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Assessing policy and governance framework for the
implementation of Nature-Based Solution (NBS) to manage
Water-Energy-Food-Ecosystem (WEFE) Nexus in a
Mediterranean watershed

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Abbreviations and Acronyms

EU	European Union
EbA	Ecosystem-based Adaptation
FAO	Food and Agriculture Organization
GWP-Med	Med: Global Water Partnership-Mediterranean
IUCN	International Union for Conservation of Nature
LAA	Learning and Action Alliance
LENSES	LEarning and Action Alliances for NexuS EnvironmentS in an uncertain future
MEA	Millennium Ecosystem Assessment
NBS	Nature-Based Solution
NEMA	National Environment Management Authority
OECD	Organisation for Economic Co-operation and Development
PRB	Pinios River Basin
REXUS	Managing Resilient Nexus Systems Through Participatory Systems Dynamics Modelling
SES	Social-ecological systems
SDG	Sustainable Development Goal
SWRI	Soil and Water Research Institute
UNECE	United Nations Economic Commission for Europe
UNIPD	University of Padova
WCED	World Commission on Environment and Development
WEF	Water, Energy and Food
WEFE	Water, Energy, Food, and Ecosystem

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Summary

Addressing the vital intersection of Water-Energy-Food-Ecosystem (WEFE) Nexus through the lens of policy and governance, this thesis marks a pivotal contribution to sustainable resource management and ecological resilience. It underscores the importance of harmonizing environmental stewardship with human development and well-being. Focused on the Pinios River Basin (PRB) in Thessaly, North-Western Greece, the study embarks on a thorough investigation of policy and governance frameworks essential for Nature-Based Solutions (NBS) within the WEFE Nexus. Utilizing a mixed-methods approach, encompassing stakeholder questionnaires, interviews, and workshops, the research provides a comprehensive evaluation of governance structures, policy frameworks, and management practices related to NBS in the PRB, guided by the specialized framework developed by the University of Padova under the LENSES project.

The analysis reveals a 76% effectiveness in 'Conducive Governance Arrangements,' highlighting the need for more streamlined responsibilities and participatory approaches. 'Supportive Policies' are notably effective, achieving a 100% score and demonstrating strong alignment with EU and national frameworks. However, the 'Supporting Policies' dimension, while solid at 75% effectiveness, requires enhancements to better serve human well-being and rights. High scores in 'Appropriate Regulatory Environment' and 'Technical Capacity' suggest a supportive climate for NBS in Greece, but also indicate a need for further specialization in NBS education.

Significant gaps in 'Access to Finance' and 'NBS Management' emphasize the need for improved project management and financial legal frameworks. The study recommends establishing dedicated governance bodies, enhancing continuous education, and developing adaptive strategies for sustainable NBS. Concluding, the thesis calls for future research focused on the practical implementation of these recommendations, exploring innovative financing and measurement methods, and conducting longitudinal studies to assess the impact of governance changes on NBS practices, with potential applications extending from Greece to a global scale."

Chapter 1: Introduction

This chapter introduces the main topics addressed by the research, providing background information for the study, defining the research problem, reporting research questions and objectives, and finally presenting the structure of this thesis.

1.1 Background

The Mediterranean region has been acknowledged for its scarce water resources, owing to its climate (Grenon and Batisse, 1991). “*The solutions for inland waters are well-known, and adaptations would be necessary sooner or later*” (Grenon and Batisse, 1991). They also warned about closely monitoring the consequences of climate change due to the greenhouse effect. Their contribution recognizes the interdependence between climate, soil, water constraints, the energy sector, agriculture, demographics, and economics. This interdependence has been recognized since ancient times. For example, Romans used smart agricultural practices and water transfers to flourish in the water-scarce environment of the Mediterranean (Dermody *et al.*, 2014). More recently, this interdependence has been conceptualized into the water-energy-food-ecosystem (WEFE) Nexus approach.

The WEFE Nexus is a complex concept that highlights the interconnections between WEFE. It has gained increased attention in recent years because of the growing recognition that these sectors/domains are interdependent, and that actions in one of them can have significant impacts on others (Bazilian *et al.*, 2011; Adamovic *et al.*, 2019; Carmona-Moreno *et al.*, 2021). The term, originally reported just as WEF (water-energy-food) Nexus, was first introduced in the Bonn 2011 Conference on the Water, Energy and Food Security Nexus. The conference aimed to improve understanding of the interlinkages between water, energy, and food security, and the necessary governance, policy, and institutional frameworks to support a Nexus approach. Since then, the concept has been mostly referred to as WEFE Nexus and has been developed and adopted in various international forums and academic disciplines. The close connections between the water, energy, and food sectors mean that actions taken in one area can have unintended consequences in others (Hoff, 2011). While Figure 1 graphically represents them, Table 1 describes more in detail these connections among the sectors. Since the four WEFE sectors/domains often operate independently, pursuing security in one of them may come at the expense of others (NA, 2015).

Managing the WEFE Nexus sustainably requires an integrated approach that considers the trade-offs and synergies between different sectors/domains (Adamovic *et al.*, 2019; FAO, 2014). Due to the limited availability of resources, trade-offs might arise; for example, once water is utilized by one sector, it becomes unavailable for other sectors such as the energy, agriculture or even industrial sectors, and moreover water use might have an impact on ecosystems from which water is sourced or that would need water for their maintenance. To identify these potential trade-offs in detail, it is important to differentiate water abstraction in water that is eventually returned to the hydrological system from water that is lost to the atmosphere through evaporation of e.g. cooling towers or irrigation water (De Roo *et al.*, 2021).

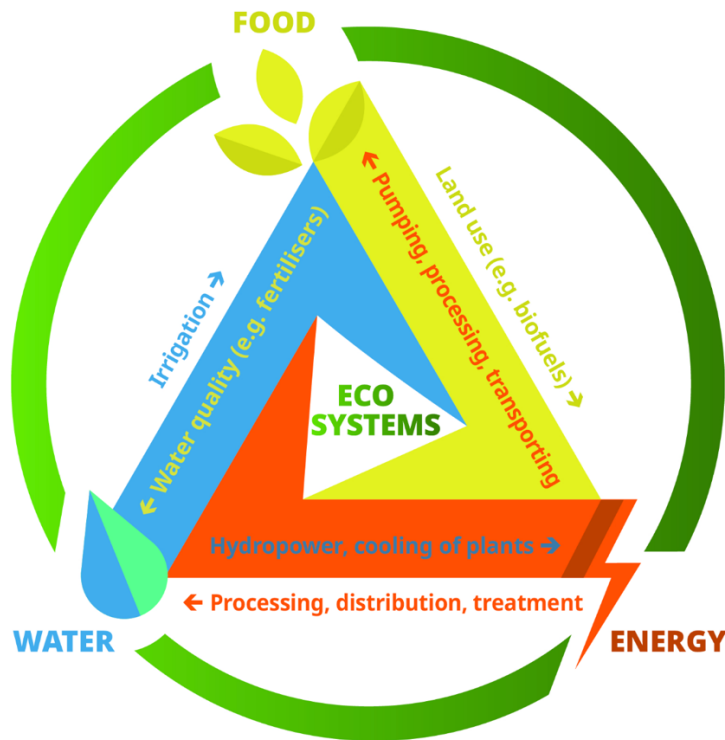


Figure 1: The Nexus approach (Source: Global Water Partnership-Mediterranean, 2020)

Table 1: Multi-dimensional interlinkages between water, energy, food and ecosystems (Source: Global Water Partnership-Mediterranean, 2020; Hoff et al., 2011)

Interlinkages	Description
Water<->Energy	Water plays a key role in energy production, e.g. in hydroelectric plants, for cooling thermal (fossil-fuel or nuclear) plants and in growing plants for biofuels. Conversely, energy is required to process and distribute water, to treat wastewater, to pump groundwater and to desalinate seawater.
Water <-> Food	Water is the keystone for the entire agro-food supply chain. Conversely, agricultural intensification impacts water quality because of
Food <-> Energy	Energy is an essential input throughout the entire agro-food supply chain, from pumping water to processing, transporting and refrigerating food. Conflicts around land use for food production may arise in the case of biofuels or extended solar installations.
Healthy ecosystems	Healthy ecosystems are an essential requirement for the sustainability of all the above and are negatively affected if water, energy or food are used in an unsustainable way.

Managing the WEF Nexus is often seen as a wicked problem that can be addressed and managed in multiple ways and with different approaches. This implies considering a broad range of technical solutions, ranging from pure grey to pure green infrastructures. In the last decades special attention has been given to Ecosystem-based Approaches (EbA), involving a wide range of ecosystem management activities and, among them, the concept of Nature-Based Solutions (NBS) has gained momentum (Figure 2). According to the International Union for Conservation of Nature (IUCN), NBS are defined as "actions to protect, sustainably manage, and restore natural or modified ecosystems, that address societal challenges effectively and adaptively, simultaneously providing human well-being and biodiversity benefits" (IUCN, 2020). NBS can provide a range of benefits related to WEF services and can help address WEF Nexus challenges (Figure 3) by promoting sustainable resource use and management, reducing risks from natural disasters, and enhancing resilience to climate change (Vanneuille *et al.*, 2015). There are several types of NBS, including green, blue, and hybrid infrastructure. Green infrastructure includes actions such as afforestation, reforestation, and the creation of green spaces in urban areas, whereas blue infrastructure involves the restoration and enhancement of wetlands, rivers, and other aquatic ecosystems. Hybrid infrastructure combines green and blue infrastructure to provide multiple benefits (IUCN, 2021).



Figure 2: Defining Nature-based Solutions © IUCN (Source: IUCN, 2020)

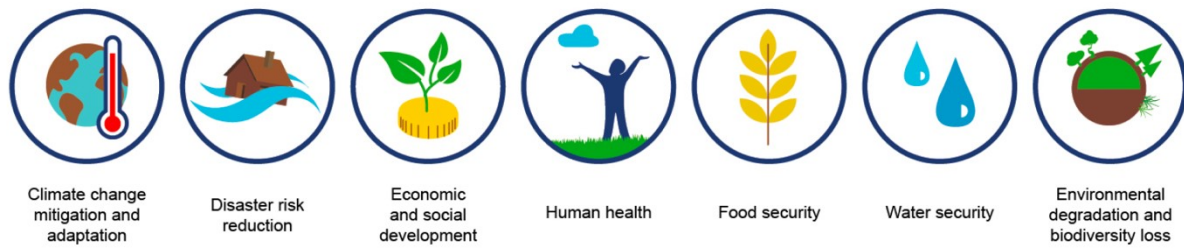


Figure 3: Major societal challenges addressed by NBS. © IUCN (Source: IUCN, 2020)

There is growing interest in the use of NBS as a way to manage the WEFE Nexus, particularly in areas facing water scarcity and environmental degradation (European Commission, 2015). However, the implementation of NBS within the framework of the WEFE Nexus requires a robust policy and governance framework that can effectively address the complex interactions between natural resources and social systems (Adamovic *et al.*, 2019; Bennett *et al.*, 2019; IUCN, 2020). Although several studies have examined the potential of NBS to address WEFE challenges (Mendes *et al.*, 2020; Wickenberg *et al.*, 2021; Kauark-Fontes *et al.*, 2023), a lack of research that systematically assesses the policy and governance aspects that enable or hinder the implementation of NBS in specific contexts has emerged. In this perspective, researchers at the Land, Environment, Agriculture and Forestry Department of the University of Padova, as part of the LENSES (LEarning and Action Alliances for NexuS EnvironmentS in an uncertain future) project, specifically under the Working Package 6 (WP6) - Environmental and Natural Resource Economics Approaches for Nexus Business Cases, have developed the LENSES-UNIPD framework. This framework encompasses policy and governance indicators for Nexus-relevant Nature-Based Solutions (NBS) as described in Deliverable 6.2 (D6.2). However, its applicability and effectiveness in the Mediterranean region remain largely unexplored (Righetti *et al.*, 2022).

The European Commission's report on NBS and re-naturing cities (European Commission, 2015) called for research and innovation efforts to better understand the social, economic, and environmental benefits of all types of NBS. To achieve this, it is necessary to answer performance-related questions when selecting a solution. In response to this call, Kabisch *et al.* (2016) identified indicators for assessing the effectiveness of NBS in climate change mitigation and adaptation, including indices for integrated environmental performance, human health and well-being, citizen involvement, and management.

This study aims to contribute to research on the factors enabling NBS implementation within the WEFE Nexus by focusing on policy and governance aspects implementing the LENSES-UNIPD framework¹ with reference to a specific case study area in Greece. By doing so, this study seeks to contribute to the understanding of the institutional factors that affect the implementation of NBS in the WEFE Nexus and provide recommendations for improving policy and governance frameworks for NBS implementation in the Mediterranean region.

The findings of this study validate the applicability and effectiveness of the LENSES-UNIPD framework in the Mediterranean region, furthering its use and development in other contexts. In addition, it will provide insights into the policy and governance aspects of NBS

¹ This framework is developed jointly by the LENSES project and University of Padova as part of the Deliverable 6.2 (Policy indicators and framework for Nexus-relevant NBS) of Work Package 6. The LENSES project is part of the PRIMA programme supported the European Union. GA # [2041] [LENSES] [Call 2020 Section 1 Nexus |A]

implementation in the study area (and possibly beyond) and offer recommendations for improving the effectiveness of current policy frameworks. The study also contributes to a broader understanding of the institutional factors affecting the implementation of NBS in the WEFE Nexus. It aims to provide guidance for policymakers and practitioners on how to design more effective policy and governance frameworks for NBS implementation in the targeted area, providing useful lessons learned for the Mediterranean region.

1.2 Problem statement and research questions

Raymond *et al.* (2017) suggest that in order to offer a complete framework for addressing an issue and finding solutions, it is important to identify any potential feedback loops or trade-offs that may exist across various aspects such as technology, finances, politics, and society. Additionally, they recommended the use of participatory approaches that involve relevant stakeholders and the development of appropriate methods for evaluating performance, including both monetary and non-monetary measures of benefits.

The implementation of the NBS to manage the WEFE Nexus requires a robust policy and governance framework that can effectively address the complex interactions between natural resources and social systems (Adamovic *et al.*, 2019). Although several studies have examined the potential of NBS to address WEFE challenges, there is a lack of research that systematically assesses the policy and governance aspects that enable or hinder the implementation of NBS in specific contexts (Zingraff-Hamed *et al.*, 2021). Moreover, although the LENSES-UNIPD framework has been pre-tested in Mediterranean pilot areas, it has never been fully implemented on the ground, and its applicability and effectiveness in the Mediterranean region remains largely unexplored.

This study mainly intends to assess the policy and governance aspects for the implementation of NBS to manage the WEFE Nexus in the selected study area. To achieve this objective, the specific research questions were as follows:

1. Which are the existing NBS practices and policies related to the WEFE Nexus in the study area and what are the challenges and opportunities associated with their implementation?
2. How can the LENSES-UNIPD WP6-D6.2 Policy indicators and framework for Nexus-relevant NBS be applied to assess the policy and governance aspects of NBS implementation in the study area?
3. Which are the WEFE Nexus challenges that could hinder the implementation of NBS in the study area and how do they intersect with each other?
4. Which recommendations can be made to improve the policy and governance frameworks for NBS implementation after testing it in the study area?

1.3 Structure of the thesis

This thesis is organized into six main chapters. Chapter 1 provides background information, research problems, research objectives, and study questions. This sets the stage for the remainder of this thesis. Chapter 2 outlines key theories and definitions pertinent to the research, offering a succinct review of essential existing literature and emphasizing aspects

crucial to this study. Section 3 describes the research approach and methodology used in this study. This includes a description of the research design, sample selection, data collection techniques, and statistical analysis methods. Chapter 4 presents the findings of the study providing a detailed description of the results obtained from statistical analysis and their significance. Section 5 discusses the implications of the findings, their limitations, and suggestions for future research. This provides a critical analysis of the results obtained and their implications for the research topic. This study provides recommendations for future research and practice based on the results obtained (sub-chapter 5.4). Finally, Chapter 6 summarizes the main findings of the study and draws conclusions based on the statistical analysis.

Chapter 2: Theoretical Background

This chapter presents relevant theories and definitions related to the research topic. It provides a comprehensive review of the existing literature and highlights specific aspects of the research topic that are important for the study.

2.1 Definitions

In this section definitions for key concepts used thorough the thesis are provided.

Nature-Based Solutions (NBS): The European Commission (2015) defines NBS as “*solutions that are inspired and supported by nature, are cost-effective, and provide simultaneous benefits for biodiversity, climate, and human well-being. NBS are designed to address a range of environmental, social, and economic challenges and to achieve both local and global sustainable development objectives*”.

WEFE Nexus: The WEFE Nexus is a concept that highlights the interdependence of water, energy, food security, and ecosystems, which underpin that security (Adamovic *et al.*, 2019 and Carmona-Moreno *et al.*, 2021). The WEFE Nexus aims to increase water, energy, and food security without compromising ecosystem services by identifying mutually beneficial responses that are based on understanding the synergies of water, energy, and agricultural policies (Carmona-Moreno *et al.*, 2021).

Policy and Governance Framework: According to the Organization for Economic Co-operation and Development (OECD), a policy framework is a set of principles, rules, and guidelines that guide decision-making and the implementation of policies. Governance refers to the processes, systems, and structures through which decisions are made and implemented in organizations (OECD, 2005).

2.2 Theoretical approaches

In this section theoretical aspects behind relevant approaches used or referred to within the thesis are presented.

The WEFE Nexus approach: The Nexus Approach is a concept that highlights the interconnectedness of the WEFE Nexus and seeks to address the trade-offs and synergies between the WEFE sectors. In doing so, it recognizes the need for integrated approaches to include the interlinkages between the WEFE sectors into management solutions (Bazilian *et al.*, 2011). The Nexus Approach is relevant for understanding the implementation of NBS in the WEFE Nexus as it acknowledges the importance of considering the interconnections between different sectors when developing NBS interventions. It also highlights the need for cross-sectoral collaboration and policy integration to ensure that NBS interventions are effective and sustainable.

The following are some key principles of the WEFE Nexus approach (Adamovic *et al.*, 2019):

- Gain an understanding of the interconnectedness of resources within a system over time and space. Emphasize the overall efficiency of the entire system rather than the productivity of individual components. This approach will lead to integrated solutions that contribute to the sustainability of water, energy, and food security policies, while also ensuring the preservation of healthy ecosystems.
- Acknowledge the interdependence among water, energy, food, and ecosystems. Promote rational and inclusive dialogues and decision-making processes that encourage the responsible and efficient use of these resources.
- Identify comprehensive policy solutions that optimize trade-offs and maximize synergies across different sectors. Encourage mutually beneficial responses that foster cooperation among all stakeholders, including public and private partnerships at various scales.
- Foster coordination among sectors and stakeholders to enable synergistic outcomes and enhance the sustainability of solutions.
- Recognize the value of natural capital, including land, water, energy sources, and ecosystems. Encourage governments and businesses to support the transition towards sustainability, such as through the utilization of nature-based solutions.

Adaptive governance: Adaptive governance is an approach that emphasizes the need for flexible governance systems that can respond to changing environmental and social conditions (Folke *et al.*, 2010). This approach recognizes that complex social-ecological systems require governance systems that are capable of learning, adapting, and evolving over time. Adaptive governance is relevant for assessing the policy and governance aspects of NBS implementation in the WEFE Nexus as it highlights the need for governance systems that are responsive and adaptive to changing conditions. It also emphasizes the importance of stakeholder engagement, collaboration, and experimentation in the development of governance systems that can respond to complex environmental and social challenges.

Environmental policy integration: Environmental policy integration is a concept that seeks to promote the integration of environmental considerations into policymaking across different sectors and levels of governance (Jordan *et al.*, 2005). This approach recognizes the need for policy coherence and coordination across different policy domains to ensure that environmental objectives are integrated into broader policy objectives. Environmental policy integration is relevant for assessing the policy and governance aspects of NBS implementation in the WEFE Nexus as it highlights the need for policy coherence and integration across different sectors to ensure that NBS interventions are effective and sustainable. It also emphasizes the importance of stakeholder engagement and participatory governance processes in promoting policy integration.

Actor-Network Theory: Actor-Network Theory (ANT) is an approach that emphasizes the role of actors and their relationships in shaping social and environmental outcomes (Latour, 2007). This approach recognizes that social and environmental phenomena are the result of complex and dynamic networks of actors and their interactions. ANT is relevant for understanding the implementation of NBS in the WEFE Nexus as it emphasizes the importance of stakeholder engagement and collaboration in shaping the outcomes of NBS interventions. It also highlights the need for understanding the complex social and political dynamics that influence the implementation of NBS interventions.

Political ecology: Political ecology is an approach that seeks to understand the relationships between social and environmental systems and the distribution of power and resources (Blaikie and Brookfield, 1987). This approach recognizes that environmental issues are often the result of social and political processes and that environmental interventions must be understood within broader social and political contexts. Political ecology is relevant for understanding the implementation of NBS in the WEFN Nexus as it emphasizes the importance of understanding the social and political dynamics that shape the implementation of NBS interventions. It also highlights the need for participatory governance processes that promote equity and social justice in the development and implementation of NBS interventions.

Ecosystem services: The concept of ecosystem services refers to the benefits that people obtain from ecosystems, including provisioning services (e.g., food, water), regulating services (e.g., climate regulation, water purification), cultural services (e.g., recreation, spiritual and aesthetic values), and supporting services (e.g., nutrient cycling, soil formation) (MEA, 2005). The concept has gained popularity as a tool for highlighting the importance of ecosystems in sustaining human well-being and as a way of integrating ecological considerations into decision-making processes (Braat and de Groot, 2012). Understanding the ecosystem services provided by NBS is important for assessing their potential benefits for the WEFN Nexus and for developing policy and governance frameworks that can support their implementation.

Sustainable development: Sustainable development is a widely recognized concept that has been discussed in the literature for several decades. It was first defined in the Brundtland Report as “*development that meets the needs of the present without compromising the ability of future generations to meet their own needs*” (WCED, 1992). The concept emphasizes the integration of environmental, social, and economic considerations in decision-making processes and has become a guiding principle for policy development at the international, national, and local levels. In the context of NBS implementation for the WEFN Nexus, sustainable development provides a framework for assessing the trade-offs and synergies between different objectives and for ensuring that the benefits of NBS are distributed equitably across different stakeholders and future generations.

Social-ecological systems: Social-ecological systems (SES) refer to the complex interactions between social and ecological components of a system, including the linkages between them (Folke *et al.*, 2010). The concept emphasizes the interdependence between human and natural systems and the need for integrated management approaches that can account for the dynamic and complex nature of these interactions. In the context of NBS implementation for the WEFN Nexus, SES provide a framework for understanding the feedback and linkages between different components of the system and for assessing the potential impacts of NBS on different stakeholders and ecosystem services.

Collaborative governance: Collaborative governance refers to a decision-making approach that involves the participation of multiple stakeholders in the development and implementation of policies and programs (Ansell and Gash, 2008). The approach emphasizes the importance of dialogue, cooperation, and joint problem-solving in addressing complex and contentious issues. Collaborative governance is relevant for NBS implementation for the WEFN Nexus

because it provides a framework for engaging with diverse stakeholders and for developing policies and programs that are responsive to their needs and perspectives.

2.3 Conceptual Framework

The conceptual framework for this thesis focuses on three main components described below.

The WEFE Nexus: The WEFE Nexus refers to the interconnectedness of WEFE resources, where changes in one system can affect the others. This concept has gained attention in recent years to address the complex and interrelated challenges related to these resources (Albrecht *et al.*, 2018). The WEFE Nexus is a useful framework for understanding the interconnectedness of natural resources and social systems and the potential for NBS to address challenges in these systems.

NBS in the WEFE Nexus: NBSs are defined as "actions to protect, sustainably manage, and restore natural or modified ecosystems that address societal challenges effectively and adaptively, simultaneously providing human well-being and biodiversity benefits" (Cohen-Shacham *et al.*, 2016). NBS have the potential to address WEFE challenges by utilizing natural systems and processes to provide ecosystem services that benefit human well-being and the environment. Examples of NBS include green roofs, ecosystem restoration, and sustainable agriculture practices.

Policy and governance for NBS implementation: Policy and governance for NBS implementation are critical for realizing the potential of NBS to address WEFE challenges. This includes the institutional frameworks, rules, and regulations that govern the implementation of NBS. Effective policy and governance frameworks should consider the complex interactions between natural resources and social systems, as well as the diverse perspectives and interests of stakeholders (Preston *et al.*, 2011). The analysis of policy and governance aspects is essential for the successful implementation of NBS in the WEFE Nexus. Although the concept of NBS has gained attention in international and European policies in recent years, its practical implementation remains challenging, and its potential is not fully utilized. Maes and Jacobs (2015) argue that effective policy changes require corresponding institutional and governance changes to ensure successful implementation. Managing NBS design and implementation is complex due to the involvement of multiple actions and effects that cross jurisdictional boundaries, requiring cooperation and coordination among stakeholders with potentially conflicting priorities, interests, or values (Dale *et al.*, 2019). NBS decision-making, including costs, location, scale, and management, involves a wide range of stakeholders with different perspectives and experiences, which must be addressed (Nesshöver *et al.*, 2017). While some scholars argue that there are gaps in knowledge regarding the cost-effectiveness of NBS compared to conventional solutions (Seddon *et al.*, 2020), Kabisch *et al.*, (2016) identify several other barriers to NBS implementation, such as the "fear of operational unknown" since NBS require new protocols for implementation and maintenance, and the "disconnect between short-term actions and long-term goals" due to different decision-making and action cycles. Additionally, NBS projects require expertise in multiple domains that may not fit within existing decision-making structures. Finally, funding for NBS projects may be limited, as high costs can deter potential funders and require long-term planning for maintenance and delivery of benefits (Harman *et al.*, 2013; Kabisch *et al.*, 2016).

Empirical data, analysis, and synthesis: To test the validity and effectiveness of the LENSES-UNIPD framework, empirical data will be collected through qualitative research methods, including semi-structured interviews, focus group discussions, and document analysis. The data collection will involve key stakeholders and actors involved in the implementation of NBS in the Pinios River Basin (PRB), including policymakers, water and land managers, civil society organizations, and local communities. The collected data will be analyzed using thematic analysis to identify patterns, trends, and recurring themes related to policy and governance aspects for NBS implementation in the WEFE Nexus. The analysis will involve coding and categorizing the data, which will then be synthesized and interpreted using the conceptual framework developed in this study. The framework will help to identify the institutional factors that enable or hinder the implementation of NBS in the PRB and provide recommendations for improving policy and governance frameworks for NBS implementation in the Mediterranean region.

2.4 The LENSES-UNIPD WP6-D6.2 Policy indicators and framework for Nexus-relevant NBS

A technical guideline to help LENSES pilot areas to assess the policy and governance challenges of NBS and to guide them in delivering Nexus-added values has been developed by a research group of the University of Padova. The group had several objectives, including investigating how WEFE Nexus and NBS concepts are addressed in key policy documents, thus creating a framework to guide pilots in investigating these concepts in their national and subnational policies. It does so by collecting information on relevant NBS policy and governance aspects, developing a new framework to assess how policy and governance conditions enable the success of an NBS project (Figure 4), and creating a user guide for the framework. The report (Righetti *et al.*, 2022) provides a useful tool to assess the enabling environment for NBS design and implementation in terms of policy and governance aspects.

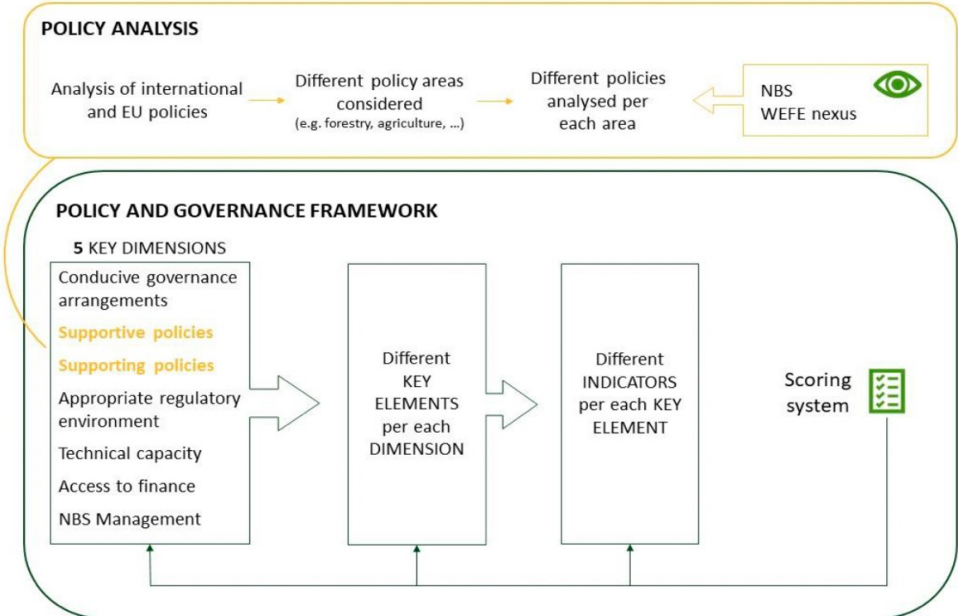
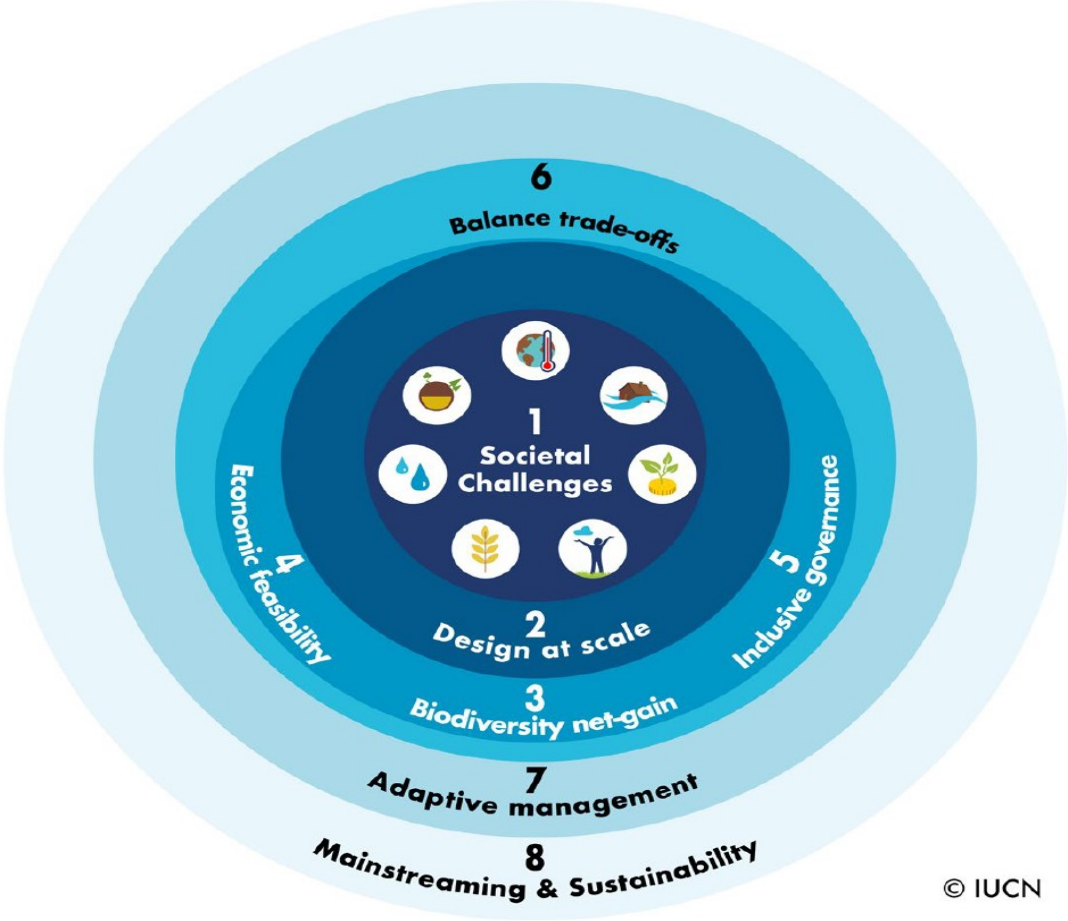


Figure 4: General scheme of the LENSES-UNIPD WP6-D6.2 framework for the assessment of governance and policy associated to Nexus-relevant NBS. (Source: Righetti *et al.*, 2022)

The purpose of the deliverable was to create an assessment framework capable to evaluate the effectiveness of policy and governance conditions in facilitating the implementation and success of a NBS project. The framework includes various dimensions, elements, and indicators, which are detailed in *Annex 1*. A variable score is used to measure the level of optimality in the policy and governance environment, as outlined in *Annex 2*.

To develop the framework, the project drew on key dimensions and elements outlined by the OECD (2020), as well as incorporating additional dimensions and elements from other sources. The project also used criteria outlined by the IUCN (2020) (Figure 5), which were translated into new dimensions and elements, and associated with IUCN indicators. Additionally, governance indicators from other studies were used, as well as newly developed indicators.

Based on the consultation from the OECD (2020) (Figure 6) and IUCN (2020), the LENSES-UNIPD framework is structured seven key dimensions, for each of these dimensions, specific indicators are defined. Indicators represent the basis for the assessment of the governance and policy aspects and the definition of the scoring system.



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Figure 5: IUCN Global Standards for NBS © IUCN (Source: IUCN, 2020)

The OECD NBS policy framework (Figure 6) focuses on the role of NBS in addressing water-related climate risks and supporting the greening of the COVID-19 recovery, while the IUCN Global NBS Standard, 2020 (Figure 5) provides a comprehensive framework for the verification, design, and scaling up of NBS, offering clear guidance on various aspects of their implementation.

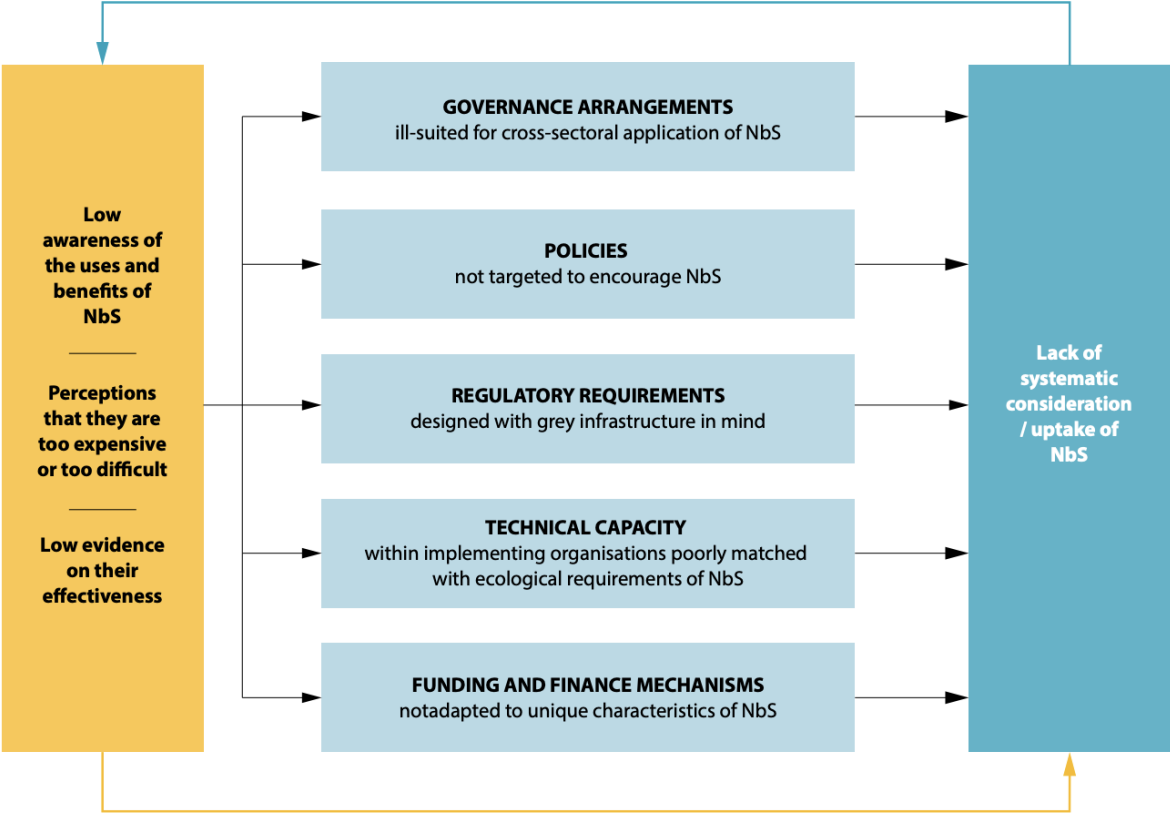


Figure 6: OECD NBS Policy Framework (Source: OCED, 2020)

A short description of both dimensions and indicators is provided hereafter.

2.4.1 Key Dimension 1 - Conducive governance arrangement

The OECD framework identifies the need for governance arrangements that coordinate different policy areas and public authorities involved in deploying and financing NBS. This includes three key elements (Table 2): (i) responsibilities for different NBS phases, (ii) coordination mechanisms, and (iii) stakeholder endorsement. The first key element has two indicators: clearly defined structure and roles, and well-defined actors' responsibilities for each NBS phase. The second key element has six indicators, including participation in all NBS intervention processes, equity in participatory processes, and represented interest of stakeholders. Intra- and inter-organizational coordination mechanisms are also essential for successful NBS implementation. The third key element includes two indicators: community support for NBS and management of negative impacts. Successful NBS implementation requires collaborative planning processes, involvement of civil society, open-mindedness of administrations, and trust among stakeholders.

Table 2: Key Dimension 1 - Conducive governance arrangement (Source: Righetti et al., 2022)

#	Key dimension	##	Key elements	###	Indicators
1	CONDUCTIVE GOVERNANCE ARRANGEMENTS	1	Responsibilities for different aspects of NbS phases (planning, implementation and maintenance)	1	Clearly defined structure and roles
				2	NBS responsibilities
		2	Coordination mechanisms (horizontal and vertical)	1	Participation in all processes of the NBS intervention
				1.1	Equity in participatory processes
				1.2	Represented stakeholders
				2	Represented interest of stakeholders
				3	Intra-organisational coordination
				4	Inter-organisational coordination
		3	Stakeholder endorsement	1	Community supporting the NBS
				2	Management of the negative impacts' strategy

2.4.2 Key Dimension 2 - Supportive policies

The OECD's framework identifies supportive policies as a key dimension for accelerating the uptake of NBS, which includes clear mandates and support for NBS, coherence between sectoral policies, and mechanisms to address trade-offs, and encouragement of NBS within infrastructure planning processes. The associated indicators include investigating how supportive policy frameworks are for NBS planning and use, as suggested by the European Commission and realized in Davis *et al.* (2017) (Table 3).

Table 3: Key Dimension 2 - Supportive policies (Source: Righetti et al., 2022)

#	Key dimension	##	Key elements	###	Indicators
2	SUPPORTIVE POLICIES	1	Clear mandate and support for NbS	1	European, national and sub-national policies supporting NBS
		2	Coherence between sectoral policies, and mechanisms to address trade-offs	1	European, national and sub-national policies' objectives
		3	Encouragement of NbS within infrastructure planning processes	1	Indication of NBS as planning options

2.4.3 Key Dimension 3 - Supporting policies

The supporting policies dimension was added as the third key dimension based on IUCN indicators 8.2 and 8.3. The key elements of this dimension are (i) encouragement of NBS

adoption towards its positive outcomes and (ii) methodologies in place for measuring NBS contribution (Table 3). The corresponding indicators are the implementation of a successful NBS and the contribution of NBS to national and global targets (Table 4). An example of the understanding of this dimension is the adoption of NBS that can contribute to achieve broader goals, such as the NEMA project in Uganda, which aims to improve ecosystem functionality for sustainable ecosystem goods and services, climate resilience, and community empowerment, thereby contributing to several sustainable development goals.

Table 4: Key Dimension 3 - Supportive policies (Source: Righetti et al., 2022)

#	Key dimension	##	Key elements	###	Indicators
3	SUPPORTING POLICIES	1	Encouragement of NBS adoption towards its positive outcomes	1	Implementation of a successful NBS
		2	Methodologies in place for measuring NBS contribution	1	Contribution of NBS to national and global targets

2.4.4 Key Dimension 4 - Appropriate regulatory environment

This dimension is based on the OECD's six key elements, including land-use regulation and zoning, permitting, safety and performance codes and standards, procurement policies, land rights, and environmental protection regulation. The dimension is broken down into indicators for each key element, such as land use designation, clear and defined construction permits, clear safety and performance codes and standards, clear procurement policies, clear land and resources tenure, usage, and access rights, and clear environmental protection regulation (Table 5). The aim of these indicators is to ensure that the NBS implementation does not infringe on anyone's rights, and that it produces benefits for different stakeholders in the area involved by the intervention. The text also notes that in many cases, NBS projects benefit from having some land available for use.

Table 5: Key Dimension 4 - Appropriate regulatory environment (Source: Righetti et al., 2022)

#	Key dimension	##	Key elements	###	Indicators		
4	APPROPRIATE REGULATORY ENVIRONMENT	1	Land-use regulation and zoning	1	Land use designation		
		2	Permitting	1	Clear and defined construction permits		
		3	Safety and performance codes and standards	1	Clear and defined safety and performance codes and standards		
		4	Procurement policies	1	Clear procurement policies		
		5	Land rights	1		1	Clear land and resources tenure, usage, and access rights
				2		Acknowledge and observance of the land and resources tenure, usage, and access rights	
6	Environmental protection regulation	1		1	Clear environmental protection regulation		

2.4.5 Key Dimension 5 - Technical capacity

The fifth dimension in OECD's NBS framework is technical capacity which refers to the skills and knowledge necessary to identify and implement an NBS (Table 6). The first key element in this dimension is partnerships and information sharing, which includes indicators for stakeholder network cohesion and procedures for collecting comments to ensure a sense of ownership and involvement in the project. The second key element is integration of NBS training in civil engineering and urban planning curricula, which includes an indicator for specific NBS courses to improve adoption by engineers and planners or NBS-related education in university curricula. The third is training and education, which includes indicators for collaborative learning among stakeholders and knowledge courses to make residents and stakeholders more involved and aware of the experience they will have in their territories. These elements aim to strengthen technical capacity and ensure the success of NBS projects.

Table 6: Key Dimension 5 - Technical capacity (Source: Righetti et al., 2022)

#	Key dimension	##	Key elements	###	Indicators		
5	TECHNICAL CAPACITY	1	Partnerships and information sharing	1	Stakeholders' network cohesion to optimize interdisciplinary co-creation and co-design of NbS		
				2	Procedures for collecting comments		
		2	Integration of NbS training in civil engineering and urban planning curricula	1	Training in NBS		
				3	Training and education	1	Collaborative learning among stakeholders
						2	Knowledge courses

2.4.6 Key Dimension 6 - Access to finance

The access to finance dimension is important for the implementation of NBS as the limited access to funding is a significant barrier. Standardized funding models and a redirection of funds towards NBS are needed. The key elements of this dimension include availability of targeted incentives, ability to capture revenue streams, financing requirements, and distribution of liabilities, each with their own associated indicators (Table 7). These indicators include the availability of resourcing options, the completeness of income sources, financial sustainability, and legal responsibilities for each legal entity involved in the project.

Table 7: Key Dimension 6 - Access to finance (Source: Righetti et al., 2022)

#	Key dimension	##	Key elements	###	Indicators		
6	ACCESS TO FINANCE	1	Availability of targeted incentives	1	European, national and sub-national resourcing options (policies, financial instruments, etc.) supporting NBS		
				2	Ability to capture revenue streams	1	Completeness of income sources
				3	Financing requirements	1	Financial sustainability
				4	Distribution of liabilities	1	Legal responsibilities

2.4.7 Key Dimension 7 - NBS management

The seventh key dimension is NBS management and the related key elements that were adopted from IUCN (2020) criteria, are made explicit in some of its indicators (Table 8). The first key element, NBS monitoring, has two indicators, the first of which is the presence and use of strategies to periodically monitor and evaluate the NBS intervention throughout its lifecycle so that the project can be recalibrated and modified if necessary. The second indicator is the presence and use of regular monitoring and evaluation, using both scientific knowledge and knowledge from tradition and local people, to ensure that NBS can continue to be effective throughout the intervention. The second key element, NBS safeguard, also has two indicators. The first indicator is the presence and use of a system to ensure that mutually agreed trade-off limits are respected and do not destabilize the entire NBS intervention. The second indicator is the presence of criteria that analyze the potential risks' type and level of each option and the available means to reduce them.

Table 8: Key Dimension 7 - NBS management (Source: Righetti et al., 2022)

7	NBS MANAGEMENT	1	NBS monitoring	1	Monitoring and evaluation strategy
				2	Adaptive NBS intervention management
		2	NBS safeguard	1	NBS safeguard system
				2	Risk strategy

2.5 Managing the Water-Energy-Food-Ecosystem Nexus

To successfully implement the WEF E Nexus, consultation plays a vital role as it requires collaboration across different sectors and disciplines. Its management could involve a collaborative approach where relevant stakeholders come together to address the existing challenges.

According to Adamovic *et al.* (2019) the consultation process is guided by the following principles:

- bringing together stakeholders from diverse sectors, governmental spheres, countries, and levels.
- establishing direct links to ongoing and emerging processes.
- developing a shared understanding of the issues, objectives, and scenarios.
- facilitating the achievement of concrete agreements on multi-sectorial and multi-scale strategies to design intervention projects and solutions that contribute to the achievement of the Sustainable Development Goals (SDGs).

Key elements for managing the WEF E Nexus (Figure 7):

- The Nexus assessment aims to improve the understanding of sectoral interactions and their environmental impacts, leading to scientifically based optimal solutions and recommendations.
- Key to the process is the initial collection of qualitative and quantitative data to identify linkages and impacts between water, energy, and food systems. However, challenges such as data inconsistency, inaccessibility, and asymmetry, especially in transboundary contexts, need addressing, and information sharing between institutions is crucial.
- Scenario Development focuses on identifying the short to long-term effects of Nexus interventions or new policies, integrating various tools and models to estimate potential benefits and impacts, fostering a unified vision of sustainability in water, energy, and food security.
- In Response Options, an inclusive dialogue fosters consensus on policy options and trade-offs, based on qualitative and, if available, quantitative data. The Nexus assessment process is iterative, allowing for the continual integration of new key issues or evidence that may emerge at various phases.

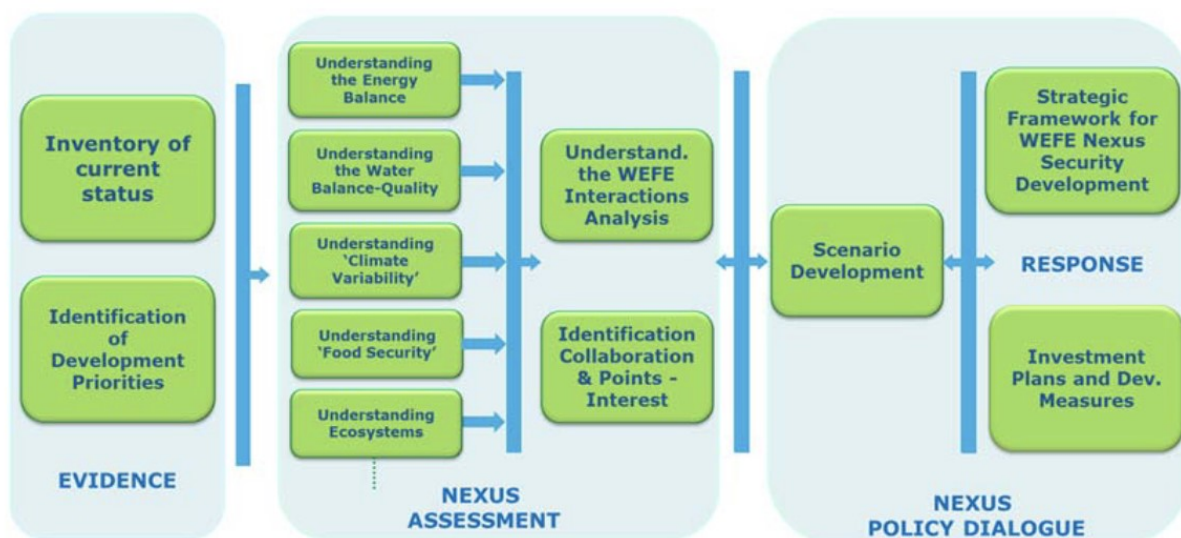


Figure 7: Nexus consultation process (Source: Adamovic et al., 2019)

2.6 Potential benefits of implementing NBS to manage WEFE Nexus in the Pinios River Basin

NBS can help manage water resources in agriculture, as demonstrated by the 'Karla' reservoir project in Central Greece (Panagopoulos *et al.*, 2020; Pistocchi *et al.*, 2022). This can lead to increased agricultural productivity and food security. NBS can increase water availability in water-scarce areas, such as the eastern part of the PRB (Panagopoulos *et al.*, 2020). This can help combat water scarcity and desertification, as well as provide water for ecosystems. NBS can reduce the risks of floods and landslides (Spyrou *et al.*, 2021). This can help protect infrastructure and communities from the negative impacts of extreme weather events. NBS can create, restore, and protect habitats, which can support freshwater biodiversity (van Rees *et al.*, 2023). This can help maintain ecosystem services and contribute to the conservation of species.

In more general terms, the application of a Nexus approach can lead to multiple and cross-sectoral benefits including (Global Water Partnership-Mediterranean, 2020): (i) economic advantages encompass enhanced sustainability of economic activities in the medium and long term, (ii) resilience in the face of climate change, mitigation of risks and associated costs related to floods and droughts, (iii) increased value added in agriculture and tourism, (iv) improved resource consumption efficiency, optimized infrastructure utilization, and enhanced trade and innovation.

Social and environmental benefits include the advancement of the Sustainable Development Agenda 2030, promotion of public health, job creation, improved water and sanitation services, conservation of natural resources, and restoration of ecosystems and habitats. Regional collaboration and geopolitical advantages entail strengthened cooperation in the management of shared resources, adoption of cross-border agreements, implementation of common regulations and protocols, development of regional markets for goods, services, and labour, and increased cross-border investments.

Chapter 3: Research Methodology

This chapter presents the research methodology employed to address the research objectives and questions. It outlines the research approach, study area, data collection methods, data analysis techniques, and provides an overview of the instruments used for measuring and assessing the policy and governance aspects of NBS implementation within the WEFE Nexus in the PRB, Greece.

3.1 Study Area

Among Mediterranean countries, Greece is a particularly relevant case study for assessing the policy and governance aspects for the implementation of NBS in the WEFE Nexus. Indeed, the region faces significant challenges related to water scarcity, ecosystem degradation, and agricultural production, which have been exacerbated by climate change and human activities (Henao *et al.*, 2022). As such, the implementation of NBS could provide a promising approach for addressing these challenges, but requires a thorough assessment of the policy and governance frameworks in place.

The study therefore focuses on the PRB in Greece. More in detail, the PRB has been selected as a case study due to its significance in terms of water scarcity, ecosystem degradation, and agricultural production reported by local experts/stakeholders and available literature, which make it a relevant context for examining the policy and governance aspects of NBS implementation within the WEFE Nexus. The selection of this study area allows for a deep understanding of the specific challenges and opportunities related to NBS implementation and provides valuable insights for improving the policy framework in place.

The PRB is located in the Thessaly region (as depicted in Figure 8 Central Greece), which is the second most productive agricultural area in Greece and is sub-divided into two major sub-basins, i.e., Agia watershed and Pinios Delta, whose key features are summarized in Table 9 below.

PRB is a vital contributor to Greece's agricultural sector. It hosts rich, fertile soils, but faces a pronounced lack of rainfall during the summer season. Typically, this arid spell coincides with soaring temperatures, causing increased rates of evapotranspiration and parched soils. These circumstances adversely impact the local flora and agricultural activities, resulting in reduced irrigation, excessive groundwater extraction, and substantial crop losses (Panagopoulos *et al.*, 2014). Excessive exploitation of water resources in the PRB can result in decreased river flows, especially during the summer, leading to the depletion of small lakes and reservoirs, as well as reduced groundwater levels. These consequences contribute to the increased cost of obtaining water through deep pumping and exacerbate the intrusion of saline water into coastal areas located in the eastern part of the basin. Consequently, the primary factor exerting pressure on the PRB is the excessive abstraction of water for irrigation purposes. Additionally, the area faces a significant environmental concern related to the contamination of surface and groundwater with nitrates, primarily due to intensive and occasionally excessive use of fertilizers in agricultural practices (Psomas *et al.*, 2016).

A major flood event occurred in September 2023 due to the ‘Storm Daniel’ causing unprecedented damages to the infrastructure, agriculture, and livestock (He, 2023; EFAS Wiki, 2023; The Guardian, 2023). Below is the stock take of the loss and damages reported:

- **Flooding:** The storm caused severe flooding in central Greece, washing away roads, isolating towns, and cutting off power. The Greek Fire Service reported 4,506 rescues or evacuations, and as of September 16, at least 17 fatalities were confirmed.
- **Agriculture:** The flooding severely impacted agriculture in the Thessaly Region, destroying hundreds of thousands of livestock and wide areas of crops and farmland. The storm is considered the worst rainfall event in Greece's recorded history.
- **Infrastructure:** The torrential rains caused significant damage to roads, bridges, buildings, and vital infrastructure, leaving whole villages submerged.
- **Public Health:** Health experts expressed concerns about the potential spread of infectious diseases in the flood-stricken Thessaly region, where a summer of unprecedented heat-induced forest fires had left the area ripe for disease.
- **Financial Impact:** Greek Prime Minister Kyriakos Mitsotakis reported that the storm caused financial damages of up to €2.5 billion.

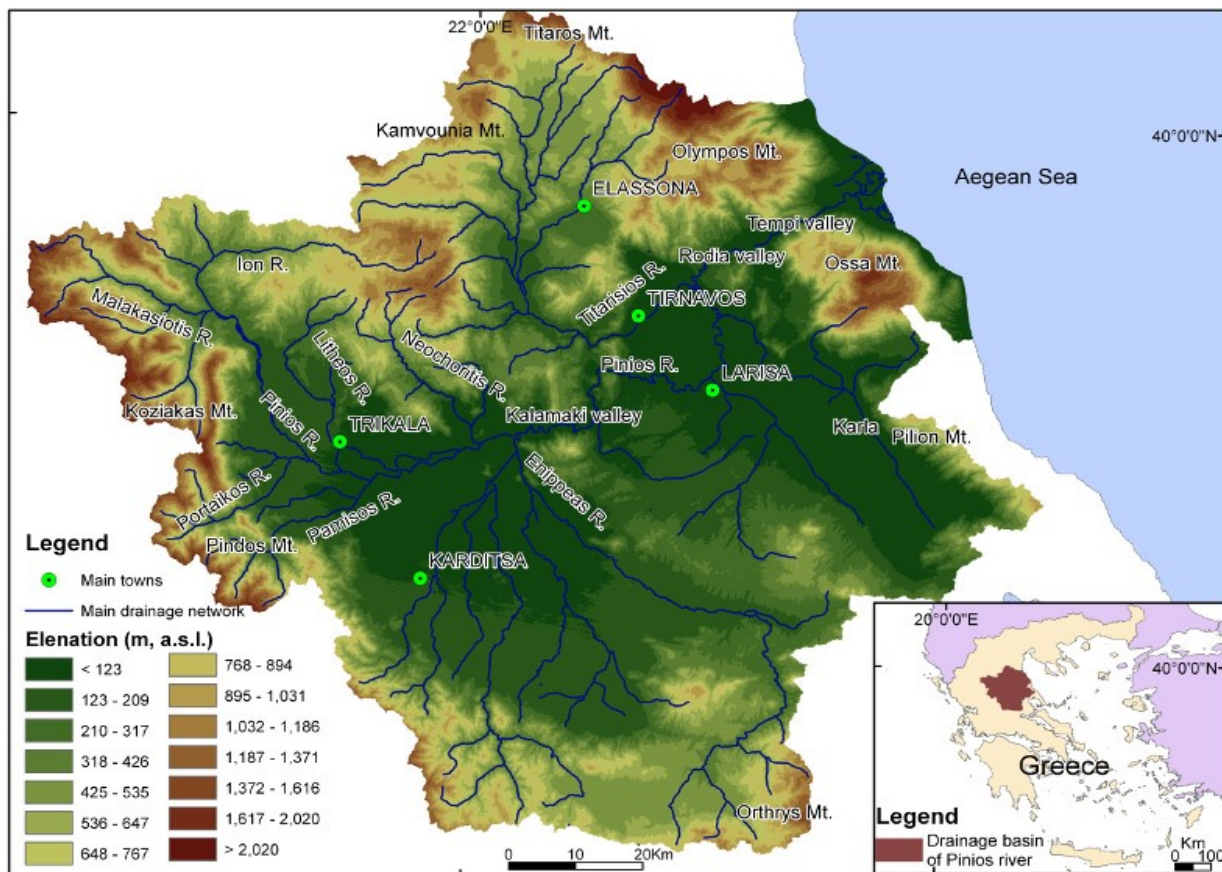


Figure 8: The location map of study area: Pinios River Basin (Source: Migiros et al., 2011)

Table 9: Main features of the two sub-basins within the Pinios River Basin (Source: LENSES Project pilot areas: Pinios Hydrologic Observatory, Greece and D3.9 Fit-for-Nexus climate projections WP3-REXUS Project Observatory)

Features	Agia watershed	Pinios Delta
Location	Western Thessaly (Trikala-Kardista plain)	Eastern Thessaly (Larisa-Karla plain)
Geomorphology	Mountainous terrain, 200-2500 m asl	Flat terrain, 10 m asl
Tributaries	Portaikos, Pamisos, Enippeas, Lithaios and Neochoritis	Pinios river
Annual Rainfall (mm)	400	1,000
Area (km ²)	5,955	2,438
Population	Approximately 240,000	Approximately 300,000
Agriculture features	Dominated by fruit orchards, mainly apple and cherry ones)	Dominated by annual crops, mainly sunflower and corn. Kiwi fruit is also up-scaling
Irrigation	Irrigation from groundwater	Irrigation from groundwater and surface water
Main problems and/or specific features	International Long Term Ecological Research (ILTER) Site, highly instrumented area	Lack of irrigation infrastructures. Water salinization

The two sub-basins are encountering several sectoral problems, including occasional water shortage and quality deterioration, environmental degradation, and agricultural production decrease as well as net income reduction over time. Investigating sectoral challenges and stakeholders' cross-sectoral concerns, along with developing NBS to reduce pilot areas' vulnerabilities, aims to enhance agricultural societies' resilience and preserve ecosystems amid the climate crisis.

3.2 Existing NBS practices and policies related to the WEF E Nexus in the Pinios River Basin and challenges and opportunities associated with their implementation

Existing Nature-Based Solution (NBS) practices and policies related to the Water-Energy-Food-Ecosystem Nexus in the Mediterranean basin aim to address key societal challenges in a variety of ecosystems, such as increased temperatures, sea level rise, more frequent extreme weather events, rapid population growth, and mass tourism. These solutions contribute to building more resilient societies by conserving nature and maintaining healthy ecosystems. NBS can be applied in different types of Mediterranean ecosystems, including forests, wetlands, and urban areas (Canals Ventin and Lázaro Marín, 2019 and IUCN, 2021).

The PRB in Greece has been the subject of several studies on NBS for sustainable water management. One such study by Panagopoulos and Dimitriou (2020) focuses on the effectiveness of the NBS to reduce high river flows and potential flood risk along Pinios River is considered low, but the water routing capacity of the transport ditches is quite high, which could be used for flood mitigation in the PRB itself with the purpose to reduce the flood inundation risk for parts of the agricultural plain downstream. A study by Pinaras *et al.* (2023) uses fully distributed water balance modeling in large agricultural areas, including the PRB, to simulate soil moisture status and crop-specific sets of rules that reflect common irrigation management practices. A study investigated the combined effects of agricultural-driven stressors on the ecology and delivered services of the PRB in Greece (Psomas *et al.*, 2016). The WEF E Nexus approach is a holistic, integrated, and transversal approach to natural resource

management that aims to promote sustainable development and balance the different goals, interests, and needs of people and the environment (FAO, 2014). Competing demands for water for energy and agriculture need to be reconciled while securing needs for underpinning ecosystems. This must be done in an integrated, transboundary, and equitable way, and by enhancing cooperation across borders (Adamovic *et al.*, 2019).

In the PRB, some challenges related to the WEF Nexus components have been identified (Adamovic *et al.*, 2019; FAO, 2022; Henao *et al.*, 2022; Panagopoulos *et al.*, 2020; Sambo *et al.*, 2023). Hereafter, they are described jointly with the possible impacts of implementing NBS to face them:

- **Water:** in the catchment there is the need to restore the status of water bodies, sustaining a sufficient quantity and quality of water to meet the needs of water users. Likewise, environmental flows to ecosystems must be maintained, improving adaptability to climate change (floods and droughts). There are competing demands for water for energy and agriculture that need to be reconciled while securing needs for underpinning ecosystems. This must be done in an integrated, transboundary, and equitable way, and by enhancing cooperation across borders. The effectiveness of NBS to reduce high river flows and the potential flood risk along Pinios River can be considered low. However, one could think of using the system also for flood mitigation in the Pinios River itself with the purpose to reduce the flood inundation risk for parts of the agricultural plain downstream. This would require more dedicated hydraulic works at the point of water withdrawal from the Pinios River towards Lake Karla.
- **Energy:** maintain/increase energy production through renewable resources to reduce emissions and to satisfy the energy needs of various uses (agricultural, industrial, domestic, etc.). Implementing NBS can have implications for energy demand, as some NBS require energy inputs for their implementation and maintenance. For example, the construction of green roofs or walls requires energy for materials and installation.
- **Food:** considering the high socio-economic impact on agriculture, maintaining food production is one of the most crucial challenges. Production costs must be optimized to achieve the viability and improve the competitiveness of agriculture, while promoting the quality elements of products produced in harmony with the environment, to increase their value added on the market. The PRB is an important agricultural area in Greece, and implementing NBS can have implications for food security. For example, the 'Karla' reservoir project in Central Greece has been successful in improving agricultural water management, but it has also led to changes in land use and crop patterns.
- **Ecosystem:** to reduce the vulnerability of productive and vulnerable sectors – agricultural production - to climate impacts. Implementing NBS can have implications for ecosystem services, as some NBS can have unintended consequences for biodiversity and ecosystem functioning. For example, the introduction of non-native species for erosion control can have negative impacts on the natural ecosystem.
- **Cost and financing:** The implementation of NBS in the PRB, such as the creation of Lake Karla, requires significant investment. The cost of the project, including the formation

of wetlands and other associated works, was estimated to be around €37.5 million (Panagopoulos and Dimitriou, 2020).

3.3 Research Approach

The research approach adopted for this study is a mixed-methods approach, combining qualitative and quantitative methods. This approach allows for a comprehensive understanding of the policy and governance aspects influencing NBS implementation in the study area.

The qualitative methodology adopted aims to garner a comprehensive understanding of the subject by employing a variety of tools and approaches. This involves collecting responses to guiding questions via a questionnaire (*Annex 3*) administered to the research team of the Soil and Water Research Institute (SWRI)², the lead contractor for the WP2 deliverable of the LENSES Project. Additionally, structured interviews were conducted under the LENSES-UNIPD framework (*Annex 4*), and stakeholder interview results were compiled from first technical workshop³ of the LENSES WP2. This approach also incorporated feedback and insights from the first technical workshops⁴ of the Pinios pilot under the REXUS project (*Annex 5*). Supplementing these methods, an analysis of secondary sources, such as policy documents, was undertaken to explore existing Nature-Based Solutions (NBS) practices, uncovering prevailing policies, challenges, and opportunities in the domain. More detailed explanations of these methods will be presented in sub-chapter 3.3.

The quantitative methodology adopted in this study actively builds on qualitative information, utilizing it to rigorously test the LENSES-UNIPD WP6-D6.2 Policy indicators and framework for Nexus-relevant NBS. Each applicable indicator and sub-indicator within the framework are evaluated and scored.

The integration of qualitative and quantitative data provides a holistic view of the research topic and enhances the validity and reliability of the research findings.

3.4 Data collection

Data collection is a crucial step in addressing the research questions and achieving the research objectives. The data collection methods, needed to apply the LENSES-UNIPD framework, employed in this study include:

- Questionnaire (sub-chapter 3.3.1)
- Structured interviews conducted within the framework of LENSES project WP2: Learning and Action Alliances (LAA) (sub-chapter 3.3.2)
- Stakeholder interviews results from LENSES WP2 LAA Recap of the 1st Pinios Pilot Technical Workshop and REXUS Project WP2 Recap of the 1st and 2nd Pinios Pilot Technical Workshop analysis (sub-chapter 3.3.3).

² The SWRI is one of the 11 research institutes of the Hellenic Agricultural Organization-DEMETER in Greece that specializes on the protection and management of soil and water resources.

³ The first Technical Workshop of the LENSES project regarding the Pinios pilot area took place on the 21st November, 2022, in "Chrisalida" cultural center of Metaxochori – Larissa, Greece.

⁴ The first Technical Workshop of the REXUS project regarding the Pinios pilot area took place on 17th May 2022, in Larissa city, Greece. The second Technical Workshop of the REXUS project regarding the Pinios pilot area took place on 20th January, 2023, in Larissa city, Greece (administrative and geographical centre of PRB).

- Secondary data sources: Greek National laws, EU Regulations, Policy documents, Technical reports (sub-chapter 3.3.4).

It shall be clarified that structured interviews and stakeholder interviews were not performed by the author of this study, rather by the LENSES and REXUS project staff. Information collected through these interviews have been used to feed the LENSES-UNIPD framework for the aims of this research.

3.4.1 Questionnaire

To gather valuable insights from the main stakeholder i.e. SWRI which is involved in NBS implementation and WEFE Nexus policy management in the study area, a questionnaire (Table 10) was thoughtfully designed. The questionnaire was based on the LENSES-UNIPD framework, providing a structured framework for data analysis. SWRI, leading the pilot area, was requested to reply to the questionnaire. The questionnaire was filled by the team of SWRI experts led by Dr. Dimitris Malamartaris, Associate Researcher. SWRI is the leading the Pilot project of PRB under the LENSES and REXUS project. These inputs have been instrumental in enabling us to score indicators that couldn't be assessed due to data limitations.

The questionnaire employed a combination of open-ended questions, enabling stakeholders to freely express their opinions, share their experiences, and offer valuable suggestions concerning NBS practices, challenges, and opportunities in the study area. By incorporating open-ended questions, the questionnaire aimed to capture a diverse range of perspectives and gather rich qualitative data.

Table 10: Questionnaire designed for unanswered indicators

Related key dimension	Guiding questions ⁵	Rationale (response from SWRI)	Means of verification/proof
1. Conducive governance arrangements	Does the participation in Natural-based Solutions (NBS) initiatives ensure mutual respect and equity, regardless of gender, age, or social status, and uphold the right of Indigenous Peoples to Free, Prior and Informed Consent (FPIC)?		
	In the NBS design that has been planned, are there coordination mechanisms established among stakeholders, such as public institutions, economic bodies, and other stakeholders, in implementing NBS initiatives?		
	Are mechanisms established to enable joint decision-making among stakeholders from different jurisdictions when the scale of NBS initiatives extends beyond jurisdictional boundaries?		
	Are there instruments in place to manage and mitigate negative impacts affecting stakeholders in NBS initiatives?		

⁵ These guiding questions cover those indicators where we did not find relevant information to perform scoring.

2. Supportive policies	Are you aware about the presence of conflicts among the objectives of different sectoral policies regarding NBS implementation?		
3. Supporting policies	Does NBS implementation facilitate policy and regulation frameworks to support its mainstreaming?		
	Are there procedures in place to capture the contribution of NBS to national and global targets for human well-being?		
	Are there procedures in place to capture the contribution of NBS to national and global targets for human rights?		
4. Appropriate regulatory environment	Does this pilot study have all needed permits to implement the planned NBS?		
	Are the tenure, usage of, and access rights to land and resources, along with the responsibilities of different stakeholders, acknowledged and respected in the implementation of NBS?		
5. Technical capacity	Are formal procedures in place to allow stakeholders to provide their comments/contributions before and during the NBS intervention?		
	Does the lead organization organize or is planning to organize specialized courses about NBS open to residents?		
6. Access to finance	Does the project have a professional project design team and a complete project management system in place capable to find solutions to capture NBS revenue?		
	Is there a professional project design team capable to gather financing to implement NBS?		
	Are there well-defined legal responsibilities in relation to the implementation of NBS?		
7. NBS Management	Is there a system in place to periodically monitor and evaluate the NBS intervention throughout its lifecycle?		
	Does the project utilize an iterative learning process to enable adaptive management of the NBS intervention throughout its lifecycle?		
	Is there a safeguard system in place to ensure that mutually agreed trade-off limits are respected and do not destabilize the entire NBS intervention?		
	Are there strategies in place to identify and manage possible risks in terms of type and level within the NBS intervention?		

The results obtained from this questionnaire survey (*Annex 3*) were then utilized to assess different indicators of the LENSES-UNIPD framework.

3.4.2 Structured Interviews

Under the framework of the LENSES project WP2 (Learning and Action Alliances), 19 structured interviews were conducted by LENSES project staff. Different stakeholders (*Annex 6*) mapped by the PRB pilot were contacted to fill the structured interviews, they were asked to identify the WEF sector (Water, Food, and Ecosystem), and PRB area (Agia watershed, Pinios Delta and Thessaly) for which they are providing the information.

The structured interview questionnaire was designed into 11 themes (Table 11). Themes 1 to 7 were answered by the concerned stakeholders from PRB area. Theme 8 questions were designed to provide inputs to the policy and decision makers. Theme 9 was asking the respondents to identify potential conflicts/issues associated with the domains. Theme 10 asked respondents to describe the connections and dependencies between the domain identified by them as important and other domains. Theme 11 was a free space provided to respondents to add anything. Theme 9 to 11 were not answered by the respondents.

Table 11: Structured interview questionnaire under the WP2 of LENSES project

Theme	Structured interview questions
Theme 1	Could you please rank the following domains for the pilot area? (From 1 - high to 3 - low): <ul style="list-style-type: none"> • water security • food security • ecosystem security
Theme 2	Referring to the main security dimension in Theme 1, could you please identify and describe the most important needs/problems that should be satisfied/faced for achieving the domain security?
Theme 3	Referring to each need/problem identified in Theme 2, in which specific areas in the basin there is a more pronounced necessity for your needs' satisfaction?
Theme 4	Referring to each need/problem identified in Theme 2, to what extent are these needs satisfied in the current system conditions for each specific area (Theme 3)? Could you please rank these needs/problems according to their importance (from 1 - high to 4 - low)?
Theme 5	Referring to each need/problem identified in Theme 2, what are the main criticalities and barriers for the achievement of the mentioned needs?
Theme 6	Referring to each need/problem identified in Theme 2, how can these needs/problems be quantified?
Theme 7	Referring to each need/problem identified in Theme 2, to what extent are these needs affected or will be affected by climate change?
Theme 8	Who are the key actors with whom an interaction is needed for the access/use of the same ecosystem resource (e.g., authorities, utilities etc.)? Please provide a description of the interaction (e.g., information exchange, flow of resources, etc.).
Theme 9	Which conflicts/issues exist? Please provide a description of the interaction.
Theme 10	Which connections and dependencies exist from your sector to other sectors? How would you describe such connections?
Theme 11	Is there anything you would like to add?

By structuring the interview around these 11 themes, the data collection process was designed to gather comprehensive and meaningful insights regarding participants' perceptions, problems, causes, effects, and key actors within the studied PRB area.

The results of these structured interviews are summarized in *Annex 4*: they have been used to assess different indicators of the LENSES-UNIPD framework.

3.4.3 Stakeholder interviews

The 1st Technical Workshop of the LENSES project regarding the Pinios pilot area took place on 21st November 2022, in "Chrisalida" cultural center of Metaxochori – Larissa, Greece. The workshop aimed to discuss the challenges and opportunities of the WEFE Nexus in the Pinios pilot area. The workshop brought together scientists, policymakers, and other stakeholders to identify synergies and trade-offs between water, energy, food security, and ecosystems.

The 1st Technical Workshop of the REXUS project regarding the Pinios pilot area took place on 17th May 2022, in Larissa city, Greece. The workshop aimed to develop and validate knowledge and tools to facilitate the transition from Nexus Thinking to Nexus Doing. The workshop brought together experts from SWRI, ELGO-DIMITRA, and other stakeholders.

The 2nd Technical Workshop of the REXUS project regarding the Pinios pilot area took place on 20th January 2023, in Larissa city, Greece. The workshop aimed to discuss the challenges and opportunities of the WEFE Nexus in the Pinios pilot area. The workshop brought together scientists, policymakers, and other stakeholders to identify synergies and trade-offs between water, energy, food security, and ecosystems.

A list of stakeholders participated in the interview of the first and second technical workshops of LENSES project and first and second workshop of REXUS project are mentioned in *Annex 5*.

The results of these stakeholder interviews during the technical workshop are summarized in *Annex 6*. These results have been used to assess different indicators of the LENSES-UNIPD framework.

3.4.4 Secondary data sources

The information from the secondary data sources such as EU Regulations, EU Strategies, EU Directives, EU Agendas, Greek National Laws, policy documents, and technical reports have been used to assess certain indicators of LENSES-UNIPD framework. Table 12 provides an overview of documents and other data sources considered to this aim.

Table 12: List of secondary data source

No.	Title	Description	Source
1	Greek National Climate Law (Law number 4936/2022)	Outlines the legal framework for climate-related actions and initiatives at the national level in your research context.	https://www.fao.org/faolex/results/details/en/c/LEX-FAOC212995
2	EU Biodiversity Strategy 2030	Sets out the strategic objectives and actions for preserving and restoring biodiversity within the EU region.	https://environment.ec.europa.eu/strategy/biodiversity-strategy-2030_en#documents
3	EU Green Deal, 2019	Comprehensive plan outlining the European Union's efforts to address climate change, promote sustainable growth, and transition to a carbon-neutral economy.	https://commission.europa.eu/publications/factsheets-european-green-deal_en

No.	Title	Description	Source
4	Greek Law on Water Resources management (Law 3199/2003)	Regulates the use, protection, and management of water resources within Greece.	https://www.fao.org/faolex/results/details/fr/c/LEX-FAOC066106/
5	Greek Law on Environmental licensing of works and activities, regulation of illegal construction (Law 4014/2011)	This law provides for the environmental assessment of works and activities in order to grant an authorisation (permit) to build (Part A, articles 1 to 22). It also makes provisions for the regulation of illegally constructed buildings, with the aim to promoting a better environmental stability (Part B, articles 23 to 37).	https://www.fao.org/faolex/results/details/en/c/LEX-FAOC108645/
6	EU Flood Directive (2007/60/EC)	Establishes a framework for assessing and managing flood risks in the European Union.	https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32007L0060
7	EU Water Framework Directive (2000/60/EC)	Sets out a framework for the protection and sustainable management of water resources within the European Union.	https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32000L0060&qid=1687075453514
8	EU Urban Agenda, 2016	Policy initiative focusing on addressing urban challenges and promoting sustainable urban development within the European Union.	https://ec.europa.eu/regional_policy/policy/themes/urban-development/agenda_en
9	Public Works, Procurement and Services (Law 4412/2016) and EU Directive 2014/24/EU on Public Procurement	Sources providing information on procurement practices and strategies at the national and EU levels, respectively.	https://www.eaadhsy.gr/index.php/en/pp-legal-framework/pp-legal-framework-list and https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32014L0024
10	Greek Law 1650/1986 on the protection for the environment	Greek law providing the legal framework for the sustainable management of forests. Includes regulations for forest conservation, protection, and utilization, aiming to balance ecological, economic, and social aspects of forestry.	https://www.fao.org/faolex/results/details/en/c/LEX-FAOC051736/
11	Greek Law 210/1973 and Law 4512/2018 on Mining code and exploration and exploitation of quarried minerals	Legislation pertaining to mining activities in Greece, providing guidelines and regulations for such operations.	https://rmis.jrc.ec.europa.eu/uploads/legislation/MINLEX_CountryReport_EL_2020.pdf
12	EU Waste Framework Directive (2008/98/EC)	Establishes the framework for waste management and promotes the use of resources in a sustainable manner within the European Union.	https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:02008L0098-20180705
15	EU Strategy on Adaptation to Climate Change (2013)	Outlines the EU's approach to adaptation to climate change, emphasizing nature-based solutions to enhance resilience and protect ecosystems.	https://climate.ec.europa.eu/system/files/2016-11/eu_strategy_en.pdf

No.	Title	Description	Source
16	Greek National Energy and Climate Plan (NECP), 2019	Presents Greece's long-term energy and climate objectives, including strategies to promote renewable energy, energy efficiency, and the integration of energy systems with the Water-Energy-Food-Ecosystem Nexus considerations.	https://energy.ec.europa.eu/system/files/2020-03/el_final_necp_main_en_0.pdf
17	EU Circular Economy Action Plan, 2020	It provides a future-oriented agenda for achieving a cleaner and more competitive Europe in co-creation with economic actors, consumers, citizens and civil society organisations.	https://ec.europa.eu/environment/pdf/circular-economy/new_circular_economy_action_plan.pdf
18	Greece Strategic Forestry Development Plan 2018-2038 (National Forestry Strategy)	Provides a strategic framework for the sustainable management and conservation of forests in Greece, addressing environmental, economic, and social aspects, as well as the role of forests in the Water-Energy-Food-Ecosystem Nexus.	https://www.fao.org/faolex/results/details/en/c/LEX-FAOC187348/
19	Greek National Biodiversity Strategy and Action Plan, 2014	Outlines Greece's strategic objectives and actions for the conservation and sustainable use of biodiversity, highlighting the interlinkages between biodiversity, water, energy, food, and ecosystems.	https://www.fao.org/faolex/results/details/en/c/LEX-FAOC163086/
20	EU Farm to Fork Strategy, 2020	Aims to ensure a fair, healthy, and environmentally friendly food system, promoting sustainable farming practices, reducing food waste, and enhancing biodiversity and ecosystem protection	https://food.ec.europa.eu/system/files/2020-05/f2f_action-plan_2020_strategy-info_en.pdf
21	EU Position Paper on Water, Energy, Food and Ecosystem (WEFE) Nexus and Sustainable development Goals (SDGs)	Sets out a strategic framework for integrating the management of water, energy, food, and ecosystems, recognizing their interdependencies and promoting sustainable practices and resource efficiency.	https://publications.jrc.ec.europa.eu/repository/handle/JRC114177
22	EU Common Agricultural Policy (CAP) 2023-2027	Aims to support sustainable agriculture and rural development within the European Union, considering the interconnections between water, energy, food, and ecosystems in agricultural practices	https://agriculture.ec.europa.eu/common-agricultural-policy/cap-overview/cap-glance_en

These additional data sources further contributed to the understanding of the legal and regulatory context related to water resources management, environmental protection, and forestry activities within Greece and at EU level.

3.5 Data analysis

The collected data were analyzed using a combination of qualitative and quantitative analysis. The qualitative data were retrieved from the questionnaire, structured interviews, and stakeholder interview results from the technical workshops of REXUS and LENSES projects. The secondary data were assessed against the key dimension, key elements, indicators, and sub-indicators of the LENSES-UNIPD framework to identify key themes, patterns, and relationships related to the policy and governance aspects of NBS implementation to manage the WEFE

Nexus in PRB. A quantitative score was given to each indicator based on sufficiency of the information. The scoring method evaluates policy frameworks against the LENSES-UNIPD criteria by assigning scores to key dimensions, elements, indicators, and sub-indicators, with weights reflecting their importance. Scores range from 0 (absent) to 1 (mostly present), with 0.5 indicating partial presence; color-coding illustrates the level of adherence, and un-assessable indicators receive no score. The overall score reflects the normalized aggregate of these weighted assessments, detailing the degree of framework adherence and guiding further evaluation.

The LENSES-UNIPD framework served as the main instrument for measuring and assessing the policy and governance aspects of NBS implementation. This framework provides a set of indicators that capture key dimensions of policy and governance, such as institutional arrangements, stakeholder participation, financing mechanisms, and monitoring and evaluation systems. These indicators are adapted and applied to the study area to evaluate the existing policy frameworks and identify areas for its improvement.

3.5.1 Qualitative data analysis

The qualitative data analysis involved the assessment of data from primary sources (i.e., questionnaire and interviews) already presented in chapter 3.4.1, 3.4.2, 3.4.3 and 3.4.4. These sources provide valuable insights into NBS practices, policies, challenges, and opportunities in the study area. Stakeholder interviews conducted during the technical workshops under the LENSES and REXUS projects were analyzed to gather further insights into the challenges and opportunities of the WEF Nexus in the PRB. These interviews provided valuable information from experts and policymakers, highlighting the synergies and trade-offs between water, energy, food security, and ecosystems. The analysis of these interviews helped identify key issues and inform the assessment of policy frameworks.

At the heart of the analysis were the insights from questionnaires completed by stakeholders, primarily the SWRI team, which provided depth and context to the quantitative indicators used in the research. The open-ended nature of these questions captured a breadth of perspectives, highlighting the stakeholders' experiences and suggestions for enhancing NBS practices within the PRB.

The structured interviews, forming a part of the LENSES project's Learning and Action Alliances, were methodically dissected to uncover stakeholders' perceptions across 11 thematic areas, although themes 9 to 11 garnered no responses. Despite this, the content revealed through these interviews informed a deeper understanding of the various sectors' interlinkages and the complexities of policy and decision-making processes within the WEF Nexus.

The dynamic interactions during the technical workshops for both the LENSES and REXUS projects brought forth the real-world challenges and synergies between water, energy, food security, and ecosystems. The qualitative content analysis of these discussions allowed for the identification of emergent themes, particularly around governance structures and the implementation of NBS.

Supplementary to this primary data, secondary sources such as EU regulations, Greek national laws, and policy documents were meticulously analyzed. This examination enriched the understanding of the regulatory and policy backdrop against which NBS are implemented and assessed within the Greek and EU contexts.

This integrated qualitative analysis, through a systematic triangulation of diverse data sources, illuminated the nuances of governance arrangements, policy efficacy, and the multiplicity of stakeholder views. It emphasized the strengths within the existing policy environment while also identifying significant gaps, such as in finance and stakeholder engagement, which must be bridged to realize the full potential of NBS.

Maintaining a reflexive stance throughout the analysis ensured that the interpretation remained objective and that the potential for researcher bias was minimized. Regular discussions with peers and transparent methodological practices were instrumental in maintaining the integrity of the analysis.





The qualitative findings thus weave together the narratives from various stakeholders and data points, presenting a tapestry of the current state of NBS governance. The insights derived underscore the critical elements that must be addressed to bolster policy frameworks and strengthen governance strategies, thereby facilitating informed decision-making and advancing the sustainable implementation of NBS within the PRB and potentially serving as a benchmark for broader applications.

3.5.2 Quantitative data analysis

The quantitative data analysis builds upon the qualitative information obtained from the previous stage to assess the adherence of the policy frameworks governing NBS implementation within the PRB as per the indicators defined in the LENSES-UNIPD framework.

Within the LENSES-UNIPD framework, the final scoring system used ranges from 0 to 1, with specific color-coding to represent the level of presence or absence of the indicator's condition (Table 13).

Table 13: Rationale underlying the scoring scale within LENSES-UNIPD framework (Source: Righetti et al., 2022)

Score range		Color code	Description of the scoring
0	0.1		Red colour means that the condition reported by the indicator is almost absent
0.11	0.49		Orange means that the condition reported by the indicator is sparsely present
0.50	0.89		Yellow means that the condition reported by the indicator is sufficiently present
0.90	1		Green means that the condition reported by the indicator is mostly present

Scoring methodology adopted for this study

The scoring methodology used for the analysis (Figure 9) was based on the following components:

- a. *Scoring*: Each indicator/sub-indicator (wherever applicable) within an element is scored based on the presence of conditions it reports. Table 14 reports scores given

while assessing different indicators and sub-indicators of the LENSES-UNIPD framework. We have adopted a slightly different scoring method than the one indicated in Table 13 above.

Table 14: Scoring system for assessing and scoring indicators/sub-indicators

Score	Criteria of assigning score
1	if conditions reported by the indicator are mostly present
0.5	if conditions reported by the indicator are partially present
0	if conditions reported by the indicator are absent
No scoring done	If no information has been found the indicators, sub-indicators, key elements, key dimensions not scored and hence not considered in assessment

- b. *Indicator's/Sub-indicator's score: This is the average sum of the scoring based on the indicators or sub-indicator score (refer a).*
- c. *Indicator Weight: Each indicator is weighted according to its importance within the element, reflecting its significance in evaluating adherence to the LENSES-UNIPD framework. Weights can be adjusted based on the pilot study area specifics and stakeholders' perception.*

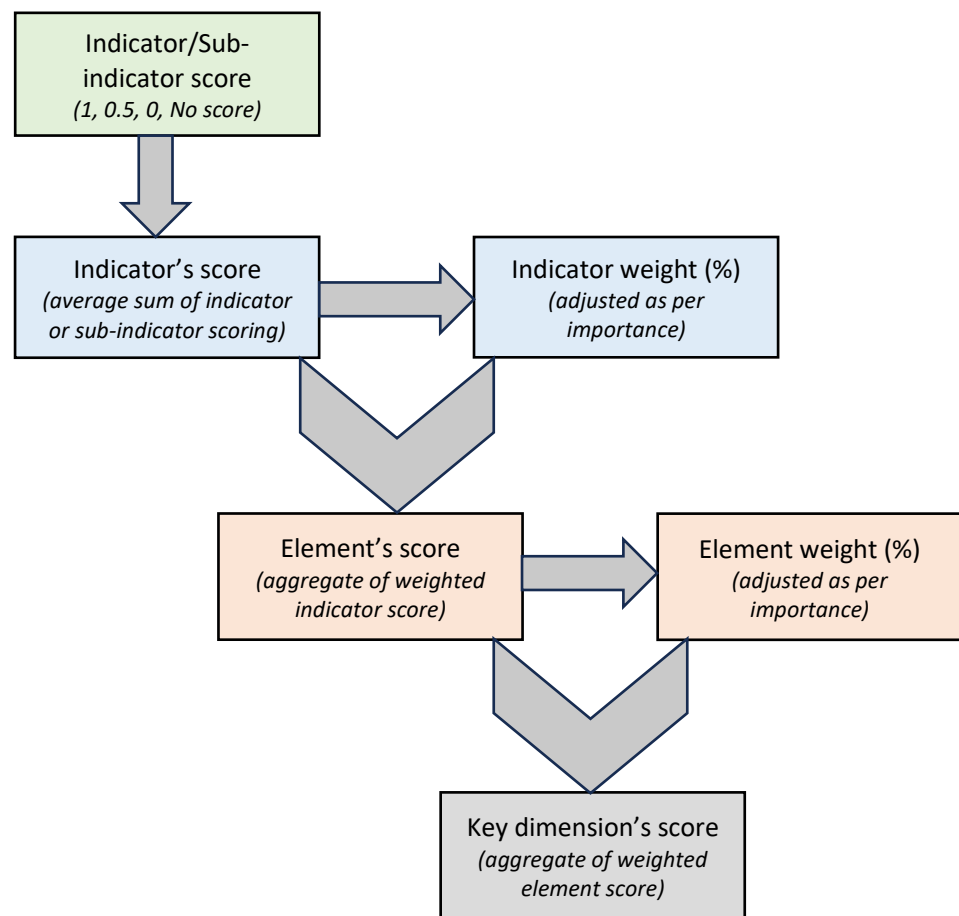


Figure 9: Schematic representation of scoring

- d. *Element's Score*: The score for each element within a key dimension is calculated by aggregating the weighted scores of its indicators.
- e. *Element Weight*: Similar to indicators, each element is weighted to represent its importance within its key dimension, with possible adjustments for area-specific and stakeholder considerations.
- f. *Key Dimension Score*: Finally, each key dimension score is determined by aggregating the weighted scores of its elements, providing a measure of how well it aligns with the LENSES-UNIPD framework.

The scoring of the indicators provides a quantitative measure of the existing policy frameworks, allowing for a comparative analysis and identification of areas for improvement for better policy and governance intervention. The analysis focuses on key dimensions of policy and governance, including institutional arrangements, stakeholder participation, financing mechanisms, and monitoring and evaluation systems.

By integrating qualitative and quantitative data, a holistic view of the policy and governance aspects of NBS implementation in the study area is achieved. The qualitative insights from stakeholders and experts provide context and depth to the quantitative scores, enhancing the validity and reliability of the research findings.

Summary of scores

Based on the scores received by each key dimension, a summary table (Table 15) of the scores has been prepared. In this summary table, the first column represents the name of the key dimensions, the second column reports the aggregate score obtained by each key dimension based on weighted score of their respective key elements and indicators. The third column represents the key dimension scores in percentage.

Table 15: Summary table of the LENSES-UNIPD framework

Key Dimension	Key Dimension Score	Key dimension percentage
1. CONDUCTIVE GOVERNANCE ARRANGEMENTS		
2. SUPPORTIVE POLICIES		
3. SUPPORTING POLICIES		
4. APPROPRIATE REGULATORY ENVIRONMENT		
5. TECHNICAL CAPACITY		
6. ACCESS TO FINANCE		
7. NBS MANAGEMENT		
Is the assessment in adherence with LENSES-UNIPD NBS Framework?		In adherence/Not in adherence

Based on the IUCN Global Standards for NBS (IUCN, 2020), a benchmarking analysis of each key dimension based on the percentage score (Column 3 in Table 15) is done, which indicates the performance of each key dimension relative to the benchmark scores. Benchmark scores are categorized as shown in the Table 16:

Table 16: Output of the LENSES-UNIPD framework assessment (Source: IUCN, 2020)

Key dimension %	Color code	Adherence	Explanation for the adherence with LENSES-UNIPD framework
<25		Insufficient	Pilot study is not in adherence with the LENSES-UNIPD framework
≥25 & <50		Partial	Pilot study is partially in adherence with the LENSES-UNIPD framework
≥50 & <75		Adequate	Pilot study is adequately adheres with the LENSES-UNIPD framework
≥75		Strong	Pilot study is strongly adheres with the LENSES-UNIPD framework

Each category is associated to a different level of adherence to the LENSES-UNIPD framework, i.e., strong (green color), adequate (yellow), partial (orange) and insufficient (red) respectively (Table 16). Finally, if all the key dimension scores more than or equal to 25%, then the pilot study area is 'In adherence' to the LENSES-UNIPD framework. If it is less than 25% then it is 'Not in adherence' with the LENSES-UNIPD framework.

The findings from the qualitative and quantitative analyses are integrated to provide a comprehensive understanding of the policy and governance aspects of NBS implementation in the study area.

Chapter 4: Result

This chapter unveils the results of analyzing governance and policy enabling environment to NBS implementation in the WEFE Nexus within PRB in Greece. It offers insights of the performance of LENSES-UNIPD framework's dimensions, unveiling strengths, improvement areas, and their interplay in supporting or hindering one another. The examination provides a holistic understanding of the policy and governance framework, thereby crafting a roadmap for enabling policy and governance conditions that optimizes the NBS implementation in the PRB.

4.1 Result analysis of each key dimension

Table 17 shows the summary of the scores achieved by each key dimension and to visualize the same, Figure 10 shows the web chart of the scores achieved by each key dimensions.

Table 17: Summary of scores for the LENSES-UNIPD policy and governance framework assessment for Pinios River Basin (Greece)

Key Dimension	Key Dimension Score	Key Dimension Percentage
1. Conducive governance arrangements	0.76	76%
2. Supportive policies	1.00	100%
3. Supporting policies	0.75	75%
4. Appropriate regulatory environment	0.92	92%
5. Technical capacity	0.94	94%
6. Access to finance	0.56	56%
7. NBS management	No scoring	No scoring
Is the assessment in adherence with LENSES-UNIPD NBS Framework?		In adherence

Summary of key dimension scores-Assessing policy and governance framework for implementation of NBS to manage WEFE Nexus in Pinios River Basin

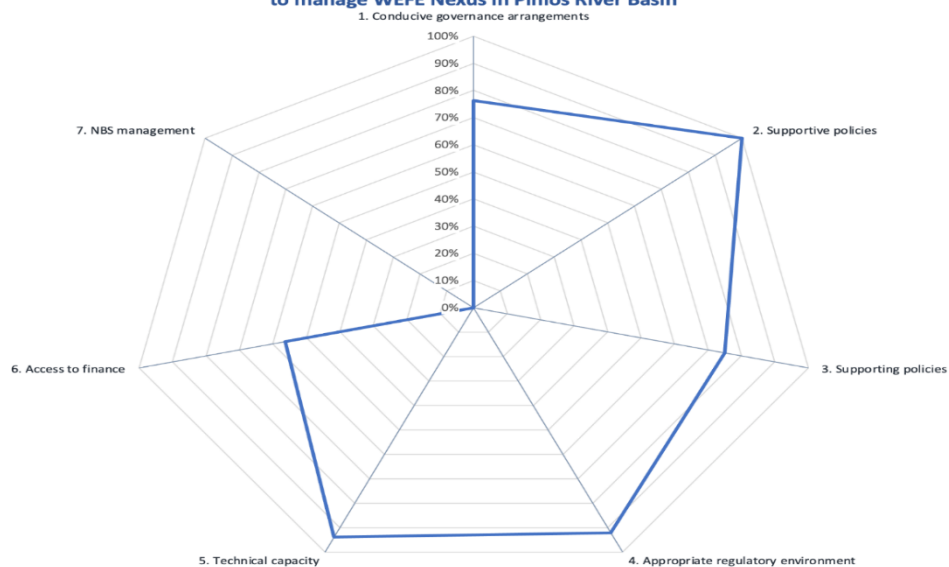


Figure 10: Web chart showing key dimension scores

Results of the analysis are reported separately for each key dimension below:

4.1.1 Key dimension 1: Conducive governance arrangements

Score: 0.76/1 (76%)

The analysis of the key dimension "Conducive Governance Arrangement" yielded a score of 0.7625, translating to a 76% effectiveness rate. The evaluation indicates a moderate to high level of structure and support for NBS initiatives, though there are areas that require improvement, particularly in consolidating responsibilities and enhancing participatory approaches across all phases of NBS interventions. There's strong inclusivity and community support, along with mechanisms to mitigate negative impacts on stakeholders. Continuous efforts to improve coordination and streamline responsibilities among actors are necessary to fortify the implementation and maintenance of NBS initiatives.

Below is the detailed result analysis for the indicators and sub-indicators of this key dimension:

1. Clearly defined structure and roles⁶

Score: 0.5

a. Planning

Responsibilities for planning are scattered among various bodies with limited actions and engagement from the responsible entities. The lack of centralized planning structure results in potential inefficiencies.

b. Implementation

The implementation phase is characterized by bureaucratic hurdles, fragmentation of responsibilities, and limited coordination among authorities. There is also a noted absence of an objective approach in the decision-making process, such as prioritization of measures.

c. Maintenance

Maintenance of NBS initiatives is hindered by the complexity of the legislative framework, making it challenging to efficiently uphold and manage these initiatives in the long term.

2. NBS responsibilities⁷

Score: 0.5

a. Planning

⁶Challenge 5: Effective management, Governance (WP2- Learning Action Alliances of The REXUS Project, Recap of the 1st and 2nd Pinios Pilot (Greece) technical Workshop

⁷ Means of verification: Challenge 5: Effective management, Governance (WP2- Learning Action Alliances of The REXUS Project, Recap of the 1st and 2nd Pinios Pilot (Greece) technical Workshop

Multiple bodies and entities are involved in the planning phase, with no single organization or entity taking the lead or having clear authority over others. The dispersed responsibility can lead to challenges in achieving coherent and unified planning for NBS initiatives. The entities responsible for planning either are not fully active or do not perform their duties comprehensively. This limitation might be due to lack of resources, unclear mandates, or inadequate coordination with other involved parties.

b. Implementation

Responsibilities during the implementation phase are divided among various bodies without clear delineation or coordination, leading to potential overlap or gaps in duties and functions. There's insufficient synchronization and collaboration among the authorities and bodies involved in the implementation phase, potentially leading to inconsistencies and inefficiencies in executing NBS initiatives. Decision-making processes during implementation lack a systematic, objective approach, with inadequate prioritization or evaluation of measures and initiatives.

c. Maintenance

The legislative framework governing the maintenance of NBS initiatives is complex and possibly ambiguous, making it difficult for the responsible bodies to navigate and effectively uphold their maintenance duties.

3. Participation in all processes of the NBS intervention⁸

Score: 0.5

a. Planning

Initial studies and monitoring also lack diverse participation, leading to plans that may not align with community needs and insights. There's a pressing need for more comprehensive and inclusive consultations to ensure plans accurately reflect and address identified community needs and conditions.

b. Implementation

The implementation phase is plagued by bureaucratic hurdles and fragmented responsibilities among authorities, leading to unclear leadership and coordination. This fragmentation creates confusion for stakeholders and affects effective engagement. Lack of clear decision-making criteria results in decisions that might not fully reflect stakeholders' views and needs, highlighting a need for improved transparency and accountability mechanisms.

c. Maintenance

⁸ Challenge 5: Effective management, Governance (WP2- Learning Action Alliances of The REXUS Project, Recap of the 1st and 2nd Pinios Pilot (Greece) technical Workshop

Maintenance faces a complex legislative framework and inadequate participatory mechanisms, hindering effective stakeholder engagement and contribution. The legislative complexity creates understanding and participation barriers for stakeholders. Lack of accessible participatory structures limits crucial stakeholder feedback for continuous improvement, emphasizing the need for simplified legislation and enhanced participatory mechanisms.

4. Equity in participatory processes⁹

Score: 1

a. Gender

The NBS initiatives do not exhibit any bias or preference towards any gender. Participation is open and accessible to all genders equally, ensuring that individuals can contribute to and benefit from the initiatives irrespective of their gender. Gender inclusivity is a critical aspect to consider in promoting equality and fairness, which appears to be well-managed and implemented in the NBS initiatives.

b. Age

Age does not restrict or influence participation in NBS initiatives. Individuals of all ages are welcome and encouraged to participate, fostering a diverse age range of contributors and beneficiaries. While it's observed that younger individuals may be more open-minded towards NBS approaches, older participants, especially those with farming experience, bring invaluable insights and practical knowledge to the initiatives.

c. Social status

Participation in NBS initiatives is not affected by participants' social or economic status. People from various social strata can engage without discrimination or bias, which is essential for promoting social equity and inclusivity. While it's noted that individuals from higher social statuses, possibly due to higher levels of education, may be more open to such initiatives, the projects do not actively exclude or favor any particular social group.

d. Indigenous rights

⁹ REXUS Del. 2.1 "Guidelines for Stakeholder Engagement".

REXUS Observatory (<https://rexus-observatory.draxis.gr/>).

REXUS Metamodel

(<https://app.powerbi.com/view?r=eyJrIjoiaZTQ2NmRkN2ltYgZC00YjVklW10ZWmtZDMzNTA3NzI2NDJhiiwidCI6IjE1ZjNmZTBILWQ3MTItNDk4MS1iYzdjLWZlOTQ5YWYyMTViYiIsImMiOiJh9&pageName=ReportSection>).

REXUS Window (<http://www.rexuswindow.eu/course/view.php?id=4>).

REXUS AirNBS website - Catalogue of NBS (under development).

LENSES Del. 2.1 "D2.1 LAA Stakeholder Engagement Guidelines".

LENSES window (<http://www.lenseswindow.eu/>).

LENSES NBS Catalogue (<https://NBScatalogue.lenses-prima.eu/>).

Indigenous rights are neither infringed upon nor are a determining factor for participation in NBS initiatives. All initiatives are conducted with respect for land property rights and in accordance with both Greek national law and EU legislation. The policy and operational framework of the NBS initiatives ensure that indigenous peoples' rights are acknowledged and respected, even though this might not be a prominent issue in the given context.

5. Represented stakeholders¹⁰

Score: 1

All stakeholders, whether directly or indirectly affected, are not only identified but also actively engaged in the decision-making process. This inclusive approach ensures diverse perspectives are considered, enhancing the robustness and acceptability of the decisions made.

6. Represented interest of stakeholders¹¹

Score: 1

The decision-making processes involved in the NBS initiatives effectively document and respond to the rights and interests of all stakeholders. This means that the concerns, needs, and rights of participating and affected stakeholders are not only acknowledged but are also actively addressed and respected in the process, fostering an environment of trust and cooperation.

7. Intra-organizational coordination¹²

Score: 1

Mechanisms are in place to ensure active engagement and coordination among the various stakeholders. These mechanisms facilitate communication and collaboration, promoting synergy in the planning and implementation of NBS initiatives. However, it is anticipated that more official coordination structures will be established in the future to further streamline and improve collaborative efforts.

8. Inter-organizational coordination¹³

Score: 0.5

While there are existing coordination mechanisms, their responsibilities and authority are typically limited to their specific jurisdictional boundaries. This limitation can be challenging when NBS initiatives extend beyond these jurisdictions, necessitating improved mechanisms for joint decision-making across different jurisdictional areas to ensure cohesive and effective implementation of NBS initiatives.

¹⁰ LENSES WP2 Recap of the 1st Pinios pilot (Greece) Technical Workshop - Stakeholder Interview Results and the LENSES Stakeholder Responses through Structured interviews

¹¹ LENSES WP2 Recap of the 1st Pinios pilot (Greece) Technical Workshop - Stakeholder Interview Results and the LENSES Stakeholder Responses through Structured interviews

¹² Documentation Text EL08-01 "Determination of Competent Authorities and their Jurisdiction Area" in the context of the 1st Update of River Basin Management Plan of Thessaly Water District in accordance with the Water Framework Directive (2000/60/EC) (http://wfdver.ypeka.gr/wp-content/uploads/2021/02/EL08_1REV_P01_Armodies_Arxes.pdf) (EL)

¹³ Documentation Text EL08-01 "Determination of Competent Authorities and their Jurisdiction Area" in the context of the 1st Update of River Basin Management Plan of Thessaly Water District in accordance with the Water Framework Directive (2000/60/EC) (http://wfdver.ypeka.gr/wp-content/uploads/2021/02/EL08_1REV_P01_Armodies_Arxes.pdf) (EL)

9. Community supporting the NBS¹⁴

Score: 1

There is clear support from the community for the NBS initiatives, as evidenced through structured interviews with stakeholders. This support is crucial for the successful implementation and sustainability of NBS initiatives as it indicates a level of community buy-in and acceptance of these environmental and conservation efforts.

10. Management of the negative impacts' strategy¹⁵

Score: 1

Proactive measures are established to manage and mitigate potential negative impacts that may affect stakeholders due to the implementation of NBS initiatives. These measures include providing compensatory benefits to offset economic losses that stakeholders might incur due to changes in land use. Such proactive management of negative impacts is essential for maintaining support and participation from the community and affected stakeholders.

4.1.2 Key dimension 2: Supportive policies

Score: 1/1 (100%)

The "Supportive Policies" key dimension achieved a 100% score, thus reflecting a robust policy framework at both the European Union and Greek national levels that clearly supports NBS. No large-scale NBS conflicts are anticipated in the Thessaly River Basin, further smoothing the path for NBS implementation. This high score underlines the strength and coherence of existing policies, making it conducive for the successful deployment of NBS initiatives.

Below is the detailed result analysis for the indicators and sub-indicators of this key dimension:

1. European, national and sub-national policies supporting NBS¹⁶

Score: 1

There are distinct laws and regulations at both the EU and Greek national levels which contain clear references to NBS. This acknowledgment and recognition of NBS within legal frameworks provide a structured and legally backed approach towards implementing NBS initiatives.

2. European, national and sub-national policies' objectives¹⁷

Score: 1

¹⁴ Structured Interviews Conducted under LENSES project

¹⁵ EU Common Agriculture Policy 2023-2027

¹⁶ National Climate Law (Law number 4936/2022), EU Biodiversity Strategy 2030

¹⁷ Documentation Text EL08-12 "Basic and Complementary Measures including cost-effectiveness analysis" in the context of the 1st Update of River Basin Management Plan of Thessaly Water District in accordance with the WFD 2000/60/EC (http://wfdver.ypeka.gr/wp-content/uploads/2020/03/EL08_1REV_P12_Metra.pdf) (EL)

The analysis revealed that there is an absence of conflicting objectives among sectoral policies regarding the implementation of NBS. With the exclusive implementation of ad-hoc environmental-friendly NBS measures, no potential conflicts are foreseen in the wider pilot area, as affirmed by the 2nd Revision of the Thessaly River Basin Management Plan.

3. Indication of NBS as planning option

Score: 1

a. Land Use Planning Regulations¹⁸

The EU Green Deal, initiated in December 2019, underlines the pivotal role of NBS in achieving climate neutrality by 2050. Through various initiatives encompassing land use planning, such as the Farm to Fork Strategy, Forest Strategy, and the Renovation Wave, NBS is spotlighted as integral to their objectives.

b. Strategies¹⁹

The adopted EU Biodiversity Strategy for 2030 distinctly incorporates NBS. With sections devoted to mainstreaming NBS in policies, plans, and investments, it acts as a key action plan targeting biodiversity loss and climate change. Furthermore, it delineates sectors where NBS could seamlessly integrate, including agriculture, forestry, water management, and urban planning.

c. Plans²⁰

The EU Urban Agenda, promulgated in 2016, endorses the use of NBS to enhance urban living standards, promote biodiversity, and counteract climate change impacts. With partnerships spanning various themes like air quality, circular economy, and urban mobility, the agenda envisions NBS as a fundamental, cross-cutting element.

4.1.3 Key dimension 3: Supporting policies

Score: 0.75/1 (75%)

The analysis of the key dimension "Supporting Policies" shows a score of 0.75, indicating 75% effectiveness. In Greece, the alignment of NBS interventions with EU's Biodiversity Strategy and Water Framework Directive presents a promising landscape for local implementation and feedback mechanisms. Additionally, there is a strong move toward mainstreaming NBS into broader policy contexts, such as the 2nd Revision of the Thessaly Water Resources Management Plan. Specifically, in areas like the Kalentzis sub-basin within the PRB, NBS measures for flood risk mitigation are scheduled for development. However, the analysis also reveals gaps; there are no existing procedures to measure NBS contributions to human well-being or human rights at the national and global levels. Despite these shortcomings, the score

¹⁸ EU Green Deal, 2019

¹⁹ EU Biodiversity Strategy for 2030

²⁰ EU Urban Agenda, 2016

underscores the readiness for implementing supportive policies, but it also highlights areas requiring further attention for comprehensive policy support.

Below is the detailed result analysis for the indicators and sub-indicators of this key dimension:

1. Implementation of a successful NBS

Score: 1

a. Uptake²¹

In Greece, national policies align with and support EU directives relevant to NBS. This alignment facilitates local implementation and provides a feedback loop for assessing policy effectiveness. The Greek landscape's rich biodiversity and natural resources serve as a foundation for NBS interventions that align with and enhance biodiversity conservation, carbon sequestration, and climate change mitigation efforts.

b. Mainstreaming²²

NBS measures, as part of the REXUS and LENSES projects, are set to undergo public consultation, aiming for integration into the 2nd Revision of the Thessaly Water Resources Management Plan. This plan covers river basin-scale strategies and includes NBS for flood risk mitigation in the Kalentzis sub-basin of the Pinios River Basin. The inclusion of NBS in strategic planning for water and soil management is definitive and supports the broader implementation of sectoral strategies.

2. Contribution of NBS to national and global targets

Score: 0.5

a. Human Well-being²³

Currently, there are no established procedures to capture the NBS's impact on national and global targets for human well-being within the Pinios River Basin.

b. Climate Change²⁴

The contribution of NBS to combating climate change is recognized and captured within the policy framework, suggesting that NBS interventions are considered effective tools for meeting climate-related targets.

c. Biodiversity²⁵

²¹ EU Biodiversity Strategy for 2030

²² Draft document of the 2nd Revision of River Basin Management Plan of Thessaly Water District in accordance with the WFD 2000/60/EC (http://wfdver.ypeka.gr/wp-content/uploads/2023/05/EL08_2REV_P4.9_Proxedia_LAP.pdf)

²³ Questionnaire filled by the SWRI team

²⁴ LENSES WP2 Recap of the 1st Pinios pilot (Greece) Technical Workshop - Stakeholder Interview Results and the LENSES Stakeholder Responses through Structured interviews

²⁵ LENSES WP2 Recap of the 1st Pinios pilot (Greece) Technical Workshop - Stakeholder Interview Results and the LENSES Stakeholder Responses through Structured interviews

Procedures are in place that recognize and measure the contributions of NBS to biodiversity targets, affirming that NBS is an integral part of biodiversity strategies.

*d. Human Rights*²⁶

Like human well-being, there is currently a lack of procedures to assess NBS contributions to human rights targets in the Pinios River Basin.

4.1.4 Key dimension 4: Appropriate regulatory environment

Score: 0.92/1 (92%)

The "Appropriate Regulatory Environment" key dimension achieved a robust 92% effectiveness score, highlighting a well-structured regulatory framework supporting NBS in the PRB. The regulatory environment in Greece is comprehensive, encompassing clear land-use definitions, permit requirements, and various regulations, codes, and standards ensuring the safe implementation of NBS. Additionally, alignment with EU directives like the Water Framework Directive and the Floods Directive ensures harmonized water management and conservation approaches. The framework respects various land tenure forms and stakeholders' rights, proving flexible and conducive for different NBS types and scopes implementation.

Below is the detailed result analysis for the indicators and sub-indicators of this key dimension:

1. Land use designation²⁷

Score: -1

The PRB land use is clearly delineated through maps and regulatory documents providing evident guidelines and designations on land utilization.

2. Clear and defined construction permits²⁸

Score: -0.5

Permit requirements for NBS initiatives depend on the type of project. Simple interventions like mulching and irrigation scheduling on private farmland do not require special permits. However, NBS projects aimed at flood risk mitigation and ecosystem improvement, involving varying degrees of land use interventions, require specific permits that have not yet been secured.

3. Clear and defined safety and performance codes and standards²⁹

Score: -1

Greece has established safety and performance standards and regulations for implementing NBS in the PRB, covering water quality, ecological sustainability, and

²⁶ Questionnaire filled by the SWRI team

²⁷ Questionnaire filled by the SWRI team

²⁸ REXUS Del. 5.3 "Finalized Core Modules for Decision Support Framework" of WP5 "Incorporating Nature-based Approaches into Nexus Solutions". LENSES Del. 5.2 "Roadmap to navigate the available catalogues of Nature-based Solutions and finalised list of candidate NBS".

²⁹ Greek Law on Water Resources management (Law 3199/2003), Greek law on Environmental Impact Assessment (law 4014/2011), EU Flood Directive (2007/60/EC), EU Water Framework Directive

environmental impact assessments. The country has also adopted EU directives related to water management and conservation, providing a legal foundation for protecting water resources and aquatic ecosystems.

4. Clear procurement policies³⁰: Score- 1

Score: -1

Greece adheres to a national procurement policy outlined in Law 4412/2016, aligning with EU procurement directives. The National Procurement Authority oversees and guides public procurement practices in the country.

5. Clear land and resources tenure, usage, and access rights: Score-1

Score: -1

a. Tenure³¹

- i. Private Land Ownership: protected by the Constitution and governed by the Greek Civil Code, private ownership allows individuals to possess, use, and dispose of land.
- ii. Public Land Ownership: owned by the state, public land is used for public purposes, such as parks, government buildings, and public facilities.
- iii. Communal Land Ownership: owned collectively by communities (like a village or municipality), communal land is used and decided upon by the community collectively.

b. Usage³²

- i. Sustainable Management: regulations ensure that natural resources (like water, forests, minerals) are used sustainably, balancing environmental conservation and economic development.
- ii. Permit Requirement: certain resource utilization activities require permits and licenses to ensure lawful and sustainable use.

c. Access rights³³

- i. Regulated Access: laws and regulations govern access to land and resources. For example, activities like mining and forestry may need permits and licenses.

³⁰ National Procurement Authority and EU Public Procurement Strategy

³¹ Questionnaire filled by the SWRI team

³² Greek Law on Natural Resources (1650/1986), Greek Law on Environmental Protection (4014/2011) and Law on Mining Activities (3986/2011).

³³ Greek Law on Natural Resources (1650/1986), Greek Law on Environmental Protection (4014/2011) and Law on Mining Activities (3986/2011).

- ii. Restricted Access: in some instances, access to resources is limited to specific groups or communities to protect the rights of indigenous people, farmers, or other stakeholders.

6. **Acknowledge and observance of the land and resources tenure, usage, and access rights**

Score: -1

a. *Tenure*³⁴

The legal tenure of land and resources, and the responsibilities that come with it, are acknowledged, and respected for all planned measures, including NBS. This ensures that the rightful ownership and control over land and resources are not violated.

b. *Usage*³⁵

The rights and responsibilities regarding the usage of land and resources are respected and acknowledged for all planned measures—safeguarding the stakeholders' legal right to use the land and resources for various purposes without undue restrictions.

c. *Access rights*³⁶

Access rights to land and resources, along with associated responsibilities, are defined and respected in all planned measures. Implementation of NBS does not in any way alter or infringe upon the legal rights of landowners and resource users, ensuring fair and lawful access to resources for all relevant stakeholders.

7. **Clear environmental protection regulation**³⁷

Score: -1

Greece complies with both national and EU environmental protection regulations and directives.

4.1.5 Key dimension 5: Technical capacity

Score: 0.94/1 (94%)

The "Technical Capacity" key dimension received a notable score of 94% effectiveness, showcasing strong technical capacities for NBS initiatives. This high score highlights strengths such as sophisticated multi-channel communication among stakeholders, formal procedures for stakeholder engagement, and well-organized platforms for contribution on projects like REXUS and LENSES, led by the SWRI Team. Educational initiatives, including specific courses

³⁴ REXUS Del. 5.3 "Finalized Core Modules for Decision Support Framework" of WP5 "Incorporating Nature-based Approaches into Nexus Solutions". LENSES Del. 5.2 "Roadmap to navigate the available catalogues of Nature-based Solutions and finalised list of candidate NBS".

³⁵ Greek Law on Natural Resources (1650/1986), Greek Law on Environmental Protection (4014/2011) and Law on Mining Activities (3986/2011).

³⁶ Greek Law on Natural Resources (1650/1986), Greek Law on Environmental Protection (4014/2011) and Law on Mining Activities (3986/2011).

³⁷ EU Water Framework Directive (2000/60/EC), EU Waste Framework Directive (2008/98/EC), Greek Law 4014/2011 for EIA

and degree programs in Greek Universities, further support NBS adoption. The bidirectional collaborative learning facilitated by projects like LENSES and REXUS also strengthens the technical capacity. Although the technical framework is robust, there is potential for further localized specialization in NBS education for residents.

Below is the detailed result analysis for the indicators and sub-indicators of this key dimension:

1. Stakeholders' network cohesion to optimize interdisciplinary co-creation and co-design of NBS³⁸

Score: 1

Stakeholders actively exchange information related to NBS projects through various communication means, facilitating clear and continuous communication among all involved parties.

2. Procedures for collecting comments³⁹

Score: 1

a. Before

For projects like REXUS and LENSES, stakeholders are actively engaged in proposing and formulating NBS interventions through workshops, online questionnaires, café meetings, and task force meetings. Furthermore, measures proposed in the 2nd update of the Thessaly River Basin Management Plan are set for public consultation.

b. After

Stakeholders can provide comments and contributions during the intervention through formal meetings, primarily at the municipality level, ensuring that the implemented measures align with technical specifications and environmental assessment guidelines.

3. Training in NBS: Score⁴⁰

Score 0.75

a. Course

³⁸ Questionnaire filled by the SWRI team

³⁹ REXUS Del. 2.1 "Guidelines for Stakeholder Engagemet".

- REXUS Observatory (<https://rexus-observatory.draxis.gr/>).

- REXUS Metamodel

(<https://app.powerbi.com/view?r=eyJrljoiZTQ2NmRkN2ItYTgyZC00YjVklWI0ZWVtZDMzNTA3NzI2NDJhIiwidCI6IjE1ZjNmZTBILWQ3MTItNDk4MS1iYzdjLWZlOTQ5YWYyMTViYiIsImMiOj9&pageName=ReportSection>).

- REXUS Window (<http://www.rexuswindow.eu/course/view.php?id=4>).

- REXUS AirNBS website - Catalogue of NBS (under development).

- LENSES Del. 2.1 "D2.1 LAA Stakeholder Engagement Guidelines".

- LENSES window (<http://www.lenseswindow.eu/>).

- LENSES NBS Catalogue (<https://NBScatalogue.lenses-prima.eu/>).

⁴⁰ Questionnaire filled by the SWRI team

Greece offers specific courses related to NBS to improve its adoption and understanding among professionals.

b. Education

Various universities in Greece incorporate NBS-related courses and degree programs into their curricula, promoting education and awareness regarding NBS.

4. Collaborative learning among stakeholder⁴¹

Score: 1

Projects like LENSES and REXUS facilitate bidirectional flows of collaborative learning among stakeholders, promoting shared understanding and cooperation.

5. Knowledge courses⁴²

Score: 1

a. Residents

While specific local courses are not planned, the benefits of NBS implementation, including water availability increase, energy saving, agricultural production enhancement, and ecosystem health improvement, are disseminated to interested parties through workshops and publications.

b. Stakeholder

Through the LENSES and REXUS projects, stakeholders have access to specialized courses and information, enhancing their understanding and involvement in NBS initiatives. Without these projects, individuals and organizations interested in NBS initiatives may have limited access to specialized courses and information, potentially hindering their understanding and involvement in these initiatives.

4.1.6 Key dimension 6: Access to finance

Score: 0.56/1 (56%)

The analysis of the key dimension "Access to Finance" reveals a 56% effectiveness score for financing NBS in Greece. Significant potential exists with access to European funds like the LIFE programme, the European Regional Development Fund, and national initiatives like the "Green

⁴¹ Questionnaire filled by the SWRI team

⁴² REXUS Del. 2.1 "Guidelines for Stakeholder Engagement".

- REXUS Observatory (<https://rexus-observatory.draxis.gr/>).

- REXUS Metamodel

(<https://app.powerbi.com/view?r=eyJrIjojZTQ2NmRkN2ItYTgyZC00YjVklWl0ZWmtZDMzNTA3NzI2NDJhIiwidCI6IjE1ZjNmZTBILWQ3MTItNDk4MS1iYzdjLWZlOTQ5YWYyMTViYiIsImMiOj9h9&pageName=ReportSection>).

- REXUS Window (<http://www.rexuswindow.eu/course/view.php?id=4>).

- REXUS AirNBS website - Catalogue of NBS (under development).

- LENSES Del. 2.1 "D2.1 LAA Stakeholder Engagement Guidelines".

- LENSES window (<http://www.lenseswindow.eu/>).

- LENSES NBS Catalogue (<https://NBScatalogue.lenses-prima.eu/>).

Fund" and "Life ElClima" project. However, there are critical gaps in project management and design capabilities, with no specific NBS design team identified, and uncertainty in securing financing beyond the research stages, each aspect receiving a score of 0.5. The nascent management systems, developed during REXUS and LENSES projects, have uncertain effectiveness post-project, while legal responsibilities for NBS are still being defined, both receiving a score of 0.5. These deficiencies highlight areas requiring improvement for successful NBS financing.

Below is the detailed result analysis for the indicators and sub-indicators of this key dimension:

1. European, national and sub-national resourcing options (policies, financial instruments, etc.) supporting NBS⁴³

Score: -1

A diverse portfolio of resourcing options is available for NBS in the EU and Greece. The EU Biodiversity Strategy for 2030 supports NBS usage across policies. Financial instruments like the LIFE programme and European Regional Development Fund provide funding for nature-conserving and sustainable urban development projects. Greece also supports NBS initiatives through the Ministry of Environment and Energy, with projects like the "Green Fund" and "Life ElClima" promoting sustainable development and environmental protection.

2. Completeness of income sources⁴⁴

Score: -0.25

a. Design team

While Greece possesses the professional capacity for developing NBS projects, a specific design team has not been identified.

b. Management team

No complete project management system is currently in place to ensure income source completeness.

3. Financial stability

Score: -0.5

a. Design team⁴⁵

⁴³ Questionnaire filled by the SWRI team

⁴⁴ Ministry of Environment and Energy, HSPN, SWRI, University of Thessaly.

⁴⁵ LENSES Del. 6.1 "Socio-economic indicators and framework for Nexus-relevant NBS".

LENSES Del. 6.2 "Policy indicators and framework for Nexus-relevant NBS".

LENSES Del. 6.3 "Business and governance models framework for Nexus-relevant NBS".

REXUS Del. 7.4 "Exploitation and Sustainability plan",

LENSES Del. 9.4 "Exploitation and Sustainability plan".

LENSES Del. 9.7 "Business plan".

Design teams propose pathways for European and national funding, but financial sustainability post-research phase is not guaranteed. However, there are hopes that governmental and systemic bank support for NBS financing will materialize.

*b. Management team*⁴⁶

Networks created during projects like REXUS and LENSES, supported by the SWRI research team, are expected to maintain some level of activity, promoting Nexus security in pilot areas.

4. Legal responsibilities⁴⁷

Score: -0.5

Legal responsibilities related to NBS implementation are currently undefined but are expected to become clearer with the adoption of national strategic plans, including the 2nd revision of Water Resources Management Plans.

4.1.7 Key dimension 7: NBS management

Score: no scoring done

The analysis of the key dimension 7, focused on "NBS Management," reveals significant gaps in the existing framework. The NBS initiatives are still in the design stage (hence no data available), therefore, it was not scored.

1. Monitoring and evaluation strategy⁴⁸

Score: no scoring done

Currently, there is not an established official system for periodically monitoring and evaluating the NBS interventions through their lifecycle.

2. Adaptive NBS intervention management⁴⁹

Score: no scoring done

There isn't a planned official iterative learning process developed to support adaptive management of NBS interventions throughout their lifecycle.

3. NBS safeguard system⁵⁰

Score: no scoring done

⁴⁶ REXUS Metamodel

(<https://app.powerbi.com/view?r=eyJrIjoizTQ2NmRkN2ItYTgyZC00YjVklWI0ZWMTZDMzNTA3NzI2NDJhiiwidCI6IjE1ZjNmZTBILWQ3MTItNDk4MS1iYzdjLWZlOTQ5YWYyMTViYiIsImMiOj9&pageName=ReportSection>).

- REXUS Window (<http://www.rexuswindow.eu/course/view.php?id=4>).

- LENSES window (<http://www.lenseswindow.eu/>).

⁴⁷ Draft document of the 2nd Update of River Basin Management Plan of Thessaly Water District in accordance with the WFD 2000/60/EC (http://wfdver.ypeka.gr/wp-content/uploads/2023/05/EL08_2REV_P4.9_Proxedia_LAP.pdf)

⁴⁸ Result of the questionnaire responses received from SWRI, REXUS Deliverable 7.4 and LENSES Deliverable 9.4

⁴⁹ Result of the questionnaire responses received from SWRI, REXUS Deliverable 7.4 and LENSES Deliverable 9.4

⁵⁰ Result of the questionnaire responses received from SWRI, REXUS Deliverable 7.4 and LENSES Deliverable 9.4

While a safeguard system to ensure that agreed trade-off limits are respected and do not destabilize NBS interventions can potentially be drafted with SWRI support, there is currently no official plan to establish such a system.

4. Risk strategy: Score⁵¹

Score: no scoring done

While there is potential for the development of strategies to identify and manage various levels and types of risks associated with NBS interventions, no official strategy is currently in place.

4.2 Interactions among the key dimensions related to their performance

1. Affecting performance

- a. **Conducive Governance Arrangements (76%):** this foundational element positively impacts all other dimensions by laying the groundwork for NBS initiatives. By focusing on consolidating responsibilities and enhancing participatory approaches, this governance framework facilitates better stakeholder engagement, which in turn can improve “Technical Capacity” and the effectiveness of “NBS Management”.
- b. **Supportive Policies (100%):** this dimension acts as a catalyst for the Appropriate Regulatory Environment, offering robust support that ensures seamless alignment. A strong policy framework underpins the regulatory landscape, providing essential support for the effective development and implementation of NBS initiatives.
- c. **Appropriate Regulatory Environment (92%):** the effectiveness of this dimension plays a pivotal role in influencing NBS implementation. It directly impacts “Access to Finance” and “NBS Management”. A clear and supportive regulatory environment positively influences these dimensions, while a restrictive or ambiguous one can have negative repercussions.

2. Posing threats to the performance

- a. **NBS Management Deficiencies:** a lack of established “NBS Management” systems present a pervasive threat to all key dimensions. Without effective management, there's a risk of undermining governance structures, policy implementation, regulatory compliance, technical capacity utilization, and the efficacy of financing mechanisms.
- b. **Access to finance:** gaps in “Access to Finance” can jeopardize the effectiveness of governance arrangements, supportive policies, and technical capacity by

⁵¹ Result of the questionnaire responses received from SWRI and Documentation Text EL08-12 "Basic and Complementary Measures including cost-effectiveness analysis" in the context of the 1st Update of River Basin Management Plan of Thessaly Water District in accordance with the WFD 2000/60/EC (http://wfdver.ypeka.gr/wp-content/uploads/2020/03/EL08_1REV_P12_Metra.pdf) (EL)

constraining the resources necessary for the deployment and sustenance of NBS initiatives.

3. Providing strengths and opportunities for better performance

- a. **Policy Support Structure:** with a foundation of “Supportive Policies” at both the EU and national levels, there’s a stable platform in place that enables all other dimensions to function effectively within a supportive policy context. This structure provides a significant opportunity for the coherent and aligned operation of NBS initiatives.
- b. **Technical Expertise (94%):** the high level of “Technical Capacity” is a monumental strength, acting as the backbone that supports other dimensions by furnishing the essential expertise and skills required for the meticulous planning, implementation, and management of NBS initiatives.
- c. **Regulatory Clarity (92%):** The “Appropriate Regulatory Environment” offers a conducive framework for NBS initiatives, ensuring that projects are executed smoothly and in compliance with established regulations.

Chapter 5: Discussion

This chapter critically examines the outcomes presented in Chapter 4, interpreting the relationships between the seven principal dimensions of NBS implementation within the PRB in Greece. It focuses on evaluating the findings within the context of existing literature, examining the broader implications, and identifying potential for enhancement in NBS applications.

5.1 Synthesis of key dimensions in Pinios River Basin

This section delves into a deeper analysis of the interplay among the key dimensions, integrating more comprehensive insights from global NBS practices and theoretical frameworks. The complex dynamics and compatibility in the PRB's NBS approach are scrutinized based on existing literature and by drawing parallels and contrasts with other regional and global examples, thereby providing a deepened understanding of the PRB's position within the broader NBS landscape.

5.1.1 Interconnections among dimensions

The mutual influence among the key dimensions reveals a sophisticated yet harmonious interplay, which is particularly evident in the PRB. Here, 'Supportive Policies' achieved a 100% effectiveness score, indicating a robust policy framework that is in alignment with EU policies, particularly those within the EU Green Deal, like the EU Biodiversity Strategy for 2030, the EU Adaptation Strategy and the Nature Restoration Law. The European Green Deal steps up efforts on climate-proofing, resilience-building, prevention, and preparedness. The implementation of NBS is considered key in achieving the objectives of major EU policy priorities, to foster biodiversity and make Europe more climate-resilient (European Commission, 2023).

NBS represent a credible means to address key societal issues, such as biodiversity loss, climate change, and disaster risk reduction provided that policy dialogues and outreach initiatives are implemented. This is consistent with literature suggesting that strong policy support, especially when aligned with higher-level policies, is pivotal for the success of NBS initiatives (de Luca *et al.*, 2021; Balzan *et al.*, 2022). The political momentum and uptake of NBS over the past few years, creates a great opportunity for further recognition of NBS in the pilot area and beyond. In the PRB, the absence of conflicting objectives among sectoral policies further reinforces the potential for successful NBS implementation.

The 'Appropriate Regulatory Environment' dimension scored 92% effectiveness in the PRB. This dimension's strength underscores the crucial role of a supportive regulatory environment, which is a finding also mirrored in broader studies that highlight the importance of regulatory clarity for NBS success (e.g., Cohen-Shacham *et al.*, 2016; Dorst *et al.*, 2019) and stress that regulatory requirements represent a key driver for the uptake of NBS (United Nations, 2018). The clarity in regulations within the PRB, including land-use planning and safety standards, provides a conducive framework for implementing NBS, as evidenced by the alignment with the EU Water Framework Directive and the EU Floods Directive. This seems to be of the utmost

importance for an area prone to flood risks and that has experienced severe flooding events, including the major one caused by Storm Daniel in September 2023 (He, 2023).

The interconnections among these dimensions in the PRB context create a synergy where the strength of one element reinforces the others. For instance, a clear policy framework underpins the regulatory landscape, providing essential support for the effective development and implementation of NBS initiatives. This is a concept widely recognized in the literature, where governance structures that are well-defined and integrated with supportive policies lead to more sustainable NBS outcomes (Seddon *et al.*, 2020).

5.1.2 Comprehensive assessment of gaps in the Pinios River Basin's Nature-Based Solution implementation

The examination of the PRB's strategies uncovers numerous significant shortcomings, especially in the precise measurement of NBS's role in enhancing human well-being. This issue is not unique to the PRB but is a common hurdle in the worldwide implementation of NBS. Various studies, including (among others) those by Turnhout *et al.* (2020) and Palomo *et al.* (2021), have pointed out the absence of solid methodologies for gauging the socio-economic effects of NBS initiatives. They argue for the development of comprehensive frameworks that encompass the multifaceted advantages of NBS, extending beyond just environmental outcomes.

To overcome this issue, it is suggested that the PRB adopts an inclusive evaluation method. According to Kabisch *et al.* (2016), it is beneficial to incorporate social, economic, and environmental indicators to thoroughly assess NBS impacts. This idea is in line with the recommendations by Raymond *et al.* (2017) for multi-criteria assessment tools adept at capturing the varied benefits of NBS. Moreover, the use of participatory methods in evaluations, as advised by Frantzeskaki *et al.* (2019), ensures that the viewpoints and priorities of local communities are integrated into the assessment of NBS contributions.

The deficiencies noted in the PRB's approach to NBS mirror wider issues in their global usage. Research by Cohen-Shacham *et al.* (2016) and Dorst *et al.* (2019) similarly highlights the necessity for enhanced evaluation frameworks that can encompass the entire range of NBS advantages. By addressing these deficiencies, the PRB can not only refine its NBS strategies but also contribute significantly to the worldwide conversation on NBS implementation, providing valuable insights and methodologies that can be applied in other areas facing comparable issues. At the same time, a common and recognized framework to assess NBS impacts would represent a valuable tool for supporting decision making about designing and implementing of NBS, including by investors who might then be guided in assessing risks as well as potential benefits associated to NBS-related investments (Atteridge *et al.*, 2022).

In sum, resolving the deficiencies in quantifying NBS contributions within the PRB entails adopting a comprehensive evaluation framework, incorporating participatory methods, and aligning with the latest global standards and methodologies for NBS assessment. This strategy will not only boost the effectiveness of NBS within the PRB but also enhance the broader understanding and application of NBS on a global scale.

5.2 Navigating risks and challenges

In this sub-chapter, we explore the risks and challenges associated with implementing NBS in the PRB. Bureaucratic inefficiencies and financial hurdles remain significant obstacles to the successful execution of NBS initiatives. We will dissect these impediments and consider strategic responses that have proven effective in other contexts, with the aim of enhancing the efficacy and sustainability of NBS within the PRB.

5.2.1 Bureaucratic inefficiencies in governance arrangements

The bureaucratic inefficiencies within the PRB present a significant obstacle to the effective execution of NBS. These inefficiencies are characterized by slow decision-making, divided responsibilities, and the absence of efficient processes. Such issues can majorly hinder the advancement of environmental projects.

The PRB's bureaucratic inefficiencies mainly stem from scattered responsibilities and the lack of a central coordinating entity. This division leads to weakened accountability and less than ideal outcomes for NBS, as shown in broader research (Sibiya *et al.*, 2023). These inefficiencies can cause delays in NBS project implementation and inequalities, especially when NBS scale exceeds jurisdictional limits.

Learning from effective examples like the governance structures in the Netherlands provides useful lessons for the PRB. For example, the Dutch model of decentralized environmental management decision-making is known to improve agility and response, essential for successful NBS (Van Herk *et al.*, 2011). In a similar vein, Singapore's integrated approach in water management shows the advantages of coordinated governance in NBS (Yi, 2020).

Theoretical models such as collaborative governance and public administration theories stress the importance of integration and coordination at various governance levels. Ansell and Gash (2008) underscore the success of collaborative governance in overcoming bureaucratic challenges, while Ostrom's principles for managing collective resources offer guidelines for effective multi-stakeholder involvement and decision-making (Ostrom, 1990).

To counter these bureaucratic inefficiencies, the PRB should consider a more centralized approach to NBS planning and execution. Creating specific bodies or teams for NBS-related decisions could reduce bureaucratic obstacles and improve governance. Moreover, incorporating stakeholder participation and public consultation in decision-making could help address issues arising from divided responsibilities (Reed, 2008). Although the PRB has strong regulatory support for NBS, bureaucratic inefficiencies pose a significant risk, leading to delays and resource misallocation. This problem is not unique to the PRB but is commonly noted in literature as an impediment to NBS implementation (Garcia and Burns, 2022). A strategic approach in the PRB could involve better coordination mechanisms, drawing on examples of centralization and integration from successful NBS cases (Sarabi *et al.*, 2020).

5.2.2 Financial stagnation in access to finance

The financial challenges in the PRB are multifaceted, impacting the viability and sustainability of NBS. These challenges are compounded by broader economic contexts, such as fluctuations in governmental funding and the complexities of accessing international financial resources (Atteridge *et al.*, 2022).

The PRB's financial challenges are partly rooted in the broader economic climate, which can influence the availability and stability of funding. Economic downturns, policy shifts, and changing priorities at both national and EU levels can lead to funding uncertainties for environmental projects (Delikanli *et al.*, 2018). Additionally, the complexity of navigating funding mechanisms at different governance levels can result in inefficient resource allocation.

Exploring innovative funding mechanisms is crucial for addressing these financial hurdles. Mechanisms such as green bonds, environmental impact bonds, and payment for ecosystem services have been identified as potential solutions in various studies (Bell and Morse, 2018; Farley and Costanza, 2010). These mechanisms can provide sustainable funding for NBS initiatives by tapping into new sources of finance and leveraging private sector investment.

Examining successful funding models from other regions can offer valuable insights for the PRB. For example, the Chesapeake Bay watershed in the United States has utilized innovative financing strategies, including public-private partnerships and performance-based contracting, to support its extensive environmental restoration efforts (Palmer and Filoso, 2009). Similarly, the Green Fund in Costa Rica has successfully mobilized resources for biodiversity conservation through a combination of government, private, and international funding (Castro and Locker, 2000).

Enhancing project management is another critical aspect of addressing financial challenges. Efficient project management can optimize resource allocation and reduce costs, thereby increasing the financial sustainability of NBS projects. This includes adopting integrated project management approaches and leveraging technological tools for better planning, monitoring, and reporting (Schaltegger and Burritt, 2018). The PRB faces potential financial stagnation that can hinder the sustainability of NBS initiatives. This challenge is exacerbated by gaps in project management and uncertainties in legal responsibilities. To address this, the PRB can benefit from the establishment of dedicated teams for project design and management, a strategy that is supported by literature advocating for specialized management to enhance NBS project efficiency (Van Herk *et al.*, 2011). Furthermore, diversifying funding sources and clarifying legal frameworks, as seen in other regions, can provide stability and attract investment (IUCN BRIDGE GBM, 2018).

5.3 Leveraging strengths and opportunities

Here, we examine the pivotal role that the technical capacity and supportive policy framework within the PRB play in enabling NBS. Furthermore, we explore how addressing existing gaps and fostering collaborative efforts can serve as a conduit for innovation and the enhancement of NBS practices within the basin.

5.3.1 Building on strong foundations: A deeper dive into the Pinios River Basin's technical and policy strengths

The PRB in Greece demonstrates several key strengths in its technical and policy level approach to NBS, which provide a solid foundation for future developments.

The PRB's technical infrastructure, particularly in terms of its communication systems and educational programs, is a cornerstone for successful NBS implementation. This technical prowess, reflected in a high effectiveness score of 94%, underpins the region's capacity to implement complex environmental projects. To build upon this foundation, there is a need to integrate state-of-the-art technologies and innovative practices that can further streamline NBS processes. The adoption of digital tools, such as Geographic Information Systems (GIS), geospatial and remote sensing technologies, has been increasingly recognized as pivotal in enhancing the efficacy of environmental management (Tsihrintzis *et al.*, 1996; De Leeuw *et al.*, 2010). These technologies can aid in precise mapping, monitoring, and analysis of environmental changes, providing critical data to inform NBS strategies, ultimately promoting social-ecological-technological integration (Wellmann *et al.*, 2022).

Expanding the scope of existing educational programs to include emerging topics like climate change adaptation, sustainable urban planning, and ecosystem services valuation can further strengthen the region's technical capacity. Recent studies have underscored the importance of interdisciplinary education in environmental sciences, highlighting how a diverse curriculum can prepare future professionals to tackle complex environmental challenges more effectively (Lundholm and Plummer, 2013; Monroe *et al.*, 2019).

The PRB's policy framework, with an effectiveness score of 100%, demonstrates a strong alignment with both EU and national environmental policies. However, to harness this strength fully, policy reforms that foster greater integration and adaptability are essential. Incorporating adaptive management principles into policy frameworks is critical for the long-term success of NBS initiatives. Adaptive management allows for flexibility and responsiveness to changing environmental conditions and stakeholder needs, thereby enhancing the sustainability of NBS (Armitage *et al.*, 2009; Chaffin *et al.*, 2014). Furthermore, the alignment of sectoral policies to avoid conflicting objectives and streamline NBS implementation can significantly boost efficiency. Recent literature suggests that harmonizing policies across different sectors, such as water management, agriculture, and urban planning, can lead to more comprehensive and effective environmental solutions (Benson *et al.*, 2013; Berkes, 2017). The integration of NBS into broader policy agendas, such as climate change mitigation and biodiversity conservation, can also amplify the impact of these solutions. As noted in the EU Biodiversity Strategy for 2030, aligning NBS with broader environmental objectives can create synergies that address multiple environmental challenges simultaneously (European Commission, 2020). Lastly, fostering public-private partnerships can mobilize additional resources and expertise for NBS projects, as highlighted in studies on collaborative environmental governance (Ansell and Gash, 2008; Bodin, 2017). Such partnerships can enhance the financial sustainability of NBS initiatives and encourage innovation through the sharing of knowledge and expertise.

In summary, the PRB's technical and policy strengths provide a solid foundation for the successful implementation of NBS. By embracing technological advancements, expanding educational scopes, and reforming policies to be more integrative and adaptive, the PRB can enhance the effectiveness and sustainability of its NBS initiatives. This approach, supported by current literature, offers a roadmap for the PRB to not only address its immediate environmental challenges but also to set a precedent for NBS implementation in other regions.

5.3.2 Capitalizing opportunities

The assessment of the PRB has brought to light several areas where innovation and improvement can significantly enhance the existing NBS management system. These identified gaps and deficiencies, rather than being seen as obstacles, present unique opportunities for the PRB to evolve into a more effective and sustainable model of environmental management.

One such opportunity lies in the current lack of a formalized monitoring and evaluation system within the PRB. This gap opens the door for the incorporation of advanced technologies like remote sensing and data analytics, which are essential for real-time monitoring and comprehensive data analysis. These tools, as suggested by De Leeuw *et al.* (2010), are crucial for assessing the impact and efficiency of NBS initiatives and align with global best practices, thereby elevating the standard of NBS interventions in the PRB.

Furthermore, the absence of an official iterative learning process in the PRB underscores the need for an adaptive management framework. This framework, which should include feedback loops, allows NBS interventions to evolve and improve over time, responding effectively to changing environmental and social conditions. This approach is supported by Allen and Gunderson (2011) and Williams (2011), who emphasize the importance of adaptive management strategies for the long-term success of environmental projects.

Another significant opportunity for the PRB is the potential for collaboration with academic institutions and technology firms. Such partnerships, as noted by Brouwer and Biermann (2011), can drive innovation in NBS by leveraging academic research and technological advancements. The concept of co-creation, where stakeholders from various sectors collaborate, has been increasingly recognized as a key driver for innovative solutions, as suggested by Ansell and Gash (2008) and Newig and Fritsch (2009).

Moreover, the lack of established systems in PRB's NBS Management presents an opportunity for adopting advanced practices and fostering an iterative development environment. This approach aligns with the literature, including Turner (2016), which supports using gaps as a springboard for innovation and continuous learning in NBS. Additionally, gaps in the design of learning management systems can be addressed by identifying the gaps and finding remedies for them, as discussed by Naz and Khan (2018). The concepts of NBS and Best Management Practices (BMPs), as explored by Qi *et al.* (2020), are closely related and can be utilized to address these gaps in NBS management.

The assessment also considers case studies and insights from collaborative and iterative approaches. For instance, urban NBS initiatives like those in Singapore, which include vertical gardens and sustainable urban drainage systems, offer valuable insights for the PRB. These

initiatives, as Yi (2020) notes, demonstrate the benefits of integrating NBS into urban planning and the potential for scaling such solutions.

Another example is the Chesapeake Bay Program in the United States, which highlights the success of iterative development approaches in watershed management. This program, as Palmer and Filoso (2009) observe, utilized adaptive management and stakeholder collaboration to address complex environmental challenges, providing a model that the PRB could adapt.

In conclusion, by identifying and harnessing the opportunities presented by its current gaps and deficiencies, the PRB can significantly enhance its approach to NBS. Adopting iterative development strategies, embracing technological advancements, and fostering multi-sector collaborations are key steps towards achieving this goal. Learning from global case studies and incorporating insights from collaborative efforts will guide the PRB in transforming these challenges into innovative solutions for environmental management.

5.4 Recommendations for policy and practice

The in-depth discussion of each key dimension in the preceding sections yields a set of policy and governance recommendations aimed at strengthening the NBS framework in the PRB.

a. Enhanced governance models

The PRB's experience suggests that dedicated entities are essential for coordinated and effective NBS management. This recommendation is bolstered by literature indicating that centralized bodies can reduce bureaucratic obstacles and enhance decision-making efficiency (Van der Jagt *et al.*, 2017). To establish more efficient governance structures in the PRB, this recommendation advocates for models that streamline bureaucratic processes and enhance decision-making. Drawing inspiration from the successful NBS governance models in regions like the Netherlands, China, and Singapore, where streamlined governance has led to effective urban greening and water management practices (Bai *et al.*, 2016; Wong and Yuen, 2011), it's clear that reducing bureaucratic barriers can significantly improve NBS outcomes. Theoretical models from NBS literature, such as those proposed by Chaffin *et al.* (2016), emphasize the importance of adaptive governance structures that are flexible and responsive to changing environmental conditions and stakeholder needs.

b. Ongoing training and capacity building

Continuous education and training programs are essential for building a competent workforce for NBS. This recommendation is grounded in research that highlights the critical role of human capital in the success of environmental initiatives (Kabisch *et al.*, 2016). Training programs should focus on interdisciplinary skills, as NBS implementation often requires a blend of ecological, social, and technical knowledge. For instance, the European Union's Biodiversity Strategy for 2030 underscores the importance of enhancing knowledge and skills among stakeholders to achieve its ambitious

conservation goals (European Commission, 2020). Building on the PRB's strong technical foundation, there is a need for ongoing training and education to support a competent workforce for NBS. Literature supports the notion that training, and capacity building are fundamental for maintaining and scaling NBS initiatives (Kabisch *et al.*, 2016).

c. Comprehensive evaluation frameworks

Developing holistic frameworks for assessing NBS impacts, including social, economic, and environmental aspects, is crucial. This aligns with the growing recognition in environmental literature of the need for multi-dimensional impact assessments (Spangenberg *et al.*, 2014). Such frameworks should incorporate recent methodologies and best practices in impact assessment, like those used in the EU's LIFE program, which emphasizes the integration of socio-economic benefits into environmental project evaluation (LIFE Programme, 2021). Comprehensive frameworks for evaluating NBS contributions are lacking in the PRB. Such frameworks should include metrics for human rights and well-being, as suggested by studies that emphasize the importance of holistic evaluations of NBS impacts (Spangenberg *et al.*, 2014).

d. Adaptive management strategies

Adaptive management strategies are essential for NBS, as they allow for flexibility and responsiveness to dynamic environmental and societal conditions. This recommendation is supported by Pahl-Wostl's (2015) work on adaptive water management, which highlights the importance of learning and adapting based on ongoing environmental feedback. The concept of adaptive management is particularly relevant in the context of climate change and biodiversity loss, where ecological and social systems are continually evolving. Adaptive strategies are critical for the PRB to respond efficiently to changing conditions. This recommendation is consistent with the adaptive management literature, which highlights the need for flexible and responsive NBS governance frameworks (Pahl-Wostl, 2015) which are also crucial for promoting transformative adaptation (Kates *et al.*, 2012), of which governance and social transformation form a key component (Scolobig *et al.*, 2023).

e. Financial innovation and diversification

Addressing financial challenges in NBS requires innovative funding mechanisms and the diversification of financial sources. Alongside traditional public finance – and even more when considering that recession and austerity are challenging public finance for NBS and opening the door to privatization schemes and private capital, not without risks (Konstantinidis and Vlachou 2018) - there is an increasing need for a safe and reliable mobilization of private capital for NBS through alternative financing techniques (den Heijer and Coppens, 2023). While much is expected from collaboration with private actors - such as real estate firms, businesses and citizens – and capital with respect to NBS delivery and financing (Kabisch *et al.*, 2016), access to private finance faces crucial challenges due to well-documented market failures in the innovation finance literature (e.g., Demirel and Parris 2015; Toxopeus 2019; Toxopeus and Polzin, 2021). Detailed

analysis on alternative financing solutions and tools to support NBS development and implementation are available in literature (e.g., Toxopeus and Polzin, 2021; den Heijer and Coppens, 2023). Insights from economic studies on sustainable funding models, such as those explored by Gómez-Baggethun and Barton (2013), emphasize the potential of green bonds and environmental impact investments. Successful financial strategies in other NBS projects, like the Green Climate Fund's investments in climate-resilient infrastructure, offer practical examples of how financial innovation can support NBS (Bowman and Minas, 2019).

These recommendations, grounded in both specific findings from the PRB and a broad spectrum of relevant literature, aim to create a robust and adaptable framework for NBS implementation. By addressing governance, capacity building, evaluation, management, and financial challenges through a lens of global best practices and theoretical insights, these recommendations offer a pathway towards a more sustainable and effective NBS approach in the PRB and similar contexts.

5.5 Future research directions

This section suggests a future research agenda that addresses critical gaps in the current understanding of NBS. It emphasizes the need for longitudinal studies, innovative financial models, advanced evaluative methodologies, and comparative research. By focusing on these areas, future research can significantly contribute to the theoretical and practical knowledge of NBS, guiding more effective and sustainable implementations in the PRB and beyond.

a. Longitudinal impact assessments

Advocating for long-term studies to monitor the impacts of NBS is critical for understanding their enduring effects. These studies should employ comprehensive methodologies encompassing environmental, social, and economic aspects (Wellmann *et al.*, 2022). The approach aligns with calls in the literature for more holistic and integrative research methods in environmental science (Kremen and Merenlender, 2018). For instance, the use of longitudinal impact assessments in areas like the PRB would provide valuable insights into the long-term efficacy and sustainability of NBS projects, addressing a gap noted by scholars like Raymond *et al.* (2017) in current NBS research.

b. Innovative financing mechanisms

Research into new financial models is necessary to support the sustainable implementation of NBS, especially in economically constrained contexts. This area of research could explore innovative funding solutions such as green bonds, environmental impact investments, and public-private partnerships. Studies in this vein could build upon work by Gómez-Baggethun and Barton (2013), Toxopeus and Polzin, 2021, den Heijer and Coppens, 2023 (just to mention a few), who discuss the potential of diverse economic instruments in environmental management. Examining different models' effectiveness, potentialities, and risks in various contexts would provide valuable insights for policymakers and practitioners looking to fund NBS initiatives sustainably.

c. *Evaluative methodologies for Nature-Based Solution (NBS)*

Investigations into advanced methodologies for assessing NBS contributions to societal goals are crucial. This includes exploring how NBS can enhance human rights and well-being. Chan *et al.* (2012) emphasizes the need for valuation methodologies that account for the diverse benefits provided by ecosystems. Research in this area could focus on developing and testing new evaluative tools and frameworks, contributing to a more nuanced understanding of the socio-economic impacts of NBS. Quantification of social and economic benefits of NBS using appropriate metrics and tools, such as for example the social return on investment (SROI) (Millar and Hall, 2012; Moron and Klimowicz, 2021), can help providing a more diverse narrative on the case for NBS for a wide range of stakeholders and communicate the crucial capacity of NBS interventions to provide multiple benefits (Bockarijova *et al.*, 2022).

d. *Comparative studies*

Encouraging comparative research that examines NBS implementation across different geographical and cultural contexts is essential for identifying universal principles and context-specific strategies. Such studies would contribute to a more global understanding of NBS effectiveness and adaptability. This recommendation draws inspiration from the work of Seddon *et al.* (2020), who highlight the importance of understanding diverse ecological, social, and economic contexts in NBS implementation. Comparative studies could elucidate how different cultural and environmental settings influence the success and challenges of NBS, offering invaluable insights for both local and international NBS initiatives.

5.6 Limitations of the study

It is important to acknowledge the potential limitations of the study. The research is limited to the specific case study area of the PRB in Greece, which may restrict the generalizability of the findings to other contexts. The sample size for the questionnaire survey is determined based on feasibility and resource constraints, which may affect the representativeness of the sample. Additionally, the study relies on self-reported data from stakeholders, which may be subject to response biases or subjective interpretations. Despite these limitations, the study's findings provide valuable insights into the policy and governance aspects of NBS implementation within the WEF Nexus in the study area and offer recommendations for improving the effectiveness of the current policy frameworks.

Chapter 6: Conclusion

This thesis provides a holistic assessment of the policy and governance structures that facilitate NBS in the PRB (Greece), blending a meticulous analysis of the environmental governance landscape with a thorough review and updated findings on the efficacy of current practices and policies within the WEFE Nexus. The research recognizes the region's readiness for NBS implementation, identifying both gaps and strengths, and now, with the revised insights from Chapters 4 and 5, suggests a more strategic approach to NBS implementation.

In the governance domain, while the initial analysis appreciated the effectiveness of current arrangements in Greece, the updated findings highlight an urgent need for enhanced participatory frameworks and clearer responsibilities to strengthen NBS initiatives. The policy framework in Greece, previously lauded for its robustness and effectiveness, continues to demonstrate a supportive regulatory environment, as evidenced by the impressive effectiveness scores. The technical capacity, originally rated highly for Greece's substantial infrastructure, is further emphasized in the new insights, highlighting the critical need for localized specialization in NBS-related education for ongoing progress.

Financing, a moderately effective yet crucial aspect of NBS management, emerges with new opportunities for advancement in project design and legal frameworks. The study now underlines the importance of systematic and adaptive management mechanisms, indicating the need for a structured approach to the effective management of NBS.

The recommendations derived from the study are manifold and have been expanded in light of the revised chapters. They include the establishment of dedicated bodies for NBS, bolstering continuous training, crafting comprehensive frameworks to optimize policy and practice, and emphasizing the indispensability of adaptive strategies and systemic reforms to promote effective and sustainable NBS applications.

Looking to the future, this research, enriched by the latest findings, lays a foundation for further exploration into the practical applications of these insights. It suggests longitudinal studies to evaluate the impact of governance reforms and the utility of innovative financial mechanisms. By integrating these findings with the LENSES-UNIPD framework's applicability, the thesis offers a foundational blueprint for enhancing NBS practices, with potential implications beyond the Mediterranean context.

In sum, this comprehensive work encapsulates the critical role of integrated governance, technical capacity, financial accessibility, and policy refinement in advancing NBS success. The updated insights contribute to a dual perspective that interlaces policy evaluation with practical implications, advocating for a continuous evolution of governance strategies and the pursuit of innovative research pathways. The fusion of insights from the WEFE Nexus challenges with practical governance considerations provides a multifaceted guidepost for policy enhancement, thereby contributing to the sustainability and resilience of environmental management practices in the PRB and beyond.

Finally, this research validates the LENSES-UNIPD framework's applicability in the Mediterranean context, serving as a potential model for other regions. It provides deep insights

into policy and governance aspects of NBS implementation, enhancing the effectiveness of current policy frameworks. This study contributes to a broader understanding of institutional factors that affect NBS implementation in the WEFE Nexus, offering practical guidance for designing more effective policy and governance frameworks in the Mediterranean region and possibly beyond, sharing valuable lessons for the global community.

References

- Adamovic, M., Al-Zubari, W., Amani, A., Ameztoy Aramendi, I., Bacigalupi, C., Barchiesi, S., ... Zaragoza, G. (2019). Position Paper on Water, Energy, Food and Ecosystem (WEFE) Nexus and Sustainable development Goals (SDGs). In C. Carmona Moreno, C. Dondeynaz, & M. Biedler (Eds.), EUR 29509 EN. *Publications Office of the European Union*. ISBN 978-92-76-00159-1. [10.2760/5295 \(online\)](#)
- Albrecht, T. R., Crootof, A., & Scott, C. A. (2018). The Water-Energy-Food Nexus: A systematic review of methods for Nexus assessment. *Environmental Research Letters*, 13(4), 043002.
- Allen, C. R., & Gunderson, L. H. (2011). Pathology and failure in the design and implementation of adaptive management. *Journal of environmental management*, 92(5), 1379-1384.
- Ansell, C., & Gash, A. (2008). Collaborative governance in theory and practice. *Journal of public administration research and theory*, 18(4), 543-571.
- Armitage, D., Marschke, M., & Plummer, R. (2008). Adaptive co-management and the paradox of learning. *Global environmental change*, 18(1), 86-98.
- Atteridge, A., Bhatpuria, D., Macura, B., Barquet, K., & Green, J. (2022). *Assessing finance for nature-based solutions to climate change*. Stockholm Environment Institute.
- Bai, X., Shi, P., & Liu, Y. (2014). Society: Realizing China's urban dream. *Nature*, 509(7499), 158-160.
- Balzan, M. V., Geneletti, D., Grace, M., De Santis, L., Tomaskinova, J., Reddington, H., ... & Collier, M. (2022). Assessing nature-based solutions uptake in a Mediterranean climate: insights from the case-study of Malta. *Nature-Based Solutions*, 2, 100029.
- Bazilian, M., Rogner, H., Howells, M., Hermann, S., Arent, D., Gielen, D., ... & Yumkella, K. K. (2011). Considering the energy, water and food Nexus: Towards an integrated modelling approach. *Energy policy*, 39(12), 7896-7906.
- Bell, S., & Morse, S. (2012). *Sustainability indicators: measuring the immeasurable?*. Routledge.
- Bennett, N. J., Blythe, J., Tyler, S., & Ban, N. C. (2016). Communities and change in the anthropocene: understanding social-ecological vulnerability and planning adaptations to multiple interacting exposures. *Regional Environmental Change*, 16, 907-926.
- Benson, D., Jordan, A., & Huitema, D. (2012). Involving the public in catchment management: an analysis of the scope for learning lessons from abroad. *Environmental Policy and Governance*, 22(1), 42-54.

- Berkes, F. (2017). Environmental governance for the anthropocene? Social-ecological systems, resilience, and collaborative learning. *Sustainability*, 9(7), 1232.
- Blaikie, P. and Brookfield, H. eds., 2015. *Land degradation and society*. Routledge.
- Bockarjova, M., Botzen, W. W., Bulkeley, H. A., & Toxopeus, H. (2022). Estimating the social value of nature-based solutions in European cities. *Scientific reports*, 12(1), 19833.
- Bodin, Ö. (2017). Collaborative environmental governance: achieving collective action in social-ecological systems. *Science*, 357(6352), eaan1114.
- Bowman, M., & Minas, S. (2019). Resilience through interlinkage: the green climate fund and climate finance governance. *Climate policy*, 19(3), 342-353.
- Braat, L. C., & De Groot, R. (2012). The ecosystem services agenda: bridging the worlds of natural science and economics, conservation and development, and public and private policy. *Ecosystem services*, 1(1), 4-15.
- Brouwer, S., & Biermann, F. (2011). Towards adaptive management: examining the strategies of policy entrepreneurs in Dutch water management. *Ecology and Society*, 16(4).
- Canals Ventín, P. and Lázaro Marín, L. 2019. Towards Nature-based Solutions in the Mediterranean. *IUCN Centre for Mediterranean Cooperation*.
- Carmona-Moreno, C., Crestaz, E., Cimmarrusti, Y., Farinosi, F., Biedler, M., Amani, A., Mishra, A. and Carmona-Gutierrez, A. eds., 2021. *Implementing the Water-Energy-Food-Ecosystems Nexus and Achieving the Sustainable Development Goals*. IWA Publishing.
- Castro, G., Locker, I., Russell, V., Cornwell, L., & Fajer, E. (2000). Mapping conservation investments: an assessment of biodiversity funding in Latin America and the Caribbean.
- Chaffin, B. C., Garmestani, A. S., Gunderson, L. H., Benson, M. H., Angeler, D. G., Arnold, C. A., ... & Allen, C. R. (2016). Transformative environmental governance. *Annual Review of Environment and Resources*, 41, 399-423.
- Chaffin, B. C., Gosnell, H., & Cosens, B. A. (2014). A decade of adaptive governance scholarship: synthesis and future directions. *Ecology and society*, 19(3).
- Chan, K. M. A., Guerry, A. D., Balvanera, P., Klain, S., Satterfield, T., Basurto, X., ... & Woodside, U. (2012). Where are cultural and social in ecosystem services? A framework for constructive engagement. *BioScience*, 62(8), 744-756.
- Cohen-Shacham, E., Walters, G., Janzen, C., & Maginnis, S. (2016). Nature-based solutions to address global societal challenges. *IUCN: Gland, Switzerland*, 97, 2016-2036.
- Dale, P., Sporne, I., Knight, J., Sheaves, M., Eslami-Andergoli, L., & Dwyer, P. (2019). A conceptual model to improve links between science, policy and practice in coastal management. *Marine Policy*, 103, 42-49.

- Davis, M., Abhold, K., Mederake, L., & Knoblauch, D. (2018). Nature-based solutions in European and national policy frameworks. *Deliverables 1.5, NATURVATION, Horizon Europe Grant Agreement No, 730243*.
- De Leeuw, J., Georgiadou, Y., Kerle, N., De Gier, A., Inoue, Y., Ferwerda, J., ... & Narantuya, D. (2010). The function of remote sensing in support of environmental policy. *Remote sensing, 2*(7), 1731-1750.
- de Luca, C., Naumann, S., Davis, M., & Tondelli, S. (2021). Nature-based solutions and sustainable urban planning in the European environmental policy framework: Analysis of the state of the art and recommendations for future development. *Sustainability, 13*(9), 5021.
- Demirel, P., & Parris, S. (2015). Access to finance for innovators in the UK's environmental sector. *Technology Analysis & Strategic Management, 27*(7), 782-808.
- den Heijer, C., & Coppens, T. (2023). Paying for green: A scoping review of alternative financing models for nature-based solutions. *Journal of Environmental Management, 337*, 117754.
- De Roo, A., Trichakis, I., Bisselink, B., Gelati, E., Pistocchi, A., & Gawlik, B. (2021). The water-energy-food-ecosystem Nexus in the Mediterranean: current issues and future challenges. *Frontiers in Climate, 3*, 782553.
- Delikanli, I. U., Dimitrov, T., & Agolli, R. (2018). *Multilateral development banks: governance and finance*. Springer.
- Dermody, B. J., van Beek, R. P., Meeks, E., Klein Goldewijk, K., Scheidel, W., Van Der Velde, Y., ... & Dekker, S. C. (2014). A virtual water network of the Roman world. *Hydrology and Earth System Sciences, 18*(12), 5025-5040.
- Dorst, H., van der Jagt, S., Tozer, L., Bulkeley, H., Gerstetter, C., McKenna, D., Iwaszuk, E., Meinecke, L-F., Naumann, S., Boros, J., Lituma, A., Runhaar, H. (2019). Structural Conditions for Integrating Nature-Based Solutions: Regulatory Domain. *Deliverable 5.2. Naturvation project*.
- EFAS. (2023). Storm Daniel affects Greece, Bulgaria and Türkiye - September 2023. <https://www.efas.eu/en/news/storm-daniel-affects-greece-bulgaria-and-turkiye-september-2023>
- European Commission (2023). Nature-based solutions research policy. Available online: https://research-and-innovation.ec.europa.eu/research-area/environment/nature-based-solutions/research-policy_en (Last access: 12.11.2023)
- European Commission. (2020). EU Biodiversity Strategy for 2030. https://ec.europa.eu/environment/nature/biodiversity/strategy/index_en.htm

- FAO. (2014). The water-energy-food Nexus: A new approach in support of food security and sustainable agriculture. *Rome The Food and Agricultural Organisation of the United Nations*.
- FAO. (2022). Water-Energy-Food-Ecosystem Nexus to increase food systems' resilience to climate change and conflict's cascading effects in the Mediterranean region. Sustainable Food Systems in the Mediterranean Webinar 2 Outcomes.
- Farley, J., & Costanza, R. (2010). Payments for ecosystem services: from local to global. *Ecological economics*, 69(11), 2060-2068.
- Folke, C., Carpenter, S. R., Walker, B., Scheffer, M., Chapin, T., & Rockström, J. (2010). Resilience thinking: integrating resilience, adaptability and transformability. *Ecology and society*, 15(4).
- Frantzeskaki, N., McPhearson, T., Collier, M. J., Kendal, D., Bulkeley, H., Dumitru, A., ... & Matthews, V. (2019). Nature-based solutions for urban climate change adaptation: Linking science, policy, and practice communities for evidence-based decision-making. *BioScience*, 69(6), 455-466.
- Garcia, R. M., & Burns, S. L. (2022). Bureaucratic politics in protected areas: The voided power projection efforts of conservation vis-a-vis forest bureaucracies in Patagonia, Argentina. *Forest Policy and Economics*, 134, 102630.
- Global Water Partnership-Mediterranean (GWP-Med). (2020). Water-Energy-Food-Ecosystems Nexus, Thematic areas and projects. <https://www.gwp.org/en/GWP-Mediterranean/WE-ACT/Programmes-per-theme/Water-Food-Energy-Nexus/>
- Gómez-Baggethun, E., & Barton, D. N. (2013). Classifying and valuing ecosystem services for urban planning. *Ecological economics*, 86, 235-245.
- Grenon, M., Batisse, M., & Pujol, D. S. (1991). Futures of the Mediterranean Basin. The Blue Plan. Environment and planning. *An International journal of urban and regional research*, (23), 1077-1078.
- Harman, B. P., Heyenga, S., Taylor, B. M., & Fletcher, C. S. (2015). Global lessons for adapting coastal communities to protect against storm surge inundation. *Journal of Coastal Research*, 31(4), 790-801.
- He, K., Yang, Q., Shen, X., Dimitriou, E., Mentzafou, A., Papadaki, C., ... & Anagnostou, E. N. (2023). Brief communication: Storm Daniel Flood Impact in Greece 2023: Mapping Crop and Livestock Exposure from SAR. *Natural Hazards and Earth System Sciences Discussions*, 2023, 1-16.
- Henao, E., López, M., and Osann, A. (2022). D6.1 Baseline Description, WP6 Pilot implementation. Managing resilient Nexus systems through participatory systems

- dynamics modelling. European Union's Horizon 2020 research and innovation programme under grant agreement No 101003632.
- Hoff, H. (2011). Understanding the Nexus. Background Paper for the Bonn2011 Conference: The Water, Energy and Food Security Nexus. *Stockholm Environment Institute, Stockholm*.
- IUCN BRIDGE GBM. (2018). Nature-based solutions and their application in river basin management: BRIDGE GBM CSO dialogue report. Bangkok, Thailand: *IUCN*.
- IUCN. (2020). Global standard for nature-based solutions. A user-friendly framework for the verification, design and scaling up of NBS. *Accessed, 15(December), 2022*.
- IUCN. (2021). Nature-based Solutions. *International Union for Conservation of Nature*. <https://www.iucn.org/theme/nature-based-solutions>
- IUCN. (2021). Planning and delivering Nature-based Solutions in Mediterranean cities: First assessment of the IUCN NBS Global Standard in Mediterranean urban areas. Málaga, Spain: *IUCN*.
- Jordan, A., Wurzel, R. K., & Zito, A. (2005). The rise of 'new' policy instruments in comparative perspective: has governance eclipsed government?. *Political studies, 53(3)*, 477-496.
- Kabisch, N., Frantzeskaki, N., Pauleit, S., Naumann, S., Davis, M., Artmann, M., ... & Bonn, A. (2016). Nature-based solutions to climate change mitigation and adaptation in urban areas: perspectives on indicators, knowledge gaps, barriers, and opportunities for action. *Ecology and society, 21(2)*.
- Kauark-Fontes, B., Marchetti, L., & Salbitano, F. (2023). Integration of nature-based solutions (NBS) in local policy and planning toward transformative change. Evidence from Barcelona, Lisbon, and Turin. *Ecology and Society, 28(2)*.
- Kates, R. W., Travis, W. R., & Wilbanks, T. J. (2012). Transformational adaptation when incremental adaptations to climate change are insufficient. *Proceedings of the National Academy of Sciences, 109(19)*, 7156-7161.
- Konstantinidis, C., & Vlachou, A. (2018). Appropriating nature in crisis-ridden Greece: Deepening neoliberal capitalism, part 2. *Capitalism Nature Socialism, 29(2)*, 108-121.
- Kremen, C., & Merenlender, A. M. (2018). Landscapes that work for biodiversity and people. *Science, 362(6412)*, eaau6020.
- Latour, B. (2007). *Reassembling the social: An introduction to actor-network-theory*. Oup Oxford.
- LIFE Programme. (2021). The LIFE Programme. *European Commission*. <https://ec.europa.eu/environment/life/>

- Lundholm, C., & Plummer, R. (2013). Resilience and learning: a conspectus for environmental education. In *Resilience in Social-Ecological Systems* (pp. 13-28). Routledge.
- Maes, J., & Jacobs, S. (2017). Nature-based solutions for Europe's sustainable development. *Conservation letters*, 10(1), 121-124.
- MEA. (2005). *Ecosystems and human well-being* (Vol. 5, p. 563). Island Press, Washington, DC.
- Mendes, R., Fidélis, T., Roebeling, P., & Teles, F. (2020). The institutionalization of nature-based solutions—a discourse analysis of emergent literature. *Resources*, 9(1), 6.
- Migiros, G., Bathrellos, G. D., Skilodimou, H. D., & Karamousalis, T. (2011). Pinios (Peneus) River (Central Greece): hydrological—geomorphological elements and changes during the quaternary. *Central European Journal of Geosciences*, 3, 215-228.
- Millar, R., & Hall, K. (2013). Social return on investment (SROI) and performance measurement: The opportunities and barriers for social enterprises in health and social care. *Public Management Review*, 15(6), 923-941.
- Monroe, M. C., Oxarart, A., & Plate, R. R. (2013). A role for environmental education in climate change for secondary science educators. *Applied Environmental Education & Communication*, 12(1), 4-18.
- Moroń, D., & Klimowicz, M. (2021). Using the social return on investment (SROI) as a measure of the effectiveness of social innovation projects implemented under public policies. *Social Enterprise Journal*, 17(2), 302-327.
- NA, U. (2016). Reconciling resource uses in transboundary basins: assessment of the water-food-energy-ecosystems Nexus in the Sava River Basin.
- Naz, T., & Khan, M. (2018). Functionality gaps in the design of learning management systems. *International Journal of Advanced Computer Science and Applications*, 9(11).
- Nesshöver, C., Assmuth, T., Irvine, K. N., Rusch, G. M., Waylen, K. A., Delbaere, B., ... & Wittmer, H. (2017). The science, policy and practice of nature-based solutions: An interdisciplinary perspective. *Science of the total environment*, 579, 1215-1227.
- Newig, J., & Fritsch, O. (2009). Environmental governance: participatory, multi-level—and effective?. *Environmental policy and governance*, 19(3), 197-214.
- OECD. (2005). *Policy Coherence for Development: A Life in Development*. Paris: OECD Publishing.
- OECD. (2020). *Nature-based solutions for adapting to water-related climate risks: Policy perspectives*.

- Ostrom, E. (1990). *Governing the commons: The evolution of institutions for collective action*. Cambridge university press.
- Pahl-Wostl, C. (2015). *Water governance in the face of global change*. Switzerland: Springer.
- Palmer, M. A., & Filoso, S. (2009). Restoration of ecosystem services for environmental markets. *science*, 325(5940), 575-576.
- Palomo, I., Locatelli, B., Otero, I., Colloff, M., Crouzat, E., Cuni-Sanchez, A., ... & Lavorel, S. (2021). Assessing nature-based solutions for transformative change. *One Earth*, 4(5), 730-741.
- Panagopoulos, Y., & Dimitriou, E. (2020). A large-scale nature-based solution in agriculture for sustainable water management: The Lake Karla case. *Sustainability*, 12(17), 6761.
- Pisinaras, V., Herrmann, F., Panagopoulos, A., Tziritis, E., McNamara, I., & Wendland, F. (2023). Fully Distributed Water Balance Modelling in Large Agricultural Areas—The Pinios River Basin (Greece) Case Study. *Sustainability*, 15(5), 4343.
- Pistocchi, A. (2022). Nature-based solutions for agricultural water management. *European Commission, Joint Research Centre (JRC)*.
- Preston, B. L., Westaway, R. M., & Yuen, E. J. (2011). Climate adaptation planning in practice: an evaluation of adaptation plans from three developed nations. *Mitigation and adaptation strategies for global change*, 16, 407-438.
- Psomas, A., Dagalaki, V., Panagopoulos, Y., Konsta, D., & Mimikou, M. (2016). Sustainable agricultural water management in Pinios river basin using remote sensing and hydrologic modeling. *Procedia engineering*, 162, 277-283.
- Qi, Y., Chan, F. K. S., Thorne, C., O'Donnell, E., Quagliolo, C., Comino, E., ... & Feng, M. (2020). Addressing challenges of urban water management in Chinese sponge cities via nature-based solutions. *Water*, 12(10), 2788.
- Raymond, C. M., Frantzeskaki, N., Kabisch, N., Berry, P., Breil, M., Nita, M. R., ... & Calfapietra, C. (2017). A framework for assessing and implementing the co-benefits of nature-based solutions in urban areas. *Environmental Science & Policy*, 77, 15-24.
- Reed, M. S. (2008). Stakeholder participation for environmental management: a literature review. *Biological conservation*, 141(10), 2417-2431.
- Righetti, C., Bottaro, G., Masiero, M., and Pettenella, D. (2022). WP6 - Environmental and natural resource economics approaches for Nexus business cases - D6.2 Policy indicators and framework for Nexus-relevant NBS, The LENSES Project.
- Sambo, B., Cocuccioni, S., Carnelli, F., Terzi, S., Sperotto, A., Torresan, S., ... & Critto, A. (2023). Water-Energy-Food-Ecosystem Services (WEFE) Nexus assessment in the context of

climate change: a literature review and conceptual model development for the Adige River basin (Italy). *EGU23*, (EGU23-11213).

Sarabi, S., Han, Q., Romme, A. G. L., De Vries, B., Valkenburg, R., & Den Ouden, E. (2020). Uptake and implementation of nature-based solutions: an analysis of barriers using interpretive structural modeling. *Journal of Environmental Management*, 270, 110749.

Schaltegger, S., & Burritt, R. (2017). *Contemporary environmental accounting: issues, concepts and practice*. Routledge.

Scolobig, A., Linnerooth-Bayer, J., Pelling, M., Martin, J. G., Deubelli, T. M., Liu, W., & Oen, A. (2023). Transformative adaptation through nature-based solutions: a comparative case study analysis in China, Italy, and Germany. *Regional Environmental Change*, 23(2), 69.

Seddon, N., Chausson, A., Berry, P., Girardin, C. A., Smith, A., & Turner, B. (2020). Understanding the value and limits of nature-based solutions to climate change and other global challenges. *Philosophical Transactions of the Royal Society B*, 375(1794), 20190120.

Sibiya, N. P., Das, D. K., Vogel, C., Mazinyo, S. P., Zhou, L., Kalumba, M. A., ... & Simatele, M. D. (2023). Overcoming bureaucratic resistance: an analysis of barriers to climate change adaptation in South Africa. *Climate*, 11(7), 145.

Spangenberg, J. H., Görg, C., Truong, D. T., Tekken, V., Bustamante, J. V., & Settele, J. (2014). Provision of ecosystem services is determined by human agency, not ecosystem functions. Four case studies. *International Journal of Biodiversity Science, Ecosystem Services & Management*, 10(1), 40-53.

Spangenberg, J. H., von Haaren, C., & Settele, J. (2014). The ecosystem service cascade: Further developing the metaphor. Integrating societal processes to accommodate social processes and planning, and the case of bioenergy. *Ecological Economics*, 104, 22-32.

Spyrou, C., Loupis, M., Charizopoulos, N., Apostolidou, I., Mentzafou, A., Varlas, G., ... & Kumar, P. (2021). Evaluating nature-based solution for flood reduction in spercheios river basin under current and future climate conditions. *Sustainability*, 13(7), 3885.

The Guardian. (2023). Greek PM under attack over handling of Storm Daniel disaster response. <https://www.theguardian.com/world/2023/sep/11/greek-pm-kyriakos-mitsotakis-storm-daniel-disaster-response>

Toxopeus, H. (2019). *Financing sustainable innovation: From a principal-agent to a collective action perspective* (No. EPS-2019-458-S&E).

Toxopeus, H., & Polzin, F. (2021). Reviewing financing barriers and strategies for urban nature-based solutions. *Journal of Environmental Management*, 289, 112371.

- Tsihrintzis, V. A., Hamid, R., & Fuentes, H. R. (1996). Use of geographic information systems (GIS) in water resources: a review. *Water resources management*, 10, 251-277.
- Turnhout, E., Metze, T., Wyborn, C., Klenk, N., & Louder, E. (2020). The politics of co-production: participation, power, and transformation. *Current Opinion in Environmental Sustainability*, 42, 15-21.
- Turner, N. (2016). Opinion: Why protect nature. *Rethinking values and the environment*.
- United Nations. (2018). World Water Development Report 2018.
- Van der Jagt, A. P., Elands, B. H., Ambrose-Oji, B., Møller, M. S., & Buizer, M. (2017). Participatory governance of urban green spaces: trends and practices in the EU. *NA*, 28(3).
- Van Herk, S., Zevenbergen, C., Ashley, R., & Rijke, J. (2011). Learning and Action Alliances for the integration of flood risk management into urban planning: a new framework from empirical evidence from The Netherlands. *Environmental Science & Policy*, 14(5), 543-554.
- van Rees, C. B., Jumani, S., Abera, L., Rack, L., McKay, S. K., & Wenger, S. J. (2023). The potential for nature-based solutions to combat the freshwater biodiversity crisis. *PLOS Water*, 2(6), e0000126.
- Vanneuville, W., Werner, B., Kjeldsen, T., Miller, J., Kossida, M., Tekidou, A., ... & Crouzet, P. (2012). *Water resources in Europe in the context of vulnerability: EEA 2012 state of water assessment*. European Environment Agency.
- WCED, 1992. Our Common Future: World Commission on Environment and Development. Oxford University Press.
- Wellmann, T., Andersson, E., Knapp, S., Lausch, A., Palliwoda, J., Priess, J., ... & Haase, D. (2023). Reinforcing nature-based solutions through tools providing social-ecological-technological integration. *Ambio*, 52(3), 489-507.
- Wickenberg, B., McCormick, K., & Olsson, J. A. (2021). Advancing the implementation of nature-based solutions in cities: A review of frameworks. *Environmental science & policy*, 125, 44-53.
- Williams, B. K. (2011). Adaptive management of natural resources—framework and issues. *Journal of environmental management*, 92(5), 1346-1353.
- Wong, T. C., & Yuen, B. (2011). *Eco-city planning policies, practice and design*. Springer Science+ Business Media BV.
- Yi, C. (2020). Re-Imagining Nature in Dense, High Rise Urban Environment: the Present and Future of Green Building Infrastructure in Singapore.

Zingraff-Hamed, A., Hüesker, F., Albert, C., Brillinger, M., Huang, J., Lupp, G., ... & Schröter, B. (2021). Governance models for nature-based solutions: Seventeen cases from Germany. *Ambio*, 1-18.

Annexes

Annex 1- LENSES-UNIPD framework template

Key dimension	Dimension's score	##	Key elements	Element Weight	Element's score	##	Indicators	Indicator or Weight	Indicator's score	Description	Sub-indicator			
Conducive governance arrangements		1	Responsibilities for different aspects of NBS phases (planning, implementation and maintenance)	25%		1	Clearly defined structure and roles	50%		Dedicated actors for NBS planning, implementation, and maintenance	Planning			
									Implementation					
									Maintenance					
									2	NBS responsibilities	50%		Well defined actors' responsibilities for each NBS phases	Planning
											Implementation			
											Maintenance			

	2	Coordination mechanisms (horizontal and vertical)	50%		1	Participation in all processes of the NBS intervention	20%		Use of participatory approaches in decision-making in all the phases of NBS intervention	Planning	
							Implementation				
							Maintenance				
					1.1	Equity in participatory processes	2%			The participation is based on mutual respect and equity, regardless of gender, age or social status, and upholds the right of Indigenous Peoples to Free, Prior and Informed Consent (FPIC)	Gender
											Age
											Social status
Indigenous right											
1.2	Represented stakeholders	3%	Identification and involvement of direct and indirect stakeholders affected by the NBS								

					2	Represented interest of stakeholders	25%		The decision-making processes documents and responds to the rights and interests of all participating and affected stakeholders	
					3	Intra-organisational coordination	25%		Presence of coordination mechanisms among NBS stakeholders (e.g., public institutions, economic bodies, stakeholders)	
					4	Inter-organisational coordination	25%		Where the scale of the NBS extends beyond jurisdictional boundaries, mechanisms are established to enable joint decision-making of the stakeholders in the affected jurisdictions	
	3	Stakeholder endorsement	25%		1	Community supporting the NBS	50%		The NBS achieves a high level of support from the community	
					2	Management of the negative impacts' strategy	50%		Presence and use of instruments to manage the negative impacts affecting stakeholders	
Supportive policies	1	Clear mandate and support for NBS	25%		1	European, national and sub-national	100%		Reference to NBS	

						policies supporting NBS				
	2	Coherence between sectoral policies, and mechanisms to address trade-offs	25%		1	European, national and sub-national policies' objectives	100%		Absence of conflicting objectives among the sectoral policies	
	3	Encouragement of NBS within infrastructure planning processes	50%		1	Indication of NBS as planning options	100%		Mention of NBS within the land use planning regulations, strategies, and plans	Land use planning regulations
								Strategies		
								Plans		

Supporting policies	1	Encouragement of NBS adoption towards its positive outcomes	50%	1	Implementation of a successful NBS	100%	The NBS facilitates policy and regulation frameworks to support its uptake and mainstreaming	Uptake	
								Mainstreaming	
	2	Methodologies in place for measuring NBS contribution	50%	1	Contribution of NBS to national and global targets	100%		Presence of procedures capturing the NBS contribution to national and global targets for human well-being, climate change, biodiversity and human rights.	Human well-being
									Climate change

		Safety and performance codes and standards				Clear and defined safety and performance codes and standards			Presence of codes and standards needed to implement the selected NBS (e.g., safety, ...)	
	4	Procurement policies	16%		1	Clear procurement policies	100%		Presence of policies	
	5	Land rights	20%		1	Clear land and resources tenure, usage, and access rights	50%		Existence of well-defined land resources tenure, usage, and access rights	Tenure

		6	Environmental protection regulation	16%		1	Clear environmental protection regulation	100%		Presence of compliance environmental protection regulation	
Technical capacity	0.9375	1	Partnerships and information sharing	40%		1	Stakeholders' network cohesion to optimize interdisciplinary co-creation and co-design of NBS	80%		Exchange of information (by phone, mail, letter, personally) among stakeholders regarding NBS project	
						2	Procedures for collecting comments	20%		Use of formal procedures to allow stakeholders to provide their comments/contributes before and during the NBS intervention	Before
		2	Integration of NBS training in civil engineering and urban planning curricula	25%		1	Training in NBS	100%		Presence of specific NBS course to improve NBS adoption (to engineers, planners' bodies of public administration) or NBS-related education (in university curricula)	During

						2	Knowledge courses	50%		The lead organization organizes specializing courses open to residents and stakeholders	Residents
											Stakeholders
Access to finance	0.5625	1	Availability of targeted incentives	25%		1	European, national and sub-national resourcing options (policies, financial instruments, etc.) supporting NBS	100%		Availability of a portfolio of resourcing options for NBS	
		2	Ability to capture revenue streams	25%		1	Completeness of income sources	100%		Presence of professional project design team and complete project management system	Design team

										Management system
		3	Financing requirements	25%	1	Financial sustainability	100%		Presence of professional project design team and complete project management system	Design team
		4	Distribution of liabilities	25%	1	Legal responsibilities	100%		Well defined legal responsibilities related to NBS implementation	Management system
NBS management	No scoring done	1	NBS monitoring	50%	1	Monitoring and evaluation strategy	50%		Presence and use of strategies to periodically monitor and evaluate the NBS intervention throughout its lifecycle	
					2	Adaptive NBS intervention management	50%		Presence and use of iterative learning process that enables an adaptive NBS intervention management throughout its lifecycle	
		2	NBS safeguard	50%	1	NBS safeguard system	50%			

				2	NBS responsibilities	50%	0.5	Well defined actors' responsibilities for each NBS phases	Maintenance	0.5	
									Planning	0.5	
									Implementation	0.5	
									Maintenance	0.5	
	2	Coordination mechanisms (horizontal and vertical)	50%	0.78	1	Participation in all processes of the NBS intervention	20%	0.5	Use of participatory approaches in decision-making in all the phases of NBS intervention	Planning	0.5
										Implementation	0.5

									Maintenance	0.5
									Gender	1
									Age	1
				1.1	Equity in participatory processes	2%	1	The participation is based on mutual respect and equity, regardless of gender, age or social status, and upholds the right of Indigenous Peoples to Free, Prior and Informed Consent (FPIC)	Social status	1
									Indigenous right	1
				1.2	Represented stakeholders	3%	1	Identification and involvement of direct and indirect stakeholders affected by the NBS		1
				2	Represented interest of stakeholders	25%	1	The decision-making processes documents and responds to the rights and interests of all participating and affected stakeholders		1
				3		25%	1	Presence of coordination mechanisms among NBS		1

									stakeholders (e.g., public institutions, economic bodies, stakeholders)							
						4					25%	0.5	Where the scale of the NBS extends beyond jurisdictional boundaries, mechanisms are established to enable joint decision-making of the stakeholders in the affected jurisdictions		0.5	
						3	Stakeholder endorsement	25%	1.00	1	Community supporting the NBS	50%	1	The NBS achieves a high level of support from the community		1
						2						50%	1	Presence and use of instruments to manage the negative impacts affecting stakeholders		1
Supportive policies	1	1	Clear mandate and support for NBS	25%	1.00	1	European, national and sub-national policies supporting NBS	100%	1	Reference to NBS		1				
		2	Coherence between sectoral policies, and mechanisms to address trade-offs	25%	1.00	1	European, national and sub-national policies' objectives	100%	1	Absence of conflicting objectives among the sectoral policies		1				

Supporting policies	0.75	1	Encouragement of NBS adoption towards its positive outcomes	50%	1.00	1	Implementation of a successful NBS	100%	1	The NBS facilitates policy and regulation frameworks to support its uptake and mainstreaming	Uptake	1
		2	Methodologies in place for measuring NBS contribution	50%	0.50	1	Contribution of NBS to national and global targets	100%	0.5	Presence of procedures capturing the NBS contribution to national and global targets for human well-being, climate change, biodiversity and human rights.	Human well-being	0
											Mainstreaming	1

										Climate change	1
										Biodiversity	1
										Human rights	0
Appropriate regulatory environment	0.92	1	Land-use regulation and zoning	16%	1.00	1	Land use designation	100%	1	Presence of documents defining the land use of the area (e.g., maps, regulations)	1

	2	Permitting	16%	0.50	1	Clear and defined construction permits	100%	0.5	Presence of needed permits to implement the selected NBS	0.5
	3	Safety and performance codes and standards	16%	1.00	1	Clear and defined safety and performance codes and standards	100%	1	Presence of codes and standards needed to implement the selected NBS (e.g., safety, ...)	1

	4	Procurement policies	16%	1.00	1	Clear procurement policies	100%	1	Presence of policies	1
	5	Land rights	20%	1.00	1	Clear land and resources tenure, usage, and access rights	50%	1	Existence of well-defined land resources tenure, usage, and access rights	Tenure Usage

		2	Ability to capture revenue streams	25%	0.25	1	Completeness of income sources	100%	0.25	Presence of professional project design team and complete project management system	Design team	0.5
											Management system	0
		3	Financing requirements	25%	0.50	1	Financial sustainability	100%	0.5	Presence of professional project design team and complete project management system	Design team	0.5

								No scoring done	Presence of strategies that allow the identification and management of possible risks' type and level		No scoring done
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b. Scoring rational, policy and governance level-recommendations, risks, impacts and challenges and strengths and opportunities

Key dimension	Key elements	###	Indicators	Sub-indicator	Scoring Rationale	Recommendations	Risk, Impacts and Challenges	Strength and Opportunities
Conducive governance arrangements	Responsibilities for different aspects of NBS phases (planning, implementation and maintenance)	1	Clearly defined structure and roles	Planning	Scattered responsibilities among various bodies, Limited action of the responsible bodies	Centralize NBS planning responsibilities under a dedicated body to streamline actions and ensure effective stakeholder engagement.	Risks: Dilution of accountability due to scattered responsibilities, poor action by responsible bodies may lead to ineffective planning. Impacts: Sub-optimal Nature-Based Solutions (NBS) that fail to meet goals; wasted resources. Challenges: Coordinating diverse responsible bodies; enforcing accountability and action. Risks: Fragmentation and bureaucracy could stall or poorly execute projects, risk of subjectivity and favouritism in decision-making. Impacts: Delayed or ineffective implementation, misuse of funds, public mistrust. Challenges: Streamlining	Strengths: The diversity of involved bodies in planning, implementation, and maintenance suggests a wealth of perspectives and expertise. Bureaucratic structures, while cumbersome, can add a layer of checks and balances. Opportunities: Consolidating responsibilities could streamline planning and action, making NBS (Nature-Based Solutions) more effective. Improved coordination and the simplification of legislative frameworks can expedite implementation and maintenance, while the adoption of an objective approach can help prioritize crucial measures.
				Implementation	Bureaucracy and fragmentation of responsibilities, limited coordination among authorities, Lack of an objective approach in decision making process (e.g. prioritization of measures)	Establish a coordinating body to oversee NBS implementation, and adopt an objective framework for decision-making to improve efficiency and coordination.		

			Maintenance	Complexity of the legislative framework	Simplify the legislative framework related to NBS maintenance, and centralize responsibility under a specialized unit for long-term sustainability.		bureaucracy, achieving multi-stakeholder coordination, ensuring objective decision-making.	
2	NBS responsibilities	Planning	Scattered responsibilities among various bodies, Limited action of the responsible bodies	Designate a central coordinating body to consolidate responsibilities and create mechanisms for active stakeholder participation.		Risks: Unclear or scattered responsibilities may lead to gaps in planning, causing inefficiencies or project failure. Impacts: Resource wastage, delays in project timelines, and potential project failure. Challenges: Consolidating roles and responsibilities, boosting engagement from responsible bodies.		Strengths: Having multiple bodies involved in the planning phase allows for diversified expertise and perspectives. Bureaucracy in the implementation phase can ensure rigorous checks and balances, while a complex legislative framework for maintenance can offer comprehensive guidelines and regulations.
		Implementation	Bureaucracy and fragmentation of responsibilities, limited coordination among authorities, Lack of an objective approach in decision making process	Streamline bureaucratic processes and establish a collaborative governance structure to ensure clear roles		Risks: Bureaucracy and fragmented responsibilities can impede seamless execution, causing delays or failure. Impacts: Higher costs, reduced effectiveness, and loss of stakeholder trust.		Opportunities: There's room for streamlining and centralizing responsibilities to improve efficiency in the planning stage. Improved coordination and objective decision-making can optimize the implementation phase,

				(e.g. prioritization of measures)	and effective coordination.	Challenges: Streamlining processes, improving coordination, and objective decision-making.	and simplifying the legislative framework for maintenance can make it more accessible and actionable.
			Maintenance	Complexity of the legislative framework	Simplify the legislative framework and create a dedicated oversight committee for regular assessment and adaptive management.	Risks: A complex legislative framework could lead to non-compliance or ineffective maintenance. Impacts: Reduced longevity and effectiveness of the Nature-Based Solutions, potential legal issues. Challenges: Simplifying or navigating legislative complexities, ensuring continuous compliance.	
Coordination mechanisms (horizontal and vertical)	1	Participation in all processes of the NBS intervention	Planning	Limited stakeholder consultation and participation in studies and monitoring	Institute mandatory stakeholder engagement sessions during planning to ensure a holistic and community-centered approach.	Risks: Reduced project efficacy and acceptance. Impacts: Wasted resources, mistrust among stakeholders. Challenges: Ensuring diverse, meaningful stakeholder involvement.	Strengths: Awareness of current limitations provides a concrete foundation for improvement. The identification of stakeholder, bureaucratic, and legislative challenges paves the way for targeted solutions. Opportunities: Broadening stakeholder engagement can enhance the overall quality of decision-making, while streamlining bureaucracy and refining legislative frameworks can lead to more effective and coordinated interventions.
			Implementation	Bureaucracy and fragmentation of responsibilities, limited coordination among authorities, Lack of an objective approach in decision making process (e.g. prioritization of measures)	Streamline decision-making through a centralized coordination body. Adopt objective criteria for prioritizing measures to enhance effectiveness.	Risks: Inefficient use of resources, conflicting goals. Impacts: Project delays, cost overruns. Challenges: Streamlining bureaucracy, improving multi-authority coordination.	

			Maintenance	Complexity of the legislative framework	Simplify legislative frameworks and provide guidelines to help stakeholders navigate legal obligations and responsibilities.	Risks: Non-compliance, inefficiency in ongoing operations. Impacts: Legal repercussions, resource wastage. Challenges: Simplifying complex legislative framework for practical application.	
	1.1	Equity in participatory processes	Gender	NBS initiatives are not affected at all by the gender of participants	N/A	N/A	<p>Strengths:</p> <ol style="list-style-type: none"> 1. The NBS initiatives emphasize inclusivity and equality, ensuring that gender, age, social status, and indigenous rights don't affect participation, fostering a diverse and holistic approach. 2. The cost-effective nature of NBS initiatives makes them accessible regardless of socio-economic status, and traditional knowledge from older farmers integrates with the open-mindedness of the younger generation, facilitating holistic solutions. <p>Opportunities:</p> <ol style="list-style-type: none"> 1. By targeting the potential openness of younger generations and the experiential wisdom of older farmers, there's an opportunity to bridge knowledge gaps and foster innovative NBS practices. 2. By enhancing education and understanding, especially among higher social strata, NBS initiatives can gain
			Age	NBS initiatives are not affected at all by the age of participants. Indirectly one may claim that younger ages may be more open minded and open to such approaches. On the other hand, older farmers are familiar with NBS solutions due to extinct farming and not only, practices			
			Social status	NBS initiatives are not affected at all by the social (and economical, in most cases) status of participants. Indeed, NBS usually have low cost compared to the structural measures. The only potential relevance relates to the level of understanding and general education, that may bring upper level social structures to be			

				more open to such initiatives.			broader acceptance and implementation, aligning with both Greek national law and the EU aquis.
			Indigenous right	NBS initiatives are not affected at all by the indigenous right. Their different implementation phases are only regulated by the Greek national law which conforms to the EU aquis and the legal land property rights (public/municipal/private land)			
	1.2	Represented stakeholders		All the direct and indirect stakeholders affected by the NBS are identified and involved in the decision making process.	N/A	N/A	Strengths: Comprehensive identification of all direct and indirect stakeholders ensures inclusive planning and robust decision-making. Opportunities: Continued engagement with these stakeholders can facilitate adaptive management and increased local ownership over the NBS.
	2	Represented interest of stakeholders		It is evident from the technical workshops and stakeholder interviews that the decision making documents and responded to the interest and rights of all participating and affected stakeholders.	N/A	N/A	Strengths: Technical workshops and interviews show that the process is transparent and respects the interests and rights of all stakeholders. Opportunities: This foundation can be used to build stronger advocacy and educational programs, solidifying stakeholder commitment and long-term support.

		3	Intra-organisational coordination	<p>Design of the proposed NBS includes the active engagement of different stakeholders (ministries, decentralized authorities, regional authorities, farmers, farmers' associations, consortium of 2nd Revision of Thessaly River Basin Management Plan). Coordination mechanisms among the stakeholders already exist which regulate the design and implementation issues of any proposed structural and non-structural measure, including NBS. These coordination mechanisms refer mainly to different hierarchy (and thus, coordination) levels among the different administrative levels of stakeholders. Also, no additional coordination mechanisms are planned to be established in the pilot area concerning the NBS design and implementation. These stand for the organisational structure of the NEXUS related and NBS oriented projects in the country. However, no official structure occurs, still due to the</p>	N/A	N/A	<p>Strengths: Existing coordination mechanisms between varied stakeholders provide a structured approach to decision-making, aiding in effective implementation of NBS projects.</p> <p>Opportunities: The imminence of formalized structures offers a chance to further standardize and optimize coordination, potentially attracting more institutional investment and support.</p>
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				fact that the institutional bodies that will have to take actions on this direction are represented by actively engaged stakeholders, we see obvious signs that the establishment of authoritative mechanisms is a matter of time (near future frame)			
	4	Inter-organisational coordination		Responsibilities of the existing coordination mechanisms are limited only within their jurisdictional boundaries whether NBS scale extends beyond these boundaries or not. In cases of admin limits are extended, clear rules on either conjunctive decision, or pass jurisdiction to one of the 2 involved admin levels occur with respect to water resources management. It is expected that these rules are extended to the implementation of the NBS	For NBS extending beyond jurisdictional boundaries, establish joint decision-making mechanisms for all affected stakeholders. Ensure clear rules for conjunctive decisions or jurisdiction delegation, especially in water resources management, mirroring current admin limit practices.	<p>Risk: Joint decision-making may lead to conflicting interests between jurisdictions when implementing NBS.</p> <p>Impacts: Delays in NBS implementation due to prolonged negotiations or disputes; potential inequalities in water resource management.</p> <p>Challenges: Harmonizing rules across jurisdictions and ensuring consistent application of decisions on water resources and NBS.</p>	<p>Strengths: Mechanisms for joint decision-making across jurisdictions ensure collaborative NBS management. Clear rules guide decision-making when NBS scale extends beyond jurisdictional boundaries.</p> <p>Opportunities: Expanding current rules to fully encompass NBS implementation can enhance cross-jurisdictional coordination and resource management.</p>
Stakeholder endorsement	1	Community supporting the NBS		Structured interviews result shows that the stakeholders are aware of the problems of WEFE Nexus and thus the support for an Integrated approach for the	N/A	N/A	<p>Strengths: High community awareness of WEFE Nexus issues increases stakeholder buy-in for NBS projects.</p> <p>Opportunities: Leverage this strong community support to</p>

					implementation of NBS is evident			facilitate smoother implementation and possibly attract additional funding or partnerships.
		2	Management of the negative impacts' strategy		Possible negative impacts of NBS initiatives mainly refer to economic loss of specific stakeholder groups - regarding the type and spatial extent of each NBS - because of land use change. European or/and nationally-originated subsidies could be provided as compensatory benefits	N/A	N/A	Strengths: Community support indicates social feasibility for strategies to manage negative impacts, particularly economic losses. Opportunities: Opportunity to leverage European or national subsidies as compensation for stakeholders affected by land-use changes, thereby mitigating resistance.
Supportive policies	Clear mandate and support for NBS	1	European, national and sub-national policies supporting NBS		There are laws in force with clear reference to NBS at European Union, and National level (in Greece).	N/A	N/A	Strengths: Existence of supporting laws at multiple levels (EU and national) provides a strong regulatory framework. Opportunities: Use these laws as a foundation to align local policies and initiatives, further bolstering NBS implementation.
	Coherence between sectoral policies, and mechanisms to address trade-offs	1	European, national and sub-national policies' objectives		Considering the fact that NBS are ad-hoc environmental-friendly measures, possible conflicts could only arise in case of large-scale NBS. However, none large-scale NBS is proposed to be	N/A	N/A	Strengths: Lack of conflicting objectives in sectoral policies minimizes roadblocks for NBS implementation. Opportunities: This regulatory harmony offers a chance to plan for large-scale NBS in future

					implemented in the wider pilot area according to the 2nd Revision of Thessaly River Basin Management Plan			revisions of the Thessaly River Basin Management Plan, should the need arise.
Encouragement of NBS within infrastructure planning processes	1	Indication of NBS as planning options	Land use planning regulations	EU Green Deal, which was launched in December 2019, aims to make Europe climate-neutral by 2050 and includes several initiatives related to land use planning, such as the Farm to Fork Strategy, the Forest Strategy, and the Renovation Wave. These initiatives also highlight the importance of NBS in achieving their objectives	N/A	N/A	<p>Strength:</p> <p>The EU Green Deal not only provides a strong regulatory framework for promoting NBS but also includes targeted initiatives like the Farm to Fork Strategy and Forest Strategy to facilitate its implementation.</p> <p>Opportunity:</p> <p>The established framework and specific initiatives provide a rich landscape for developing NBS-specific policies while encouraging multi-sectoral collaboration.</p>	
			Strategies	The EU Biodiversity Strategy for 2030, which was adopted in May 2020, includes a section on "Mainstreaming nature-based solutions in policies, plans, and investments" as a key action to address biodiversity loss and climate change. The strategy also identifies several sectors where NBS can be integrated, such as agriculture, forestry, water	N/A	N/A	<p>Strength:</p> <p>The EU Biodiversity Strategy for 2030 directly incorporates NBS as a key action and applies it across multiple sectors, thus facilitating a comprehensive and integrated approach.</p> <p>Opportunity:</p> <p>The strategy serves as a roadmap for aligning NBS initiatives among member states and offers the potential for interdisciplinary projects that bring together sectors</p>	

					management, and urban planning.			like forestry and water management.
				Plans	the EU Urban Agenda, which was adopted in 2016, promotes the use of NBS as a way to improve the quality of life in urban areas, enhance biodiversity, and mitigate the effects of climate change. The Urban Agenda includes several partnerships on different themes, such as air quality, circular economy, and urban mobility, which integrate NBS as a cross-cutting element.	NA	N/A	<p>Strength: The EU Urban Agenda explicitly supports NBS and incorporates it into various partnerships focused on themes such as air quality and circular economy, thereby broadening its scope.</p> <p>Opportunity: The focus on urban environments serves as a unique platform for scaling NBS, and the cross-cutting nature of these themes provides the opportunity for aligned efforts and shared best practices.</p>

Supporting policies	Encouragement of NBS adoption towards its positive outcomes	1	Implementation of a successful NBS	Uptake	In Greece, the EU's Biodiversity Strategy and Water Framework Directive are relevant policies for NBS interventions related to ecosystem restoration and water management. NBS interventions can help identify how these policies can be implemented at the local level and provide feedback on their effectiveness. The Greek landscape is rich in biodiversity and natural resources, and NBS interventions can help map the impacts and opportunities of policies and regulations related to biodiversity conservation, carbon sequestration, and climate change mitigation.	N/A	N/A	<p>Strength: Alignment with EU policies and Greece's rich natural landscape provide a strong foundation for effective NBS interventions.</p> <p>Opportunity: Local-level implementation coupled with comprehensive mapping can enrich policy feedback and multi-dimensional impact assessment.</p>
				Mainstreaming	Definitely yes. Proposed (scheduled) by stakeholders NBS in the context of REXUS and LENSES projects will be made available for public consultation with the aim at incorporating these measures into the 2nd Revision of the Thessaly Water Resources Management Plan (at river basin scale). Currently, flood	N/A	N/A	<p>Strength: Public consultation and integration into the Thessaly Water Management Plan ensure both social buy-in and seamless policy alignment.</p> <p>Opportunity: Pilot projects like REXUS and LENSES can serve as stepping stones for broader NBS implementation, offering immediate benefits in flood risk mitigation.</p>

				<p>risk mitigation NBS proposed in a relevant project are scheduled to be implemented/developed in the Kalentzis sub-basin located within the Pinios River Basin boundaries. In total, numerous of the proposed measures are NBS and certainly support the implementation of the sectoral strategic planning for water and indeed for soil management</p>			
Methodologies in place for measuring NBS contribution	1	Contribution of NBS to national and global targets	Human well-being	<p>Currently, there are no procedures in place to measure the contribution of NBS in Pinios River Basin to national and global targets for human well-being</p>	<p>Develop and implement a comprehensive framework for measuring the impact of Nature-based Solutions (NBS) in the Pinios River Basin on human well-being metrics such as public health and social equity.</p>	<p>Risks: Failure to recognize the holistic benefits of nature-based solutions (NBS) could result in overlooked well-being opportunities. Impacts: Reduced potential for sustainable development and well-being improvement for the local population. Challenges: Establishing a comprehensive and accurate procedure to quantify the direct and indirect contributions of NBS to human well-being.</p>	<p>Strengths:</p> <p>The absence of current procedures highlights a clean slate for innovation and development of new methods.</p> <p>Opportunities:</p> <p>A clear gap exists to develop procedures that align with national and global targets, enabling policymakers to demonstrate how NBS contributes to human well-being in the Pinios River Basin.</p>

				Climate change	Yes	N/A	N/A	<p>Strengths:</p> <p>Existing procedures indicate readiness and capability to contribute to targets for climate change.</p> <p>Opportunities:</p> <p>Could become a benchmark model for other sub-indicators and regions that lack such procedures.</p>
				Biodiversity	Yes	N/A	N/A	<p>Strengths:</p> <p>With established procedures, there's a strong foundation for immediate action and improvement.</p> <p>Opportunities:</p> <p>The existing framework allows for further fine-tuning and customization to meet evolving national and global biodiversity goals.</p>
				Human rights	Currently, there are no procedures in place to measure the contribution of NBS in Pinios River Basin to national and global targets for human rights	Create a multi-stakeholder working group to define human rights metrics influenced by NBS. Incorporate these metrics into existing monitoring and evaluation mechanisms for NBS in the Pinios River Basin.	<p>Risks: By not evaluating the influence of NBS on human rights, violations or improvements might go unnoticed.</p> <p>Impacts: Marginalized groups may remain vulnerable, and potential rights-related benefits of NBS may be missed.</p> <p>Challenges: Developing metrics and indicators that aptly bridge the intersection of NBS with human rights concerns.</p>	<p>Strengths:</p> <p>The absence of procedures indicates the potential for creating a framework tailored to the unique needs of the Pinios River Basin.</p> <p>Opportunities:</p> <p>An opportunity exists to be a pioneer in developing and implementing NBS-focused human rights measures, thus fulfilling national and global targets.</p>

Appropriate regulatory environment	Land-use regulation and zoning	1	Land use designation		Land-use of the PRB is evident from the maps and other regulatory documents.	N/A	N/A	<p>Strengths:</p> <ol style="list-style-type: none"> 1. Clarity in land-use designation aids in informed decision-making for future projects. 2. Presence of regulatory documents enhances legal compliance and minimizes conflicts. <p>Opportunities:</p> <ol style="list-style-type: none"> 1 Can serve as a model for other regions lacking clear land-use documentation. Offers a foundation for interdisciplinary research and policy formulation. 2. Potential for optimized urban planning and sustainable development strategies.
	Permitting	1	Clear and defined construction permits		The answer depends on the type of each planned NBS. In the case of mulching and soil water management through irrigation scheduling, no special permits are required since they are developed on a private farm land. However, in case of NBS related to flood risk mitigation and ecosystems health improvement where low/medium/high land use interventions are required, specific permits are required which however, have not been proceeded yet.	<ol style="list-style-type: none"> 1. Standardize and clarify permit requirements for various NBS interventions, ensuring that stakeholders understand the criteria. 2. Expedite the permit processing system for NBS related to flood risk mitigation and ecosystem health improvement. 3. Encourage private landowners to adopt mulching and soil water management techniques by 	<p>Risks:</p> <ol style="list-style-type: none"> 1. Potential legal consequences for proceeding without the necessary permits for flood risk mitigation and ecosystem health improvement projects. 2. Delays in project implementation due to permit acquisition process. <p>Impacts:</p> <ol style="list-style-type: none"> 1. Possible fines or penalties if projects are initiated without required permissions. 2. Reputational damage for not adhering to local regulations and standards. <p>Challenges:</p> <ol style="list-style-type: none"> 1. The need to navigate the 	<p>Strengths:</p> <ol style="list-style-type: none"> 1. Flexibility in permitting for private land applications such as mulching and irrigation scheduling allows for quick implementation of these NBS. 2. Established guidelines for land use interventions offer a structured permitting process for flood risk mitigation and ecosystem projects. <p>Opportunities:</p> <ol style="list-style-type: none"> 1. Expedite the permit approval process for NBS related to public issues like flood risk and ecosystem health to encourage wider adoption. 2. Develop a streamlined, unified permitting system to ease the complexity for

					<p>providing guidance and support, given the lack of permit constraints.</p> <p>4. Establish a dedicated task force to guide stakeholders through the permit acquisition process for NBS initiatives.</p> <p>5. Review and, if necessary, revise land-use policies to ensure they facilitate the effective implementation of essential NBS projects.</p>	<p>permit acquisition process, which can be complex and time-consuming.</p> <p>2. Potential resistance from local authorities or stakeholders when seeking necessary permits.</p>	<p>projects that require multiple permits.</p>
Safety and performance codes and standards	1	Clear and defined safety and performance codes and standards		<p>The Greek government has various regulations, codes, and standards in place to ensure that the implementation of NBS in the Pinios river basin is safe and effective. These regulations cover areas such as water quality, ecological sustainability, and environmental impact assessments. In addition, Greece has adopted various EU directives related to water management and conservation, such as the Water Framework Directive and the Floods Directive, which provide a legal framework for the</p>	N/A	N/A	<p>Strengths:</p> <ol style="list-style-type: none"> 1. Established regulations and codes ensure a comprehensive and safe approach to NBS implementation. 2. Compliance with EU directives strengthens the legal framework and brings international best practices into local efforts. <p>Opportunities:</p> <ol style="list-style-type: none"> 1. Leveraging EU directives can potentially unlock additional funding or expertise. 2. Continuous updates to these regulations can further adapt to emerging environmental challenges or scientific advancements.

				management of water resources and the protection of aquatic ecosystems.			
Procurement policies	1	Clear procurement policies		Greece has a national procurement policy in place that provides guidelines and regulations for public procurement. The current legislation governing public procurement in Greece is Law 4412/2016, which implements the European Union's public procurement directives. The National Procurement Authority (NPA) is the central coordinating body for public procurement in Greece. It is responsible for overseeing the implementation of the public procurement policy and providing guidance to contracting authorities.	N/A	N/A	<p>Strengths:</p> <p>Existence of a national policy and legislation provides a clear roadmap for public procurement. The National Procurement Authority serves as a centralized body for oversight, adding an extra layer of governance and quality assurance.</p> <p>Opportunities:</p> <p>The policy can be adapted to focus more on sustainable or eco-friendly options for NBS. Collaboration with EU entities could refine procurement processes and open doors to a broader range of suppliers and technologies.</p>

Land rights	1	Clear land and resources tenure, usage, and access rights	Tenure	Greek legal system recognizes three types of land ownership: private, public, and communal. Private land ownership is governed by the Greek Civil Code and is protected by the Constitution. Public land is owned by the state and can be used for public purposes. Communal land is owned collectively by a community, such as a village or municipality, and is subject to the collective decision-making of the community.	N/A	N/A	Strengths: The legal framework in Greece offers multiple avenues for land ownership, enhancing inclusivity. Constitutional backing provides strong legal protections for private landowners. Opportunities: Clear delineations between private, public, and communal land offer opportunities for targeted policy-making and resource management. Opportunity to leverage communal lands for community-led development initiatives.
			Usage	Greece has laws and regulations that govern the use of natural resources, such as water, forests, and minerals. These laws provide for the sustainable management and use of these resources and aim to balance economic development with environmental protection.			Strengths: Existing laws encourage sustainable use of natural resources. Regulatory framework aligns economic interests with environmental conservation. Opportunities: Potential for further sustainable economic development through well-managed resources. The existing framework could serve as a blueprint for developing more detailed guidelines or standards.

			Access right	Access to land and resources is generally governed by these laws and regulations. For example, permits and licenses may be required for certain activities, such as mining or forestry. In some cases, access to resources may be restricted to certain groups or communities, such as indigenous people or farmers.			<p>Strengths:</p> <p>Permits and licensing procedures help regulate and monitor resource exploitation. Some inclusivity measures are in place to prioritize access for certain communities, such as indigenous people or farmers.</p> <p>Opportunities:</p> <p>Streamlining permit processes could make access more equitable and efficient. More targeted policies could be developed to further support marginalized or specialized groups in resource access.</p>
	2	Acknowledge and observance of the land and resources tenure, usage, and access rights	Tenure	Land and resources tenure along with the associated responsibilities are legally acknowledged and respected in case of all the planned measures, including NBS	N/A	N/A	<p>Strengths:</p> <p>Legal acknowledgment ensures clarity and fairness in property rights. Legal backing reduces potential for conflict over land and resource claims.</p> <p>Opportunities:</p> <p>Setting the foundation for sustainable land management practices. Opportunity to involve multiple stakeholders in responsible land use through legal frameworks.</p>

				<p>Usage</p> <p>Land and resources usage along with the associated responsibilities are legally acknowledged and respected in case of all the planned measures, including NBS</p>
				<p>Access right</p> <p>Land and resources access rights along with the associated responsibilities are legally acknowledged and respected in case of all the planned measures, including NBS. By no means NBS implementation changes legal rights of land owners and/or other resources users</p>

<p>Strengths: Legally defined usage rights contribute to more predictable and planned resource utilization. Fosters compliance and awareness among stakeholders regarding responsible usage. Opportunities: Allows for adaptive management practices that can integrate new forms of sustainable land usage. Provides an avenue for equitable distribution and utilization of land and resources.</p> <p>Strengths: Legal acknowledgment ensures no disruption in existing access rights through NBS or other measures. Provides certainty and security for landowners and resource users. Opportunities: Offers a basis for integrating community-based resource management systems. Enables the crafting of policies that balance access rights with ecological sustainability.</p>

	Environmental protection regulation	1	Clear environmental protection regulation		Greece is in compliance with environmental protection regulations under Greek and the EU laws and directives.	N/A	N/A	<p>Strengths: Compliance with both national and EU laws ensures a high standard of environmental protection.</p> <p>Opportunities: Being in compliance creates trust among stakeholders and may attract eco-conscious investments.</p> <p>Provides a framework for adopting advanced environmental practices beyond the minimum regulatory requirements.</p>
Technical capacity	Partnerships and information sharing	1	Stakeholders' network cohesion to optimize interdisciplinary co-creation and co-design of NBS		Stakeholders are exchanging the information related to the NBS project through various sophisticated communication means.	N/A	N/A	<p>Strengths: Strong communication among stakeholders enhances interdisciplinary collaboration.</p> <p>Various communication channels allow for quick and efficient information exchange.</p> <p>Opportunities: Potential for co-creating and co-designing more effective and inclusive NBS solutions.</p> <p>Fosters a community of practice that can adapt to emerging challenges and opportunities in NBS projects.</p>

		2	Procedures for collecting comments	Before	<p>In case of REXUS and LENSES projects, NBS interventions are proposed and formulated through the active engagement of stakeholders (workshops, online questionnaires, café meetings, Task Force meetings with the consortium of the 2nd Update of the Thessaly River Basin Management Plan). The above procedures are organized by the SWRI Team within the context of the aforementioned projects. Besides, all the measures (NBS and non-NBS) proposed in the 2nd Update of Thessaly RBMP will be under public consultation within the next few weeks (estimated on late-June 2023).</p>			<p>Strengths: Diverse engagement methods ensure broad stakeholder input and increased legitimacy of NBS proposals. The SWRI Team's organization of procedures provides a structured and accountable approach.</p> <p>Opportunities: Upcoming public consultation offers further transparency and potential for community-based suggestions. Varied platforms like workshops and Task Force meetings allow for more nuanced stakeholder contributions.</p>
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				During	During all (NBS and non-NBS) measures intervention, stakeholders could provide their comments/contributes through relevant formal meetings, mainly at municipality level. During these meetings, stakeholders could express their objections in case that a measure is implemented not in line with the technical specifications and/or without following the guidelines of the relevant Environmental Assessment Study.			Strengths: Formal municipality-level meetings provide an institutionalized channel for ongoing stakeholder input. Mechanisms are in place for stakeholders to flag deviations from technical or environmental guidelines. Opportunities: Real-time feedback can help in immediate course correction during NBS implementation. These meetings can serve as a model for future community engagement in environmental projects.
	Integration of NBS training in civil engineering and urban planning curricula	1	Training in NBS	Course	There are some courses specific to the NBS present in Greece to improve adoption.	Standardize NBS Curriculum: Ensure a standardized curriculum for NBS courses across all educational institutions in Greece. Mandatory Inclusion: Make the integration of NBS courses mandatory for all university programs related to engineering and urban planning. Professional Development: Encourage and provide incentives for public administration	Risk: Limited availability or regional concentration of NBS courses might hinder nationwide adoption and understanding of NBS principles. Impacts: 1. Regions without access to NBS courses may have inadequate NBS adoption. 2. Disparities in NBS knowledge and practices among engineers and planners could arise. Challenges: 1. Ensuring uniform distribution and standardization of NBS courses across Greece. 2. Integrating NBS education seamlessly into	Strengths: Presence of specific NBS courses encourages specialized training, boosting adoption rates. Aligns with policy recommendations to standardize and mandate NBS curricula for professionals. Opportunities: Expand the availability of courses nationwide to address regional disparities. Leverage public administration engineers and planners for professional development in NBS.

					<p>engineers and planners to undergo NBS training. Collaborate with Experts: Engage NBS experts in the continuous updating and improvement of course content to remain relevant and effective. Promote & Incentivize: Create awareness campaigns and financial incentives for institutions that pioneer advanced NBS-related education.</p>	<p>university curricula for relevant disciplines.</p>	
			Education	<p>Various NBS-related courses/degree programs are taught in Greek Universities.</p>	<p>Establish formal partnerships between universities and governmental bodies to integrate NBS education into public administration training programs. Update accreditation standards for engineering and planning disciplines to require NBS coursework or training. Offer financial incentives or grants to universities to update their curricula to include more comprehensive NBS training.</p>	<p>Risks: Over-specialization in NBS-related courses may not prepare students for broader career prospects. May create a perception of "academic siloing," with NBS viewed as separate from other sustainable practices. Impacts: Improved local expertise in NBS, contributing to more effective and informed implementations. Challenges: Keeping academic curriculum up-to-date with rapidly evolving NBS techniques and technologies.</p>	<p>Strengths: University programs allow for deep, academic exploration of NBS, fostering expertise. Addresses the recommendation to integrate NBS education into university curricula. Opportunities: Collaborate with NBS experts to continuously update course content, ensuring relevance and effectiveness. Awareness campaigns and financial incentives can be used to promote advanced NBS-related education.</p>

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Mandate the inclusion of NBS training in ongoing professional development courses for existing public administration staff.

Ensuring practical, real-world applicability of academic concepts in NBS.

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	Training and education	1	Collaborative leaning among stakeholders	LENSES and REXUS project	N/A	N/A	<p>Strengths (LENSES project):</p> <p>Addresses an emergent need for creating a Water Energy Food (WEF) Nexus narrative. Focuses on "Resilient Nexus Doing," aiming to bring a paradigm shift from mere thinking to action.</p> <p>Opportunities (LENSES project):</p> <p>The visual tools designed to reach the general public open avenues for widespread awareness.</p> <p>The cross-disciplinary approach offers a chance to build synergies among different sectors, potentially creating new socio-economic opportunities.</p> <p>Strengths (REXUS project):</p> <p>Backed by Horizon 2020, providing credibility and resources for its innovative solutions.</p> <p>Bridges the gap between science and policy, ensuring practical application of research.</p> <p>Opportunities (REXUS project):</p> <p>Its operation in 5 pilot sites across two continents provides a robust testing ground to refine the model. The focus on climate-resilient solutions presents an</p>
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								opportunity to set a new standard for sustainability across the WEF sectors.
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		2	Knowledge courses	Residents	Direct and collateral benefits of NBS implementation are currently regarding water availability increase, energy saving, agricultural production enhancement and ecosystems health improvement. The results are constantly disseminated to all the interested parties through workshops, publications etc. No specific courses are planned to be implemented at local scale.	N/A	N/A	<p>Strengths:</p> <p>Diverse benefits such as increased water availability, energy savings, enhanced agricultural production, and ecosystem health are achieved.</p> <p>Active dissemination of results ensures residents are well-informed.</p> <p>Opportunities:</p> <p>Opportunity exists to deepen engagement by implementing specialized courses at a local level.</p> <p>Extend the current communication channels like workshops and publications to include course outlines and educational material.</p> <p>Strengths:</p>
				Stakeholders	LENSES and REXUS project	N/A	N/A	<p>Opportunities:</p> <p>Involvement in specific projects like LENSES and REXUS indicates a targeted approach to knowledge enhancement.</p> <p>Opportunities:</p> <p>The projects could serve as a model for other specialized courses or educational programs.</p> <p>There's room for expanding these projects to address additional needs and interests of residents.</p>

<p>Access to finance</p>	<p>Availability of targeted incentives</p>	<p>1</p>	<p>European, national and sub-national resourcing options (policies, financial instruments, etc.) supporting NBS</p>	<p>In the European Union, the Biodiversity Strategy for 2030, which was adopted in May 2020, includes a commitment to increase the use of nature-based solutions across all EU policies. The EU also has a number of financial instruments available to support nature-based solutions. These include the LIFE programme, which provides funding for nature conservation and environmental projects, and the European Regional Development Fund, which supports sustainable urban development projects that incorporate nature-based solutions. In Greece, the Ministry of Environment and Energy has launched several initiatives to promote nature-based solutions. These include the "Green Fund", which provides financial support for projects that promote sustainable development and environmental protection, and the "Life ElClima" project, which aims to reduce the impact of climate change</p>	<p>N/A</p>	<p>N/A</p>	<p>Strengths:</p> <p>The adoption of the Biodiversity Strategy for 2030 signifies strong political will at the EU level to incorporate nature-based solutions (NBS) into policies. Multiple financial instruments like the LIFE programme and the European Regional Development Fund provide diverse avenues for funding NBS projects.</p> <p>Opportunities:</p> <p>The existence of national and sub-national initiatives, like Greece's "Green Fund" and "Life ElClima," can serve as models or case studies for other member states. With financial and policy support on multiple governance levels, there's a ripe environment for cross-sectoral collaborations to further advance NBS. Current initiatives could potentially be scaled up or adapted to address additional environmental issues beyond biodiversity and climate change.</p>
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					on biodiversity and ecosystems.			
Ability to capture revenue streams	1	Completeness of income sources	Design team	Greece has a professional capacity to develop NBS project, however a design team is not identified.	Establish a dedicated design team for Nature-Based Solutions (NBS) projects to harness existing professional capacity. Mandate the inclusion of multi-disciplinary experts in the design team to ensure comprehensive planning. Develop standardized selection criteria and protocols for design team identification and recruitment.	Risk: Absence of a clearly identified design team. Impact: Potential delays and lack of focused expertise in NBS project development. Challenges: Mobilizing and organizing a cohesive design team from available professionals.	Strengths: Greece's existing professional capacity in NBS project development. Opportunities: Leveraging multi-disciplinary expertise can lead to innovative and sustainable NBS projects, making Greece a regional leader in this domain.	
			Management system	No	Implement a complete project management system for overseeing NBS projects. Allocate resources specifically earmarked for the development and maintenance of this system. Train existing staff or hire qualified project managers to operate within this	Risk: Absence of a project management system. Impact: Inefficiencies, cost overruns, and mismanaged resources. Challenges: Establishing a robust management system from scratch to oversee project execution.	Strengths: None identified, indicating a clean slate for implementing a state-of-the-art system. Opportunities: The absence of a pre-existing system provides the flexibility to adopt best practices and technologies, potentially setting a benchmark for efficient project management.	

					management framework.		
Financing requirements	1	Financial sustainability	Design team	<p>The relevant project design teams only propose pathways to find European or/and national funding from different sources. However, financing could not be secured after the completion of the research projects. At this stage, it is hoped that the project will support and direct shaping NBS support tools for financing through the governmental institutional bodies augmented by systemic banks</p>	<p>1. Redefine the role of the project design team to not just identify but also secure long-term financing sources beyond research completion. 2. Establish partnerships between the project teams and governmental institutional bodies for continuous funding opportunities. 3. Involve systemic banks early in the project lifecycle to co-create sustainable financing mechanisms tailored for NBS support tools.</p>	<p>Risks: 1. Overreliance on European and national funding sources without diversification. 2. Possible stagnation if financing is not secured post-research. Impacts: Potential inability to progress beyond research due to financing challenges. Dependence on uncertain governmental support tools for financing. Challenges: 1. Ensuring funding sources beyond European and national avenues. 2. Gaining consistent financial support from governmental institutions and systemic banks.</p>	<p>Strengths: Expertise in identifying European and national funding options enhances the likelihood of initial project funding. The design team's focus on collaborating with governmental bodies and systemic banks indicates a strategic approach to financing. Opportunities: Implementation of the policy recommendation to redefine the role of the design team can facilitate long-term funding. Forming partnerships with governmental bodies and systemic banks, as suggested, can create a more sustainable funding model. Diversifying funding sources can mitigate risks related to overreliance on European and national funds.</p>

				Management system	<p>Learning and Action Alliances along with Task Forces of stakeholders have been developed during REXUS and LENSES implementation with a main aim at enhancing the Nexus security of the pilot areas. After the completion of the project, the developed bonds is envisaged to maintain activity to a some extent and being supported by SWRI research team.</p>	<p>1. Embed a continuous engagement strategy in the REXUS and LENSES projects to ensure lasting collaboration beyond project completion. 2. Mandate an ongoing support role for the SWRI research team to oversee and mentor the post-project activity of the Learning and Action Alliances and Task Forces.</p>	<p>Risks: 1. The potential decrease in activity and engagement after the completion of REXUS and LENSES. 2. Reliance on SWRI research team for continued support. Impacts: 1. Loss of momentum in the pilot areas' Nexus security efforts. 2. Possibility of weakened alliances if SWRI team support is inconsistent. Challenges: 1. Maintaining the bonds and activity level of Alliances and Task Forces post-project. 2. Ensuring long-term commitment and support from SWRI research team.</p>	<p>Strengths: The formation of Learning and Action Alliances and Task Forces indicates an inclusive, stakeholder-driven approach. The focus on Nexus security in pilot areas suggests that the project has a clear, impactful goal. Opportunities: A continuous engagement strategy, as recommended, can help maintain momentum and stakeholder involvement post-project. Mandating ongoing support from the SWRI team can ensure a more sustainable and effective long-term strategy. Addressing challenges of maintaining activity levels can sustain the alliances and fulfil project objectives beyond the implementation phase.</p>
Distribution of liabilities	1	Legal responsibilities			<p>Currently not, but hopefully will be through the adoption of relevant measures in the national strategic planning (amongst which the 2nd revision of the water resources management plans)</p>	<p>Develop clear guidelines that delineate the roles and responsibilities for the implementation of Nature-Based Solutions (NBS) within the water resources management plans. Set up an oversight committee that reviews the effectiveness of NBS-related legal</p>	<p>Risk of ineffective NBS implementation due to lack of legal clarity. Challenge in coordinating multiple agencies and stakeholders if roles are not well defined. Potential impact on environmental sustainability if NBS measures are not legally enforced.</p>	<p>Opportunity to set a precedent for NBS implementation through legal frameworks. Strength lies in the political will, as indicated by plans for a 2nd revision of water resources management. An explicit legal framework could attract more public and private investment in NBS.</p>

						frameworks. Update national strategic plans to incorporate NBS, making sure legal responsibilities are explicitly stated.		
NBS management	NBS monitoring	1	Monitoring and evaluation strategy		No official established system exists	Establish a formalized, government-approved system for NBS (Nature-Based Solutions) monitoring and evaluation. Allocate dedicated funds and human resources for implementing and maintaining this system.	The absence of an official system limits understanding of NBS effectiveness. Lack of monitoring may result in sub-optimal resource allocation.	The absence of an existing system offers a blank canvas to design an effective, cutting-edge monitoring mechanism. Opportunity to collaborate with academic and international bodies to develop best practices.
		2	Adaptive NBS intervention management		No official iterative learning process is planned to be developed to support NBS interventions	Develop an official iterative learning process to make NBS interventions more adaptive. Integrate feedback loops into NBS projects to ensure continuous learning and improvement.	Without iterative learning, NBS interventions may not adapt to changing conditions, reducing their long-term efficacy. Stakeholders may resist change due to the lack of a structured approach to adaptation.	The absence of a system allows for the potential to create a highly adaptable, state-of-the-art framework. Collaboration with tech firms could lead to the development of real-time monitoring and adaptive systems.
	NBS safeguard	1	NBS safeguard system		This could be drafted with the support of SWRI, however currently no official safeguard system is projected to be established	Collaborate with SWRI to develop a robust NBS safeguard system. Establish regulatory frameworks to monitor trade-off limits and ensure their enforcement. Require third-party audits of NBS	Lack of a safeguard system may lead to unforeseen negative outcomes. Regulatory non-compliance risks, including potential legal liabilities. Difficulty in reaching consensus on mutually-agreed trade-off limits.	SWRI's expertise can expedite the development of a sound safeguard system. Regulatory frameworks provide an opportunity for standardization and credibility. Third-party audits offer transparency and build stakeholder trust.

						interventions to evaluate adherence to safeguards.		
	2	Risk strategy		No, but could be developed		Form a risk management committee to oversee the development of risk strategies. Mandate the use of risk assessment tools in all NBS interventions. Include stakeholders in risk strategy formulation for comprehensive coverage.	<p>Failure to identify risks can result in inefficient resource allocation and potential crises.</p> <p>Difficulty in establishing universally applicable risk assessment criteria.</p> <p>May be time-consuming and costly to develop a detailed strategy.</p>	<p>Opportunity to build a foundational risk assessment tool for future projects.</p> <p>Involving stakeholders can bring in diverse perspectives, enhancing risk identification.</p> <p>A well-established risk strategy can serve as a benchmark for similar interventions.</p>

Annex 3- Result of the questionnaire based on the LESNES-UNIPD framework answered by SWRI research team

Key Dimension	Key Element	Indicator	Description	Sub-Indicator	Guiding questions for SWRI team	Rationale	Means of Verification/Proof
1. Conducive Governance Arrangements	2. Coordination mechanisms (horizontal and vertical)	1.1 Equity in participatory processes	The participation is based on mutual respect and equity, regardless of gender, age or social status, and	Gender	Does the participation in Natural-based Solutions (NBS) initiatives ensure mutual respect and equity, regardless of gender, age, or social status, and uphold the right of Indigenous Peoples to Free, Prior and Informed Consent (FPIC)?	NBS initiatives are not affected at all by the gender of participants	<p>_REXUS Del. 2.1 "Guidelines for Stakeholder Engagemet".</p> <p>- REXUS Observatory (https://rexus-observatory.draxis.gr/).</p> <p>- REXUS Metamodel (https://app.powerbi.com/view?r=eyJrIjoiTQ2NmRkN2ItYTgyZC00YjVklWl0ZWmtZDMzNTA3NzI2NDJhliwidC16IjE1ZjNmZTBILWQ3MTItNDk4MS1iYzdlWZlOTQ5YWYyMTViYiIsImMiOjh9&pageName=ReportSection).</p> <p>- REXUS Window (http://www.rexuswindow.eu/course/view.php?id=4).</p>
				Age		NBS initiatives are not affected at all by the age of participants. Indirectly one may claim that younger ages may be more open minded and open to such approaches. On the other hand, older farmers are familiar with NBS solutions due to extinctic farming and not only, practices	

			upholds the right of Indigenous Peoples to Free, Prior and Informed Consent (FPIC)	Social status		NBS initiatives are not affected at all by the social (and economical, in most cases) status of participants. Indeed, NBS usually have low cost compared to the structural measures. The only potential relevance relates to the level of understanding and general education, that may bring upper level social structures to be more open to such initiatives.	- REXUS AirNbs website - Catalogue of Nbs (under development). - LENSES Del. 2.1 "D2.1 LAA Stakeholder Engagement Guidelines". - LENSES window (http://www.lenseswindow.eu/). - LENSES Nbs Catalogue (https://nbscatalogue.lenses-prima.eu/).
				Indigenous right		NBS initiatives are not affected at all by the indigenous right. Their different implementation phases are only regulated by the Greek national law which conforms to the EU aquis and the legal land property rights (public/municipal/private land)	
		3. Intra-organisational coordination	Presence of coordination mechanisms among NBS stakeholders (e.g., public institutions, economic bodies, stakeholders)		In the NBS design that has been planned, are there coordination mechanisms established among stakeholders, such as public institutions, economic bodies, and other stakeholders, in implementing NBS initiatives?	Design of the proposed NBS includes the active engagement of different stakeholders (ministries, decentralized authorities, regional authorities, farmers, farmers' associations, consortium of 2nd Revision of Thessaly River Basin Management Plan). Coordination mechanisms among the stakeholders already exist which regulate the design and implementation issues of any proposed structural and non-structural measure, including NBS. These coordination mechanisms refer mainly to different hierarchy (and thus, coordination) levels among the different administrative levels of stakeholders. Also, no additional coordination mechanisms are planned to be established in the pilot area concerning the NBS design and implementation. These stand for the organisational structure of the NEXUS related and NBS oriented projects in the country. However, no official structure occurs, still due to the fact that the institutional bodies that will have to take actions on this direction are represented by actively engaged stakeholders, we see obvious signs that the establishment of authoritative mechanisms is a matter of time (near future frame)	Documentation Text EL08-01 "Determination of Competent Authorities and their Jurisdiction Area" in the context of the 1st Update of River Basin Management Plan of Thessaly Water District in accordance with the Water Framework Directive (2000/60/EC) (http://wfdver.ypeka.gr/wp-content/uploads/2021/02/EL08_1REV_P01_Armodies_Arxes.pdf) (EL)

		4. Inter-organisational coordination	Where the scale of the NBS extends beyond jurisdictional boundaries, mechanisms are established to enable joint decision-making of the stakeholders in the affected jurisdictions		Are mechanisms established to enable joint decision-making among stakeholders from different jurisdictions when the scale of NBS initiatives extends beyond jurisdictional boundaries?	Responsibilities of the existing coordination mechanisms are limited only within their jurisdictional boundaries whether NBS scale extends beyond these boundaries or not. In cases of admin limits are extended, clear rules on either conjunctive decision, or pass jurisdiction to one of the 2 involved admin levels occur with respect to water resources management. It is expected that these rules are extended to the implementation of the NBS	
	3. Stakeholder Endorsement	2. Management of the negative impacts' strategy	Presence and use of instruments to manage the negative impacts affecting stakeholders		Are there instruments in place to manage and mitigate negative impacts affecting stakeholders in NBS initiatives?	Possible negative impacts of NBS initiatives mainly refer to economic loss of specific stakeholder groups - regarding the type and spatial extent of each NBS - because of land use change. European or/and nationally-originated subsidies could be provided as compensatory benefits	EU Common Agricultural Policy 2023-27
2. Supportive Policies	2. Coherence between sectoral policies	1. European, national and sub-national	Absence of conflicting objectives among the sectoral policies		Are you aware about the presence of conflicts among the objectives of different sectoral policies regarding NBS implementation?	Considering the fact that NBS are ad-hoc environmental-friendly measures, possible conflicts could only arise in case of large-scale NBS. However, none large-scale NBS is proposed to be implemented in the wider pilot area according to the 2nd Revision of Thessaly River Basin Management Plan	Documentation Text EL08-12 "Basic and Complementary Measures including cost-effectiveness analysis" in the context of the 1st Update of River Basin Management Plan of Thessaly Water District in accordance with the WFD 2000/60/EC (http://wfdver.ypeka.gr/wp-content/uploads/2020/03/EL08_1REV_P12_Metra.pdf) (EL)

	, and mechanisms to address trade-offs	policies ' objectives					
3. Supporting Policies	1. Encouragement of NBS adoption towards its positive outcomes	1. Implementation of a successful NBS	The NBS facilitates policy and regulation frameworks to support its uptake and mainstreaming	Mainstreaming	Does NBS implementation facilitate policy and regulation frameworks to support its mainstreaming?	Definitely yes. Proposed (scheduled) by stakeholders NBS in the context of REXUS and LENSES projects will be made available for public consultation with the aim at incorporating these measures into the 2nd Revision of the Thessaly Water Resources Management Plan (at river basin scale). Currently, flood risk mitigation NBS proposed in a relevant project are scheduled to be implemented/developed in the Kalentzis sub-basin located within the Pinios River Basin boundaries. In total, numerous of the proposed measures are NBS and certainly support the implementation of the sectoral strategic planning for water and indeed for soil management	Draft document of the 2nd Revision of River Basin Management Plan of Thessaly Water District in accordance with the WFD 2000/60/EC (http://wfdver.ypeka.gr/wp-content/uploads/2023/05/EL08_2REV_P4.9_Proxedia_LAP.pdf)
	2. Methodologies in place for measuring NBS contribution	1. Contribution of NBS to national and global targets	Presence of procedures capturing the NBS contribution to national and global targets for human well-being, climate change, biodiversity and human rights.	Human well-being	Are there procedures in place to capture the contribution of NBS to national and global targets for human well-being?	Currently, there are no procedures in place to measure the contribution of NBS in Pinios River Basin to national and global targets for human well-being	NBSs fall under the common strategy of index based assessment of the efficacy of each measure. This means of course that a specific small scale NBS can have measurable effects or not. Definitely in group of measures (e.g. agro-ecologic) the bulk impact per region may be assessed through soft indicators which at this stage may refer to extent of land implementing such measures or the gross expected gain out of their implementation. But in no case are we aware of quantitative indicators of biotic or abiotic parameters that can be solely attributed to NBS implementation
				Human Rights	Are there procedures in place to capture the contribution of NBS to national and global targets for human rights?	Currently, there are no procedures in place to measure the contribution of NBS in Pinios River Basin to national and global targets for human rights	

4. Appropriate regulatory environment	2. Permitting	Clear and defined construction permits	Presence of needed permits to implement the selected NBS		Does this pilot study have all needed permits to implement the planned NBS?	The answer depends on the type of each planned NBS. In the case of mulching and soil water management through irrigation scheduling, no special permits are required since they are developed on a private farm land. However, in case of NBS related to flood risk mitigation and ecosystems health improvement where low/medium/high land use interventions are required, specific permits are required which however, have not been proceeded yet.	REXUS Del. 5.3 "Finalized Core Modules for Decision Support Framework" of WP5 "Incorporating Nature-based Approaches into Nexus Solutions". LENSES Del. 5.2 "Roadmap to navigate the available catalogues of Nature-based Solutions and finalised list of candidate NBS".
	5. Land Rights	2. Acknowledge and observance of the land and resources tenure, usage, and access rights	The tenure, usage of and access rights to land and resources, along with the responsibilities of different stakeholders, are acknowledged and respected	Tenure	Are the tenure, usage of, and access rights to land and resources, along with the responsibilities of different stakeholders, acknowledged and respected in the implementation of NBS?	Land and resources tenure along with the associated responsibilities are legally acknowledged and respected in case of all the planned measures, including NBS	
				Usage		Land and resources usage along with the associated responsibilities are legally acknowledged and respected in case of all the planned measures, including NBS	
				Access right		Land and resources access rights along with the associated responsibilities are legally acknowledged and respected in case of all the planned measures, including NBS. By no means NBS implementation changes legal rights of land owners and/or other resources users	

5. Technical Capacity	1. Partnerships and information sharing	2. Procedures for collecting comments	Use of formal procedures to allow stakeholders to provide their comments/contributes before and during the NBS intervention	Before	Are formal procedures in place to allow stakeholders to provide their comments/contributions before and during the NBS intervention?	In case of REXUS and LENSES projects, NBS interventions are proposed and formulated through the active engagement of stakeholders (workshops, online questionnaires, café meetings, Task Force meetings with the consortium of the 2nd Update of the Thessaly River Basin Management Plan). The above procedures are organized by the SWRI Team within the context of the aforementioned projects. Besides, all the measures (NBS and non-NBS) proposed in the 2nd Update of Thessaly RBMP will be under public consultation within the next few weeks (estimated on late-June 2023).	<ul style="list-style-type: none"> · REXUS Del. 2.1 "Guidelines for Stakeholder Engagemet". - REXUS Observatory (https://rexus-observatory.draxis.gr/). - REXUS Metamodel (https://app.powerbi.com/view?r=eyJrIjojZTQ2NmRkN2ItYTgyZC00YjVklWl0ZWMtZDMzNTA3NzI2NDJhliwidCI6IjE1ZjNmZTBILWQ3MTItNDk4MS1iYzdjLWZlOTQ5YWYyMTViYiIsImMiOj9&pageName=ReportSection). - REXUS Window (http://www.rexuswindow.eu/course/view.php?id=4). - REXUS AirNbS website - Catalogue of NbS (under development). - LENSES Del. 2.1 "D2.1 LAA Stakeholder Engagement Guidelines". - LENSES window (http://www.lenseswindow.eu/). - LENSES NbS Catalogue (https://nbscatalogue.lenses-prima.eu/).
				During		During all (NBS and non-NBS) measures intervention, stakeholders could provide their comments/contributes through relevant formal meetings, mainly at municipality level. During these meetings, stakeholders could express their objections in case that a measure is implemented not in line with the technical specifications and/or without following the guidelines of the relevant Environmental Assessment Study.	

	3. Training and Education	2. Knowledge courses	The lead organization organizes specializing courses open to residents and stakeholders	Residents	Does the lead organization organize or is planning to organize specialized courses about NBS open to residents?	Direct and collateral benefits of NBS implementation are currently regarding water availability increase, energy saving, agricultural production enhancement and ecosystems health improvement. The results are constantly disseminated to all the interested parties through workshops, publications etc. No specific courses are planned to be implemented at local scale.	
6. Access to Finance	2. Ability to capture revenue streams	1. Completeness of income sources	Presence of professional project design team and complete project management system	Management Systems	Does the project have a professional project design team and a complete project management system in place capable to find solutions to capture NBS revenue?	No	LENSES Del. 6.1 "Socio-economic indicators and framework for Nexus-relevant NBS". LENSES Del. 6.2 "Policy indicators and framework for Nexus-relevant NBS". LENSES Del. 6.3 "Business and governance models framework for Nexus-relevant NBS". REXUS Del. 7.4 "Exploitation and Sustainability plan", LENSES Del. 9.4 "Exploitation and Sustainability plan". LENSES Del. 9.7 "Business plan".
	3. Financing requirements	1. Financial sustainability	Presence of professional project design team and complete project	Design Team	Is there a professional project design team capable to gather financing to implement NBS?	The relevant project design teams only propose pathways to find European or/and national funding from different sources. However, financing could not be secured after the completion of the research projects. At this stage, it is hoped that the project will support and direct shaping NBS support tools for financing through the governmental institutional bodies augmented by systemic banks	

			managem ent system	Manag ement System s		Learning and Action Alliances along with Task Forces of stakeholders have been developed during REXUS and LENSES implementation with a main aim at enhancing the Nexus security of the pilot areas. After the completion of the project, the developed bonds is envisaged to maintain activity to a some extent and being supported by SWRI research team.	_REXUS Metamodel (https://app.powerbi.com/view?r=eyJrJlJoiZTQ2NmRkN2ItYTgyZC00YjVklWl0ZWtZDMzNTA3NzI2NDJhliwidCI6IjE1ZjNmZTBILWQ3MTItNDk4MS1iYzdjLWZlOTQ5YWYyMTViYiIsImMiOjh9&pageName=ReportSection). - REXUS Window (http://www.rexuswindow.eu/course/view.php?id=4). - LENSES window (http://www.lenseswindow.eu/).
	4. Distribu tion of liabilitie s	1. Legal responsi bilities	Well defined legal responsibi ties related to NBS implement ation		Are there well-defined legal responsibilities in relation to the implementation of NBS?	Currently not, but hopefully will be through the adoption of relevant measures in the national strategic planning (amongst which the 2nd revision of the water resources management plans)	Draft document of the 2nd Update of River Basin Management Plan of Thessaly Water District in accordance with the WFD 2000/60/EC (http://wfdver.ypeka.gr/wp-content/uploads/2023/05/EL08_2REV_P4.9_Proxedia_LAP.pdf)
7. NBS Manag ement	1. NBS monito ring	1. Monito ring and evaluat ion strateg y	Presence and use of strategies to periodicall y monitor and evaluate the NBS interventio n throughout its lifecycle		Is there a system in place to periodically monitor and evaluate the NBS intervention throughout its lifecycle?	No officially established system exists.	REXUS Del. 7.4 "Exploitation and Sustainability plan", LENSES Del. 9.4 "Exploitation and Sustainability plan".
		2. Adaptiv e NBS interve ntion manag ement	Presence and use of iterative learning process that enables an adaptive NBS interventio n manageme		Does the project utilize an iterative learning process to enable adaptive management of the NBS intervention throughout its lifecycle?	No official iterative learning process is planned to be developed to support NBS interventions through their lifecycle.	

			nt throughout its lifecycle				
	2. NBS safeguard	1. NBS safeguard system	Presence and use of a safeguard system to ensure that mutually-agreed trade-off limits are respected and do not destabilise the entire NBS intervention	NBS safeguard system	Is there a safeguard system in place to ensure that mutually-agreed trade-off limits are respected and do not destabilize the entire NBS intervention?	Assurance of trade-off limits respect system could be drafted with the support of SWRI, however currently no official safeguard system is projected to be established.	
		2. Risk strategy	Presence of strategies that allow the identification and management of possible risks' type and level	Risk strategy	Are there strategies in place to identify and manage possible risks in terms of type and level within the NBS intervention?	No, but could be developed	Documentation Text EL08-12 "Basic and Complementary Measures including cost-effectiveness analysis" in the context of the 1st Update of River Basin Management Plan of Thessaly Water District in accordance with the WFD 2000/60/EC (http://wfdver.ypeka.gr/wp-content/uploads/2020/03/EL08_1REV_P12_Metra.pdf) (EL)

Annex 4- Results of the structured interview conducted under WP2 of LENSES project

Level	Obstacles	Information source
A. Institutional Level	A.1 - Lack of knowledge and skills at farm level	LENSES WP2 Recap of the 1st Pinios pilot (Greece) Technical Workshop - Stakeholder Interview Results
	A.2 - Lack of support and guidance at farming (also for financial tools)	
	A.3 - Lack of EU and national funding	
	A.4 - Inefficient subsidies policy (e.g. for young farmers)	
	A.10 - Shutdown of supportive (guidance-management) public services (e.g. Regional Land Reclamation Service)	
	A.11 - Land over-fragmentation	
	A.12 - Limited organization in groups and consortia (for improved network management and equipment use), lack of cooperation in agriculture	
	A.13 - Limited law enforcement mechanisms, supervision and sanctions	
	A.14 - Improper management of extreme events (floods and droughts)	
	B. Infrastructural Level	
B.2 - Limited available data and insufficient monitoring		

	B.3 -Lack of new irrigation infrastructure projects and renovation of old ones	
	B.4 - Lack of control and monitoring of pollution	
C. Legal Level	C.1 - Illegal behaviors (for irrigation) and sense of water ownership at farm level	
	C.2 - Complexity of legal framework	
	C.3 - Outdated legislation on irrigation water management	
D. Education/Training/Information Level	D.1 - Lack of information and education on efficient water use (all sectors)	
	D.2 - Lack of information and education on the use of agrochemicals	
	D.3 - Lack of information and education on benefits related to soil conditions-appropriate management	
	D.4 - Lack of environmental awareness	
E. Policy Level	E.1 - Limited stakeholder consultation and participation in studies and monitoring	
	E.2 - Inefficient and unsustainable water pricing policies	
	E.3 - Limited promotion of environmentally friendly measures compared to 'hard' infrastructures	
	E.4 - Political willingness to support specific actions/policies	
	E.5 - Limited promotion of /guidance to irrigation water saving systems	
	E.6 - Limited promotion of/guidance to rainfed or low water demand crops	
	E.7 - Lack of long-term planning of agricultural activities (e.g. transition to irrigated crops without infrastructure, expansion of agriculture to low productivity areas)	
	E.8 - Lack of funding/support for water management projects (e.g. reservoirs)	
	E.9 - Limited consideration of climate change effects in new projects	

	E.10 - Insufficient land planning and management, absence of a specialized regional/rural development plan	
F. Effective management, Governance	Bureaucracy and fragmentation of responsibilities, limited coordination among authorities	
	Lack of an objective approach in decision making process (e.g. prioritization of measures)	
	Complexity of the legislative framework	

Annex 5- Results of the stakeholder interviews held under the Technical workshops organised under the LENSES WP2 and the REXUS project WP2

Challenges identified	Problems	Indicator	Obstacles, Inhibitors	Risks, Impacts	Strengths/Opportunities	Source of Information
Water						LENSES WP2 Recap of the 1st Pinios pilot (Greece) Technical Workshop - Stakeholder Interview Results
1. Achieving and maintaining sufficient quantity and good quality of water resources	High water abstractions to meet irrigation needs	Groundwater availability (level, volume) [in relation to the highest rainfall]	Lack of efficient water consumption audit in the agricultural sector, lack of GW control and limited monitoring	Desertification of agricultural areas	High availability of groundwater	
	Limited availability of water resources	Amount of water pumped / used per unit area	Illegal behaviours (for irrigation) and sense of water ownership at farm level	Reduction of agricultural production	Plenty of studies have been carried out regarding Pinios pilot for the future	
	Lack of reservoirs and surface water storage systems	Indicators proposed by EU Water Framework Directive	Insufficient land planning and management, absence of a specialized regional/rural development plan		Knowledge of quantity of surface and ground water	
					Full monitoring of data	
					Sustainability of the region	

Food						
2. Sustainability of the agricultural sector	Increased production cost	Cost / Profit of agricultural production per unit area	Lack of support and guidance at farming (also for financial tools)	Unsustainability & abandonment of agricultural sector	High-quality products	
	Irrational use of pesticides and other agricultural supplies	Yield per crop and unit area	Inefficient subsidies policy (e.g. for young farmers)	Increase in youth unemployment	Geographical position	
	Limiting available markets for agricultural exports	Irrigation costs (water, energy, environmental fee, maintenance) per m3 or ha	Land fragmentation	Concentration of crops to few people	High availability of soil and crop cultivation data	
					Implementation of agroecological practices	
Ecosystem						
3. Protection and restoration of ecosystems	Preservation of the ecological flow of the Pinios River	Ecological flow of the Pinios river	Lack of easy access to EU and national funding	Destruction of the Delta and salinization of soils from the reduction of the ecological flow of the Pinios river	Important areas belong to NATURA	
	High pressures on the riparian habitats of the Pinios River	Conservation level of flora and fauna of riparian habitats	Bureaucracy and fragmentation of responsibilities, limited coordination	Ecological destruction of water, birds, soil and food/loss of species	Good water/environmental condition	
	Irrational management of used agricultural packaging	Continuous monitoring of Tempi Valley sources	Overlapping responsibilities	Risk of interrupted river flow/supply	Rich biodiversity	
		Measurement of critical substances in areas with high pesticide/insecticide use		Water quality degradation (groundwater and surface)	Existing knowledge about ecosystems and biodiversity	
Energy						
4. Efficient use of energy	Irrational management of energy resources	Cost of energy use per conventional form of energy and produced kWh	Time needed for licensing new Hydroelectric Power Plant	Increase of photovoltaics in agricultural land of high productivity	Steep slopes in topography - utilization of hydropower potential	REXUS Project WP2 Recap of the 2nd Pinios pilot (Greece) Technical workshop -

	Difficulty in maintaining and developing renewable energy sources	Cost of energy use per Renewable Energy Source and produced kWh	Complexity of the legal framework in the energy sector	Increase in production costs, increase in environmental impact (climate change)	Climatic and meteorological conditions suitable for RES	Stakeholder Interview Results
		Energy consumption for irrigation per m3 of water used	Limited data availability and poor monitoring		Unfinished projects in the upper part of Acheloos, existence of locations suitable for construction of dams and production of hydroelectric energy, in order to replace pumps from wells	
					Integrated Rural Development Infrastructure Program "HYDOR 2.0"	
					Existence of surface potential for energy production	

Annex 6- Stakeholders involved in the chapter 3.4.2 and 3.4.3

a. Stakeholders involved in structured Interviews under LENSES project

Sr No	Stakeholder groups
1	Agronomist, Municipality of Agia
2	Farmer in Agia Municipality
3	Farmer mainly of apple orchards and cherries, Agronomist. Agia watershed
4	Member of the Department of EU Projects Municipality of Agia
5	Deputy Mayor of Agia in Environmental, Rural development and Fisheries sector
6	President of the Agricultural Cooperative "Kissavos"
7	Management Body of the Ecodevelopment Area of Lake Karla - Thessaly, Professor in Democritus University of Thrace
8	Farmer of kiwi, Head of Pirgetos farmers' cooperative
9	Farmer, sheep breeder, region of Omolio
10	Deputy Mayor of Tempi, Former President of Agricultural Cooperative of Pyrgetos, Farmer

11	Research Biologist, Greek Biotope/Wetland Centre
	Director of Averofios Vocational School
12	Hellenic Ministry of Rural Development and Food
13	Piraeus Bank - Agricultural Sector Development
14	Professor of Agronomy, Department of Agriculture Crop Production and Rural Environment, University of Thessaly
15	Department of Hydro-Economics and supervision Local Organizations of Land Reclamation, Thessaly's Regional Organization of Land Reclamation
16	Directorate of Planning and Management of Water Services, General Directorate of Water, Hellenic Ministry of Environment and Energy
17	Directorate of Water in the Decentralized Administration of Thessaly – Central Greece
18	Water, Professor of Hydrology and Water Resources, Department of Rural and Surveying Engineering, Aristotle University of Thessaloniki

b. Stakeholder interview results- 1st Tech Workshop REXUS project

Stakeholder groups	Expert Stakeholders		
	Name	Organization	Role
Lawyer	Andreas Panagopoulos	Research Director, Soil and Water Resources Institute (SWRI) of Hellenic Agricultural Organization "DEMETER".	Facilitator WG-I
Ministry of Environment and Energy	Evangelos Hatzigiannakis	Research Director, Soil and Water Resources Institute (SWRI) of Hellenic Agricultural Organization "DEMETER".	Facilitator WG-I
Former president of Geotechnical Chamber of Greece	Anna Chatzi	Researcher, Soil and Water Resources Institute (SWRI) of Hellenic Agricultural Organization "DEMETER".	Facilitator WG-I
Agricultural University of Athens	Dimitrios Tassopoulos	DRAXIS S.A.	Facilitator WG-I
Agricultural Cooperative "Kissavos"	Alexandros Kandarakis	Global Water Partnership – Mediterranean	Facilitator WG-I
Ministry of Rural Development & Food	Jose Gonzalez Piqueras	University of Castilla-La Mancha	Rapporteur WG-I
Hellenic Agricultural Organization DEMETER"	Vassilios Pisinaras	Research Associate, Soil and Water Resources Institute (SWRI) of Hellenic Agricultural Organization "DEMETER".	Facilitator WG-II

Thessaly Water Directorate	Dimitrios Malamataris	Researcher, Soil and Water Resources Institute (SWRI) of Hellenic Agricultural Organization "DEMETER".	Facilitator WG-II
Ministry of Rural Development & Food	Konstantinos Babakos	Researcher, Soil and Water Resources Institute (SWRI) of Hellenic Agricultural Organization "DEMETER".	Facilitator WG-II
Consortium of River Basin Management Plan	Christina Papadaskalopoulou	DRAXIS S.A.	Facilitator WG-II
Directorate of Environment and Spatial Planning of Larissa	Alessandro Pagano	Water Research Institute of the National Research Council of Italy	Rapporteur WG-II
University of Thessaly			
Local Organization of Land Reclamation of Pinios			
General Organization of Land Reclamation of Thessaly			
Interprofessional Organization of cotton, Local Organization of Land Reclamation of Titanio			
Management Body of Lake Karla in Thessaly, Democritus University of Thrace			
Former Member of EuroGreen			
Ministry of Environment and Energy			
Directorate of Agricultural Economy and Veterinary Magnesia			
Aristotle University of Thessaloniki			
Ministry of Environment and Energy			
Hellenic Authority for Geological and Mineral Surveys			
Public Power Corporation – Hydroelectric Station in the Prefecture of Lake Plastira			
Hellenic Centre of Wetlands			
University of Thessaly			

c. Stakeholder interview results- 2nd Tech Workshop REXUS project

Stakeholder groups	Expert Stakeholders		
	Name	Organization	Role
Legal advisor, collective irrigation organisations	<i>Andreas Panagopoulos</i>	<i>Research Director, Soil and Water Resources Institute (SWRI) of Hellenic Agricultural Organization “DEMETER”.</i>	<i>Facilitator WG-I</i>
Water services planning and management Directorate of Hellenic Ministry of Environment and Energy	<i>Anna Chatzi</i>	<i>Researcher, Soil and Water Resources Institute (SWRI) of Hellenic Agricultural Organization “DEMETER”.</i>	<i>Facilitator WG-I</i>
Center of study and protection of the environmental and cultural heritage of Lake Karla “Voevis”	<i>Tiaravanni Hermawan</i>	<i>DELTARES</i>	<i>Facilitator WG-I</i>
Natural Resources Development and Agricultural Engineering Department - Agricultural University of Athens”	<i>Alexandros Kandarakis</i>	<i>Global Water Partnership – Mediterranean</i>	<i>Facilitator WG-I</i>
Civil Engineering Department - Aristotle University of Thessaloniki; UNESCO Sustainable Development Solutions Network Black Sea	<i>Evangelos Hatzigiannakis</i>	<i>Research Director, Soil and Water Resources Institute (SWRI) of Hellenic Agricultural Organization “DEMETER”.</i>	<i>Facilitator WG-II</i>
Civil Engineering Department - Democritus University of Thrace	<i>Dimitrios Malamataris</i>	<i>Researcher, Soil and Water Resources Institute (SWRI) of Hellenic Agricultural Organization “DEMETER”.</i>	<i>Facilitator WG-II</i>
Former member of EuroGreen; Former member of Hellenic Agri-Environmental Association	<i>Konstantinos Babakos</i>	<i>Researcher, Soil and Water Resources Institute (SWRI) of Hellenic Agricultural Organization “DEMETER”.</i>	<i>Facilitator WG-II</i>
Wind Farm Development and Installation company	<i>Marina Antoniadou</i>	<i>DRAXIS S.A.</i>	<i>Facilitator WG-II</i>
Joint Venture of 2nd Update Revision of the River Basin Management Plan for the Water District of Thessaly	<i>Maria Livanou</i>	<i>Global Water Partnership – Mediterranean</i>	
Farmer; Agricultural consultant			
Rural and Surveying Engineering Department - Aristotle University of Thessaloniki			

Consultant of 2nd Update Revision of the River Basin Management Plan for the Water District of Thessaly
Joint Venture of 2nd Update Revision of the River Basin Management Plan for the Water District of Thessaly
Public Power Corporation Renewables S.A.
Water Directorate of Thessaly
Joint Venture of 2nd Update Revision of the River Basin Management Plan for the Water District of Thessaly
Hellenic Authority for Geological and Mineral Exploration
Environment and Spatial Planning Directorate - Regional Unit of Larissa
Farmers' Cooperative of Thessaly
Irrigation Organisation
Emeritus professor of Agricultural Engineering - University of Thessaly
Worldwide Fund For Nature (WWF) Greece
Hellenic interprofessional organisation of cotton; Irrigation Organisation
Former President Geotechnical Chamber of Greece- C. Greece Division
Farmers' Cooperative of Thessaly
Agricultural Economy and Veterinary Services Directorate - Regional Unit of Larissa
Hydro-Economy Department of Larissa
Irrigation Organisation
National Association of Irrigators

Water Services Costing and Pricing Directorate - Hellenic Ministry of Environment and Energy	
Hellenic Center for Cotton Quality Control, Classification and Standardization - Hellenic Agricultural Organization "DEMETER" "	
Land Reclamation, Soil and Water Directorate - Hellenic Ministry of Rural Development and Food	
Land Reclamation, Soil and Water Directorate - Hellenic Ministry of Rural Development and Food	
Department of Spatial Planning, Urban Planning and Regional Development Engineering - University of Thessaly	
Biodiversity and Protected areas Department - Greek Biotope/Wetland Centre	
Management of Ichthyology & Aquatic Environment Department - University of Thessaly	
Lake Plastira Hydroelectric Plant - Public Power Corporation	