

"Integrating nature-based solutions for flood risk management in Greece: Insights from the aftermath of storm Daniel"

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# ABSTRACT

In the context of climate change, floods are becoming more severe with devastating consequences, while human activities and urbanization have degraded ecosystems. These ecosystems, however, play a vital role in mitigating flooding and enhancing climate resilience. Traditional grey infrastructure has shown limitations in managing the growing unpredictability of flood events, prompting a shift toward nature-based solutions (NbS), which leverage natural processes to address hazards and improve urban environments. Despite their potential, integrating NbS into existing flood risk governance systems is fraught with challenges due to entrenched institutional inertia and established governance paths. This thesis examines these dynamics, focusing on Thessaly, Greece, a region that has faced catastrophic floods and is known for its complex political contexts, to explore how traditional strategies and governance structures influence NbS adoption and ecological transitions.

*Keywords*: Nature-based solutions, flood risk governance, governance paths, ecological resilience, transitions



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# **1** INTRODUCTION

Floods have become a significant concern in the context of climate change (Stefanidis et al., 2022). Many areas are experiencing more frequent extreme weather events or events that have not occurred in the past (Hettiarachchi et al., 2018). However, other contributing factors like land use changes and urban growth can increase flood vulnerability as they can result in the degradation of natural ecosystems, compromise the soil's infiltration capacity, and increase impervious cover (UFCOP, 2017). Rapid urban growth can also contribute together with unplanned urban development surpassing the construction or improvement of vital drainage infrastructure, leaving communities exposed to flood risks (UFCOP, 2017). Considering these challenges and the projected flood risks, there is an ongoing search for better ways to enhance flood resilience to protect urbanized areas and the environment (Driessen et al., 2016).

Since the early 2000s, new scientific research and data have led to a transition in policy approaches (Meng et al., 2022). Before that time, the fields of natural and technical science dominated, thus influencing research on flood risk management (Driessen et al., 2016). Historically, cities have chosen structural measures (also known as grey infrastructure) that are designed for two different purposes: protect developed areas from estimated flood risk (through flood defenses such as levees and flood walls) or direct flood water away from developed areas (by improving drainage with pipes, canals, and storage basins) (UFCOP, 2017). As a result, natural water cycles are often replaced by urban water cycles, where rainwater cannot equally infiltrate into the soil due to large paved surfaces; instead, it flows as surface runoff, decreasing the capacity of the soil to absorb water in the long term, put pressure in urban drainage systems, and pollute receiving water bodies by wash-off pollutants if not properly purified, impacting the overall ecosystem and urban infrastructure (Volkan Oral et al., 2020). This approach and planning principles seem to have limited ability and adaptability to cope with increasing flood hazards, leading to the emergence of more flexible and multifunctional solutions, such as nature-based solutions (Ferreira et al., 2022). NBS focuses on restoring and utilizing ecosystems to improve soil and water retention, reduce surface runoff, and create space for rivers (Ferreira et al., 2022). The concept of Nature-Based Solutions (NBS) is mainly linked to broader conversations about adapting to climate change, ecosystem services, and blue-green infrastructure (Wamsler et al., 2017). Despite its benefits and possibilities, there is still a gap in mainstreaming and upscaling NbS (Wamsler et al., 2017).

Even though NbS is gaining popularity and there have been incremental policy changes in many countries over the last two decades, grey infrastructure continues to lead flood management for historical and cultural reasons(Parsons et al., 2019). This situation, where past decisions shape and influence current decision-making, can be explained by exploring paths created by governance systems (Davies & Lafortezza, 2019). As mentioned in evolutionary governance theory (EGT), governance paths could help explore and explain the reproduction and persistence of policies or paths that are "blocking" the emergence of new pathways (Parsons et al., 2019). This thesis will dive into the challenges of implementing and mainstreaming nature-based solutions by exploring the paths that previous engineering flood approaches have created. The



region of Thessaly in Greece will be used as a case study, as it has experienced multiple flooding incidents in the past years, with the most significant being in 2023. Storm Daniel was one of the costliest recorded storms in the country's history, with devastating ecological consequences and public health implications. Despite the lack of effectiveness of the existing flooding measures and the EU directives promoting NbS, Greece's flood measures rely on engineering-based approaches displaying characteristics of path dependency.

## **1.1 SOCIETAL RELEVANCE**

The World Bank and IUCN developed the NbS concept in the 2000s to emphasize the important role of biodiversity and ecosystems in climate change mitigation and adaptation.(Pauleit et al., 2017). Many other similar concepts have emerged that fall under the umbrella of NbS such as ecosystem-based adaptation (EbA), and urban green infrastructure (UGI) to mitigate flooding, including other climate change effects (Pauleit et al., 2017). According to IUCN, "Nature-based



Figure 1: Engineering and ecological resilience concepts.

Engineering resilience refers to a system's ability (represented by the ball sitting in a cup) to withstand a disturbance and a system's ability to absorb disturbances and reorganize during change, often resulting in a new equilibrium instead of returning to the original state. (Liao 2012).

Solutions address societal challenges through actions to protect, sustainably manage, and restore natural and modified ecosystems, benefiting people and nature simultaneously. They target major challenges like climate change, disaster risk reduction, food and water security, biodiversity loss and human health, and critical to sustainable are development." Countries like the Netherlands and China have created national programs where NbS was effectively used focusing on flood mitigation through the Room for the River and Sponge Cities programs. However, not many countries have followed their example (van de Ven et al., 2024).

For many years, the measures implemented to reduce flood risk were based on engineering quickly return to its original state. Ecological resilience refers to resilience. This resilience focuses on a system's ability to retain its original state during a hazardous event (see Figure 1) (Srivastava & Sahay, 2023). These measures include dikes,

drains, walls, etc., and their purpose is to avoid flooding (Srivastava & Sahay, 2023). However, the failure of structural measures can have dramatic social, economic, and environmental consequences and provide a misleading sense of protection and security (Ferreira et al., 2022). Grey solutions appear to be more effective against frequent and mild flooding events, with only a few being able to respond to extreme events (Ferreira et al., 2022).



On the other hand, ecological resilience (see **Figure 1**) is based on a system's ability to survive, with fluctuations being a part of the system's behavior (Srivastava & Sahay, 2023). NbS focuses on mimicking natural processes through interventions to help mitigate different hazards contributing to long-term sustainability (Souliotis & Voulvoulis, 2022). Ecosystems can also provide multiple benefits, such as enhancing water quality through filtration, regulating the climate by carbon absorption and cooling effects (Kopsieker et al., 2021), and improving the quality of life by providing mental relaxation, encouraging physical activity, and reducing air pollution, etc. (Braubach et al., 2017). These are a few examples of the multiple benefits provided by NBS; which despite the growing acknowledgment of their importance, the application of nature-based solutions remains limited. (Ferreira et al., 2022).

In literature, this limitation is explained by the broadness of the concept as it combines multiple policy objectives, such as climate change, biodiversity conservation, disaster risk reduction, and promoting a green economy(Pauleit et al., 2017). The broadness of the concept extends to the diverse range of actions that can be taken, ranging from protecting and expanding forest areas to planting windbreaks, green roofs, and urban green spaces (Pauleit et al., 2017). Moreover, there is currently no suitable framework for evaluating the cost-effectiveness of Nature-based Solutions.(Raparthi & Vedamuthu, 2022). As a result, the economic benefits of nature due to non-market value are often underestimated (Raparthi & Vedamuthu, 2022).

On the other hand, public stakeholders have questioned the effectiveness of Nature-based Solutions (NbS) due to a perceived lack of evidence and higher confidence in traditional "grey" as they have been established for decades (Anderson & Bausch, 2005). This skepticism is attributed to the "complexity" of NbS and difficulty to grasp compared to conventional options (Anderson & Bausch, 2005). Also, the lack of regulatory frameworks, planning systems, and economic instruments hinders their implementation (Pauleit et al., 2017).

Lastly, the concept of NbS involves collaborative and participatory approaches such as co-design, co-creation, and co-management (Pauleit et al., 2017). This cooperative nature in implementing NbS is only sometimes the case for designing grey infrastructure or in different governance systems, thus requiring societal and governance transformations (Pauleit et al., 2017).

# 1.2 SCIENTIFIC RELEVANCE/ GAP IN KNOWLEDGE

Most NbS case studies are performed on a small scale, and examples on a large scale are still limited; thus, the full capabilities of NbS are not known yet (Frontiers, 2024). Moreover, studies comparing the effectiveness of NBS and grey solutions are still lacking (Pauleit et al., 2017). As a result, the knowledge and lessons gained from implementing NbS and transitional processes to NbS differ in each case and are not fully explored (Frontiers, 2024). Even though these are the most talked-about limitations and hindrances in upscaling NbS, there is a lack of clarity regarding why some countries or cities have chosen to pursue ecological resilience while others have not.

Recent studies suggest that planning cultures relying on engineering approaches may hinder flood-prone areas from adopting different adaptation measures in response to flooding. (Meng



et al., 2022). This can result in resistance to policy changes and a continuation of existing routines (Meng et al., 2022). This situation can be explained through the exploration of governance paths. Davies and Lafortezza (2019) describe paths governance creates as active memories conditioned by past decisions that control decision-making. This phenomenon leads to institutional inertia and the perpetuation of errors despite individuals' autonomy in decision-making and their pursuit of rational self-interest within governance systems.

Wiering et al. (2018) argue that this social sciences perspective of governance paths can help explain why flood risk management approaches are evolving in some countries, hence adopting NbS while staying the same in others that continue to follow engineering approaches. Through their analysis, it occurred that the need for change is not always clear or agreed upon by everyone, and willingness for change lies in all parties seeing an existing policy or situation as not optimal. The more people view the current policy as inadequate, the more likely it is to change. Typically, this can happen after flooding incidents (shock events) or elections that work as "windows of opportunity." However, "cultural legacies," as Harries and Penning-Rowsell (2011) have described, contribute to the resistance to policy changes. These legacies relate to social identity, norms including habits, preferences, and organizational stories which create a shared purpose helping institutions function.

The existing literature on Nature-based Solutions (NbS) frequently fails to address crucial aspects, such as the institutional barriers. This thesis will elaborate on the impact of governance paths, which create obstacles in transitioning from traditional to nature-based flood management.

# **1.3 OBJECTIVE AND RESEARCH QUESTIONS**

This thesis investigates the role of governance paths in the evolution of flood governance from engineering-based solutions to nature-based ones. For this purpose, the region of Thessaly in Greece will be used, as it faced a shock event that could be described as a window of opportunity. The main research question and two sub-questions are listed below.

**MRQ:** How are paths created by governance systems influencing the mainstreaming of naturebased solutions for flood risk management in Greece?

**SRQ1:** How have the policy documents evolved to promote NbS?

**SRQ2:** What institutional and regulatory barriers can be identified?



# 2 THEORETICAL FRAMEWORK

The theoretical framework for this analysis will utilize the social science concept of governance paths, which refers to processes where previous events or decisions limit or influence subsequent events or decisions. By incorporating this dependence into flood risk management, we can better comprehend how historical decisions shape current vulnerabilities and opportunities, ultimately leading to more sustainable and adaptive solutions.

# 2.1 EVOLUTIONARY GOVERNANCE THEORY

In literature, achieving policy objectives has mainly revolved around creating strategies and gathering capital (Frantzeskaki, 2016). However, governance procedures and conditions are equally essential to ensure the implementation of resources and achieving the desired policy objective or goal (Frantzeskaki, 2016). Governance includes different actors, their agendas, power, responsibilities, accountability, and the relationships they have with one another. Their characters and interactions form specific power dynamics and conditions that form the way decisions are made (Beunen et al., 2015). However, the components and interactions forming a governance system evolve. The emergence of new knowledge, trends, political ambitions, changes in perspectives, etc., can influence decision-making, governance structures, arrangements, and, therefore, how decisions are made. (Meng et al., 2022) The Evolutionary Governance framework recognizes that governance systems evolve and are influenced by historical, cultural, social, economic, and environmental contexts, which, if examined closely, can give insights into how current, previous, and future paths form.

In the context of flood governance, flood defense (prevent flooding) has evolved into flood management (reduce impacts), flood risk management (minimize flood-related risks), integrated flood risk management (holistic approach to flood resilience), and so on. Those terms do not significantly diverge from one another but rather showcase an evolution of how floods are perceived and, therefore, managed. Generally, new conditions, concepts, and trends may require updating or changing institutions and governance structures if the old ones are no longer effective (Schlüter et al., 2019). Since floods are becoming more unpredictable and have devastating consequences, they cannot always be solved by a single approach or intervention (e.g., a dam), thus contributing to the adoption or considerations of different approaches to flood protection that rearranges institutions by initiating policy changes and very likely requiring collaboration among stakeholders, such as local communities and non-governmental organizations, jurisdictions and sectors (Ran & Nedovic-Budic, 2016). This governance perspective regarding flood risk management can improve our understanding of how societies can effectively deal with current and future flood risks by offering insights into how governing actors can work together to assess policy strategies and tools and potentially inspire changes in public discussion and institutional practices (Driessen et al., 2016). Actors and institutions are vital to existing and future governance paths, serving as the main components of governance



systems (Assche et al., 2014). Therefore, a thorough analysis of them is crucial for a better understanding of governance and decision-making.

Actors and institutions are usually seen as separate but co-evolve and interact over time. Actors refer to the participants in governance who play a "role" as they represent someone (e.g., organization) or something (e.g., ideology) (Beunen et al., 2015). Conversely, institutions refer to policies, plans, laws, rules, norms, etc. The interaction of actors (decision-making) produces institutions, while previous and current institutions shape actors (Beunen et al., 2015). Decision-making can be seen as an arena of ideas, perspectives, knowledge, agendas, and power where actors are the leading players but must be coordinated (Assche et al., 2014). Coordination is achieved through institutions which define the game's rules (Assche et al., 2014). These guidelines have emerged from past decisions that influence future decision-making and the behavior of actors (Wiering et al., 2017). Policies are institutionalized outcomes of decision-making that can be imposed, reformed, utilized, or forgotten depending on the governance system's needs and state (Assche et al., 2014). However, not every actor or institution holds equal power to shape current and future governance.

The characters and interactions of actors and institutions form specific power dynamics and conditions that influence decisions (Beunen et al., 2022). Actors can also utilize knowledge (scientific, local, etc.) to strengthen their power while undermining the credibility of competing actors' knowledge (Assche et al., 2014). Therefore, knowledge is an intertwined part of power. Whether and how each type of knowledge will be utilized stems from how it will be processed within the power dynamics system. The final decision will be made through the debates of actors and the power each one holds to promote specific knowledge (Assche et al., 2014). Moreover,



Figure 2: Governance structure and the evolution of its components (created by the author)



evolutionary approaches indicate that changes in governance systems emerge from the interplay of various intentional, unintentional, and unexpected events (Beunen et al., 2022). Acors and institutions co-evolve through time, creating their governance arena. However, external factors such as new knowledge, scientific breakthroughs, political changes, or unexpected events can force actors or institutions to reform or act differently (see **Figure 2**) (Wiering et al., 2017). Those critical moments, also called "windows of opportunity," can make governance systems evolve, adapt to new realities, or stay on the same path.

# 2.2 PATHS AND DEPENDENCIES

The EGT implies that all these "*paths*" produced by governance systems create specific environments and preconditions that influence the future of governance (Beunen et al., 2015). The governance path is marked by "*dependencies*," which means that reaching specific other points from any given point is not equally easy (Assche et al., 2014). The structures created through the ongoing reproduction of governance are the outcomes of this process and the conditions necessary for it to continue (Assche et al., 2014). These structures limit the options available at each point. There are three kinds of dependencies: path dependencies, interdependencies, and goal dependencies (see **Figure 3**) (Beunen et al., 2015).



Figure 3: Governance path creation (Beunen et al., 2022)

**Path dependency** refers to the idea that events in the past can shape the possible outcomes of a series of events that occur in the future (Uyttebrouck et al., 2022). Persistent steps toward a specific direction can lead to further movement in that specific direction. Path dependency shows the tendency of paths to reinforce, making it hard to change a chosen path (Wiering et al., 2017). Even though alternative options are available to policy and decision-makers, their decisions do not diverge much from those made in the past(Parsons et al., 2019). Over time, these choices



become deeply ingrained assumptions that shape institutional practices and are widely accepted (Parsons et al., 2019). This makes it challenging for decision-makers to change courses or consider alternative options once decisions have been made (see **Figure 4**) (Parsons et al., 2019). Davies and Lafortezza (2019) have addressed that path dependence could be the most significant obstacle to mainstreaming nature-based solutions, contributing to malfunctioning landscapes. The continuity of engineering measures has created a path where deviations are complex for various reasons and to maintain stability within pathways. Based on the research of Meng et al. (2022), even shock events, which often trigger policy changes, may not be sufficient to overcome



Figure 4: Creation and persistence of a path (Schreyögg et al., 2011)

path dependency. Engineering methods have been well-established in policy and practice for decades, with non-engineering measures occasionally implemented during a crisis or temporarily and less establishment in policy and practice (Meng et al., 2022). These paths and decisions are not random; they appear or happen and result from power struggles, compromises, pressures, and value systems (Parsons et al., 2019). They include many formal rules, norms, cognitive frameworks, and worldviews (Parsons et al., 2019). They significantly shape how decision-makers understand and approach various situations and influence their subsequent actions (Parsons et al., 2019).

**Interdependency** is the web formulated from the variables affecting actors and institutions and how they evolve (Assche et al., 2014). Actors involved in governance rely on each other, forming networks or coalitions with similar or common interests (Rolo, 2019). This implies that the various entities involved in governance are interconnected, and their historical interactions influence their decisions (Assche et al., 2014). Examining the connections between various elements and the structures they exist within reveals multiple interdependencies that affect existing paths, block new ones, or make others disappear (Beunen et al., 2022). Their interplays are stabilized



within institutions, such as policies and laws (Beunen et al., 2022). A shift in opinion may occur if actors convince other actors of a change in the existing path. If actors in favor of a change do not have enough power or knowledge, or due to circumstances, the existing paths are not questioned, most actors will not be convinced (Wiering et al., 2017). On the other hand, simply getting multiple actors and groups to agree does not guarantee that institutional changes will happen (Wiering et al., 2017). It takes resources and influence to bring about change, and there needs to be a solid willingness to alter the rules (Wiering et al., 2017).

Rules and actors aim to establish and strive to achieve goals. However, new goals arise as circumstances, paths, and external or internal forces shift. **Goal dependency** refers to the visions of the future that are the foundations of current and future decision-making (Beunen et al., 2015). Like other dependencies, goal dependencies have varying importance and influence (Van Assche et al., 2017). They can be ideas, visions, or scenarios, either as positive images of a future or as images that should be avoided (Van Assche et al., 2017). Goals can shape the future and influence governance, narratives, and ambitions. However, the impact of policies, plans, and projects may sometimes not align with the envisioned reality (Rolo, 2022). This can be attributed to the varied interactions between actors, institutions, and power dynamics, leading to uncertainty and outcomes that may not align with the goals set (Rolo, 2022). However, when goals are achieved, the processes led to a successful implementation (Rolo, 2022).

It is becoming clear that governance systems and their paths are complex. Stakeholders and policymakers are often criticized for not making "better" or "radical" decisions, but previous conditions influence the decision-making process. Governmental systems might be hampered by complex institutional cultures comprising many components and relations between them (Harries & Penning-Rowsell, 2011). Investigating actors and institutions through a case study that indicates characteristics of path dependence can help unpack aspects of decision-making that are often overlooked but essential in changing the course of paths.



# 3 METHODOLOGY

# 3.1 RESEARCH STRATEGY

This thesis explores the connection and relation of governance paths with flood risk governance and its role during transitional times. Since this concept comes from social sciences and will explore social constructive governance, the research will be qualitative. Qualitative research provides deeper insights and understanding of specific processes and patterns within governance systems. This approach is used to gather information about participants' experiences and perspectives. By collecting data on people's experiences, thoughts, opinions, and visions, qualitative research can reveal new insights into existing situations and generate ideas for further research.

# 3.2 CASE STUDY DESIGN AND SELECTION



Figure 5: The region of Thessaly (Wikipedia)

In this case, the concept of governance paths will be tested regarding its relevance to the transitions from engineering to NbS. The region of Thessaly was selected since it has a long history of catastrophic floods, including the infamous Storm Daniel. The region's flood management relies on engineering, which has been questioned due to recent events. The recent flooding incident in the country was one of the most expensive and devastating, which could be seen as a window of opportunity for a change in the current path as this incident brought much discussion about the current and previous flood risk governance, which is considered problematic and raises questions about the future and its ability to evolve. This

situation shows the characteristics of path dependence, which will be explored further.

# 3.2.1 Case Study Description

Thessaly is Greece's third-most populated region, with 703,459 inhabitants and a total area of 13,140 km<sup>2</sup> (General Water Directorate, 2018). The region's geomorphological landscape consists of mountainous areas around the perimeter and plains in the central regions. The water basin is a tectonic depression split into two hydrological basins, LAP Piniou and Almyros-Pelion (see **Figure 6**) (General Water Directorate, 2018). The land coverage within those basins is the following (see **Table 1**)



According to historical data, most floods occurred between 2001 and 2010, with 128 events (87.1% of the total). From 1991 to 2000, there were 15 events (10.2%), and from 1981 to 1990,

Table 1: Land Cover (adapted by the general water directorate,					
Categories	LAP Piniou	LAP Almyros- Pelion			
Urban	<1%	<1%			
Pastures	23%	11%			
Agriculture	45%	34%			
Forest	27%	52%			
Roads/Water	5%	2%			

4 events (2.7%) (General Water Directorate, 2018). A rising trend in floods has been observed in recent decades, with the average annual surface rainfall estimated at 678 mm (*YD Thessaly – EL08*, n.d.). Storm Daniel occurred in 2023 exceeded this number, breaking a record for the region and the country with areas receiving up to 1096,2 mm of rain in 4 days (Vougioukas et al., 2023). Storm Daniel

that also affected other countries including Turkey, Libya and Bulgaria was the deadliest Mediterranean tropical-like cyclone in recorded history.

The severe rainfall led to rivers overflowing with high-velocity water, destroying and sweeping away infrastructure, houses, cars, trees, and other. Many villages were submerged under the water, and dozens of residents were trapped. Areas were left without water or electricity, which exacerbated the problematic situation. Approximately 720,000 hectares of land were flooded (see **Figure 7**), around 90% of which was agricultural land.(Beyond Centre, 2023). The upcoming period is expected to impact the economy of Thessaly significantly and, consequently, the



Figure 6: Water Basins of Thessaly (adapted by the general water directorate, 2018)

national economy due to the extensive production of the country's food in the region. Flooding can lead to the destruction of mature crops and erosion of fertile topsoil, affecting future crop cycles and posing risks to local and national food security (Atsalakis, 2023).





Figure 7: Areas flooded by storm Daniel (Copernicous Managment Service as cited by Koukoumakas, 2023)

The incident had serious repercussions, including destroying infrastructure and posing risks to public health. The presence of dead animals, garbage, pesticides, oil tanks, and other waste led to water contamination, causing various infectious diseases and exacerbating environmental problems (HuffPost Greece, 2023).



# 3.3 DATA COLLECTION

## 3.3.1 Conceptualization

Data was collected using two methods: Semi-Structured interviews and policy documentation analysis. Combining the data from these methods will give comprehensive insights into how governance systems address flood risk management. As explained in the theoretical framework, governance evolves. The evolution of flood risk governance towards ecological resilience will be explored by investigating how new knowledge of NbS is received and integrated into the system while policy documents can give insights into how this knowledge is institutionalized and to what extent. On the other hand, interviews can show how stakeholders utilize these policies and knowledge and what influences their decision-making. Changes in the existing path can also occur from external pressures, such as the EU, or critical moments like Storm Daniel. Their ability to cause a diversion in the existing path and the root causes and dominance of the existing path will be investigated. A visualized conceptualization of this strategy can be found in **Figure 8**.

Given the complexity of floods and each area's topology, mainstreaming NbS for flood risk management requires cross-sector collaborations; therefore, policy documents and interviewees from different sectors were selected.



Figure 8: Framework Conceptualization (created by author)

## 3.3.2 Framework Operationalization

The four main themes identified by the Evolutionary Governance Theory are path dependence, interdependency, goal dependence, and evolution. The theory highlighted that governance is an evolving system consisting of actors and institutions that interact and are dependent on each other (interdependency), goal dependency, which refers to the goals those systems set and how they are going to achieve them, and the path dependency referring to how governance systems





*Figure 9: Framework Operationalization (created by author)* 

and goals were previously operated and set. Moreover, new knowledge, sock events, and external pressures can influence governance systems and their paths. This structure (see **Figure 9**) was the initial guide to help me identify what information was needed and which data collection methods would be suitable to gather each piece of information and later structure the results.

#### 3.3.3 Semi-Structured Interviews

A semi-structured interview guide was created to conduct the interviews, helping me gather the information needed while allowing for a natural flow of conversation. The structure of the interviews would start by gathering background information about the interviewee, introducing myself and my research, and then starting with the main questions. The interview guide was split into sections based on the previously identified themes (governance structure, path dependence, interdependencies, goal dependencies, external factors), and the specific questions asked can be found in **Appendix A.1** of this report. At the end of the interviews, the interviewees could also make remarks and share other information they believed was essential and not touched upon or wanted to emphasize.

In total, 13 people were interviewed. The interviewees were found through desktop research and snowballing. To understand the hindrances and opportunities for upscaling and mainstreaming NbS, interviewees came from different sectors such as farming, nature conservation, planning,



environmental sciences, water management, and engineering. Most worked in the public sector, and some worked in academia, NGOs, and private consultancies (see **Table 2**). Since the interviewees had different backgrounds and did not work in the same sector, some questions were adjusted for in-depth interviews.

All interviews in this thesis project were conducted via Microsoft Teams. The interviewees agreed to be recorded, and the application's transcription tool was used to create the transcripts. Later, the transcripts were edited, as specific sentences were not correctly transcribed when the audio quality was poor.

FUNCTION	DATE	DURATION
INTERVIEWEE 1: REGIONAL ENVIRONMENTAL STAKEHOLDER	03/04/2024	31:24
INTERVIEWEE 2: REGIONAL ENVIRONMENTAL STAKEHOLDER	04/04/2024	26:24
INTERVIEWEE 3: SPATIAL PLANNING ACADEMIC	05/04/2024	28:19
INTERVIEWEE 4: NATIONAL FLOOD MANAGEMENT STAKEHOLDER	10/05/2024	41:57
INTERVIEWEE 5: NGO REPRESENTATIVE	17/05/2024	37:48
INTERVIEWEE 6: FARMERS REPRESENTATIVE	23/05/2024	28:51
INTERVIEWEE 7: WATER MANAGEMENT STAKEHOLDER	24/05/2024	29:54
INTERVIEWEE 8: FORESTER	02/06/2024	36:26
INTERVIEWEE 9: REGIONAL ENVIRONMENTAL STAKEHOLDER	06/06/2024	19:34
INTERVIEWEE 10: REGIONAL PLANNING STAKEHOLDER	07/06/2024	N/A
INTERVIEWEE 11: MUNICIPALITY BUILT ENVIRONMENT ENGINEER	07/06/2024	31:36
INTERVIEWEE 12: SPATIAL PLANNING ACADEMIC	09/04/202	32:17

 Table 2: Information about the interviewees (created by author)

#### 3.3.4 Policy Documentation Analysis

With the document analysis, I wanted to examine whether Nature-based Solutions were integrated on a policy level, how, and to what extent. Moreover, I wanted to investigate their abilities as tools to respond to the needs of the current and future times as well as the needs of the stakeholders. Interviewees could say if there is a gap in implementation between policy documents and reality and how they have evolved.

To find the documents, research on the website of the Ministry of Environment, Energy and Climate Change of Greece was conducted under the categories climate change, water (floods were addressed in this category), and biodiversity as it gives an overview of how Greece is dealing



with challenges in each sector, the goals it has set, and the policy documents that the country has developed. Those national policy documents were first selected for document analysis, and documents/plans stemmed from them on a regional level, focusing on Thessaly. The exact process for agriculture was followed on the Ministry of Rural Development and Food website, where the national agricultural plan was found. In total, ten documents were found. After reading the documents, eight were thoroughly analyzed further, with five of them being the most significant. In the water and flood management section, documents explained how directives from the EU would be translated into the Greek context; therefore, those documents were not used as they did not provide new information but repeated the EU directives. The EU directives are essential as they set the tone for national policies, but looking into how Greece implemented them is more critical, therefore the numbers eight and five. All the documents referred to can be found in the following table (see **Table 3**).

SECTOR	DOCUMENT TITLE	LEVEL	PAGE	DATE
FLOOD MANAGEMENT	Directive 2007/60/EC "On the assessment and management of flood risks"	NATIONAL	8	2007
	Approved Flood Risk Management Plan for the Water Division of Thessaly – (EL08)	REGIONAL	331	2018
	National Strategy for Adaptation to Climate Change (ESPKA)	NATIONAL	115	2016
ADAPTATION	Regional Planning for Adaptation to Climate Change (PESPKA) of Thessaly	REGIONAL	544	2022
AGRICULTURE	The common agricultural policy: 2023-27	NATIONAL	76	2022
	Water Framework Directive	NATIONAL	72	2000
WATER MANAGEMENT	River Basin Management Plan of the Water Division of Thessaly	REGIONAL	107	2014
BIODIVERSITY AND FORESTRY	National Biodiversity Strategy	NATIONAL	134	2014

Table 3: Policy document information (created by author)



# 3.4 DATA ANALYSIS

The complete transcriptions of the semi-structured interviews and the policy documents underwent thematic analysis. Since qualitative research involves non-numerical data, it is crucial to explain how it will be processed and analyzed to form knowledge.

# 3.4.1 Coding

In qualitative research, coding is essential to organizing and categorizing the data. To answer the research questions, thematic categories that aligned with the theoretical framework (see **Figure 9**) and the interview guide were created. Later, the transcripts were coded line by line, identifying



Figure 10: Analytical framework operationalization (created by the author)

codes fitting within the previous categories and emerging themes. After completing the transcript coding, similar codes were merged and added to the previously mentioned groups.

For the document analysis, the following table was made for each document to "measure" the level of integration. The explanation for what falls under what group is the following:

1. Explicit mention of NbS

<u>Criteria:</u> Referencing NbS, green-blue infrastructure, wetland and floodplain restoration, green roofs, green corridors, river restoration, constructed wetlands or ponds, and natural water



retention systems. Also, measures that directly mention the utilization of nature or ecosystems for flood mitigation and protection.

#### 2. Implied NbS

<u>Criteria:</u> Technics and measures not explicitly labeled as NbS align with the measure's principles and could further contribute to flood mitigation and protection. Such terms include improving biodiversity, ecosystems, soil health, riparian buffer zones, urban green spaces, and parks.

#### 3. **Opportunities for NbS**

<u>Criteria</u>: Measures where NbS could be integrated or promoted to improve flood management but currently do not mention or imply the use of NbS. Such measures could include new plans, guidelines, research, and educational programs.

#### 4. <u>Gray/ Technical measures</u>

<u>Criteria</u>: Measures known as grey infrastructure, such as dams, embankments, dikes, levees, storm drains, or other construction measures.

5. <u>Other</u>

In **Figure 10**, the main themes and their subgroups can be found. The document analysis process was similar, even though the documents were studied primarily to understand the level of NbS integration.



# 4 **RESULTS**

#### 4.1 ACTORS

#### Structure

Since 2011, Greece has had seven decentralized administrations supervising administrative regions and municipalities. In the context of flood management at the national level, the Special Secretariat for Water of the Ministry of Environment, Energy, and Climate Change is responsible for the National Flood Risk Management Program, and they are responsible for monitoring, evaluating, and controlling its implementation. This structure was established in 2007 with the European Flood Directive. At the regional level, the water departments are responsible for conducting flood risk assessments and maps, implementing flood risk management plans, and coordinating the implantation of national plans. Municipalities have more of a participatory and consulting role. However, this structure is not that straightforward. Many stakeholder responsibilities overlap, and the lack of clear communication leads to problems in achieving a particular goal, with stakeholders blaming each other for this outcome. "There is a fragmentation of responsibilities regarding flood management. For example, in Thessaly, the region itself has often been the cause of flooding due to a lack of coordination." (interviewee 5). "The public sector is very fragmented, with unclear responsibilities. There needs to be some form of internal oversight regarding each person's actions, with clearly designated individuals responsible for conducting specific studies, plans, etc." (interviewee 11). Many stakeholders explained that each region and each department within is focusing on resolving their own problems in their own way, missing the sense of collectivity. This fragmentation is apparent in various aspects of the Greek governance system and even inherited based on some stakeholders' opinions. "Creating a comprehensive plan in a modern state is not simple. There are established structures, so fragmentation has a historical continuity related to the country's trajectory. You cannot design a country's administrative structure on a blank slate. There is a historical aspect that reflects the historically formed social and political structures of each area. Therefore, this fragmentation is an inherent element of all modern societies. This might be less profound in smaller countries with high population density, like Malta or the Netherlands. In larger countries like Germany and Greece, the distances are greater, and the area covered is significant, making it essential to manage these spatial distances" (interviewee 4). Based on the stakeholders' responses fragmentation appears to be inherited withing the country's governance system and its presence is evident throughout it. Stakeholders from higher governance levels attribute its continuous presence to the "big" size of the country and therefore regions making difficult to manage space and communicate efficiently. However, that does not explain why there is fragmentation within municipalities, regions, etc.



#### **Coordination-Cooperation**

The issue of fragmentation and overlapping responsibilities that leads to either lack of initiatives and action or to isolated initiatives and lack of collectivity based on most stakeholders' opinions lies in the lack of coordination and cooperation. Open dialogue and communication could help bridge this gap created and reproduced by and in the governance system but even when specific workshops and meetings in frameworks are mentioned as prerequisites in developing, evaluating, and implementing flood management plans and an active part of the decision-making process, they are often not held, or stakeholders are absent. "Collaboration between services in the Greek public sector is always a bit difficult; that's a problem. We have an extremely complex legal framework. No one knows what's going on" (interviewee 8). Many stakeholders blame the complexity of the legal framework, but the reality is more nuanced. They express the need for an apparent framework, almost forcing them to collaborate since the culture of collaboration is not there. As a result, during and after flooding incidents, when flood protection is inadequate or nonexistent, they blame other stakeholders, even though this stems from their inability to collaborate and act together. "In Greece, there is a lack of a culture of collaboration and synergy. There should be holistic planning, but the culture for it is lacking, and this issue starts from the very beginning. For example, municipalities within a region often do not collaborate. Municipalities that share borders do not cooperate, yet nature does not stop at these borders (interviewee 9). Authorities are still trying to determine who has jurisdiction over the rivers. There is always a conflict between the municipalities and the region. Who is responsible for cleaning them? Who is responsible for opening the riverbeds?" (interviewee 11). Moreover, stakeholders are not held accountable for their behavior, allowing them to "hide" behind the complex framework for their inability to complete specific plans and tasks. It would be challenging to achieve synergies between different fields and interventions, which is essential for upscaling NbS when the existing system lacks this culture of collaboration. "It is required that there are not only synergies but also joint consultations, planning, and mutual commitments on a program not only for the reconstruction of our region in the context of the climate crisis but, more generally, for the required planning" (interviewee 2). Stakeholders recognize the importance of synergies and the complexity of climate change as to how hazards are connected; however, this was not translated into their actions. "We encounter disputes and individual interests that fragment a collective" (interviewee 2). "There may be clientelist relationships with politicians that resist such changes" (interviewee 5). Political and personal interests appear to hinder the smooth functioning of the existing system, indicating that this situation will also have a negative impact on the future development of governance systems.



#### 4.1.1 Interdependency

#### **Power Struggles**

The lack of progress within the existing system and the concerns about the future based on the information provided in the previous section mention also personal interests that hinder collective initiatives including political agendas. There appears to be a lack of trust between stakeholders at the same level but also between national and local levels. "Since December 2023, everything has fallen under the government's jurisdiction, which carries out the studies/projects together with the technical services of the municipalities" (interviewee 2). "Even though we are in Europe of regions. The Greek region is still searching for its own dimension" (interviewee 2). Regions and municipalities are the closest administrative form to citizens understanding and acknowledging their and the region's needs. Bottom-up approaches and initiatives regarding implementing NbS are always mentioned in the literature, highlighting their importance for successful transitions. However, whether the government wants to prepare local governmental bodies for more responsibility and initiatives is up to the question. "I do not believe decentralization is the solution. We tried decentralization, and so far, the regions were responsible. Whether it is a municipality, a region, a decentralized administration, or the central state, we face the same problems. We must adapt to the realities we have. We are judged based on the world we live in, not an ideal world that should exist but does not. I cannot do my job because that ideal world does not exist" (interviewee 4). The central governmental bodies seem to believe it would not be better if they gave up some of their power in decision-making and that regional and local governments are finding excuses for not doing their job. On the other hand, regions and municipalities are asking for more responsibility. "It would be better for many responsibilities and tasks to remain within the region's jurisdiction. There are also central administration and governmental political problems as they make decisions without considering the region and the regional governor" (interviewee 2). The lack of trust between stakeholders deepens existing problems, as they blame one another, leading to either decision-making without considering other entities or inaction due to the prevailing issues.



# 4.2 INSTITUTIONS

## 4.2.1 Flood Risk Management Plan

The goal of this flood risk assessment and management framework is to minimize the negative impacts of flooding on human health, the environment, cultural heritage, and economic activities. The plan identified and mapped areas at high risk of flooding and thoroughly analyzed their characteristics. They included areas near rivers and several streams and areas surrounding large urban and semi-urban centers. Despite the analysis, it failed to address the reasons behind their vulnerability or provide suitable measures for each zone. This is not surprising as this is the first big step that the country has taken toward flood management and the first step towards holistic plans.

The reasons contributing to the flooding incidents were briefly mentioned: heavy rainfall, overflowing rivers, embankment failure, and other causes, such as land use in flood plains. Those reasons were generic and did not provide new insights. Moreover, existing practices were not criticized. "Quite often, the prevailing perception among citizens and responsible agencies regarding managing flood risk is that this risk can be eliminated simply by constructing appropriate technical works. On the other hand, sometimes, the flood risk has been entirely neglected during the development of various residential or business activities. These perceptions and practices often create difficulties in communicating and conveying the objectives of such plans." (Flood Risk Management Plan Issue B' 2685/06.07.2018, p.3200) Even though the researchers addressed this, the measures provided did not try to change those perspectives. The following measures were developed and categorized into four groups (see **Table 4**):

- Prevention Measures: Mitigation of flood exposure
- Protection Measures: Reduction of flood probability
- Preparedness Measures: Enhancement of flood response preparedness
- Restoration Measures: Improvement of recovery mechanisms for affected areas

Measures	Prevention	Protection	Preparedness	Restoration
Explicit NbS Mention	0	3	0	0
Implied NbS	0	0	0	0
NbS Opportunities	1	3	2	0
Grey/Technical Measures	1	3	0	0
REST	5	1	5	2
TOTAL	7	10	7	2

**Table 4**: Flood risk management plan NbS measures integration (created by author)



**Prevention measures** were focused on improving or creating databases (e.g., DMT models) and equipment modernization (e.g., meteorological data collection network). The lack of databases regarding the impact of climate change, existing flood protection works, and the current state of the rural and urban environment make it challenging to implement and evaluate plans, as without these resources, it is impossible to develop indicators or maps that track long-term changes. These measures are fundamental and should have already been implemented, as during the recent flood event, authorities were unaware of the precise coordinates of specific flood protection works and infrastructure, let alone whether they could respond to flooding incidents. It becomes apparent that Greece is in an early stage of protection against flood risks.

**Protection measures** vary between NbS-related, grey/technical, and others. This category has three measures: "Promotion of practices for mitigating flood and debris flows, with an emphasis on natural water retention measures," "New regulations for the study of stormwater drainage and flood protection works," and "land use management in watersheds." In those measures, horticultural works (forestation, shrub planting), dry detention ponds on rivers and steam beds, the restoration of streams, promoting green interventions on upland and riparian areas, as well as natural water retention methods forest-meadow and agroforestry systems and afforestation and forestation to limit soil erosion are promoted. These measures are the most popular and effective NbS measures, and it is a big step that they are promoted through a national policy document. Masterplans should be developed to be realized, which another measure mentions.

The rest of the protection measures focus on improving and maintaining dams, storage tanks, drainage, and sewage networks. The effectiveness of engineering-based solutions is not strongly questioned, as their lack of effectiveness is mainly attributed to the lack of maintenance or the fact that many of them were designed in the 1970s when climatic conditions and pressure on infrastructure from urbanization were different. Greece must compensate for all these years of neglect and inability to adjust to climate change. However, multiple transitions must happen in technology, infrastructure, plans, policies, databases, education, and views. At the same time, economic resources are limited, and catastrophic floods are taking place with consequences.

**Preparedness measures** include measures such as warning systems and emergency action plans. However, two indicate opportunities for NbS and address a vital problem, focusing on education and spreading awareness. It raises the concern that people in high flood-risk zones should be aware of their vulnerable position and that private and community mitigation measures should be adopted, including natural retention measures. The other measure focuses on educating stakeholders on flood risks and mitigation practices, as they are the ones who will make final decisions and determine the future paths of flood protection. Educational programs are critical in bringing new knowledge, leading to a possible change in the current paths.

Lastly, *restoration measures* focus on the assessment of damages and compensations.



# 4.2.2 The Regional Adaptation Plan for Climate Change (PeSPKA)

PeSPKA is a comprehensive plan that identifies and prioritizes the necessary measures and actions to adapt the 14 Regions of Greece to climate change. According to five different climate models, significant changes in the climatic conditions of Thessaly are expected. PeSPKA gives a clearer view of the region's vulnerability to climate change, focusing on the rise of drought days and desertification problems due to decreased precipitation. However, they highlight the increased risk of flooding as prolonged droughts lead to a significant increase in the maximum amount of water precipitated within three consecutive days. It clearly explains the connection between droughts and floods, which is often overlooked as people think they are two different phenomena that do not interact. A vulnerability analysis indicates that agriculture, biodiversity, and the built environment are highly vulnerable to these changes. Based on this information and considering the Flood Risk Management Plan of the Region, the main conclusions that were drawn are:

- River overflows affect parts of urban areas due to the overflow of streams passing through the cities and the pressures exerted by technical works.
- In zones where significant flooding incidents appear, interventions on the main riverbeds and streams should be limited to restore and minimize flood runoff, reducing frequent flooding events and ensuring a given level of protection. For rarer flooding events, it must be accepted that these will discharge into their designated floodplain areas. These areas must be managed with special measures to ensure they provide additional protection, prevention, and readiness to handle such floods effectively.
- Agricultural land with crops is highly vulnerable to flooding, mainly inside the plains of Thessaly. Given the significant probability of flooding, this highlights the need for better flood risk management in these areas.
- According to the flood hazard maps, many bridges and railway infrastructure seem to flood.

The PeSPKA plan was created after the flood management plan, which provided more information as each plan was built on top of another. PeSPKA gives a clearer view of the reasons behind the region's vulnerability to flooding compared to the flood management plan and addresses the need to develop a Strategic Flood Protection Plan that will closely examine the region's vulnerabilities and suggest short-term and medium-term measures and actions combining a mix of structural and non-structural measures. However, no new or breaking-through information was provided; instead, already-known information was gathered and institutionalized through legal documents. On the other hand, it is helpful for stakeholders to have certain documents to refer to and not have to debate or try to convince different stakeholders or citizens about the consequences of climate change or the need to take urgent action. The information provided, however, would have been more helpful if known a decade ago as now the region is already experiencing these phenomena with a plan not providing the radical measures nor solutions needed. It is essential to mention that it indicates the importance



of spatial and urban planning and the ability of these fields, through their legal documents, to find solutions or help mitigate the consequences of climate change. It is crucial as planning is often overlooked; hence, Greece faces many problems with urban sprawl, off-plan buildings, and entire neighborhoods built in flood plains.

Nevertheless, the proposed Action Plan offers actions, measures, and interventions to adapt the region to climate change for multiple sectors, including tourism, fishing and aquaculture, energy, transportation, public health, etc. However, those will not be analyzed in this thesis. The rest of the sectors and their measures will be analyzed based on their connection with Nature-Based solutions (see **Table 5**). When it comes to flood management, it was in the same category as water management and was labeled as *"Development of Early Warning Systems and Management of Flood Events."* Seven measures were suggested that were the same as those from the flood risk management plan. Those chosen were the following without addressing why these were preferred over others:

- Development of Flood Warning Systems
- Promotion of practices for mitigating flood and debris flows, with an emphasis on natural water retention measures
- Multipurpose reservoirs with flood protection components
- Utilization of existing storage projects for flood flow retention
- Modernization and restoration of sewerage/drainage networks
- Flood protection works/plans
- Land use management in watersheds

Measures	Horizontal Governance	Agriculture	Biodiversity Forestry	Flood Management	Built Environment	Water Management
Explicit NbS Mention	2	0	3	2	4	0
Implied NbS	0	1	10	0	7	0
NbS Opportunities	4	5	5	2	4	0
Grey/Technical Measures	0	0	0	2	3	5
REST	4	15	12	1	8	13
TOTAL	10	21	30	7	25	18

#### Table 5: PeSPKA NbS measures integration (created by author)

The analysis regarding vulnerability to flooding was more elaborate and insightful than the measures, as it did not add to the previous ones by adding supplementary measures or suggesting new ones. The flood management plan appears to be the primary tool for mitigating floods, and PeSPKA emphasizes some of them. This could also be because PeSPKA realized that climate change is complex, and each sector will be affected, so specific measures will be developed to



provide relief. It is accepted that different forms of NbS can provide the solutions the region needs, highlighting their ability to deal with multiple problems. Ecosystems and green-blue infrastructure can help mitigate floods, droughts, and wildfires, therefore emphasizing the synergies specific measures can bring to floods and other hazards.

In the Horizontal Governance section, NbS are explicitly mentioned for the first time in the measure "Development of a Green Infrastructure Program in the Region of Thessaly." They are described as "a network of natural and semi-natural areas and areen spaces that provide ecosystem services and improve human well-being and quality of life." They compare them to gray infrastructure by highlighting their ability to address different problems simultaneously. However, they do not undermine or question traditional grey infrastructure but state that nature-based solutions can enhance their performance. This could also be the first step towards transitioning from engineering to ecological approaches, creating supplementary green infrastructure to build trust. It later gives an example of how green infrastructure can reduce stormwater entering sewage systems and, subsequently, lakes, rivers, and streams through plants' and soil's natural retention and absorption capacities; planners should first consider the benefits of wetland restoration and floodplain areas and then consider grey measures. The text is thorough, addressing also the "problems" of NbS. Those problems are that it is a relatively new concept lacking a widely recognized definition and a quantitative analysis framework besides ecological corridors (products) and natural water management systems, like green roofs, which tend to have precise functions and established performance evaluation measures. Those problems are generally found in literature, and it seems that no research has been done on what obstacles are specifically in the Greek context. Nevertheless, it is recognized that it is essential to develop both a National Green Infrastructure Integration Program and related Regional Programs that could contribute to addressing climate change. The other measure that aligns with the code's explicit mention of NbS is "Management of Water Resources, Agriculture, Forestry, and Biodiversity in the Region of Thessaly," which mentions adopting programs such as green infrastructure and zero carbon. Unfortunately, it does not seem that any of these proposed measures have been implemented. Educational programs on climate change, mitigation practices, and hazards, as well as other measures that mention hazard mitigation and possible pilot programs proposed by the EU, could be opportunities for NbS to realize the previous measures.

In the **agricultural sector**, the proposed measures involve many technical measures related to crop production, but a few measures are related to NbS. They addressed the need to improve soil quality and enhance biodiversity, as it would enhance the ability of agricultural systems to adapt to climate change. Farmers could understand the severity of climate change through educational and research programs and adopt new agricultural practices involving NbS.

Given the nature of this category, **Forestry and Biodiversity**, many measures refer to protecting and restoring forest ecosystems and enhancing biodiversity. They highlighted their importance during these times of climate risk; however, only three directly connected them with flood risk,



mentioning the need to restore wetlands and reforestation in previously burnt areas or other areas to enhance the soils' capacity to retain water during extreme rainfall events and droughts. As Greece faces devastating wildfires every year, restoring and protecting natural areas is of high priority.

The measures for the **Built Environment** focused a lot on and around NbS. It is recognized that it is essential to incorporate more blue and green measures to make urban areas more resilient. Flood relief projects that would include green infrastructure, dry ponds, and green rooftops are highly recommended alongside the regeneration of urban rivers. Much of the focus is on mitigating the Urban Heat Island Effect, with measures including green infrastructure, rooftops, ecosystem services, and green and blue infrastructure. Even though those measures are not connected with floods in the written text, they can be used for flood mitigation. Measures implying NbS are the design of local plans for climate mitigation that will include the previously mentioned measures and measures as incorporate more urban green and parks. Gray/Technical measures include using different materials on new buildings and public areas. Opportunities varied between educational programs for the municipality and locals and upgrading or extending sewage networks.

In the **Water Management** section, dam construction is the primary mitigation measure for the desertification and recharge of underground aquifers.

## 4.2.3 Common Agricultural Policy CAP (2023-2027)

CAP is an EU policy initiative that aims to support farmers in improving their productivity and income, tackling climate change, and maintaining rural landscapes across the EU. Over the years, this policy tool has been working towards a greener approach, ensuring it aligns with environmental and climate legislation and goals. Within the main eight goals of this policy in the Greek document, one goal solely focused on climate adaptation and mitigation, sustainable use of resources such as water and soil, and biodiversity protection. These goals will be achieved through green architecture, which involves sustainability enhancement, ecological schemes, and interventions related to climate change (see **Table 6**).

**Sustainability enhancement** involves different "rules" that farmers must comply with, including protecting the environment and animals and improving soil and plant health. Two of the three explicitly mention restoring wetlands and using nature to minimize flooding incidents.

Out of the 10 **Ecological schemes,** two explicitly mentioned NbS. The first included the ecological protection and restoration of areas, including wetlands and small lakes, and the other focused on conserving traditional agricultural practices and enhancing lynchets that contribute to flood safety. The other four focused on enhancing biodiversity, agroforestry, and ecosystem protection, which are important for further promoting NbS.



The proposed **interventions related to climate change** varied. Two focused on afforestation, and lynchets explicitly mentioned their ability to retain water, promoting flood safety. The other three measures focused on biodiversity protection, restoration, and enhancement.

Measures	Sustainability enhancement	Eco-Schemes	Interventions related to climate change
Explicit NbS Mention	2	2	2
Implied NbS	0	4	3
NbS Opportunities	1	0	0
REST	0	4	26
TOTAL	3	10	31

Table 6: CAP 2023-2027 NbS measures integration (created by author)

#### 4.2.4 NATIONAL BIODIVERSITY STRATEGY & ACTION PLAN

This plan aims to highlight the importance of biodiversity while providing measures to protect and restore ecosystems and their functions that may have been degraded. This action plan aims to achieve 13 goals with different measures. In the following table (see **Table 7**), their connection with NbS is analyzed.

 Table 7: National biodiversity plan NbS measures integration (created by author)

Measures	NATIONAL BIODIVERSITY STRATEGY & ACTION PLAN
Explicit NbS Mention	5
Implied NbS	2
NbS Opportunities	17
REST	15
TOTAL	39

Considering the nature of this sector, many measures were approaching NbS. The measures categorized as explicit mentions to NbS involved restoring ecosystems that are likely to include wetlands or floodplains, promoting ecological corridors and green infrastructure, and enhancing forestry ecosystems for climate change mitigation. Implied NbS involves measures for protecting ecosystems. Many measures could be opportunities for promoting and upscaling NbS as they involve educational and awareness programs about ecosystems' abilities and services. Furthermore, much focus was given to integrating ecosystem services and their protection in other sectors and their plans or policies for more comprehensive decision-making.



## 4.2.5 RIVER BASIN MANAGEMENT PLAN

In water and flood management, rivers are essential water bodies. The EU established the Water Framework Directive (2000/60/EC) for protecting and managing water resources. River Basin Management Plans (RBMPs) were the tools for realizing the objectives of this framework. Based on the 2<sup>nd</sup> and latest Revision of the plan, the connection of the measures promoted with NbS is the following (see **Table 8**)

Measures	RIVER BASIN MANAGEMENT PLAN
Explicit NbS Mention	0
Implied NbS	4
NbS Opportunities	3
Gray/Technical Measures	1
REST	14
TOTAL	22

**Table 8**: River basin management plan NbS measures integration (created by author)

Measures ranged from protecting water resources to imposing taxes, administrative actions, and initiatives for aquifer recharge. The measures related to NbS included actions to limit the pollution of water bodies by promoting organic farming and using methods that will improve soil quality. Moreover, natural flooding areas are mentioned in ecology and as a natural process and method to artificially recharge aquifers, including artificial lakes or the restoration of existing water bodies and other measures. There are also a few opportunities to integrate NbS through suggested new and master plans. They focus on finding solutions for drought and ensuring longterm water security. These could be opportunities to use Nature-based Solutions (NbS) to collect more rainwater and create more space for natural water bodies, which in turn helps in recharging aguifers. This contributes to flood safety a water security. This plan focused more on water and how it could be protected and sustainably used. There was not much about restoring rivers, lakes, or streams. Also, measures mentioning flood protection involved dams and not natural retention measures. The plan seemed to have a more engineering rather than environmental approach emphasizing synergies. For example, since water resources are becoming scarce, jeopardizing the future of agriculture, "There are no areas where water could be collected to be later used for crops" (interviewee 6). "Some warnings indicate that the necessary water resources may not be available" (interviewee 6). The lack of holistic planning has led to the pollution and mismanagement of water resources; therefore, the plan focused more on that. "The lack of enforcement and status checks has led to arbitrary plans and decisions, which have led to different problems. For water management, this has led to the mismanagement and abuse of water resources, contributing to current drought problems" (interviewee 1). These problems could severely jeopardize water resources, so eliminating them is essential. The second river basin could be a management plan focusing more on sustainability and restoring water bodies.



# 4.3 VIEWS ON INTEGRATION

## 4.3.1 From Legislation to Reality

Stakeholders recognize that there has been progress in strengthening policies and creating plans. "There is an improvement, but this improvement primarily exists at an institutional level. The legislation stems mainly from European directives requiring us to harmonize with specific European guidelines." (Interviewee 3), "If it weren't for the EU directives that oblige us to develop flood risk management plans, Greece would not be doing them on its own" (Interviewee 13). Those statements confirm the importance of EU directives and how progress may not have existed without them. Nevertheless, this evolution is prolonged, has not reached more local levels, and translated to the built environment. This is mainly due to the undermining of climate hazards, which has not prioritized the implementation of those plans nor their significance in the existing and upcoming climate crisis. It appears to be a rather superficial approach to climate change as plans are made to fulfill the needs of EU directives. "The flood risk management plan remained limited to hazard maps. It did not progress further, which we now expect to change as it is being revised in 2024 under the pressure of the European Union, as you may know" (interviewee 7). The EU has referred Greece to the Court of Justice for its inability to finalize and review the flood risk management plans multiple times. This involves many fines and leaves the country exposed to flood hazards. Moreover, as years pass by, the data are changing, and outcomes of the flood management plans lose their relevance. "A study done in 2006 may not be sufficient for today, as data changes and evolves rapidly. The problem in Greece is monitoring, both in terms of climate change and flood management, as well as spatial planning. This needs to be actively monitored. These plans represent a policy that must be evaluated regularly and appropriately, with adjustments, corrections, and updates as required. Unfortunately, in Greece, this is not done effectively; it is done for formal reasons, as required by legislation but not correctly" (Interviewee 3). In the following section, Flood Perception, it will be analyzed how flood and climate-related hazards were undermined; therefore, it is a logical outcome that these frameworks and their importance were taken lightly and not implemented correctly.

## 4.4 PERCEPTIONS

#### 4.4.1 Flood Perception

When climate change was mentioned, floods were not the main issue for Greek authorities, whereas wildfires and desertification seemed more prominent. Therefore, little to no action was taken toward flood protection. Even though tools, including high flood-risk maps indicating the vulnerability of rural and urban environments, have been created, they were not adequately utilized, as confirmed by recent flooding incidents. However, what was not confirmed was the flood recurrence periods of 50 and 100 years, as the time difference between the lanos and Daniel storms was three years. *"The perception was that these phenomena have a return period* 



of 50 to 100 years, but that is not the case" (interviewee 2). When lanos occurred in 2020, people were almost reassured that events like these have a return period of 50 years, so they were not to worry with stakeholders thinking they had time to prepare for another flooding incident. "People thought lanos was an extreme event that wouldn't happen again. Even on the eve of the Daniel disaster, despite all the warnings, no measures were taken, and there was a lack of communication and public awareness" (interviewee 9). Climate change is unpredictable, with climatic models incapable of predicting the exact future conditions, leading to the undermining of specific hazards. However, even though lanos was, up till that point, one of the most significant flooding incidents, it was not enough to change people's perspectives. "In 2020, during the lanos storm, which was considered the most critical flood event in Greece up to that time, no adjustments were made to adapt to the new reality. Much money was allocated for flood protection projects in Greece, which primarily involved deepening and cleaning rivers and creating new barriers. Additionally, dams are increasingly being referred to as flood protection projects" (interviewee 5). On the other hand, Storm Daniel completely changed the perspective on flood hazards and protection. It indicated that we must do some things differently and that some people should be forced to act differently (interw.2). People started to realize that floods cannot be eliminated or avoided, can become worse and more frequent, and that structural measures may not be the solution to mitigate them. "Society is now beginning to worry about the recurrence of such phenomena. I want to believe that this will also lead to correct judgments and political choices. This is our reality; our daily lives are now in climate crisis conditions" (interviewee 2). "There is a shift in opinion, but unfortunately, it is not happening as fast as the effects of the climate crisis" (interviewee 1). Sociotechnological changes require time. The first step is for society to realize the need for change and start changing, and then later, this change will be visualized in the built environment. Unfortunately, this change might not align chronologically with flooding incidents. It was not until flooding incidents of 50 and 100 return periods occurred that most people realized the severity of climate change and questioned the existing engineering flood protection approaches and why other methods were not followed.

## 4.4.2 Current State of NbS

After the latest flooding incident, the concept of NbS started to be more present in dialogues regarding flood protection and why other countries are following these approaches while Greece has not and if they would have been more effective during this event. All this information was presented in the media, mostly by academics. When participants were asked about their views on NbS interviewees with an environmental background and most local stakeholders were positively biased towards NbS, believing that a more nature-based approach towards flood management is the only sustainable and promising solution. *"I believe in such a nature-based model; I do not see any other solution (interviewee 1)" "If we provide such solutions and fight for them, which are a priority for us, I believe we will address certain issues comprehensively (interviewee 2)."* Moreover, it was mentioned in PeSPKA that an additional plan/framework should be developed focusing solely on NbS. On the other hand, some stakeholders already have



specific projects in mind that should be carried out. "Thessaly itself, its geomorphology, and its situation indicate what we should do. An important issue, for example, in flood control and protection, is the restoration of Lake Karla. It was a lake that dried up in the '60s, and today, after the floods, it has returned to its original size; nature indicates how things should move" (interviewee 2). The lake's restoration would be a significant step towards ecosystem restoration and a great example to be followed by other regions or inside the region as the restoration of rivers and streams could follow. So far, the examples of NbS are minimal. "The interventions that do exist have been made on a small scale, primarily by the scientific community within the framework of research projects and similar efforts. This has not been established, it has not grown, and it is not followed by enough people to become mainstream" (interviewee 5). Since NbS is a relatively new and broad concept, it is logical for its implementation to start at an experimental scientific level and then later move to pilot projects and so on. For this transition to happen in a centralized state, stakeholders on a national level should be open to experimentation; however, it seems that they do not have much trust in NbS. While effective in many regions, nature-based solutions may not be as realistic for our area. "Unlike other countries, we do not have large, mountainous areas where water can be redirected into wetlands or forests to make such systems work effectively. These solutions also include gray infrastructures, meaning large-scale projects that serve additional purposes. For example, they can act as storage areas, which could address the significant issue of water scarcity in drought. Until the Daniel storm hit, drought was, and likely will remain, the primary concern for Thessaly" (interviewee 7). "It is a theoretical framework that cannot respond to reality without a built environment and an established situation" (interviewee 4). Those statements show that they do not fully understand the concept of NbS nor their abilities as they can provide flood safety and help during drought times. They believe these solutions can only work in specific environments where conditions are "ideal," and since that is not the case for Thessaly, they cannot be implemented. "If we do not adopt a medium-term approach to gradually open and widen riverbeds, it will inevitably happen on its own, but not in a controlled manner. Without a medium- or long-term plan, such as setting a goal to clear certain areas within 10 or 20 years, progress will be slow and uncoordinated. The primary issue is space, and closely tied to that is gaining acceptance from local communities, as these changes affect people's properties and lives" (interviewee 5). Following the catastrophic floods, Lake Karla, previously drained, and riverbeds and rivers that were channeled have returned to their original state to some extent. Despite opposition from some stakeholders, these natural elements will continue to reappear, indicating the need for them to be restored.



# 4.5 PATH-DEPENDENCE

### 4.5.1 Spatial Planning

Existing and previous planning policies have created a reality in the region that can make many constraints in realizing plans or developing more radical ones. Many areas do not have spatial plans today, meaning that over the past decades, many rural/urban settlements have been developed and expanded without proper planning, often in vulnerable areas. "Greece is only now beginning to implement spatial planning, whereas it did not have one 10-20 years ago, and many areas still do not today. Even the areas with spatial planning lacked sufficient enforceability to solve or mitigate problems effectively" (interviewee 13). "Aside from the illegal structures, where there are entirely unauthorized settlements, the issue extends even to the legal ones, where procedures were not followed properly. For example, a permit was granted for one house outside the city plan, and then three or four more houses sprung up in the same area" (interviewee 8). The issue of unauthorized development of communities and buildings has been a problem for many years as the state has been unable to monitor the extent of this issue nor stop it. This inability is also projected into policies. The 2011 Law on Unauthorized Buildings (Law 4014/2011) was a significant legislative initiative introduced to respond to the widespread problem and put an effort to improve urban planning and protect the environment. However, it was not as radical as the situation demanded. "A major mistake was the law on Unauthorized Buildings, which allowed the legalization of certain constructions for 30 years, regardless of whether it was built in forests, streams, or elsewhere. You have a green fund that is supposed to assist with climate change and flood protection, but its resources come from regularizing structures in flood-prone areas, creating a somewhat paradoxical situation" (interviewee 11). In a way, it legitimized this behavior, fostering the belief that money can solve the problem. However, it only contributes to the problem of creating paradoxical situations that only delay addressing the real problem. In the long term, this complicates the situation as people will have to face the actual consequences, of climate-related dangers or have already. "In a way, some of these buildings have been legitimized since being built decades ago, and investments have been made in them. However, the reality is that they must be removed. This requires a coordinated policy from both the government and local authorities. People need to be convinced of this, potentially with some incentives" (interviewee 7). Citizens often lack proper education regarding climate change; however, this is extended to the stakeholders as they are not proactive in addressing those issues and the core of the problems. The reasons for this issue vary.

The criteria for hiring employees and setting up departments hoping to make changes are not set in a way that will lead to better outcomes. "One issue is the limited public administration staff, consisting of individuals who do not understand climate change and spatial planning. For example, an architect might understand spatial planning but at a different scale compared to a planner. The right people need to be put in place. For instance, currently, the spatial planning department of the Ministry of Environment has 15 people, only 2 of whom are spatial planners"



*(interviewee 3).* This is often the case in Greece, as people with proper knowledge are undermined or not considered even though essential to solving a problem. Recently, positions were opened in the public sector to develop flood management plans. However, these positions were limited to civil engineers, architects, and surveyors. The role of spatial planners was undermined in this process despite being crucial for creating comprehensive plans.

The problem with spatial planning in Greece is more nuanced as spatial planning plans have also not been considering environmental aspects for long. "Until now, we have not considered climate change, but this has to change, as there are new specifications for spatial plans. Therefore, the planner must also create a map showing the risk levels" (interviewee 13). Even though a change is appearing, the damage of previous policies in the built environment and mindsets is evident and reversing them while promoting NbS would require concerted efforts. Moreover, rivers and riverbeds were seen as a dispute in urban areas, leading to their channelization and the disappearance of many streams. These practices and settlements inside riverbeds were also promoted by planners for decades due to the anthropocentric approach that was at its peak in the previous century. "I see riverbed widths of 120 meters reduced to 18 meters 8. In 99% of the cases, the problem is the spatial planning we have created. If someone demolished everything built in inappropriate locations, it would save everyone else, and the laws and everything would become more manageable. However, since we do not demolish, we create paradoxical laws" (interviewee 8). "Instead of some floodplains being, let's say, 300 meters wide (this number is just an example), two-thirds of it has been occupied by buildings. Therefore, the issue is also within the urban fabric, where some have even established livestock farms within the flood zone. All of this has caused problems, which will be difficult to address because they require significant expenditure and social issues. We didn't manage it properly" (interviewee 7). Restoring riverbeds and flood plains is essential for improving flood safety and designing NbS; however, the complexity of flood governance is becoming more apparent regarding how it goes beyond flood management. Resolving existing issues and creating holistic plans in other sectors is almost a requirement before moving towards NbS interventions.

#### 4.5.2 Persistence of Engineering

The adoption and upscaling of NbS require organized and targeted interventions to foster a transition from engineering to ecological resilience. This transition is evident in policy documents, but as explained in the previous section, there is a gap between policy and reality. "Steps that have been taken, especially after the Green Deal, and even before that, there were various references to Nature-based Solutions (NbS), albeit small. This is not a reality even in documents like the Water Framework Directive and the Flood Risk Management Plans Directive, which reference natural water retention measures. These green measures are not integrated or promoted" (interviewee 5). The policy document analysis confirmed that most measures involving NbS were more of a recommendation and a rising new concept that should be considered; therefore, they lack a binding character. Stakeholders appear to lack proper education on the abilities of NbS and how they are designed and implemented, therefore



continuing to promote engineering measures. "Discussions with public administration reveal that even they do not fully understand these measures. Although such measures exist on paper, they are either not practically implemented or, when they are, they are often misapplied" (interviewee 5). "Many planners do not know how to approach them and require support" (interviewee 10). Therefore, even if there is trust, there is a lack of expertise within public services.

One other reason is that structural measures also provide visual safety, meaning that people see a structure protecting them from flooding and it being constructed. "A major anti-flood project receives much more publicity than, for example, a plot of land that will function as a floodplain as it will not make it to the news for the citizens to notice" (interviewee 4). "Contractors often favor this approach because it allows for more opportunities for under-the-table transactions" (interviewee 9). "Another reason is how the system is set up, potentially involving corruption and money flow, with large companies securing big projects" (interviewee 5). Often, the main reason NbS is not promoted, which is also evident here, is the lack of education and the broadness of the concept. However, these quotes highlight how other social and cultural phenomena hinder this transition. The existing governance system faces problems with many stakeholders, politicians, and citizens being part of what appears to be a bigger corruption problem, shaping specific power dynamics. Changing this structure and flow of money would "negatively" influence the ones profiting from it. "When you have plenty of money, it is much easier to create a comprehensive plan because you have the funds to allocate. However, with limited resources, you must prioritize, and the stricter the prioritization, the more challenging it becomes. If you can only fund one large project or five smaller ones, politically, there is a tendency to fund the 15 smaller ones to satisfy 15 municipalities" (interviewee 4). As Greece has been facing economic problems, it is often the scapegoat of why things are not changing; however, after Daniel, an investigation showed that the regional governor had received funds for flood protection measures, but many of them were not implemented or given for the construction of roads as they would receive more publicity and acknowledgment by the citizens, while other funds were missing. "NbS solutions have taken a backseat because the motivation was to achieve food self-sufficiency. Subsequently, profit became the focus, leading to some of these nature-friendly solutions being undermined to some extent" (interviewee 7). The way flood protection measures are chosen and, if selected, are often based on factors other than safety and effectiveness. "We still do not know which flood protection projects will be decided. They will differ from the previous ones, and I imagine a conflict of interest will exist. Most likely, they will be technical works undertaken by specific companies" (interviewee 1). Even though some stakeholders are trying to promote different flood protection measures, they feel that previous power dynamics and decisions will be obstacles. "This plan should be developed without political interference, indicating what should and should not be included in the study and focusing on the plan's quality, not on which company can produce it at the lowest possible cost" (interviewee 10). "Here, this culture of long-term planning does not exist and starts with politics. Whoever is elected does not know if they will be re-elected in five years, so they focus on short-term goals" (interviewee 10). Politics and governance are intertwined, influencing the priorities of studies and plans and how and to what extent they will be



implemented. The culture of short-term success and gains and positive publicity are embedded in the Greek governance structures and various aspects. Policies and governments do not cooperate and build on top of each other to create a path toward a desirable outcome or future; rather, they work competitively to promote their agenda.

Changing an existing situation can often be perceived as breaking a habit. There is more to it besides simply making some decisions. "There are various reasons for this situation. One reason is that these are the methods we grew up with, trust, and know. People are afraid to venture into something new because it requires studying, experimentation, and accepting failures to move forward" (interviewee 5). "This is what they have seen; this is what the political forces are cultivating for them" (interviewee 1). The lack of scientific background for many stakeholders and their position in the power dynamic level is preventing them from coming forward with new ideas and being able to support them in a debate. On the other hand, most citizens are unfamiliar with other flood protection measures since they have not seen them in the Greek landscape or have a background in similar fields. Hence, their possible involvement in a project regarding the implementation of NbS is undermined by authorities and by them as they think it is the government's job to build dams and other structures for flood protection. "I do not think the problem is that there are insufficient standards or the authorities are not informed enough. We often make the wrong decisions because a stronger scientific foundation is lacking. Even if everyone was informed, they might still make the wrong decision. However, we could improve decision-making if a scientific team used cutting-edge knowledge and technologies" (interviwee13). Investing in new knowledge and technology can help the decision-making process in the long term rather than repeatedly making the same decisions that are proving to be inadequate since the environment and its conditions are changing. "In a model based on science, people know, whether they disagree or agree with us and our choices, that what we do is based on documented scientific data" (interviewee 2). The trust between the citizens and authorities is racked as authorities undermine the citizens, and the citizens do not believe that authorities make decisions for the greater good of the country and their future. Letting people know that decision-making is based on scientific data and breakthroughs will slowly bridge communication and trust in this relationship and, more importantly, transparency.



## 4.6 GOAL-DEPENDENCY

#### 4.6.1 Hindrances of goal setting

Due to the lack of a sufficient number of employees and employees with expertise, the public sector does not develop most plans and studies. "The public sector in Greece operates more procedurally than strategically, and in these studies, we often find ourselves in a monitoring committee" (interviewee 9). "Our authorities no longer have the capacity to conduct studies, especially specialized ones like flood management. We have shifted purely to oversight and bureaucratic tasks" (interviewee 11). This hinders the functioning of public services, making them unable to meet current needs or contribute effectively to the region's future development. Moreover, the lack of expertise and knowledge results in misjudgment and poor execution of studies. This extends to identifying the region's future needs and developing preliminary studies. "A significant problem here is that there is no long-term planning. I don't see any thought about what we want to achieve as a region. We need to prepare and mature studies not only in the flood management sector, which is essential for safety reasons but also various projects. We should develop studies and seek funding rather than just chasing after funding opportunities as they arise. Often, we respond to calls for proposals to secure financing without a clear strategy" (interviewee 12). Public services are in a state of decline, lacking the resources, expertise, and financial capacity to plan the region's future across various sectors and scales. The primary incentives come mainly from the European level and the European Union funds. This has longterm implications; if these sources were to cease, the future would be uncertain. Those initiatives should be part of a bigger vision each region has set for itself and not the other way around, as this leads to maladaptation and fragmented development within regions. Then, the question arises about whether the central government wants to help local stakeholders with these issues. "Here, we are talking about a super-centralized state, and this government made it even more centralized. To some extent, it is justified because the other decentralized, regional, or local administrations are not staffed or do not have the necessary resources. This is a valid excuse up to a point. At some point, we need to staff the regions, we need to staff local administration, and so on. Not every decision can be made by the central administration. Central administration, meaning the ministries, has a strategic role in creating policies, monitoring them, and adapting them promptly. Beyond that, the regions should be responsible at a more local level" (interviewee 3). The true intentions of the central government bodies are increasingly ambiguous, given the apparent contradictions in statements, views, and actions. The actions of regional and local administrations are perceived to be inadequate despite their coordination and cooperation challenges, alongside staffing and funding shortages. Rather than investigating and resolving these issues, there is a trend toward centralizing power at higher governmental levels with plans to create a unified organization (will be further explained in section 4.6.2) that will lead to resolving those issues.



#### 4.6.2 Future Structure Role of the Region

Since the lack of cooperation and coordination has been a widespread problem for years (explained in section Coordination-Cooperation), the government has decided it would be best to create the Unified Water Management Agency of Thessaly. This organization will be a pilot one to develop similar organizations throughout the country. Thessaly was chosen because it faces many water-related problems, from floods to desertification, and because of the latest flooding incidents. Stakeholders believe this is a good solution as all decisions would be made there, leading to more holistic approaches and plans, but they are also concerned. It would take time to form this organization, educate stakeholders to make better decisions, assign them clear responsibilities, and learn how to work together effectively. "Now, the fact that we have not achieved this level of collaboration until now means that many coordinated efforts need to be made, and that is where the government is betting, saying that with the new organization, it will be able to carry out this work. It aims to be a single decision-making center. It is a risk for which I have many doubts; it requires much work" (interviewee 7). The new organization could "force" stakeholders to collaborate and create plans that address water-related issues from a wellrounded perspective. "With whom will they make this organization when the employees who hear about it leave and transfer to other departments? They are either afraid or don't want to disrupt the existing system" (interviewee 10). However, not everyone is pleased with these changes and refuses to participate. Many people are comfortable within the existing system and do not want it to change or do not have a clear picture of their role within that organization; therefore, they choose a position they are familiar with in another department. Moreover, many of the current employees are considered not to have the proper knowledge to complete specific tasks and studies; however, they are the ones who will be transferred to a unified organization. "We have many hiring restrictions, which are significant because for organizations to be vibrant, they need young people. Older employees are accustomed to a way of working that is not easy to change. They have adapted to an established situation to feel comfortable in their work environment, leading to inadequate technical and scientific staff" (interviewee 4). The government's plan raises many questions and concerns about the future of this organization and whether it will be able to solve the existing problems or transfer them to the new organization where they will continue to exist and reproduce within new governments and employees.



# 4.7 OTHER SECTORS

The focus of this thesis was flood governance; however, other sectors also play a vital role in minimizing or exacerbating flood hazards or being affected by them. As a result, brief research into the agricultural and environmental sectors was conducted. The results from the policy document analysis were presented in sections 4.2.3, 4.2.4, and 4.2.5. In contrast, the interviewee's views on the documents and current state are presented in the following sections, except for water management, which was presented in the policy document analysis due to the lack of participants and, therefore, sufficient information.

## 4.7.1 Farmers Views

#### **Current Situation**

Agricultural land is one of the most extensive land covers in Thessaly, with the sector being the most affected by floods and climate change. Combining agriculture with NbS will help farmers adapt to climate change. Moreover, it would be a leading example for the other Greek regions. However, the reality is that the existing agricultural model is severely unsustainable, contributing to its vulnerability. "Previously, there were certain practices that people did not question, which were very destructive to the environment, such as the intensive agricultural model using pesticides that damaged both ecosystems and the groundwater" (interviewee 13). For many years, cotton production was promoted, and the EU gave many initiatives and funding to its cultivation. This crop is hydrophilic and not sustainable for an area facing many desertification problems. "This situation has begun to worry the agricultural community, and there is increasing concern directed towards the responsible authorities. They are seeking solutions, as when a producer finds that their crop requires irrigation and there is no water available, they realize that this can significantly impact their yields" (interviewee 6). This problem is becoming more severe as drought periods have increased over the last few years, leading to farmers interfering with flood protection systems. "The drainage networks and flood protection infrastructures, which were the recipients from agricultural fields, were used by farmers and simultaneously acted as water storage areas because there were no proper irrigation projects. As a result, when flood events occur, these networks often fail to function as intended, compromising their role in flood prevention" (interviewee 7). "Due to the lack of water, farmers use them in the summer by disputing the drainage" (interviewee 4). The scarcity of water and the change in climatic conditions have already made farmers change their practices and raise concerns about the future. "Climate change is a reality that has recently started to affect and make many producers reconsider their practices. The climatic conditions have changed, and they no longer plant during the same period. This has shifted their entire schedule back. More intense rainfall and weather phenomena lead to significant floods, which has undoubtedly made farmers more concerned. I hope they gradually understand the new conditions and adjust their overall cultivation practices accordingly" (interviewee 6). However, the changes in their schedule are a small step towards



adapting to climate change and realizing its severity. More initiatives must be given to reframe the current agricultural model.

#### **Constraints and Opportunities**

The real issue lies in the agricultural model and the ability of farmers to become critical players in this change. "Until now, it would have been difficult for them to consider anything different. However, now, they might be more receptive to such ideas. The goal is not to impose changes from the above but to support and integrate them into their practices. They may not be ready to make changes, but they are willing to listen and discuss. Therefore, if scientific teams or the government begin to provide information and engage in dialogue, we might be pleasantly surprised" (interviewee 13). "Farmers, especially older generations, find adapting difficult because they have invested their entire lives in specific machinery related to certain crops. Therefore, I think it is very challenging for them to change now. We rely on the younger generation, but unfortunately, we see a decrease in interest among young people in agriculture. Although some isolated programs provide incentives, they are unfortunately not sufficient. I do not know where all this will lead. In 30 years, I wonder how much agricultural activity will still exist" (interviewee 6). It is easier and more effective to invest in younger generations, give more initiatives, and educate them about environmental problems, climate change, and sustainable practices that try to "reform" the practices of previous generations. CAP gives few of those initiatives, but 90% of farmers in Greece do not have received higher education, with their knowledge being empirical. Therefore, even if the initiatives exist, they are not fruitful as they are not educated enough to make different decisions. The current flooding incidents, however, have made them more receptive to listening to different approaches, which, if used smartly, could help future decisions. "There needs to be training as the empirical methods typically followed in the countryside are ineffective. Guidance, education, and a comprehensive approach must convince farmers to use new crops" (interviewee 6). "We do not have the appropriate education or awareness to think critically about these issues, and I think we will face severe problems in the future. The only thing that concerns producers—and I do not blame them for this—is selling their products and ensuring production. This often leads them to use more pesticides and fertilizers to increase their yields, cover the costs of their cultivation, and manage to get by" (interviewee 6). Farmers' costs have increased in the past years, with their profits decreasing, and many of them rely on government subsidies to cover their costs in the long term. This is not sustainable for the farmers or the government and is also a reason for new people not wanting to engage in this sector. Moreover, the last flooding incidents made many of them quit their profession. "The costs for farmers and their crops have become extremely high and burdensome. Therefore, after the flood and in discussions with the producers, they have suffered such significant losses that they are not considering returning to their profession. Many are leaving and turning to other professions. Unfortunately, there have not been opportunities in the past to synchronize what is called agriculture and livestock farming" (interviewee 6). The



agriculture sector faces many challenges as there have not been enough efforts to modernize it and make its products competitive.

#### **NbS Transition**

Transitioning from this agricultural model to a more sustainable one and combining it with NbS would be time-consuming as many barriers exist to overcome. The interviewees, though, believe that if farmers were assured that they would have a more secure income by adopting different practices, they would be more receptive. "Farmers would not have a problem adopting a different model if you could guarantee them the same or greater income" (interviewee 7). Economic initiatives and a sense of security could give farmers the initial boost needed to adopt certain practices. Educational programs are essential for the initiatives to grow further and become more successful; it is also up to the farmers to grow those initiatives by combining them with other activities, such as tourism. "These solutions could also aid in transitioning this region to a more ecological agricultural model, which it may need in the future. It may not want it, though, as it might want to continue with intensive farming practices that may not be sustainable. This scenario can be supported by Nature-based Solutions (NbS) but not by grey infrastructure like dams and levees. Such hard engineering solutions are designed to support the current development model" (interviewee 13). Given the current and predicted climate conditions, the existing agricultural model must evolve. However, it appears to be somewhat stagnant, leading to irreversible damage for farmers and food security. Farmers do not grasp their practices' total impact on the environment or care enough, as they lack environmental consciousness. "If you were to tell someone right now that this proven method contributes to flood management, they would first ask, "What profit will I get from it?" And I can't blame them for that" (interviewee 6). Transitions require time and experimentation. Farmers have been impacted by catastrophic floods at least once, with inadequate water resources available for their crops, and some still unable to cultivate them as their fields remain underwater. There is a mix of frustration, a need for stability, and growing despair about the future. This situation has led to increased skepticism, with farmers needing an alternative model that can guarantee a stable income, or they are receptive to any solution that might help. For this transition to be successful, it is essential to have qualified experts who can provide guidance, and an administration committed to implementing change, supported by a population willing to adopt new practices and engage in experimentation.

## 4.7.2 Views on Ecosystems

The design and implementation of NbS presupposes that stakeholders and society recognize nature's value, services, and benefits. In this case, there appears to be a hesitation about whether nature could provide flood safety as, in many cases, it appears to be a "problem" for further development (e.g., residential areas, hotels, agriculture, etc.). Moreover, there appears to be a fear of more greenery due to wildfires. "Everything happening in Greece now mainly aims to prevent fires, so they eliminate vegetation everywhere and treat forests like parks. However, I do



not know what will happen with flooding events and the risk it poses to biodiversity" (interviewee 8). After wildfires, concerns about floods are evident, especially among the residents of the areas, with many reforestation projects taking place mainly in mountainous areas. However, there have not been holistic plans to restore and protect nature besides the Natura 2000 project. "We haven't yet addressed ecosystem restoration or coastal erosion control. Here, we are focused on halting the destruction of ecosystems and nature; I believe we are one step away from protecting nature and the next step is to apply NbS through planning. In Greece, we have not fully realized the value of ecosystem restoration is limited to areas that have experienced wildfires and other isolated initiatives; however, there is no holistic management plan to protect and prevent future degradation. Thereby, there is a gap in bridging NbS with other restoration projects.

Moreover, based on the National Biodiversity and Action Plan, most wetlands are undocumented and face many threats. "The documentation and knowledge of mainland wetlands are limited only to the larger ones, creating a significant gap. Considering the changes due to human activities and the current climatic and hydrological conditions, we urgently need to improve, supplement, and update the geographical data on wetlands" (National Biodiversity Strategy and Action Plan, p.42). "Many human activities in wetland areas and their drainage basins significantly impact wetlands. The leading causes of degradation are identified as point and non-point source pollution from intensive agriculture and the expansion of agricultural land, unregulated and unauthorized urbanization, road construction, unsustainable development of tourist infrastructure, over-extraction of water, and the clearing of natural vegetation, among others" (National Biodiversity Strategy and Action Plan, p.41). Sustainable management of all ecosystems is essential during the existing and future climatic crises. Their functions combined with NbS could help adapt urban and rural environments and provide safety from different hazards simultaneously; however, their ability seems not transparent to many stakeholders. Moreover, Greece's economic struggle and its priority for temporary economic development, especially in the tourism and agriculture sectors, resulted in severe environmental degradation.



# 5 RESULTS AND DISCUSSION

This section discusses the findings from the interviews and policy documents and connects them with the theoretical framework.

#### SRQ 1: Have policy documents promoted the evolution towards NbS?

As verified by interviewees, policy documents have promoted an ecological transition toward NbS. This evolution in policy documents is driven by "external pressures," the EU frameworks. Greece's obligation to adopt frameworks issued by the EU and conduct the necessary studies/plans based on the interviewees is the main reason for promoting NbS, which would otherwise likely not have progressed.

The power of external pressures to initiate evolutionary processes in governance systems is confirmed. The EU frameworks bridge scientific knowledge and governance, and as Greece lacks investments in scientific research, understaffed public organizations, and expert teams, these frameworks provide the necessary tools for the evolution of institutions. Policy documents are part of institutions; therefore, they can influence changes that reform them.

Promoting Nature-based Solutions (NbS) introduces a new approach to flood risk governance. As a result, adopting specific goals and strategies that align with this approach is essential. The flood risk management plans promoted NbS measures for flood protection and measures, such as educational programs, monitoring committees, departments, etc., to create guidelines and coordinate the various actors involved in governance systems and local communities to achieve those goals. The European Union is known for investing in generating new knowledge through research programs and collaboration with research institutes. Since it is the highest authority, it considerably influences the Greek governance structure. This gives the EU the power to promote particular knowledge that influences various governance paths. This power to initiate evolution aligns with Wiering et al. (2018), who describe EU Flood Directives as forces of change in policy levels. Although significant progress has been made, there are still notable gaps between policy and its implementation.

#### SRQ 2: What istitutional and regulatory barriers can be identified?

The interviewees **n**identified numerous institutional and regulatory barriers hindering the evolution of flood risk management in Greece. While policy documents exhibit progress aligned with EU directives, their impact is "blocked" by governance paths. These paths include barriers such as institutional inertia, norms, and other obstacles leading to the reinforcing of the existing governance path. Institutional inertia and norms were systematically analyzed through the interview process by analyzing information provided that has been influencing perceptions and decision-making practices that could or are hindering the mainstreaming of NbS.



#### Institutional Inertia

Institutional inertia involved the lack of long-term planning, as elected administrations focus on short-term goals to please specific groups or communities and possibly get reelected. Policies such as the legalization of illegal buildings and the extensive agricultural model prove this short-sightedness, resulting in negative long-term consequences that exacerbate environmental problems and climate vulnerability and limit opportunities for change.

Other inertia includes historical reliance on structural measures, such as dams, which have created a system where specific development companies monopolize most flood management projects. This association between flood protection and these companies limits opportunities for exploring alternative solutions like Nature-based Solutions (NbS). Moreover, the higher cost of structural measures has created significant financial flows from governmental agencies toward private companies, making this system resistant to change.

#### **Structural and Regulatory Barriers**

As mentioned, fragmentation within and among municipalities and regions has led to poor communication and stakeholder cooperation, exacerbating this lack of cohesion. Centralizing power at higher governance levels further amplifies these challenges, which is a solution by many stakeholders, with local and regional actors feeling excluded from critical decision-making processes. This exclusion diminishes local stakeholders and communities of flood risk management initiatives.

Additional barriers include hiring limitations, which have resulted in understaffed governmental bodies that cannot conduct plans, research, and reports. This has resulted in private-sector researchers conducting that work, whose interests do not always align with broader public objectives. Moreover, the lack of technical expertise within the public sector hinders their ability to evaluate and monitor the quality of private-sector products.

#### Norms

Norms within the governance structure appear to amplify institutional inertia. As a result of the short-term planning mindset, the prevailing norm is to avoid the development of policies or plans that might "disturb" communities or industries, even if such measures are necessary. At the same time, publicity plays a vital role in selecting flood protection projects. Visible projects like dams are preferred over less visible solutions, such as floodplains functioning as natural water retention ponds despite scientific evidence, the effectiveness of alternative measures, and climate change considerations, highlighting how public perception shapes governance decisions.

Moreover, development companies' monopolization of flood protection projects has shaped longstanding relationships between contractors and government administrations, fostering "favoritism" and, in some cases, corruption. Accusations of "under-the-table transactions" involving public sector stakeholders, private developers and researchers, and citizens contribute to a governance "culture" resistant to change due to financial and political interests.



Lastly, the fragmentation and lack of coordination have resulted in stakeholders not being held accountable for their lack of action or unsuccessful plans. Stakeholders shift the blame to the systemic issues within the governance system; therefore, important issues are not addressed or resolved.

The current structure of the governance system and relations of actors and institutions appear to be dependent on one another, as they interact continuously, contributing to the reproduction of the existing path. Institutional inertia has shaped norms and vice versa, establishing rules for the current governance system that, despite their ability to be effective and lead to sustainable outcomes, create a sense of stability as, through time, they become more integrated into the system. The actors who are the key players have reformed to these rules whether they profit from them or not, while actors who do not reform get marginalized and eventually excluded from governance systems. Other factors, intentional or unintentional (structural and regulatory barriers), also contribute to maintaining the structure of the current path.

While EU directives provide external pressure for reform, their impact is limited as inertia and norms dominate the current system and block external pressures or keep reinforcing despite the appearance of the new path in a way they have managed to co-exist. However, achieving the goals outlined in these directives requires reforms in various aspects of the existing governance system that will address the root causes of the current governance system, including regulatory barriers and the undermining of climatic and environmental risks.

# MRQ: How are governance paths influencing the mainstreaming of nature-based solutions in Greece?

By examining the critical concepts of Evolutionary Governance Theory (EGT), such as path dependencies and governance structures, it becomes evident that governance paths significantly hinder the transition and scaling-up of Nature-based Solutions in Greece. The upscaling of NbS appears to be hindered by the norms and power dynamics that have evolved around gray infrastructure and existing governance paths. Those governance paths were formed years ago and have been constantly changing and reproduced within governance systems. However, recent external pressures, such as catastrophic floodings, challenge these established paths, exposing their inability to address contemporary challenges.

Storm Daniel has acted as a window of opportunity for change, starting with the election of a different regional governor (elected on the 15th of October in 2023 with Storm Daniel having occurred between the 5th and 12th of September in 2023) with a background in academia. Based on the interviewees, the outcome of the election was strongly influenced by the devastating consequences of Storm Daniel, as people were displeased with the previous governor of 13 years. These events changed people's perspectives on the current flood protection measures and the current governance system. Transformative change, though, would require the reformation of governance structures, power dynamics, and societal norms that perpetuate reliance on gray infrastructure. The interplay between external pressures, such as flooding incidents, and internal



resistance highlights the complexity of achieving systemic change within path-dependent governance systems.

In conclusion, governance paths in Greece exhibit a strong tendency for re-enforcement that hinders the mainstreaming of NbS through norms, inertia, and other barriers. While external disruptions, such as extreme flooding events and EU directives, offer opportunities to challenge and change these paths, the long-term impact of such shifts will depend on the ability of governance systems to address the underlying institutional and normative barriers and realize the need for change. It is clear that significant events, often referred to as "sock events," have the greatest potential to alter the course of affairs. When systems remain stable and despite their effectiveness, they tend to be widely accepted. However, when that stability is disrupted such as by a flooding incident opportunities for change and critique emerge. Adopting and upscaling nature-based solutions (NbS) appear more complex and require deeper transformations of governance structures and societal attitudes.

## 5.1 RESEARCH LIMITATIONS

Reflecting on the research, I experienced a few challenges. Firstly, not many policy documents and plans existed regarding flood hazards or climate change, so an institutional analysis could be conducted to examine how these policies have evolved and changed over time. This made it challenging to clearly define how and when paths were reproduced, appeared, or ceased to exist. Therefore, the policy document analysis gave an overview of the current situation, which is also why documents from different fields were chosen to give a clearer picture of what is happening and try to identify patterns. This historical element was explored through interviews.

Finding participants for this research proved to be quite challenging. As a result, certain sectors were either underrepresented or not represented at all. Notably, no researchers from the private sector who worked in the companies or offices that conducted relevant studies were interviewed, which limited input on the content and methodologies of these studies. Additionally, the participation of individuals from NGOs focused on environmental protection or ecosystem restoration was restricted, as was the involvement of farming representatives and professionals in environmental and water management. It is important to highlight that less emphasis was placed on identifying these individuals compared to those involved in flood management plans in the public sector, who were perceived to have more information.

Lastly, the framework of evolutionary governance theory has not been widely used in case studies that involve interviews as a method. This made it challenging for me to develop a strategy for utilizing the framework in my study, conducting the interviews, and structuring the results. I found the framework quite complex due to its numerous concepts and the connections between them as well as visualizing it, but it was essential so that I could present it clearly to the reader. Concluding, I aimed to explain it straightforwardly while ensuring that every concept and detail of the framework was included and thoroughly explained.



# 6 CONCLUSIONS

Flood risk governance is critical in shaping how societies address, adapt to, or potentially fail to manage the increasing complexity of climatic hazards. Flood management is more than a set of measures and strategies—it reflects how various actors and systems respond to environmental risks and their capacity to adapt or find solutions. Governance paths and their components strongly correlate with flood measures and broader climate resilience strategies, demonstrating how integrated governance systems are essential to addressing these evolving challenges.

The rising focus on nature-based solutions (NbS) offers a promising approach but also presents practical challenges in implementation, including issues like education, concerns for their effectiveness, limited space, regulatory frameworks, etc. Existing research on ecological resilience often emphasizes the role of policies and stakeholders but does not directly examine how policies, governance systems, and stakeholders interact and affect transitions. Using evolutionary governance theory (EGT) as a framework, this research exposes the deeply integrated interdependencies and hidden connections within governance paths that can either drive or obstruct the transition to NbS. Addressing these systemic challenges requires technical interventions and a societal transformation in perceptions of hazards, sustainability, and resilience. Factors such as unwritten rules, power dynamics, and cultural influences are critical in determining how governance systems evolve.

It reveals that specific governance structures are so deeply rooted that only significant disruption might lead to substantial change. While EU frameworks provide guidance, each country ultimately decides how to implement these frameworks, leading to uneven progress across nations. Some countries have advanced by building on necessary preconditions, while others face obstacles that prevent these frameworks from growing, factors often overlooked by EU-level policy.

Understanding governance systems through an EGT lens provides valuable insights for designing interventions that enhance resilience and adaptive capacity. Strengthening governance systems is essential for improving decision-making and addressing the upcoming challenges posed by climate change. Improving flood risk management is crucial for dealing with the growing effects of climate-related hazards and ensuring long-term sustainability.

# 6.1 FURTHER RESEARCH

Further research on governance systems and their pathways in flood risk management would help fill the knowledge gap regarding transitions from engineering approaches to nature-based solutions. Therefore, conducting more case studies where institutional analysis—such as policy documents—can be compared with interviews would be beneficial. This comprehensive analysis would help reveal whether and how evident governance paths are and their role in these transitions.



Conducting interviews with multiple stakeholders from various sectors and fields would provide deeper insights into the ongoing issues and identify potential hindrances. It could also uncover issues that may not have been evident in this specific context but might arise elsewhere, allowing for exploring correlations among the different components and concepts existing within governance paths and the evolutionary governance theory.

Focusing on this case, it would be advantageous if a study including a broader range of stakeholders could be conducted. Additionally, conducting comprehensive studies in other regions of Greece would help determine whether the findings are consistent with those from this case study. Analyzing interactions at a national level and examining their relationships with different regions and municipalities and the relationships between different regions and their municipalities would enable a detailed assessment of the existing pathways and opportunities. The findings of those studies could be utilized to create more resilient governance systems capable of making better decisions regarding flood risk management.



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# ANNEX 1

#### **INTERVIEW PROTOCOL**

Information on forehand:

- Personal introduction:
- Introduction topic: My thesis focuses on the challenges associated with implementing Nature-Based Solutions (NBS) in Greece, emphasizing the impact of Storm Daniel. Specifically, I concentrate on how these solutions have been integrated into the country's flood management planning. My research also explores the decision-making process regarding flood control projects and how future goals in this sector are defined. Through my investigation, I examine the perceptions of various stakeholders regarding flood management and how it has evolved. Through this analysis, I aim to understand the progress made in incorporating NBS into Greece's flood management planning and the potential challenges and obstacles that persist.
- Audio recording
- Data processing
- Consent form.

#### Interviewee: Environmental Sector

Formalities: audio recording, data processing, and consent form (confidentiality and anonymity)

#### **Background Information**

- 1. Could you tell me a bit about yourself? What is your educational background? What is your experience? And what is your current role?
- 2. Could you provide more details about your connection to flood management? Have you conducted any research, or held roles in governmental or non-governmental organizations, etc.?

#### Current State of Flood Management and the Evolution of the Governance System

- 3. Can you tell me a bit about how flood management studies are conducted and how projects are implemented in Greece? Which authorities are responsible? How has this evolved over the years?
- 4. Do central authorities or regional governments set these goals? Where do you think the current system excels, and where does it fall short? Could you provide some examples?
- 5. How have these priorities changed over the years? Has EU legislation contributed to this?



#### **Nature-Based Solutions**

- 6. To what extent and how do you think nature-based solutions (NbS) can contribute to flood safety?
- 7. Could you elaborate on the overall level of NbS integration in Greece? Do you think there are many examples in Greece?
- 8. Have NbS been integrated more into the plans of other regions compared to Thessaly?

#### Path Dependence and Historical Factors

- 9. What past decisions in spatial planning (urban or rural) have affected current possibilities for the integration of NbS?
- 10. Are there existing policies or regulations in urban or rural planning that hinder the application of NbS? If so, what are they?
- 11. What have been the most significant changes in legal frameworks?
- 12. When did nature-based solutions start being incorporated? What are the most important documents on this topic?
- 13. Is their translation into policy documents equivalent to their implementation? Why or why not?
- 14. Why do you think there is general trust in engineering-based solutions compared to nature-based ones?
- 15. Are there other factors that contributed to the dominance of engineering-based solutions in the landscape?

#### Perceptions of Extreme Flooding Incidents in the Aftermath of Storm Daniel

- 16. How many extreme flood events has the region faced? How have they changed over the past decades (e.g., becoming more frequent or intense)?
- 17. How were these incidents perceived by stakeholders and locals? And how has their perception changed?
- 18. What changes in policies/plans were made after each incident? How effective did they prove to be later on?
- 19. How did this storm contribute to the re-evaluation of these practices compared to previous events?
- 20. What were the main vulnerabilities of the current system and planning practices highlighted by the storm?



#### **Barriers and Solutions**

- 21. How and to what extent is the implementation of nature-based solutions feasible?
- 22. Can you describe the main barriers (e.g., lack of education, incentives, costeffectiveness, etc.)?
- 23. Would there be opposition from other stakeholders or locals to their implementation?
- 24. What are the institutional barriers to their widespread adoption? Can the current government structure support these changes (e.g., cross-sectoral collaboration and more bottom-up approaches)?
- 25. What other changes/measures/frameworks, etc., do you think are necessary to support this transition?

#### **Closing Remarks**

Are there any additional insights or knowledge you would like to share regarding the challenges and opportunities in implementing nature-based flood management in Greece?



# ANNEX 2

# DATA MANAGEMENT PLAN Landscape Architecture and Spatial Planning (LSP)

#### Data management MSc thesis (V 1.0)

Complete the categories 1 to 6 as part of your research proposal and add it as an Annex to the final research proposal. After submitting your draft proposal, update the information of categories 1 to 6 if necessary, and complete the details of category 7. Add the completed data management document to the data you submit to your supervisor.

#### **1.** Details of the MSc thesis

Name student	Ioanna Toziopoulou		
MSc thesis code			
Supervisor(s)	Jasper de Vries		
Start date thesis	10-11-2023		

#### 2. Short description of your research

Preliminary title	Integrating Nature-Based Solutions for Flood Risk Management in Greece: Insights from the Aftermath of Storm Daniel
Abstract (max 100 words)	

#### 3. Data management roles

Roles	



Who is <b>collecting</b> the data?	Ioanna Toziopoulou
Who is <b>analyzing</b> the data?	Ioanna Toziopoulou

#### 4. Expected types of research data

Data stage	Types of research data & software choice to process it (if applicable)
Raw data	Interview Transcripts, Policy Documents
Processed data	Coded interviews and policy documents
Other?	N/a

#### 5. Short-term storage solutions

Describe where the data will be stored physically during your research (e.g. on paper, laptop, USB drive, youruniversityM-drive,other)andhowabackupisorganized.

Data stage	Storage location and backup
Raw data	Laptop storage and teams/onedrive
Processed data	Laptop storage and teams/onedrive
Other?	N/A

#### 6. Sharing, ownership and privacy

Sharing, ownership and privacy (With) who(m), what and how?	Sharing, ownership and privacy	(With) who(m), what and how?
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Data sharing	N/A
- Do you have plans to share your data with other parties	
(besides your supervisor)?	
Data ownership	N/A
- Are there agreements about the data ownership with	
other involved parties? (besides your supervisor)	
Privacy	N/A
- Are there privacy or security issues, and if there are,	
how are you dealing with them?	

7.			Long-term				storage
Your supervisor wi	ll take care of the	long-term	storage of your	data.	Which part of your	research	data has value for
long-term	storage	and	how	is	the	data	organized?

Data stage	Which data will be stored for the long term or should be destroyed?			
Raw data	Stored for 1 year on teams before deletion on a personal laptop. Also sent to Monique Jansen for storage.			
Processed data	Stored for 1 year on teams before deletion. Also sent to Monique Jansen for storage.			
Other?	N/A			
Describe how the	Filed in computer and teams under folder "thesis". Within that folder there are other folders			
stored data is	labeled "draft versions", "feedback"', "figures", "consent forms", "articles", "presentations",			
organized (e.g. file	"interview recordings", "interview transcripts", "policy documents", "coded data", and			
structure and file	"archived".			
names)				



# ANNEX 3

# **CONSENT FORM**

*Title of study:* Integrating Nature-Based Solutions for Flood Risk Management in Greece: Insights from the Aftermath of Storm Daniel

#### Interviewee:

I declare that I understand the aim and content of the interview, which have been clearly explained to me. I have been able to ask questions about the study and my questions have been answered to my satisfaction.

I understand that:

- O I can refuse to answer questions and I can withdraw from the study at any time, without having to give a reason.
- O I understand that personal information collected about me that can identify me, such as my name, will not be shared beyond the research team.
- O the audio recording will be destroyed after the interview has been transcribed.

I declare that:

- O I consent voluntarily to be a participant in this study.
- O I give permission for the use of the results of this interview in a scientific report or publication.
- O I give permission to audio record the interview.

Signature: .....

Name: .....



Date: .....

#### Researcher

I have accurately explained the aim and content of the interview to the potential participant and, to the best of my ability, ensured that the participant understands to what he or she is freely consenting.

Signature: ......
Name: .....

