for agricultural purposes (irrigation, livestock), about 2,000 for drinking and domestic purposes, about 1,000 for hydroelectric use and about 215 for artificial snow production (Provincia Autonoma di Bolzano, 2017).

In order to increase the availability of water during periods of intense use, reservoirs have been built for some of the watercourses. The first were built in Alto Adige at the end of the 19th century to ensure greater water availability for irrigation channels. In recent years there has been a steady increase in the number of small reservoirs for snow-making on ski slopes and for irrigation. Finally, some ponds have been created for the practice of sport fishing.

Drinking water use - In the province of Bolzano in Alto Adige, most of the municipalities in the province are supplied with water from springs, with wells used only in the valley bottoms. The PGUAP – Piano Generale Utilizzazione delle Acque Pubbliche - della provincia di Bolzano - reports about 2,000 springs and about 100 wells (ibidem). Thanks to the geographical position and the characteristics of the subsoil, the quality of the drinking water is good. In most cases, the water is not treated and is used as it comes from the spring. The demand for drinking water is about 52

[85] PGUAP-Autonomous Province of Bolzano Alto Adige, 2017

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million m³ per year, of which 11 million m³ are used to satisfy the needs of tourists, who consume twice as much as the average inhabitant (241 vs. 448 l/day) (ibidem).

In Trentino, the supply for civil uses, including drinking water, is about 35 million m³/year for a total of 752 intakes.

For the municipalities of Veneto along the river, the Adige is the main source of drinking water supply and water needs treatment to be potable.

Irrigation use - Water is abstracted from springs, phreatic wells or pressurized systems and, finally, there are many diversions from surface watercourses. Surface abstractions seem to predominate. In particular, the largest abstractions for irrigation purposes are concentrated in the Veneto section of the Adige, where significant volumes are abstracted from the river during the irrigation period.

In the Upper Adige, irrigation is carried out through irrigation canals, using sprinklers or drip irrigation methods. In recent years, drip irrigation has become more widespread, especially in areas where water is less available. This method has the advantage of saving a great deal of water. However, it cannot be used for anti-brine irrigation and it uses a lot of energy. While in all parts of the province the "natural pressure" of surface water is used for irrigation purposes, in the valley floor areas south of Merano, irrigation is mainly carried out by means of wells. The average annual water demand for irrigation for the whole Alto Adige is about 150 million m³ (Provincia Autonoma di Bolzano, 2017).

In Trentino, all the main irrigation methods (e.g., flow, rain, drip) are used. By far the most widespread is the sprinkler method, which has been replaced by micro-irrigation methods in the renovation of systems where possible. The orientation of the province of Trento department of Agriculture has been to direct users to those with higher yields (typically drip). As in Alto Adige in all areas potentially prone to late frost, late frost protection is strictly required. Recent data are not available, but in 2012 a water balance carried out by the province of Trento identified 920 abstractions for agricultural use with an average annual volume of about 35 million m³/year. Abstractions for agricultural use are distributed throughout the Adige valley floor, with particular pressure in the area most suitable for viticulture, which runs from Mezzocorona to Rovereto (Provincia Autonoma di Trento, 2013). In terms of the type of abstraction, both in terms of number and volume, the well abstraction is predominant.

Hydroelectric power production - There are 61 hydroelectric power plants in the Adige basin, 34 of which produce more than 650 MW. There are 28 artificial reservoirs in the basin, 15 in the province of Bolzano and 13 in the province of Trento.

Some reservoirs are also equipped with flow facilities (*centrali ad acqua fluente*), which divert water through crossings and return it further downstream. In this case, there is no possibility of regulation and the energy produced depends on the flow of the watercourse (subject to the ecological flow and the volume of the concession).

There are 936 hydropower plants in Alto Adige - 29 large plants with a nominal capacity of more than 3,000 kW (3 megawatts) supply 86.25% of the electricity produced in Alto

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Adige while the 792 small plants contribute less than 3% to production. About 40% of the energy produced is used in the province. From an administrative point of view, plants with a nominal capacity of more than 3,000 kW are considered 'large plants'. The construction of most of these plants was completed by the end of the 1960s. In the same years, large reservoirs were built in order to use the water stored in them to boost energy production during lean periods and at times of peak demand. In recent years, however, there has been a steady increase in the number of small reservoirs for snow-making on ski slopes and for irrigation. Finally, some ponds have been created for sport fishing (Provincia Autonoma di Bolzano, 2017). The water in concession for hydroelectric use in Alto Adige is 600 m^3/sec.

The net efficient power of renewable source plants installed in Trentino Alto Adige stands at 3,759 MW, representing 95% of the net power available in the region. Among these, hydroelectric is the technology with the highest installed power of 3,247.5 MW (86.4%), followed by photovoltaic with 475 MW (11%) and bioenergy plants 95.3 MW (11.3%). Only 0.01% is represented by wind power with 0.4 MW.

The total electricity production in Trentino Alto Adige is 10,534 GWh/year, of which 9,494 GWh/year from renewable sources, i.e. 89.1% of the total. The largest contribution comes from water energy 8,713.4 GWh/year (91.8%), followed by solar energy with 428.5 GWh/year (4.5%). The remainder is produced by bioenergy 351.6 GWh/year (3.7%). At the tail end is wind energy with only 0.1 GWh/year (Terna, 2021).

Trentino-Alto Adige is the second region in Italy with the highest share of renewable energy in relative terms, with 92.1% (after Valle d'Aosta region).

Annex 12: Additional information on the institutional regime context in the Inkomati-Usuthu River basin

The Inkomati River Basin has at least seven basin-specific institutional regimes, four non-basin specific institutional regimes and one non-aggression pact. It also contains the first basin-wide Tripartite Permanent Technical Committee in the Southern African region, which was brought to a success when the Interim Inco-Maputo Agreement (IIMA) was signed in 2002. This comprehensive agreement recognises the right of riparian states to specific volumes of water, elaborating water-formulae, and specifying water quality standards. Avoiding conflicts around the use of water often require strengthening of local and national institutions and governance systems through institutional development. The institutional regimes of the Inkomati River Basin have demonstrated a high level of resilience (surviving during difficult years) and have evolved substantially since 1999. This is promising for dealing with future challenges.

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General division of powers

South Africa has three levels of government - national, regional and local (at the local level – metropolitan areas, district councils and local municipalities). Each level has their own legislative and executive authorities. At the national and regional levels, there are additionally advisory bodies constituted of traditional leaders.

The national level sets policy frameworks and the regional level sets the implement framework/programme for those policies - generally working independently with recommendations from the national level. Local governance organs are responsible for service and infrastructure delivery, local economic development, capacity building and district-wide planning.

There are groupings of government departments ("clusters") with cross-cutting programmes aimed at an integrated approach to governance at the national and regional levels. The clusters are: (1) Economic Sectors, Investment, Employment and Infrastructure Development; (2) Governance, State Capacity and Institutional Development; (3) Social Protection, Community and Human Development; (4) International Cooperation, Trade and Security; and (5) Justice, Crime Prevention and Security.

Decision-making process

Prior to 1994, the institutional structure and the management approach of water resources in South Africa were centralised. Post 1994, a decentralisation process started, with the National Water Act (1998) mandating the decentralisation of water resource management through Catchment Management Agencies (CMAs). Accordingly, CMAs (which are public enterprises) for water management areas (WMAs) were established for the protection, use, development, conservation, management and control of water resources. Separately, the Local Government, via the Water Services Act (1997), has the mandate to deliver water services. As water management was delegated to the regional level, decision-making processes became more open to a wider range of stakeholders, especially local communities.

The Inkomati-Usuthu CMA (IUCMA) is mainly responsible for the co-ordination of water-related activities of organisations in WMAs, monitoring and control of water-use, administration of water licences, development of catchment management strategy, facilitating public participation and creating institutional structures and conditions for management. The Regional Office of the Department of Water and Sanitation and the IUCMA are responsible for the management of water resources. However, the ICUMA still reports to several government entities.

Water, Energy, Agriculture and Environment management

The authorities (from national to local) benefit from different types of support (law, action plan, strategy, etc.) to manage the resources on their territories (water, energy, food and ecosystem).

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Each case study leader was asked, with the support of a policy inventory table (Table 25), to list and describe the most important policy instruments related to the WEFE sectors. **Error! Reference source not found.**

Table 24: Main policy instruments related to the WEFE nexus in the Inkomati-Usuthu River River Basin, South Africa.

SECTOR	TYPE	LEAD	TITLE	LEVEL
Climate change	Legislation	National Treasury of South Africa	*Carbon Tax Act, 2019 (Act 15 of 2019)*	National
Climate change	Legislation	Department of Fisheries, Forestry and the Environment	*Climate Change Bill*	National
Ecosystem	Legislation	Department of Fisheries, Forestry and the Environment	*National Environmental Management Act (Act 107 of 1998)*	National
Ecosystem	Legislation		*National Environmental Management: Biodiversity Act, 2004 (Act 10 of 2004)*	National
Ecosystem	Legislation	Department of Agriculture, Land Reform and Rural Development	*National Forests Act, 1998*	National
Ecosystem	Legislation	National Government	*National Environmental Management: Protected Areas Act, 2003 (Act 57 of 2003)*	National
Ecosystem	Plan	South African National Parks	*KNP Park Management Plan*	Municipal Local
Ecosystem	Strategy	Department of Forestry, Fisheries and the Environment	*National Protected Area Expansion Strategy for South Africa*	National
Ecosystem	Plan	Mpumalanga Tourism & Parks Agency	*Mpumalanga Biodiversity Sector Plan*	Regional Provincial
Ecosystem	Plan	Department of Forestry, Fisheries and the Environment	*National Biodiversity Strategy and Action Plan*	National
Energy	Plan	Department of Minerals and Energy	*Integrated Resource Plan (has been updated a multitude of times to reflect changes - latest is 2019)*	National
Energy	Legislation		*National Energy Regulator Act*	National
Energy	Policy		*White Paper on the Energy Policy of South Africa (1998)*	National
Energy	Policy		*White Paper on Renewable Energy (2003)*	National
Energy	Legislation	Department of Minerals and Energy	*Mineral and Petroleum Resources Development Act, 2002*	National
Energy	Legislation		*National Energy Regulation Act 40 of 2004*	National
Energy	Strategy		*National Energy Efficiency Strategy*	National
Energy	Plan		*Integrated Energy Plan*	National
Energy	Plan	Department of Energy	*Department of Energy Strategic Plan 2011/12 - 2015/16*	National
Energy	Strategy		*South Africa's Low Emission Development Strategy*	National
Food	Policy	Department of Agriculture, Land Reform and Rural Development	*White Paper on Agriculture 1995*	National
Food	Plan		*Integrated growth and development plan (IGDP) for agriculture, forestry and fisheries*	National
Food	Legislation	Department of Agriculture, Land Reform and Rural Development	*Conservation of Agricultural Resources Act 1983*	National
Food	Policy	Department of Agriculture, Land Reform and Rural Development	*Policy on Agriculture in Sustainable Development*	
Food	Policy	Department of Agriculture, Land Reform and Rural Development	*The National Policy on Food and Nutrition Security for the Republic of South Africa*	National
Food	Policy	Department of Agriculture, Forestry and Fisheries	*National Policy on Food and Nutrition Security*	National
Food	Plan	national government	*National Food and Nutrition Security Plan for South Africa*	National

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Food	Strategy	Department of Agriculture, Land Reform and Rural Development	*Livelihoods Development Support Programme*	
Food	Legislation	Department of Agriculture, Land Reform and Rural Development	*Preservation and Development of Agricultural Land Bill*	National
Food	Plan	(former) Department of Agriculture, Forestry and Fisheries	*The Agriculture Integrated Growth and Development Plan*	National
Water	Policy	South. African National Parks	*A revised water-distribution policy for biodiversity maintenance in the KNP*	Municipal Local
Water	Legislation	Department of Water and Sanitation	*National Water Act (Act No. 36 of 1998)*	National
Water	Plan	Inkomati-Usuthu Catchment Management Agency	*Annual Performance Plan 2022/23*	
Water	Policy	Department of Water and Sanitation	*National Sanitation Policy*	National
Water	Policy	Department of Water and Sanitation	*White paper on a national water policy for South Africa*	National
Water	Strategy	Department of Water and Sanitation	*National Water Conservation and Water Demand Strategy*	National
Water	Policy	Department of Water and Sanitation	*Use of water for aquaculture purposes operational policy*	National
Water	Strategy	Department of Water Affairs	*National Water Resource Strategy 2nd Addition*	National
Water	Framework	Department of Water Affairs	*Water for Growth and Development*	National
Water	Plan	Department of Water and Sanitation	*National Water and Sanitation Master Plan*	National
Water	Transboundary Agreement	operational water management institutions in Swaziland, South Africa and Mozambique	River and Environmental Management Cooperation (REMCO) Collaboration Agreement	International
Water	Transboundary Agreement	Komati Basin Water Authority (KOBWA)		International
Water	Transboundary Agreement	ARA-Sul Basin Committee		International
Climate Water Energy Food	Policy	Intergovernmental Committee on Climate Change (IGCCC)	*National Climate Change Response Policy*	National
Water Energy Food Ecosystem	Framework	Department of Cooperative Governance and Traditional Affairs, MP	*Mpumalanga Spatial Development Framework*	Regional Provincial
Water Energy Food Ecosystem	Framework	Province of *Mpumalanga*	*Mpumalanga Vision 2030 Strategic Implementation Framework*	Regional Provincial
Water Energy Food Ecosystem	Strategy	Department of Forestry, Fisheries and the Environment	*National Climate Change Adaptation Strategy*	National

International management of waters

The Komati river basin extends over 14.000km². Growing demand for water and poor domestic and international coordination have led to conflicts between riparian States and water users. Water use is intense, with at least 50% of the water generated in the basin being withdrawn, in a context of recurring droughts, periodically alternated by dramatic floods. Floods have caused massive economic damage and alien invasive species (terrestrial and aquatic) pose another threat to ecosystems.

Conflicts are further exacerbated by different levels of wealth and development (poorer countries with insufficient funds for water resources development).

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Political instability has further weakened legal and institutional frameworks; difficult political circumstances resulting from the civil war in Mozambique (ended in 1992) inhibit cooperation efforts and trust. Frequent droughts exacerbated these conflicts: in one incidence of serious drought, consumers in Mozambique were rationed because insufficient water could be stored in reservoirs; the situation was exacerbated politically because the Injaka dam (South Africa) was perceived by Mozambique as a violation of the Tripartite Permanent Technical Committee water agreement. However, cooperation seems to have improved.

Some actions have been taken to manage these challenges:

- 1983: Transboundary Tripartite Permanent Technical Committee (TPTC) was established to discuss water issues between the three countries;
- Joint Permanent Technical Committees (JPTCs) were formed bilaterally; in 1992 the JPTC of Swaziland and South Africa turned into the Joint Water Commission (JWC) (chaired by Department for Water) through signing the Joint Water Commission Treaty; formal meetings are held twice a year;
- 1998: Southern Africa Development Community (SADC) signed protocol on shared watercourses, calling for cooperation between riparian States;
- 2002: Three countries signed the Interim Inco-Maputo Agreement, aiming for cooperation, sharing water resource development plans, assessments and monitoring data on floods and droughts (e.g., 2000s floods devastated Mozambique), joint funding applications for joint projects and programmes to face hydrometeorological extreme events;
- 2002: Inkomati Systems Operation Task Group (ISOTG) was established to formulate operating rules for the river; recommended inter-sectoral governance to the local level and to establish the Komati Joint Operations Forum (KJOF), comprising water users to advise the Komati Basin Water Authority (KOBWA);
- 2002 to present: KOBWA manages the Komati River on the operational aspects of water resources management.

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